Research Brief

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Perennial Cornucopia

Planning the Next Agricultural Revolution

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Abstract

Perennial polyculture farming (PPF) offers great benefits for the environment and humankind. Farmland would be reengineered to emulate ecosystems, such as prairies, that require no maintenance yet provide food, continuous ground cover to minimize erosion, and natural methods to fertilize crops and control pests. Food production would be sustainable, the undesirable effects of modern agriculture would decrease, and poverty and hunger would be reduced. While the promise of PPF is not yet widely recognized, early steps to explore its feasibility are under way.

Ideally, improved agricultural practices should continue to increase food production while reducing environmental damage and other undesirable effects of current methods. RAND Corporation researcher James Dewar explores an innovative approach, called perennial polyculture farming (PPF), that could be an important step toward realizing that goal. PPF differs from most farming in two fundamental ways. Typically, today's agriculture centers on planting and harvesting a *single species of annuals* (such as wheat). PPF involves growing *multiple species of perennials* on a single section of land. Proponents of PPF believe that its widespread adoption could reap significant benefits, both for the environment and humankind.

One natural model of thriving perennial polycultures is the prairie that covered much of the Great Plains in the United States before wheat farming was introduced. Prairies, consisting of many kinds of perennials growing together, required no maintenance, yet provided food for various animals along with continuous ground cover that minimized erosion, legumes that provided fertilizers, and natural measures that controlled pests. PPF involves reengineering such natural ecosystems as prairies for farming purposes. Its proponents envision land that thrives the way these ecosystems did before humans arrived but is designed to rival the productivity of modern industrial agriculture.

Polycultures and Perennials

Many farmers already grow more than one species of crops on a plot of land. Such polyculture farming can be either sequential or intercropped. The sequential approach means planting crops in the same space in different seasons. Intercropping means having different crops grow on the land at the same time. In Mexico, for example, it is common to plant maize, beans, and squash on one plot. Growing a variety of plants together with no distinct row arrangement is *mixed intercropping*, a situation that resembles natural ecosystems such as prairies. It is mixed intercropping of perennials that offers the greatest sustainability benefits and is central to the PPF approach.

Perennials currently produce fruits and nuts but do not produce significant amounts of cereals. Since cereals account for at least half of dietary energy worldwide, PPF can play an important role in global agriculture only by changing the way cereals are produced. Among other challenges, such a step would require developing perennial grains that would thrive in mixed intercropping and could be easily harvested.

Environmental Benefits

Successful PPF would have powerful environmental effects, addressing many problems connected with existing agricultural methods. The perfect "reengineered prairie" would provide year-round ground cover to minimize erosion by wind and water. This constant ground cover would also

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diminish the need for irrigation and its huge thirst for water resources. Soil degradation caused by depletion of minerals and/or contaminations by pesticides, herbicides, and other means would be reduced because the polycultures would produce their own soil nutrients and provide their own pest control. Contamination of freshwater systems would likewise be curtailed by lower use of fertilizers, pesticides, and other chemicals. This reduced use, in turn, would help prevent such environmental problems as ocean dead zones, caused in large part by agricultural runoff. Additionally, PPF would help reverse biodiversity loss.

Social Benefits

PPF could also lead to reductions of hunger and poverty, to improvements in health and education, and to lower energy use. Agricultural productivity in developing countries is often inadequate because of poor soil, erosion, and insufficient irrigation, as well as lack of money for seeds, fertilizer, and pest control chemicals. The environmental benefits of PPF outlined above would increase productivity by reducing or eliminating most of these problems. Greater productivity would alleviate undernourishment among children and potentially improve the lives of women whose lack of education stems in part from increased responsibilities in agricultural work. In developed countries, PPF would save energy by cutting reliance on heavy farm machinery and fossil-fuel-intensive fertilizers and other chemicals.

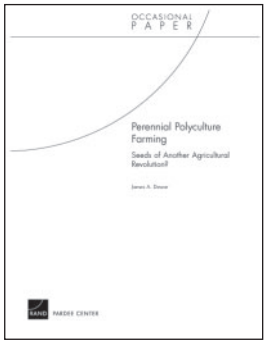
Feasibility of PPF

While PPF may appear fanciful, modern farmers already use techniques that emulate PPF methods: They rotate crops to limit the need for pest control chemicals and fertilizer, use cover crops to improve soil quality and reduce erosion, use low-till farming to increase water retention, and so on. In recent years, institutions such as The Land Institute and The Rodale Institute have been conducting research on perennial polycultures to see if the PPF approach could be a feasible alternative to monoculture farming. The results suggest that while PPF could be made to work, its economic viability is difficult to gauge. Proponents do not maintain that PPF should replace all annual monoculture farming, but they do believe it would make economic sense on marginal lands with highly erodible soils, a situation that exists in many areas of the world, including much of the United States.

The Road Ahead

A natural prairie may have more than 200 plant species and several times that number of microscopic soil animals working in concert. To reengineer such an environment for the purpose of yielding specific crops would be a great challenge. But perhaps an even greater challenge is making sure that the necessary intellectual and experimental work takes place. Most agricultural research is conducted by large agricultural businesses that are not likely to see significant economic promise in PPF. There is, however, an opportunity to continue research on PPF in developing countries, where the development community is paying increasing attention to agriculture as a key to reducing poverty.

While the current focus is mainly on improving industrial agriculture—in Africa in particular, institutional, social, and technological advances work in favor of including PPF as a means of improving agriculture and reducing poverty. In the institutional arena, the creation of the Comprehensive Africa Agriculture Development Programme provides a mechanism for funding agricultural research that may open the door for studies on perennial polycultures. In the social realm, along with the increased attention to poverty reduction that has fueled interest in agriculture, a growing emphasis on sustainability also makes PPF look attractive. Finally, two technological developments provide impetus for research into perennial polycultures. The first is the increased ability of biotechnology to modify characteristics of plants. The second, which affects Africa specifically, is the cataloging of neglected native crops to identify those that might be more successful than species in common use—a line of inquiry that could be an invaluable asset in the search for species appropriate to PPF. In short, there are elements in place that could help make PPF a reality. Only lacking are greater recognition of the role that perennials could play and the will to include them in the future of agriculture. ■



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