

Moral confidence in agriculture

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Abstract. Those engaged in agriculture possess a definite but unexamined moral confidence or certainty about the correctness of what they do. This paper examines the origins of that confidence and questions its continued validity. The paper argues that those engaged in agriculture are morally confident about the rightness of their activity. The basis of the moral confidence is not obvious to those who possess it or to the public. In fact, the moral confidence that pervades agricultural practice is potentially harmful because it is unexamined. Suggestions for expanding agriculture's moral scope are made to approach the question of where moral values originate, and what are, or ought to be, the moral standards for agriculture in our post-industrial, information-age society. Part of expanding agriculture's moral scope will be giving up some of our hubris about the goodness of our culture and its agriculture. The paper advocates analysis of what it is about our agriculture and our society that thwarts or limits our aspirations for agriculture and needs modification. We must strive to nourish and strengthen those features of our agriculture that are beneficial and change those that are not. To fit ourselves to this task, we must be sufficiently confident to study ourselves and our institutions and dedicated to the task of modifying both.

Key words: agricultural practice, moral scope, moral values

Introduction

Ethics is about what one ought to do. Ethical analysis involves analysis of what one does, and attempts to provide reasons to show why one's actions are the right thing to do. It must probe stated and unstated goals and the values presupposed by them. A good analysis will try to develop a rational way of deciding how an individual ought to live and how a profession ought to proceed toward realization of its goals (Singer, 1994). Such an analysis might lead one toward a set of 'rules, principles, or ways of thinking that guide, or claim authority to guide, the actions of a particular group' (Singer, 1994). It will make explicit what is valued and may lead to action on those values.

This paper argues that those engaged in agriculture, whether practitioners, research scientists, extension agents, technology developers or technology suppliers, share an unexamined moral confidence about the goodness of their activity. The paper also argues that the basis of that moral confidence is not obvious to those who have it or to those not involved in, but who may be curious about, agriculture and its technology. In fact, the moral confidence that pervades agricultural practice is potentially harmful because it is unexamined by most of its practitioners.

Perhaps the best that can be sought in the moral realm is not absolute certainty but the best available option, which

many defenders of agricultural practice appear to believe is what we now have. We live in a world of moral ambiguity, but it is also a world where some moral values seem to have been accepted by all cultures (Kroeber and Kluckhohn, 1952). No culture tolerates indiscriminate, harmful lying, stealing or violence; incest is universally forbidden; no culture values suffering as a desirable goal; all cultures have death rituals; protecting children is universally regarded as good in civilized societies; and all societies despise cowardice and applaud bravery.

Even though there is moral certainty on these matters among cultures, that same degree of moral certainty may not be desirable or achievable for the world's major environmental interaction, i.e., agriculture. Because absolute moral certainty and the consequent lack of moral debate stifle discussion and progress, debate about what agriculture ought to do, rather than agreement on what agriculture must do or be, is preferred. Debate about morality should reveal the foundational theories and values and thus provide a guide for action. Moral theories are the, often invisible, foundation on which our judgments rest. Exploration of foundational theories will expose them to debate and discussion. When one understands the foundation of moral judgments, that understanding ought to lead to more confident judgments, but foundational values are not the answers to problems. They are ways to assist in constructing the personal, social and cultural world we inhabit. Exploration of the moral confidence posited for agriculture will not reveal a single guiding principle, the use of which will solve all moral dilemmas in agriculture. It will reveal several principles that are used in the morally ambiguous, pluralistic world in which agriculture is practiced.

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The benefits and costs of modern agriculture

Hugh Sidey, a contributing editor for Time magazine, delivered the 1998 Henry A. Wallace lecture to the Wallace Institute for Alternative Agriculture on 'The greatest story never told: the food miracle in America'. Sidey (1998) quotes Dumas Malone, a biographer of Thomas Jefferson, who said 'The greatness of this country was rooted in the fact that a single farmer could produce an abundance of food the likes of which the world had never seen or imagined, and so free the energies of countless others to do other things'.

US production agriculture: envy of the world

So much of recorded history is about the struggle of individuals and families to feed themselves. That changed dramatically in this country. Sidey contends that the story of the productivity and success of American agriculture is the greatest story never told. Few, if any, other segments of the American scientific-technological enterprise have amassed such an impressive record of predictive, explanatory and manipulative success over many years. American agriculture has been a productive marvel and is envied by many other societies where hunger rather than abundance dominates. Examination of yield records for nine major crops [corn (*Zea mays* L.), cotton (*Gossypium hirsutum* L.), peanut (*Arachis hypogaea* L.), potato (*Solanum tuberosum* L.), rice (*Oryza sativa* L.), sorghum (*Sorghum bicolor* (L.) Moench), soybean (*Glycine max* (L.) Merr.), tomato (*Lycopersicon esculentum*) and wheat (*Triticum aestivum* L.)] in the US during the 20th century shows that yield increases have varied from two- to sevenfold (Warren, 1998). No yields decreased. Scientific advances that led to these steady yield increases include development of higher-yielding cultivars, synthetic fertilizers, improved pest control, better soil management and mechanization. Warren (1998) suggested that the rate of yield increase does not appear to be slowing. Avery (1997) points out that without the yield increases that have occurred since 1960, the world would now require an additional 10 to 12 million square miles (roughly the land area of the US, the European Union countries and Brazil combined) for agriculture to achieve present levels of food production. Avery (1997) claims that modern high-yield agriculture is not one of the world's problems but rather the solution to providing sufficient food for all, sufficient land for wildlife and protecting the environment.

Questions and costs of social and environmental sustainability

American agricultural producers are proud of these achievements. Our food production system, including growing, distributing, processing and preparation, are now all part of a large, vertically integrated commercial system (Blatz, 1995). The family farm as an independent, self-supporting entity and a cultural icon is dying. The agricultural legacy that came from family farms and is the heart of the Jeffersonian agrarian tradition, that few Americans now experience but most value, no longer serves as an immediate, experiential source of societal

values or moral sustenance. The abundant production that all involved in agriculture value highly is, in the view of Berry (1977), illusory, because 'it does not safeguard its producers, and in American agriculture it is now virtually the accepted rule that abundance will destroy its producers' and the land base. The evidence supports Berry's prediction. Stauber et al. (1995) provide census data that verify farm population decline from 1940 to 1990 in Iowa (72%), Minnesota (77%), Montana (74%) and North Dakota (82%). Stauber et al. (1995) also show that as farm population declined, farmland remained nearly constant because farm size increased in Iowa (88%), Minnesota (89%), Montana (121%) and North Dakota (123%). These trends were foreseen by Goldschmidt in 1947 and verified in his recent work (1998). He claims that 'large-scale, labor intensive, technologically innovative production made industrial farming possible but not necessary; social policies were needed for that'. The policies that made the decline of family farms inevitable were devised in a system where 'social relationships were money-based and social standing was money-driven'. The singular goal of the US agricultural system was 'to gain wealth, without the least concern for the welfare of those whose lives' were being destroyed. There was also no concern, or, at best, minimal concern, for the effects of the money-driven system on the environment, on which agriculture and life are dependent. The monetary rewards of the agricultural system are handsome for the survivors—profit. The social rewards of belonging to a caring community, the spiritual satisfaction of serving a larger public purpose, and the communities themselves and the businesses that they support have been sacrificed to the bottom line (Goldschmidt, 1998). These losses are the social costs of technological improvements in agriculture. They are neither necessary nor desirable. Goldschmidt (1998) argues that these losses are not trivial and should not be thought of as simply the inevitable price of progress. He argues that the changes in agriculture have made a big, and largely unnoticed, difference to our nation.

The highly productive agriculture that Sidey (1998) applauds, is a business like any other business, where producers seek high production at low cost. Each strives to adopt new technology rapidly to stay ahead of other producers and gain a competitive edge that leads to greater profit. The idea is not to work out ways for all to thrive, but to gain as much of the market and profit as possible so others cannot (Blatz, 1995). If a neighboring farmer's autonomy or survival is threatened by this system, it is not viewed as a systemic problem but as the neighbor's failure to adapt and survive. Agriculture has become industrialized not only in terms of its size and methods of operation, but in the values its practitioners espouse. The guiding purpose of each practitioner is to produce as much as possible at the lowest cost of capital and labor to generate maximum profit (Blatz, 1995). Much rhetoric is heard about the necessity and obligation of American farmers to feed the world. We also hear that keeping food costs low for consumers is a requirement of our system, in spite of the fact that both of these goods lead to the moral wrong that Berry (1977) deplores, the destruction of producers who care for each other and the destruction of the land. It is not

unreasonable to claim (Berry, 1977; Blatz, 1995; Jackson, 1980) that the highly productive American agricultural system is environmentally unsustainable at present levels of production.

At this point, many readers will assume that this paper will plead for a return to small-scale farming and for support of the possibly false claim of the moral virtue of family farmers and farming communities; and that the author, a Luddite (early 19th-century English workmen who advocated destruction of labor-saving machinery in protest for saving their jobs), wants to abandon the great achievements of scientific agriculture. On the contrary, the paper will suggest that the quantitative claims of US agricultural abundance are true. Sidey (1998) is correct. But blind acceptance of that fact may lead societies to assume that agricultural abundance is assured. No society can assume its agricultural abundance is assured, and the system that produces food should not be regarded as similar to a factory that, with the right inputs, can manufacture abundance at will (Blatz, 1995). Food is essential to life, but it comes from the land, not from money (Berry, 1999). Therefore the land that produces food is essential. If the foundational values of the food production system do not place protection of the land, the source of agricultural abundance, as an essential part of human life, and if food is regarded as another industrial commodity that can be purchased by those with money, then the ethics of the system ought to be a subject of societal concern.

It is common knowledge that the poor are hungry, even in the richest countries. It is a problem not amenable to an easy technical fix or social algorithm that will lead to its solution everywhere or quickly. In face of the undeniable success of agriculture in the developed world, its practitioners should at least ask the qualitative question about whether hunger is a problem of insufficient production, inequitable distribution or irresponsible consumption by the rich (Thompson, 1989). Many, certainly not all, agriculturalists often see more production as the solution, because they consider hunger to be only a problem of insufficient production (Avery, 1997). The other possibilities (inequitable distribution of abundance and overconsumption by the rich) are not considered or are readily dismissed.

As agriculture's productive capabilities have been enhanced by science-based technological discoveries, it is not surprising that the pursuit of production has conflicted with other societal values (Thompson, 1989). Any technology has effects in addition to those intended. For example, air in urban areas is polluted partially because of automotive exhaust: an unplanned effect. Similarly, agricultural technologies have undesired and often unanticipated effects (Thompson, 1989). Nitrates from fertilizer increase production and pollute water. New cropping techniques may expose soil to excessive erosion. Monoculture agriculture leads to loss of species diversity. Many technologies save labor, but what happens to the people whose jobs are lost is not considered. Pesticides increase production by limiting pest damage, but they pollute soil, air and water, and harm non-target species. New agricultural technologies have reduced the risk of production failure for producers but increased the risk of harm to other species, including humans. Advances in medicine and environmental science have made all of us more cognizant of

risks that may have been unknown in the past (Thompson, 1989). Agricultural technology has always exposed people to risk. In the past most of the risk was borne by the user of the technology. Now many risks of agricultural technology are known, and it is known that they are borne by others. Technology developers, sellers, regulators and users, in their moral confidence, have not secured, or even considered, the importance of securing the public's consent to use production aids that expose people to involuntary risk. Thompson (1989) says:

Agricultural producers and those who support them with technology may have been seduced into thinking that, so long as they increased food availability, they were exempt from the constant process of negotiating and renegotiating the moral bargain that is at the foundations of the modern democratic state. Democratic societies will not entrust their water, their diets, or their natural resources blindly into the hands of farmers, agribusiness firms, and agricultural scientists. Agricultural producers must participate in the dialogue that leads to social learning and social consensus about risks, and they must be willing to contribute the time and resources needed to understand the positions of their fellow citizens, and to make articulate statements of their own position.

For most non-agricultural segments of society, these are not new demands. For agriculture they are. Agriculture has been so confident of its narrow pursuit of increased production that its practitioners have frequently failed to listen to, and understand, the position of others (e.g., environmental groups, modern agrarians, organic practitioners). Agriculturalists have not taken the time to articulate any value position other than the value of production and have not articulated the reasons that value ought to retain its primacy. Unintended consequences of agricultural technology are never just scientific or production questions. They always include a moral dimension that demands thought about fundamental values and the ethical foundation of those values.

Goals for Agriculture

Production of abundant food and fiber must remain a goal of agriculture. If agriculture does not produce, it fails to fulfill an essential goal of interest to all members of any society. When one asks what agriculture's goals ought to be, production must remain near the top of any list. However, because we live in a culturally pluralistic world, we are compelled to ask what other goals ought to be considered by agriculture, and when and why one or more of these may take precedence over production. Without describing all possible or desirable goals for agriculture, it is possible, for purposes of discussion, to divide goals into two groups: social and environmental.

Social goals for agriculture

Proper social goals for agriculture were dealt with by Aiken (1984). He, like Day (1978), ranked profitable production as the primary goal of agriculture, a notion with which nearly all

agricultural practitioners would agree. However, Aiken (1984) then suggested sustainable production, environmentally safe production, meeting human needs and contributing to a just social order, as four additional goals, which may often be of greater moral importance than profitable production. This array diverges from the dominant agricultural view, and crucially that of Day (1978). Few agricultural voices speak of achieving a just social order. There is no inherent objection to a just social order, but it is not an agricultural goal. Thompson's analysis (Thompson, 1986) of Aiken's article (Aiken, 1984) ascribes the ranking to a straightforward principle for ordering of duties or rights: 'The principle would hold that one right or duty is more basic than another whenever the moral benefits associated with the second can be extended to all people only after the first has been protected or fulfilled.' Thus, 'a right to life is more basic than a right to an education'. One presumes that education is desired only by the living and that they must be fed, so the agricultural goal of production of sufficient food is not unreasonable.

Agriculturalists begin to diverge from others when discussion of sustainability occurs. Many in agriculture see sustainability as achievable by modification of the present system, and do not countenance abandoning the system that has been so successful. Achieving sustainability is regarded as a scientific matter. However, because agriculture is the largest and most widespread human interaction with the environment, achieving it also has social and ecological effects. Sustainability can be achieved best when the discussion includes consumers and producers (Thompson, 1986) and considers environmental effects. Thus, achieving a sustainable agricultural system is a societal not just an agricultural responsibility.

The agricultural market, as part of the greater market of all goods and services, distributes agricultural supplies to producers and produce to consumers. Markets are very powerful mechanisms, but they often are not just. If they were just, then America would not have hungry people. Those who emphasize the primacy of production must recognize the connection between what is produced, the market that distributes it and a just social system.

Thompson (1986) acknowledges the persistence of the agrarian ideal in the American mind. As family farms and rural communities disappear, the virtues they instilled in past generations (love thy neighbor, be kind to animals, help those in need, respect the family, respect your elders, etc.) are still valued by our society. Churches and schools try to teach these virtues, although schools are frequently chastised for teaching values. I suggest that most parents want children to learn what they regard as traditional values and they mourn their loss. We cannot figure out how or where to teach what used to be obtained by osmosis from the culture. Thompson (1986) suggests that one way to encourage these values is to have them 'prominently displayed in the social purpose of an economically central and vital activity such as agriculture'. To accomplish this, those in agriculture are going to have to abandon the singular pursuit of production as their only goal and incorporate the conscious pursuit of social goals as part of the practice of agriculture. This necessitates debating what the right goals are.

Environmental goals for agriculture

Environmental goals for agriculture should not be, and perhaps cannot be, divorced from social goals. Sustainability is regarded by those in agriculture as primarily a production and secondarily as an environmental goal, but others see it as a social goal. The view depends on what one wants to sustain. In agriculture, to sustain usually means to protect the productive resource base (soil and, more importantly, soil quality, water and gene pools) and maintain production. Others will agree that protecting these is important, but might rank protecting them below sustaining environmental quality, family farms, rural life, small businesses that serve agriculture, small communities, and a way of life that can only be achieved on the farm. This is not merely a semantic debate. It goes to the heart of what agriculture ought to do; what values it ought to espouse. Leopold (1947) addresses the essential issue regarding land when he suggests that the last great moral divide is between those who regard land as property that they own and can do with as they please and those who see land as part of the community to which they belong. Leopold (1947) based his land ethic on the absolute human need for community. We humans want to belong. In Leopold's view we need to protect the land so there will be a community left to which we can belong. Agriculture has a major responsibility because it has the potential to care for, or harm, so much land. This is a different view from protecting land only because it is a productive resource. Land, as Leopold (1947) claimed, is the basis of life. It is the necessary resource for a productive and profitable agriculture (Thompson, 1988). Without the land there will be no agriculture, so land must be regarded as something more than other productive resources (e.g., fertilizer, machines, irrigation water, pesticides or seed). Its importance to agriculture should not be thought of only in monetary terms. The ecological imperative of interconnectedness must be stressed more than a simple production ethic allows. To harm or destroy the land is not just a matter of profit and loss, because such actions destroy that which is essential to life, and that certainly raises a moral question.

The challenge and problem of social and environmental goals for agriculture are that they involve values as the defining characteristic of the questions raised. It is generally not recognized in agricultural science that values are not peripheral to the science and technology but are foundational (Capra, 1996). Scientists know they are responsible for the scientific integrity of their work and for its intellectual contribution. They do not as readily assume responsibility for moral aspects of their work, but it can be argued that they should.

Biotechnology, which has captured the university, State, and Federal research systems, is a good example. Just as pesticides were from the 1950s through the 1970s (Cate and Hinkle, 1993), biotechnology is now in its ascendancy. In the earlier era, massive resources were turned toward learning how to use pesticides to make agriculture more productive. Now the same institutions are turning from the talents of agronomists, chemists, entomologists, pathologists, toxicologists and weed scientists to the talents of molecular biologists and biochemists. In the first era, pest-management problems were solved through chemistry,

and now genetic engineering (genomics) is becoming dominant (Cate and Hinkle, 1993). However, agricultural systems are not products to be discovered, wrapped in a shiny package and sold. They are continually evolving toward changing goals and objectives. Effective management of any pest is fundamentally an exercise in applied ecology (Cate and Hinkle, 1993), which is not achieved by one more product from the genetic engineer or chemist. Neither group has the education, nor often the inclination, to address the ecological, social or moral questions that arise. The true social and environmental costs of any technology are rarely measured by the developer. They are not part of most profit and loss calculations, and many such costs are not even known, although all are paid by someone. Pesticide developers were alerted to ecological, social and moral questions by many authors (Carson, 1962; Murray, 1994; Perkins, 1982; Van Den Bosch, 1978; Wright, 1990). The current public controversy about genetically modified organisms has a familiar ring.

Anyone can dismiss any criticism of technology by saying 'Well, its not true for me'. This makes our personal beliefs, our assumptions, absolutely secure, and then there is no reason for beginning the difficult task of examining them (Melchert, 1995, p. 63). How any idea strikes us, especially one that is critical of our activity or profession, is not a reliable guide to how we ought to respond. Our first reaction, our intuition, may be mistaken. It is best to know and consider the arguments that support the idea or criticism. In science the data or theory that best explains the observations usually win. In ethics the best arguments win. It is indeed unwise to avoid the temptation to ignore good arguments that disagree with our assumptions. We may often find ourselves finding the truth we want; not by inventing it, but by allowing the emergence of only the part of the whole truth we want to hear (Barrow, 1995). When agriculturalists think of the future of agriculture, it is important that they recognize that their vision of the future (their truth) affects the decisions they make (Harman, 1976) and how they practice or recommend agriculture be practiced. The research and teaching we do now involves a view of a future we expect, desire or fear (Harman, 1976). If our view of the future changes, the decisions we make each day change. Our view moves from what is, to how we would like things to be, to what we perceive to be good. We then move quickly to a description of what we ought to do to achieve the good we desire. It is in this transition that we depart from the domain of science and enter the domain of evaluation, from which an ethic can be developed (Rolston, 1975). If the good we desire is inspiring, it will impel us and others to action. If our view is uninspiring or wrong, there may be no common image of what is worth striving for. Then a discipline or a profession will decline because it lacks an inspiring vision and adequate motivation.

Most of my colleagues in Land Grant University Colleges of Agriculture are confident that their research and teaching are morally correct. They defend their objective approach to science and their objectivity in defending agriculture and agricultural research against emotional attacks from people who don't understand either. I often hear 'People should not complain about our agricultural system with their mouth full' a conceit

that dismisses the complaint without hearing it. The scientist's frequent appeal to the value of objectivity in science is evidence of a lack of awareness of the inevitable subjectivity of science. Niels Bohr, a pioneer in quantum mechanics, suggested the scientifically heretical idea that the mental decisions of the investigator influenced the outcome of an experiment. His point was that observers create the reality observed (Shlain, 1998). This does not mean that there is no such thing as objectivity, or that all of science has to be discarded. It does mean that science has 'to admit its nemesis—subjectivity—into its calculations'. No science, including agricultural science, is immune to the nemesis of subjectivity. For example, a study done of the faculty of the college of agriculture at Washington State University (Beus and Dunlap, 1992) showed that faculty members were slightly more in favor of conventional agriculture than farmers statewide were. They were slightly less conventional than proponents of conventional agriculture and far more conventional than known proponents of alternative agriculture. Beus and Dunlap (1992) also found that women, younger faculty, and faculty not raised on farms were somewhat more likely to endorse the alternative agriculture paradigm than their counterparts. These faculty groups have made a transition from the scientific to the ethical realm, perhaps without knowing they have changed. They moved quickly and easily from observation of what is, to knowing that it is good and ought to continue to occur (Rolston, 1975). The supporters of the status quo of conventional agricultural research direction and practice are morally confident of the rightness of their unexamined position.

An additional example is provided by a series of articles in the *High Country News*. Jones (1994) accuses land grant universities of having 'elevated efficiency and scale of production above all other values'. Their efforts have nearly eliminated the original land grant constituency of small family farms because rural people and the environment have not been central concerns. Jones (1994) suggests that this is because the faculty and administration are tightly connected with traditional rural interests, and faculty have lacked the freedom and encouragement to implement new ideas. She laments the lack of creative ideas flowing from land grant universities about such rural problems as land use planning in rural areas, grazing or logging. Land grant university faculty, in Jones' view, have handed over to others the intellectual oversight of major agricultural issues. As apologists for exploitive industries, land grant universities 'usually value the economic interests they serve above the public interest' (Wuerthner, 1994). Jones (1994) concluded that the institutions have been challenged and 'in their own, ponderous way, they are responding to that challenge'. As the Washington State University study (Beus and Dunlap, 1992) shows, younger faculty are aware of agriculture's problems and are dealing with them.

Expanding Agriculture's Moral Scope

To suggest expanding agriculture's moral scope is not to suggest that agriculture and its practitioners lack moral standards, or that all past achievements and values must be abandoned. It also does not suggest that this paper is about to

reveal a new, correct set of moral standards for agriculture that will solve the problems. Expanding the moral scope includes asking where moral values come from, and what are, or ought to be, the sources of moral values for agriculture.

The utilitarian standard

Agricultural research and agricultural policy have had an identifiable utilitarian ethical standard since inception (Thompson et al., 1991b). The clear emphasis on increasing production and reducing production cost to increase profit identifies the utilitarian ethical standard—to provide the greatest good for the greatest number—that has been implicit in agriculture (Thompson et al., 1991b). This standard, accepted and largely unexamined within agriculture, has assumed that increasing production and reducing cost will optimize the social benefit of agriculture. There has been almost no dialogue within agriculture about the correctness of the standard for all agricultural issues. One result has been that many scientists, ignorant of their own social context and all results of their technology, have, without questioning, accepted the loss of small farmers and rural communities as part of the necessary cost of achieving the greater goal of maintaining a cheap food supply (Stout and Thompson, 1991). The utilitarian standard is evaluated in terms of outcomes, and agriculturalists use easily observed outcomes to evaluate what they do. They measure total production, crop yield and profit (which, according to the USDA as reported in the New York Times (November 28, 1999), has decreased by 38% since 1997). They conclude that they are acting morally because good results have and, it is assumed, will continue to follow increased production. The morality of an act according to the utilitarian standard lies in its consequences, but it does not focus on intentions, as other moral standards (e.g., Deontological ethics) do. Thus, the cry for justice by the poor, or the pleas of those concerned about loss of environmental quality, are overwhelmed by the achievement of increased production and are often regarded as simply pusillanimous appeals.

Utilitarian thinking allows individual research scientists to believe that each research program is ethically correct because of its perceived good effects. Utilitarian standards are able to assign moral responsibility to any agricultural program or research area without considering the entire system (Thompson et al., 1991a). Agricultural scientists often see agriculture as a system of separable goods (e.g., seeds, bags of fertilizer, liters of pesticide, etc.) rather than as a unified system. This view is a result of our reductionist heritage. Agriculturalists have learned to deal with highly divisible technologies (separable goods) rather than with non-divisible systems (e.g., tractors, dams, irrigation systems) that usually demand a more holistic perspective.

None of the foregoing should be interpreted as an attack on the personal moral standards of individual scientists. I assume that anyone who has a research or teaching position knows the ethical norms (Holt, 1997). But as Ruttan (1991) has said, 'agricultural scientists have been reluctant revolutionaries'. They have wanted to change agricultural practice and results but have neglected the revolutionary effects of their efforts on society. They have believed that their work could be reduced to their

little piece of agriculture, and then added without changing the whole system. Increasing production was the goal, and it was believed that could be accomplished without creating, or at least without out being bothered by the creation of other, revolutionary effects (Ruttan, 1991). The ethical standards Holt (1997) assumes operated only within the immediate confines of the scientific enterprise; all else was external and could, therefore, be neglected. Agricultural research is done in a morally narrow and ambiguous context, with little recognition of either.

The relevance of the Western agricultural model

The shift in the developed world, after the Second World War, to intensive farming systems with modern chemical and energy technology, led to major increases in plant and animal production. These systems maximized production through specialization, increased scale of production units, minimization of labor requirements and maximum use of technological inputs. They allowed Western nations to fulfill more adequately than any societies have before what Ponting (1991) calls 'the most important task in all human history': to find a way of extracting from the ecosystem enough resources to maintain life. The concomitant problem, in Ponting's view, is that human societies have had difficulty balancing their 'various demands against the ability of ecosystems to withstand the resulting pressures' (Ponting, 1991). Countries that employ intensive agricultural systems have met the needs and many of the wants of their citizens, a high value; but, in the view of many, they have made excessive, unsustainable demands on the ecosystem, which was less valued. We in the West use this story of success (Sidey, 1998) in meeting human needs to support our belief in the universal suitability of intensive agriculture.

Huntington (1996) proposes that 'this belief is expressed both descriptively and normatively'. Descriptively, agriculturalists believe that all societies want to adopt Western agricultural techniques to increase production. We also believe that others are willing to accept Western institutions and practices to achieve these good ends. If they seem 'not to have that desire and to be committed to their own traditional values, they are victims of a "false consciousness", e.g., failure to adopt genetically modified seed. Normatively, the Western agriculturalist proposes that all societies ought to adopt our methods, institutions and the associated values, because they embody 'the highest most enlightened, most liberal, most rational, most modern, and most civilized thinking of humankind'. Huntington (1996) says that belief in the universality of Western values and culture suffers from three problems: 'it is false, it is immoral, and it is dangerous'. In looking at other cultures with Western lenses and assumptions about what is good, we make the further error of assuming we are learning about what other people's conceptions of the world are, rather than observing how the world really is. Only we understand how the world really is and, therefore, we assume we know how agriculture ought to be practiced. Thus, part of expanding agriculture's moral scope will be to give up some of our hubris about the moral correctness and value of our culture and its agriculture.

Bottom-line thinking

Goldschmidt (1998) claims that the singular goal or 'bottom-line' of our agricultural system was 'to gain wealth, without the least concern for the welfare of those whose lives' were being destroyed. There was little thought about the effects of the money-driven system on the environment. The social rewards of belonging to a caring community, the spiritual satisfaction of serving a larger public purpose, and the communities themselves and the businesses that they need and support have been sacrificed to the bottom line (Goldschmidt, 1998). Convenience, ready availability and low cost are not the only things that matter. There are other things that are important, such as the presence of local businesses, friendliness, service, the essentiality of business to any community's survival and local employment opportunities, and if large-scale farming eliminates or harms these things, then perhaps we should think again about the importance of the bottom line. The losses Goldschmidt (1998) speaks of are the social costs of technological changes in agriculture. In agriculture, bottom-line thinking is the norm and may be part of the hubris we must reconsider if we are serious about our communities, and our agriculture.

Sustainability

As we reconsider our hubris and the bottom line, there will inevitably be conflicting interests that arise from opposing world views, incompatible analyses based on different views of the nature of the problem, rising material expectations and different views of sustainability (Allen, 1993). Few oppose sustainability, but there are many different views of what ought to be sustained. Expanding agriculture's moral scope requires that we give up the common two-track agricultural defense used when issues ranging from pesticides to sustainability and loss of small farms to animal treatment are raised. The first track has been to deny that the suggested problem exists (e.g., pesticides don't harm people or wildlife, people who use them incorrectly do; and the loss of small farms is unfortunate but it is an economic not an agricultural matter). The second defense has been to explain, calmly but forcefully, that the reforms advocated (e.g., reductions in pesticide use, maintenance of small farms, humane animal treatment) will make food too expensive and diminish or eliminate the favorable balance of trade the US enjoys from its agricultural surplus. The argument claims that the public will not tolerate higher food costs to save a few small, inefficient farms; the reforms would surely diminish or eliminate the trade surplus; and neither is politically acceptable.

Expanding agriculture's moral scope demands considering challenging views of agricultural practice. For example, Ludwig et al. (1993) posit a 'remarkable consistency in the history of resource exploitation: resources are inevitably over exploited, often to the point of collapse or extinction'. The view is shared by Berry (1977), Jackson (1980), Ponting (1991) and other commentators on modern agriculture. Ludwig et al. (1993) suggest that wealth, or the prospect of wealth, generates social and political power that is used to promote unlimited exploitation of a resource. Exploitation of land and farm communities are good examples. Scientific understanding is hampered by lack

of controls, and the natural variability that is expressed on a large scale makes detection of effects very difficult. The complexity of large agricultural systems encourages a reductionist approach that precludes observation of large-scale effects. In the view of Ludwig et al. (1993), the long-term outcome is a heavily subsidized industry that overharvests the resource. That is an accurate description of modern agricultural practice. Ludwig et al. (1993) suggest that sustainable exploitation is always preceded by overexploitation. If they are correct, then agricultural sustainability will not be achieved by adjustments to the present system. Experience over 3000 years, documented by Ponting (1991) and cited by Ludwig et al. (1993), suggests that good scientific understanding of exploitation, its causes and the appropriate prophylactic measures is not sufficient to prevent destruction of the vital resource. It is a sobering commentary that must be considered and addressed by the agricultural community and the larger society in the quest for sustainability.

Kirschenmann and Youngberg (1997) understand the complexity of agriculture's striving for sustainability. They acknowledge that those involved in the discussion must consider biotechnology, continuing agricultural industrialization, public concern about food quality and safety, pesticide use and abuse, rural community deterioration, worker welfare, international trade, global competitiveness, farmland preservation, wildlife and habitat protection, public funding of agricultural research and extension programs, natural resource conservation, and how to identify, and somehow include, what have been external agricultural costs. None of these are simple issues. Kirschenmann and Youngberg (1997) believe that agriculture will develop along two paths. The first will be 'larger, highly specialized, vertically integrated farms' with efficient input management and precision farming techniques. The second will be 'small, intensively managed, diversified operations' with low input and an emphasis on sustainability. Many of the latter will emphasize organic production methods (see also den Hond et al., 1999). The two paths are not necessarily heading in opposite directions and should not be viewed as conflicting agricultural futures. Kirschenmann and Youngberg (1997) forecast that biotechnology will be the primary force that shapes tomorrow's agriculture, and that water quality will be the major environmental issue. There will be increased reliance on export markets to sustain grower profitability, while the primary concern of consumers will be food safety. There will be a resurgence of rural communities near cities but a continued, slow demise of isolated rural communities. Development of sustainable agriculture will be emphasized, but there will be a decreasing level of public support for agricultural research in publicly supported agricultural institutions.

Conclusions

Agricultural scientists share with other scientists a passion for the truth. We hold the Socratic belief that the search for the truth is the very best way of life (Melchert, 1995, p. 452). We err when we engage in distorting the truth by hiding it from ourselves or pretending that it is other than what we know it is. We tend toward that mistake when we think that what has no

price has no value, that what cannot be sold is not real, and that the only way to make something actual is to place it on the market (Merton, 1960). Merton tells us that bottom-line thinking cannot answer all questions. Small-scale farmers may be necessary to care for the land, our most precious resource; small communities may be important to our national and personal character. Neither is susceptible to pure economic analysis. Merton (1960) also deplores in strong, environmental language 'constructing a world outside the world, against the world, a world of mechanical fictions which condemn nature and seek only to use it up, thus preventing it from renewing itself and man'. Strong environmental criticism is not foreign to agriculture, but it is not valued as a means to seek the truth about agriculture.

As agriculture searches for an ethical standard, while being compelled to deal with criticism of its apparent bottom-line standard and the environmental problems that have followed modern agricultural practices, one must ask, as Holt (1997) has, 'How do we find our way?' Holt's answer comes in the context of his concern that 'if there are no revealed truths, immutable principles, or even practical, utilitarian generalities, such as the importance of honesty and integrity, that apply to science, how can we determine what constitutes ethical behavior?' When there are no points of reference, no moral certainty, in 'a sea of uncertainty', how can one make ethical judgments? Holt's answer is bottom-line thinking and apparently utilitarian. He argues that in the global marketplace of which agriculture is now a part, 'the question of whether it is ethical to conduct research on certain subjects, including products or services that might do harm to the environment or make food unsafe, e.g., chemicals, is moot. The need for effective pest control will be so great that no options can be precluded before research reveals the potentials.' He goes on to suggest that research on technology that might cause dislocations (a locution that avoids the unpleasant connotation of suffering) of small farmers is also moot. Market-oriented economies and diminished government interference in agriculture will 'assure that less efficient and productive practitioners will be dislocated'. Holt's (1997) concluding message for agricultural scientists is quoted in full below.

I think there is an important message for agronomists and other agricultural researchers and research administrators in this analysis of driving forces. It says that as you plan and implement research on the environment, natural resources, safety, social issues, or other themes, keep it within the context of quality, productivity, and efficiency. In order for any technology or information generated in that research to find fruition in practice, it will have to contribute to quality, productivity, or efficiency or at least not detract from them.

Holt (1997) believes that the 'broadly focused ethical debates of the past' are also moot. His view is consistent with Day's view that agriculture has only one proper goal: profitable production (Day, 1978). This view ignores the necessity of balancing the often conflicting goals of profitable production and environmental quality, or the loss of small farms and the rise of

corporate agriculture. Agriculture's continuing problems with pollution by pesticides and nitrates, animal welfare, soil erosion, loss of genetic diversity, genetic modification of plants and animals, and food safety are all swept under the carpet of profitable production that makes all other arguments moot. To be moot is, first, to be open to discussion or debate, to be debatable, and, second, to be so hypothetical as to be meaningless. It is the latter definition that Holt (1997) uses, and I fear it is the view shared by most in agriculture. It is a view that claims 'we are doing the most ethical thing of all, feeding the world and when you are hungry you will recognize the wisdom and rightness of our actions and methods'. The view dismisses the cries for justice, environmental quality or food safety as pusillanimous appeals that are moot.

In Holt's view there is no compelling moral argument for saving family farms, because of the economic realities of the global market within which agriculture must operate (Holt, 1997). Wendell Berry (1977) and others who argue for preservation of family farms, on the basis of a Jeffersonian agrarian appeal about the virtue of the small farm and how it was and remains the basis of our civilization, obviously, just don't understand the modern world.

I conclude that while agricultural scientists are ethical in the conduct of their science (they don't cheat, don't fake data, etc.) and in their personal lives (they earn their wages, take care of family, are responsible for their actions, etc.), they do not extend ethics into their work at a deeper level. Agricultural scientists are the reluctant revolutionaries that Ruttan (1991) identified, but they are also realists. Realists run agricultural research and the world; idealists like Berry and Jackson do not. Idealists attend academic conferences and write thoughtful articles and books from the sidelines (Kaplan, 1999). The action is elsewhere. The rule is produce profitably or perish in the real agricultural world. Realism rules, and philosophical and ethical correctness are no more necessary for useful work in science than theological correctness is in religion (Rorty, 1999).

I find that true, but I want more. I want my colleagues to accept the burden of beginning the difficult task of doing a discriminating cultural and moral analysis of agriculture and its results. We must strive for a careful analysis of what it is about our agriculture and our society that thwarts or limits our aspirations and needs modification. That analysis must include the work of the US Department of Agriculture, agricultural colleges, scientific societies and the many commercial organizations that serve and profit from agriculture. We must nourish and strengthen those features that are beneficial, and change those that are not. To fit ourselves for this task, we must be sufficiently confident to study ourselves and our institutions, and dedicated to the task of modifying both. It takes a combination of intellectual rigor and management skill to do this well. Management skill is required but difficult to achieve. Intellectual rigor annoys people because it interferes with the pleasure they derive from allowing their wishes to be the father of their thoughts (Will, 1999).

To preserve what is best about modern agriculture, and to identify and oppose the abuses that modern technology has

wrought on our land, our people and other creatures, and finally to begin to correct them, will require many lifetimes of work (Berry, 1999). We agriculturalists must try to see agriculture in its many guises—environmental, economic, political, productive, scientific, social and moral. It is no longer sufficient to justify all agricultural activities on the basis of increased production. Other criteria, many with a clear moral foundation, must be included. We live in a post-industrial, information-age society, but we do not, and no one ever will, live in a post-agricultural society. Societies have an agricultural foundation within their borders or in other countries. Those in agriculture must strive to assure all that the foundation is secure.

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Evaluating Indirect Ecological Effects of Biological Control

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