
Module II— Diminishing the Ecological Footprint

Introductory Remarks

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This module witnesses the competition between two goods, namely agriculture and its related rural environment. They are goods because we all partake of the benefits of agriculture, and we all agree that the condition of and the services (e.g. water cycling, oxygen-carbon dioxide exchange, carbon sinks, pollination, soil formation, nutrient release-capture, and biodiversity) provided by the total environment are vital (Smith, 1974). However, to many environmentalists and conservationists, agricultural development and expansion take place at the expense of the environment; *i.e.* they are competitors. In that regard they are correct, and the challenge is to balance both interests.

As we view landscapes from airplanes, it is clear that agriculture and forestry are the two human cultures that have most shaped the face of the planet. It could be said that agriculture, with its enormous movements of soil and water, and its international movement of nutrients as foods, is now among the largest geological forces acting on Earth's surface. It is inevitable that, as the size of the human population increases, the size of the agricultural impacts on the planet will increase, both directly as wild lands are converted to crop production, and as the energy-technology base increases to service the needs of modern agriculture.

Awareness of the impacts of agriculture on the environment is not new. Bismarck observed that the trends in agriculture and forestry in Europe during the late 1800s selected for species that flourished under those conditions. He termed them culture lovers (*Kulturliebe*), as opposed to those species that required more wilderness habitats, which he termed culture haters (*Kulturhese*). Indeed, the modern agricultural community has brought about major changes in the community structure of animal populations. This is apparent in the species composition of waterfowl populations of Europe and North America that benefit from the vast areas of cereal grain culture.

Prairie grouse species eclipsed by the advent of agriculture were replaced by introduced game-birds, such as Asiatic pheasants and European partridges. During the last 30 years, the rehabilitation of the once-endangered wild turkey (*Meleagris gallopavo*) has succeeded because it has adjusted to cash-crop/hardwood landscapes throughout its ancestral range. White tailed deer (*Oidocoleus virginianus*) populations have undergone enormous increases throughout North America due to the effects of grain agriculture and the abandonment of agricultural lands to early ecological succession. These are just a few of the examples that can be mentioned.

Generally, most of society sees this as being good, as an ability of nature to profit from agricultural imposition upon the landscape. Modern programs of wildlife management, itself an offshoot of applied production agriculture, exploit the agricultural environment and its new suite of species, to provide recreation for the public. Few are aware of the decline of many native species and their replacement by desirable species, and even fewer see that as environmentally problematic.

During the early 1900s, the ecologist Aldo Leopold documented in detail the very competitive effects of over-grazing on native plant communities by sheep, goats and cattle, the wide-scale erosion of the southwest of the United States, and the introduction of exotic forage species. His writings explained the ephemeral nature of open-range ranching in this part of the continent (Leopold, 1933; Callicott, 1991). What appears natural and acceptable to us depends very much on our personal timeframe: in essence, it is what we can remember and relate to. After some time, exotics and farmed landscapes (just like human immigrants) acquire a sort of ecological citizenship (such as the mustang, the burro, the feral pig, wheat, sheep and cattle). The same can be said of modern forested landscapes, complete with their many exotics, reduced diversity, monocultures, and longer cycles of cash-crop production.

We accept the radically modified landscapes of agricultural Europe and North America, despite their changed biological diversity and community structure. Large, lush expanses of crops engender a positive feeling, no matter how simple the plant community structure. The Caledonian Forest that once covered so much of Britain has, over two millennia, been replaced by a system of small land parcels interspersed by hedges and small woods, the “idyllic” British countryside. Monocultures of grapevines have long clothed the hillsides of much of France, the Rhine-Moselle regions of Germany, and other parts of Europe, generating a high added-value product. For many parts of Europe and North America, nature is now confined largely to the interstices of the agriculturally modified landscape, and is thus highly susceptible to agricultural change. Society has welcomed these cheap agricultural goods, and provided that there were some adjacent areas of unmanaged lands, no great concerns were raised. However, as human conurbations spread permanently like grease spots, and as agriculture appears to be more consumptive of its land base (as in greater soil erosion, salination, and soil organic matter depletion) and exerts more collateral damage on non-target insect species,

concerns are being expressed. Now, we add the new dimension of biotechnologically changed phenotypes to that mix.

The recent growth of approaches to agriculture termed “lower-input,” “organic,” and “ecological agriculture” reflects an awareness of having to conduct agriculture in a different manner from the current emphasis on the high-energy and high-chemical approach (Thomas and Kevan, 1993). Notwithstanding the savings generated by minimal-till and zero-till cultivation, it is clear that the “greening” of agriculture has a long way to go to reduce its many externalities (Jackson, 2004).

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This module’s title, *Diminishing the Ecological Footprint*, contains two major assumptions that will be addressed. The first is that the agricultural production system is intrinsically sustainable, and that agriculture can be conducted in future with a smaller ecological footprint due to biotechnological advances. The second assumption is that awareness of the value of wild environments to the human well-being will result in societies having a will to achieve a preservation of those wild environments.

This module presents three experts to shed light on those assumptions: William Rees, Klaus Amman and David Lavigne. None is an agronomist, but all are systems ecologists who understand the nature of biological production. This is in keeping with this conference’s desire to solicit insight and debate from outside the discipline of production agriculture.

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