**Weed Science for A Sustainable Agriculture and Environment -**

**An Ethical Perspective**

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Asian-Pacific Weed Science Society. Kuching, Sarawak, Malaysia September 3-6, 2019.

 Whether one lives in a developed or developing country and whether one is rich or poor, male or female, formally educated or not, we all live in a post-industrial, information-age society. We live in an era of scientific achievement and technological progress, unequaled in human history, which has created the good life many of us, but not all, 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 tablet 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 - abundant food.

The problems include:

 global climate change - affecting mean temperature, rainfall amounts and seasonal distribution

 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 people know and benefit from the achievements of agricultural science but many also are concerned about the problems science and technology have wrought.

 We live in a world where progress is frequently equated with growth, which is generally regarded as good.

 Many want more of the good things of life

 We expect the future to be bigger, better, easier, and faster.

 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 science and technology, which promises to solve the problems of society, agriculture, and industry. Many involved in agriculture believe that development and use of more and more energy dependent technology is always good and more will be better. The problems caused by the unintended consequences of technology will, many are certain, be solved by improved technology.

 I do not mean to imply that we should abandon science and technology. I do assert that we need “to abandon the 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). Having achieved this power we should think carefully about whether our shaping of the landscape is desirable and sustainable. Although we may often know what we are doing, we should, and are obligated to consider, what we may be undoing. We must cultivate in ourselves and our students the intellectual humility (Jensen 2016) that helps us be more careful with our science and our technology and that leads to thinking critically about the moral dimension of what we do and undo.

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

 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?

 How do we decide what to do?

 We can know things scientifically by experimentation. The **empiricist** goes and looks.

 We can know **pragmatically**. We test validity by practical results. What works best?

 We can be **skeptical** where there is reason to believe the truth must be in question.

 Each of these is an acceptable way to know what is right. There are other, more common, ways that most people use to determine what is right.

 We defer to **authority** - the government or a parent (My father says...).

 We defer to **tradition** - we have always done it this way in my family, mosque/church, or community.

 We defer to **legal authority** - it’s the law.

 We may defer to **revealed truth** - the Koran/Bible. We often defer to revealed truth without examination to determine if we are seeing the whole world when we tend, often in spite of our best efforts, to see only one aspect but think we have grasped the whole of it.

 Finally, we can know what is right by **reason**. The philosopher’s position. Reason is the ability to think, form judgments, draw conclusions. It is sound thought and judgment based on coherent, logical thought.

 Reason requires critical thinking — an open-minded, intellectually disciplined process of analyzing and evaluating information gathered from observation and experience. It should be a guide to belief and action. It uses universally accepted concepts and principles to consistently solve problems based on sound evidence and good reasons.

 It is difficult.

 We all have a sense of what is right and wrong, but that sense 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. These principles may help decide what is right and wrong, but they do not alone provide answers.

 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 that support it. We have assumed that agriculture has an adequate ethical foundation. That assumption is seldom 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 demands 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: slavery, civil rights, women’s rights, environmental rights, and animal rights. But there has been no comparable change and little critical thinking about agriculture’s ethical foundation.

 I suggest scientists have a concept of truth - rational truth. 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 are similar. Ethical claims are supported by careful, logical reasoning. They speak of what is most important and why it is or ought to be valued. Moral/ethical reasoning has evolved and 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. It is a worthy moral imperative to produce food and fiber to benefit all humanity. It is what must be sustained and we should build upon it. 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 that can be added to our worthy moral foundation (feeding the world)

 achieving sustainable production practices,

 decreasing pollution, eliminating soil erosion,

 eliminating harm to other plant and animal species,

 ending habitat destruction,

 ending water pollution and mining of water for irrigation,

 and ending harsh working conditions for agricultural labor.

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

 We have assumed that as long as our research and technology increased food production and availability, we and the end users were 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 to feed people. It is assumed that agricultural practitioners are technically capable and that the good results of their technology make the agricultural enterprise 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)

 Three points about agriculture

 **1.** Those in agriculture (and in weed science) are certain about the moral correctness, the goodness, of their activity - the goodness of what they do.

 **2.** The basis of that moral certainty is not clearly recognized by those who have it.

 **3.** 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 about its origin and justification 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.

 Agriculture in developed countries is envied by many societies where hunger rather than abundance predominates. Science and technology have created steady yield increases by development of

 higher yielding cultivars, synthetic fertilizers, improved soil management, mechanization, and improved insect, plant pathogen, and weed management.

 Western agriculture has been called the greatest story never told.

 It is a productive marvel

 With an admirable moral goal (feeding the world)

 I am compelled to add at this point that cultural diversity challenges the Western and particularly American belief in the universal relevance of Western culture (Huntington 1996, p. 310). This belief holds that people in all societies want to adopt Western values, institutions, and practices. If they seem not to have the desire and are committed to their own traditional cultures they are, in the view of many, victims of a false consciousness. The Western belief suggest that people throughout the world should embrace Western values and culture because they embody the highest, most enlightened, most liberal, most rational, most modern, and most civilized thinking of humankind. It is my view that

 Western belief in the universality of Western culture suffers three problems: it is false, it is immoral, and it is dangerous.

 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 about agriculture that justifies everything because it increases production. Then we - agriculture’s practitioners - have a responsibility to ourselves and to society to confront, discuss, and debate them.

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

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

 It is my view that agriculture must develop a broader ethical foundation to obtain long-term societal support. We must recognize and deal with agriculture’s negative and positive effects.

 It is not just about results.

 We should not assume that because those in agriculture believe in what they do and people are fed than ever before—that those who practice and support agriculture automatically have ethical acceptability from society

 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. Agricultural technology 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.

 A consequence of moral certainty is that 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 - much of which exposes people to risk involuntarily. That is not acceptable in modern societies. 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. In addition, there is increased demand for 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, health conscious). Agriculturalists have seldom 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 concern? Is it production? Of course it is.

 But

 distribution, food waste (Institution 2013), and poverty are also important. Production of abundant food and fiber must remain a goal of agriculture. But the 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.

 An example of a social goal: Developing a 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.

 An important challenge to 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 ethical consideration to 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!

 The current reality needs to be questioned. 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 focus to production. 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 we must dedicate ourselves 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 but not answered two questions.

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

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

 These questions ask you to do something you may not have done or done carefully enough

 The old miner as a reminder of doing new things.

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