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Taste, Distaste, and Food

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Synonyms

Aesthetics; Agency; Animals; Art; Aversion; Body; Change; Class; Desire; Disgust; Displeasure; Emotion; Experience; Gender; Imagination; Judgment; Literature; Market; Materiality; Meaning; Moral regard; Normativity; Ontology; Pleasure; Power; Race; Relationality; Senses; Social distinction; Value

Introduction

Taste and distaste are influential constituents of our relations with food. This essay describes their nature and interconnections and highlights their links with disgust. Reviewing difficulties that arise for the notion of taste (and hence for that of distaste, which has received far less attention), the article turns to literary and philosophical investigations of material life to suggest alternative ways of comprehending taste, distaste, and their bonds with food.

Theories of taste lie at the heart of the notion of the aesthetic in Western philosophy. Traditionally, such views evince an ambivalent stance toward food, one that deploys gustatory taste as a model for aesthetic taste yet also distinguishes these two kinds of taste from one another, decidedly ranking the latter above the former (Bourdieu 1984; Korsmeyer 1999). Carolyn Korsmeyer documents how the historically discredited position of food and gustatory taste in aesthetics reflects a tendentious hierarchy between mind and body, a correlative privileging of the so-called higher over the supposedly lower senses (which include also touch and smell), and a pervasive neglect of food's cognitive import. She observes that these forces make their appearance even in a range of defenses of the aesthetic status of food and of artworks that take food as their subject matter. In her alternative account, food's context-dependent cognitive and experiential resources invest it with a profuse variety of aesthetic meanings. Besides expressive and representational dimensions, such meanings encompass the corporeally intimate and social aspects of eating and its ability to yield extraordinarily intense memories.

Enlightenment theories of taste and their descendants in philosophy and cultural theory have given rise to a broadly accepted perspective that places taste at the core of the idea of the aesthetic. In laying out standardized, generally applicable criteria designed to validate judgments of taste, philosophers have simultaneously circumscribed a field of human practice and meaning constituting the so-called aesthetic realm, an area of activities harboring distinctive kinds of values, experiences, and norms (see Roelofs 2014, 55).

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While complexities surrounding taste speak to wide-ranging and profound difficulties under debate in philosophy and cultural theory, they do not give reason to jettison the concept of taste or the aesthetic. Enlightenment constructions of taste exhibit philosophical, ethical, and political problems that reveal shortcomings in the notion of the aesthetic but also point up avenues of response. Taste, distaste, the aesthetic, and food are densely interwoven with many intricate facets of our lives, provoking meanings and questions that literary and other artistic inquiries often are able bring into sharp relief (see Korsmeyer 1999, 8–9, 146–7, 185–6). Particularly intriguing in light of the possibilities and limitations of taste are undertakings by authors such as Franz Kafka and Clarice Lispector to conceptualize forms of change – social, corporeal, imaginary, symbolic – that involve mutations in the areas of eating and food, including developments of the gustatory aesthetic tastes and distastes of their fictional characters (Kafka 1915/2003; Lispector 1964/1988). These writers implicitly stress the interconnectedness of our sensory desires for eating with other aesthetic registers in which we conduct our relationships with other humans, nonhuman animals, and the material world. They situate disgust alongside an array of sensory attractions and aversions in a field of shifting relationships. Food tastes appear to carry out their aesthetic operations, in part, as devices that steer trajectories of material becoming; they contribute prompts as well as obstacles to processes by which agents attempt to realize alternative ethical and political possibilities within hierarchical social arrangements. Kafka and Lispector thus provide insight into the complex ethical status of food tastes, broaching a field of questions that contemporary scholars also take up in studies of food, taste, and disgust (Korsmeyer 1999, 2011; Ahmed 2004) and the materiality of social change (Braidotti 2002; Bennett 2007).

Taste and Distaste: Philosophical Perspectives

The concept of taste, as we inherit it from eighteenth-century philosophical giants such as David Hume and Immanuel Kant, refers to the human capacity to undergo aesthetically appropriate responses in relation to objects of nature and cultural artifacts, including artworks. The appreciative reactions issuing from the operations of the faculty of taste instantiate a dimension of aesthetic normativity, or, in short, value-ladenness. The value-bearing kind of experience that results from taste's workings is typically called aesthetic experience. Taste, on this widely accepted philosophical view, consists then in a propensity for aesthetic experience. The faculty can be exercised well or poorly. Most philosophers assume it to be educable, that is, liable to improvement through acculturation. Taste prevalently counts as a source of pleasure as well as displeasure: good taste, in influential perspectives along these lines, offers us pleasure in relation to aesthetically worthy objects of appreciation; it engenders displeasure (or distaste) in confrontation with aesthetically unworthy elements. Bad taste gets these matters wrong. Taste's normative character further reveals itself in its role as a faculty of judgment or evaluative experience: suitably functioning taste is standardly understood to respond with approbation to aesthetic value and with condemnation (or, again, distaste) to aesthetic disvalue. Contemporary philosophers frequently believe our proper taste reactions to apprise us of the aesthetic qualities of the objects of our aesthetic perceptions. They have formulated numerous proposals to this effect, often reworking Kant's view of the disinterested functioning of our common cognitive faculties or Hume's account of the true critic (Kant 1951; Hume 1998).

Kant and Hume are influential precursors of the prominent view that locates the aesthetic domain at a distance from practical considerations. Their alignment of taste with disinterested attention and freedom from prejudice, respectively, lends support to the notion of aesthetic autonomy. At the same time, these philosophers invest taste with significant moral weight. Both recognize an elaborate set of connections between aesthetic and ethical meanings and evaluations. The existence and importance of such bonds between aesthetics and ethics are fairly

uncontroversial in current scholarship, even if questions about how these ties are to be conceived are subject of heated debate.

Taste Versus Distaste

Taste, understood as a culturally situated faculty, enjoys greater prominence in aesthetic theory than distaste. Far from the antithesis of taste, in the sense described above, distaste generally implies a tendency to entertain aesthetic responses that include elements of aversion and displeasure. Many young children profess a distaste for brussels sprouts; such children are inclined to pass over these vegetables, which they experience as repulsive or appalling. Distaste, so conceived, involves a propensity to react with displeasure to objects of aesthetic antipathy; it constitutes a component of taste, defined as a portal guiding us toward aesthetic experience. There is of course a sense in which taste and distaste are opposites. "Taste" regularly denotes an aesthetic inclination toward sensory enjoyment of substances or objects, as when we say of children who look forward to eating green beans, that they have a taste for these vegetables; they find them tasty. This sort of taste does indeed stand in contrast to the kind of distaste identified earlier. But the broader notion of taste as a proclivity to undergo aesthetic experience includes both taste and distaste in this narrower sense.

The above vegetable examples focus on taste's axes of pleasure/displeasure and desire/aversion. Yet the same point applies to its specific workings as a capacity for judgments of aesthetic value and disvalue and for a host of value-inflected "qualitative" experiences of aesthetic properties: the faculty of taste comprises not only taste, understood as a tendency to appreciate aesthetic goodness – as when you have a taste for crispy lettuce, judging its fresh leaves to have a sprightly taste and experiencing their textures, flavors, looks, and sounds as frisky to the taste; it subsumes also distaste, comprehended as a propensity to denounce aesthetic deficiency – as when you have a distaste for overcooked brussels sprouts, judging these mealy blobs to have an insipid taste and experiencing them as flat or bland to the taste.

Taste, Distaste, and Disgust

Distaste and disgust are not the same (Jones 2000). Distaste involves a kind of sensory aversion, a form of displeasure, or a type of disapproval that can draw on a great variety of other experiences, including disgust. For example, instances of distaste can involve elements of the grotesque, the uncanny, formlessness, abjection, or the horrific. Furthermore, a distaste that turns us away from celery need not have us recoil in disgust. Disgust displays its own, distinctive contextually based, cognitive and experiential structure, which engages us in an immediate visceral reaction and often manifests aspects of attractiveness and fascination (Ahmed 2004; Korsmeyer 2011), components that distaste does not require (see also Nussbaum (2004, 87–8, 94–6, 121)). The affect of disgust is typically taken to rely on bodily proximity (even if mediated through a chain of contacts among elements (Ahmed 2004, pp. 87–88) or imaginings (Korsmeyer 2011, p. 30, pp. 56–7). Korsmeyer ascribes to disgust, aroused as a constituent of aesthetic experiences of food, art, and other elicitors, a unique power to offer an intimate apprehension of death, transience, and bodily dissolution. In short, differences between distaste and disgust abound.

However, Pierre Bourdieu surmises that "tastes are perhaps first and foremost distastes, disgust provoked by horror or visceral intolerance ('sick-making') of the tastes of others" (Bourdieu 1984, p. 56). This speculation hints at complex affiliations among taste, distaste, and disgust. Bourdieu suggests here that aesthetic taste counts taste among its objects, being substantially *about* taste(s), and proposes that this disposition functions by way of distaste and disgust. He alerts us to the possibility that the three phenomena enter into one another's workings, an idea that, we shall see, is also borne out by several literary treatments.

Critiques of Taste

Taste faces pressure from the sides of art, theory and a variety of other social practices. Artists and scholars have recognized ways in which long-standing asymmetries involving race, class, gender, ethnicity, coloniality, and nation permeate aesthetic experiences, standards, and judgments, at the level of philosophical analysis and everyday cultural existence. At issue are systemic phenomena, such as the fact that creations by white European men have generally been considered of greater aesthetic value than ones by African women. In tandem with this line of criticism, thinkers have examined the contributions of aesthetic elements to constructions of social difference and hierarchy (Bourdieu 1984; Shusterman 1993; Korsmeyer 1998; Roelofs 2014). For example, food tastes, such as an appetite for light, or, to the contrary, heavy and fat foods, regularly appear to serve as grounds for distinguishing classes of eaters from one another (Bourdieu 1984, p. 185). The entwinement of aesthetic matters with unjust forms of social differentiation engenders a host of ethical and political quandaries for philosophy, cultural theory, and social collectives: what place does and should the aesthetic occupy vis-à-vis the various markets surrounding the production, consumption, and exchange of cultural artifacts? More specifically, how might we conceive and reconceive the functioning and the philosophical underpinnings of taste? What role should we accord aesthetic experience and evaluation, understood in their full richness and complexity, as dimensions of our engagements with one another and the world and of food practices in particular? (On these questions, see Korsmeyer 1999; Heldke 2011, 2012a, 2012b; Probyn 2012; Roelofs 2014).

Numerous artists explore intricately interwoven aesthetic and ethical conundrums surrounding eating and food. Franz Kafka and Clarice Lispector, among others, accord sensory desires for and aversions toward edible materials an organizational role within webs of power and discipline (Kafka 1915/2003; Lispector 1964/1988). These authors mark out a significant place for taste and eating rituals, which, in their texts, function both as impediments to processes of change and as sites at which transformations are revealed to disrupt boundaries of gender, class, and race and to upend divisions between human and nonhuman life forms.

Food, Taste, and the Orchestration of the Ordinary

Our tastes and distastes form an integral part of the organization of everyday existence. In Kafka's novella *The Metamorphosis*, breakfast constitutes a regular feature of family life, one that typifies also the routines of a commercial traveler such as Gregor Samsa, the story's protagonist. Upon his mutation into an insect – or, more precisely, a verminous being of an unspecified sort – Gregor's habitual desires for food undergo a sea change. Sweet milk, formerly his favorite drink, no longer holds any appeal to him. Attentively left for the creature by his sister, the substance currently fills him with aversion. In his present condition, Gregor's preference turns to half-rotten vegetables, a hardened white sauce, and, most of all, a chunk of cheese he had declared inedible just two days ago, when matters in the home were still run as usual. Shifting social and domestic arrangements precipitated by his transformation prominently materialize in the realm of food. The cook resigns. The father puts an end to his prolonged breakfast ritual, during which he customarily absorbed physical nourishment along with the news. Financial exigency forces him to supply bank clerks with breakfast and, as the predicament of his son-turned-insect persists, to prepare meals for lodgers who take up quarters in the house. Mother, father, and sister eat and drink less and less. Their mealtime discussions dwindle. As life goes on, the sister, in her brother's eyes, grants him whatever edibles happen to be around in the house, apparently having lost all consideration for what he might or might not wish to eat. Kafka imagines the turnabout visited on the family in terms of a changeover in what is eaten, how, and when. He asks us to contemplate a revision of the bonds

between food and work, along with an adjustment in what elements are prepared and presented for digestion by whom and for whom.

The uprooting of the family's fate takes place as a development within foodstuffs: items that were previously considered refuse, waste, and leftovers, in the current situation, satisfy Gregor's hunger and offer him gustatory pleasure. Materials gain new functions. To expel his son from the living room he has entered, the father takes recourse to the fruit bowl, fielding a cannonade of apples at the insect, one of which harms its back. Delectable dishes thus not merely become repulsive, while unpalatable remnants turn scrumptious, but food also acquires a different, nonfood-based utility under the altered domestic circumstances.

Reverberations in the social armature encompassing the material paraphernalia of food extend yet further than this: analogous substances engender correspondences between body parts and objects molding the shapes and movements through which we usher food. On the first morning of his new incarnation, locked up in his bedroom, Gregor attempts to unlatch the door by turning the key with his jaw. The endeavor demands a great physical exertion on his part, one that injures his maw. A brown fluid runs from Gregor's mouth, which flows over the key to drip onto the floor. Yet the bug's effort is successful. Shrinking back from the creature, who has been coming all too close, the mother bumps into the breakfast table set behind her. A large coffee pot tumbles from the table and spills a flood of coffee over the carpet. Bringing together and yet separating the worlds of human and nonhuman animals, and subverting the distinction between processes transpiring inside and outside the body, the two brown liquids forge an uncanny resonance between the neither fully human nor altogether nonhuman orifices represented by the mouth and the kitchen utensil, between the ambits of bodily experience and material artifacts (key, coffee pot, carpet), and between the purview of intentional animal agency and involuntary human response. The dividing lines partitioning these elements appear to be mobile. At this point, the reader's sense of bodily integrity becomes somewhat destabilized. Kafka renders the shake-up afflicting the Samsa household tangible as an overhaul of body parts, objects, and corporeal acts involved in the handling, consumption, and expulsion of foodstuffs.

Tastes and distastes guide the characters' behaviors in multiple sense modalities throughout the story. Gustatory, olfactory, and tactile attractions and repulsions in the realm of food collaborate with desires and aversions embodied by the other senses to orchestrate an array of material and symbolic relationships among persons, animals, humans, objects, and spaces. Among the propensities structuring these relationships are auditory sensibilities (Gregor's appreciation of his mother's voice, mirrored inversely by individuals' fear of the sounds he utters), visual likings and loathings (the parents' ultimately high regard for the sister's looks, which parallels their disdain for the brown mass that is Gregor), and tactile and proprioceptive conditions (such as Gregor's initially uneasy settling into his body, his continued experience of his own bodily states, and the presumably repugnant quality to human touch of the slimy traces he leaves in his path). Tastes and distastes comprise dispositions that are instrumental in the steering of our daily comportment at the level of multiple, conspiring sensory registers.

Gregor's aesthetic aversions to food connect his life as a commercial traveler with his existence as a bug. One of the hardships of his itinerant existence used to be the inevitability of bad, irregular meals. His metamorphosis intensifies the trials he undergoes with respect to the necessities of eating and drinking and the conferral and withholding of provisions. The insect's tastes and distastes exert a humanizing effect. They signal capacities he shares with human beings. These sensibilities, which make food matter to him in specific, ethically salient ways, call for moral regard. They are instrumental in upholding his moral standing, in the reader's eyes. His companions' indifference to the pleasures, pains, and meanings sustained by his phenomenal world bespeaks their callousness. Their disgust proves to be decisive to the unfolding of the domestic ordeal. The family finally finds relief from its misery in ridding itself of the bug.

Upon his death, the cleaning lady expeditiously removes the corpse, which has evidently been demoted to dirt or trash. Disgust, at once morally problematic and soliciting respect, does not permit us to separate the animal from the human across a rift between, on the one hand, the position of rebel or victim and, on the other, that of boss, patriarch, petty bureaucrat, or collaborator in oppression, because the cleaning lady (who participates in Gregor's expulsion and who we can assume to be human, even if presumably not as unwaveringly human as her employers) is the one and only creature not driven by disgust – Gregor as well as his family members participate in this emotion. The affect does not straightforwardly connote humanity or a deficiency thereof; and neither does the absence of disgust clearly intimate these conditions. Kafka registers taste's, distaste's, and disgust's ties to categories of living beings and objects (class, gender, person, animal, thing, food/nonfood, useful/disposable object) and the tangled fault lines such categories tenuously and tendentiously specify among various entities.

Gregor's interest in food declines as the story proceeds. The digestion part of his eating comes to an end: he chews substances only to spit them out again. His own disgust mingles with his submission to the disgust of others. The absorption of materials stymied, the emotion manifests a stubborn cyclicality. Foregrounding Gregor's double standing as a subject *of* taste and an agent who is subjected *to* others' taste and placing the power of disgust in tension with his aesthetically underwritten status as a being worthy of moral consideration, Kafka discloses the thorny ethical significance sustained by taste and distaste (On forms of vulnerability, aggression, and violence emerging in this affective zone, see Nussbaum (2004) and Highmore (2010)). The novella situates the reader in a position of uncertainty, in which the ethical tenability of her aesthetic investments has been called into doubt.

Moving Through Distaste

Clarice Lispector's novella *The Passion According to G.H.* lends the transformative potentialities of eating an importantly different kind of spin (Lispector 1964/1988). Its narrator, the white Brazilian sculptress, G.H., tells us of the conversion experience she underwent the day before, in the course of which she shed the forms of her culturally shaped identity. Intent on putting in order her former black maid's room, G.H., to her consternation, enters a meticulously cleaned space. Under the influence of its barren purity, the grounds of her social being begin to dissolve. She comes to partake of the continuity of living matter, which encompasses, among other things, a cockroach with which she comes face to face in a wardrobe. The difference between her and the animal, two pieces of the same energetic substance, slips away. She abandons the disgust she feels for the insect (impelled by both its attractiveness and repulsiveness [54]) and eats the white pulp that seeps out of the dying bug's broken back. G.H. forfeits her taste for beauty and her distaste for ugliness to allow for a more delicate "taste of the living" (146). Unconstrained by her customary tastes, such as an appetite for the potato's seasoning that effaces the more delicate taste of the tuber's earthy substance, she is able to experience an impersonal, nonhuman contact with the materiality of things. In this contact she finds a basis for a different kind of goodness and morality. Discarding the trappings of the human, as well as the promise of an "aesthetic plane of goodness" (152), she learns that a true humanization of the human may ensue if humans give themselves over to unknown aspects of their interdependency with the world. That evening she plans to go eating shrimp and dancing with her friends. The eating mouth exemplifies her impassioned, desiring material connection with the world, as she returns to regular happiness.

Shifting the boundaries of eating constitutes a stage in G.H.'s passing through a sedimented form of social being that casts her into a predictable mold toward a more expansive set of relationships with others and the material world. Her metamorphosis clearly takes place in a woman's body and counters gendered philosophical hierarchies such as the indefatigable mind-body opposition. Underscoring the ethical,

political, and ontological significance of sex-specific processes of change, Rosi Braidotti describes it as a process of feminine becoming (Braidotti 2002, pp. 160–171). But eating-through-and-into-otherness often engages us in exoticizing quests (hooks 1992; Heldke 2003). Such projects valorize enticing aspects of racial and class difference as instances of ostensibly more general, open-ended types of alterity. G.H.'s case is no exception to this. Her aesthetic desires and aversions both track and fuel intersecting racial, colonial, class, and sexual parameters, modalities that are coded by and play themselves out in the human-animal relation. In contemplating and taking part in the aesthetics and ethics of transformation, we thus need to explore the ways in which eating and food tastes channel or derail such forces, including the forms in which we attempt to dispel already existing forms.

Kafka and Lispector posit a baseline of everyday life in which taste is complicit. This condition of normalcy unravels in consequence of the aesthetic shifts traversed by their characters. Nonetheless, at the end of each story, an ordinary rule of things reasserts itself, albeit with a material, symbolic difference. These contravening tendencies bring out unsettling ethical predicaments inherent in a long-standing history of taste's relational operations (Roelofs 2005).

Food, Taste, and Agency

Drawing on Friedrich Nietzsche and Henry David Thoreau, political theorist Jane Bennett argues that eating involves a recorporealization of human and nonhuman bodies in response to one another. Both kinds of bodies contribute formative powers to this process and yield materials that are being acted upon by other forces. Bennett rejects what she labels "a conquest model of consumption," which "disregards the effectivity of not only animal bodies, but also the 'bodies' of vegetables, minerals, and pharmaceutical, bacterial or viral agents" (Bennett 2007, p. 133). For food to nourish an eater, she indicates, both have to be changeable under the other's influence. Eating, in her view, consists then of a series of transformations in which food exercises capacities of agency in conjunction with other participants in complexes of bodies, substances, and forces (Bennett 2007, p. 134). As an example of the agency of edible materials, she cites the apparent effects of dietary fat. Several studies of fatty acids have found that lipids influence subjects' cognitive and social states, affecting attention span as well as rates of depression and aggression. According to Bennett, Nietzsche and Thoreau, likewise, affirm the agentic capacity of food in commentaries on the moral and political efficacy of diet. Both philosophers, along with the more recent slow food movement, she notes, advocate projects of artful (or, as we can call it, aesthetically innovative) eating, with the intention of instigating changes within heterogeneous constellations of elements. To suggest an example, an increase in the consumption of fish rich in omega-3 fatty acids might, by way of a rather unpredictable chain of effects, issue in a greening of your concrete-dominated street corner and a greater incidence of parties, romances, and high achievers in school. Such mixed configurations of components, labeled assemblages, in Deleuzian terminology, are precisely the flexible material entities that Bennett, more generally, understands as the loci of social and political agency. Although she does not mention taste specifically and her explicit references to aesthetic aspects remain for the most part quite abstract, her discussions of food implicitly outline a prominent place for taste as a force within the collectivities she sees at work in the realization of cultural change.

Bennett highlights how beer, according to Nietzsche, exerts social power in the context of other cultural artifacts, such as newspapers, politics, and Wagnerian operas. She draws attention to the conative potentialities that Nietzsche's figure of Zarathustra attributes to "warrior-" or "conquerer-food," in contrast to what is to be expected from "flatulent vegetables." In Thoreau, she documents a shift from a hunger for raw, wild birds that he encounters in his path to a repugnance he feels for animal corpses.

Meat's oozing and dripping put him off; its filthiness troubles him. He then craves the "true flavor[s]" and tastes of freshly picked huckleberries and blueberries, unprocessed by the market (Bennett 2007, pp. 139–142). Bennett next underlines the slow food movement's double focus on environmental, social, and economic stakes and gastronomical aims (these latter goals involve the promotion of the savoring of food, of cultures of preparation, and of communal aspects of these practices).

Although Bennett does not foreground taste, we can readily see how it would be a crucial element of the network of forces and things she theorizes. Food tastes, in the writings she cites, function in collaboration with a wide range of tastes, as they do in Kafka and Lispector. These include desires for sounds, for ostensibly uncultivated contact with nature, and for intimate participation in sociality and cultural forms. Taste, distaste, and disgust, as the above quotes suggest, once more, exhibit a close interconnectedness.

Besides being experiential capacities, our tastes and distastes are institutionalized phenomena. They constitute social forces permeating commodity markets, agribusiness interests, political movements, public health policies, and school lunch programs. They operate at an ontological level at which subjects and objects evince interdependencies, conferring both malleability and traction on the exchanges among bodies, human and nonhuman. They must be considered fundamental participants in the multifarious capacities for agency exercised by and surrounding food.

Summary

Allied with the moral and the immoral, the concept of taste enjoys a controversial ethical standing. Along with other kinds of aesthetic desire and aversion, tastes and distastes for food fulfill structural roles in the organization of everyday existence. In contemplating complex sorts of bodily transformation, authors investigate how eaters, food practices, and acts of tasting implement shifting categorial alignments among living beings and among living beings and objects. Literary fictions examine how agents, activities, and experiences involved in eating collaborate to enact aspects of cultural change. Novels thereby implicitly or explicitly accord food tastes a vital role in supporting and modifying the social, material relationships we inhabit. These artistic perspectives resonate with recent scholarship in aesthetics (Korsmeyer 1999, 2011; Heldke 2011; Roelofs 2014), affect theory (Ahmed 2004), and materialist approaches to social change (Braidotti 2002; Bennett 2007). At the same time, the philosophical and ethical conundrums engulfing our aesthetic proclivities indicate that important questions about the makeup, the grounding, and the cultural functioning of our tastes and distastes remain open, calling for further inquiry.

Cross-References

- ▶ Aesthetic Value, Art, and Food
- ▶ Animal Welfare: A Critical Examination of the Concept
- ▶ Food-body Relationship
- ▶ Food and Class
- ▶ Food, Class Identity, and Gender
- ▶ Food and the Avant-Garde
- ▶ Gustatory Pleasure and Food
- ▶ Human Ecology and Food
- ▶ Literature, Food, and Gender
- ▶ Nietzsche and Food
- ▶ Race, Racial Identity, and Eating
- ▶ Slow Food
- ▶ Waste and Food
- ▶ You Are What You Eat

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Technologies used for Animal Breeding, Ethical Issues

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Synonyms

Animal ethics; Breeding ethics; Ethics of animal biotechnology; Ethics of reproduction technology

Introduction

Animal breeding, as part of domestication, has a long history going back more than 10,000 years (FAO 2007). The selection of animals with desired traits and the crossbreeding of different lines have resulted in many different breeds of use to humans. For most of that time, the required knowledge and skills were developed by means of practical experience. However, since the nineteenth century, scientific knowledge has increasingly been utilized in the practice of breeding. Until the second half of the twentieth century, however, most breeding technologies were still based on the natural mating of animals. After World War II, nonnatural reproductive technologies were commercially introduced and served to accelerate the breeding process. Artificial insemination (AI) in cattle, for example, has replaced natural fertilization in many Western countries. Another, more recent technology is the introduction of embryo transfer (ET), which consists of removing embryos from a female donor and transplanting them into recipient animals, where they will develop until birth. More recently, biotechnologies such as marker-assisted selection (MAS) have been developed; these can speed up the breeding process, because embryos can be tested for desired features before transplantation (Mapletoft and Hasler 2005, FAO 2007).

Breeding technologies have resulted in an enormous increase in food production based on animals. For example, Rauw et al. (1998) describe how cow milk production per lactation in Norway, the USA, and the Netherlands has doubled in the second half of the last century, that the slaughter weight of broiler chickens in the USA and the Netherlands has increased by 50 % in the last third of that century, and that the daily growth rate of pigs in Norway and the Netherlands increased by more than 13 % between 1980 and 1995.

To be clear, this increase in animal production is not just the result of improved breeding technologies but should also be considered as the result of a combination of various technologies and scientific breakthroughs, such as the application of antibiotics, improved feed content, housing conditions, mechanization, and so on. This could only happen in combination with a change in the livestock production system in a more general sense. For example, Orland (2003) describes how the rise of high-productivity dairy cattle in Germany and Switzerland in the nineteenth and twentieth centuries was made possible by a change in consumer milk demands and the introduction of train transport that made the importing of feed economically feasible. It changed local farming – which was traditionally based on the interrelationship of soil, animals, and fodder on a local scale – into the practice of external inputs and external markets. This has led to what is sometimes referred to as industrialized animals (Harfeld 2010). Critics point to the fact that the benefits have occurred at the cost of the animals. For example, this has resulted in negative immune performance and higher mortality rates among broiler chickens and to leg weakness and diseases in pigs and cows (Rauw et al. 1998). It also threatens animal agro-biodiversity because of the selection focus on a limited number of traits such as milk, meat, and egg production and an adaption to and tolerance for certain housing conditions (FAO 2007).

The technologies described so far are essentially based on technologies that have resulted in breeds that could, in principle, have also been obtained through classical breeding approaches based on natural mating. This is not the case with the most recent technologies such as genetic modification and cloning. Genetic modification or engineering is the artificial modification (alteration, insertion, or deletion) of genes in living organisms. Unlike breeding, this technology is not restricted by the species barrier. Genes from completely different species may be inserted into the genome of an organism, which can then lead to novel features. Cloning refers to reproductive technologies by which a new organism is produced from a somatic cell or tissue. The new organism will have the same genetic makeup as the original organism from which it was cloned.

A well-known and early example of genetic modification in animals is the "Beltsville" pigs created in 1989 in Canada. These pigs were equipped with a human growth hormone gene that caused them to grow faster. However, they suffered from several serious abnormalities and diseases, and accordingly the experiment was halted (Thompson 1997). Another example is the genetically engineered "Bull Herman" that was born in 1990 in the Netherlands. This animal had received the human gene for the hormone lactoferrin. The idea was that this hormone could be harvested from the milk from its female offspring for medical purposes. This application led to widespread concern among the Dutch public, especially since this was considered as offending the intrinsic value of the animal in order to equip it with a human gene (Schroten 1998).

A more recent example is genetically engineered Atlantic salmon. This fish species is equipped with genes from the Chinook salmon and the ocean pout and is meant for fish farming (http://www.aquabounty.com). It grows nearly twice as fast as the original salmon and is much more feed efficient. Accordingly, this application has also met with societal resistance, especially on ecological grounds. Critics are afraid that the engineered fish may irreversibly and negatively affect natural salmon populations if they escape into marine ecosystems (Smith et al. 2010).

Another very recent application of animal biotechnology has been described in a report of the

Dutch Committee on Animal Biotechnology (CBD 2011). This committee advises the Dutch government on the ethical issues of animal biotechnology in non-biomedical applications. In the proposed application, male but not female chicken embryos would receive a gene inserted that codes for a fluorescent protein. This would make it possible to identify male embryos in freshly laid eggs noninvasively and then to exclude them from the brooding process. It could prevent the annual killing of hundreds of millions of day-old male chicks that cannot be used in the egg-production poultry industry. This killing practice is currently the object of criticism in political circles in the Netherlands, and several alternatives, including genetic modification, are being investigated (Leenstra et al. 2011).

The cloning of animals as a reproductive strategy has also resulted in great deal of societal concern. Dolly the sheep, born in 1996 in Scotland, was the first mammal to be successfully cloned, and acknowledgement of this event caused a shock among scientists and citizens, because it had been generally believed that mammal cloning was really not possible. After the acknowledgement of the successful cloning of Dolly, a full-blown debate raged in many countries, since many saw it not only as a threat to animal welfare and animal dignity but also as a first step towards future human cloning. Cloning may in the future contribute to animal industrialization, because it makes it possible to rather rapidly replace one herd with another. Currently, more than 20 mammal species have been cloned. Most applications are still in the research phase, but some have already been applied, especially for the preservation of breeds with specific traits or for sporting purposes, for example, in horse racing (COGEM 2011).

Ethical Issues

Many ethical issues have arisen with respect to modern breeding technologies, because they have an impact on the welfare of animals, on agro-biodiversity, or on the environment. In addition, the rise of modern biotechnology in the form of genetic modification and cloning has specifically brought up fundamental issues with respect to the intrinsic value of animals and the role of animal technology in present-day society.

Animal Ethics

Already in the early 1960s, there were many authors who took into consideration the moral position of animals. The publication of *Animal Machines* in 1964 by Ruth Harrison especially raised a great deal of public concern (Van de Weerd and Sandilands 2008). The book describes how the focus on efficiency was taking place at the expense of animal welfare when it came to castration, tail docking, beak trimming, dehorning, etc. In response, the British government set up the Brambell Committee in order to investigate this issue. The resulting report stated that "farm animals should have the freedom to stand up, lie down, turn around, groom themselves and stretch their limbs." This viewpoint was accordingly adopted and codified into "Five Freedoms" by the British Farm Animal Welfare Council (http://www.fawc.org.uk/freedoms.htm). Farm animals should be free:

1. From hunger and thirst – by ready access to freshwater and a diet that maintains full health and vigor
2. From discomfort – by providing an appropriate environment including shelter and a comfortable resting area
3. From pain, injury, or disease – by prevention or rapid diagnosis and treatment
4. To express normal behavior – by providing sufficient space, proper facilities, and the company of the animal's own kind
5. From fear and distress – by ensuring conditions and treatment which avoid mental suffering.

Except for Freedom 4, this approach reflects a subjective welfare approach towards domesticated animals: The (subjective) experience of the animal itself, although sometimes difficult to assess, should be decisive when it comes to what is considered to be a violation of the interest of the animal. In contrast, Freedom 4 refers to a functionalistic view, where welfare is considered in terms of the normal functioning of the

animal with respect to health, growth, and physiological and behavioral aspects.

The Five Freedoms express a code of morality, that is, a set of moral rules humans should follow with respect to their behavior towards animals that fall within the aegis of their responsibility. However, ethics is much more than simply expressing the kind of moral rules we should follow; it also attempts to explain *why* we should follow such rules. It explains why animals have moral standing, that is, why they should be considered as members of the moral circle. Three types of answers, representing the various main theories in animal ethics, predominate: utilitarian, animal rights, and biocentric answers.

Utilitarian Considerations

Utilitarianism is a consequentialist form of ethics, which argues that avoiding suffering or enjoying life is considered to be intrinsically valuable for sentient beings, including human and nonhuman sentient animals. Consequently, animals are within our moral circle if they have sentience, that is, if they possess the morally relevant ability to suffer or to enjoy life. Accordingly, in as much as humans and nonhumans have the ability to suffer or to enjoy life, they have a similar moral standing. "The question is not, Can they reason? nor Can they talk? but Can they suffer?" – this according to the famous and often cited statement by nineteenth-century philosopher Jeremy Bentham (Gruen 2010). Although this approach is based on the individual properties of affected beings (sentience), it stresses a population-based weighing approach.

According to utilitarian calculus, we need to take into account all effects on well-being of all involved sentient beings when we weigh our actions. Breeding, genetic modification, cloning, etc., may lead to animal suffering but have on the other hand positive consequences for humans, because it contributes to efficient animal production and consequently to human prosperity. However, in some cases, it can also contribute to the animal's well-being, for example, in terms of increased disease resistance or by becoming less vulnerable to housing conditions or farming practices. This latter may however be questioned from a functionalistic welfare standpoint as it may result in animals that do not show normal and natural behavior.

In agriculture, most of the suggested applications of genetic modifications will most likely not lead to any heavy impact on the animal welfare of the thus-created animals (Thompson 1997). Moreover, regulation in many countries does not allow any genetic engineering and cloning that may result in animals suffering. In the chicken case described above, the inserted gene is not expected to have any effect on the animals. However, we should not just look at those animals resulting from engineering and cloning technologies. Producing these animals in itself often implies many experiments and the use of many animals. For example, hundreds of sheep were needed to bring about the cloned sheep Dolly. And, although procedures have much improved since the 1990s, many animals are often still needed for experiments, which may also fail and may cause animal suffering (COGEM 2011).

From a utilitarian point of view, one may consider cloning and genetic engineering as not so very different from the older reproduction and breeding technologies. This does not mean, however, that genetic modification or cloning is essentially acceptable. Rather it means that, while the technology itself may not be a moral issue, the possible consequences for the welfare of the creatures involved should be a primary consideration.

Animal Rights Considerations

A quite different reasoning is applied when it comes to animal rights approaches that are generally based on deontological considerations, meaning that it is not primarily the consequences of an act that should be considered, as is done in utilitarian approaches, but rather the act itself, which should be in accordance with certain principles. Taking an example from human society, one should respect, on principle, other people as autonomous individuals. Similarly, according to animal rights approaches, animals have moral standing because of what they are: sentient beings having subjective experiences, that is, the ability

to experience the quality of life and to enter into and maintain relationships with others (Regan 1983). Such beings have an inherent or intrinsic value, and our behavior towards them should express this. Inherent value is, according to Regan, "a categorical concept. One either has it, or one does not. There are no in betweens. Moreover, all those who have it, have it equally. It does not come in degrees" (p. 241). Following this line of reasoning, it is thus not suffering as a consequence of sentience but the ability to have sentience itself that counts.

According to this line of thought, cloning and genetic engineering of sentient beings (and actually all modern animal technologies that aim to contribute to the food industry) should be considered as offending the inherent or intrinsic value of animals.

Biocentric Considerations

The reasoning in both the utilitarian and animal rights approaches is limited to animals having a certain level of sentience. However, moral objections against genetic modification often not only refer to sentience and sentient animals but also to those with other backgrounds and often to more organisms. For example, the Bull Herman case, already mentioned in this entry, led to much public opposition, because many people considered genetic modification of animals as playing God and/or as an unnatural act.

Biocentric reasoning especially played a role in this discussion. According to biocentrism any living organism should be considered as a "teleological center of life," having an intrinsic good in its own right. The organism's good consists of fulfilling its capabilities and satisfying its needs in a manner suited to the species. Life is worthwhile in itself, and one should respect it as it is and not in terms of anthropocentric presumptions. According to Taylor (1986) all living entities have, because of this own good, an "inherent worth," as he calls it.

In the discussions on genetic modification of animals, the biocentric approach is often expressed in terms of the animal's integrity, that is, "the wholeness and completeness of the animal and the species-specific balance of the creature, as well as the animal's capacity to maintain itself independently in an environment suitable for the species" (Rutgers and Heeger 1999).

Respect for integrity (in addition to welfare and subjective considerations) was also an important consideration in the case of the genetically modified chickens. The committee concluded that the current practice of killing millions of day-old chicks shortly after hatching should be considered as a major infringement of the integrity of the animals. It acknowledges that although integrity on the genetic level was at stake in the proposed application, the genetic modification would probably not affect the chickens' autonomy, their phenotypical identity, or their vulnerability to diseases (CBD 2011, p. 13). Consequently, the committee agreed that the application was acceptable in terms of animal ethics considerations (however, see the last section of this entry).

In general, according to biocentric approaches, it is not primarily welfare or having sentience but the integrity or authenticity of the animal's constitution that counts when assessing the moral acceptability of breeding and reproductive technologies such as cloning and genetic modification, for example.

Environmental Ethics

Welfare, subjective, and biocentric approaches are the main considerations when it comes to animal ethics. However, animal reproduction and breeding technologies such as artificial insemination, embryo transfer, genetic modification, or cloning may also effect the environment such as ecosystems, species, or animal populations, for example. According to anthropocentric environmental ethics, the environment is an ethically relevant entity if it directly or indirectly serves human interests. Anthropocentrism therefore often has a utilitarian flavor. In contrast, according to ecocentric reasoning, ecosystems and populations have an intrinsic value that should be respected and should not be negatively affected or, if so, only for strong, compelling reasons (Brennan and Lo 2011).

Although underlying justifications may differ, these two approaches may converge in practice. For example, agro-biodiversity may be considered as a human interest, inasmuch as it contributes to genetic resources, food, and other services (FAO 2007). Modern breeding technologies may reduce agro-biodiversity and may even imply the disappearance of breeds. This may be accelerated by means of genetic engineering and cloning, since they often focus on a few species or races. The reduction of animal agro-biodiversity not only affects the interests of farmers who earn a living from keeping rare breeds but may also be considered as a threat to breeding in general, because it may exhaust the genetic variability on which breeding depends (FAO 2007).

However, agro-biodiversity is not valued only because of anthropocentric utilitarian considerations such as these. Indigenous animal breeds have evolved under specific, societal, and biophysical circumstances, and they may also have an inherent or intrinsic value as a particular species or breed, or because they represent local and historical human traditions and cultures (FAO 2007).

Genetic engineering of animals may also effect the environment directly. For example, genetically modified animals may escape into the wild and interbreed with wild congeners. Wild species, populations, and ecosystems may subsequently be negatively affected, which is questionable or even unacceptable from the standpoint of environmental ethical considerations. This is the main concern when it comes to the development of the genetically modified Atlantic salmon described earlier. Another example is the environmental introduction of genetically modified mosquitoes to combat human diseases. These mosquitoes are genetically modified in such as way that they will not have viable offspring. By introducing huge numbers of these mosquitoes into a local population that is causing a disease (e.g., dengue fever), the pest population will collapse. However, this implies the possible irreversible introduction of genetically modified organisms into the environment with possibly unacceptable consequences (COGEM 2011).

On the other hand, a number of animal engineering applications are meant to benefit the environment. For example, in the genome of the "Enviropig," genes are inserted that result in a more efficient phosphate uptake and consequently a lower phosphate content in pig dung, which will thus lead to a lower environmental load (COGEM 2011). The development and commercial introduction was halted, however, because of public concern about this application and resistance to it (Pollack 2012). Finally, a number of people have suggested that modern reproductive technologies, including cloning, may play a role in nature conservation and the preservation of endangered and rare species in the future, although there are many hurdles yet to be surmounted (Andrabi and Maxwell 2007).

Ethics, Animal Technology, and Society

The environment, species, or populations are known as collective entities: They may have moral value of their own as a collection of individual entities and not simply as the sum of the moral values of the individuals. There is also another relevant collective entity at stake when we consider the rise of modern reproductive and breeding technologies: human society. Technology affects our world, leads to new issues, and makes a particular world possible and thus a particular culture. For example, the introduction of the contraception pill in the 1960s drastically changed sexual morality in Western countries (Fukuyama 1999). More recently, we see an enormous impact from the rise of the Internet and smartphones on how people communicate and interact, which in turn leads to new technologies. Similarly, assisted reproduction and breeding technologies have stimulated the development of large-scale or bio-industrial farming practices, which in turn have led to new technologies such as the application of pharmaceutics to control the appearance of diseases related to crowded stables. In general, we may say that there is a coevolutionary relationship between technology and society. This means they affect and steer each other. Technology

therefore carries with it certain moral codes and should not be considered as simply a neutral driver of societal change.

The interrelationship between technology and society is nicely illustrated in the case of the modified chicken. The killing of millions of chicks in the egg-production industry, according to the report of the CBD (2011), is a consequence of a rationalization process in poultry farming in the second half of the last century. It has led to instrumentalization and adjustment of animals for purposes of efficiency, in a similar way as was already described by Ruth Harrison in the early 1960s.

This has led to separate chicken lines: efficient meat-producing and efficient egg-laying lines. However, the male chicks of the egg lines can clearly not be used for egg production and appear to not be useful for commercial meat production. They are therefore killed immediately after hatching. The committee acknowledges that the killing of these animals directly after birth does not respect these animals as living beings from a biocentric point of view. It is a problem that now seems to be solved by a new technology: genetic modification.

Although the committee considered the genetic modification in the application as morally less problematic compared to the killing of so many day-old chicks, it has questioned the application from an ethics of technology perspective as perhaps an irreversible continuation and intensification of the instrumentalization and rationalization tendencies in poultry farming. Accordingly, the committee has put forward the question of whether this is what we want as a society or whether we should instead look for quite different trajectories of technological development. The committee also concluded that this last question should be answered in a societal debate and has suggested this to the Dutch government. The example of the chicken case demonstrates that ethical questions of modern animal breeding technologies go beyond the level of animal ethics and environmental ethics. In general, ethical issues related to modern reproductive technologies question our relationship to animals and to our environment and, not least, ask us what kind of society we are really aiming for.

Summary

In this entry we have discussed the rise of modern reproductive technologies in animal breeding that have contributed to an industrialized farming system and consequently to animal welfare problems. Starting with the Five Freedoms concept, we outlined three ethical theories as being those which underlie justifications for attributing moral status and thus respect to animals. Utilitarian considerations focus on the welfare of animals and specifically argue for minimizing or avoiding animal suffering. Animal rights approaches argue that sentient animals should be respected because they have as subjects, experiencing the quality of life, an inherent value, while biocentric approaches stress the moral value of life as an underlying motive for respecting the animal's integrity.

However, animal ethics considerations are not alone in playing a role in this. Animal breeding may affect ecosystems, species, and animal populations. Modern reproduction technologies, for example, may decrease agro-biodiversity that may be questioned from both an anthropocentric and an ecocentric environmental-ethics standpoint. Moreover reproductive technologies such as genetic modification may affect the ecosystem more directly.

Finally, it is argued that technology and society interact and that technologies carry with them implicit moral codes. Modern reproductive animal technologies put questions on the table that exceed the level of animal or environmental ethics and ask us to consider what kind of society we really want.

Cross-References

- ▶ Agricultural Science and Ethics
- ▶ Animal Welfare in the Context of Animal Production
- ▶ Egg Production: Ethical Issues
- ▶ Environmental Ethics

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Telos and Farm Animal Welfare

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Synonyms

Farm animal welfare and animal physical and psychological nature

There are many reasons why there is relatively scant history of theorizing regarding human moral obligations to animals. First, ethics was largely seen as a highly local phenomenon, governing interactions among limited members of select groups of human beings – witness differing biblical ethical standards for the treatment of Israelites, foreigners, women, slaves, and other subgroups of humans. Second, as St. Thomas Aquinas teaches, animals were not perceived as enjoying genuine moral status. At best, it was obligatory not to treat them cruelly, as they

sufficiently resembled humans so that gratuitous abusive treatment of them was likely to eventuate in cruelty towards full objects of moral concern, i.e., human persons. Most importantly, the overwhelmingly dominant use of animals in society was agricultural, being used for the production of food, fiber, locomotion, and power. As I explain below, this obviated much of the need for theorizing about human obligations to animals.

The key to produce success in animal agriculture was *good husbandry,* wherein the farmer placed the animals in optimal conditions dictated by their needs and natures and augmented their ability to survive and thrive by provision of food during famine, water during drought, protection from predation, medical attention, help in birthing, and so on. So powerful is the hold of the concept of husbandry on the human psyche that when the psalmist wishes to create a metaphor for God's ideal relationship to humans, he uses the Shepherd in the 23rd Psalm. Good husbandry was sanctioned by the most powerful of human motivations – self-interest. Failure to provide for the needs of one's animals resulted in diminished productivity – loss of weight, sub-optimal reproduction, and susceptibility to disease. For this reason, only an extremely minimalistic ethic for animal treatment was required – forbidding deliberate, sadistic, purposeless infliction of pain and suffering on animals, and the failure to provide basic sustenance such as food and water – to cover those deviant humans for whom sadistic gratification was more important than productivity.

A philosophical need for a rationally articulated, robust, animal ethics probably arose with the advent in Europe of Cartesian philosophy which denied consciousness, as well as the ability to feel pain or to suffer, to animals. In response, philosophers in the British empiricist tradition felt compelled to provide a basis for moral concern. These thinkers generally worked in the utilitarian tradition and included Bentham, Mill, Sidgwick, Salt, and Singer, as well as and related philosophers such as Hume. Being empiricists, the desire on the part of all organisms to seek pleasure and avoid pain seemed to them to be an observable and obvious basis for ethics that lent itself well to quantification. This focus enabled British moral thought to escape from continental European, rationalistic skepticism, as articulated by Descartes, Spinoza, and Kant, about more complex animal thought that excluded animals from the realm of direct moral concern. Animal ethics could thus be grounded in the common sense awareness that animals experienced pleasure and pain even as humans did; that pleasure and pain *matter* to animals.

Practical, societal ethical concern with animal treatment only began in the mid-twentieth century, as society began to recognize the major limitations of the animal cruelty laws and the ethic of anti-cruelty conceptually underlying them. It is almost certain that less than 1 % of the suffering that animals experience at human hands is the result of deliberate cruelty. This societal thrust to supplant the cruelty laws continues to grow, as evidenced in 2004, when no fewer than 2,100 pieces of legislation pertaining to animal welfare were proposed in federal, state, and municipal legislatures across the 50 United States (Flemming 2005).

When I and others began work on improving the moral status of animals in society during the 1970s, the greatest problem we faced was deriving a robust animal ethic that would overcome the limitations inherent in the ethic of anti-cruelty. Equally vexatious was the question of creating an animal ethic that ordinary people would find plausible. While the utilitarian emphasis on maximizing pleasure and minimizing pain had much to recommend it as a basis for animal ethics, it also suffered some severe drawbacks. In particular, I recognized that not every sort of harm humans inflict upon animals counts as pain in any ordinary sense of the word, unless the notion of pain is stretched so broadly as to cover all sorts of misery not usually classified under the rubric of pain. Such states as loneliness, boredom, fear, inadequate stimulation, inability to exercise, separation from offspring or parents, impoverished diet, inability to forage, hunt, or otherwise secure one's own food, and myriad others certainly harm animals, yet do not lend themselves to being arrayed along a single axis of pleasure and pain.

In dealing with this problem, Rollin recalled Plato's dicta that ethics proceeds from preexisting ethics and that in dealing with ethics and adults, one cannot *teach*, one can only *remind*. If society wished to expand the purview of ethics over the treatment of animals, it needed to look towards established ethical concepts with which it was already familiar. People would look to the ethical concepts applied to humans and carry them forward, mutatis mutandis, to the treatment of animals.

Recall that, before the mid-twentieth century, the key to agricultural success was good husbandry, which meant taking great pains to put one's animals into the best possible environment one could find to meet their physical and psychological needs and natures (which, following Aristotle, can be called *telos*) and then augmenting their ability to survive and thrive. Thus, traditional agriculture was roughly a fair contract between humans and animals, with both sides being better off in virtue of the relationship. Husbandry agriculture was about placing square pegs into square holes and round pegs into round holes and creating as little friction as possible in doing so.

The rise of confinement agriculture in the twentieth century, based in applying industrial methods to animal production, broke this "ancient contract." With technological "sanders" – hormones, vaccines, antibiotics, air handling systems, and mechanization – one could force square pegs into round holes and place animals into environments where they suffered in ways irrelevant to productivity. If a nineteenth-century agriculturalist had tried to put 100,000 egg-laying hens in cages in a building, they all would have died of disease in a month; today, such systems dominate.

At the same historical moment, animals began to be used on a large scale in research and testing, again causing new and unprecedented degrees of suffering.

The amount of suffering arising from these sources far outweighed what is produced by deliberate cruelty. Further, the anti-cruelty laws do not cover these new uses and cannot be twisted to fit practices such as steel-jawed trapping, sow stalls, or toxicology testing, since these exemplify "ministering to human necessity," which is the standard legal test for cruelty. Since trapping is hardly a "human necessity," this case graphically illustrates how cavalier the cruelty laws were with respect to animal welfare. Thus, a demand was called forth for a new ethic.

In Western societies, human ethics balances utilitarian considerations – the greatest good for the greatest number – against concern for individuals by building "protective fences" around essential features of human nature; these fences are called *rights*. Rights are a moral/legal notion designed to save features constitutive of individuals' human nature – e.g., the desire for free speech – from being sacrificed for the general welfare. The logic of this notion is being exported to animals – society wishes to assure that their most important interests, flowing from their *telos*, are not sacrificed and that farm animals live decent lives and laboratory animals have pain controlled.

Direct rights for animals are of course legally impossible, given the legal status of animals as property, the changing of which would require a constitutional amendment. (Many legal scholars are working to elevate the legal status of animals (Wise 2000).) But the same functional goal can be accomplished by restricting how animal property can be used. Thus, the US federal laboratory animal laws require pain and distress control, forbid repeated invasive uses, require exercise for dogs, etc., unless exceptions to these are approved by the appropriate review committee as being required for scientific or animal welfare reasons. And some European laws have forbidden sow stalls. This mechanism is the root of what I have called "animal rights as a mainstream phenomenon." This also explains the proliferation of laws pertaining to animals as an effort to ensure their welfare in the face of historically unprecedented uses.

In place of pleasure and pain, society is looking towards the ancient Aristotelian notion of *telos* as the locus of moral concern for animals. An adequate morality towards animals must recognize the full range of possible "matterings" unique to different sorts of animal *telos*, or animal

nature, the root notion of Aristotle's functional, teleological biology. Whereas modern biology focuses on reductionist, molecular, and mechanistic explanations, while Aristotle's biology emphasizes the unique set of traits and powers that make the animal what it is – the "pigness" of the pig, the "dogness" of the dog.

Aristotle recognized that different animals evidenced different ways of fulfilling the fundamental nature of living things, i.e., nutrition, locomotion, sensation, cognition, and reproduction. Biology studies these functions in different sorts of animals, and it is these functions that constitute an animal's nature. Secondary school biology is still studied in this Aristotelian way. There is nothing mystical about *telos*; it is simply what common sense recognizes in such sayings as "fish gotta swim, birds gotta fly." The only departure that must be made from Aristotle today is to see *teloi* not as fixed and immutable but as snapshots of a dynamic process of evolution, genetically encoded and environmentally expressed.

Thus, an adequate morality towards animals should address not only pleasure and pain but also the full range of possible "matterings" following from animals' natures. When one evaluates, for example, gestation crates for sows, they must be compared to what a sow does in nature when she actualizes her *telos,* covering a mile a day rooting and foraging, nest building, building her nest on a hillside so that urine and fecal material will run off, trading off piglet care with other sows, all of which behaviors are impossible to perform alone in a crate. In fact, given the *telos* template, it is evident that fundamental interests of animals determined by their natures are regularly violated in modern agriculture. Their freedom of movement is truncated; they are stopped from eating what they are naturally built to consume by not letting them graze, hunt, or forage; their ability to cope with weather change is aborted, as is their ability to exercise. Denying these natural activities harms the animals in many ways, impeding their exercise of powers they possess to survive.

A nonobvious example of violating animal nature or *telos* may be found in a story recounted by Hal Markowitz. He relates that the Portland, Oregon zoo built a showpiece exhibit for servals, even importing sand and plants from the Kalahari (Markowitz and Line 1990). The exhibit was a dud; the servals lay around in obvious depression, refusing to eat. When Markowitz visited their native habitat, he found that the bulk of these animals' time was spent predating low-flying birds, their main source of food. He told the zoo that, instead of feeding horsemeat in chunks, the keepers should grind the rations into meatballs, which were then to be shot randomly across the exhibit enclosure by a compressed air cannon. The animals' behavior changed overnight; they became excited and active, clearly exercising the predating aspect of their *telos*. Despite the power of the food drive, it was trumped here by failing to accommodate *how* they had evolved to eat. Similar strategies provide for *telos* accommodation for many animals in captivity.

An example from coyote behavior strikingly illustrates how *telos* needs can trump even major physical pain. It has been recounted for years that coyotes, caught in a leg-hold trap, will chew their legs off, enduring terrible pain, rather than submit to immobility. (This is also true for other animals, such as raccoons.) This is understandable given the coyote's *telos* as a free-ranging predator (or, on occasion, prey). It is not plausible to suggest that the animal chews its leg off to avoid death, since it is not possible that a nonlinguistic being *has* a concept of death, though it clearly understands the inability to escape. Clearly the animal is not chewing the leg in order to escape the pain, as any attempt to chew the leg off will greatly *increase* the pain.

Other animals, wild and domestic, will endure pain and injury to escape close confinement. Though confinement agriculturalists in the United States claim that all the needs of confined sows – food, water, protection from the elements, and protection from predators – are met in confinement, these animals escape when they can, with no reports of any ever trying to return. Chickens will trade ad libitum feeding in confinement for sporadic access to food outdoors. Chickens will also work for food in confinement when given a choice of doing so (Duncan and

Hughes 1972). Monkeys and other animals will self-mutilate in deprived, impoverished environments, the pain presumably providing some stimulation, as a counter to boredom (Berkson 1967; Ridely and Baker 1982; Chamove et al. 1984).

Kilgour (1978) cites evidence showing that cattle being exposed to a new herd show a physiological response for 30 days. In animals, the initial exposure to the experimental setting (i.e., major novelty) evoked the largest elevations in plasma cortisol (Mason et al. 1957; Hennessy and Levinee 1979). This is not surprising, since cattle are herd animals who come to know their conspecifics as individuals and hence do not know how new animals will behave. Novelty of any sort evokes stress in most if not all animal *teloi*. Even in human experiments, the introduction to the experimental situation for the first time was often more effective in increasing steroid level than anything else the experimenter could devise, including electric shock (Michalski 1998).

Researchers know that animals can be trained by reward to accept some physically painful experimental procedures. In one instance, a researcher was drawing blood from dogs daily for a vaccine study. She would enter the facility, play with each dog, draw the blood, and give the dog a treat after the draw. On one occasion, one of the dogs set up such a howl as she was leaving that she raced back to see if his paw was caught in the cage door. It turned out she had forgotten to draw blood from that dog, and he had missed his play and his treat, which bothered him more than the blood draw (Kesel 1983). Separation of a newborn calf, routine in modern dairies, can cause mooing on the part of the mother cow bespeaking distress for over a week, even longer if the cow can see the calf (Flower and Weary 2001). This is no surprise, as calves in more natural situations will suckle and remain with the mother for up to 9 months or more.

All of these examples illustrate four major points:

1. Pain, as a physical phenomenon, does not begin to capture all the ways in which what we do to animals matters to them.
2. Other things done to the animals can be worse for them than physical pain. Unfortunately, we have no words for many of the myriad ways we can harm or cause animals to suffer, for example, not allowing the pig to forage, separating a newborn animal baby from its mother at birth, and stopping a chicken from nest building. (For others, of course, we do have words, e.g., creating boredom, social deprivation, and fear.)
3. In general, interfering with or impeding actualization of *telos* creates a negative experiential state for an animal.
4. Appeal to the concept of *telos* provides a far more comprehensive basis for animal ethics than does anything else, including the concepts of pleasure and pain. In addition, the notion of an animal's nature and its moral importance are both plausible and evident to common sense.

A moment's reflection will reveal to any reader the extent to which the vocabulary for dealing with ways of harming animals is impoverished. Virtually none of the ways enumerated above in animals can be harmed even have names or precise descriptions. Yet, the ways in which confinement agriculture infringes upon and aborts needs and desires built into an animal's nature are legion. Even more importantly, now that husbandry agriculture that respects animal *telos* is virtually universally overridden for the sake of profit, efficiency, and productivity and society condemns the resulting suffering, reference to *telos* provides far greater precision regarding what needs to be restored than does talking about pain. All high confinement systems deployed in modern industrialized agriculture are aptly described in relationship to animal *telos*. Whether one is talking about sow confinement, unnatural diets, tail docking in dairy cattle, restrictions on movement, truncation of play, isolation of veal calves, and the animal's never seeing a blade of grass or sunshine, *telos* provides a measure of the inadequacy of these systems.

It is simply mistaken to refer to such infringements as causing pain. A very simple argument demonstrates this point conclusively. Suppose one could medicate animals in a way that totally

abolished any experience of pain. By hypothesis then, the animals would be experiencing no pain and thus no harm and would not be wronged according to utilitarian ethics. Yet, it would be a deviant person indeed who would fail to accept that the animals are being consistently mistreated and wronged by severe limitations on the exercise of their natural abilities.

In the case of all domestic animals, one can further mount the argument that humans are responsible not only for shielding them from harm, but also for assuring them a context in which they can flourish. Acting morally towards horses requires providing them with food, water, shelter, and shade, so as to avoid negative influences on the quality of their lives. But, there is also a moral requirement to provide positive value in their lives, i.e., by helping them be happy. Those who have kept horses know that there are resources that can be provided to these animals that result in positive experiences, for example, when they are given access to a pasture where they can eat, play, and run in relative freedom. Clearly, the equine behavior displayed under such conditions evidences that these animals are experiencing happiness: galloping out of a pen when they are released for the first time in months, kicking up their heels, and giving the uniquely equine "fart of joy." In other words, not only does *telos* allow us to home in precisely on all of the harms we inflict on animals in the course of using them, it also provides caretakers with guideposts for assessing the extent to which "negative mattering" can be replaced with positive mattering.

There will of course still be some theorists who believe that the notion of *telos* is unreservedly and unacceptably metaphysical. And, indeed, it *is* metaphysical, in the sense that metaphysical concepts are those categoreal notions we utilize as basic concepts when talking about reality. A concept like *telos*, like other commonsensical concepts such as cause and effect, thing, emotion, and indeed all ethical concepts, do not profess or claim to capture absolute, ultimate reality. Rather, they capture the reality of ordinary experience, daily life, and common sense. And such is the realm of common decency and of the ethics that attempts to capture and to codify it. Even if one is ultimately a scientific materialist and realist, in one's ethical moments common sense is regnant, and concepts like an animal's nature occupy center stage.

One can thus argue that the utilitarian concepts of pain and pleasure, as important as they undoubtedly are, are nonetheless inadequate to serve as a comprehensive basis for animal ethics, particularly when ethical questions arise with regard to modern, intensive, industrialized, confinement agriculture. The multiplicity of insults and deprivations inflicted upon animals in such systems are most naturally and plausibly captured by invoking the notion of animal nature or *telos*. The needs and interests that make up what the animal's nature is inform caretakers when they are harming that animal or behaving in a manner conducive to its happiness in a simple, nonsensical, and straightforward manner. As society begins to address animal ethics in ever finer-grained detail, it is likely that the concept of *telos* will assume ever-increasing importance in the discussion.

Summary

Historically, the overwhelming use of animals in society was agriculture. Since animal production depended on good husbandry, no ethic for animal treatment was needed short of prohibiting deliberate cruelty. Philosophical need for animal ethics arose following Descartes's denial of animal consciousness and plausibly was answered by appeal to pleasure and pain. It was only when society began to worry about animal treatment in a multiplicity of areas that it became necessary to go beyond pleasure and pain to extend moral concern to all aspects of animal life. Rollin revived the Aristotelian concept of *telos* or nature to accomplish this. Just as human nature, and the rights flowing therefrom, govern our moral obligation to humans, one could plausibly extend this reasoning to animals and base our obligations to them on respect for the their biological and psychological needs and natures. Such a move goes well beyond pleasure and pain to meet such

natural animal requirements as moving, grazing, foraging, nest building etc., i.e., all the ways animals meet their needs for nutrition, locomotion, sensation, cognition, and reproduction. Thus, animal ethics must be based in respect for *telos,* which is a much more comprehensive basis for ethics than pleasure and pain, and allows us to recognize both positive and negative mattering.

Cross-References

► Animal Welfare: A Critical Examination of the Concept

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The 2003–2006 WTO GMO Dispute: Implications for the SPS Agreement

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Synonyms

GMO = agricultural biotechnology

Introduction

In recent decades, global flows – whether of goods, services, capital, pests, chemicals, or greenhouse gases – have expanded together with new technologies, norms, and institutions that govern these flows. Several processes tend to denationalize what had been constructed as national in the modern era – policies, markets, capital, culture, and etc. – and to establish new global powers.

The World Trade Organization (WTO), which superseded the General Agreement on Tariffs and Trade (GATT) in 1995, is a central node of this newly emerging global order. Established to police trade barriers for compliance with internationally agreed rules, it also sets global norms, such as standards of intellectual property and risk assessment for health and environmental issues. An agile institution, the WTO Secretariat is a relatively small bureaucracy linking hundreds of country representatives in Geneva.

While many international institutions have suffered a significant reduction in budget and political power in recent decades, the WTO has

exerted a growing influence on nations throughout the world. Unlike most UN institutions and conventions, the WTO has a stringent enforcement capacity with efficient, fast dispute settlement procedures (Yerxa and Wilson 2005). The WTO's dispute resolution mechanism was employed over 400 times in its first 15 years of existence, as compared to the mere 300 disputes settled over the 45+ years of the GATT era. While only one GATT dispute settlement drew upon scientific experts, more than a dozen trade disputes did so in the early years of WTO (Pauwelyn 2002).

Globalization has prompted new means of knowledge production, validation, and appropriation alongside the burgeoning of new technologies. Conversely, science and technology craft and legitimize the new global arrangements. Under the WTO trade regime, science and law are articulated in specific powerful ways, expanding the scientific-expert authority to scrutinize any domestic regulations that impose trade barriers. The WTO's basic assumption is that free trade is good for the world, so no product ought to be excluded from free circulation unless proven dangerous through a risk assessment with scientific evidence. Hence trade disputes constitute a key arena for analyzing how the WTO jointly establishes global legal norms and what counts as relevant knowledge.

To understand how the WTO coproduces global norms and authoritative knowledge in practice, this essay examines the mobilization of scientific expertise in the dispute over genetically modified organisms (GMO). A complaint was filed in 2003 by the USA, Canada, and Argentina against the European Communities (EC) for operating a de facto "illegal moratorium" since 1999. The WTO Dispute Settlement Panel reached its findings on that complaint in 2006, largely supporting the plaintiffs' accusations against the EU.

This essay asks the following questions: How were particular forms of legal reasoning were elaborated through the judicial procedure? How does this matter for understanding the expanding power of WTO discipline over health and environmental policy-making in the world? What are implications for future trade disputes involving issues of human health and environmental protection? To answer those questions, the essay draws upon interviews with staff from the WTO Secretariat, parties to the dispute, as well as scientific experts and also publicly available documents and unpublished correspondence between the Secretariat, the Panel, and parties.

Putting the Dispute into the SPS

After inconclusive attempts at diplomatic negotiation, in September 2003 the WTO's Dispute Settlement Board appointed a Dispute Settlement Panel to review the case. WTO Panels are composed of three "judges," who are economists or trade lawyers by profession. The procedure is usually as follows: the Panel issues a report of findings, which parties can appeal, and then the appeal is heard by the Appellate Body, consisting of seven judges, which also files a report. This process is supposed to last no more than 15 months. However, in the GMO case, that process extended to almost 3 years, even without an appeal.

From the start of the dispute, the parties disagreed over its nature, its legal basis, and the relevance of science. The US Trade Representative (USTR) emphasized that European measures contradict the SPS Agreement's requirement that procedures should be completed "without undue delay," thus posing unjustified trade barriers (USTR 2004a, p. 5). The European Commission Legal Services justified regulatory delays by mentioning scientific uncertainty about environmental and health risks. To avoid the narrower SPS disciplines, which would limit any precautionary approach, the Commission argued that the WTO Agreement on Technical Barriers to Trade (TBT) and the Cartagena Protocol on Biosafety also should be reference points for judging EC regulatory procedures. As early as 2004, however, the Panel had decided to frame the GMO dispute within the SPS Agreement alone, thus rejecting the EC's broader framing (Peel 2006).

To fit the entire dispute into the SPS, the Secretariat and the Panel redefined the ontology of GM crops within a relevant risk category. Originally the SPS Agreement targeted *epizootic and epiphytic* diseases – which were seen as risks to "human, animal, and plant life or health" – that may justify national measures limiting trade. As its first move, the Panel classified any environmental harm, including threats to biodiversity, under the SPS category of risks to "animal and plant life or health" (WTO 2006, paragraph 7.219). Secondly, the Panel cast GMOs as SPS agents: GM crops were redefined as "pests" (*transgene* escape hence becoming a "pest effect") or as "invasive species." Transgenes were recast as "food additives." GM pollen became a kind of "animal feed" because it could be ingested by bees (WTO 2006: paragraphs 7.225–7.299). Within the latter move, EC regulations on GMOs become SPS measures applied to protect human life or health from risks arising indirectly from the entry, establishment, or spread of weeds *qua* "pests" (WTO 2006, paragraph 7.360).

With those two ontological moves, the Panel established a particular link between GMOs' biological identity as ecological agents and GMOs' legal identity as subjects of SPS rules. Some of these new constructs contradicted definitions from the very international expert bodies that the SPS Agreement itself had designated as global benchmarks for regulatory standards. For instance, the Panel's framing of transgenes as "food additives" diverged from Codex Alimentarius' definition of "food additives" as additions made "in the manufacture" stage of food production. Nevertheless, the Panel argued that in the special case of "plant production," substances intentionally added at the stage of seed development and production could be reasonably considered to be substances added in the manufacture of the food plant, if the substances are present in the harvested plant as a component or affect the characteristics of the harvested plant (WTO 2006, paragraph 7.299)

The Panel hence created new legal ontologies for GMOs and related ecological effects to make them amenable to SPS disciplines. This SPS plot, in turn, constrained how scientific advice would be mobilized and performed in the dispute settlement procedure.

Framing Questions for Experts

In August 2004 the Panel announced its decision to seek expert advice, as in previous disputes involving the SPS Agreement. Once the Expert Panel members were selected, they were invited to express their views on specific questions, "solely for the purpose of assisting the Panel in its limited task of making findings of *fact* for purposes of these disputes" (Unpublished Terms of Reference, WTO Secretariat, September 2004).

During autumn 2004, the Panel and parties exchanged views on the questionnaire that would be sent to the experts. The final version included 114 questions. One quarter addressed general risk issues, such as sanitary risks related to genetic markers for antibiotic resistance, toxicity of Bt insecticidal crops for humans and nontarget animals, and invasiveness of herbicide-tolerant crops. In line with the Panel's SPS framing, most questions focused on the scientific basis of the 27 regulatory delays and 11 national bans.

The US proposed to amend the initial draft questions in order to increase the burden of evidence on the Commission to demonstrate clearly that such a scientific basis existed. It also argued that:

> . . . even if evidence of risks exists, an SPS measure must be 'based on an assessment, as appropriate to the circumstances, of the risks.' Furthermore, evidence of 'existence' of risk is not dispositive to the application of Article 5.7. Instead, the 'relevant scientific information' with regard to the risk must be insufficient. (unpublished correspondence, USA to Panel, September 24, 2004).

For instance, the USA proposed to ask the experts about all of the disputed delays or bans in which extra data had been requested from the companies on the potential risks associated with their products: "Is there any basis to expect that [this requested data] would identify any adverse effect that had not previously been identified?"

(USTR 2004b, p. 59). Such questions strongly shifted the burden of evidence to the Panel to demonstrate that extra data were necessary as well as feasibly obtainable.

By contrast, the EC sought to broaden the experts' role. It posed questions highlighting uncertainties and limitations of scientific knowledge during the decade before the plaintiffs filed their complaint in 2003. The EC's strategy was thus to emphasize knowledge gaps and uncertainties within scientific knowledge – understood as evolving over time, with much dissensus among scientists. The extra questions aimed to focus the experts' attention on temporal changes. As the EC later reiterated, "We should not forget that we are looking at the science at that time" (WTO 2006, Annex J, paragraph 437). By engaging experts in a reflexive historicization of scientific knowledge, the EC strategy demonstrated how science was coevolving along with regulatory concerns.

In such ways, the Commission framed the dispute as a debate on past decisions made with knowledge at the time, which was then – but less so now – uncertain and thus insufficient for risk assessment. This historical narrative provided a way to manage the tension between the EC's international and domestic agendas. The Commission Legal Services could defend the EC's regulatory sovereignty, while also limiting member states' scope to continue the de facto moratorium (Levidow and Carr 2010, pp. 156–159).

In the context of the dispute, the Commission's strategy also aimed to broaden the notion of risk assessment by emphasizing divergent scientific views as evidence of uncertainty. In the beef hormone dispute, the Appellate Body had stated that:

> [SPS Agreement] Article 5.1 does not require that the risk assessment must necessarily embody only the view of a majority of the relevant scientific community . . . governments may act in good faith on the basis of what, at a given time, may be a divergent opinion coming from qualified and respected sources (WTO 1998, paragraph 194).

In this understanding of the Appellate Body, a minority scientific view can justify a precautionary measure (SPS Art. 5.7), without needing a formal "risk assessment" required by SPS Article 5.1 (Boisson de Chazournes et al. 2009).

The final version of the questionnaire accommodated the USA's stringent view of the legitimate basis for regulators to adopt provisional measures under SPS Article 5.7. Many questions challenged the evidence for regulatory delays or bans, by asking experts the following: was there enough information to make a proper risk assessment as required by Article 5.1 before taking a precautionary measure under Article 5.7? Was the additional information requested really necessary to ensure the safety of the product? Or could not a "technical deficiency" be mitigated by providing other available safety information? Such questions pressed experts to challenge the Commission's defense arguments, thus eliciting expert opinions that could both be cast as "scientific" and be used along SPS lines of legal reasoning.

Expert Disagreements on the Panel's Questions

In the dispute settlement process, science was deeply framed by the WTO setting and a narrow interpretation of the SPS Agreement as the basis for judging the defendant's regulatory practices. On the one hand, in the SPS Agreement, Article 5.1 requires that any measure restricting trade must be based on a risk assessment.

> Members shall ensure that their sanitary or phytosanitary measures are based on an assessment, as appropriate to the circumstances, of the risks to human, animal, or plant life or health, taking into account risk assessment techniques developed by the relevant international organizations (WTO 1994).

On the other hand, Article 5.7 leaves some room for precautionary measures in the face of scientific uncertainty:

> In cases where relevant scientific evidence is insufficient, a Member may provisionally adopt sanitary or phytosanitary measures on the basis of available pertinent information, including that from the

> relevant international organizations .... In such circumstances, Members shall seek to obtain the additional information necessary for a more objective assessment of risk and review the sanitary or phytosanitary measure accordingly within a reasonable period of time (WTO 1994).

The Panel's questions directed the experts to scrutinize EC regulatory practices, especially in relation to the above criteria in the SPS Agreement. Scientific experts sometimes expressed divergent views, especially on the state of scientific knowledge and its adequacy for risk assessment. As in the case of molecular characterization mentioned above, for each risk issue, some members declared that the available knowledge was already sufficient for a favorable risk assessment. According to more cautious experts, however, available scientific knowledge in the late 1990s had not always been sufficient. For instance, one expert regarded the French rejection of herbicide-tolerant oilseed rape as "compatible with the tone of the SPS Agreement" (WTO 2006, Annex I-4, paragraph 657).

The plaintiffs asked particular experts whether the EC defendant's delays or bans were the only way to manage scientific uncertainty and whether the additional information the defendants requested from companies was essential and if there were alternative ways to manage the potential risks. These questions pressed the experts to comment on risk-management issues. For example, the Panel and plaintiffs posed questions about whether the EC procedures delayed product authorizations by requesting extra molecular data. In response, two experts argued that detection methods were not a necessary component of risk assessment (WTO 2006, Annex J, paragraph 22).

Giving the Panel's Verdict

The Panel's findings focused on the defendant's procedures: between 1999 and 2003 the EC had applied a general de facto moratorium, which led to its failure to complete regulatory procedures for 24 applications (out of 27 targeted by plaintiffs) without "undue delay," thus violating Article 8 and Annex C of the SPS Agreement. Additionally, the nine national safeguard measures (bans) violated SPS Article 5.1's requirement for a "risk assessment."

For both categories of complaint, the Panel gave the EC's advisory body a decisive role, while maintaining distance from any particular judgement by scientific experts:

> EC committees issued opinions on each product and also reviewed the arguments and the evidence submitted by the member State to justify the prohibition and did not consider that such information called into question its earlier conclusions. The Panel thus considered that sufficient scientific evidence was available to permit a risk assessment as required by the SPS Agreement [Article 5.1]. Hence in no case was the situation one in which the Panel had been persuaded that the relevant scientific evidence was insufficient to perform a risk assessment, such that the member State might have had recourse to a provisional measure under Article 5.7 of the SPS Agreement. (WTO 2006, p. 1068, paragraph 8.09).

In that way, the Panel rejected the defendant's main argument, ostensibly on legal-procedural grounds. The EC had cited SPS Article 5.7 as a basis for precautionary measures due to scientific uncertainties, as evidenced by disagreements among the scientific experts during the dispute procedure as well as the wider risk debate. By contrast, the Panel interpreted SPS Article 5.7 as a legitimate basis for a provisional restrictive measure *only* when the relevant scientific evidence was insufficient to perform a proper risk assessment under Article 5.1.

For that legal issue, the Panel deferred to favorable EC risk assessments – such as those from the Scientific Committee on Plants and Scientific Committee on Food, whose earlier opinions had declared that information was adequate for a risk assessment on GM products relevant to the WTO dispute. Moreover, given the existence of official EU risk assessments, this placed a retrospective burden of evidence on EU member states for an alternative risk assessment to demonstrate the inadequacy of evidence at that time. In this regard, the Panel cited the SPS Agreement, which defined a risk assessment as "the evaluation of the likelihood of entry, establishment or spread of a pest or disease within the

territory of an importing Member . . . , and of the associated potential biological and economic consequences" (WTO 1994, Annex A(4)).

The Panel did not explicitly judge whether EC scientific committees' opinions fulfilled that definition, but it did judge that national objections failed to do so. With the Panel's narrative of "sufficient evidence available," any scientific uncertainties and scientific dissensus were cast as irrelevant. This excluded the EC's narrative of science as historically contingent and contested.

Implications for the SPS Agreement

The Panel made substantive claims – for example, by innovating ontological categories (GMOs are pest, transgenes are food additives, etc.), by asserting that antibiotic markers genes are not dangerous, or by disregarding uncertainties that did not fit its narrow model of risk assessment. But these substantive judgements were not acknowledged as such. They were represented either as dictionary-based elaboration of terms and definitions in the SPS Agreements or else as a purely legal review of the EC's regulatory procedures, rather than as an engagement with scientific knowledge. Hence it seemed pointless to address substantive risk issues in the findings.

While previous Panels' findings in SPS disputes had reviewed both defendants' regulatory practices on substantive grounds and the opinions of scientific experts, the GMO Panel chose a different strategy. Its findings focused on the defendant's regulatory procedures, while avoiding any serious discussion of expert claims. This procedural turn was later reinforced by the Appellate Body's 2008 ruling which criticized the Hormones II Panel for having "reviewed the scientific experts' opinions and somewhat peremptorily deciding what it considered to be the best science" (WTO 2008, p. 612; Peel 2010, p. 216).

This shift may be understood in a political context where previous Panels' engagement with scientific risk issues had been criticized by anti-globalization activists, EC officials (Christoforou 2000), and scholars (Busch et al. 2004). The WTO was even warned against becoming a new "trans-science organization," thus undermining regulatory pluralism through a false, narrow conception of science (Walker 1998). Facing such criticism, especially in the hot social-political context of the GMOs dispute, WTO decision makers found apparently less intrusive means to review the risk issues as a basis for their decisions. Hence the procedural turn in SPS jurisprudence constituted a significant shift in the WTO's formation of knowledge and norms.

As pioneered in the GMO dispute settlement, the procedural turn constructs both an interface and boundary between science and law. The legitimacy of the judgement rests on its "science-based" imprimatur, hence mobilizing scientific experts and scientific knowledge in the dispute settlement arena. Yet this expertise is framed in a way that allows WTO judges to avoid any explicit engagement with scientific knowledge. Under a procedural requirement for a "risk assessment," the Panel applied a stringent standard of review to the defendants' substantive risk claims. In several cases involving technical issues, by contrast, US courts have operated a legal epistemology whereby judges explicitly engage with scientific claims in order to separate sound science from junk science or marginal scientific views (Jasanoff 1995; Edmond 2002; Leclerc 2007). Such explicit engagement can also be found in previous SPS findings (Peel 2010, p. 254).

As this case illustrates, the WTO settlement process mobilizes scientific expertise in particular ways that can achieve multiple aims: it recruits a source of credibility from the scientific arena, reinforces the standard narrative of a "science-based" trade discipline, and constructs a new scientific expertise for the main task – namely, challenging trade restrictions for being unduly cautious. Moreover, by operating a procedural turn in the WTO's way of knowing, the Panel now keeps implicit its own judgements on substantive scientific issues. The decision makers' engagement with scientific aspects therefore becomes less explicit and less accountable.

Summary

The World Trade Organization (WTO) dispute settlement procedure is a key arena for establishing global legal norms for what counts as relevant knowledge. As a high-profile case, the WTO trade dispute on GMOs mobilized and appropriated scientific expertise in somewhat novel ways. As shown above, the Panel interpreted the SPS framework as a requirement for "risk assessment" – quantifying likelihoods and consequences and imposing extra burdens upon the defendant to produce evidence. By imposing "the narrowest applications to date of the notion of SPS risk assessment" (Peel 2010, p. 244), the WTO Panel further globalized a "science-based risk assessment" narrative that had emerged during the USA's Reagan administration (Jasanoff 2011).

Early on, the Panel put the dispute under the Sanitary and Phytosanitary (SPS) Agreement through a new legal ontology; it classified transgenes as potential pests and limited all environmental issues to the "plant and animal health" category. For the SPS framing, focusing on the defendant's regulatory procedures, the Panel staged scientific expertise in specific ways that set up how experts were questioned, the answers they would give, their specific role in the legal arena, and the way their statements would complement the Panel's findings.

Moreover, the Panel operated a procedural turn in WTO jurisprudence by representing its findings as a purely legal-administrative judgement on whether the EC's regulatory procedures violated the SPS Agreement. Meanwhile the Panel kept implicit its own judgements on substantive risk issues. As this case illustrates, the WTO settlement process constructs a new scientific expertise for the main task – namely, challenging trade restrictions for being unduly cautious.

Cross-References

► Food Legislation and Regulation: EU, UN, WTO and Private Regulation

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Trade and Development in the Food and Agricultural Sectors

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Synonyms

Agricultural policy; Aid for Trade; Economic development; Economic growth; Food security; International trade; Plurilateral agreement on commodity; Regional trade integration; Trade in commodities; Trade policy; World governance

Introduction

The fact that farmers in the poorest countries have very little benefited from the recent price spikes in agricultural commodities is one of the greatest paradoxes of the last few years. Furthermore, in these same countries, city dwellers have suffered just as much from price increases without being better fed by local production. This is why, according to the FAO, the small decrease in the number of malnourished people suddenly stopped in 2007–2008. The reasons explaining this paradox are well established: Third World farmers only have access to local markets. Roads are poor, means of communication are limited, and storage capacities which would reduce the need to sell produce immediately after harvesting are often unavailable. There are no credits at affordable interest rates and very few mutual organizations to facilitate mutual assistance and insurance.

In fact, this paradox asks us about the ethical dimension of international trade. It is urgent to improve international trade relations taking into account the social welfare, economic, and environmental performance of smaller producers and consumers. Ethical trade aims to bring social and environmental improvements in the existing international trade unlike fair trade which is parallel trade. Thus, an international strategy more aware of the ethical issues should encourage us to develop a more appropriate legal framework for international trade of agricultural products so that trade promotes economic development in poor countries and ensure food security in the world. Such reflection will help us to ensure that ethical issues are not neglected in the international negotiations.

The rising cost of agricultural commodities will benefit the very poor only if agricultural investment is increased and if, perhaps most importantly, the trade capacities of small producers and states are strengthened. This is in fact related to the crucial issue of the link between trade and development: how can trade in agricultural raw materials be better organized and regulated in order for it to foster food security as well as economic development in poor countries? This is an especially important matter as, according to the World Bank, it is in low-income countries that agriculture contributes the most to poverty reduction and general economic development (World Bank 2008).

Commodity markets, sources of income for farmers in developing countries, are in need of ambitious policies and must be a particularly important focus point for the international community. Indeed, 2.5 billion people are engaged in small-scale agriculture in developing countries, and about 1 billion draw part of their income from

commodity exports. Ninety-five of the 141 developing countries depend by more than 50 % on commodity exports for their export income. In particular, the economies of the least developed countries (LDCs) are based on the exportation of tropical products which account for around 70 % of their total merchandise exports (UNCTAD 2011b).

The international economic order has never managed to address satisfactorily the issue of commodity trade. However, in view of the challenges faced by agriculture, the problems tied to commodities must urgently be placed on the top of the international priority list. The goal to achieve is to assure trade in agricultural commodities, thereby ensuring global food security, providing leverage for the economic development of poorer countries, and ensuring also an important source of raw materials supplying the agro-industrial sector of developed countries.

It is thus important to ensure the consistency of trade policy goals with the aims of development as well as with food security. This necessarily requires a new international consensus on development and a reinforcement of development programs in the area of basic agricultural commodities. It also entails taking into account non-trade-related aspects linked to agriculture in order to respect sustainable development objectives.

Legal recognition of a secure and continuous access to agricultural raw materials for importing countries in exchange for a better organization of the primary commodity markets would be desirable. In the absence of an agreement under the WTO Doha Development Agenda framework, reaching a less comprehensive multilateral agreement on basic commodities, based on the model of a partnership and cooperation agreement placed under the auspices of the WTO and UNCTAD, would strengthen international cooperation on the management and trade of basic commodities.

A New International Consensus on Agricultural Commodities

The failure of the Washington Consensus and of structural adjustment programs entails a need for new thinking on development. The current economic crisis has indeed put into question some of the basic paradigms of the economic model which has prevailed in the last couple of decades, as can be seen from certain evolution at the World Bank.

Agriculture has critical capacities in terms of poverty reduction. Agricultural growth has a specific impact on poverty reduction in every category of country. It is estimated that GDP growth attributable to agriculture contributes at least twice as much in reducing poverty as growth in GDP related to the nonagricultural sector. For China, aggregate growth originating in agriculture is estimated to have been 3.5 times more effective in reducing poverty than growth outside agriculture and for Latin America 2.7 times more (World Bank 2008). Agriculture is thus a crucial development tool for the achievement of the Millennium Development Goal of halving by 2015 the number of people living in extreme poverty and suffering from hunger. This is the core message of the World Bank's 2008 *World Development Report*. Moreover, according to the World Bank, one of the key factors in agricultural growth is the development of agricultural trade. Trade is critical for economic life: without exchange, progress and economic development are impossible. As a matter of fact, trade in basic commodities contributes to three fundamental objectives: global food security, economic development of developing countries, as well as supplying with resource-poor countries.

However, if promoting trade of agricultural products is important, it is also essential to strengthen both production and trade-related capacities of small producers and poor countries which will enable them to sell their products on international markets. Indeed, market access commitments (e.g., reduction of tariff barriers) are rendered useless if poor countries are faced with capacity constraints which restrain their ability to take advantage of these commitments. The Aid for Trade Initiative is consequently indispensable in order to help the countries concerned to integrate themselves in the world market and to exploit their trade and growth

potential. The Aid for Trade Initiative was officially instituted following the Hong Kong 6th Ministerial Conference in December 2005. It has been presented as a promising development tool, aiming at furthering trade integration of developing countries. Aid for Trade is about helping developing countries, in particular the least developed, to build the trade capacity and infrastructure they need to benefit from trade opening. For example, investing in the infrastructure – roads, ports, telecommunications, and energy networks – is needed to link products to global markets or strengthening economic to increase competitiveness in export markets. Such efforts also play a major part in achieving the Millennium Development Goals concerning food security and economic development.

Is the Resource Curse Inevitable?

Contrary to popular belief, primary commodities' trade does not necessarily lead to underdevelopment (P. Bairoch 1993). Trade in mineral raw materials and agricultural basic commodities has often been linked to a *resource curse* causing impoverishing growth for certain commodity-exporting countries. Though the resource curse is certainly a reality, it is far from being inescapable (Havro and Santiso 2008) as shown by the cases of Norway, Chile, or Malawi. These countries offer valuable lessons to developing countries in terms of sensible management of mineral and agricultural resources. The key to such success stories is due above all to the quality of institutions and reforms which have been instigated over time. Clearly, these countries have been able to devise efficient political and economic governance in order to successfully manage these resources.

If basic commodity exports do not necessarily lead to underdevelopment, nevertheless, the best way to encourage further development remains industrialization as well as product and export diversification. Markets function most effectively when the institutional environment in which they operate is stable and efficient. This entails virtuous political and economic governance which is unfortunately still lacking in many poor countries.

Aid for Trade in Support of Development and Food Security

All studies agree on the need for an increase in agricultural production in order to achieve global food security. However, although increased production is important, it is also essential to ensure the conservation of agricultural products and their proper commercialization. According to the FAO, 630 million tons of agricultural products (or 1/6 of the world's production) are lost in developing countries due to poor storage facilities and a lack of infrastructure enabling proper processing of these products (FAO 2011).

Opening markets and trade preferences by themselves are not sufficient to generate development and ensure food security. Though international trade does potentially have an important role in the fight against food insecurity and poverty, there are some necessary prerequisites in order to be able to seize the opportunities offered by trade. The major constraints in poor countries are low trade capacities and high costs of production. Developing the supply capacity of agriculture as well as infrastructure (transport, energy, telecommunication) and creating a judicial and economic environment favorable to production thus seem crucial. Moreover, even when they do exist, trade preferences granted by developed and emerging countries to products originating from developing countries are not sufficient as the latter must also meet stringent international norms and standards. Help in achieving compliance with international standards and in improving the quality of products is fundamental.

Aid for Trade – which covers about one third of all public development aid (Lamy 2011) – aims at putting trade at the service of development. It helps countries take advantage of the opportunities offered by the multilateral trading system to generate economic growth and fight against poverty. Providing market access opportunities is a necessary condition, though not always sufficient, to ensure that countries benefit from trade. Other actions are also necessary to help developing countries, and especially the least developed ones, to upgrade their trade-related infrastructure and to overcome the limitations of their production and trade capacities in

the agricultural sector. It is therefore necessary to improve the trade capacity of least developed countries to ensure food security of the world and increase the livelihoods for small farmers.

Market Access: A Necessary Albeit Insufficient Condition

During the past 50 years, access to developed countries' markets has been facilitated by a reduction of tariffs and quantitative restrictions, although the practices of levying higher tariffs on finished goods than on raw materials (tariff escalation) and of charging unusually high tariffs on goods thought to be sensitive (tariff peaks) remain very worrying. Tariff escalation may have the effect of protecting processing industries in high-income countries while making it more difficult for developing countries to enter value-added markets. Clearly, market access alone is not a sufficient condition to ensure development gains flowing downstream to commodity producers, traders, and processors in developing countries.

Free trade agreements – whether bilateral or regional – are meant to promote and expand trade. But no matter how noble they may be, they will have very little impact if their potential beneficiaries are not able to produce goods of the quality demanded in the developed countries' markets. For example, duty- and quota-free access for products from the African, Caribbean, and Pacific countries (ACP) to the European Union, under the Economic Partnership Agreements, means little if these countries cannot meet the applicable standards.

One of the major impediments to free market access and trade has been the proliferation of safety and quality standards, not to mention divergent laws and technical regulations. In recent years, legitimate concerns have also increased over the safety and quality of food entering the world market due to health hazards associated with avian influenza, bovine spongiform encephalopathy (BSE, or "mad cow disease"), dioxin in eggs and pork, melamine in dairy products (infant milk), and swine flu. Mycotoxins (toxic elements produced by fungal agents) have also been found in agricultural products, salmonella in peanut products, and pesticide residues in plants.

In response to this situation and in order to safeguard the health of humans, animals, and plants, developed countries, in particular, have adopted a great number of food safety and quality standards as well as legal provisions and technical regulations. Most commodity-dependent developing countries are ill equipped technically to comply with these regulations and standards, whether public or private, and do not have the financial resources to offset the excessive costs of compliance.

Reinforcing Development Programs in the Agricultural Commodities' Sector

Without adequate processing and packaging immediately after the harvest, agricultural losses can represent 60 % of the production and that even before reaching the first point of sale. The lack of packages for perishable products meeting international standards also results in huge losses and dramatically reduces profit margins for both producers and exporters. Africa (apart from South Africa and the Maghreb region) could increase its agrifood exports by 30 % simply by improving the quality of its packaging. In Western Africa, on around a 100 billion dollars of exports each year, there is a potential income loss of approximately 30 billion dollars (International Trade Centre 2010).

Compliance with sanitary and phytosanitary standards (SPS) and infrastructure are crucial trade issues for poor countries. These SPS standards significantly reduce the agricultural exports from the South to the North but do not affect North-North trade, confirming the fact that SPS standards have a real impact on trade due to the incapacity of developing countries to meet these norms (Otsuki et al. 2001; Chan et al. 2006). Compliance with international standards can thus be regarded as a major obstacle to the full participation of developing countries in the multilateral trade system.

It therefore seems clear that programs to help developing countries comply with international standards and effectively develop adequate infrastructure would dramatically boost their trade

performances. As a matter of fact, a great number of donor agencies as well as intergovernmental bodies and NGOs have started to provide technical and financial assistance to developing countries to enable them to comply to these standards or to obtain certification from well-respected bodies. For example, the Codex Alimentarius (FAO/WHO) finances the participation of developing countries in standardization meetings, and the WTO's Standards and Trade Development Facility (STDF) is funding projects that support developing countries in building their capacity to implement sanitary and phytosanitary standards as a means to improve their ability to gain market access.

However, in 2010, the UNCTAD noted that "Commodity-related policies have often been neglected when it comes to designing national development strategies, which has resulted in missed opportunities for the commodity sector. Although the objectives of the Enhanced Integrated Framework and the Aid for Trade initiative are to assist countries in integrating trade into their development strategies, commodities are seldom explicitly singled out" (UNCTAD 2010).

The producer's ability to provide a product that meets the buyer's requirements in terms of certification clearly depends, on the one hand, on the producer's knowledge of these requirements and, on the other hand, on having the resources to satisfy such exigencies.

Fuller integration of commodities in the objectives of development strategies based on the Aid for Trade Initiative should thus be a priority on the international policy agenda. The work of the WTO's Enhanced Integrated Framework (EIF) and of Standards and Trade Development Facility (STDF) should therefore be sustained and reinforced. (The STDF is a global partnership that supports developing countries in building their capacity to implement international sanitary and phytosanitary standards.) Strengthening development programs which aim at improving the production and trade capacities of developing countries in the sector of basic commodities would not only benefit poorer countries given the high share of agricultural products in their exports but would also have more global effects such as boosting worldwide economic development and food security. In fact, improved sanitary and phytosanitary capacity in developing countries supports sustainable economic growth, poverty reduction, food security, and environmental protection.

A Partnership and Cooperation Agreement for Agricultural Commodities

The criticism of the Washington Consensus and of structural adjustment programs calls for new thinking on development and for a new development-based international consensus – or in WTO's Director, Pascal Lamy, words, it is time for a "consensus on making trade work for development"(Lamy 2006). But what could be the concrete translation of such a new consensus on development in the commodities sector? A partnership and cooperation agreement on commodities in the framework of a renewed international architecture would be a major step towards meeting the Millennium Development Goals concerning food security and economic development.

Regional Trade Integration: A Necessary Prerequisite

According to a World Bank report (World Bank 2012a), regional integration can contribute enormously to food safety. However, regional integration is still almost nonexistent in developing countries, and cross-border trade within the African region represents less than 10 % of its total trade exchanges. The report even notes that it is easier for Africa to trade with the rest of the world than with itself.

Regional trade integration therefore needs to be deepened – especially in Africa – in order to avoid trade misappropriation (Rakotoarisoa 2011): as long as trade barriers remain among countries within the region, trade flows risk being diverted away and revenue and employment potentially lost. These losses could weaken the regional agricultural sector when the latter could have been an efficient and reliable supplier

had the intra-regional barriers not existed. For some agricultural products, regional partners sometimes face much higher applied tariffs than outside suppliers. Many nontariff barriers still exist in the different African regions (Koroma et al. 2009) hindering the free flow of trade. In a report published in December 2005, the FAO stressed that "for developing countries as a whole the greatest potential gains from agricultural liberalization will depend not on reform of the agriculture support system in OECD countries but on reforming their own trade policies, which would encourage greater trade between them" (FAO 2005).

Africa does indeed have the means to produce and supply enough food to feed its population (World Bank 2012a), but this potential is not exploited because farmers are confronted by multiple trade barriers. Among these, many obstacles can be mentioned: the poor general state of infrastructure and roads especially, high transport costs, and the unpredictability of trade policies. The liberalization of intra-regional trade is therefore crucial in a context of rapid urbanization and dramatically increased demand for foodstuffs.

The Objectives of a Multilateral Agreement on Agricultural Products

In November 2011, the Cannes G20 summit observed: "We stand by the Doha Development Agenda (DDA) mandate. However, it is clear that we will not complete the DDA if we continue to conduct negotiations as we have in the past" (§ 66 of Final Declaration of the G20 Cannes Summit). It is therefore necessary to review agricultural trade negotiations in terms of both framework and content.

Given the issues at stake concerning agricultural commodities and to provide crucial support for importing countries, it would be desirable for the international community to recognize a secure and uninterrupted access for agricultural commodities in exchange for better organization of the commodities market.

However, launched since 10 years ago in the WTO, the Doha Round is blocked and undermines the chances of concluding a multilateral agreement ambitious, comprehensive, and balanced. In the ongoing discussions on how to overcome the current deadlock in the Doha Round, the idea of using plurilateral agreements is increasingly discussed.

According to the WTO, there has been an increase in the number of preferential trade agreements (PTAs). Over the past 20 years, their number has more than quadrupled, with nearly 300 today PTAs in force (WTO 2011).

Plurilateralism must be rehabilitated because it is less harmful than the "minilateralism." In particular, it remains under the control of the multilateral organization, which de facto is not the case of bilateral agreements. The prospect would be to encourage countries to join gradually this type of agreement to "multilateralize" it after. Obviously, a plurilateral agreement on agricultural products should be perceived not as a rule ideal but as a safeguard, a blessing in disguise.

Reaching a (plurilateral) agreement on commodities, based on the model of a partnership and cooperation agreement and under the aegis of the WTO and the UNCTAD, would enable to strengthen international cooperation on the management and trade of commodities. This agreement would not be aimed at trade promotion; it would focus on food safety and agricultural development through trade.

A (plurilateral) agreement on agricultural commodities should thus include a development aid component with funding provided for producing countries to, among other things, increase their production and trade capacities. It would consist in:

Better integrating commodities in aid for trade strategies

Supporting international initiatives aimed at strengthening the capabilities of the poorest countries to comply with international standards (SPS) but also striving to encourage their involvement in standard development

Encouraging commodity processing in poor countries as it is an important source of added value by eliminating the adverse effects of tariff escalation for commodities processed by LDCs

Supporting the economic organization of production and supply chains

The Cannes G20 summit recognized the importance of innovative funding mechanisms for development. The idea is to introduce a tax on the financial sector designed to boost a coordinated development policy. In the agricultural sector, innovative funding could have a considerable impact on food safety and the economic development of poor countries.

Indeed, agricultural commodities markets have become increasingly financialized (UNCTAD 2011a): commodity derivatives, which were traditionally considered as hedging instruments, are now seen as financial investments and are the object of a huge volume of transactions. As such, they are sometimes completely disconnected from the reality of commodity trade. Each year, on the Chicago stock exchange, the equivalent of 16 times the production of corn and 8 times the production of wheat is traded on the derivatives markets.

Therefore, could we imagine the introduction by the international community of a tax, even minimal, on financial transactions related to agricultural commodities? The goal is not to limit financial transactions as they are an important source of liquidity but to fund agricultural development projects aimed at boosting infrastructure and strengthening the production and trade capacities of poor countries. Once again, the idea is not to counter the market but to, just as in the case of trade, accompany it and adjust its rules.

An International Framework to Secure Trade of Agricultural Products

More than trade liberalization, on which the Doha negotiations have stumbled, the major aim of the multilateral system should be to regulate and update the rule of law. The WTO must contribute to judicial safety and to the predictability of the trading framework. Even though agricultural products represent only 7 % of world trade, two thirds of all the countries in the world are net importers of foodstuffs, and only a third are net exporters.

As such, a (plurilateral) agreement on agricultural commodities should be conceived as a framework for securing agricultural trade in order to ensure the supply of commodities for importing countries. Such an agreement should therefore be conceived as:

A partnership and cooperative agreement combined with a development aid program in the field of agricultural commodities

An international framework to assure trade in agricultural products achieved through the progressive phasing out of custom duties and quantitative restrictions on trade of products originating from signatory countries as well as through the prohibition of unfair trading practices

The recognition of the importance of non-trade concerns in agriculture such as social and environmental issues (food safety, land tenure security, and the multifunctionality of agriculture)

Contemporary agricultural and food global relations have profoundly changed due to, in particular, the risk of a structural imbalance between supply and demand of agricultural products, a growing demand for food and raw materials in emerging economies, the necessity to take into account global climate change, and the related increased politicization of the supply issue. Given the scarcity of agricultural raw materials and mineral, governments are rediscovering the political necessity to secure their supply management (e.g., exports restrictions and taxes in Russia and China). The structure of agrifood trade has also considerably changed since the 1980s. Whereas trade used to be heavily influenced by states, agricultural commodities markets are now increasingly privatized and managed by agribusiness industries.

To what extent could the current international architecture distance itself from zero-sum competition and tend instead towards positive-sum global coordination in the agricultural sector? Though it is crucial for the international community to recognize safe and continuous access to commodities for importing countries, it also desirable that, in exchange, agricultural products' markets be better organized for the benefit of exporting countries.

The producer has always had to make a trade-off between market expectations and desired

income from his/her work. It is therefore necessary to secure his/her income through contractual arrangements. Knowing that he/she is going to be able to sell his/her agricultural production at a guaranteed price is a necessary, if not existential, condition for the producer. Why not, then, encourage the development of a legal and economic framework for such a purpose: a supply contract would be the legal instrument which would establish the transaction between the importer (state or industry) and the exporter (state or industry) and through which the former would commit to be supplied by the latter on a continuous basis or for a determined period of time and a financial consideration based on indexed or fixed prices. Given the ever closer worldwide ties resulting from trade globalization and from the increasing importance of non-state actors, the main stakeholders in the global commodities' supply chain should collaborate more efficiently in order to find some win-win solutions – which should be both efficient and sustainable – for these various, and now global, issues. A multi-stakeholder partnership on commodities similar to the one established for mineral resources (the *Extractive Industries Transparency Initiative*, *EITI*) should be established. The EITI was launched in 2002 at the World Summit on Sustainable Development with the goal of coordinating public and private sector activities related to the exploitation of natural resources.

Given the tensions and uncertainties related to agricultural products markets – illustrated by the "land-grabbing" phenomenon, for example – international governance is necessary in order to reconcile trade necessities and ethical imperatives. The 2008 food crisis and rising food prices in 2011 led to a skepticism more marked towards the global market. Some states have concluded that they could no longer rely on the international market for grains for sustenance. The scramble for farmland (land grabbing) in Africa and Latin America is a sign of distrust in global markets and will be the source of future geopolitical tensions over access to resources "rare" increasingly coveted. Commodities will be tomorrow the cause of international crisis.

In the majority of raw material-producing countries, the development model based on natural resources does not ensure fairness nor does it stimulate development. Governance of commodity trade still remains to be tackled. A (plurilateral) agreement on commodities, under the auspices of the WTO and UNCTAD, should therefore be based on the classic principle of states' economic interdependence: in exchange for better organized commodity trade, producing countries would commit themselves to guaranteed supplies for consuming countries. The 2008 and 2011 food crises have highlighted the dangers and disruptive effects of export restrictions. Agricultural basic commodities should no longer constitute the cause of international crises. They should be an important factor of economic cooperation between rich and poor countries and not a battleground.

Summary

In the twenty-first century, agriculture remains a fundamental instrument of sustainable development and poverty reduction. Nonetheless, continued worldwide food supply problems reveal weaknesses in the model of world governance we have inherited from the past. States and world actors should thus organize a new global network that facilitates the coordination of worldwide trade and agricultural policies in order to let trade truly benefit development. Commerce is vital, because it is the foundation of economic life, and without exchange, there can be no progress or economic development. The challenge is to organize international commerce of agricultural products in a way that improves world governance of agriculture because fighting hunger and making agriculture work in the interests of development demand a minimum amount of regulation of international agricultural commerce. This necessarily requires a new international consensus on development and a reinforcement of development programs in the area of basic agricultural commodities. It also entails taking into account non-trade-related aspects linked to agriculture in order to respect sustainable development objectives.

Cross-References

- ▶ Biodiversity and Global Development
- ▶ Food Security and International Trade
- ▶ Multilateral Trade Organizations, Food, and Agriculture

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Trade Policies and Animal Welfare

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Synonyms

Animal treatment; Cruelty to animals; Sanitary barriers; Standards for animal care; Trade in animal products

Introduction

International trade law makes no specific provisions relating to animal welfare. Nation-states are the entities that make commitments to the governance of trade in international agreements. Within societies, ethical preferences for animal welfare vary in both the level of welfare desired for animals and the specific provisions that are deemed to provide acceptable levels of animal welfare (e.g., types of housing, how animals can be slaughtered, what constitutes cruelty, etc.). The distribution of individual preferences pertaining to animal welfare varies among societies, and national regulatory regimes tend to reflect those broad differences among societies. Differing national standards lead to trade frictions either because (1) countries with what they perceive as higher standards wish to exclude animals and animal products that originate in countries that are perceived as having lower standards or because (2) countries wish to use trade sanctions to induce other countries that have what

they consider unacceptable standards to improve their provisions for the welfare of animals.

Ethics in International Trade Law

The major multilateral institution that fosters the negotiation of rules for international trade is the World Trade Organization (WTO). There are also hundreds of preferential trade agreements among regional groupings of countries and bilaterally between individual countries. These preferential agreements could have provisions pertaining specifically to animal welfare, such as those of the European Union, but unless otherwise stated, the discussion below will deal with the WTO agreements. Further, there are multilateral environmental agreements such as the Convention on International Trade in Endangered Species of Fauna and Flora (CITES), which has provisions that regulate international trade in animals and animal products, and standards setting scientific organizations such as the World Organization for Animal Health, which, for example, has been mandated to take the lead internationally on animal welfare, including establishing standards for how trade in animals is conducted.

The current multilateral rules of trade stem from the institutional arrangements put in place at the end of the Second World War to reduce the sources of conflict among countries. The United Nations was established to reduce political conflicts between nations, the World Bank was established to deal with differences in the level of development between countries, and the International Monetary Fund was put in place to reduce the use of strategic currency devaluations. A fourth institution was negotiated, the comprehensive International Trade Organization (ITO), but was stillborn, primarily because the US Congress was not expected to ratify it (Kerr 2000). One of the ITO's subagreements, the General Agreement on Tariffs and Trade (GATT), was ratified by the US Congress and by default became the de facto multilateral organization making rules for international trade. The GATT came into being in 1947. The GATT was primarily concerned with removing barriers to trade put in place to provide economic protection against imports; almost no provision for ethical objections to trade was included. The only exception was in GATT Article XX (a) which allows countries to impose trade barriers *necessary to protect public morals*. The provision recognized that countries might wish to limit imports of pornography or products not allowed for religious reasons such as pork or alcoholic beverages in Islamic countries. It has not, as yet, been invoked for reasons pertaining to animal welfare.

Part of the reason that provisions for ethically based trade barriers were not included in the GATT was that the economic model that underlies it only expects producers (facing competition from imports) to ask for protection. As protection raises prices for consumers, and hence as they are worse off, they are never expected to ask for protection (Kerr 2010). This model makes sense in the context of economically motivated protection from import competition – the original concern of the GATT. In 1994, the GATT was rolled into the new more broadly based World Trade Organization (WTO). Much of the original 1947 GATT was simply incorporated without change into the WTO. No new provisions on ethics were included in the updated GATT 1994. Any such change would have required consensus from the 100-plus member states of the GATT.

The perception enshrined in the WTO that requests for protection come only from producers in importing countries seeking economic benefits has led to increasing difficulties for the organization since its inception in 1995. Other groups in society are increasingly interested in specific attributes (other than price) of the imports in their markets and sometimes request that their governments put protectionist measures in place. In particular, consumers and environmentalists have been active in requesting protection – one obvious example is genetically modified organisms and food (Kerr 2010). Other examples include products produced using child labor, timber produced in an environmentally unsustainable manner, beef produced using growth hormones, and products from animals killed in ways some consumers consider excessively cruel (e.g., leg

hold traps, clubbing of seal pups). The WTO has no mechanism for directly dealing with governments faced with consumer, environmental, or other groups seeking protection (Perdikis et al. 2001). As a result, governments faced with protectionist pressure from consumers or environmentalists in society have often attempted to use other existing mechanisms as justifications for the imposition of trade barriers. In particular, for food safety and the conservation of natural resources, trade barriers are allowed in the WTO and have been areas where contentious consumer or environmental issues have been raised. These ostensive *food safety* or *conservation* issues often embody ethical concerns as well (e.g., genetically modified products or timber from rainforests). Countries may also simply choose to ignore their WTO commitments and put trade barriers in place – countries can impose barriers as long as they are not challenged. As challenges are not costless, in both resource terms and political terms, a challenge may simply not take place. Further, if challenged, a country can choose to ignore an adverse WTO panel ruling and, instead, accept retaliation while keeping its trade barrier in place – as was the case for the EU when the WTO ruled that its import ban on beef produced using growth hormones contravened its WTO commitments (Kerr and Hobbs 2005).

The only direct attempt to have animal welfare concerns incorporated in multilateral trade agreements at the WTO came from the European Union. In response to ethical concerns of consumers across the European Union, in the 1980s and 1990s, the European Commission had been gradually raising animal welfare standards across the EU. This led to two trade issues. First, while consumers in the European Union could be assured that the animal products they were consuming which originated in the EU conformed to the EU-mandated standards for animal treatment, no such assurances could be provided regarding animal products imported into the European Union. This issue could be dealt with through labeling requirements that would require those exporting animal products to the EU to label their products regarding the animal welfare standards that were applied during their production (Hobbs et al. 2002). Labeling would allow consumers to choose those imported products that they felt had been produced in an ethically acceptable manner.

Labeling is governed by the WTO's Agreement on Technical Barriers to Trade (TBT). Under the TBT, labeling is allowed for new products. It could be argued that animals produced to meet recently introduced higher animal welfare standards constituted new, different, products than those produced using previous (old) animal welfare standards, and labeling could be required. In the negotiations when the TBT was established, however, developing countries feared that allowing trade barriers (including labeling requirements) on the basis of the technology used in production would allow developed countries to erect trade barriers on the basis that less sophisticated technology was employed in production (e.g., cotton shirts produced using handlooms when sophisticated machinery was used in developed countries to produce the same shirt). This was a difficult negotiation, and the eventual compromise that was struck was that trade barriers could be put in place for new products if they are discernibly different, but not based on how they are produced (Isaac 2007). This is known as the production and processing methods (PPM) provision. Animal products such as meat can only be differentiated by the animal welfare standards used in their production – a PPM. They are not visually differentiable by consumers. Thus, any animal welfare-based labeling requirement for imports was rejected by developing countries. For them, it would have represented the *thin edge of the wedge* for the erosion of their hard-fought achievement of the PPM provision (Hobbs et al. 2002). The PPM provision has been at the heart of much of the controversy regarding the WTO, not only over animal welfare but also environmental sustainability, genetically modified products, child labor, and a host of other issues that have an ethical dimension (Kerr 2010).

The second trade effect of the EU's implementation of stricter animal welfare standards than most of its trading partners was that it increased

the costs of producing livestock products in the EU relative to those of import-competing countries – it reduced the international competitiveness of EU livestock producers (Hobbs et al. 2002). Hence, it was not the direct ethical issue that led the EU to push for some recognition of differences in animal welfare regulations in multilateral arrangements dealing with international trade, but it was the competitiveness issue.

At the second special session of the WTO's Committee on Agriculture in 2000, the EU submitted a formal proposal on animal welfare and trade in agriculture calling for animal welfare standards to be addressed by the WTO. The EU put forward several ideas as to how the issue of animal welfare standards could be addressed within the WTO. Their first suggestion was for the creation of a new multilateral agreement on animal welfare. It is unclear whether the EU intended the new agreement to be part of the WTO framework (e.g., like the Agreement on Technical Barriers to Trade) or outside it (e.g., like the CITES).

The second idea was to allow the imposition of a labeling regime pertaining to animal welfare standards for imported foods using products from commercially produced animals as inputs. The EU argued this would enable consumers to make an informed choice.

Third, the EU proposed allowing the provision of compensation to enable producers to meet the additional costs of producing food to EU animal welfare standards – in other words non-actionable (green box) subsidies. Under the WTO disciplines on subsidies, non-actionable subsidies can be used without the threat of countervailing measures from other members (Meilke and Cranfield 2007). According to the EU, this suggestion was aimed at reducing disparities in competitiveness between countries with different standards and would have no, or at most minimal, effects on trade and production. The EU stated that its three proposals are not mutually exclusive and that some combination of the three would be possible. They conclude their statement by reiterating their aim to "address adequately the issue of animal welfare within the WTO, without conflicting with the long-term objective of trade liberalisation in agricultural and food products" (WTO 2000, p. 3).

The response from other members of the WTO to the EU proposal was emphatic and somewhat predictable. Developing countries responded strongly to all three aspects of the proposal. A number of countries (Uruguay, Bolivia, Thailand, India, Pakistan) took up the theme that, while not indifferent to animal welfare, the priority for their resources was the alleviation of human poverty (Hobbs et al. 2002). This was interpreted as an implicit rejection of the EU's suggestion that there be a separate multilateral agreement on animal welfare. In a similar vein, Argentina and India stressed that countries should be left to set their own standards. Colombia and India rejected the labeling proposal as simply disguised barriers to trade. A number of countries, both developed and developing, suggested that it was up to consumers to decide if they wished to pay for higher animal welfare standards – indicating rejection of both mandatory labeling and the extension of non-actionable subsidies to cover the extra costs. A number of countries, including the USA, rejected any extension of non-actionable subsidies to encompass compensatory payments for higher animal welfare standards, and Argentina explicitly stated that it could not accept any extension of the Green Box list of WTO-sanctioned subsidies to cover the issues raised by the EU (Hobbs et al. 2002).

Some developed countries, however, seemed more willing to accept that animal welfare is worthy of multilateral discussion. Most did not think the WTO was the correct forum for that discussion, suggesting that a separate agreement outside the WTO might be the way to proceed. Australia, however, suggested that the issue should be left to the World Organization for Animal Health (OIE) (Hobbs et al. 2002). The latter suggestion may have had some resonance with the multilateral community as the OIE was mandated to take the international lead for animal welfare. Since 2005, the OIE's members have developed and adopted eleven welfare standards, eight for animals, and three for aquatic products (OIE n.d.). These include transport of animals by

land, transport of animals by sea, transport of animals by air, slaughter of animals for human consumption, and the killing of animals for disease control purposes, among others.

The OIE is recognized in the WTO's Agreement on Sanitary and Phytosanitary Measures (SPS) as an official standards setting organization. This does not mean that WTO members must adopt OIE standards. In the trade context, it means that any country adopting the OIE standards cannot be challenged by other countries that might perceive the standards as trade barriers – they are a *safe haven* (Isaac et al. 2002). As yet, however, there are no direct provisions pertaining to animal welfare in the WTO agreements.

Trade Sanctions

Countries have also attempted to use trade sanctions to induce other countries to alter their practices in ways that would improve animal welfare but justified on grounds of environmental sustainability. GATT Article XX (b) allows trade measure to be put in place when necessary to protect human, animal, or plant health, while Article XX (g) allows them for conservation of natural resources, which some countries have taken to mean marine mammals. The most famous, and controversial, cases involved fishing practices for tuna that lead to the snaring of dolphins in nets leading to dolphins being killed or maimed. In response to the concerns of animal welfare advocates and others, the USA enacted measure to regulate tuna fishing practices so that such *incidental* takings of dolphins would be reduced (Isaac et al. 2002). These measures were contained in the Marine Mammal Protection Act (MMPA) of 1972 and applied to the US tuna fishing fleet. Other countries, however, continued fishing for tuna in dolphin-unfriendly ways. The MMPA also authorized the imposition of import embargoes on fish caught by nations that do not adequately provide for dolphin conservation. It should be noted that expanding the set of products that could be embargoed beyond tuna was clearly intended as an economic sanction to be used to induce a change in the behavior of other countries (Gordon et al. 2001). In 1991, the US government imposed an import ban on the importation of tuna from Mexico. In response, Mexico requested a GATT dispute resolution panel be struck. The panel, through convoluted reasoning, found in favor of Mexico. According to Spracker and Lundsgaard (1993), the heart of the panel's reasoning was that the import ban could not be employed "in order to regulate production methods that do not affect the character of the imported product" (p. 395) – tuna fishing is a PPM that does not alter the imported product, the tuna. The judgement outraged animal welfare advocates (and environmentalists) and to a large extent soured them on the WTO. Protesters dressed as dolphins became a regular feature of anti-WTO protests. It should be noted, however, that the WTO has no legislative function and only administers what the member states have already agreed to, including the adjudication by dispute panels.

A second Tuna-Dolphin dispute was also brought by the European Union against the USA because the MMPA also authorized a ban on tuna products imported from countries that source their tuna from a country covered by the primary embargo – because the EU imported tuna from Mexico which was embargoed. The panel ruled, among other things, that the exceptions in Articles XX (b) and (g) could not apply to environmental measures whose impact was achieved by forcing a member state to change its policies (Isaac et al. 2002). Again, the ruling was widely condemned by environmental and animal welfare nongovernmental organizations (NGOs). According to Isaac et al. (2002): "The decision of the panels in the Tuna-Dolphin disputes raised serious questions as to the ability of states to further environmental objectives by the use of trade-related measures" (p. 85). As environmental issues are often comingled with animal welfare issues, the same conclusion can be made.

Following the Tuna-Dolphin cases, a further issue where animal welfare concerns were comingled with environmental concerns was brought to the dispute settlement system – what is known as the Shrimp-Turtle dispute. Formally,

the issue was dealt with as an environmental issue rather than an ethical issue pertaining to animal welfare. Sea turtles are considered highly endangered under the CITES. The most significant threat to the species arises from incidental capture and drowning caused by shrimp harvesting operations. In response to domestic pressure from animal welfare and environmental groups, in 1989, the USA mandated that all shrimp trawlers fishing in waters likely to contain sea turtles, no matter what their country of origin, be equipped with Turtle Excluder Devices (TEDs) (Isaac et al. 2002). Contained in the legislation was the requirement that the importation of shrimp or shrimp products be prohibited if harvested using a fishing technology that could have a deleterious impact on the sea turtle population.

In response, India, Malaysia, Pakistan, and Thailand requested a WTO panel to determine if the US measures violated the rules. The USA countered that the measures should be allowed under Article XX (b) and (g) exceptions. The dispute went through a long process of panel deliberations and appeals (Isaac et al. 2002). Initially, the panel ruled against the USA, and as a result, protesters dressed as turtles joined those dressed as dolphins as a feature of anti-WTO protests. In an appeal judgement, however, the US measure was accepted in principle as being eligible for Article XX exceptions, but the way the USA had implemented its measure was not consistent with WTO obligations (Isaac et al. 2002). This was judged to be a major victory by legal scholars interested in environmental issues.

The threat of imposing trade sanctions has been used to good effect in other cases where ethical animal welfare issues and environmental issues are comingled. The mere threat of trade sanctions cannot be taken to a WTO dispute panel. One example of the effective use of the threat of trade sanctions has been in the regulation of fishing and, in particular, whaling in international waters. Domestic legislation in the USA – a number of laws grouped around what is known as the Pelly Amendment (Gordon et al. 2001) – gives the US President the discretion to impose trade sanctions on imports of fish from countries not complying with the conservation and management standards embedded in a number of US laws. The USA first used the Pelly Amendment to threaten Denmark, Norway, and West Germany over those countries' continued fishing of Atlantic salmon. The threat was effective and led to an agreement in 1976 to end the high seas fishing of Atlantic salmon (Gordon et al. 2001). The Pelly Amendment's ability to threaten trade sanctions has also been used with great effect, and repeatedly, to bring countries into compliance with the International Whaling Commission's (IWC) restrictions or bans on whaling – either by inducing countries to join the IWC or by complying with its ban on whaling. Gordon et al. (2001) report that, at various times, Japan, the Soviet Union, Chile, Peru, South Korea, Spain, and Taiwan were induced to alter their practices when threatened with trade sanctions on their fish shipments to the USA. Other countries, however, weighed up the cost of potential sanctions and chose not to alter their practices.

Strategic Use of Trade Barriers and Trade Sanctions

Unless a trade partner objects by asking for a dispute panel, a country can impose trade bans or other trade restriction for animal welfare reasons. One example is the EU ban on imports of seal products. In September 2009, the European Union announced a virtual ban (with a few exceptions) on the import of seal products. Canada is the world's major producer of seal products. Canada (and Norway) first sought consultations with the EU through the WTO; when those failed, they asked for a formal dispute settlement panel. They had the option of not seeking a dispute panel and accepting the ban. The decision to initiate a dispute is a complex calculation. Formal dispute settlement is expensive and time consuming. Further, even if the EU were to lose the case, it could choose not to comply with the WTO ruling – as the EU did in the case of its ban on imports of beef produced using growth hormones (Kerr and Hobbs 2005). Of course,

noncompliance can lead to retaliation being authorized, but the extent of the retaliation is limited to the value of trade lost. The EU may have done a calculation that can easily absorb the cost of retaliation in the case of seal products. Canada and Norway can also do the calculation. In that vein, it is interesting to note that Namibia, another seal product producer, did not join the dispute, choosing instead to accept the economic cost of the ban. While the dispute is going forward at the time of writing, this was not a forgone conclusion at the time the ban was imposed. In any case, the economic impact of the ban for Canada and Norway will continue at least over the period when the dispute is being heard. This is the first time a dispute panel has been asked to decide directly on the legitimacy of a trade barrier imposed for ethical animal welfare reasons.

Multilateral Cooperation

Disputes are an inefficient and not particularly efficacious means of altering public policy. A better mechanism is to obtain multilateral agreement on appropriate public policy. One example where this has been accomplished in the case of ethical animal welfare concerns (although again comingled with environmentally based conservation concerns) is the CITES. In the CITES, countries have come together to, among other things, establish rules of trade that support the objective of preserving endangered species. The CITES trade provisions may, in fact, not be compliant with some WTO provisions, but due to widespread acceptance of the CITES, there has been no WTO challenge, nor is there likely to be one (Isaac et al. 2002).

Summary

The multilateral system for international trade as embodied in the WTO, as yet, takes no direct account of ethical animal welfare concerns in its rule-making or jurisprudence. Some preferential trade agreements – such as the EU – have included animal welfare provisions. Animal welfare issues are often comingled with environmentally based animal conservation measures, and a number of clarifications regarding the legitimacy of trade measures have been sought through the WTO dispute settlement system. The results have often disappointed those advocating the use of trade restricting measures to encourage stricter animal welfare standards. Countries have, however, at times, used trade measures to advance animal welfare objectives. The CITES is an example of multilateral cooperation in establishing trade policy to achieve ethical objectives outside the WTO.

Cross-References

- ▶ Animal Welfare: A Critical Examination of the Concept
- ▶ Food and Agricultural Trade and National Sovereignty
- ▶ Food Labeling
- ▶ Free Trade and Protectionism in Food and Agriculture
- ▶ Multilateral Trade Organizations, Food, and Agriculture

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Trade Policies and Organic Food

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Synonyms

GMO-free; Hormone-free; Natural food; Organic agriculture

Introduction

Organic foods are produced using farming methods that may be less harmful to the environment while also leading to foods that are better for human health. Many environmental ethicists who believe that there is a moral obligation to protect the environment may view organic food as more sustainable and thus ethically superior to conventional food (Scialabba 2007; Byerlee and Alex 2005). Some scholars believe that access to safe and nutritious food is a human right seeing organic production as a viable means to achieve this right (Altieri 2009). Attributes such as healthiness and sustainability are invisible to consumers of organic products. Organic foods are differentiated from conventional alternatives because they are produced through different processes (characterized by crop rotation, absence of synthetic fertilizers, and biological control of pests rather than chemical treatments) as opposed to having different physical attributes. In the absence of information that reliably communicates these desirable characteristics, organic foods can only compete on price, and as they are usually more expensive to produce, there will be little incentive for markets to form. Setting up standards and a system to label or certify organic foods can help consumers in making an informed choice. Since countries may differ in how they define standards and certify organic foods, there is a potential for trade conflicts.

Organic Food Standards

Organic food standards determine which products can legally be labeled as organic. According to the International Federation of Organic Agricultural Movements (IFOAM), the market for organic food is confronted with hundreds of national government and private standards, as well as a number of global certification and accreditation systems. Examples include the US National Organic Program (USNOP) and the part of the Japanese Agricultural Standard (JAS) pertaining to organic agricultural products. Global standards include IFOAM standards, the Codex Alimentarius Commission guidelines maintained by the Food and Agriculture Organization (FAO) of the United Nations, and at a regional level, the European Economic Community's (EEC) Council Regulation 2092/91(Schmid et al. 2007). Some of the private standards include BIO AUSTRIA, Bio Suisse (Switzerland), Naturland (Germany), and the Soil Association (UK) (Setboonsarng 2008). The EEC guidelines are considered the minimum standards with which all EU member states have

to comply. If required, any state can have a national or private standard with more detailed requirements, depending on local or regional concerns (Schmid et al. 2007).

Heterogeneity and Trade Conflicts

A detailed review of the differences between the EEC and selected national and international organic standards is reported in an article by Schmid et al. (2007). National standards from 16 European countries, and the United States, and international standards – IFOAM Basic Standards, Codex guidelines – were compared with those of the EEC. The standards differed in terms of their organic labeling schemes, recommended crop and livestock production methods, processing techniques required for organic produce, and environmental protection provisions.

There are differences in the way the US certification system and the EEC regulations handle the question of whether a food can be labeled organic if it is made from less than100 % organic ingredients. The EEC regulations apply to livestock feed, while the Codex does not include provisions for organic feed (Schmid et al. 2007).

Standards related to organic crop and livestock production (such as the use of fertilizers, manures, crop rotations, and animal stocking densities) also vary to a considerable extent. For instance, though most of the EU member states require that seeds and vegetative propagation materials be of organic origin, they differ in the way seeds from conventional sources are allowed when organic seeds are not available. A study by Thommen and Schmid (2006) shows that the areas cultivated with nonorganic cereal seeds were much higher in Belgium, Italy, and Spain compared to other member states because they had different criteria for accepting the use of nonorganic seeds. Because organic seeds are more expensive, these countries may have had a competitive advantage as a result of these differences. EU regulations include limitations on the use of livestock manure (170 kg of nitrogen from manure per ha/year of agricultural area used) and the export of surplus manure, while Codex and USNOP do not set any limitations for nitrogen use. Some private standards such as Naturland (Germany) and Bioland (Germany) have even tighter regulations allowing only 112 kg N/ha. Such differences can lead to trade distortions by lowering costs for firms in countries that have set looser restrictions on manure use. Schmid et al. (2007) note that several countries have more detailed requirements for crop rotations and tighter restrictions on fertilizer use.

Regulations on pesticide contamination and contact with genetically modified organisms (GMOs) also vary between countries. To prevent cross fertilization between organic and GMO crops such preventive measures as windbreaks or buffer zones may be required. For instance, USNOP requires buffer zones to prevent contamination from conventional farms, but the EU does not have such provisions. Countries in which such measures are not required will have a cost advantage relative to those in which they are required. Five private standards allow greenhouse production but with limits on the use of artificial light and heating systems to reduce the consumption of nonrenewable resources. Such restrictions could represent a particular burden on producers of organic products in the colder, northern European countries compared to the costs in the central and southern Europe.

Although the global organic market size has increased threefold since 2000 (Willer and Kilcher 2012), most of the food produced and consumed around the world comes from conventional agricultural systems. Alroe et al. point to negative externalities such as soil and water degradation and the loss of biodiversity that may arise from both conventional and organic food systems. Organic standards may require attention to some of the negative effects, but in many cases, they do not include restrictions related to critical aspects of soil, water, and biodiversity conservation (Alroe et al. 2006).

Harmonization and Equivalency

Although there are both national and international organic standards, there is no clear mechanism for resolving trade disputes that might arise from different organic standards. The WTO does not have specific provisions on organic food standards (Daugbjerg 2012). Trade conflicts due to

differences in standards can give rise, however, to cases that could lead to complaints under the WTO technical barriers to trade (TBT) provision. For example, some delegations to the WTO expressed concern about a draft organic certification procedure under discussion in Korea requiring that organic foods be certified by Korean authorities or by agencies approved by the Korean government (WTO 2012). Several delegates objected that the draft provisions did not include ways to establish equivalency with standards in other countries, and in the absence of a means to establish that other standards are equivalent to those in Korea, the Korean standards would be inconsistent with Korea's WTO obligations under the TBT agreement.

As the Korean example shows, the standard procedure for international trade in organic food involves agreements between nations that their standards are substantially equivalent. Such agreements allow foods certified as organic in one jurisdiction to be sold as organic in another. An alternative to equivalency agreements would be complete harmonization of organic standards so that a single set of standards could be applied worldwide (Schmid et al. 2007). Because of the difficulty of reaching agreement on a single set of standards and the lack of an international enforcement body, equivalency agreements have been the most practical approach to reconciling different organic standards so that organic products can be traded.

The equivalency agreement between the United States and the EU offers a good example of how such agreements are structured. This agreement, the "Organic Equivalence Cooperation Agreement" adopted on February 15, 2012, specifies that standards in the US National Organic Program (USNOP) will be considered as equivalent to the EU Organic Program, thereby allowing organic goods certified by the appropriate authorities in each country or region to be marketed as organic in the other (Bendz et al. 2012). Traded organic products must have an "organic export certificate" showing the location from which they come and the agency providing the certification as well as assurances that all relevant standards have been met. The information provided with these products insures that consumers can be confident that the organic foods being purchased are, in fact, produced and handled using recognized organic methods.

The agreement includes specific requirements regarding the origin of the products. Organic products certified in the EU and the United States but not produced, processed, or packaged in these countries cannot be exported under this agreement. For example, Ecuadorian bananas certified under EU regulations cannot be directly exported from Ecuador to the United States. The agreement is to be reassessed after three years with a view toward achieving greater harmonization of the two sets of standards (Bendz et al. 2012). Some of the areas for future discussion include differing requirements for veterinary treatments and handling of manure and fertilizer.

Ethical Issues in the Trade of Organic Foods

So far, trade in organic foods does not appear to raise a lot of ethical issues. Equivalency agreements allow trade in organic foods which, in turn, means that over time organic production and consumption is likely to grow. Because organic production is generally thought to be less harmful to the environment than conventional production, this evolution can be seen as positive. For some, organic food embodies certain ethical characteristics. For example, IFOAM identifies four ethical principles that define organic agriculture:

> The principle of health – organic agriculture should sustain and enhance the health of the soil, plants, animals, and humans as one and indivisible.
>
> The principle of ecology – organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
>
> The principle of fairness – organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
>
> The principle of care – organic agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

Differences in national organic standards may reflect the fact that countries place different weights on the various principles identified by

IFOAM (IFOAM 2006). For example, organic standards on antibiotic use in the EU and in the United States may differ because of national variation in attitudes toward animal rights. According to Zanoli (2004), consumers in the EU are concerned not only about the overuse of antibiotics in animals (for them lower antibiotics use implies healthier food products) but also about the welfare of the animals themselves. EU consumers are more likely to feel that the principles of care and fairness should be extended to animals than consumers in the United States. These value differences may be obscured by equivalency agreements that require all certified foods to be treated as if they met local standards.

Some might suggest that organic food is problematic. If resources are directed away from conventional food for use in organic production and if the amount of food that can be produced from a unit of productive resources is less with organic than conventional, expansion of organic may not be a good thing. Organic production is currently pretty small relative to conventional food output, and it seems unlikely that organic will ever replace more conventional production methods. If expanded organic production were to lead to food shortages, prices would increase providing an incentive for producers to switch back to conventional methods to increase output. Short of some kind of absolute authority that could override market forces and make organic mandatory, it is unlikely that there would be a big problem of this nature.

Trade Implications for Developing Countries

Though Europe and the United States account for around 90 % of the global sales of organically certified products, the domestic supply of organic products in these countries has been unable to keep pace with the growing market demand (Barrett et al. 2002; Dimitri and Oberholtzer 2009). For instance, in the United States, inadequate availability of inputs for organic dairy and livestock production is an important reason for retail shortages in organic dairy and meat products (Oliver 2006). Organic food shortages in developed countries represent opportunities for developing countries to produce and export organic products. Because much agricultural production in developing countries is done with few or no chemical inputs, it may be easier for growers in these areas to switch to completely organic production. To gain access to export markets, however, producers in the developing countries must abide by the international standards and foreign organic certification systems, and compliance with these standards may be costly (Barrett et al. 2002). Setboonsarng (2008) examines the role in developing countries of the IFOAM international standards and some national and private organic standards. He claims that clear organic standards and certification systems may allow producers in developing countries to market organic food in high-income countries, potentially avoiding extensive use of chemical and energy inputs. The expansion of organic production in developing countries could have beneficial effects on the environment while at the same time raising their incomes. Both of these developments are consistent with environmental and development ethics. A joint project known as Global Organic Market Access (GOMA 2012) has been undertaken by the IFOAM, the FAO, and the United Nations Committee on Trade and Development (UNCTAD). A regional subgroup of GOMA is attempting to establish common organic standards among Asian countries.

Summary

Organic food standards are necessary for markets for these products to develop. Without standards, consumers cannot be certain that the foods being purchased really are organic with all the ethical attributes they associate with these products. This is true for both domestic and international markets. Conflicting national standards could impede international trade slowing the growth of organic production and consumption. Because organic food is less harmful to the environment and may have desirable attributes

for consumers (e.g., health and taste), mechanisms to coordinate organic certification across international markets are beneficial. The WTO does not have special provisions on organic food standards, but countries are expected to recognize certification equivalency, and these expectations are backed up by the WTO's TBT regulations. Recently the EU and the United States have agreed to recognize each other's standards as substantially equivalent, thereby allowing US certified organic food to be sold in the EU as "organic." Both have agreed to forge a common understanding on various environmental and animal welfare issues important to achieve harmony and facilitate trade. Compliance with international organic food standards and certification systems, though costly, may be beneficial in the long run for developing countries which may have certain advantages in organic agricultural production with positive consequences for both the environment and development in low-income countries.

Cross-References

- ▶ Canada, US-EU Beef Hormone Dispute
- ▶ Environmental Ethics
- ▶ Environmental Justice and Food
- ▶ Food Ethics and Policies
- ▶ Food Labeling
- ▶ International Food Quality Standards
- ▶ Trade Policies and Animal welfare

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Transgenic Crops

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Synonyms

Genetically engineered crops; Genetically modified crops; Transgenic seeds

Introduction

Since transgenic crops first took root, they have been embroiled in numerous controversies from questions about their safety to the future of the food system. Today, transgenic crops make up a considerable portion of the planted areas of crops such as soy, corn, cotton, and canola, but find very little adoption in other sectors. Farmer adoption of transgenic soy happened so quickly that by some measures it is often described as the most rapidly adopted agricultural technology in human history. While some agricultural sectors have benefited from transgenic crop adoption, they remain much maligned in wider discussions about agricultural sustainability. Before describing these apprehensions toward transgenic crops, this section describes what transgenic crops are and how they are made.

The term transgenic is used as an adjective to describe an organism where genes have been moved from one place to another in its genome or from one species' genome to another. The etymology of "trans-" is believed to be Latin for the phrase "to cross." Sometimes transgenic organisms are referred to as genetically modified (GM) or genetically engineered (GE); GM organisms (GMOs) are probably the most colloquial in use, although GE organisms (GEOs) are also commonly used. Some analysts and activists restrict the term transgenic to instances where genes are moved across species barriers, but by and large it is agreed that the movement of genes within the same species should also be considered transgenic. The developments that make transgenesis or genetic engineering possible come with the tools of recombinant DNA technology, which have allowed scientists and genetic engineers to move genes around at a scale not possible with conventional breeding. Often it is the use of these recombinant DNA techniques that determine whether or not an organism deserves the transgenic label.

Genetic engineering introduces foreign DNA into the host organism (or moves it within an organism) in several different ways. This transgenesis is referred to as an event. The most common way is to introduce the DNA with a viral or bacterium invasion into the host's nucleus. This virus or bacteria is commonly described as the promoter sequence. Transferring genes using a bacterium involves combining the desired gene with a plasmid, which is then carried by an agrobacterium, most commonly *Agrobacterium tumefaciens*. The agrobacterium moves through the cell wall, depositing the desired gene in the host organism. After gene transfer, both the promoter and the desired gene remain in the plasmid. These plasmids are then cultured in a petri dish and in the case of plants moved to a greenhouse where it is determined whether or not the desired gene is expressed in the plant's phenotype. This is often done with a marker gene that is attached to the promoter, which when expressed makes it easy to identify which plants contain the desired gene. The most widespread marker genes are those for antibiotic resistance. When applied, the antibiotics kill any cells without the new genes, leaving behind only cells that have taken up the marker gene and promoter. The use of antibiotic resistance genes has raised many food safety concerns about foods made from transgenic plants because it is unclear whether or not the antibiotic resistance affects human health or promotes resistance in the wider human and animal populations. Alternative marker genes include traits of phosphorescence from jellyfish, where the desired trait can be ascertained from the organism's exposure to a black light.

Other means of making transgenic plants use non-viral promoters. The particle gun or "gene gun" technique uses gold- or tungsten-covered

pellets coated with bits of DNA that penetrate the cell wall and randomly insert themselves into the host's DNA. Electricity can also be used to create momentary holes in the cell wall, which allow promoters and markets to be delivered to the nucleus.

This essay will describe ethical issues derived from the interplay between science and politics of transgenic crops. With transgenic crops comes a new technology that allows an unprecedented pool of genes for plant breeders to work with. But at the same time the technology raises a host of ethical questions about property rights, ecological viability, and the role of public sector plant breeding research. The first section explains the emergence of transgenic plants out of the labs and into the fields as well as the scientific controversy to understanding their early evolution. The second section introduces the views taken by biosafety ecologists about their potential risks to the environment. The third section summarizes a few of the social implications from transgenic plants. The final section describes the current extent of transgenic crop deployment today as well as future deployment scenarios.

The Evolution of Transgenic Crops

The first product of recombinant DNA technology destined for open-air use and to receive considerable public attention was the deliberate release of the "ice minus" bacterium (*Pseudomonas syringae)* developed by University of California plant pathologist Stephen Lindow (Krimsky and Plough 1988). The goal of the project was to spray potatoes near Tule Lake in Northern California with an "ice-nucleation active" bacterium to inhibit the formation of frost on the plants, which could have important implications for staving off early season frosts, with potentially tremendous saving to growers. While not a transgenic crop per se, the treatment of the ice minus bacteria by regulatory officials would become the basis for future field trials of transgenic crops, which would dominate the deployment of GEOs over the following two decades. Concerns about the unintentional escape of the ice minus GEO included its impact on ecosystems adjacent to the fields where it was introduced, as well as possible implications on global weather patterns. This aroused local reactions in the San Francisco Bay Area cities of San Francisco, Berkeley, and Oakland, which included moratoria and outright bans on outdoor experiments.

The National Institute of Health (NIH) Recombinant Advisory Committee eventually approved field trials of the ice minus bacteria. Activist Jeremy Rifkin of the Foundation on Economic Trends obtained a court injunction to stop the release, arguing before the court that the experiment posed an environmental hazard and that there were no adequate containment protocols in place. Rifkin argued that the NIH was required to conduct an Environmental Impact Assessment under the National Environmental Policy Act to evaluate environmental impacts because a federal agency was making a decision that could impair the environment.

The fallout from the controversy led to a new round of discussions about how GEOs should be regulated, ultimately leading to a decision by Congress in 1985 to regulate them through the existing regulatory system. Under what is known as the "Coordinated Framework," the Food and Drug Administration (FDA) evaluates food safety concerns; the Environmental Protection Agency (EPA) oversees concerns about toxicity from mobile plant tissues like pollen and root exudates, as well as issues related to insect resistance to plant incorporated pesticides; and the Department of Agriculture's Animal and Plant Health Inspection Service oversees problems related to increased weediness and biological invasion. At the time, many activists and ecologists simply saw the Coordinated Framework as an effort to manage GEO introduction instead of regulate it.

Ecological Risks from Transgenic Crops

Genetically engineered organisms in general, and transgenic crops in particular, have always raised questions about how they will impact ecological

processes both within and outside farmer fields since the first plans to release them in the early 1980s (Altieri 2000). The Ecological Society of America (ESA), a professional society of ecologists, released a statement noting the potential ecological and environmental hazards associated with introducing GEOs into the environment in 1985. They noted that the products of genetic engineering and recombinant DNA technologies posed no new classes of ecological hazards. But the novelty of the new technology warranted regulatory oversight, because there is the potential for more extreme and uncertain ecological hazards. The ESA scientists that signed onto that statement strongly advocated a robust system of containment to prevent to escape of the transgenes into the environment. For plants this meant controlling seed dispersal and possibilities for inadvertent cross-pollination. They also argued for early ecological risk assessments of GEOs to ensure they did not pose significant impacts to native flora and fauna before release. However, early planning for ecological risk assessments faces considerable challenges given the importance of trade secrets in the development of commercial transgenic crops.

Ecologists' opinions on the risks from GEOs vary widely. Some suggest that some organisms pose threats to the environment, while others argue that GEOs will suffer greater fitness consequences from having their phenotypic expression altered in ways that make them more dependent on human intervention to reproduce in areas outside agricultural production. More holistic frameworks urge an approach to evaluating the risks of biotechnology recognizing that uncertainty, complexity, and incomplete knowledge must factor into any regulatory approach including post-release monitoring to more comprehensive ecological risk assessments.

Loss of Plant Genetic Diversity

One important impact from transgenic crops is the loss of genetic diversity through gene flow – the transfer of genes from population to another (Letourneau and Burrows 2002). Gene flow may have consequences to genetic diversity through outbreeding depression or genetic swamping where there are sexually compatible wild relatives near or in farm fields where transgenic crops are planted. In outbreeding depression, the fitness of the offspring is lower than the originating plants. In the long run these plants will not be successful competitors and risk extinction or extirpation. Outbreeding depression would occur if short-term fitness advantages favor the increased presence of the transgene in the population but with long-term fitness consequences over time (e.g., reduced fecundity, increased disease susceptibility). Genetic swamping occurs when there is a high ratio of transgenic plants to the wild relative. In effect the wild relative is swamped with genes from the transgenic crop field, compared to other wild relatives. Genetic swamping would most likely occur where the receiving plants are relatively rare and exposed to high rates of hybridization. Both of these phenomena occur with conventionally bred crops, but risks may be heightened with transgenic crops.

Areas most susceptible to concerns about loss of genetic diversity are in the Vavilov centers of genetic diversity and crop domestication (Fowler and Mooney 1990). These centers serve as sources for genes used in breeding programs and at times throughout recent history have been critical to efforts to combat disease in conventional crops with the corn blight of the early 1970s being a prime example. After the blight wiped out significant portions of successive corn crops, researchers returned to Mexico, an important site of corn domestication, where they were able to find genes for resistance to the disease in the wild relative *teosinte*. The loss of crop genetic diversity is often raised in the controversy over transgenic maize in Mexico, where both small farmers and international research institutions depend upon the diversity of wild relatives and landraces for plant breeding.

In 2001, a University of California at Berkeley professor and his graduate student tested maize landraces grown in Oaxaca, Mexico, the center of crop diversity for maize, and found the presence of patented transgenes despite a moratorium on transgenic maize (Quist and Chapela 2001). Their study found not only the presence of

transgenes in maize landraces but also suggested that the transgenes inherited did not exhibit the stability ensured by the crop's developers and patent holders. Their initial findings were published in a brief article in the journal *Nature*. Shortly after publication, the journal came under fire from the scientific community, particularly those supportive of the life sciences industry and from within the discipline of molecular biology. *Nature* retracted the article, questioning the researchers' methodology and interpretation of evidence. When data were subsequently submitted supporting the findings, *Nature* refused to publish them, to retract the retraction, or to provide a forum to pursue earlier editorial commentary.

Despite concerns that transgenic crops may pose threats to plant genetic diversity, the *Nature* controversy continues to be framed as one of academic practice and integrity. The point that transgenic traits were found in Mexican maize landraces, a Vavilov Center of crop-wild diversity, seems to be lost in the debate. Opponents were noticeably silent about the permeability of the food and seed systems in response to questions from NGOs, indigenous groups, and ecologists about the adequacy of regulatory institutions to control the deliberate introduction of transgenic crops in areas of critical plant genetic diversity.

Herbicide Resistance, Increased Weediness, and Superweeds

Another ecological risk from transgenic crops comes from the use of traits for herbicide tolerance. These traits are attractive to farmers because instead of costly weeding techniques, growers can spray herbicides after their crop has emerged from the seed. Without genes for herbicide tolerance, this would damage the crop. But herbicide-tolerant crops will not die when exposed to the herbicides. The use of herbicides this way has increased the amount of no-till weed control in crops such as soy.

However, widespread use of herbicide-tolerant crops such as RoundUp Ready™ and Liberty Link® varieties could lead to the rapid evolution of resistance to herbicides like glyphosate and glufosinate in weeds, either as a result of increased exposure to the herbicide which would select for tolerance over time or as a result of the horizontal transfer of the trait to weedy relatives of crops (National Research Council 2002). These have become known as superweeds in the public discourse on the topic. Eventually herbicide-tolerant crops could change the mix of herbicides applied as some become ineffective due to overuse, which could result in greater levels of overall environmental harm. Since herbicides differ in acute toxicity and persistence, loss of some herbicides may be detrimental to the environment overall. Moreover, the herbicide RoundUp is used in some ecological restoration sites, so increased weed resistance could force restoration managers to use more toxic herbicides.

Insect Resistance

The introduction of transgenic crops also raises concerns about insect resistance. The naturally occurring microorganism *Bacillus thuringiensis* (*Bt*) has been used as a pesticide for several decades. When ingested by many species of Lepidoptera, and some Coleoptera, it crystallizes and blocks the passage of food into the stomach, effectively killing them. Its rapid degradation when exposed to UV light keeps it outside of the EPA's oversight allowing it to be widely used in powdered form by organic farmers. However, many studies have shown that *Bt* resistance can evolve rapidly in agroecosystems (National Research Council 2002). Incorporating the genes that produce the *Bt* endotoxin into plants and subsequently planting them on such a large-scale could, unless properly managed, hasten the evolution of resistance, with implications for both organic and conventional farmers.

Currently, industry uses a high-dose refuge model to suppress the evolution of resistance in Lepidoptera. They argue that the high dose of *Bt* will kill most of the pests and that the alleles that develop resistance will be "diluted" by the presence of a non-*Bt* refuge harboring *Bt*-susceptible Lepidoptera (Alstad and Andow 1995). However, this argument rests on two assumptions. The first is that *Bt* resistance is a recessive trait; the second

is that farmers actually plant the refuge. On the latter point, it is worth noting that the responsibility for employing the high-dose refuge model is shifted from the seed developer to the farmer in the technology use agreements often required to buy transgenic seed.

Changes to Chemical Use Regimes and Impacts to Biodiversity

The impacts of transgenic crops on biodiversity from changes in farming practices may be to the detriment of the biodiversity near and in farms. In October 2003, the Royal Society of the UK published its findings from farm-scale evaluations (Andow 2003). Two out of the three crops studied demonstrated an association between transgenic crops and practices harmful to wildlife as well as a tendency to decrease biodiversity. The report attributed the impacts to changing in spray regimes of herbicides, finding that wildlife adjacent to GE crops was subject to increased exposure to agrochemicals such as atrazine, pointing to a significant difference in agronomic practices associated with GE and conventional varieties.

Impacts to Nontarget Organisms

Nontarget effects of GE crops could threaten both biodiversity and agronomic practices such as integrated pest management. Plants engineered to produce toxins in mobile tissue parts such as pollen pose threats not only to susceptible species that enter into areas where the crop is grown but also to the adjacent field margins where the pollen may drift as in the monarch butterfly controversy. Researchers from Cornell University suggested that *Bt*, *Bacillus thuringiensis*, which drifted onto milkweed growing in adjacent to fields of *Bt* corn, increased the mortality rates of monarch larva (Letourneau and Burrows 2002). At the time, the EPA did not consider nontarget organisms as an area to explore in risk assessment. Further research revealed that the impacts of *Bt* corn on monarch butterflies were affected by the amount of *Bt* expressed in the pollen itself, and industry soon eschewed *Bt* varieties with high levels of *Bt* in corn pollen.

Toxic mobile plant tissues may impact soil biota as well. Shielded from UV rays, *Bt* has been shown to accumulate in the soil through the root exudates of transgenic plants. The impact of dosing the rhizosphere with the *Bt* endotoxin has not been evaluated for consequences to nontarget soil organisms or to soil health. Beneficial insects used in the biological control of pests are also subject to nontarget effects. One study suggests that the green lacewing, an insect beneficial to farmers because it eats the same pest that *Bt* is used against, suffers greater mortality rates after consuming *Bt*-fed prey (Letourneau and Burrows 2002).

Viral Resistance

Viruses are known to attack some kinds of plants, and transgenic crops are being designed that are resistant to these viruses. Transgenic crops bred for viral resistance have the potential to create new or more virulent viruses through two mechanisms: recombination and transcapsidation. The former can occur between the plant-produced viral genes and closely related genes of incoming viruses; the latter occurs when nucleic acids from one virus are incorporated into the protein structure of plants. Both can result in viruses that infect a wider range of hosts, demonstrate increased virulence, or lead to a biological resistance "arms race." Furthermore, some viruses play an ecological role in plant community dynamics. For example, barley yellow dwarf virus resistance has been engineered into cultivated oats to prevent yield losses. But this virus also suppresses invasive wild oats. The transfer of viral resistance here may increase the invisibility of wild oats in natural communities as it alters plant competitive interactions (Letourneau and Burrows 2002).

Ecological Risk Assessment and Biosafety Regulation

Biosafety ecologists agree that ecological impacts are greatly unknown (Snow et al. 2004). Ecological risk assessments to date suggest that some organisms pose threats to the environment, while others will suffer greater fitness consequences from having their phenotypic expression altered. A more modest approach to evaluating the risks of biotechnology recognizes

uncertainty, complexity, and incomplete knowledge while emphasizing the precautionary principle from post-release monitoring to designing rigorous ecological risk assessment.

Social Impacts from Transgenic Crops

Activists urge that assessments of transgenic crops be accompanied by analyses of the social consequences of these novel technologies. The history of technology adoption is littered with inequality and disproportionate burdens of impacts. To this end, many activists have been successful in using biosafety as a surrogate for getting at questions about access, control, and development of new technology.

Market Impacts

The most apparent social impact from transgenic crops adoption has been the losses of sales and markets to genetic contamination (Mulvaney et al. 2011). In several cases including the StarLink™ controversy – where unapproved transgenes were found in processed foods – growers were not able to sell their crop because of the presence of transgenic traits. In some instances they also were shut out of future opportunities to sell their crops. In the StarLink example, the USA was immediately blocked from selling corn to Europe, a market they never regained.

Intellectual Property Rights

Patents are the form of intellectual property right invoked to protect the investments in scientific research and technological development made by seed companies to breed and market transgenic plants. Legal battles over patent violations involving Percy Schmeiser, Hugh Bowman, and other farmers against agribusiness giant Monsanto demonstrate how the norms of patent law often conflict with farmer practice. Who owns the crop when patented seed is inadvertently introduced to a field? Should damages be paid if the crop is no longer marketable or seed no longer useable? Some legal scholars contend that common law concepts of nuisance or trespass can be used to settle unintentional movement of transgenic seed into a farmer's field. Others have argued that if seed is not being used for the trait that is patented, for example, if herbicides are not used on herbicide-tolerant seeds, that use does not constitute a patent violation. In secondary seed markets, where farmers obtain seed from leftover grain, should a patent be recognized as abandoned if seed companies do not set up systems at grain elevators to separate common from patented seed? Or are all users of common grain at risk of patent violations, and should they use the seed admixture? Also related to the issue of protecting patented seed is the use of genetic use restriction technology, colloquially known as terminator gene technology.

Farmworkers and Chemical Use

One important benefit from the use of insect-resistant crops is the possibility that it could reduce farmworker exposures to pesticides. There has been some research that suggests that farmworker poisonings in China's cotton fields were reduced with the adoption of *Bt* cotton. But more longitudinal studies are needed to ensure that short-term chemical reductions are not offset by increased chemical use in the long run if *Bt* cotton becomes ineffective or chemicals are required to eliminate secondary pests.

Privatization of University Research

Perhaps the most significant impact from the development of transgenic crops is the loss of public plant breeding institutions (Busch et al. 1991; Lacy 2000). As the high-tech costs of r-DNA technologies increase the budgetary needs of plant breeders, there are increasingly partnerships between public institutions and private corporations. While many public plant breeding institutions have historically provided seeds to farmers (Kloppenburg 2004), the entry of private companies and the need to develop patents into university research may make such arrangements an anachronism.

The Extent of Transgenic Crops Today and Future Deployments

Today transgenic crops cover approximately 400 million acres as of 2011 according to the annual

numbers posted by the International Service for the Acquisition of Agri-Biotech Applications. The most widespread transgenic crops are engineered for herbicide tolerance and for insect resistance – over 98 % – though other traits are becoming increasingly more common. The most widespread crop types are soy, corn, canola, and cotton. Other crops grown commercially include papaya. Wheat and rice, two of the world's largest crops in terms of global acreage, still remain in research and development as no transgenic seeds of these crops are commercially available as of 2012.

Controversies on the horizon include the development of crops that are resistant to more toxic kinds of agrochemicals such as 2, 4 D. One concern is that weeds may become resistant to the chemicals used on first-generation crops and be replaced by transgenic crops tolerant of more toxic chemicals. Many new transgenic crops are being grown for biofuels particularly for novel algae and cellulosic feedstocks. Many emerging biocatalysts and yeasts are genetically engineered as well. A number of crops designed for industrial traits are also grown as bioplastic feedstocks. The use of pharmaceutical, fuel, and industrial crops will also continue to present challenges to pollen and seed management as these kinds of crops may cross-pollinate with food crops and introduce genes coding for boutique chemicals, posing threats to food safety. For this reason some advocate the ban the production of these chemicals in food crops or crops that can cross-pollinate with food crops.

The global land area dedicated to transgenic crops will continue to grow so long as they do not impact grower sales and if social resistance can be overcome. The challenge for the industry will be to demonstrate that the benefits to growers outweigh any additional seed technology use fees and convince the public of their safety. For scholars looking to understand the implications of transgenic crops on society and the environment, there is now a track record of widespread crop adoption to evaluate. Much of the research to date has been on questions related to r-DNA transfer techniques and productivity of transgenic crops. But there is a growing literature reflecting on the ethical, biosafety, and social implications from transgenic crops that can aid future inquiries.

Summary

This essay explores the evolution of transgenic crops, their ecological risks, and their political economies. The introduction explains what transgenic crops are, how they are made, and how they are regulated. The section on ecological risk explores the various categories of risk that biosafety scientists and ecologists have identified to be related to the release of transgenic crops into the environment. The final section describes future directions and ethical challenges for transgenic crops.

Cross-References

- ▶ Biopharming
- ▶ Biofuels: Ethical Aspects
- ▶ Cross-Contamination of Crops in Horticulture
- ▶ EU Regulatory Conflicts over GM Food
- ▶ Food Labeling
- ▶ GMO Food Labeling
- ▶ Herbicide-Resistant Crops
- ▶ The 2003–2006 WTO GMO Dispute: Implications for the SPS Agreement

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