**Integrated Weed Management for Sustainable Agriculture - An Ethical Perspective**

Robert L. Zimdahl

Professor Emeritus

Colorado State University, USA

Canadian Weed Science Society, Niagara Falls, Ontario, Canada, November 21, 2018.

 Whether one lives in a developed or developing country and whether one is rich or poor, male or female, educated or not, we all live in a post-industrial, information-age society. We live in an era of scientific achievement and technological progress, perhaps unequaled in human history, which has created the good life many of us enjoy and some of the problems from which we suffer. The achievements include:

 Waking up this morning to music from your cell phone.

 Preparing breakfast in your microwave as you review the news on your computer, which gives you nearly instant access to information that is orders of magnitude greater than the resources of most of the world’s libraries.

 Medical advances that cure what used to kill or cripple.

 Immunization to prevent childhood diseases.

 Elimination of smallpox and possibly polio in the near future,

 Vastly improved detection and control of some diseases.

 Travel at speeds and convenience unknown to our grandparents, across oceans and mountains that were once formidable barriers.

 Finally, for many, but sadly not for all, because of agricultural research and technology, abundant food.

The problems include climate change,

 global warming,

 pollution of all forms,

 social inequality,

 environmental degradation,

 and soil erosion.

 Weed science, a subdivision of agriculture, has additional problems: herbicide resistance, invasive species, biotech/GMO’s, and concern about sustainability. Many citizens of developed countries know and benefit from the achievements of agricultural science and are concerned about the problems science and technology have wrought.

 We live in a world where progress is frequently equated with growth, is expected, and generally regarded as good. Many want more of the good things of life and expect the future to be bigger, better, easier, and arrive faster. We exult in the good and lament the bad. So many aspects of our life change faster than we are able to keep up. We may not always know our destination, but we are going there in a hurry. We are beneficiaries and believers in the efficacy of technology, which promises to solve the problems of society, agriculture, and our extractive, industrial economy. Those involved in agriculture believe that development and use of more and more sophisticated, high energy, advanced technology is always good and more will be better. The agricultural problems caused by the unintended consequences of technological solutions will, many are certain, be solved by improved technology.

 I do not mean to imply that we should abandon science and its resultant technology. I do assert that we need to “to abandon the narcissistic illusion that we can control our interventions in an infinitely complex world” (Jensen 2016). We humans, earth’s dominant species, are not just figures in the landscape — we are shapers of the landscape (Bronowski 1973, p.19). It is my view that we should carefully think about whether our shaping of the landscape is desirable and sustainable. Although we may always know what we are doing, we should and are obligated to consider what we may be undoing. A degree of intellectual humility might compel us to be more careful with our tinkering (Jensen, 2016). We need to cultivate in ourselves and our students the intellectual humility that helps us be more careful with our science and our technology and leads to thought about the moral dimension of what we do and undo.

 With that brief introduction I ask two questions (Zimdahl 2012):

 How do you know what to do in agriculture and in life?

 How do you know what you choose to do is the right thing to do?

We all have a sense of what is right and wrong, which is often unexamined and not supported by careful reasoning. A guide toward helping decide what one ought to do is found in our societal principles, which are guides not answers that help us decide and may govern what is right and wrong.

 Understanding and using ethical principles, our invisible guides, is often complicated by confusion over what ethics is and is not. Ethics is not four things.

 1. It is not a set of prohibitions—do not rules concerned with our behavior or religion.

 2. Ethics is not an ideal system that is noble in theory but useless in practice. An ethical judgment that is no good in practice has serious theoretical faults.

 3. Ethical principles are not relative to time, culture, or society. They are influenced by, but are not necessarily determined by them.

 4. Ethics is not just subjective. Many people think that an ethical act is always deemed to be right or wrong based on one’s feelings and nothing more. Such an attitude means there is no such thing as an objective right or wrong.

 Critical thinking, an open-minded, intellectually disciplined process of analyzing, and evaluating information gathered from observation and experience and using it as a guide to belief and action, is required. It employs universal intellectual values to consistently achieve accuracy based on sound evidence, good reasons. It is difficult.

 We all have personal ethics which guide our daily behavior. We are subject to social ethical expectations about torture, pornography, civil rights, and treatment of children. Scientists also have professional ethics: don’t fabricate data, give proper credit, be honest, include opposing results, and disclose conflicts of interest.

 When ethical standards go wrong, as they do, they are a prelude to sweat shops, mistreatment of women, concentration camps, child labor, and torture. We also know that ethical standards change. Examples include business hours, smoking, women’s rights, and treatment of animals and the environment.

 I suggest that the truest test of the moral condition of any scientific or other discipline, indeed of one’s life, is a willingness to examine its moral condition. In agriculture, we have not examined our ethical base or the reasons for it. We have assumed that agriculture had an adequate ethical foundation. That assumption, was not questioned. We humans don't want our assumptions questioned we want to use them. In natural resources and environmental study, examination has occurred because public pressure demanded it.

 Philosophers study ethics.

 They don’t tell us what is right and wrong,

 they show us how to think about what is right and wrong. Change occurs because a principle, once articulated, examined and found lacking is abandoned in favor of other more carefully constructed thinking. Our respective cultures provide several examples of change: civil rights, women’s rights, environmental rights, and animal rights. But there has been no comparable change and little critical thinking in agriculture.

 Scientists claim that in the scientific realm there are answers which can be defined mathematically, are publicly verifiable, literal, definitive, precise, and falsifiable. In contrast it is common to believe that ethical positions are purely subjective - they are only opinions and lack a rational justification. That is false. When I say slavery, Nazi Germany, torture, rape, and female genital mutilation are wrong, is this just my view, that I, at this time and place say they are wrong? No! There is widespread, perhaps near universal agreement that these things are wrong and the reasons provided across cultures will be similar. Ethical claims are supported by careful, logical reasoning. The normative, descriptive language speaks of what is most important and why it is or ought to be valued. Moral/ethical reasoning reflects a long, distinguished history of rational public discourse.

 The ethical position that characterizes agriculture is productionism. It is the central, indeed often the only norm, of agriculture. The moral imperative is to produce food and fiber to benefit all humanity. It is what must be sustained. Those involved in agriculture whether they are producers, suppliers, or researchers, and regardless of their employer should ask and debate if production is a sufficient criterion for judging all agricultural activities.

 Does it justify everything? What about other specific responsibilities:

 achieving sustainable production practices,

 decreasing pollution, eliminating soil erosion,

 eliminating harm to other plant and animal species,

 ending habitat destruction,

 and ending water pollution and mining of water for irrigation.

All segments of the agricultural enterprise ought to work toward accomplishing these equally worthy, morally good goals. Developing integrated weed management systems should, at a minimum, consider these goals.

 We will gain little if we win the production battle and lose the moral battle

 Agricultural scientists have assumed that as long as their research and the resultant technology increased food production and availability, they and the end users were somehow exempt from negotiating the moral bargain that is the foundation of the modern democratic state (Thompson 1989). It is unquestionably a moral good to feed people. Therefore it is assumed that anyone who questions agriculture’s morality or the results of its technology simply doesn’t understand the importance of what is being done. It is assumed that agricultural practitioners are technically capable and that the good results of their technology make them morally correct. We are obliged to question that assumption.

 We have lived by the assumption that what was good for us

 would be good for the world. We have been wrong. For I do

 not doubt that it is only on the condition of humility and

 reverence before the world that our species will be able to

 remain in it. (Berry 2002)

 The public is concerned about pesticides in soil, water and food, cruelty to animals, biotech/GMOs, corporate agriculture, mining of water, loss of small farms and rural communities, loss of genetic diversity, pollution by animal factory wastes, exploitation of and cruelty to agricultural labor, and soil erosion.

 Are these just concerns of a radical fringe of society - a few whackos?

If they are general societal concerns an agricultural system that justifies everything because it increases production has ethical challenges, which should not be ignored.

 Agriculture is the the largest, most widespread, and most important human interaction with the environment.

 It is an essential human activity. However, agriculture has well-defined, unavoidable, negative environmental consequences,

 It is my view that agriculture must develop a firm ethical foundation.

 It is not just about results.

 We should not assume that because those in agriculture believe in what they do, and the results have been mostly good—more people are fed than ever before—that those who practice and support agriculture automatically have societal acceptability.

 Three points about agriculture

 Those in agriculture (and in weed science) are certain about the moral correctness, the goodness, of their activity.

 The basis of that moral certainty is not clear to those who have it.

 Therefore, agriculture’s moral certainty is potentially harmful because it is unexamined by most of its practitioners.

 Moral certainty and the absence of reasoned discourse and debate inhibit discussion about what sustainable integrated weed management systems ought to do or be. Debate will uncover the foundational moral theories, the often invisible foundation on which actions rest. Debate will reveal the reasons, the justification for deciding that what one does is what one ought to do.

 Exploration of agriculture’s moral foundation will not reveal a single guiding principle that will solve all agricultural dilemmas. It will reveal several principles that will be useful as alternative production technologies are explored.

 Western agriculture is the greatest story never told. It a productive marvel which is envied by many societies where hunger rather than abundance dominates. Science and technology have created steady yield increases by development of higher yielding cultivars, synthetic fertilizers, improved soil management and mechanization, and improved weed control.

 Modern high-yield agriculture may not be one of the world’s problems, but rather the solution to providing sufficient food for all, sufficient land for wildlife, and protecting the environment.

 But there are risks. The technology required to feed the world has always exposed people to risk. In the past most of the risk was borne by users of the technology. Now many risks of agricultural technology are borne by others.

 Technology developers, sellers, regulators, and users, in their moral certainty, (Zimdahl 2002) have not secured or even considered how to secure the public’s consent to use technology that exposes people to involuntary risk.

 Agricultural producers and those who support them with technology have been seduced into thinking that, as long as they increased food availability, they were exempt from seeking societal approval for employing the technology that modern agriculture requires, which exposes people to involuntary risks. That is not how modern democracies are supposed to work. A result is that citizens of democratic societies have become reluctant to entrust their water, their diets, or their natural resources blindly into the hands of farmers, agribusiness firms, and agricultural scientists. Another result is development of small-scale farmers’ markets where consumers trust the food and those who produce it and demand more governmental regulation of agricultural and weed management practices.

 Agricultural people must participate in the dialog that leads to social consensus about risks, and they must be willing to contribute the time and resources required to understand the positions of their fellow citizens. For most non-agricultural segments of society, these are not new demands. For agriculture they are. Agriculturalists have been so certain of the moral correctness of their pursuit of increased production that they have failed to listen to and understand the positions of other interest groups (e.g., environmental, organic). Agriculturalists have not articulated any primary value position other than the value of production and have not offered reasons why production ought to retain its primacy.

 What is the primary agricultural problem? Is it production? Of course it is.

 But

 distribution, waste (Institution 2013), and poverty must be considered. Production of abundant food and fiber must remain a goal of agriculture. A morally pluralistic world compels us to ask if the endless pursuit of more production is the right answer to the many ethical dilemmas agriculture faces. I encourage you to explore other goals that ought to be considered and ask when and why one or more of them should take precedence over production.

 For example: sustainable, resilient, environmentally safe production that meets human needs and contributes to a just social order may be of greater moral importance than profitable production.

 That is not the dominant agricultural view. Sustainability is regarded by those in agriculture as primarily a production and secondarily an environmental goal. In weed management, to sustain usually means protecting the productive resource (soil, water, gene pools) to maintain production. Others argue the productive resource is important, but ranks below sustaining environmental quality. This debate goes to the heart of what agriculture ought to be. Agriculture has a major responsibility because it is so widespread and has the potential to care for or harm so much land. This is a different view from protecting only the productive ability of land. Land is not simply a productive resource. It is the basis of life. Without the land there will be no agriculture, so land must be regarded as something more than one of a number of other productive resources (e.g., fertilizer, machines, irrigation water, herbicides, or seed). To harm or destroy the land is to destroy something essential to life, and that certainly raises a moral question.

 The challenge of achieving agricultural sustainability is that it involves values. It is generally not acknowledged in agricultural science that values are not external to the science and technology but its basis. Scientists know they are responsible for the scientific integrity and the intellectual contribution of their work. They do not as readily assume responsibility for the moral aspects of their work. All of science and all of agricultural science is involved in moral/value questions. Science is not value-free, it is value-laden.

 The research and teaching we do now involves assumptions and a view of a future we expect, desire, or fear. As weed scientists proceed toward truly integrated weed management systems there will be conflicting interests, incompatible analyses based on different views of the nature of the problem, rising material expectations, and different views of sustainability. It is unusual to find anyone against sustainability. It is equally clear that there are many views of what ought to be sustained and how to achieve sustainability.

 What is the right thing to do?

 I know that agricultural scientists are ethical in the conduct of their science and in their personal lives, but they do not extend ethics into their work. They are realists not idealists. Realists run agricultural research and the world; idealists do not. Idealists attend academic conferences and may write thoughtful articles. But the action is elsewhere. The reality is produce profitably or perish in the real agricultural world. Realism rules, and philosophical and ethical correctness may be interesting but they are not necessary for useful work in agriculture or other scientific disciplines.

 I want more!

 Such a position needs to be called into question. We need to accept the difficult task of conducting an ethical analysis of weed science and its results. We must strive for an analysis of what it is about agricultural practices, our technology, and our purposes that limit our aspirations and need modification. The analysis must include departments of agriculture, university departments, scientific societies, research institutions, and commercial organizations that serve and profit from agriculture. We must strive to strengthen those features that are beneficial to society and change those that are not. We must be sufficiently confident to study ourselves and our institutions and dedicated to the task of modifying both.

 To preserve what is best about modern agriculture and to identify the abuses modern technology has wrought on our land, our people and other creatures, and begin to correct them will require many lifetimes of work. Agriculturalists must see agriculture in its many forms — productive, scientific, environmental, economic, social, political, and moral. It is not sufficient to justify all management activities on the basis of increased production. Other criteria, many with a clear moral foundation, should be included. We do not and no one ever will live in a post-agricultural society. All societies have an agricultural foundation within their borders or elsewhere. Those in agriculture must strive to assure all that the ethical foundation of the largest and most important human interaction with the environment is secure.

 I have asked and not answered two questions.

 1. How do you know what to do in agriculture and in life?

 2. How do you know what you choose to do is the right thing to do?

 They ask you to do something you may not have done.

 The old miner as a reminder of doing new things.

**Literature Cited.**

Berry, W. 2002. *The Art of the Commonplace*: *The Agrarian Essays of Wendell Berry*. Edited and introduced by Norman Wirzba. Shoemaker & Hoard, Washington DC. 330 pp.

Jensen, R. 2016. What is the world? Who are we? What are we going to do about it? The land and Report. Issue 16, Fall. The Land Institute, Salina, KS. P. 22-26.

Thompson, P. B. 1989. Values and food production. J. Agric. Ethics 2:209-223

Zimdahl. R. L. 2012. Agriculture’s Ethical Horizon. Elsevier, Inc. London, UK. 274pp.

Zimdahl, R.L. 2002. Moral Confidence in Agriculture. American Journal of Alternative Agriculture. 17(1):44-53.