1 The Horizon of Agricultural Ethics

We should be on our guard not to overestimate science and scientific methods when it is a question of human problems; and we should not assume that experts are the only ones who have a right to express themselves on questions affecting the organization of society.

Albert Einstein

There are many differences in the words used and in the understanding of their meanings as one moves from the scientific to the experiential realm; from the laboratory where life’s processes are studied to the world where life is experienced. The words of scientific language are necessarily precise and understandable to other scientists, whereas the words of experiential language rarely have the same meaning to all.¹

For example, a scientific description of the common synthetic organic herbicide (2,4-dichlorophenoxy)acetic acid (2,4-D) might use these words: 2,4-D is a herbicide composed of a benzene ring with chlorine atoms in the ortho (2) and para (4) positions. An acetic acid moiety is in the 1 position via a phenoxy (oxygen) link. The herbicide’s mode of action is that of a persistent auxin whose concentration cannot be controlled by susceptible plants. Most broadleaf species (dicotyledons) are susceptible (i.e., their growth is severely reduced or they may die) and most grasses (monocotyledons) are not. Several formulations of 2,4-D are available and they can be used for selective weed control in wheat, barley, oats, rye, sorghum, and field and sweet corn. The molecular formula is C₈H₆Cl₂O₃ and the molecular weight of 2,4-D acid is 221.04. Epinastic symptoms in susceptible plants occur within a few days after application and absorption occurs through roots or shoots. Susceptible plants die within 3–5 weeks. It is translocated in the symplast and metabolism occurs slowly. 2,4-D has a field half-life (t₁/₂) in soil of 10–12 days. It leaches in soil but rapid microbial degradation in soil and plant uptake prevents leaching below 6 in. in most soils. Volatility occurs for some ester formulations, but is typically negligible for acid, salt, and low volatility ester formulations.

Another example of the precision of scientific language is a description of the common simple perennial weed, dandelion. I suspect that all plant scientists and most homeowners know the common dandelion. The plant scientist (taxonomists in particular) properly calls it Taraxacum (the genus) officinale (the species) Weber in Wiggers (the authority). The authority is the name or designation of the person or persons given credit for unequivocally identifying and naming the species.

¹I am indebted to my colleague Dr. J.W. Boyd, Professor Emeritus of Philosophy, Colorado State University, who guided me toward an understanding of the importance of language and models of truth.
Dandelion is a member of the lettuce tribe of the sunflower or Asteraceae family. It was introduced to the United States from Europe. It is a deep-rooted simple perennial that reproduces by seed and, if cut, asexually reproduces from its tap root. The plant has a bitter, milky latex in all parts. Leaves are all basal, 2–12 in. long, and are lightly pubescent especially beneath and on the midvein. They sometimes form a flattened rosette, and other times are more or less erect. They are oblong to spatulate and deeply and irregularly cut. Leaves are coarsely pinnatifid, sinuate-dentate, and rarely subentire. The paired lobes or divisions are somewhat acute. The inflorescence is bright golden yellow to orange, 1–2 in. across, containing 150–200 ray florets. Involucral bracts are not glaucous but the outer ones are elongated and conspicuously reflexed. Each composite flower is borne on a hollow stalk, 2–18 in. tall. At maturity they form white, fluffy, seed-bearing blowballs, about 1½ in. in diameter. Achenes are gray to olive-brown, 1/8 in. long, ridged, oblong, bluntly muricate, and bear a silky white pappus. Dandelion is distributed throughout the world’s temperate and tropical zones.

A child and most adults who read such descriptions of 2,4-D or dandelions would probably regard them as nearly incomprehensible. Both descriptions are correct statements of scientific truth. That is to say, both are rational, publicly verifiable, falsifiable, literally true, definitive, and specific. These characteristics describe the language of science. Rationality, based on or derived from experiment and observation, is a cornerstone of scientific language. Often the language is mathematically based and precise. The language and the truth it represents are publicly verifiable, a hallmark of good science. Scientific findings, the result of research, are published in open, accessible journals and can be verified or denied by others. The meaning of the words in research reports is precise, when one understands them, and that understanding is available to anyone with a glossary of terms, a dictionary, or the right textbook. The language is definitive in that the words define 2,4-D, but not any of several other herbicides, and dandelions, but not other common dicotyledonous plants.

The language of rationality is the ideal model of objective scientific truth. But what of the child who picks the pretty, yellow dandelion flower or blows the pieces (the pappus) from the gray-white puffball of the mature flower and watches them float away and settle on the ground? What of the adult who has heard of 2,4-D and may even have used it to kill dandelions in the lawn, but is concerned about it and all pesticides and their possible effects on human and environmental health? Scientifically rational language may speak to them, but usually does not address what they see and feel. The objective of science is to understand phenomena, not judge them (Pinker, 2008). The language of rationality, the model of scientific truth, is not adequate to describe the child’s experience or the adult’s attitude. The flower’s attraction, its beauty, the fun one can have with it, and one’s concern, perhaps fear, about a herbicide and its possible side effects, require a different language—the language of experiential truth.

The language of experiential truth is personal and subjective. It is purposefully vague, and because it is so personal, it is not subject to public verification. My granddaughter told me as I was using 2,4-D to kill dandelions in my lawn, that she thought dandelion flowers were really pretty. Words such as pretty, playful, concern, and possible effects are imprecise. The language of experiential truth is rich in meanings because it is nonliteral, symbolic, and dependent on the personal subjectivity
of the speaker, which scientific truth wants to diminish, if not eliminate. Subjective, personal opinions are least worthy of consideration in a model of scientific truth, but have the highest importance in a model of experiential truth.

When my granddaughter picked and showed me “the pretty dandelion flower,” I realized quickly that my rapport with her in the midst of the flowers (or were they just weeds?) would have been damaged by the scientific response—“Well, actually what you think is a flower is not a flower at all. It is a complex inflorescence composed of several ray florets, etc.” My rational, precise, literal, publicly verifiable words would have fallen on deaf ears or on no ears at all as she wandered off to pick more pretty flowers. My relation to her is durable, but my relation with her at that moment would not have been improved. My focus on correct, scientific, exterior data would have clashed with her focus on her interior consciousness about dandelion flowers.

Among the models of how truth can be perceived, the scientific model is valued by the scientific community, all of whom also know experiential truth, but many of whom have not considered the differences, place, and value of each model of truth. The order of value in the scientific model is:

1. **Rational truth**: Can be defined mathematically, is publicly verifiable, literal, definitive, falsifiable, and precise.
2. **Relational truth**: Exterior data take precedence over one’s interior consciousness of the relationship of one observation to another.
3. **Personal truth**: The realm of subjectivity is least worthy of being called scientific truth.

A model of experiential truth reverses the order and importance of the two models of truth.

1. **Personal truth**: The language is often vague, imprecise, nonliteral, symbolic, descriptive, and highly subjective. It speaks of what is most important; what has the highest value.
2. **Relational truth**: Interior consciousness determines what one sees and how it is described and valued. Exterior data concerning the relation of one observation to another are interpreted subjectively.
3. **Rational truth**: Is present, but has the lowest value as a determinant of what is true.

**Scientific Truth and Myth**

Many citizens of the world’s developed countries are very well connected to their work. One sees examples everywhere: Blackberrys, I-pads, Kindles, cell phones with Internet access and more “apps” than many can use or know how to use, watches that tell time and connect to e-mail, etc. Cell phones may indicate status, are fashion statements and cameras as well as links to the daily grind (Coleman, 2000). Those who possess these marvelous technological achievements assume they lead to greater efficiency, productivity, and perhaps even more importantly, greater happiness. Another view says that we are so connected that we never can be disconnected. Proximity and constant connection reduce the time available to disconnect. Such time is required to think and reflect and to see where we have been so we can determine where we ought to go (Coleman, 2000). Most agricultural scientists
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are well-connected models of efficiency and productivity. However, they are often so busy being productive that direction becomes secondary or lost. Gallopín et al. (2001) suggest that there is a growing feeling (not a scientific certainty) that in spite of the marvels of communication and the appearance of efficiency and productivity, agricultural science is not responding adequately to the challenges of our time. Many of those engaged in agriculture are aware of the critique. However, they operate within the usually unexamined (frequently because it is unknown), guiding myth, the paradigm, that increasing production and profit is the proper (perhaps the only) goal for agriculture. They adhere to the paradigm while the real world reveals new realities (Kirschenmann, 2010). People frequently are so committed to the old ideas that they learned represented the world as it is that they resist change, even though they know the world is changing. They illustrate the fallacy of misplaced concreteness. In Whitehead’s (1997) terms, the fallacy occurs when an abstract belief, opinion, or concept (the old paradigm) about the way things are, is reified. That is, one treats something which is not a real thing but an idea as if it were a physical or concrete reality. As Kirschenmann points out, the trick is determining which idea(s) really reflect what is happening in the real world and distinguishing them from unrealistic ideas.

It takes effort for any group to become aware of its guiding myths and then to gain sufficient intellectual distance from the myths so they can be examined dispassionately. The difficulty is compounded by the fact that groups believe strongly in the value of the governing myth, even though it is generally unexamined and the fact that in science, admission of the existence of a guiding myth is so foreign that scientists dismiss discussion of such things because they are not scientific and inherently subjective. This view helps explain why agriculture’s practitioners dismiss those who criticize agriculture and agricultural science because they do not understand their importance; the essentiality of agriculture’s mission. Critics question the paradigm, the operative myth, which is to say that such discussions lie in the arena of personal as opposed to rational truth. Asking agricultural scientists to describe the myths that guide their science is like asking a fish to describe water. The myths (the guiding paradigm) for the scientists, like the water for the fish, are just there. It is the nature of a myth that those who hold it do not believe it to be a myth (Bronowski, 1977, p. 21). Myth and science are like first cousins who strongly resemble each other and passionately hate the resemblance (Alexie, 2003).

Agriculture’s practitioners seem to be so preoccupied with the vision of the necessity, indeed the responsibility, of continuing to increase production so the world’s people will be fed that they do not pause to reflect on means (Midgley, 2002, p. 36). To properly criticize alternative visions of agriculture’s present and its future:

*we need to compare those visions, to articulate them more clearly, to be aware of changes in them, to think them through so as to see what they commit us to. This is not itself scientific business, though of course scientists need to engage in it. It is necessarily philosophic business (whoever does it) because it involves analysing concepts and attending to the wider structures in which those concepts get their meaning*

(Midgley, 2002, p. 36)
The philosophic process of analyzing concepts will lead toward a just and realistic balance among competing visions of agriculture’s future. The process will include consideration and analysis of scientific and experiential truths. The scientific view will, of course, not be hostile to science, but the point of view that includes experiential truth should also not be regarded as hostile. It is potentially a wider point of view from which science and our scientific myths arise and that provides support for them. The purpose is to strive for rational analysis to achieve what Midgley (p. 37) calls “a just, a realistic balance among our various assumptions and ideals.”

*The scientific point of view is itself an abstraction from it. The scientific angle is the one from which we attend only to certain carefully selected abstractions which are meant to be the same for all observers. When we move away from that specialized angle to the wider, everyday point of view we are not ‘being subjective’ in the sense of being partial. Instead we are being objective—i.e. realistic—about subjectivity, about the fact that we are sentient beings, for whom sentience is a central factor in the world and sets most of the problems that we have to deal with.*

(Midgley, 2002, p. 101)

Agriculture and all its subdisciplines (e.g., soils, animals, breeding of plants and animals, economics, entomology, plant pathology, weed science, etc.) are guided by a core mythology—an arena of experiential truth, which I claim is usually unknown and unexamined. Such mythologies are not myths in the sense of lies or in the colloquial sense of a false tale, but imaginative visions or pictures that express a belief and appeal to the deepest needs of our nature (p. 200)—our need for myth (May, 1991). They are essential. In agriculture and in life, we cannot live without myths. A lack of myths would break our required links to the past; we would become uprooted from the past and from our own society. It is our myths that may or may not be founded on fact, that capture human imagination so powerfully. They are one way we order our and other’s experiences. It is an essential way we use to order our world that is not exhaustive (Midgley, 2002, p. 101). It is best when considered with other views, other ways of ordering and interpreting the world.

Scientific truth, spoken in empirical language, refers to objective facts, whereas myth refers to experiential things, the quintessence of the human experience that gives meaning and significance to life (May, 1991, p. 26). When we examine our myths, we automatically move away from the realm of scientific truth, but that does not mean one dismisses scientific truth. The examination of guiding myths often compels questions that cannot be answered easily and may not be answerable. It is asking that is cathartic (p. 284).

Part of our knowledge about scientific agriculture includes some level of certainty about the ability of technology to continue to solve problems as it has in the past. Technology, the knack of so arranging the world that we do not experience it (p. 57), can tell us what it is possible to do and perhaps how to do something but not why. Technology deals with the “what” of human existence rather than the “why” and it is the latter for which we are famished (p. 57). There is no question that scientific agriculture has solved many production problems. Part of the prevailing mythology
of agricultural science is that the problems that some identify as being caused by
the science lie in the way the science and its associated technology are used and
misused (what to do), but not with the scientific approach to problem definition or
problem solving (why to do something) (Gallopín et al., 2001). No thoughtful agri-
cultural scientist denies that soil erosion, soil salinization, pesticide resistance, pesti-
cide presence in groundwater, and a host of other problems are real problems caused
or exacerbated by agricultural technology. Few go on to the possibly cathartic ques-
tion about “the existing rules of enquiry, and to what extent (and in which situations)
the scientific rules themselves have to be modified, or even replaced” (Gallopín
et al., 2001). That is, few go on to question the myth of the objectivity of the scientific
method and how science is done. Science is criticized because of its use and misuse,
but the model of scientific enquiry is not usually questioned. Gallopín et al. suggest
it is necessary to consider modifying or replacing the fundamental rules of scientific
inquiry in some situations, especially when it comes to study of agricultural sustain-
ability, which requires integrating economic, social, cultural, political, and ecological
factors. Sustainability (see Chapter 7) is not simply a scientific question.

Agricultural science has defined its domain as solving agricultural produc-
tion problems. It is what scientists and technologists do. The world is a vast array
of problems, many known and many unknown. The job of the scientist is to work
on and solve the problems the world presents (Gallopín et al., 2001). In close asso-
ciation has been what Gallopín et al. call a strong “privileging of the intended pur-
pose” of the scientific enterprise. That is the intended outcome, the desired solution
is consistently seen as good and likely, while the unintended side effects are ignored
or dismissed as externalities (Gallopín et al., 2001).2 There may be inconvenient or
undesirable effects but they are relegated to another domain and are not the respon-
sibility of the scientists who developed the technology or those who apply it. For
example, herbicides were not designed or intended to leach to groundwater and their
presence there is unfortunate. But removing them or paying the costs created by their
presence is not regarded as the responsibility of those who develop, study, apply, or
benefit from the herbicides used to control weeds in crops. The problems are exter-
nal to agricultural science, which strives to eliminate future problems but does not
emphasize solving or apologizing for the problems created. The accepted view
within weed science has been that the benefits of weed control and herbicides exceed
the negative costs, including the externalities. The view is reinforced by economic
analysis. Possible negative effects (soil, water, and air pollution; resistance; loss of
biodiversity; poisoning or physical or mental impairment of humans and other spe-
cies; etc.) are difficult, if not impossible, to evaluate by standard cost/benefit analy-
sis because determining a monetary value is unavailable and some are priceless (see
Ackerman and Heinzerling, 2004). That is, cost/benefit analysis does not clarify, it

2 An externality is a cost that is not reflected in price, or more technically, a cost or benefit for which no
market mechanism exists. In the accounting sense, it is a cost that a decision maker does not have to
bear, or a benefit that cannot be captured. From a self-interested view, an externality is a secondary cost
or benefit that does not affect the decision maker. It can also be viewed as a good or service whose price
does not reflect the true social cost of its consumption.
can confuse. Simple cost/benefit analysis cannot and it is unacceptable to determine the value of a child’s life, a fragile forest, or the view into the Grand Canyon. It can be especially inappropriate in developing countries (Atreya et al., 2011).

Tegtmeier and Duffy (2004) suggest, with adequate supporting data, the negative external cost effects of crop and livestock agriculture in the United States are between $5.7 and $16.9 billion each year. Crop production had negative effects between $4,969 and $16,561 million annually, while livestock’s negative externalities were $714 to $739 million per year. Their work was based on 417 million US acres cropped in 2000.

Is a system that yields very high external costs one that should remain unexamined for its defects or means of change? Is the method of scientific inquiry that contributed to the production of these external costs above question? The obvious answer is no. The complexity of the problems faced by agriculture and agricultural science is clear to all involved in agriculture. It is not a simple enterprise. The approach and the answer to many of the questions agriculture faces require value judgments. Determining whether something is good or bad, right or wrong, decent or indecent is frequently complex and requires more than scientific truth. Such judgments are subjective and experiential and although they may be supported by reason, they are not totally dependent on scientific evidence. Scientific reasons alone are a poor guide to matters of value and judgment (Ehrenfeld, 1978, p. 223). Consensus about goodness may be reached, but it is not subject to proof or verification by science.

The problems of agriculture seem to multiply faster than the solutions. Gallopín et al. (2001) offer three reasons why things have become more complex. The first reason is ontological or human-induced changes in the nature of the real world. This is not just a twentieth-century concern (see Marsh, 1864; Turner et al., 1990). Humans are a new force of nature (Lubchenko, 1998) that modifies “physical, chemical, and biological systems in new ways, at faster rates, and over larger spatial scales than ever recorded on Earth.” Humans stand in sharp contrast to all other species that must adapt to the environment. Man and nature have become separate. Man is master now, and it was meant to be so. Man’s power yields dominion and the ability to subdue nature even though we strive to obtain goals that are ecologically unsound and unsustainable. Those engaged in agriculture can be justly accused of being moral hypocrites. Their actions yield results they would condemn in others (e.g., air pollution from cars, water and soil contamination from industrial sites, cruelty to animals, etc.). Nature and natural things are judged by what they can do for man, not by any value judgment about intrinsic natural patterns that control us and are affected by our actions. For example, carbon dioxide (CO₂) emitted from the fossil fuels burned (mostly in the north) combined with carbon dioxide produced by deforestation (mostly in the south) increased atmospheric CO₂ levels by about 20% over the pre-industrial background (Turner et al., 1990, p. 6). CO₂ and methane, whose atmospheric concentration has doubled since the mid-eighteenth century (Turner et al., 1990), have become primary drivers of global climate change. Data from Mauna Loa show that atmospheric, CO₂ concentration increased an average of 1.8 parts per million (ppm) per year from 1995 to 2009. Since 2001 the average annual increase has been 2 ppm. World CO₂ levels are the highest they have been in 650,000 years. In 2010 the atmospheric CO₂ level at the Mauna Loa Observatory was 387 ppm up almost 40% since the industrial revolution (Adam, 2008).
Soil erosion caused by human and natural activity continues. “The overwhelming impression is that transfer of materials is changing the face of the earth at a faster rate than that at which the world’s population is growing” (Douglas, 1990). More atmospheric nitrogen is fixed by humans than by all natural terrestrial sources combined (Vitousek et al., 1997). The high productivity of modern agriculture is dependent on modifications of the Haber-Bosch process for synthesis of nitrogen fertilizer. More than one-half of all the nitrogen fertilizer used in all of human history has been used since 1990 (Clayton, 2004) and as much as half of that ends up in the atmosphere or local waterways releasing 2.1 billion tons of carbon dioxide equivalent as nitrous oxide (World Watch, 2008), a potent greenhouse gas. As much as 1.5 billion pounds of nitrogen fertilizer is applied, primarily to US corn fields each year. About 50–60% is used by the corn and the rest is free in the environment. This massive use has contributed to the growing hypoxic (O₂ concentration <2 mg/L), dead zone in bottom water on the Louisiana–Texas coast. The sediment load in the Missouri/Mississippi river basin is about 616 million tons (2,000 lb/t) (or approx. 550 million metric tons; 2,200 lb/t) annually. Much of the nitrogen that does not fertilize corn and other crops reaches the Gulf of Mexico in sediment and creates the growing hypoxic zone. The ultimate cause of hypoxia is excess nutrient loading from human activities which causes algal blooms. The algae sink to the bottom and use oxygen to decompose at a rate faster than it can be added back into the system by physical mixing. The lack of oxygen (anoxia) kills bottom-living organisms and creates dead zones.

The US area begins where the Mississippi River enters the Gulf of Mexico. In 2010 it extended east to Alabama and west to Galveston, Texas. The area in mid-2010, 7,722 mi², was 10% less than the area of Massachusetts (8,721 mi²). Sewage effluent contributes but the primary cause is application (or over application) of nitrogen fertilizer in the Missouri/Mississippi river drainage basin. There is a growing consensus that corn grown for ethanol production in the United States exacerbates the problem due to high nitrogen fertilizer use and the substitution of corn for soybeans, which do not require nitrogen fertilizer. The combination of increasing corn acreage, nitrogen fertilizer use, the quest for ever-higher production, and government subsidies for ethanol production creates human-induced change (Goolsby et al., 2001; Rabalais et al., 2002). Mean annual nitrate N concentrations at St. Francisville, LA from 1980 to 1996 were more than double the average concentration from 1955 to 1970 (Goolsby et al., 2001). Hypoxia is not limited to the United States. It has spread rapidly in recent decades. There are at least 146 areas in the world (Postel, 2005, p. 23). The largest hypoxic dead zone is in the Baltic Sea (northern Europe). The Gulf of Mexico is 7.5 times larger than the Baltic but the hypoxic area in the Baltic is 14% larger. Hypoxia is “the most widespread anthropogenic induced deleterious effect in estuarine and marine environments” (Diaz, 2001). More than half of all accessible freshwater is used by humans (Postel et al., 1996); most to irrigate crops and hypoxia is a common outcome.

However, one must acknowledge that doubling food production by 2050 will require increasing nitrogen application 2–2.5 times, which will exacerbate its well-documented negative effects (Myers, 2009, p. 24).
The second reason agriculture problems multiply more rapidly than solutions (Gallopín et al., 2001) is epistemological change. Epistemology is the branch of philosophy concerned with the nature of knowledge. It is the study of the origin, nature, and limits of knowledge. Essentially it is study of the foundation of knowing. Gallopín et al. assert that our understanding of the world has changed because modern science has made us aware of the behavior of complex systems, especially of their unpredictability. Surprise is part of the world’s reality at the microscopic and macroscopic level. Scientists are coming to understand that the mysteries of ecology, in all its grand complexity, are more important (albeit more difficult) science than economics (Midgley, 2002, p. 188). Agricultural economics has a role to play in measuring agriculture’s future, but limiting definition of that role to economic analysis based on efficient use of resources is too limited because it ignores the human dimension of agriculture (Dundon, 2003). The focus of economic analysis is on developing a better society, but economics often limits the purview of better to price and profit. Madden (1991) suggests that focus must be expanded to “ethics and values far beyond those embodied in current market prices.” This, of course, makes things more complex, less scientifically precise, and increases the significance of personal truth.

Much of what we need to know about agriculture is related to the behavior of complex ecological systems, about which we know little. Ecosystem services operating on generally unappreciated and unknown large and small scales are impeded by human activities and cannot be replaced by technological advances in agriculture as they have been in the past (Daily et al., 1997). The weed scientist who asks what herbicide will control weed X in crop Y is asking a good but incomplete question. It is a technical question that leads to ignoring or assuming that it is someone else’s responsibility to ask questions such as:

- What happens to the herbicide after it is applied?
- What are the effects of attempts to remove the weed on the system?
- Are weeds an inevitable concomitant of agriculture or is the weed there because of the way agriculture is practiced?

All involved in agriculture are aware of the third reason for added complexity offered by Gallopín et al. (2001): changes in the nature of decision making. A more “participatory style of decision making” is gaining and “technocratic and authoritarian” decision making is less in favor. The ecocentric as opposed to technocentric view often prevails. Other decision criteria (gender, human rights, the environment) are gaining credibility as nongovernmental organizations (NGOs) and multinational corporations expand the dimensions that define issues and solutions. In general, while changes in the nature of decision making are known and often lamented in agriculture, that knowledge has not led to changes in agricultural practice. Change in the ways agriculture is practiced have been imposed from outside. It is reasonable to posit that changes resulting from environmental concern, gender issues, human rights, and animal rights have initially been resisted within agriculture.

Everyone is for agricultural sustainability (see Chapter 7). It has achieved the universally good status of God and motherhood. Even though all do not agree on what it is, there seems to be agreement that a sustainable agriculture must be economically
successful. It also has to be ecologically, socially, culturally, and politically acceptable. Lubchenko (1998) said that the goal of obtaining a more sustainable biosphere means obtaining that which is ecologically sound, economically feasible, and socially just. She, as President of the American Association for the Advancement of Science, asked if the scientific enterprise that “had met these past challenges is prepared for the equally crucial and daunting challenges that lie in our immediate future.” Her answer was, No, science is not prepared to meet future demands because “the real challenges facing us have not been fully appreciated nor properly acknowledged by the community of scientists whose responsibility it is, and will be, to meet them.” Lubchenko firmly says that it is time for the “scientific community to take responsibility for the contributions required to address the environmental and social problems before us, problems that, with the best intentions in the world, we have nonetheless helped to create.”

The agricultural community knows that our modern agricultural system is very productive but not always profitable for those who produce. It has been quite profitable for corporations that create and sell agricultural technology and for many large farms. More than 40 years ago, Berry (1970, p. 78) noted the condition of the American farmer in an era of unparalleled affluence and leisure. His view is still valid:

… the American farmer is harder pressed and harder worked than ever before; his margin of profit is small, his hours are long; his outlays for land and equipment and the expenses of maintenance and operation are growing rapidly greater; he cannot compete with industry for labor; he is being forced more and more to depend on the use of destructive chemicals and on the wasteful methods of haste and anxiety. As a class, farmers are one of the despised minorities. So far as I can see, farming is considered as marginal or incidental to the economy of the country, and farmers, when they are thought of at all, are thought of as hicks and yokels whose lives do not fit into the modern scene.

The modern agricultural system created by the cooperative research of colleges of agriculture in the nation’s land grant universities and by agribusiness companies has done at least seven things worthy of note. They are:

- Food and fiber production have increased,
- The long-term health of soil and groundwater has declined,
- Plant and animal genetic diversity have been reduced,
- The political and economic climate have reduced crop and livestock choice,
- The US diet favors animal over plant products,
- The creation of a capital, energy, and chemically intensive production system that to survive requires high production volume at low cost, and
- The system has driven small- and medium-sized farms out of business.

Many college of agriculture faculty members will claim that their work was not intended to create this kind of system and in fact did not create it. This may be true and, if it is, one must ask, what these faculty members were doing? Perhaps their work was irrelevant to the creation of the modern agricultural system the above characteristics describe. One cannot be sure. Therefore, we must ask, as Lubchenko (1998) did, if the challenges “facing us have not been fully appreciated nor properly
acknowledged by the community of scientists whose responsibility it is, and will be, to meet them.”

We must continually ask the cathartic questions. What should we do? What is the agricultural research task? What are the questions we ought to be asking? Maintenance of production and, presumably, profit have been the premier, perhaps the only, goal of agricultural research and of colleges of agriculture. Production has been maintained and even increased for most crops, grower profit has not, except for some large farms. We ought to explore whether this has been a proper and sufficient goal, and if it is the proper goal for the future.

Those engaged in agriculture must begin to examine and expand agriculture’s ethical horizon. Most people think of a horizon as the apparent line where the sky meets the earth. A horizon can also be regarded as a limit or the extent of one’s outlook, experience, interest, knowledge, etc. In the same sense as the earth–sky horizon, our intellectual horizon is what separates, divides, binds, and defines us. An intellectual horizon is the full range or widest limit of our perception, interest, appreciation, knowledge, and experience. It is the intellectual horizon that those engaged in agriculture must examine and it is a major purpose of this book to explore agriculture’s intellectual horizon, particularly as our collective, yet unexamined, ethical position, may limit what agriculture’s ethical horizon defines.

Lubchenko (1998) concludes with a Calvin and Hobbes cartoon (Watterson, 1992). Watterson, through Calvin and Hobbes, has been a perceptive commentator on our society. His observations apply to our agricultural and general scientific dilemma.

Calvin and Hobbes are careening through the woods in their red wagon.

Calvin: “It’s true, Hobbes, ignorance is bliss!
Once you know things, you start seeing problems everywhere...
... and once you see problems, you feel like you ought to try to fix them...
... and fixing problems always seems to require personal change...
... and change means doing things that aren’t fun!
I say phooey to that!”

Moving downhill, they begin to go faster.

Calvin: (looking back at Hobbes): “But if you’re willfully stupid, you don’t know any better, so you can keep doing whatever you like!
The secret to happiness is short-term, stupid self-interest!”

Hobbes: (looks concerned): “We’re heading for that cliff!”

Calvin: (hands over his eyes): “I don’t want to know about it.”They fly off the cliff: “Waaawggghhh!”

After crash landing,

Hobbes: “I’m not sure I can stand so much bliss.”
Calvin: “Careful! We don’t want to learn anything from this.”

Another comic strip we all know well is Peanuts by Charles Schulz, now presented as Classic Peanuts®. The comics often comment succinctly and incisively on

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3 Peanuts, a creation of C.M. Schulz, is published by United Features.
a fundamental truth. It is wise counsel as we proceed to discuss agriculture’s ethical horizon.

*Charlie Brown asks Lucy—“What are you looking for?”*

*Lucy:* “A tennis ball.”

*Charlie:* “How did it get way out here?”

*Lucy:* “I threw it at Linus. He ducked and it flew into these weeds.”

*Charlie:* “You know what?”

*Lucy:* “What?”

*Charlie:* “Perhaps this is the punishment you get for losing your temper.”

Lucy then slugs Charlie and knocks him over.

*Charlie:* “I always moralize at the wrong time!”

In contrast to Calvin and Hobbes, we bear a responsibility to ask: What do we know and what must we learn from the agricultural experience and the limits of agriculture’s ethical horizon? What are we responsible for that we can be proud of and what are we responsible for that we regret? We must learn how to ask as Eliot did:

*Where is the wisdom we have lost in knowledge?*

*Where is the knowledge we have lost in information?*

_Eliot, 1934 Choruses from “the Rock”_

Finally, Charlie Brown wisely tells us that there is a time to moralize and a time to be quiet.

**References**


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A Glimpse Ahead

We shall not cease from exploration and the end of all our exploration will be to arrive where we started and know the place for the first time.

T.S. Eliot, 1942. Little Gidding

There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.

Shakespeare, Hamlet, Act 1, Scene 5

When I was a young boy, everyone had read, or at least said they had read, J. D. Salinger’s novel The Catcher in the Rye (1951). Salinger introduces Holden Caulfield, a young man in search of himself, as all young men seem to be. Holden wants to be somebody who engages in some form of service, but he is having trouble, as young boys do, in defining what that service might be.1 At one point in the story (pp. 224–225), Holden is conversing with his sister, Phoebe, who asks him what he would like to become.

“You know what I’d like to be? I mean if I had my goddam choice?…”

Phoebe responds, “What? Stop swearing.”

“You know that song, ‘If a body catch a body comin’ through the rye’! I’d like—”

(Phoebe breaks in.) “It’s ‘If a body meet a body coming through the rye’! It’s a poem. By Robert Burns.”

“I know it’s a poem by Robert Burns.”

Holden regains his composure from this unwanted correction offered by his younger sister and continues.

“I thought it was ‘If a body catch a body.’”

… “Anyway, I keep picturing all these little kids playing some game in this big field of rye and all. Thousands of little kids, and nobody’s around—nobody big, I mean—except me. And I’m standing on the edge of some crazy cliff. What I have to do, I have to catch everybody if they start to go over the cliff—I mean if they’re running and they don’t look where they’re going I have to come out from somewhere and catch them. That’s all I’d do all day. I’d just be the catcher in the rye and all. I know it’s crazy, but that’s the only thing I’d really like to be. I know it’s crazy.”

I suspect many of those engaged in agriculture, whether they are farmers, ranchers, equipment dealers, grain dealers, farm supply dealers, university researchers,
and so forth, see themselves and their profession as having achieved what Holden Caulfield wanted to become. They are the only big ones around and they are quite literally catching the helpless of the world who do not or cannot produce their own food. They are the catchers in the rye, saving those who are about to fall off the cliff of starvation. However, as Phoebe Caulfield points out, they have misread the lines. Burns’ poem does not say, “if a body catch a body.” It says, “If a body meet a body.”

All in agriculture (farmers, ranchers, suppliers, marketers, and, yes, even professors) need to “meet” head on the deeper ethical challenges. Our planet now (2011) has 7 billion people and perhaps 9 billion by 2045, when population may stabilize. However, over the next few decades, hundreds of millions of people who are not fed well now and have poor agricultural practices will suffer. It can be argued that the rich and prosperous have some duty to help the less fortunate. In general, they are helped, but not enough. If all in agriculture and all in the developed world view themselves as catchers, it is likely they will see the solution of the problem of hunger as more production so they can “catch” those who may starve. But if they are to “meet” the body of challenge(s) then they must find the root causes of hunger, which may include lack of food, but as Sen (1981) found, is more likely to be caused by inadequate or absent food distribution, inappropriate or inadequate agricultural technology, oppressive political systems, and omnipresent poverty. These exist in several nations outside US, but are also here. All engaged in agriculture ought to confront the large body of difficult questions that lie ahead and thereby arrive where they began, and know it well. If they do not they may be able to “catch” only a few until the hard questions are met addressed and answered.

Is more production in developed countries really a solution?
Are any existing agricultural systems sustainable?
Are present agricultural systems ecologically responsible?
Do we, does anyone, know how to successfully transfer appropriate technology?
Is US foreign aid organized to help those in need?
What will be the effects of climate change on food production and on the poor?

Living with such hard questions is never comfortable. If we are to meet those in need, we will necessarily proceed with the nagging uncertainty that we cannot know for certain that the right course of action is being followed. We will always see through a glass, darkly and will only know the wisdom of our actions later, after we are compelled to begin. It is certain that the glass will be much darker and the future much less certain if we proceed without considering what ought to be done as well as what can be done. Knowing what can be done is not sufficient. The difficult ethical questions must be addressed to create a firm ethical foundation as we go forth to meet the people and act to solve well-defined problems that lack well-defined solutions.

It is common to believe that Americans have a God-given right to the American dream, in its purest form. Economic growth will continue and, in fact, must continue if we are to have the prosperity and continued consumption we have earned and deserve. Many see this attitude as the epitome of American arrogance and misunderstanding of the world. Yet, we continue to charge ahead without a firm ethical foundation
and without even taking the time to consider that foundation. We are like Dickens’ Mr. McCawber in *David Copperfield*. We are sure that “something will turn up” to enable us to go on. We will somehow continually expand the horizon of accomplishment in agriculture. We will somehow feed more people a better diet because agriculture’s progress, we assume, is limited only by our skill and scientific knowledge. In fact, with the advent of biotechnology, many believe that agriculture’s horizon is, once again, unlimited. Many of the strongest defenders of modern agriculture, its wonderful technology, and its undeniable achievements live in what could be characterized as an echo chamber of their own opinions. They grant credence to good science that supports their opinions and ignore all other information or put it in the category of bad science, whereupon it is dismissed. The dominant world view is reminiscent of Dr. Pangloss, Candide’s mentor and a philosopher (*Voltaire, 1759*). Pangloss is responsible for the novel’s most famous idea: that all is for the best in this “best of all possible worlds.” The optimistic sentiment is the main target of Voltaire’s satire.

Agricultural scientists, the larger scientific community, and the general public now recognize a large set of problems that have been created, at least partially, by agriculture: contamination of water, food and feed by pesticides, eroded soil, “mining” soils of their natural fertility, fertilizer pollution, pesticide harm to people and other living things, atmospheric contamination by ammonia and methane and their relation to ozone depletion, global warming, overuse of nonrenewable resources, loss of wildlife habitat, and groundwater mining (*Pretty, 1995; Kirschenmann, 2000b*). It is not unreasonable to claim that the agricultural community has been late in acknowledging and addressing these problems. Kirschenmann, citing *Baskin (1997)*, identified six agricultural problems not all of which were caused by the practice of agriculture, but agriculture is intimately involved in and affected by all.

**Six Important Issues/Problems/Matters of Concern**

*Highlight 11.1*

During the next 50 years, agriculture “has the potential to have massive, irreversible environmental impacts,” producing sources of global change that “may rival climate change on environmental and social impacts.” If past global effects of agriculture on human population and consumption continue, 1 billion hectares of ecosystems would be converted to agriculture by 2050, accompanied by at least a doubling of nitrogen and phosphorus driven eutrophication of terrestrial, fresh water, and near-shore marine ecosystems, and comparable increases in pesticide use.


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2“I have known him to come home to supper with a flood of tears, and a declaration that nothing was now left but a jail; and go to bed making a calculation of the expense of putting bow-windows to the house, ‘in case anything turned up,’ which was his favorite expression.” D. Copperfield, Chapter 11.
Agricultural Production/Soil Erosion/and Desertification

Production

A major challenge for the agricultural community is to design sustainable production systems that produce sufficient, high-quality food without causing further harm to the ecological systems on which production depends.

Many citizens acknowledge and agree with the negative view of agriculture’s environmental effects. For example, McNeill (2000, p. 358) says “In any case, human history since the dawn of agriculture is replete with unsustainable societies, some of which vanished, but some of which changed their ways and survived. They changed not to sustainability but to some new and different kind of unsustainability.” McNeill suggests that ecological buffers—available new agricultural land, unused water, unpolluted spaces—that made it possible for earlier societies to make it through difficult times are now gone. Every technological advance designed to increase agricultural production created some negative ecological and social effects.

However, other authors argue forcefully that the negative views of agriculture are wrong. Bailey (1995, p. 12) states that the environmental movement that began with Earth Day 1970 has “scored some major successes” but has “been spectacularly wrong” about many things. Global famines predicted in the 1970s (see Paddock and Paddock, 1967) have not happened, all forests have not been cut down, global warming is not as serious a problem as predicted (a brief discussion of global warming follows), and far less damage has been caused by pesticides than Carson predicted in 1962. Bailey cites several things that support his optimistic view:

- Global life expectancy more than doubled in the twentieth century.
- Despite a tripling of world population, global health and productivity have exploded.
- The world’s population growth rate has steadily declined.
- Problems typically associated with overpopulation (hunger, overcrowding, poor living conditions) are more properly identified as problems of poverty.
- Global per capita food availability rose by almost a third from the 1930s to the 1980s.
- Worldwide per capita food availability has kept pace with population growth.
- Where natural resource supplies have dwindled, they are more properly related to poor government policies.

Bailey’s (1995) book was followed by the much more successful work by Lomborg (2001). He argued that all (not just some) of the literature and science of environmental pessimism has been written by dissembling environmentalists whose aim is to panic citizens and legislators into inappropriate action to save a planet that is not in danger. The environment, in Lomborg’s view, is not bad and getting worse, it is good and getting better. “On practically every count, humankind is now better (italics in original) nourished. The Green Revolution has been victorious.” Production has tripled in developing countries, calorie intake per capita has increased, and the proportion of starving people in the world has decreased. (Due to population growth this is correct, but the total number has remained about the same.) In short, the negative environmentalists have been totally wrong.
Thus, Bailey and Lomborg see progress wherever they look and discount the fears of the pessimists. Many find their views refreshing. Others argue with good evidence that pessimism is warranted.

**Soil Erosion**

Under agricultural conditions, it takes about 500 years or more to create an inch of topsoil, which can be lost in minutes. For all practical purposes, topsoil is a nonrenewable resource. World agriculture contributes to loss of 24 billion tons of soil each year (Baskin, 1997). In 1982, the USDA estimated that 3.1 billion tons of US topsoil were lost annually from wind, sheet, and rill erosion on cropland and conservation reserve land. The situation has improved, but not enough. The US average for sheet and rill erosion was 2.9 tons/acre/year in 1987, 2.2 in 1992, and 1.9 in 1995 and 1997. The USDA also reported that erosion rates in some areas in the 1970s were above soil’s estimated natural renewal rate (5 tons per acre) on 33% of corn, 34% of cotton, 39% of sorghum, and 44% of soybean acreage. Cropland soil erosion varies from an average of 10 metric tons per hectare in US to 40 in China, and as high as 5,600 in parts of India (Pimentel and Wilson, 2004). The 2011 data show US soil loss is 10 times faster, but China and India are losing soil 30–40 times faster than the natural replenishment rate. Soil erosion is in the US costs about $37.6 billion/year in lost production. Worldwide damage from soil erosion is estimated to be $400 billion/year.

As a result of erosion over the past 40 years, 30% of the world’s arable land has become unproductive.

Soil is agriculture’s, indeed the world’s, ultimate resource. Modern agriculture is dependent on maintaining soil as its productive base but is failing to do so. Since widespread farming began in the eighteenth century in US, it is estimated that 30% of all farmland has been abandoned because of soil erosion, salinization, or water logging (Pimentel, 1995). As much as one-third of all US topsoil has been lost and most US land is eroding at a rate above the regeneration rate (Pimentel). Soil tillage, a mainstay of modern agriculture, is estimated to erode soil at 1–2 times the rate of formation (Myers, 2009).

**Desertification**

Baskin (1997) suggests that 70% of the world’s drylands are now threatened by desertification and no one knows how to reverse the process once it has begun. Douglass (1994) estimates that desertification is removing at least 50 million productive acres in the world’s arid and semi-arid regions. Today the world will lose

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3A particularly favorable review appeared in The Economist, September 8, 2002, pp. 89–90.
another 72 square miles to encroaching deserts, an area equal to the size of West Virginia over a year (Orr, 1994, p. 7).

**Depletion of Water Resources**

About 1% of the earth’s water is all that is available for human consumption. In US, 70% is used in agriculture; globally 60+ % is used for agriculture, primarily to irrigate crops that provide nearly more than one-third of the world’s food. In western US states, 85% of available water is used to irrigate crops. The US Geological Survey estimates that agricultural withdrawal (e.g., Ogallala aquifer) averages 34% of total withdrawals. In the Rocky Mountain region agricultural withdrawal, primarily for irrigation, is almost 90% of total available water. Irrigation, a proven technique to increase and assure yield, has allowed production of high value crops in areas where only low-yield, dryland agriculture was possible. In many of the world’s irrigated areas (e.g., the southern Ogallala aquifer under the high plains of the western US where withdrawal is three times greater than recharge, India’s irrigated areas, China), water is being used at a rate faster than the source is being replenished. Therefore, water is being mined with abundant short-term gain leading inevitably to long-term failure. Doubling agricultural production will require at least 2,000–3,000 km$^3$ (yes, kilometers) of irrigation water each year, which more than triples current demand. Myers (2009) estimates it is equal to the flow of 110 more Colorado rivers. Water scarcity is the biggest threat to world food production. A blue agricultural revolution may be as or more essential than another green revolution (Postel, 1999). People can’t do anything to change the amount of water on the planet, but can and do change its location and quality. As the worldwide demand for fresh water increases and the supply of good quality water diminishes, it is becoming more a manipulated commodity than a free good and its inequitable distribution has enormous political ramifications. For example, India has 2.2% of the world’s arable land, 4% of its fresh water, and 17% of its population. It would require 2.5 billion gallons of water to support 4.7 billion people with the UN daily minimum water requirement. Worldwatch (Anonymous, 2004) estimated that is equal to the water used to irrigate the world’s golf courses. National Geographic (2010) estimated 2 billion gallons were used daily to irrigate US golf courses. Which, if correct, pales right pales in comparison to the ethical question, which is not foremost among US citizens. Several examples illustrate water’s moral dimension (National Geographic).

- Americans use about 100 gal of water daily at home.
- Millions of the world’s poor subsist on less than 5 gal.

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8 Personal communication, Dr. Reagan Waskom, Director, Colorado Water Institute, Colorado State University, Fort Collins, CO.

9 US agriculture irrigates 56 million acres, 14 million acres (25%) are irrigated by the Ogallala aquifer. It is used in Nebraska, eastern CO and NM, and western KS, OK and TX. In 1990, it was estimated the aquifer held 3.2 billion acre feet. Eight percent (270 million acre feet) had been withdrawn by 2007. The aquifer recharge balances withdrawals in parts of NE but consumptive withdrawals exceed recharge in other states. Current annual consumptive withdrawals are 19 million acre feet. Personal communication, Dr. Reagan Waskom, Director, Colorado Water Institute, Colorado State University, Fort Collins, CO.
Women in the world’s poor countries walk an average of 3.7 miles each day to get 5 gal of water.

Forty six percent of the earth’s people do not have water piped to their home.

One of eight (12%) of the world’s people lack access to clean water.

3.3 million people die annually from water-borne diseases.

**Highlight 11.2**

Coleridge had it right when, in 1798, he published the first version of the *Rime of the Ancient Mariner*:

**As idle as a painted ship**

*Upon a painted ocean.*

*Water, water, everywhere,*

*And all the boards did shrink;*

*Water, water everywhere,*

*nor any drop to drink.*

That is a reasonable description of water supply for many people in the world. Water is the most common substance on earth, but 97.4% of it is in oceans. Of the 2.6% that is fresh water, almost 2% is in polar ice and glaciers. All that is available to us in rivers, streams, lakes, and groundwater is about 0.32% of all the water on earth. That is all we have to drink, bathe in, swim in, irrigate crops with, and do all the other things we do with water. It takes about 2 liters per person per day to keep us hydrated. That is about the volume of 5.6 cans of soda pop. For a life acceptable to most people in the world’s developed countries, each person requires about 22 gallons a day, which equals 7900+ gallons per year. That means the planet’s water supply could support a population of 20 to 25 billion people or 3.5 times the present population.

No matter what we do, we cannot affect the total amount of water on earth but we can and do affect its quality. Postel (2000) asserts that because water is essential to the lives of humans and all other creatures, every decision made about water is an ethical decision. There is a finite supply of usable water that can support life. We value a continued healthy life, but Postel makes the moral claim that no living creature has a greater right to life than any other living creature. Environmental preservation and sustainability, for all creatures, are dependent on water.

In the United States, about 85% of the fresh water used is used in agriculture and most of that (at least 80%) irrigates crops. Most US irrigation is in the 17 Western states, on 12% of the US crop acreage that produces 27% of the US crop value. Worldwide, about 18% of crop land is irrigated, and that land produces about one-third of the world’s crops.

The following are some examples of the dimensions of the water problem.

- An unrealized (in 2011) Colorado plan illustrates the urban rural water dilemma. Suburbs of Denver formulated a plan to bring water from northeastern Colorado to thirsty front range cities through a 140 mile pipeline that will cost more than $1 billion. Farmers were to be paid to fallow 20% of their land each year and sell the water to the front range cities.
• An estimated 2 million children die each year (6,000 each day) from diseases linked to bad water. Most of these children live in Africa and Asia, but some live in the United States and Europe.

• The world’s golf courses use 2.5 billion gallons for irrigation each day. The same amount of water would support 4.7 billion people with the UN daily minimum intake (World Watch March/April 2004, p. 36).

• My household water costs $34.50 per month for up to 5000 gallons. I irrigate pasture for sheep. My allocation is 4 acre feet/share at $110/share (1 acre foot = 325,000 gal). I pay the bargain rate of $0.42 for 5000 gals of irrigation water. Almost 60% of the world’s fresh water withdrawals are for irrigating agricultural crops. In 2000, this amounted to 137,000 million gallons per day (153,000 acre feet per year). The amount of fresh water stored behind dams has quadrupled since 1985, and agricultural use has exceeded long-term supplies by 5% to 25%. By 2030, most estimates project that farmers will need 45% more water and probably won’t get it due to demand and power of urban users. What we choose to eat and how efficiently it is produced matter. It takes 1150 to 2000 liters of water to produce 1 kg of wheat and about 16,000 liters to produce 1 kg of beef.

• The wetlands area (150,000 acres) of the Colorado River delta receives about 0.1% of the water that once flowed through it. The same area could be covered to a depth of 2 feet with water drawn from the river by the city of Las Vegas, NV, which uses much of the water to irrigate more than 60 golf courses (World Watch March/April 2004, p. 36).

• The human demand for water has been particularly devastating to wetlands. Globally the world has lost half of its wetlands, most in the last 50 years. One-fifth of the world’s fresh water fish are endangered, vulnerable, or extinct (see Greenbiz.com Feb. 5, 2003).

• Wealthy citizens of the world spend US $14 billion on ocean cruises each year. According to the World Watch Institute (State of the World 2004, p. 10), US $10 billion annually could provide clean water to the estimated 1.1 billion people who lack it, in a world that spends about $240 million a day on tobacco products.

• The Glen Canyon dam created Lake Powell, which was designed to hold 24.3 million acre feet of water. In 1999, the lake was full, forcing water releases. In April 2004, the lake had only 10.2 million acre feet (42% of capacity), a level last seen in 1971. Given the continuing drought in the Western United States, experts predicted in 2004 that the lake could be dry by 2007. However, in July 2011, Lake Powell was 45.8 feet below its full level and 72.9% of its full capacity (24,322,000 af). In 2004, Lake Mead behind Boulder Dam was at 59% of capacity. Partially due to the upstream Lake Powell, scientists predicted in 2008 that there is a 50% probability that Lake Mead would be completely dry by 2021, because of climate change and unsustainable overuse of Colorado River water. The conclusion was the lake was at or beyond the sustainable limit of the Colorado system. The alternative to reasoned solutions to the coming water crisis is major societal and economic disruption in the desert Southwest; something that will affect all who live in the region.

In 2010, the prediction was that if Lake Mead's water level drops below 1075 feet, it will automatically trigger emergency measures, including rationing, agreed on by
the seven states that depend on Lake Mead’s water. Ironically, the proposed rationing does include California, whose water demands get first priority.

- Half of all the world’s hospital beds are occupied by people with water-borne diseases.
- In India, only 30% of the population has access to clean water. India has 2.2% of the world’s people, 4% of its fresh water, but 17% of its population.
- Over-pumping of ground water is causing water tables to decline in important agricultural regions of Asia, North Africa, the Middle East, and the United States. The quality of groundwater is also declining (State of the World—2004; Worldwatch Inst., p. 17). The Ogallala aquifer, the nation’s biggest source of underground water, is being drawn down eight times faster than the rate of replenishment. Total decline of the Ogallala reservoir since it has been monitored is about 200 million acre feet. It provides about 25% of the irrigation water used in the United States (14 million acres in Ogallala, 56 million total). Egan (2006) estimates that the rate of decline in Ogallala is about 1.1 million acre-feet a day. This is for withdrawal without recharge. The USGS estimates annual withdrawal is 19 million acre feet, still a large amount.
- Annual water withdrawals per person in cubic meters. Withdrawal is not equal to consumptive use. The thermoelectric (power generation) sector withdraws more water than agriculture but consumes very little.

<table>
<thead>
<tr>
<th>Country</th>
<th>Withdrawal</th>
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<tr>
<td>US</td>
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<tr>
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<tr>
<td>Germany</td>
<td>712</td>
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<td>China</td>
<td>431</td>
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<td>UK</td>
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</tr>
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More than a third of the world’s people may soon live in areas that are water stressed. One can only conclude that water will be one of the primary factors that limits future world population growth and economic development. It is right to begin to consider if the proper goal is water for the wealthy nations or fresh water for the two-thirds of the world population that faces daily water stress?


No irrigation-dependent society, with the possible exception of Egypt, has survived, all have failed due to water logging or salinization of the soil, or both. “The overriding lesson of history is that most irrigation-based civilizations fail. As we enter the third millennium A.D., the question is: Will ours be any different?” (Postel, 1999, p. 12) It is accepted that these failures have been caused by poor irrigation practices, but salinization and water-logging of soil still occur. The question is an agricultural not a moral issue. However, we must also ask if feeding the rich by using water to maintain growth of expensive crops, irrigating golf courses, and consumptive home
use, should rank above the very survival of others (see Singer, 2009). Those are moral questions.

**Climate Change**

When addressing climate change/global warming, a major issue for most agricultural scientists, we humans have an advantage over other species. We are able to think ahead—anticipate the future—and prepare for change. We don’t always use our advantage. It is likely that the earth will be at least 3°C warmer at the end of this century than at the beginning of the industrial revolution. The accepted projections by crop ecologists are that for every 1°C (1.8°F) rise in average temperature, wheat, rice, and corn yields are likely to decrease 10%. Days above 30°C can decrease yield at least 1%; days above 32°C may be twice as harmful. This is especially important in much of the corn growing region of Africa. If drought is added, the effects multiply. The Intergovernmental Panel on climate change forecast that the models are not keeping pace with the change. Greenland is losing about 52 cubic miles (miles is correct) each year and melting is increasing. Food security will become a major issue for the rich and the poor. The rich in industrial nations will be able to deal with global warming and higher food prices. The poor cannot.

Food production is a major issue, but there are also important environmental issues: Yellowstone Park is experiencing more severe fires, partially due to climate change, which could shift forests to the North and by the end of this century, Yellowstone could be dominated by scrub and grasslands. Few doubt the scientific basis of the projections. Many fear the presently inadequate policy response. Skepticism that the political response will be adequate dominates.

Climate change may shift agro-ecological zones away from the equator toward the poles (Zilberman et al., 2004). The International Food Policy Research Institute (IFPRI) found that nearly all the results of climate change studies suggested yields of the world’s primary cereal crops (wheat, rice, corn) are likely to be lower in 2050 than they were in 2000 (Economist, 2011). Half the studies predicted reductions between 9% and 18%. Wheat was the most vulnerable crop. However, although the planet has warmed during the past 30 years, temperatures in the mid-US, where up to 50% of corn and soybeans are produced, have not warmed. No one knows why and no one knows if it will last. Severe drought in 2011 in the southern US reduced the winter wheat crop. The results of a study by Deschênes and Greenstone (2007) were sharply different than most others and critically disputed by others (Fisher et al., 2007). They conclude the effects of climate change will be insignificant or positive and project that it will increase annual profits on US agricultural land by 4% or $1.3 billion (in 2002 dollars). Similarly, some argue that because plants require carbon dioxide for photosynthesis, increasing atmospheric levels will enhance

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10 Severe fire frequency which was once every 100–300 years has become once every 10 years.
photosynthesis and yield will increase. Wheat will benefit enough to offset some of the negative temperature effects. Increasing carbon dioxide increases the efficiency of water use by rangeland grasses and unfortunately some weeds, which results in more growth for warm-season grasses (Morgan et al., 2011). Corn, which uses a different photosynthetic pathway, may lose efficiency.

As the planet warms, some species that are wanted or liked are likely not to have an important advantage that the unloved have. Insects, diseases, and weeds can and will adapt more easily to warming than large mammals and trees. They evolve quickly and unfortunately for agriculture, many are pests. There is a term for the fate of species that cannot evolve to keep pace with the change: extinction. Gardner (2006) claims climate change is humanity’s most urgent environmental challenge because it:

- Is global in scope.
- Has the capacity to remake human civilizations (i.e., ice melting in the north could shut down the Gulf Stream; Europe’s temperature would plummet).
- Brings a cascade of unpredictable effects. Of special importance to agriculture are the unknown effects on pests.
- Is occurring faster than predicted.
- Could soon become irreversible.

Berry’s (1999, p. 104) always wise counsel is that human “ethical traditions know how to deal with suicide, homicide, and even genocide; but these traditions collapse entirely when confronted with biocide, the extinction of vulnerable life systems of the Earth, and geocide, destruction of the Earth itself.” Climate change challenges our ethical foundation in both respects. Berry claims that the danger to and misuse of the earth stem from deficiencies in the “spiritual and humanist traditions of western culture.” Both are primarily or exclusively committed to human domination of the earth and its resources.

**Pollution**

Soil erosion depletes agriculture’s ultimate resource and lost soil pollutes water. Erosion increases the amount of dust carried by wind, which acts as an abrasive and can carry about 20 human infectious disease organisms, including anthrax and tuberculosis. About 60% of eroded soil ends up in rivers, streams, and lakes, making them more prone to flooding and contamination from applied fertilizer and pesticides. Fertilizer in soil leads to eutrophication of rivers, streams and lakes, loss of biodiversity, groundwater and air pollution, and soil and water acidification. Between 30% and 80% of applied nitrogen is lost to the environment (Conway and Pretty, 1991). The relationship between fertilizer use, soil erosion, nitrogen runoff, and the dead zone in the Gulf of Mexico was mentioned in Chapter 1. Harm to nontarget species from pesticide use in production agriculture is a major ecological concern. Global pesticide use has increased from almost none prior to 1950 to 4.7 billion tons per year. The 3 million cases of pesticide poisoning in the world each year (WHO, 1990) mean that, on average, six people are poisoned by pesticides somewhere in the world each minute. Of those poisoned, 220,000 die, mostly in the world’s developing countries (WHO cited by Pimentel and Greiner, 1997, p. 52).
To double food production to meet expected demand will exacerbate these problems. Doubling with present technology will require increasing application of nitrogen and phosphorus by more than 2 times. Humans already release more nitrogen and phosphorus to terrestrial ecosystems than all natural systems combined. Doubling food production will increase eutrophication of marine ecosystems, loss of biodiversity, and groundwater and air pollution (Myers, 2009).

**Loss of Farmers**

Soil is agriculture’s most important productive resource, but farmers are agriculture’s primary knowledge resource. Most nonfarming people regard farming and ranching as a routine, humble, nonintellectual activity performed by people (usually, it is assumed, by men) who are fundamentally, poorly educated hicks. They farm because they chose to or could not make it in a more challenging career. Nothing could be further from the truth. Farmers and ranchers are the custodians and stewards of the world’s productive land and they are disappearing rapidly. We may be compelled to decide that lots more of them are needed. We may decide they should be paid to be stewards of the land and ecological care takers as well as producers. Those who derive their primary income from farming were fewer than 960,000 in 2002, less than 1% of the US population. Forty percent were over 55 and twenty-six percent were over 65. The number of full-time farmers less than 35 has steadily declined to 5.6%. Thus, the few who know how to care for the world’s most important resource, the land, is declining as their average age increases. Average farm size was 140 acres in 1910, 216 in 1950, 464 in 1992, followed by a decline to 418 in 2009. There were 6.5 million farms in US in 1935; about 2.4 million in 1980 (Gardner, 2006) and 2.2 million in 2009. While the number of farms and farmers has declined, production per farm and farmer has steadily increased, labor required has steadily decreased, yield per acre has increased, and the cost of food to consumers has steadily declined as the farmer’s share of the food dollar decreased (Gardner). Of the remaining farms, 61% of sales is captured by 163,000 large, industrial farms and most of these are contractually tied with a corporation in a prescribed value chain that obligates them to produce for and sell to the corporation and thus they have ceased to be traditional family farms (Kirschenmann, 2000a) where the farmer owns the land, makes the management decisions, and provides most of the labor.

**Highlight 11.3**

Visit [http://www.kansasfreeland.com](http://www.kansasfreeland.com) (accessed 2005 and August 2011) to learn that if you are willing to move to Plainville, KS or one of 10 other cities, you can obtain a building lot for free. Plainville (population just over 2000) in Rooks County (population 5,800) of northwest Kansas, is offering free 143 by 175 foot lots for the construction of new homes. The North Town Addition project will give people a chance to build a home and live in a small-town
atmosphere, and at the same time, have big-city conveniences not far away. In May 2005, four building lots were available on a first-come, first-served basis. Several communities in Kansas are offering free land and other incentives. The goal is to keep rural areas viable and promote economic growth.

In the first edition of this book, Chugwater, WY had a similar program. In 2000, the population was 244, with a median annual income of $23,750. The average temperature was 46.7 in January and 69.4 in July. The wind blows most of the time. Beginning in May 2005, but no longer, Chugwater granted newcomers a 100 by 120 foot city lot, if the applicant agreed to build a house and live in it for 2 years. If you like peace and quiet, Chugwater may still be your place. In 2000, the town had no policeman, no traffic light and not much traffic, no grocery store, and no bar, but it did have a soda fountain with 48 flavors of milkshakes (see Denver Post April 24, 2005, p. 1a and 8a). In 2011, there is a sheriff in town, still no traffic light, not much traffic, and no grocery store, but there is a bar at the Buffalo Lodge and Grill. The Soda Fountain still offers lots of choices for malts and shakes, and if one wants peace and quiet, it is a great place to live.

Rural America is emptying. Almost 700 rural US counties lost more than 10% of their residents between 1980 and 2000. Most, but not all, are in the Central Great Plains. In 1900, 60% of the US population was engaged in some kind of agriculture; today less than 2% is and their number is declining. Fewer than 4% of US farms produce about 56% of all agricultural sales. In Colorado, nearly 6 million acres were “developed” from 1992 to 1997; more than double the conversion rate from 1982 to 1992. There are a few exceptions, but in most US states, census data show that, the number of farmers declined from 1940 to 2000 and the size of farms increased. The average age of US principal farm operators was 55.3 years in the 2002 census and has increased in each census since 1978.

Use of these data often elicits an accusation of nostalgia for the good old days. I am guilty. I am nostalgic for what I know I have lost. The challenge then goes on to assert that society does not have any obligation to preserve or to save what someone may love. The corner gas station is gone. The Mom and Pop grocery store has disappeared in most places, and few lament their passing. Are there any rural blacksmiths left? It is progress, and one gets in its way at one’s peril.

Small farms are economically (they make little, if any, profit) and productively inefficient. Yields are frequently high per unit area, but total production is low. Our economic and production system compels small farmers to use technology that they may know is not sustainable and is not compatible with being a good farmer. Survival has a higher value than environmental correctness. Small family farms may not be good stewards of the land. Without thinking about it, the American public has tacitly agreed with the political decision to let small farms disappear. They are small, after all, and they disappear quietly
without political turmoil. Those affected don’t demonstrate in city streets, they don’t riot or cause riots; they just go away quietly.

What we are headed toward is a food system that is supplied by 50,000, or so, large farms and ranches each of which will be efficient and productive. That is what will be gained. What is lost? When we lose farms and ranches where a family owns a majority of the capital resources, makes the important management decisions, and provides most of the labor, have we lost anything else? We have lost a group of people who have a daily, personal contact with nature. People who create, populate, and assure the continuance of rural communities with a social contract that works. These folks are in it for the long haul. They create sustainable human and agricultural systems. Their communities have a tightly knit social fabric that seems to be the antithesis of the alienated urban centers where most Americans live. We have also, in a very real sense, lost our seed stock. Those who teach in land-grant agricultural universities can teach students a lot about farming and ranching but to really learn how to farm or ranch one must walk the land with a farmer or rancher. That knowledge base is disappearing. We always think we know what we are doing and what we are gaining. Dwelling on what we are losing, as we gain is not just foolish nostalgia.

So what? We no longer need a large number of automobile producers to make all the vehicles we need. Why do we need all those farmers and ranchers? Consolidation has been beneficial in most manufacturing industries and, it is assumed, it ought to be in agriculture as well. With ever-improving agricultural technology small, inefficient producers are simply not needed. We need production, and if it can be done best (i.e., at lowest cost) by a few producers, then it should be, even if that means moving much of our food production outside US. That is the nature of the capitalistic enterprise. Capitalism, a process of creative destruction, has winners and losers. The latter, ideally, are absorbed by the winners, the more efficient enterprise. However, as family farms are lost, we will lose the rural communities that the farms and ranches created and sustained. That loss is also regarded by many as a loss that removes a problem, but does not create one. No one, it is claimed, wants to live in rural backwaters that have few of what many assume are the required amenities of modern life (convenient entertainment, places to buy almost anything, fast food, convenient coffee, and so on). However, if these places are the source of important American values and if the people who inhabit them take care of the land, we may lose those things as well. Economists and consumers understand what cheap food costs but it is much more difficult to place costs on qualitative things: the lives of farm families that are destroyed when the farm is lost, the loss of communities, the loss of heritage. We do not understand these costs, because we calculate only what can be quantified. We don’t know how to calculate the costs of fundamentally qualitative things. It is worth thinking about.

After spending my career teaching agriculture in a university, it is hard to admit, but undeniably true, that one cannot learn how to farm or ranch in a university. One
can learn a lot about farming or ranching and about techniques and technology. But if one wants to learn how to farm or ranch, one must ask (must study with) a farmer or a rancher. They are the best teachers and they are disappearing. According to the US Dept. of Agriculture,\textsuperscript{12} Gardner (2006), and Dimitri et al. (2005), the number of farmers has been declining in nearly all US states. We do not understand what the costs of the loss of their experiential knowledge may be.

Some countries have capital to export, but must import food because their land resource is not adequate to feed a large, growing population. Food production is being outsourced to countries that need capital and have abundant land. Capital-rich nations acquire the right to produce food elsewhere. They fulfill their obligation to provide food for the people and thereby recognize the absolute necessity of land. Rich importing nations are acquiring vast tracts of farmland in poor countries. Supporters of these arrangements claim the rich, importing country provides new seeds, technology, and money for agriculture, which poor nations do not have, even though agriculture has been the basis of their economy for decades. The projects claim they will improve agriculture. Opponents say the projects are primarily land grabs and argue that poor farmers will be pushed off the land and the people or the country will not be helped because all the food is exported. There are reasons for skepticism, but it is too early to tell if these programs will reverse the decline of farming in poor countries. The point is that rich countries with minimal land at least tacitly admit that if food is to be produced, land and farmers are the essential resources.

**Population**

The world’s population is still growing, and barring a major disaster (earthquake, nuclear war, massive flooding, worldwide disease epidemic, and so on), it will continue to grow for the next few decades, but the growth rate (1.4% per year, \textit{World Bank, 2002}; 1.2%, \textit{World Bank, 2010}) will continue to decline. One cannot blame those who practice agriculture for population growth but agriculture’s role is clear. Without production increases, it will not be possible to feed the expected increase in population. There will not be enough food. Agriculture’s practitioners have always claimed credit for feeding people, therefore they must share at least some of the blame for population growth. Most of the problems enumerated herein were, at least partially, enabled by agriculture’s adoption of practices that increased production, while creating societal externalities. As mentioned previously, the human ecological footprint (see Wackernagel and Rees, 1996) has grown due to the increased wants of the rich and to the sheer increase in the number of people the planet must support.

**Dominant Scientific Myths**

\textbf{Kirschenmann (2000b)}, and other thoughtful commentators on agriculture know the agricultural myth that production is all that matters must be abandoned. Production

does matter, but it is not all that matters. We must acknowledge that agricultural practice has caused real, enduring harm to the environment and to people (e.g., migrant labor and small family farmers who have been driven off the farm). As we dispense with pervasive myths about agriculture, we must also dispense with the scientific myths that pervade agricultural and general science. They have been described by Sarewitz (1996, Chapters 2–6) and cited by Busch (2000, pp. 66–67).

When science began, the intent of most scientists was to explore and understand nature’s complexity. This was the only course available, because scientists had not yet developed the ability to command or attempt to dominate the natural world. Early agricultural scientists and farmers might have wanted to dominate and subdue nature, but they could not. Humans were dependent on and subject to the natural world. Farming often failed due to bad weather, poor fertility, lack of water, or pest outbreaks that could not be controlled. As science developed, efforts were more and more directed toward developing “technologies that could extract economic benefits from nature” (Kirschenmann, 2002). For example, in weed science the emphasis nearly from the beginning has been on ways to kill weeds selectively in crops. Only recently has it turned toward developing an understanding of the complex biological systems in which weeds occur and often dominate. Weeds were regarded as inevitable companions of growing crops. They were the inevitable outcome of the way crops were grown. They were not seen as problems of the production system that, if modified, might be diminished. That view is changing.

It is a certainty that over time, agricultural scientists have developed myths (stories to explain a phenomenon of nature) that guide the conduct of the science. The dominant and commonly accepted myths about science govern not only the science that is done but also its public acceptance and social consequences. Every scientist brings a conception of science to a problem or a new field. There is no such thing as a scientist with a clean slate (Larson, 2004, p. 165). The following dominant myths are unavoidable (Sarewitz, 1996; Busch, 2000).

**The Myth of Infinite Benefit**

This asserts “if more science and technology are necessary for a better quality of life, then the more we spend on research the better our quality of life will be” (Sarewitz, 1996, p. 19). Thus, more science and more technology will always yield more public benefits. The scientific enterprise is seen as separate from society and in a pure utilitarian sense it “exists to provide a constant flow of benefits to all” (Busch, 2000). Sarewitz says many scientists hold that “the more innovation we have, the more competitive we will be as an economic entity, and the healthier we’ll be as a nation.” Science is to be regarded as, and scientists often think of themselves as, people engaged in an activity that provides the greatest benefit to the greatest number of people. This attitude ignores two things: the benefits of science are usually most readily available to the rich, and agricultural research and the resultant technology very often create new, unforeseen problems that have to be solved. The benefits are accepted and credit is sought for solving some problems. Unsolved and new agricultural problems are commonly externalized and become social costs.
Kirschenmann (2002) pointed out that this utilitarian science has at least three unintended consequences. The first is that the scientists often misapprehend the true nature of the problem—why weeds exist in crops may be a more important long-term question than how to control them annually? The dominant question for most agricultural scientists has been how to increase production. This resulted in acceptance of the productionist agricultural ethic defined by Thompson (1995, p. 48), which accepts that any behavior and any technology is good as long as it increases productivity. There was only one imperative: to produce as much as possible, regardless of the ecological costs and perhaps even if it was not profitable to the producer (Thompson). The productionist ethic has become the dominant ethic, because those who practice agriculture have always believed that hard work is followed by an accumulation of wealth, which is morally acceptable. High agricultural production is a sign that the producer has been favored by God’s grace. Thompson suggests that the ethic has dominated because it is believed that to leave land alone is to squander resources provided by God for our use. We are the designated stewards and producing more is the best sign of our stewardship, because production benefits all. Second, Kirshenmann suggests utilitarian science has separated us from nature. Utilitarian science believes that nature is to be used by humans but use has led to abuse. Humans believe that they have been selected to have dominion over and to subdue the natural world to provide the greatest good for the greatest number of people. We are not part of nature, it is a place from which we extract benefits; not something to which we belong. While abuse may not be the intent, it is the inevitable result of modern agricultural practice. The experts who conduct agricultural research and those who apply the resultant technology to produce food have not paid much attention to the long-term ecological and social effects of the enterprise because the immediate utilitarian benefit of production has been apparent and welcomed. The productionist ethic is bankrupt (Kirschenmann, 2004), because it fails to prescribe any standard for agriculture that views nature as anything other than a static, mechanistic structure that can be and ought to be controlled by humans with technology. It assumes nature is stable and largely immune from harm and it assumes that agriculture operates in an economy where value is solely determined by price (Kirshenmann). Because the evidence is clear that the productionist ethic has led to more harm than good (Green et al., 2004), a new ethic is demanded that guides an agriculture that does not ruin the ecological and social communities on which its success and future are dependent. The history of agriculture is replete with examples of ecological failure in single fields and for entire civilizations (Thompson, 1995, p. 76; see McNeill, 2000) but agriculture’s practitioners, in their quest for greater production have ignored their own history. In Logan’s (1995) view, ignorance is at the base of the problem. “More technology, greater planting rates, more intensive use (of soil), greater dependence on larger holdings, and fewer farmers are supposed to save the day. Instead they hasten decline.”

The Myth that Science and Scientists are Value Free

When I was a student, I don’t recall any professors who made the explicit claim that science was value free. Of course, one might argue that I don’t recall much of what I
learned during my student days. However, I did learn or acquire the fact that science is value free and presumably free of the constraints of ethics; an unexplored topic. I and my student colleagues learned that science and scientists value objectivity over subjectivity. Subjectivity, I learned, is the realm of values. Objectivity, the scientific approach, is a “value-free” position. This illustrates what Rollin (2011, p. 91) identifies as an “ideological ubiquitous denial of the relevance of values in general, and of ethics in particular, to science.” The denial blinds scientists to moral issues, which are often at the heart of societal concern about science (Rollin). The argument that science is value free is one of a number of value claims and ethical issues that are fundamental to the scientific enterprise. Science includes a mind-set that assumes certain value claims. Its foundation stands within the arena of values and ethics. For example:

- Objectivity is valued over subjectivity.
- Because science is value free, considering the ethical implications of scientific research is not necessary.
- Human life is of greater value than other forms of life.
- Only humans deserve moral consideration.

Claims that value judgments, ethical arguments, and moral questions stand outside science betray a naiveté regarding the assumptions on which science rests.

I and my student colleagues learned that the difference between empirical (scientific) facts and value judgments is that only the former are meaningful. We learned we were logical positivists although none of our teachers ever used or defined the concept. Scientific education and subsequent thought was guided and perhaps distorted by denial of the meaningfulness and relevance of value questions. Science dealt with facts. Ethics deals with what ought to be, with values. One should not, indeed one cannot, get values from facts. Facts do not provide reasons for action. Facts help us make sensible decisions, but no amount of facts can make up my mind about what I ought to do (Singer, 1981, p. 75).

Opponents of scientific technology deserve to be heard, as they raise issues that ought to be addressed by the scientific community. Those who take different positions on the proper value orientation of (pesticides, biotechnology, or sustainability) should not be dismissed because, it is claimed, they simply muddle scientific debate with irrelevant ethical arguments and moral claims, which, of course, is a position with a moral foundation, albeit an unrecognized one.

The Myth of Unfettered Research

This myth asserts that any scientifically reasonable basic research—the study of fundamental natural processes—will yield social benefits, ought to be permitted, and be publicly funded. Scientists are well-educated people whose specialized training demands they be detached from the concerns of daily life—a value—so they can pursue scientific interests that will advance the frontiers of knowledge and improve human life (Busch, 2000). In fact, “researchers motivated by curiosity about nature have produced a great abundance of startling, unexpected and marvelous discoveries
over the past fifty years” (Sarewitz, 1996, p. 48). This myth is related to the belief that the scientist, qua scientist, engaged in research using the scientific method is and should be unhindered by values. This is patently false. “Political and historical milieus strongly influence the course of basic research” (p. 39) in all scientific fields. Agricultural science, like all science, is controlled by the constant, required quest for funding. Legislators and funding agencies have priorities that value some lines of research more than others. Therefore, agricultural research and the scientists who conduct it are not unfettered. They are tightly bound in a vortex of largely unexamined and unquestioned values.

**The Myth of Accountability**

This claim is that peer review of scientific results prior to publication and the necessity of repeatability of conclusions are sufficient to maintain the intellectual integrity and ethical responsibility of scientists. This neat locution which says—trust me, I am a scientist—leaves out the public, which is asked to fund the work and ignore its consequences. If the research meets the criteria of high intellectual integrity and established scientific standards for performance, then society must be satisfied, even if, as has been the case for much agricultural research, it may have undesirable ecological or social consequences.

This myth is explored in Dürrenmatt’s (1964) play “The Physicists,” in which he asks several relevant questions:

- Is it always best to seek to know everything?
- Who is to be held accountable for the wrongs science commits: those whose work leads to discoveries that harm ecological and social relationships or those who use the work that others have done to cause the harm?
- Can anyone be held accountable for the moral aspects of science?

The play asks the audience to consider, when can one be sure they are doing the right thing, and how does one decide what the right thing is? Dürrenmatt’s work raises important questions of accountability for all scientists. It is reasonable to postulate that science is essential to the solution of many of the world’s problems. It follows then that it is vital that the public’s current high esteem (Sarewitz, 1996, p. 58) for and trust in science must be maintained. The integrity of science does not and cannot end with delivery of a product that is quality controlled and intellectually sound according to science’s internal criteria. The scientific honor code, in Sarewitz’s view (p. 59), is not just about the conduct of science. It must also be about the “ethics and values of science as a component of society.”

**The Myth of Authoritativeness**

The assertion is that science can provide a rational, objective basis for creating political consensus by separating fact from perception. In fact, the opposite seems to be the case: “political controversy seems uniformly to inflame and deepen scientific controversy” (Sarewitz, 1996, p. 77).
Scientists often believe science is objective and value free (see 2 above, Hollander, 2000); therefore, one need only examine the data to know what to do. The falsity of this claim should be immediately obvious. It has been the most contested areas of science that have been the most vigorously debated in the political realm. In agriculture, for example, pesticide use is highly regulated, but there is little political or scientific consensus on the effects of pesticides on human health. Animal rights are also prescribed in law, but there is still great controversy about animal treatment. Most people are meat eaters, but prefer not to know too much about how the animals they eat are treated (e.g., see Schlosser, 2002).

Busch (2000) points out that when scientific consensus emerges, public and political consensus quickly follows. Global warming is a good example of a problem referred to the scientific community by politicians, and, as scientific consensus emerged, international willingness to confront the issues also emerged. But we are a long way from consensus on the use of pesticides in agriculture, confinement rearing of animals, or the value of the productionist paradigm.

The Myth of the Endless Frontier

New scientific knowledge generated at the cutting edge of basic science is or ought to be free of careful consideration of its moral and practical consequences because it will be transformed into new technologies that will be benefit all. Basic science therefore should not be subject to careful scrutiny for its potential consequences because they cannot be known in advance. “Fundamental scientific knowledge is a thing apart, accumulating as if in a reservoir, from which it can later be drawn by applied scientists” (Sarewitz, 1996, p. 98) … who create products and processes. It is the consequences of applied science (technology) that should be of concern and good technological advances are dependent on basic science. Busch (2000) suggests the division is false because basic science and technology are inextricably linked in several ways. Scientific problems emerge from new technologies and most scientific work is dependent on technology developed by science. For example, many university research scientists owe the existence of their position to early observations that some chemicals could be used to selectively control some agricultural pests. Further exploration of pesticides is highly dependent on new chemical analytical technology developed to find pesticide residues.

Sarewitz (p. 103) points that the rise of the environmental movement in the industrialized world marked the end of the myth of the endless frontier. People began to recognize that the conquest of the frontier enabled “liberation from elemental want” and a steadily rising standard of living, but carried with it an “acceleration of exploitation, modification, and despoliation of nature.” Moral and practical consequences became more or equally as important as material benefits.

Production and Ethics

In spite of the apparent railing herein against the productionist ethic, production is essential. Production of sufficient, high-quality food and fiber is the only viable way to
feed the world’s people (Rist, 1988). However, one must ask production for what and by whom? Agriculture should not abandon its quest to improve and ethically justify production (Kirschenmann, 2004). However, production should not have primacy over everything else. What is needed is public participation in development of an ethical foundation that considers the priority of production in comparison to ensuring the need of all humans for food is met (Rist, 1988). It is an important issue that ought to be part of discussions of agriculture’s ethical horizon, but it has not come to the fore. It is readily acknowledged that agricultural systems must be highly productive and sustainable. That affirmation is consistent with agriculture’s moral obligation to feed the world. But it has not been accompanied by debate about whether or not there is a human right to food. The Scandinavian nations have done more per capita than others to fulfill the duty to give food and other types of aid to developing countries. Food aid is a priority for international aid agencies (especially the World Food Program) (Thompson, 2010). But in spite of their commendable efforts, a human right to food has not been affirmed. I recommended that agricultural organizations should formulate and prominently include in their mission and objectives a statement of their ethical position that recognizes the obligation to conduct agriculture “in a manner that makes a decent life for humans possible while, at the same time, retaining the ecological dynamics that sustain life on the planet” (Kirschenmann, 2004). It must be an ethic that is human oriented but acknowledges the ecological relationships that make farming possible. Part of achieving food for all is ensuring that markets function to achieve distribution to the one billion people who are not fed well. Markets are essential to the task. To achieve this requires that those involved in agriculture cooperate with all members of the general society. Creating a sustainable agriculture is not and cannot be just an agricultural responsibility, it is a social responsibility (see Chapter 7). It is an agricultural task in that those who practice agriculture must change some of their practices. Some changes that should be considered include (Rist, 1988):

- Reducing losses. Losses during harvest, postharvest storage, and processing should be reduced. Agriculture could lead the way toward a true recycling economy, where the waste from one enterprise becomes the feed stock for another.
- Ending wasteful habits. There are clear, well-reasoned arguments concerning the moral status of animals (e.g., see Cavalieri, 2001; Rollin, 1989, 1992; Singer, 1977, 2002; and others cited in Chapter 10). There are equally clear, well-reasoned arguments that animals are essential to a truly integrated, sustainable agriculture (von Kaufmann and Fitzhugh, 2004; Smil, 2000; Chapter 10). This debate must be resolved and part of the resolution will be a diminution of the excessive consumption of meat by the rich, which is harmful to human health and wasteful of resources (e.g., land and grain) that could be used to feed people.
- Ending pollution. Pesticide use, especially prophylactic use, and excessive fertilizer use will have to be diminished. Erosion of soil must decrease to protect our most valuable environmental resource and to diminish water and air pollution.
- Policy changes. If the public wants farmers to conserve energy, reduce pollution, and promote ecological stability, policies that reward farmers for adopting such practices will have to be developed. Most farmers know how to farm in ways that prevent soil erosion, do not mine water, reduce pollution, promote animal welfare, and achieve ecological harmony. Present government and market policies that reward only production must be changed so desirable practices are rewarded.
The preceding pages have emphasized some of the harms agriculture has done in its endless quest for more production. Those harms have created agriculture’s public image, which is not favorable. Kirschenmann (2000a) proposes that those who practice agriculture must change its public image, essentially because agriculture has lost its connection to the public. Most people in developed countries are not farmers or ranchers and have no connection to the source of their food. People eat but do not know how their food is produced. Kirschenmann said it well:

*If agriculture is purely an industrial act whose only purpose is to manipulate the technologies required to produce some wheat with which we have no connection, that is ground into flour in some distant factory with which we have no connection, made into frozen bread dough in some warehouse-like bakery with which we have no connection, and placed in to a microwaveable plastic container with which we have no connection—and all the while the process may be harming monarch butterflies, or rendering our water unfit to drink, or killing off the fish in our favorite streams—how could we expect the public to support agriculture?*

The Imperative of Responsibility

To create a new, widely accepted public image, those who practice agriculture, those who study it, and all who benefit from it because they eat should consider adopting, as a general standard, what Jonas (1984) calls an ethic of responsibility. The responsibility is to future people, a philosophically debatable proposition because no one knows what the future holds. We cannot know the people who will inhabit the distant future (100 years hence), what their situation will be, or the kind of world they will inhabit, therefore, we cannot assume we are obligated to them. We cannot “catch” them and won’t ever “meet” them because we won’t be there. Jonas strongly suggests that even though these things are true, we ought to accept an obligation to the future. He suggests present humans do not want to (will not) accept an obligation to assure the happiness of future generations if the price is unhappiness or even death of some present humans. Given this position, it is not logically inconsistent, in Jonas’ view, to posit that the price of the happiness and well-being of present humans should not be bought at the cost of the existence or happiness of future generations. The difference in the two cases is that in the first case, the well-being of future humans is ensured, albeit, perhaps, in diminished circumstances, while in the second case, future humans may be eliminated. Sacrifice of the future for the present is logically in Jonas’ view “no more open to attack than the sacrifice of the present for the future.” The imperative thus becomes— “Act so that the effects of your action are compatible with the permanence of genuine human life.” Or, in a negative expression, “Act so the effects of your action are not destructive to the future possibility of such life.” In Jonas’s view, we are obligated to try, to the best of our ability, to create “the conditions for an indefinite continuation of humanity on earth.” Why? Because anyone may choose to risk or end one’s own life, but no one has the right “to choose or even risk, nonexistence for future generations to assure a better life for the present one” (Jonas). It is a compelling moral claim.
According to the World Bank, almost one-half of the 6.4 billion people on earth live on less than US $2 per day and more than 1 billion live on less than US $1 per day. “Some of this misery is caused by incompetent and rapacious governments in the developing world, but not all of it. For more than two decades, dozens of impoverished countries have been forced to spend more money servicing loans outstanding to wealthy foreigners than on hospitals and schools. In many cases, the governments that took out these loans no longer exist, but their successors are shackled by onerous interest payments.”

When one attempts to apply the imperative of responsibility to agriculture, the essential human activity, it is clear that the obligation is a collective not just a personal one. Agriculture is a private enterprise with large public consequences and therefore, the public must act to help create the kind of agriculture that assures “the indefinite continuation of humanity on earth.” To illustrate the point that the achievement of a sustainable agriculture is not just an agricultural responsibility one need only look at some trends in US agriculture. From 1900 to 2000, average farm size more than tripled, the number of farms declined by about one-third, while the number of acres farmed remained about the same. The percentage of the US work force in agriculture declined from almost 40% of the population in 1900 to less than 1% in 1990. The US population steadily increased; farm population steadily declined as did the percentage of the population living on farms. Total farm output declined slightly; required inputs and productivity per worker increased dramatically. The market value of agricultural production became concentrated on fewer farms because of the combined effects of the increased capital requirements in farming, higher levels of costly technology, and higher government price supports. Farming and ranching became more efficient in terms of production per worker, more costly, and less profitable for farmers. Improved technology increased production and created the environmental and social problems that have been mentioned. The ethics of agriculture and the ethical dimension of its many problems have not been of concern within agriculture as long as production increased. The USDA web site (footnote 10) claims there is a recognition among US citizens that “families involved in farming and the diversity of farm operators are important to the cultural identity of our country. The farming and ranching lifestyle is still believed to be an important and virtuous endeavor, worthy of continued support.” The statistical evidence does not lead to the conclusion that those engaged in this virtuous endeavor have received much support to continue or even to survive in agriculture.

Many will argue that the observed trends in agriculture are to be expected. They simply follow the trends of consolidation and promotion of production efficiency in all important industries. If US can be fed by 10 (or some small number) large, highly efficient, well-managed farms and ranches, that will be good for all. The argument is a clear

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**Highlight 11.4**

According to the World Bank, almost one-half of the 6.4 billion people on earth live on less than US $2 per day and more than 1 billion live on less than US $1 per day. “Some of this misery is caused by incompetent and rapacious governments in the developing world, but not all of it. For more than two decades, dozens of impoverished countries have been forced to spend more money servicing loans outstanding to wealthy foreigners than on hospitals and schools. In many cases, the governments that took out these loans no longer exist, but their successors are shackled by onerous interest payments.”

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economic one and is persuasive. It is not a moral argument and as Busch (2000) says, “ultimately moral suasion is more effective for most adults than incentives.” But agriculture has not engaged in moral suasion. Those engaged in agriculture have ignored moral arguments because they have thought they had already won the moral case by feeding people, a morally acceptable act, and ignoring the harms done. No one in agriculture has tried to learn if the public really wants more production if the environmental and social costs remain high. The Green Revolution helped to feed the poor especially in Asia but not in Africa because the successful high-yield crops (wheat and rice) are less widely planted in Africa. The clear environmental and social costs (massive, often inappropriate, pesticide use, loss of genetic diversity, disruption of stable rural cultures, development of a system that favored large farms, small farmers being driven from the land, and development of genetic crop monocultures with increased disease and insect susceptibility) have been high and largely ignored by agricultural scientists and agribusiness people. These costs have been regarded as the price of bounty. Such unexamined, yet certain, moral positions are potentially dangerous because, if they persist, the argument about agriculture’s future may be lost without being engaged.

There is competition and conflict within agricultural science for research funds and attention from the media. There is no concern about agriculture’s moral status because it is not debated. Agricultural science, similar to other sciences, has its scientific facts in order although its underlying theories, which determine what facts are acceptable, may be less certain (Barker and Peters, 1993). Agricultural science suffers in its quest for funding and in its public image because there is not one scientific reality but several, which is as it should be and is not unique to agriculture (Barker and Peters). Scientific advice on public policy issues should, at its best, be conflicting because the social and physical worlds are so. Science in agriculture, or in any other discipline, cannot and should not attempt to give the final definitive answer on what ought to be done in public policy. The task is to interpret scientific findings with all their uncertainty, but not to provide definitive answers to complex social and environmental questions. However, those who give advice will be more certain of their answers and advice when they rest on a firm, well-articulated ethical foundation. A firm ethic is a moral theory in which considered intuitions have been brought into equilibrium with moral principles and scientific knowledge (facts) (Comstock, 1995). If science promotes its technology, as it has in the past, in the absence of moral scrutiny, the results are likely to be technologically successful, as they have been, but the social and ecological effects may discredit rather than honor the scientific developments and the entire scientific enterprise (Wright, 1990, p. 236).

Wildavsky (1995, pp. 439–441) is correct in his assertion that many of the public’s fears about the harm caused by agricultural science have a moral foundation. The fears explain people’s risk perception and may determine government policy, but they are out of place in determining risk consequences. A fear based on a perceived moral wrong (e.g., it is morally wrong to use pesticides that harm humans, nontarget species, or the environment) and the perception of harm, is not the same as the presence of harm. Wildavsky advocates “citizenship in science” as a prerequisite to moral outrage and demands to stop an action or “to get rid of the stuff,” regardless of the cost. What is wrong in Wildavsky’s view is that moral outrage has been allowed
to lead policy in spite of clear scientific evidence, which although the moral outrage is clear, does not support the claim that harm to anything has been caused or is likely to result from continuation of the practice. Those who practice agriculture, those who do agricultural science, and those who raise moral issues and complaints must all be responsible morally and scientifically.

**Finding Partners**

As those engaged in agriculture expand the realm of inquiry about agriculture, they may find it interesting to know who is asking the same questions and with whom it may be good to form partnerships to raise and discuss agriculture’s ethical and other issues. Zimdahl and Speer (1998) examined mission statements of agricultural producer groups and asked if they shared missions and objectives with environmental groups and agribusiness companies. They asked which of these might be the best source of intellectual and moral support as land-grant universities strive to fulfill their mission.15

When discussing interpretation of scientific results with students and colleagues, a common approach is to examine the data. Show me the data is a prominent research theme and pedagogic technique. What the data reveal when expressed quantitatively helps guide one toward the meaning and conclusions of an experiment. Scientists prize and teach students to prize conciseness. When a large truth can be expressed with simplicity and brevity, it approaches scientific truth and perhaps beauty (Krauthammer, 1997). They believe in the wisdom of Occam’s razor: When confronted with two or more explanations for a phenomenon, the simpler, less complicated one is most likely to be correct. The goal is to find simple explanations supported by the data.

Agricultural scientists are continually challenged and frustrated by questions based on feelings or opinions, but not on, or in ignorance of, the data. These may come from colleagues in nonscientific fields or from the general public. They are questions that cannot be answered by the data or by attempts at elegant simplicity, because they originate outside the established bounds of scientific procedure. Questions may be about what the data mean. Often they are about what one intends to do because of the data, or about why such work was done at all. They probe the process and goals of science, but they are not empirical, narrow scientific questions that can be answered by appeals to the data. Ultimately, they are questions about the nature or acceptability of the mission of agricultural science and the techniques used to accomplish the mission.

The purpose of Zimdahl and Speer’s (1998) paper is to examine divergent views of agriculture and its mission. Publicly available mission statements or statements of objectives from 16 agricultural businesses, 22 agricultural producer and allied groups, and 25 environmental groups were examined (Table 11.1). In 2011, mission

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<table>
<thead>
<tr>
<th>Agribusinesses (13)</th>
<th>Producer and Allied Groups (21)</th>
<th>Environmental (25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgrEvo (only 98)</td>
<td>Ag in the classroom</td>
<td>California Food Policy</td>
</tr>
<tr>
<td>American Cyanamid (only 98)</td>
<td>Agricultural Women's Leadership Network</td>
<td>Advocates</td>
</tr>
<tr>
<td>Archer Daniels Midland</td>
<td>Agriculture Council of America</td>
<td>Californians for Pesticide Reform</td>
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<td>BASF</td>
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<tr>
<td>Bayer</td>
<td>American Agri-Women</td>
<td>Campaign for Food Safety</td>
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<tr>
<td>Cargill</td>
<td>American Egg Board</td>
<td>Center for Food Safety</td>
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<tr>
<td>Conagra</td>
<td>American Soybean Council</td>
<td>Center for Rural Affairs</td>
</tr>
<tr>
<td>Continental Grain (98)</td>
<td>Animal Industry Found.</td>
<td>Center for Science in the Public Interest</td>
</tr>
<tr>
<td>Dow Agro-Sciences</td>
<td>Council for Agric. Sci. and Technol. (CAST)</td>
<td>Consortium for Sustainable Agriculture Res. and Education</td>
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<tr>
<td>DuPont</td>
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<tr>
<td>Farmland Industries, Inc.</td>
<td>Dairy Management</td>
<td>Consumers Union</td>
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<tr>
<td>Monsanto</td>
<td>Farm Bureau</td>
<td>Environmental Defense Fund</td>
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<tr>
<td>Mycogen</td>
<td>H.A. Wallace Institute for Alt. Agric.</td>
<td>Food Research and Action Center</td>
</tr>
<tr>
<td>Novartis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhône Poulenc (only 98)</td>
<td>National Agric. Inst. for Alt. Agric.</td>
<td>Greenpeace International</td>
</tr>
<tr>
<td>United Agri Products</td>
<td>National Agric. Center and Hall of Fame</td>
<td>Interfaith Center on Corporate Responsibility</td>
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<td></td>
<td>National Cattlemen’s Beef Assoc.</td>
<td>Izaak Walton League of America</td>
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<td>National Corn Growers Assoc.</td>
<td>Loka Institute</td>
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<td>National Cotton Council</td>
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<td></td>
<td>National Council of Farmer Cooperatives</td>
<td>Organic Consumers Association</td>
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<td>National Farmers Union</td>
<td>National Audubon Soc.</td>
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<td></td>
<td>Future Farmers of America</td>
<td>National Coalition Against Misuse of Pesticides</td>
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<td></td>
<td>National Grange</td>
<td>National Resources</td>
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<td>Pesticide Action Network</td>
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<td>Resources For the Future</td>
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<td>Rural Advancement</td>
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<td>Foundation. Int.</td>
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<td>Sierra Club</td>
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<td>The Nature Conservancy</td>
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<td></td>
<td>Union of Concerned Scientists</td>
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<td></td>
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<td>Worldwatch Institute</td>
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</table>
statements for 15 agricultural businesses, 21 agricultural producer and allied groups, and 24 environmental groups were reviewed. A few reviewed in 2003 had merged or ceased to exist. Although each group is involved in agriculture, it was assumed that their separate mission statements would create differing views of what agriculture’s mission is and perhaps what it ought to be. There was no attempt to pick all possible representatives of each group.

The intent was to ascertain if the mission statements of agribusinesses, agricultural producer, environmental groups, and Land-Grant Colleges of Agriculture demonstrated shared goals. A hypothesis was that colleges of agriculture and environmental groups might share goals even though these groups frequently regard each other as adversaries. A second hypothesis was that agribusiness companies do not share missions or operational objectives with agricultural producer groups. Common interests are rare, although they usually regard each other as allies. Zimdahl and Speer (1998) discussed these hypotheses. That discussion continues herein together with a comparison with the mission statements of 50 land-grant colleges of agriculture. A major limitation is confounding of statements. One must assume that members of each group use accurate, descriptive words they believe will convey the intended message to the public.

**Mission Statements (Summary—Tables 11.1 and 11.2)**

Some in each of the four groups proclaim that promotion of the public good is their highest goal. It is an important standard by which they wish to be judged. Agricultural producers and allied groups contribute to the public good by producing food, feed, or fiber. Agribusiness does this by creating the technology for high yields and adding value to farm products. Environmental groups serve the public by working to protect and preserve the environment. Some, but surprisingly very few, mission statements suggest that members of each group agree that environmental integrity is the *sine qua non* for life on the planet.

Although few mission statements say so, it can be assumed, with confidence, that some members of each group recognize the value of good science as a basis for agricultural policy and practice. Science is among the primary tools needed to determine what policy and practice should be. A great deal of agricultural research is done by agribusiness companies. Much (not all) of it is proprietary, which means that, in some cases, neither the process nor the results are published in open, peer-reviewed scientific journals, and are therefore unavailable for use in determining agricultural policy and practice. The results are confidential and used to further the company’s interests, rather than to build the corpus of general scientific knowledge or to serve as a basis for public decision-making. This is not *a priori* ethically objectionable; it is good business practice. The frequently closed scientific community of agribusiness does not have great concern about the importance of public participation and evaluation of their business, but they cultivate a favorable public image. This acknowledged good business practice may not be ethically objectionable, but there is a rising belief in US that companies owe stakeholders (whose number is larger than
the number of stockholders and includes customers, employees, activist groups, agricultural producers, and other citizens) an accurate, complete reporting of their scientific activities, including both positive and negative findings (Grose, 1999).

The mission statements of US state- and federally-supported land-grant universities were studied in 2003 and in 2011. These institutions receive some funding from their state legislature and funds allocated by the Morrill Acts of 1862 and 1890. There are 105 land-grant universities (Rahm, 1997), at least one in each US state or territory. The number includes 29 Native American Tribal Colleges established in 1994. Not all land-grant schools have a College of Agriculture (e.g., New Jersey, Rutgers School of Environmental and Biological Sciences; the University of Rhode Island, College of Environmental and Life Sciences).

Because land-grant universities receive governmental support, it follows that in the democratic tradition, those affected by the consequences of any activity and those who pay have a right to a voice in decisions about the activities supported by their tax dollars (Sclove, 1998). In short, because of the nature of these institutions, in contrast to agribusiness companies, there is an obligation to be open and public about scientific research and its meaning. Further, it should not be assumed that scientists, professors, and administrators of science programs in universities neither have a monopoly on expertise, nor any claim to a privileged ethical view from which to evaluate the declared scientific, social, or environmental missions that affect scientific research, science policy, the use of scientific research, or the public (Sclove, 1998). Based on their 2011 mission statements, none favor public participation and evaluation of their work.

Zimdahl and Speer (1998) suggested that agribusinesses claim that new agricultural technology and current agricultural practices inevitably support the public good by increasing production of abundant, high-quality food, feed, and fiber. Their evidence supports the claim. Environmentally based objections to this view derive primarily from disagreement about all effects of the technology required or advocated to accomplish the goal of feeding the world’s growing population, and secondarily, disagreement on the perceived imperative for increased production to feed a growing world population. Environmental groups often suggest that insider-only approaches to science policy and practice are antithetical to open, vigorous, creative public debate on which democracy and good science thrive (Sclove, 1998), but the mission statements of most environmental groups do mention public participation. Several include the importance of communities and quality of life to their mission. Environmental groups argue (Smith, 1997) that technology developed by agribusinesses in capitalist societies tends “to further social inequality, undermine popular sovereignty, generate environmental crises, and colonize every nook and cranny of everyday life with corporate propaganda.” An agricultural example is the rise and ubiquity of herbicide-resistant crops and their advocacy in print media by manufacturers. A large percentage of US corn and soybeans acreage is now planted with seeds genetically modified to be resistant to one or more herbicides and/or be tolerant of an insect. Questions about the effect of this technology on small farmers and rural communities are asked but largely ignored in promotional material.

Resistance to purchasing genetically modified products in many European countries has been recognized by involved agribusinesses (see Chapter 8). The concern, initially dismissed, was to be overcome through education by company marketing
and advertising groups. This tactic, regarded as corporate propaganda (see Kroma and Flora, 2003; Chapter 3), was dismissed by the public. Environmental problems (some anticipated and others unknown) will likely follow large-scale planting of herbicide-resistant crops (e.g., resistant weeds). Creation of such problems seems to be antithetical to achievement of human-oriented goals that all groups share, and to agribusinesses’ goal of improving business profitability.

Many members of each group, and many scientists, claim that science is value free, a claim that has been dealt with earlier. Science has never been value free. The logic, practice, and results of science are moderated by social and ethical concerns. Rollin (1996) provides examples of the influence of ethics on science, and similar agricultural examples are plentiful. Within agriculture, the massive public and agribusiness support provided for pesticide research versus the comparatively minimal support for organic or alternative agriculture demonstrates the social determination of the subjects that agricultural science investigates. Similarly, there have been few publicly supported investigations of the effects of modern agricultural technology on the survival of small farms and farming communities (see Goldschmidt, 1998). Second, Rollin suggests that social control of scientific methods is demonstrated by the fact that biomedical (and pesticide) research is done on rats, who as subjects have no choice, rather than mentally deficient children, who could not express a choice. At present, pain felt by the rats must be controlled, yet it was not too long ago in biomedical and pesticide research that pain in test animals was not even considered (Rollin, 2011). Most humans recoil at the suggestion that mentally deficient children, who surely would be more appropriate subjects to determine human effects, could be used to test the potential for human harm from agricultural pesticides. It is beyond the pale to even consider such thoughts, and our social ethic tells us so. Finally, the degree of statistical reliability demanded when a new pesticide is being evaluated, versus testing a new survey instrument to determine social opinion, shows the influence of our social ethic. Statistical estimates of performance and safety are demanded and accepted when an agrichemical manufacturer proposes new pesticide chemistry or a new use for an old pesticide to the US Environmental Protection Agency (EPA) or to a state regulatory agency. On the other hand, when one proposes a new ethical standard, statistical probability is not even considered. For example, who would accept the statement: It is likely that in 5% of the cases (95% probability) the public will reject any justification for preservation of family farms. Such a claim accompanied by a probability statement is outside the bounds of moral philosophy. Science, as suggested above, is regarded as value free and statistical probability is appropriate. Ethical matters, on the other hand, are regarded as value laden. Therefore, there is no clear standard of proof because we tell ourselves it is all just a matter of opinion. In science, one can prove within acceptable statistical limits what the facts are. Science, we often think, reveals the truth, unencumbered by value considerations. Ethics, it is thought, cannot reveal the truth because there is no ultimate truth in matters that rest on opinion rather than fact.

Agribusiness does many things superbly, but its marvelous successes in bringing new products to market, satisfying consumer needs (and wants), and creating wealth should not lull us into believing that the ethics of agribusiness (or any other kind of business) are equally applicable to all realms of life. The market, the sine qua non of modern business, deserves a place, and democratic institutions frequently, but not always, provide
controls that keep it in its place (Okun, 1975; Kuttner, 1997). Unfettered markets are regarded as “the essence of human liberty and the most expedient route to prosperity” (Kuttner, p. 3). However, everything must not be for sale (p. 363). The value of business, even in a capitalistic society, is only instrumental, it has no intrinsic worth. According to George Soros, an extraordinarily successful capitalist entrepreneur, “economic theory is an axiomatic system: as long as the basic assumptions hold, the conclusions follow” (Soros, 1997). The predominant words in mission statements (Table 11.2)

Table 11.2 Words and Their Frequency in the 2011 Mission Statements of 13 Agribusinesses, 21 Agricultural Producer Allied Groups, and 25 Environmental Organizations and 50 Land-Grant Universities. Numbers in Parenthesis are the Percent Responding

<table>
<thead>
<tr>
<th>Word Frequency</th>
<th>Agribusiness</th>
<th>Agricultural Producer</th>
<th>Environmental</th>
<th>Land-Grant Agricultural Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human-oriented goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>6 (29)</td>
<td>6 (29)</td>
<td>33 (66)</td>
<td></td>
</tr>
<tr>
<td>Land-grant mission</td>
<td>2</td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Pursuit of knowledge</td>
<td>1</td>
<td>1</td>
<td>41 (82)</td>
<td></td>
</tr>
<tr>
<td>Human progress</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health, well-being</td>
<td>4 (30)</td>
<td>2</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>safety, nutrition, nurture</td>
<td>6 (46)</td>
<td>2</td>
<td>3</td>
<td>24 (48)</td>
</tr>
<tr>
<td>Social goals, justice, Social responsibility</td>
<td></td>
<td></td>
<td>2</td>
<td>36 (72)</td>
</tr>
<tr>
<td>Quality of life</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>24 (48)</td>
</tr>
<tr>
<td>Community</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International service</td>
<td>1</td>
<td></td>
<td></td>
<td>19 (38)</td>
</tr>
<tr>
<td>Feed the world</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental goals</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Sustain agric, conserve restore, preserve env.</td>
<td></td>
<td>10 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustain Inc/Agric. production enhance improve agric.</td>
<td>1</td>
<td></td>
<td>2</td>
<td>37 (74)</td>
</tr>
<tr>
<td>Stewardship</td>
<td>1</td>
<td>1</td>
<td>5 (20)</td>
<td>28 (56)</td>
</tr>
<tr>
<td>Protect nature, preserve respect, biodiversity</td>
<td>1</td>
<td>5 (20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science-based Res/Info.</td>
<td></td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Business goals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit, value, growth</td>
<td>8 (62)</td>
<td>6 (28)</td>
<td>24 (48)</td>
<td></td>
</tr>
<tr>
<td>Economic well-being</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethical standards</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethically responsible</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pursue strategic opp.</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Influence agric. policy</td>
<td>3</td>
<td></td>
<td>5 (20)</td>
<td></td>
</tr>
</tbody>
</table>

16 Numbers in each column are the number of members of each group that used the term.
show that consideration of ethics is included by two agribusinesses but not by any of the other three groups. Moral questions are not addressed by any group’s mission statement. Agribusinesses understandably emphasize profit, growth, and market principles. Table 11.2 shows some, but far from all, of the members of each group include human and environmental concern. Some agribusiness mission statements mention, but few emphasize, the environment or nature. Mission statements of agricultural producer groups rarely include words that emphasize improving environmental quality. All use human-oriented words. Ensuring food supply receives more emphasis than social goals (e.g., sustaining communities, justice, public participation). Promotion of the public good is not to be a high goal. Perhaps the most interesting thing that can be learned from study of the mission statements of a diverse set of organizations is that not much can be learned about the purpose, objective, and overall mission. Mission statements are useful but not conclusive evidence of purpose.

The Role of the University

Universities in general, and those with colleges of agriculture in particular, frequently see themselves trapped among the competing interests (Table 11.2) and demands of the three groups: agribusiness, agricultural producer, and environmental. Well-funded agribusiness is eager to benefit from the intellectual and technological resources of the university to fulfill its research and technology development needs. Most agricultural producer and allied groups regard the university, especially the Cooperative Extension Service of land-grant universities, as an unbiased source of technological and production information about what agribusiness offers. They also fund research, but not at the level agribusiness does. Environmental groups are not notable sources of research funding. They act as a public conscience and are frequent critics of university-based research.

In 2006, private sector funding for US agricultural research and development expenditures was $2.8 billion, federal funding $3 billion, and state and private funding for state experiment stations $2 billion. Gardner (2002, p. 182) showed a steady increase (approx. $40 million per year) for “real” public spending on agricultural research from 1950 to 1990. “In recent years, State funds have declined, USDA funds have remained fairly steady (with changes in the composition of funding), but funding from other Federal agencies and the private sector has increased. Efforts to increase competitively awarded funds for research have fluctuated over time, as have special grants (earmarks). Along with shifts in funding sources, the proportion of basic research being undertaken within the public agricultural research system has declined.” In 2012, USDA funding declined 17%. With declining public funding, university scientists have been compelled to find other sources to support

research and graduate programs. Agribusiness is an obvious and willing source. Those able to attract such support find acclaim within the university. When such funding is sought and accepted, intellectual leadership may pass from the university scientist to the funding source. Thus, land-grant colleges of agriculture that were conceived and designed to serve agricultural producers find themselves compelled to accept funds and intellectual leadership from agribusinesses, whose logical interest in sales and market share may run counter to the best interests of producers. Private R&D funds are understandably commercially oriented. Companies, which must hold down costs, concentrate funds on research that is likely to result in sales and profits, and lead to intellectual property that can be protected by patents. No company is interested in supporting research that will benefit competitors. For example, more than 40% of private agricultural research support is invested in product development, compared with less than 7% of public agricultural research.

The university also finds itself succumbing to demands for service to its “customers,” formerly called students. Now instead of only the student cafeteria, we find McDonalds or Carl’s Jr. in the student center near the flower store, beauty parlor, branch bank, and ATM machine. The library has a coffee and snack shop. Each is regarded as a gain without much thought about what has been lost. We risk losing the university as the locus of intellectual culture which exceeds the sum of its mechanically acquired parts (Readings, 1996, pp. 74–75). We risk losing the essence of the university: a place where thinking is a shared process, a place where one thinks and learns how to think. One could argue that McDonalds and ATMs make allocation of time and money more efficient. Once efficiency is invoked, arguments about what may have been lost fade quickly. It is said that efficiency is one of the things the university must increase or intensify in its quest to be excellent. Readings (p. 119) tells us that the omnipresence of the criterion of excellence in modern universities merely “brackets the question of value in favor of measurement and replaces questions of accountability or responsibility with accounting solutions.”

The university is confronted with instrumental decision-making within an imposed system that ignores the needs and values we live by and want to live by (Readings, p. 94), so the institution can become as efficient as business. The bottom line of a university’s research program should not be measured in dollars or technological advances, but rather in ideas and intellectual creativity (Mac Lane, 1996). Close university/agribusiness partnerships are neither antithetical to ideas and intellectual creativity nor inevitably against the university’s best interest and incompatible with the public good. However, if the liaison becomes too close or if the university becomes too dependent on agribusiness, the central locus of investigation may shift from ideas and intellectual creativity toward the university becoming one site among many where judgment is held open (Readings, p. 120).

Although not unanimous, environmental groups, in general, support Smith’s (1997) strong accusation that “The university is in danger of becoming like the muscle-bound freak with tremendously developed biceps who has lets the rest of his mind and body atrophy. Corporate funds are the steroids.” Corporate funds could also be regarded as the narcotics that lull their recipients into the belief that pursuit of corporate interests (i.e., commercializable technologies) will achieve the greatest good
for the greatest number. It is argued that the pursuit maximizes public good, a stated goal of some agribusinesses. I understand these accusations neither achieve the reader’s acceptance of the premise that agricultural producer’s best friends may be found among environmental groups, nor build consensus for future action. As a strategy to build consensus, Daly (1996) reminds us that “it is probably good to keep the most controversial issues for last, even if they are ultimately the most important. But it would be quite dishonest not to bring them up at all.”

A related and equally controversial issue is the nature of the university’s primary task, which is to take the long view (Mac Lane, 1996). It is important to maintain the essence of the place where one thinks and learns how to think. This view does not emphasize satisfying the wants of the customer of the moment, but rather the legitimate needs of society for years ahead. Universities have existed longer than any modern industrial corporation. They are one of the best ways societies have devised to accomplish the difficult task of discovering and evaluating ideas and transmitting them and the process to new generations (Mac Lane). Of 50 land-grant colleges of agriculture, 33 identified education and 41 the pursuit of knowledge as primary goals. Only agricultural producers (29%) came close to similar emphasis (Table 11.2). Education—transmission of knowledge—is slow and unpredictable and does not fit the corporate competitive model (Mac Lane), which is often the apparent standard for judgment in the modern university. How big one’s grant is seems more important than how big one’s ideas are. If the long view is the correct view of the university’s mission and therefore of the mission of a college of agriculture, one must ask if that view is most compatible with the stated missions of agribusiness, producer, or environmental groups. Which of these groups will be the best sources of intellectual and other forms of aid to the university as it strives to fulfill its mission of discovery, evaluation, and transmission of ideas through teaching, scholarship, and service? Similarly, are the goals of either agribusiness or environmental groups more compatible with the goals of agricultural producers, and how do these groups support producers? Table 11.2 provides some clues but does not answer the questions.

Orr (1994) in his discussion of the problem of education begins by citing a bit from an unpublished paper by Elie Wiesel,19 who noted that the designers of the Holocaust were the heirs of Kant and Goethe and were widely believed to be the best educated people on earth. Wiesel described what was wrong with their excellent education:

> It emphasized theories instead of values, concepts rather than human beings, abstraction rather than consciousness, answers instead of questions, ideology and efficiency rather than conscience.

Orr (1994) argues that the same can be said of modern environmental (and by implication) agricultural education: it emphasizes theory, concepts, abstraction, answers (the right ones) and efficiency. There are correct answers to all questions. Technical efficiency is paramount. Orr argues that education, even a lot of it, is no guarantee

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of “decency, prudence, or wisdom.” He does not advocate ignorance but a different kind of education that emphasizes standards of decency and human survival. Sir Francis Bacon, the founder of modern science, told us that with increasing knowledge, we would gain power over nature (Busch, 2000). But, is power the proper goal? Orr (p. 8) says that we gain insight into what is wrong with modern education and our culture from the characteristics we know or ought to know well. Each of these shows the madness of the drive to dominate nature that typifies modern agriculture. Marlowe’s Faust trades his soul for knowledge and power, Shelley’s Dr. Frankenstein refuses to take responsibility for the monster he created (an externality), and Melville’s Captain Ahab said “all my means are sane, my motive and my object are mad.”

Our modern educational system teaches us that all problems are solvable and even ignorance, which may be part of the human condition, is correctable (Orr). I recall learning as a student that metaphorically speaking, science was able to shine light on human problems and solve them. I learned that as the area of light expanded, it indicated that we knew more and more problems were solved. However, as the area of light grew, the area of darkness surrounding it grew more. It seemed incongruous, but as knowledge grew, ignorance grew even more. But that is how the world works. Education teaches us what we don’t know.

Orr also suggests we suffer from the dangerous and false myths that as human knowledge and technology increase we will know better how to manage the earth, human goodness will increase, and we will repair or restore that which has been damaged through human ignorance. I learned that we, the educated, given enough time and money, will be able to fix any problem. The results and recommendations of agricultural research and technology are, after all, “science based,” which implies that the scientists know all that needs to be known. Questioning, especially moral questioning, is not required. Further explanation is not needed and, in fact, is likely to be counter-productive (Kirschenmann, 2009).

The data, in each case, incorrectly deny that bad things have happened. Increased agricultural knowledge has led to increased dominance of the natural world, more human misery, and almost no repair of damage. Our cleverness has increased, but our wisdom has not. Agricultural education cannot ignore the necessity of facts. Students must know about the laws of probability, plant and animal physiology, chemistry, and so forth. However, agricultural education must also teach students to think about what to do and why some things should be done and others ignored. Students must somehow learn about the facts and how to deal with what James (2003) identifies as Type I and Type II ethical problems (see Chapter 4). Type I problems are important because of difficulty in deciding what ethical norm should apply. Type II dilemmas, common in agriculture, occur when the general social consensus on what ought to be done is combined with incentives to violate the societal consensus. Presently such things are not an integral part of agricultural education, which has an excess of how to and a paucity of why to. Students arrive with a set of personal and social ethical standards. They will learn some professional ethical standards. It is not as likely that they will leave with a greatly different set of personal or social ethics than those they had when they arrived. It is highly likely that they will
leave the university without a firm moral foundation that will guide them as they engage in the practice of agriculture. In that sense, their professors have failed.

**Sustainability as a Goal**

Bandwagons come and go (Simmonds, 1991); some pass quickly while others endure and the words associated with them become part of the lexicon. Sustainability is a popular bandwagon term. It is too early to tell if it will endure. Because of its current popularity in agriculture, one might expect it to appear frequently in mission statements, but with the exception of land-grant colleges of agriculture (37 of 50), it does not. The word is common in agricultural publications and in academic discourse. As discussed in Chapter 7, there is no agreed definition; the word means what the user wants it to mean. A simple definition of sustainable agriculture is, “Farmers should farm so they can farm again” (Wojcik, 1989). Harwood (1988, p. 4) suggested: “[An] agriculture that can evolve indefinitely toward greater human utility, greater efficiency of resource use, and a balance with the environment that is favorable both to humans and to most other species.” There are many other definitions and each is value laden with words such as human utility, efficiency, balance, and favorable. Most definitions are from Western, developed countries and overlook the fact that a sustainable agriculture in a developing country may be that which increases food production to sustain a growing population (Gressel and Rotteveel, 1999). Most definitions derive from an *ego*centric ethic of management in which the land is an instrument to achieve human ends. They are not based on an *eco*centric ethic in which the land has inherent value (Merchant, 1990). In an ecocentric ethic, the land and its needs are regarded as coincident with human needs. Both are sustained; neither is consistently dominant. Sustainable agriculture demands a shift from an anthropocentric or egocentric to an ecocentric ethic. The former view, often called ethical egoism, is a normative theory about how one ought to behave. It says we have no moral duty except to do what is best for ourselves; self-interest rules (Rachels, 1986). It is the ethical equivalent of Adam Smith’s “invisible economic hand.” In this view, what is to be sustained is production of abundant food or fiber, and profit for the producer and for those who supply the resources (inputs) required to produce. The primary problem with this view is its failure to internalize the inevitable externalities (Merchant, 1990). Sustaining production is a good thing, but it surely cannot always be the only or the highest value. When the technologies required to sustain production pollute water, harm nontarget species, or contaminate food, it is hard to support the claim that production and profit should always be the highest goals. Thus, producers who are dependent on the land ought to ask if the missions of agribusiness and environmental groups sustain or mitigate against the sustainability of the land, the producer’s primary resource. The evidence (Table 11.2) from the mission statements studied, once again, does not answer the question. While it is obvious that brief mission statements cannot include everything, it is equally obvious that what is omitted may be as important as what is included.
In 1997, I was invited to spend two months as a Visiting Professor in the Institute of Plant Production and Agroecology in the Tropics and Subtropics of the University of Hohenheim, Stuttgart, Germany. My host, Professor Herr Dr. Werner Koch, enjoyed walks in the countryside and invited me to accompany him. On one occasion, as we walked over a slight rise, I was most impressed with the agricultural vista ahead. There were many small fields; some bare soil, some green with a winter crop or hay, and some with stubble from the last crop. The large area was laced with cement paths on which people were strolling, jogging, biking, pushing children in strollers, or roller-blading. There were no obvious farm buildings. I commented to Prof. Koch that it was nice of the government to pave all the paths so the public could enjoy the countryside. Prof. Koch kindly and firmly informed me that the paths were built by the Government, but not for the uses I observed. They were built so the farmers, who lived in nearby villages, could get equipment to their fields. He then went on to explain what he called the German Landscaping Program. A major purpose of the program was to keep small farmers in farming. The Government offered farmers the option of accepting some or all of the following conditions for five years: no herbicide or growth regulator use, the inter-row distance in cereals was greater than 17 cm, a cover crop would be kept on the land between crops, 20% less fertilizer than normal would be used, and the land would not be plowed. When a farmer agreed to abide by one or all of these conditions, the Government offered a subsidy of points per hectare, which were converted to a payment of Deutschmarks at the end of the cropping season. Each of the stated conditions lowered yield.

Germany is a rich country and does not need all of its farmers to produce more food. Public policy did not favor increasing production but did favor keeping farmers in business. Farmers were valued because they maintained the land and they maintained villages, the center of valued German culture. Maintaining farmers, Professor Koch, assured me, also meant that Germany would look well when tourists visited, a lesser but important goal of the program.

The German state of Baden-Württemberg had a similar program in 2005, Markentlastungs und Kulturlandschaftsausgleich (MEKA), which roughly translates to a program to reduce production while preserving and improving the quality of the cultivated area. The program included:

- Regular soil analyses to assure appropriate fertilizer use.
- Preservation of vineyards on steep slopes to prevent soil erosion. Old supporting walls are maintained.
- Preservation of land races of economically useful animals (especially cattle).
- No use of pesticides, fertilizers, and growth regulators.
- Reduction of use of nitrogen fertilizer on arable land by 20%.

Highlight 11.5

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Inevitable decreases in crop yield are compensated by Government subsidies to maintain farmer’s income. The program is used most by small farms. Other German states and European Countries have similar programs tailored to their area and specific needs. Each program is part of the agriculture-environment initiative of the European Union and is financed by the European Union.

The programs accomplish four desirable agricultural goals (see Lehman 1995; Chapter 10). Safe food is produced, resources are conserved, and the practices are environmentally benign or friendly. Profit is assured by Government subsidies. The programs achieve desirable elements of agricultural sustainability, including protecting producers but they are not sustainable economically, without public subsidy. American agricultural subsidies, it is worth noting totaled more than $300 billion between 1978 and 2002, while small farmers disappeared and the environment was not favored.

The US Department of Agriculture distributes between $10 billion and $30 billion in cash subsidies to farmers and owners of farmland each year. The amount depends on market prices for crops, the level of disaster payments, and other factors. More than 90% of the subsidies go to farmers of five crops—wheat, corn, soybeans, rice, and cotton. More than 800,000 farmers and landowners receive subsidies, but the payments are heavily tilted toward the largest producers.

Lehman (1995) claims that a sustainable agricultural production system ought to be one that conserves resources, achieves relatively high energy outputs given its energy inputs, and provides sufficient, safe food for a community of people. Such a system might not yield income in excess of costs. That is, the system may not be profitable for the farmer. The words used in mission statements show that members of all three groups agree with Lehman concerning conservation, energy, food sufficiency, and food safety. Environmental groups use environmental words much more frequently than either of the other groups and therefore have objectives coincident with those of producers. The mission statements provide little evidence, but suggest that members of each group will strenuously object to the thought that any nation could endure an agriculture that was not profitable to producers. Profit is important to agribusiness and producers if they are to survive and meet the continuing demands for change. The evidence suggests it is not important to environmental groups. People in agribusiness believe that agriculture is a business and must respond to the same profit demands and follow or be susceptible to the same economic and market rules that govern any other business.

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In spite of the lack of a precise definition, and disagreement over the role and necessity of profit, sustainability is in vogue. Where it does not appear it is implied
by the use of words such as environment, conserve, restore, preserve, and stewardship, but these words do not appear in all mission statements. Sustainability is something one might assume all groups support. It might be one of the things that all could agree is good. But in spite of its current popularity, it is not included in most mission statements. It seems obvious that farmers/ranchers want to sustain their farms/ranches. It is not illogical to conclude that environmental groups may be the best allies in their quest.

Mission statements may reveal a great deal about what an organization is about, and still not reveal everything. One must assume they reveal what their creators want to reveal. It is tempting, but not acceptable, to read other meanings into such statements, to read between the lines or try to evaluate what is not included. Mission statements must be accepted for what they say. **Coletti (1999)** notes that codes of ethics come in glossy brochures, and environmental and social duties are featured in annual reports and presumably in mission statements. However, chief executives do not put such things at the top of their respective agendas. Environmental and social issues ranked only 13th among 16 marketplace challenges in a survey of 656 CEOs worldwide (Coletti, 1999). The top five issues were downward pressure on prices (mentioned by 48% of CEOs), changes in type or level of competition (43%), industry consolidation (41%), changing technology (25%), and increasing innovation (24%). Environmental, health, and safety issues were mentioned by only 46 (7%) of the CEOs. What is omitted may be as important as what is said, and what is said may not be what is meant when the going gets tough. Those in search of partners ought to be aware of both the stated and, in so far as possible, the unstated goals of other organizations. An appropriate question is—Are the words in mission statements reflective of public relations efforts or an accurate reflection of intent?

A test of **Zimdahl and Speer’s (1998)** first hypothesis, that agricultural producers share missions and objectives with environmental groups and that their mission statements demonstrate their shared goals, is not a simple objective exercise. It is not obvious from the mission statements that these groups share missions or objectives with each other or with land-grant universities. It is not obvious that they regard each other either as allies or as adversaries. Nor do the mission statements immediately reveal clear objective information on the second hypothesis, that agricultural producers do not share missions or operational objectives with agribusiness companies, and their mission statements demonstrate the lack of common interests.

**Harwood (1988, p. 5)** said: “In the early 1900s, popular thinking among farmers had led to the rejection of the portion of Jeffersonian thought that held individualism to be supreme.” This led to establishment of farmer organizations such as the Farm Bureau and Grange. Farmers became convinced they could not stand independently of their neighbors, and their knowledge, equipment, and ideas needed to be shared if all were to succeed. **Harwood (1988)** cites **Marcus (1985)** to describe two sources of agricultural knowledge. Systematic agriculturalists looked to the developing agricultural support industries as their model and guide about how agriculture should be practiced. These industries included farm machinery as exemplified by the cotton gin, reaper, combine, and steel moldboard plow. The fertilizer industry led the way to the chemicalization of agriculture, and although pesticides existed prior to
World War II, their rapid development was a postwar phenomenon. Agribusiness has been, and continues to be, the source of numerous innovations and the technology for rapid increases in crop yield. Agricultural industry was widely regarded within and outside farming as progressive and forward-looking. New products and new ways led to greater production and profit.

This view was opposed (and still is) by scientific (Harwood, 1988), or as I prefer, natural agriculturalists who look to nature as their model of how agriculture ought to be practiced. The central idea is that nature is the best teacher and its workings can be rationalized and formalized into proper agricultural practice. Farmers were regarded as natural historians whose knowledge of place and process would create good, environmentally benign agricultural systems. The twentieth century exponents of this view included Robert Rodale and Louis Bromfield, and more recently Wendell Berry, Wes Jackson, Miguel Altieri, and Francis Moore Lappé.

The view of the systematic agriculturalists is exemplified by the work of Avery (1995, 1997) and Waggoner (1994). In this view, human population growth is regarded as inevitable. There is general agreement among systematic and scientific agriculturalists that the UN median projection of 9–10 billion people by 2050 is reasonable. Those who will create the children are already here. The systematic agriculturalists assume that food demand will exceed supply. Avery (1997) concludes that by 2040, the world must once again achieve a tripling of yields on existing farmland. If that is not accomplished we will lose millions of square miles of presently wildlands and many now endangered species. Land that should not be farmed will be farmed. The fundamental claim is that one of two things must happen:

1. The same amount of land must become three times as productive or
2. Three times as much land must be brought into production.

It is likely that neither will happen but they set the boundary conditions for the future. Avery (1997) claims that the “world has only one proven, effective strategy for protecting its wildlands and endangered species in the 21st century: getting higher yields of crops and livestock from the land we’re already farming.” Farmers, in this view, work at the hub of sparing land for nature (Waggoner, 1994). Farmers, enabled by modern technology, can raise more crops or animals per unit area of land. This, in Waggoner’s (1994) view, helps keep food prices low and spares land for nature that would have to be used to produce food if yields are not raised. Avery (1995, 1997) suggests that crop protection technology and all of modern agriculture should be seen for what they are, “one of mankind’s greatest environmental achievements, in the most conservation-minded era of human history.” This view of agriculture is the view that agribusiness supports even though the evidence for this conclusion cannot be obtained from mission statements.

Those with the opposite view, what Harwood (1988) citing Marcus (1985) called the scientific view and I call the natural view, hold that modern/industrial agriculture views only human beings as having inherent worth. The rest of nature has only instrumental value as a resource for humans. This is what Merchant (1990) called the egocentric position. The evolution to modern, capital, energy, and chemically intensive agriculture was not done because of rational ecological analysis, but because of
scientific contributions that made it feasible, and low-cost energy that made it possible
to use nature as an instrument to produce food (Altieri, 1985). Excessive dependence
on the technology that characterizes modern agriculture is not sustainable because of
two inherent technological problems (Ausubel, 1996). First, technology’s success is
self-defeating. It has made the human niche elastic (Ausubel, 1996). It enabled us to
overcome the limits of the natural world and impose our will upon it. Dominating and
subduing are easier. But technology solves and creates problems at the same time. A
good example is insect, weed, and disease resistance to pesticides. In the early days of
pesticide development, resistance was not a problem. Now it is a huge problem that is
dealt with, in part, by continuing to create and use more of the same technology that
creates resistance. Resistance management is now part of pest management science.
This is precisely the kind of problem solving that alternative agriculturalists deplore.
Second (Ausubel) is the “paucity of human wisdom.” Technology creates the ability
to kill and cure, destroy and create, do good or evil, and to sustain or harm the earth.
Few set out to do evil but few can see all consequences of any technology. As agricul-
ture changed rapidly after World War II, agricultural science focused on what could be
done: the soil’s natural fertility was replaced by adding fertilizer, high-yielding plants
were developed, pests were controlled with pesticides. The dominant question was,
Can we do it? But unbridled use of agricultural technology has not increased the well-
being of all members of society and has hurt some.

I do not argue, as some might suspect, that therefore we ought to stop science or
control it more carefully. Scientific freedom is a great virtue. There is no question
that the scientific advances that have led to modern agriculture have created more
human pleasure than pain. The abundance of a modern grocery store is evidence
of the achievements of agriculture. But, more and more, we are faced with a moral
question: What ought to be done? What should be done? This means that what was
once just a technical question (Can we do X?) is now also a moral question (Ought
we do X?).

As those engaged in agriculture begin to ask what ought to be done they may also
ask specific questions:

1. What groups in our society seek answers to the same questions?
2. What groups think as we do?
3. With whom should we try to partner and form working relationships?
4. With what groups do we share common goals and methods?

It was assumed that answers or clues to answers to these questions could be found
in the words used in the mission statements of agribusiness, producer, environmental
groups, and land-grant colleges of agriculture. One must conclude that mission state-
ments are not particularly revealing of an organization’s purpose or methods. As any
group looks for partners, it is unrealistic to expect that all divisions will disappear as
common interests are discovered. It has happened in other areas that groups that were
at odds have found common ground and new alliances have been formed (Wilkinson,
1999). Environmentalists and loggers in Pacific Northwest timber towns have found
that economy and ecology share more than the same prefix (Wilkinson, 1999). Their
alliance has come about because of the marginalization of the labor and environmental movements by corporations. Agricultural producer and allied groups that value small farms and rural communities and the sustainability they imply may want to seek similar alliances. Analysis of mission statements is a place to begin to learn about those with whom one must work or one may choose to work. But it is only a beginning. Behavior and actions, as they always have, speak more loudly than words.

**Conclusion**

The preface of this book says a primary goal is to continue the discussion of agricultural ethics begun by others. The task was to explore ethical positions in agriculture or the lack thereof using the metaphor of agriculture’s horizon: the boundary that separates and delineates one’s outlook and knowledge. The book praises agriculture’s myriad accomplishments that have vastly increased food and fiber production and the efficiency of that production per acre and per animal. It has, while acknowledging some opposing arguments, been unrelentingly critical of the fact that consideration of the ethics of agriculture has been lacking and that lack has limited agriculture’s horizon and has created some of the public’s negative view of agriculture—the essential human activity.

A related task was to demonstrate that underlying each set of views on important agricultural issues there is always an ethical position. I conclude that this is true. However, to demonstrate the correctness of the conclusion one must illustrate it with ethical positions held by those in agriculture and here the book fails. I and others cited herein who have explored the ethics of agriculture more carefully, have concluded that agriculture has only one dominant ethic, which is not openly debated. It is accepted. It is the ethic mentioned above and best described by Thompson (1995): there is only one imperative—to produce as much as possible, regardless of the environmental/ecological costs and perhaps even if it is not profitable to the producer. Therefore, it is incorrect to argue that agriculture has no ethical standard at all. That is not true. The argument should be that the dominant ethical standard is unexamined and should not remain so. Agricultural science and technology have been major contributors to the liberation from elemental want of most who reside in the world’s developed countries. Scientific advances and especially agriculture’s achievements have been central to attaining a standard of living for many that was beyond human imagination in the mid-nineteenth century (Sarewitz, 1996, p. 103). However, as Sarewitz points out, a parallel consequence has been “an unprecedented acceleration in the exploitation, modification, and despoliation of nature.”

Those who practice agriculture cannot escape responsibility for its effects on nature but the dominant ethic ignores such effects. The effects are not a cost but a set of problems to be solved through more science and better technology. They are the price of bounty. Environmental effects are also evidence of human mastery over nature which, we are wont to assume, has been subdued by science (Sarewitz). The highest priority for agricultural research is to continue to produce through domination of nature.
It is logical to conclude that agriculture’s practitioners believe they have been extraordinarily successful and therefore deserve praise not criticism. Raising questions about agricultural practice and results is to miss the point. Agriculture is about results. What matters is whether or not people are fed. Ethical questions just get in the way. If one believes there is no objective truth in ethics, then it follows that a search for objective moral truth, “ethical facts,” is futile. Objective ethical truth, given this view, is just a clever philosophical illusion.

Agriculture’s practitioners including agricultural scientists clearly care about scientific truth. It exists and part of the scientist’s task is to discover what is true. Lynch (2004), in a perceptive essay, points out that “caring about truth means that you have to be open to the possibility that your own beliefs are mistaken.” It is mistaken beliefs about ethics that inform agriculture and need to be changed. Debates about the ethics of agriculture are not trivial but essential to progress just as the search for scientific truth is. No scientist will hold to a scientific belief that is patently false. Similarly no one should hold fast to an ethical view or a view of ethics that is unexamined. There is objective truth in ethics and knowing the ethical foundation for action is just as essential as knowing the scientific hypotheses that support experimentation. Because agriculture is the essential human activity, it is essential that it rest on a firm ethical foundation. Agriculture is not just about results—principles matter for they determine what truths are sought.

Forgive my vehemence, which has deep causes in my hope for the future. This is my subject. I know, or partly know, what I want. I know, and clearly know, what I fear.

*John Maynard Keynes’ letter to Dean Acheson, August 1941*

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