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Alternative agriculture in an energy- and resource-depleting future

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Abstract

Industrial principles of specialization, simplification and concentration began to be applied to agriculture after the Second World War with positive production results. But it is now widely recognized that this agriculture and food system faces daunting challenges in the decades ahead, including increased human population growth, natural resource depletion, ecological degradation, climate change and escalating energy costs. These challenges have refocused the attention of agriculturalists and food scientists on the question of how we can continue to feed the human species. But these challenges also provide opportunities to rethink and redesign our food system. Agriculturalists are recognizing that resilience is at least as important to food security as maximum production, and consumer concerns provide us with unprecedented opportunities for farmers and consumers to come together as 'food citizens' to determine appropriate changes in our food system. To that end it is important to examine the various production systems and infrastructures in an effort to select the most viable options for long-term sustainability.

Key words: population growth, industrial agriculture, agro-ecology, biodiversity, resilience

Introduction

> The evidence to date strongly suggests that both biodiversity conservation and food security can be effectively addressed using alternative agricultural practices. Although the majority of food insecurity at present is caused not by a lack of available food or insufficient agricultural production but by poverty and problems of socio-economic access, alternative agriculture nonetheless does appear capable of producing sufficient yields. The evidence also supports the intuitive conclusion that alternative agriculture, which is generally targeted at sustainability and compatibility with biodiversity conservation, is indeed on average better for biodiversity conservation than conventional agriculture, which usually (though not always) targets increases in yield to the exclusion and even detriment of direct concerns about biodiversity, equitability, and food access.
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> —Michael Jahi Chappell and Liliana A. LaValle[1]

In 1798, the Reverend Dr Thomas Malthus, British scholar and political economist, published the first edition of *An Essay on the Principles of Population*[2]. Malthus wrote the essay in part to question the day's popular assumption that human civilization was on a path of 'limitless improvement' toward a utopian society. Malthus wrote that such a proposition was flawed because human populations increase *geometrically* while any earthly power to produce adequate 'subsistence' for humans could increase only *arithmetically*. Malthus argued that a sustainable future has to impose some severe discipline (such as delayed marriage or celibacy) to provide needed checks on population growth. Lacking such 'virtuous behaviour', we should expect that 'premature death must in some shape or other visit the human race'[2].

With the development of modern industrial agriculture, we were able to dramatically increase the yields of several critical crops, notably wheat, rice, corn and soy, and ever since we have congratulated ourselves in proving Malthus wrong and laying the Malthusian ghost to rest.

Of course with increased food availability and improved living conditions, the human population has also increased dramatically. From 1900 to 1960, the human population doubled (from 1.5 billion to 3 billion) in just 60 years for the first time. Then it doubled again in just 36 years, from 3 billion to 6 billion between 1960 and 1996. Most of the current projections expect world population to increase to 9 billion by 2050.

The prospect of such rapid population growth has revived the question of whether we can continue to increase

productivity to meet the caloric requirements of an expanded human population. That dilemma is exacerbated by the fact that the human population is also rapidly changing its consumption patterns to include more meat. According to some estimates, global meat consumption will double or triple by 2070.

The anticipation of population growth, combined with changing food consumption patterns, has ignited a new version of the Malthusian debate. Proponents on one side of the debate contend that we can continue to develop technologies to feed an expanding human population indefinitely and that *only* the further intensification of industrial methods of agriculture can achieve that end[3]. Those on the other side of the debate point to the unintended consequences of our modern industrial agriculture which have *reduced* our potential to feed the human species in the future. That side in the debate, consequently, argues that alternative, agro-ecological and social models of agriculture must be developed to feed the expanded human population[4,5].

This is just one of many challenges on the horizon which may require us to radically rethink and redesign our food and agriculture system. One of these challenges is the depletion of natural resources that up to now have been the essential ingredients which sustained our industrial agriculture. Among them are cheap fossil fuels, abundant supplies of fresh water and a storehouse of genetic diversity and biodiversity. All of these resources, accrued over many millennia, have been critical to the success of the modern, highly specialized, input-intensive, monocultures that form the bedrock of industrial agriculture.

In addition, the time frame for the rise of industrial agriculture coincided with what the National Academy of Sciences Panel on Climate Variation called 'abnormally' stable climates[6]. The panel pointed out that this unusual period of exceptional climate stability was *at least* as responsible for the success of increased yields since 1960 *as our new, industrial technologies*. The panel went on to emphasize that more normal climate destabilization conditions are certain to return in the future. These conditions are likely to be exacerbated by increased levels of greenhouse gases in the atmosphere, and the panel recommends that we would be wise to prepare for that sort of future.

The return of more normal, unstable climates will be especially threatening to highly specialized monoculture agriculture, which relies on relatively stable climates. These new climate challenges, the end of cheap energy, declining freshwater resources, dramatic reductions in biodiversity and genetic diversity (and with it the loss of healthy soils) need to be included in any future designs for agricultural sustainability.

Furthermore, as we contemplate the future of agricultural sustainability, we now must take into account the current state of ecological degradation, caused in part by some of the very agricultural practices which produced the unprecedented yield increases of the past half century. As the *UN Millennium Ecosystem Assessment Synthesis* report pointed out, 'humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fiber, and fuel'[7]. Additionally, it is important to recognize that this impact on the health of ecosystems has severely damaged seafood ecologies, which in turn threatens the food source of the 60% of the world's population that has traditionally depended on fish and seafood for 40% of its annual protein[8].

The Millennium report concludes that while these changes to ecosystems 'have contributed to substantial net gains in human well-being and economic development', they 'have been achieved at growing costs in the form of the degradation of many ecosystem services'. And the report predicts that 'the challenge of reversing the degradation of ecosystems while meeting increasing demands for their services' will require '*significant changes* in policies, institutions, and practices that are not currently under way'[7].

The loss of genetic diversity and biodiversity, as well as the loss of soil health, will make it especially challenging to implement these 'significant changes'. In recalling the story of the great Russian botanist Nikolay Vavilov's quest to end famine, Gary Paul Nabhan warns us of the potential disaster confronting us if we do not restore the diversity that will be essential if farmers are to adapt their production practices to changing conditions in their own ecosystems. Nabhan reminds us that 'it is the *social, economic, and political access to seed diversity* at critical moments that can make or break a community's means of achieving food security'[9].

Nahban's vision for a sustainable food future, given the likely challenges facing us, is consistent with the evolving new vision of our food future being proposed by many agriculture and food scientists working with the United Nations. As the International Assessment of Agriculture Knowledge Science and Technology for Development (IAASTD) report indicates, while technology, trade and aid will continue to be useful tools in addressing our new global food future, those tools will have to be employed within a new context, one that engages populations of people within their own communities[5], a concept which is now often described as 'food justice, food democracy and food sovereignty'. Food sovereignty, a concept originally coined and defined by the international Via Campesina peasant movement, is taking hold, especially in the global south. It appears to have begun revitalizing the productivity and accessibility of food for populations that were food insecure during much of the global neoliberal 'feed the world' era[10].

Given that the restoration of biodiversity is critical to the success of this approach to food security, a crucial question must be entertained: which food paradigm can best achieve *both* food security *and* the re-establishment of biodiversity? In this regard, Michael Jahi Chappell and Lilianna A. LaValle have made a significant contribution to this debate

in their new paper, 'Food security and biodiversity: Can we have both? An agroecological analysis'[1]. After an exhaustive analysis of both industrial and agro-ecological approaches to solving this problem, they conclude that properly designed, agro-ecological approaches have a distinct comparative advantage. But they warn that 'agriculturalists and ecologists will need to work together to continue to investigate agro-ecological interactions and landscape integration and to look beyond short-term biodiversity conservation to the more general concern of sustainability'. This new inter-disciplinary cooperation will be crucial to the development of the redesigned agriculture of the future. Fortunately, we already have farmers who are experimenting with designs that feature complex, inventive, biological synergies within production systems wherein energy is exchanged among species and self-regulating and self-renewing, resilient, adaptive systems replace input-dependent, energy-intensive, control systems[11]. The further development of perennial polyculture grains, spearheaded by the Land Institute in Salina, Kansas, could also be part of this inter-disciplinary effort.

This view is consistent with Aldo Leopold's observation 60 years ago that we ultimately have to develop a new 'land ethic' which 'reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity'[12].

To achieve the goal of enabling the capacity of the land to renew itself, which Leopold identified as the core principle of sustainability, we now will need to attend to the critical question of the appropriate number of the human species in relation to the rest of the biotic community. As Leopold also recognized, nature abhors a 'density' of any species. He observed that in all species, density is always 'conditioned and controlled' and 'one is impressed by one common character: If one means of reduction fails, another takes over'[13].

This potentially points us to a return of a quasi-Malthusian dilemma, but Leopold did not subscribe it. Leopold continued to be hopeful about our capacity to develop an ecological conscience and nurture healthy land that had the capacity for self-renewal. However, while nature's ecology is enormously resilient, we need to remember that it has its limits, and eventually even nature's ecosystems cross thresholds to different kinds of functioning, some of which may make it difficult to imagine the survival of the human species.

Chappell and LaValle suggest that this also means that 'alternative methods and agro-ecological research to specifically support small-scale rather than industrialized agriculture will need to be reinvigorated, and with co-operation between ecologists and political economists, research to support these efforts will be needed, such as accurate valuation and incorporation of life-cycle costs and benefits of different food systems and diets'[1].

In our own time there is still reason to be hopeful, especially as the many challenges facing our current food system are raising consumer concerns and increasing their demand for changes in how our food is grown and handled. We are at a critical stage where societal demands for an agriculture that combines social, economic and ecological performance to achieve the necessary resilience to insure food security for the future, and provides all people with affordable, healthy, pleasurable and adequate food, can bring about changes not even imagined just a few years ago. This powerful force for change can revolutionize our food and agriculture system to meet the challenges we face.

Another hopeful sign is that an increasing number of young people are expressing interest in becoming farmers. Their vision of what it means to farm is much closer to the agro-ecological and community paradigm of food production than the industrial commodity system of the past half century has been. These new farmers, together with the consumers who are seeking them out to purchase the food they produce, are rapidly evolving into a community of 'food citizens' who aim to create the new food future that our challenges require.

All of this suggests the possibility of a significant restructuring of our food system in the decades ahead. While such changes will not come easily, there are reasons to believe they will eventually occur.

First, the fact that a new generation of young farmers is choosing farming careers and partnering with food handlers and food customers to create new food chains based on partnerships and shared values, and that these relationships are creating a new sense of food sovereignty, indicates that a new food culture could emerge. Two excellent articles which anticipated the sudden increased interest in the concept of the 'foodshed' is but one expression of this new development[14,15]. The foodshed concept is currently being explored by several communities, including New York City and San Francisco, as a way to address some of the problems of sustainable food accessibility and diet and health within their environs.

Second, the increased awareness of the vulnerability of our concentrated, global market infrastructures, including our food system, is causing a re-evaluation of the economic and social costs and the inherent safety of our current food system. Some of the most creative leadership in this regard has come from Charles Perrow, Professor Emeritus of Sociology at Yale University. In one of his early books, *Normal Accidents: Living with High-Risk Technologies*[16], Perrow pointed out that we can never design systems with the kind of control that eliminates accidents, because accidents are a 'normal' occurrence in any system. He argued that the only way to prevent accidents from becoming catastrophes is to restructure our economies to reduce the number of 'tightly coupled' systems in which accidents inevitably become catastrophes. Our current highly concentrated industrial food system is a classic example of a 'tightly coupled' system, and it is not surprising that we regularly experience food safety calamities.

In his more recent book, *The Next Catastrophe*, Perrow points out that not only do our large, concentrated market infrastructures *not* produce the efficiencies with which they are often credited, but they also are much more vulnerable to the natural, industrial and terrorist disasters from which we are increasingly at risk. He reminds us that:

> There is an alternative model for relations between organizations, first theorized about fifty years ago after economic demographers in Italy discovered a strange phenomenon. Northern Italy had a very large number of small firms, and while this should have been associated with low economic development it was actually associated with high economic development. Many of the firms were in high-tech industries and leaders in their field, but they generally had fewer than twenty employees. They were in increasingly prosperous areas, with low rates of unemployment and high rates of access to child care and higher education for females. Since its first theorization, there has been a burgeoning literature on the efficiency, resiliency, reliability, innovativeness, and positive social outcomes of networks of small firms in a variety of communities[17].

Perrow's analysis suggests that there is great potential for increased natural and industrial disruptions (a likely outcome given more unstable future climates) and increased costs of maintaining energy-intensive infrastructures in the face of escalating energy costs. Given Perrow's analysis, we could imagine a food system comprised of marketing networks of smaller, diversified farmers, linked to networks of smaller community processing facilities, serving regional foodsheds. This may be a more successful economic arrangement as well as a more socially acceptable system than the current specialized, concentrated, mass-production commodity system, focused entirely on economies of scale. Such market networks could still effectively reduce transaction costs while taking advantage of the reduced risk of natural, industrial and terrorist disruptions.

Third, all of this may additionally suggest the emerging need for a revised culture of economics that is better suited to the realities we will be facing in the decades ahead. The industrial economy of the past several centuries has been based on what Riane Eisler calls the '*domination* or top-down control system' of economics. She argues persuasively that this economic system is becoming increasingly dysfunctional and no longer achieves its desired goals. Given our new challenges, Eisler contends that our society would be much better served to adopt a new 'partnership' system which would replace our dominate-and-crush way of doing business with a more 'equitable and sustainable economic system' that 'requires attention to the interaction of economic and social systems'[18].

While such a significant cultural shift in our economic system may seem wholly unachievable in our current economic climate, we should not dismiss it out of hand. Some farmers and businesses are already using such a co-operative, partnership-based, market network model and apparently doing so successfully. For example, a group of wheat farmers in the western USA has networked together to form a marketing coalition to produce a variety of high-quality wheat. They make the wheat available to a coalition of millers and bakers that produce a high-quality line of breads, using the farmers' brand name (Shepherd's Grain) as the identifying mark of the product. The farmers, millers and bakers decide together what farmers should be paid for their wheat, based on the farmers' actual cost of production plus an adequate return on their investment. By all reports this is a business model that has been successful for everyone in the food chain, and given how the 'story' of this new way of doing business has enhanced sales, the venture appears to be very successful, economically and socially.

Many other family farmers have created similar marketing networks throughout the USA. Some of the well-known groups are Organic Valley of Family Farms, Country Natural Beef, Red Tomato, Good Natured Family Farm Alliance, Tall Grass Beef and New Seasons Market.

New challenges always produce new opportunities, and since we will not be lacking for challenges in the decades ahead, we might at least anticipate the possibility of creating a new food system. It could be rooted in a new social venture, driven by food citizens who are determined to achieve a new level of food sovereignty and participate in developing a new food system that is ecologically resilient, economically viable for all partners and socially just.

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