The People—Food Race, And How to Win It

By Joseph J. Marks, H. R. Fortmann, J. B. Kendrick, and S. H. Wittwer

Here we go into the future. It could be a pretty rough trip. World population keeps growing. Energy and other resources are limited. Some accommodation for this situation must be found.

We could keep going the way we are. That means we find some miracle that gives us boundless new resources . . . or that we just continue using up our resources in one final orgy of 20th century materialism.

Or we can take another route. Change life styles—at least enough to buy time for agricultural scientists to learn how to squeeze more out of every acre.

As agricultural experts, we are optimistic about food production. We think we can "feed the world of tomorrow" . . . by reshaping plants to make better use of photosynthesis, by harvesting the oceans, by building super plants and animals, by "inventing" food in ways that haven't even been thought of yet.

That may not be enough, unless we solve some "people problems" too.

There is increasing evidence that we must have population control. If population projections for the future hold true (the United Nations has predicted there will be 12.3 billion human beings on this planet before the numbers level off in the next century), we must either control population or create a Shortage Society.

Even if it were possible to feed, clothe and house all these

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Right, Rutgers specialists brought trickle irrigation and mulching to this Nigerian village, in research on extending limited water resources. Left, youngsters in Nigerian refugee camp dip into daily bowl of high-protein porridge. They also are furnished with milk daily, in U.S.-assisted program.

projected billions, we could expect a whale of a lot of other problems with people living under such crowded conditions.

Those of us involved in science have, heretofore, contributed mainly to the technical innovations that relate to such "people problems." We think it's time for scientists to move out from behind their test tubes to give guidance to world leaders. We expect scientists to become more involved in the social issues of the day and apply what reasoned knowledge they can to help solve them.

What are research priorities for the future? It's easy to conclude that we need more of everything: more research on the environment, plants and animals, the elements, etc. Equally important is *how* we get the job done.

You've heard the cliches: "teamwork" . . . "pulling together" . . . "interdisciplinary research" . . .

Cliche or not, that's the way it's got to be if we are going to be successful. Agricultural problems no longer are the exclusive property of agricultural scientists. Right now, around the world, we're designing more coordinated attacks on agricultural problems that involve the diverse talents and resources of many organizations and institutions.

More important, however, is the *feeling* that we must work together for the whole human race.

That love . . . that caring for all those who reside on this

humble planet . . . is the most important influence on research priorities.

Our research programs must know no borders, geographical or otherwise. We must avoid being locked into old formulas, organizational patterns and concepts. We must build a *broader basic research base.*

If agriculture is to do all this and feed those projected billions of people, our claim on energy needs must come ahead of air-conditioning, personal transportation, and the like. In other words, it calls for financial and moral support for agricultural research as an investment in developing and conserving energy.

As we keep building on that international resource we call food production, we must keep in mind that a research effort must be based on *environmental management.*

Making Allies of Nature

The idea is to make allies of the components of nature and think in terms of getting the greatest return in food production with the least expenditure of energy. It means we don't spend the money and resources required to wipe out every disease or pest that comes along. We learn to *manage* pests with the least cost to ourselves and our invironment.

Population control . . . a broader research base . . . environmental management . . . teamwork. Those are the requirements for the future.

We have only so much talent, skill and money. How do we use them most effectively? We asked this question of the Agricultural Experiment Station directors and land grant universities across the country.

Here are some of their priorities:

Monitor the environment. That means knowing our environment from the inside of molecules to outer space. The information-gathering capabilities of electron microscopes and orbiting satellites provide warnings of disease and insect outbreaks and help us manage our environment.

Watch weather and climate. Scientists estimate that 60 to 80 percent of the variability in crop production, whether boom or bust, can be explained by weather variability. The message: Don't take climate for granted; help plants and animals (including humans) adapt to it.

Advanced weather forecasting and weather modification, plus

computerized farm management, will help farmers take full advantage of rainfall, sunshine and temperature changes.

Build gene "banks." The idea is to avoid genetic vulnerability. Complete characterization of genetic lines stored in computer banks will give us insurance that new varieties and species can be brought forth to replace those being toppled by existing diseases, pests, or other environmental conditions.

Use the sun. Scientists recognize the sun as an "endless" energy source that can be used directly (solar heat) or indirectly (photosynthesis).

Engineers have made breakthroughs to exploit solar heat. Other scientists have only begun to tap the photosynthesis miracle which offers tremendous potential for increased food productivity. More about that under the next item . . .

Maximize protein energy. We need a bigger research effort on the two most important energy producing biochemical processes on earth: Photosynthesis and biological nitrogen fixation.

With photosynthesis, the plant traps energy from sunlight and uses this energy to grow. Scientists already are changing plants' shapes so more leaf area is exposed to the sun, thus improving their sunlight trapping system.

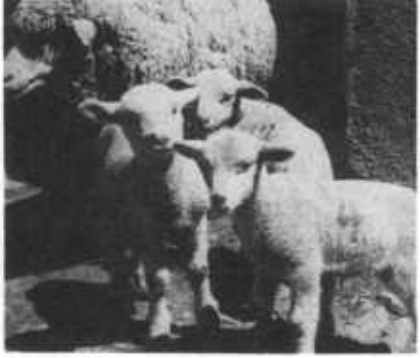
In the case of biological nitrogen fixation, soil microorganisms and certain plants work together to trap nitrogen from the air. Since fertilizer nitrogen is one of those limited resources, you can see the value of exploiting this *natural* nitrogen fixation process.

To state it bluntly, we must aim for the energy/protein limits in crop production.

This means new strategies for pest control, protective cultivation, multiple and intensive cropping, reduced tillage, using plant growth regulators, and so on. And we must circumvent environmental limitations, improve quality, enhance production and aid crop harvesting.

As part of building protein, we should upgrade it in plants and make better use of it in animals. Plant scientists are building essential amino acids (like lysine in corn and sorghum). Their job: upgrade plant protein so it can be substituted for animal protein in human diets.

Animal scientists are building protein by using nonprotein nitrogen (like urea or anhydrous ammonia) and combining it with corn silage and other roughages as a ration for ruminants (dairy cows, beef cattle, sheep). This way, livestock are less competitive with man for protein and energy, because the animal is



Top left, harvesting fish farm pond, Thailand. Top right, Corriedale ewe with her three lambs, Iran. Bottom, solar heat collector is tested for drying grain; this Ohio research is funded in part with a National Science Foundation grant administered by USDA.

converting what we cannot use into nutritious meat and milk.

Put it all together—for animals. That means exploiting their genetic potential (such things as multiple births and weight-gaining efficiency).

It also means building diets for optimum conversion of energy into meat, milk, and eggs.

Waste not. An ultimate goal is to recycle all plant and animal waste through the food chain—as an energy producer, animal feed and/or crop fertilizer.

Farm the waters. Since two-thirds of this planet is covered by water, it seems logical to investigate water fully as a food source.

Water—whether ocean or pond—could be a great protein producer, whether you're growing algae, lobsters, oysters, salmon, shrimp, catfish, or whatever.

Perfect the package. Efforts are being made to save some of the energy and billions of dollars spent each year to package products. Aim: recyclable packages. It may even mean reconstituting or eliminating conventional packages so the end product is in more readily consumable form. (Would you believe shell-less eggs?!)

Streamline distribution. We must cope with the food logistics problem—from production to processor to user. That means

building systems that minimize or eliminate the energy we now waste by moving too much bulk too far.

Reward the farmer. A major research priority is to give farmers an incentive for the job they do. These rewards, whether in the form of fair incomes and/or other benefits, will help us get and keep the quality of people we need in this profession.

There you have some of the ideas of future research priorities as we see them. They are intentionally quite general. We figured our colleagues had the benefit of the previous chapters of this book to get into more of the specifics.

Agricultural Experiment Stations must be in the forefront for designing systems to improve the quality of life of all our citizens. Economists, nutritionists, sociologists, plant and animal scientists, engineers and others must work together to achieve these ends. All need to keep an eye on the environment as the pressures of limited resources continue to mount.

As we talk of the future, we recognize that we are dealing in speculation. But we also know that unless we continually carry out research, we'll be forced into some intolerable situations. It's much less expensive to *act* to prevent these crises than to *react* once the damage is done.

That Delicate Balance

We recognize full well the importance of reassessing our national goals. We see the need for well balanced, interdisciplinary teams to screen, guide and project national programs and provide the support for sound agricultural research. We also see the need for maintaining a delicate balance between man and his environment as we carefully use energy, land, water and our nonrenewable minerals.

Looking back and considering the odds, the mere handful of publicly-supported agricultural research scientists have wrought miracles. There are only about 10,000 scientists at the 55 State Agricultural Experiment Stations and the U. S. Department of Agriculture. Yet, they deal with nearly 500 major commodities and resources—all subjected to a mind-boggling galaxy of problems and all deserving their full attention.

We think that team of agricultural scientists and farmers have done quite well, thank you. Our people are not only fed, but fed well with the world's most plentiful supply of nutritious, healthful food for the smallest part of their incomes anywhere in the world. But that's in the past. The tougher job lies ahead.