AMER. ZOOL., 25:407–413 (1985)

Science as a Way of Knowing: Man and Food[1]

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SYNOPSIS. The author congratulates the Education Committee of the American Society of Biologists for undertaking the Science as a Way of Knowing project. The project objective, to improve first-year, college-level biology courses, is excellent, and how to handle food and man in the courses is an important issue needing attention.

The author recognizes that course content should vary among institutions because their programs serve widely divergent clientele. Suggestions are made concerning topics which the author believes generally should be given greater attention.

Hunger and famine were recognized as being critical problems in the world, and students should learn more about them. Science is humankind's great hope, and through it the problems the world faces are solvable. Instructors are encouraged to take a positive approach and demonstrate what science can do.

Hunger and famine are largely the result of misguided national and international policies and not the result of our not knowing how to meet the food needs of all the world's people. The challenge is as much to apply what we know as it is to increase our stock of knowledge. This calls for greater emphasis on problem solving.

Teachers are encouraged to view food in its broadest context and call attention to the variations in the *systems* utilized to produce and distribute it. Attention should be given to environmental impacts, efficiency, risk, and managerial requirements for the various systems.

Global food needs in relation to the World's carrying capacity are discussed and information provided on the causes of hunger and famine. Vital issues in food and hunger are discussed.

INTRODUCTION

The Education Committee of the Association is to be congratulated for sponsoring the Science as a Way of Knowing project (SAAWOK) and for devoting a session on the program to man and food. Early this month (December 1984), I returned from Africa, where I once again became painfully aware of the fact that poverty, misery, hunger, disease, and finally, *despair* are a "way of life" for from one-half to three-quarters of the typical developing countries' inhabitants. In many countries, life in the rural areas, where the major economic activity is generally food production, has become too wretched to endure. Millions of people are abandoning the countryside and heading for the cities—seeking jobs that do not exist.

The population data Dr. Anne Erhlich presented is the "straw that is breaking the camel's back." Without major changes in the policies and actions of developing countries and the world community at large, in many countries the bulk of the rural folk and many of the migrants to the cities are doomed to live with the threat of famine continually hanging over them like a threatening storm cloud. Also of recent concern is the increase in hunger in the United States and other industrialized countries where the worldwide economic recession and revised social policies are taking their toll.

DISCUSSION

Is there any hope for the hungry, famine-threatened masses? Yes; and it is science. In the remarks which follow, I hope to show that, in most cases, science already has provided "the answer." We know how to produce the food needed and protect the environment. We can "feed our people." This leads to the first of a series of suggestions which, in my opinion, could improve first year classes.

Suggestion #1: Be realistic, but positive

I recognize that the world is in a mess *vis-à-vis* man and food, but there *is* hope,

[1] From the Symposium on *Science as a Way of Knowing—Human Ecology* presented at the Annual Meeting of the American Society of Zoologists, 27–30 December 1984, at Denver, Colorado.

and humanity will be better served if teachers take a realistic, but positive, approach. I suggest teachers stress science as a problem solver; point out the risks and dangers from ecological degradation and from the human population explosion, but give "equal time" to showing how the problems could be solved. Demonstrate the role science can play in solving our critical problems.

Suggestion #2: Emphasize "doing"

Our challenge is more than to "know." If we are to "feed our people," we must find ways to move nations and people to act on what is "known." Therefore, I urge teachers of first year biology courses to stress doing as well as knowing. The final section in *Science as a Way of Knowing II—Human Ecology* (Moore, 1985), which I assume all have read, is excellent. The title is "It's Time to Take a Stand"; I agree 100 percent. Perhaps Phase II of SAAWOK should be "Science as a Way of Knowing *and Doing.*"

Suggestion #3: Lead students into an awareness of "who benefits most from science and new technology" and "who needs help?"

It is in the Third World where the relationship between man and food—the topic of this session—can be seen in its most direct and fundamental form. It is there where science could "do the most" for people, but it is, in fact, where the least is being done. We who live in the developed world have traditionally benefited most from new scientific discoveries, and among us, the poor have been the last to benefit. Sophisticated technology developed by science which makes heart by-pass surgery, etc., possible is of little direct consequence to the starving people in Africa. Teachers of first year biology and other science courses should stress that "knowing" is important, but for many in the world, it can be sterile. Of course, this is why we—the world—need more than "to know"; we need problem solvers.

Suggestion #4: Expose students to a problem solving approach

A consequence of stressing a "doing" approach should be that students will become better problem solvers. I urge all teachers to foster a problem solving orientation in the classroom and laboratory. The following questions may be helpful to teachers as they review their courses.

On any issue or in any problem area, have the students learned *what* is being done, by *whom,* and *why*?

Have present and future potentials been ascertained (estimated)?

Have the constraints and limitations to achievement of full potential been identified?

How could the constraints be relieved or the limitations by-passed? What are the alternatives? What are the costs?

Has a pragmatic approach been demonstrated wherein various means/ends schemes are weighed against one another? What are the trade-offs?

The above is very sketchy. The point is, I want to urge teachers to organize their courses and present materials in a form which encourages the development of a problem solving mentality.

Suggestion #5: Recognize that the causes of many problems are not biological, and neither are many of the solutions, but they are still proper concerns for biological scientists

There are many constraints which keep humanity (us) from reaping many of the potential benefits from the sciences, and some are in the socio/political/economic arena. Identifying and removing the constraints, wherever they may be, are proper, honorable concerns for scientists. I am pleased Dr. Paul Ehrlich mentioned values in his keynote address. Hunger, even if its major cause is misguided economic policies, is still a proper concern for biologists.

Misguided national policies in both the developing and developed countries are the major causes for millions of people lacking access to the food they need. Enlightened national and community leadership is necessary if corrective action is to be expected. The future leaders of our and many other nations; namely, the influential citizens, will, with few exceptions, be "exposed" to a first year course in biology. Reaching the future leaders with the right material is of tremendous importance. However, leaders

cannot do the job alone. Of greater importance is reaching the rank and file citizenry. Here, we must look to the future teachers in primary and secondary schools. Reaching them should be given high priority, too.

Suggestion #6: Present a thought-provoking global view of food

Beginning biology classes will vary from campus to campus. Each professor must decide what to include. I suggest the following, at minimum:

Define "food" in its broadest context and show how people meet their needs through a system. Students need to know that food is carbohydrates, proteins, etc., and I think we do very well in this regard. However, there is much more to "food"—it is marketing, storage, processing, production (farming), provision of inputs, risk taking, transportation, financing, technology, values, etc. I suggest that after having the students read, and perhaps having a lecture or two on the evolution of agriculture, a detailed description of three food *systems* in typical situations would be helpful. The following are suggested:

a. A "modern" market economy, commercial agriculture-based system.
b. A heavily subsistence-oriented system.
c. A largely pastoral/nomadic system.

In the discussions of the three systems, consider the environmental impacts, use of technology, efficiency (economic and energy), risk, role of government, and managerial requirements. Show where science "fits." Differentiate between the *need* and the *market* for food. Select a country where one of the three systems prevail, and call students' attention to the percentage of the typical family's real income (or effort) which is expended for food. Also, note where each country stands on the development scale.

Review projections on world needs. Need is largely a function of population, and I agree completely with Dr. Anne Ehrlich that in beginning biology, students must be exposed to population projections and to the variations in them. However, don't beat the topic to death. Explain why projections vary. This presents an excellent opportunity to explore the importance of assumptions. Then, accept a creditable projection, and move on to other issues. I suggest using the projections in the United Nations' *World Population Prospects as Assessed in 1980* (New York, 1981). The projection is for 6.1 billion people in the year 2000, and a leveling off by 2050 at 9–10 billion.

Review the worldwide potential for food production. Students need insights into the absolute potentials, and there are numerous studies on the world's absolute carrying capacity. Here, as on other topics, the conclusions vary greatly. On one extreme, it is postulated that, technologically, enough food could be produced to meet the needs of at least 90 billion people! At the other extreme, one can find authors who argue the world cannot continue to support the 4.8 billion some authorities say is our current population.

The more reasonable projections are probably those based on what would be produced if current-day technology utilized in the more developed countries were applied uniformly on a worldwide basis. Under those conditions, world food production would meet the needs of about 9 billion people, which is the leveled-off population projection many authorities I have read say is expected in about the year 2050.

An analysis of the various projections on the world's carrying capacity will probably lead students to conclude that soil loss, threats of deterioration to the environment, etc., are indeed serious problems, but the absolute physical limitation is not a great worldwide issue now, nor will it likely be in the next few years. I believe it is extremely important for students to be exposed to this viewpoint early in their college careers. To identify the great issues requires a narrower and more specific focus. If they do not learn to narrow their focus early in their careers, they will waste much time and energy in later life.

Suggestion #7: In order to improve students' perceptions of "the problem," analyze the current global situation

A situational analysis can be an excellent teaching tool, and there are several good

sources for analyses of the food situation we face today, and will face in the future. Every biology teacher should have ready access to a copy of *Global 2000* (Barney, 1980), *Global 2000 Revisited* (Kahn and Simon, 1983), and Holden's (1983) summary of the two. When students become aware that there is enough food being produced in the world today to meet the dietary needs of all the people, and hunger and malnourishment are not the result of an inadequate world food supply, they will have taken an important step in sharpening their analytical skills. The facts may surprise some college freshmen, but the sooner they get the idea that they must avoid reaching conclusions too quickly, the better. Students should be encouraged to broaden their vistas, and they need to be encouraged to be relevant.

Looking to the future, the *Global 2000* authors (they are on the gloomier side) project food production will increase at 2.2 percent per annum. A paper in *Global 2000 Revisited* projects an annual rate of 2.8 percent. The latter projection assumes no *major* breakthroughs in technology, but does assume continued modest successes in plant breeding. Most of the increase comes from more widespread adoption of current technology and use of production increasing inputs. Since the world's population is projected to increase at 2.5 percent, the idea that the supply of food is not a great global issue per se and the need to "focus in" is reinforced. Students should then be ready to discuss *the issues* in food and hunger.

A booklet entitled *World Food Issues,* is excellent, and I commend it to you. The short, well-researched articles cover the more relevant topics. Every biology teacher should have access to a copy, and parts of it should be required reading for students. I draw heavily from it.

From the global view, the fact that the whole world never goes hungry, or starves, should be obvious to students. I have seen no case where hunger is even national in scope, and this includes Ethiopia today. A wag once quipped, "Hunger is a very personal thing." *Individuals* go hungry, suffer, and die from diseases which strike the weakened body.

To gain the greatest insight into the hunger and famine problem, the relevant questions are "*Who* goes hungry?" and "*Why*?" I think these questions should be asked in beginning biology classes. While hunger and famine strike individuals, the probability it will strike varies by where people live, their class, and their place in the family. Let this sink into the awareness of the students.

The bulk of the hungry and malnourished live in what is commonly called Third World countries. We really do not know how many people suffer from mal- or under-nutrition there, but it is probably a billion or more. With the Third World's population literally exploding as Dr. Anne Ehrlich told us this morning, the situation is likely to get much worse in the next few years.

In the introduction to this discussion this morning, I mentioned that many of those who faced the threat of famine in the Third World are rural people. The *rural sectors,* where poor health, hunger, and malnutrition prevail, are generally characterized by agricultural systems in which the typical rural family, utilizing a minimum of purchased inputs and relying on conventional wisdom-based technology, works a small tract of land or herds a few livestock. The family spends many days of labor to produce a total food supply, which will, under the best of conditions, provide only a meager subsistence. The family that produces the food consumes most of it; therefore, the system may be, and generally is, referred to as the "traditional sub-sector" or the "subsistence sub-sector." Money, including that needed to pay doctors and immunize children (which would make them more productive), is hard to come by. There is little opportunity for off-farm employment, even to process or handle the food which is exported to the urban areas. The real cost of feeding the typical family is very, very high.

In areas where people face the most serious food–nutrition–health problems, production is highly dependent upon weather and other acts of God. When drought,

flood, or pestilence strikes, less than subsistence requirements are available, and people suffer. Frequently, the labor requirements for subsistence or major crops are concentrated into a critically short period; therefore, production cannot readily be increased. Thus, we find massive underemployment most of the year, while farmers complain about the shortage of labor constraining production. In many areas, women provide most of the labor, and in some areas, they are the key production decision makers as well. In vast areas, rapid increases in population and ecological degradation are reducing the resource base per family very rapidly; hence, the number of people on the very edge of survival is increasing.

Dual economies have emerged in most developing countries—a "modern economy" and a "traditional economy." Wages and salaries in the modern economy are high (relatively), and people who break into it have real incomes many times greater (sometimes ten to fifteen times) than those in the traditional economy. People in the modern economy have the money to buy food, and it flows to them. Unfortunately, the modern economy is generally urban-based, and the skills required to break into it are *not* those most rural folk have. The number of jobs in the modern economy is very limited; yet, many go unfilled because the number of people with the skills, attitudes, and experience required is even more limited.

The dual economy concept can also be applied to agriculture. Dualistic agricultural economies have emerged in most of the developing countries—a commercial sub-sector and a subsistence sub-sector. The commercial sub-sector is often export-based; however, in some cases, it is providing the food for urban consumers in the home country. Yields per hectare, production per person per year of labor, and return to investment in the commercial sub-sectors are frequently, perhaps generally, satisfactory. Development strategies in many developing countries concentrate effort on export crops and on the commercial sub-sectors.

The *urban sectors* have generally contained a relatively smaller share of the hunger-prone and sick than have the rural sectors, but there are still plenty. Many, and probably most, of the urban poor are recent rural-to-urban migrants; however, the situation is changing. The crux of the urban food-nutrition problem appears to be the availability of more adequate basic services in the urban areas amid a lack of employment opportunities. Rushing to the cities without the skills required to get a job in the modern, progressive, commercializing and/or industrializing economy, the new arrivee is likely to be disappointed. Many live in slums, which in developing countries tend to be new settlement areas (in contrast to developed countries, where the slums are the old decayed areas).

In spite of all the problems the slum-dwelling, recent rural-to-urban migrant family faces, the total family is likely to be better off than it would have been had it remained in the rural area, and in free societies, it is not likely ever to return to the countryside. Education for the children and health services for all members of the family are likely to be much more readily available in the urban areas—even for the poorest of the poor. If the family was landless before migrating to an urban area, *i.e.*, dependent upon labor only, it may find food cheaper to purchase in the city because of developing country policies designed to hold urban food costs down. Returning to the countryside is not a promising option for the urban poor who are hungry.

Five key terms highlight the food–nutrition–health situation of the developing countries and are extremely important in terms of strategies. They are majority, productivity, income, access, and technical and managerial skills.

The *majority* of the people in most developing countries are dependent upon the agricultural sector for a livelihood. In most developing countries, the majority are in the subsistence sub-sectors of the agricultural sector where *productivity* of the human resource is very low. In agriculture, there are those who have access to land, and there are the landless poor. The latter struggle to find jobs where few exist, and often live an almost animal-like existence, largely on

family, village, or some other form of welfare. Real *income* is extremely low, and the numbers of people affected are so great that the average level of living in a nation so affected cannot be satisfactory. Those who have access to land, while generally much better off than those who do not, frequently lack access to production-increasing inputs and supplies and marketing services. Frequently, the *majority* of the farm families lack ready access to production credit, marketing services, or production-increasing purchased inputs. Almost all—the landed and the landless—lack the *skills and knowledge* needed to become more productive. Low productivity is thus the first order cause of rural poverty; this, in turn, is linked directly to malnutrition, famine, and poor health.

The urbanite on the thin edge of survival is equally likely to be in a family in which the productivity of potential income earners is very low. The problem may be unemployment, underemployment, or employment in an occupation where the reward for work is low. Lacking income, people are unable to buy the food or health care they need. Food and health services are produced largely in response to a money incentive, and both flow to where the money is. This applies to areas, as well as individuals and families. The poor, lacking money, simply cannot channel the flow of nourishing food or health services in their direction.

No discussion of famine is complete without recognizing the crucial role of war and refugees. There are millions of refugees. Almost all are poor, and in their current situation, it is hard for them to be productive and earn income. Obviously, anything that will lessen conflict among nations will reduce famine.

The developed countries have options for solving hunger and famine which are not viable for many of the developing countries. They have the wealth and productive capacity to provide for many people without requiring that they be productive. This is not a very promising option for developing countries.

The potential for developed nations, such as the United States, to increase food production is important and will contribute to the world food supply via international trade, but it does little to solve the basic famine problem. The developing countries, where the bulk of the hungry reside, do not have the foreign exchange needed to buy great quantities of food from abroad. Developed countries are reluctant to continue to give food to any country on a permanent basis. Ultimately, the "food problem" must be solved rather close to where the hungry reside, and the solution will require the poor to become more productive, either in terms of producing more food for themselves or through gainful employment.

The potential the developing countries face for feeding themselves, either through production of food or buying it in the marketplace, varies greatly. Some have vastly underutilized physical resources. Some lie along trade routes and could add value to products in international commerce. Unfortunately, some are "basket cases," and the outlook for them is very dim. The differences among the developing countries was highlighted in a paper to a conference held in 1979 and reported in *Human Resources for Primary Health Care in the Middle East* (Fischer, 1979).

I suggest that each biology teacher call attention to the need for all countries to develop a "food for all" strategy. In each government, somebody should be thinking about food and hunger issues, and providing guidance. Teamwork between government and private sector institutions will be required.

Suggestion #8: Highlight some of the vital issues in food

The booklet cited earlier (Drosdoff, 1984) and entitled *World Food Issues* is an excellent source, and the various articles provide insights into the problems and their potential solutions. The articles take a look at topics such as plant breeding, plant protection, irrigation and water resources, mechanization, post harvest losses and care, technology development and transfer, agrarian reform, and food aid. All of the

potential topics cannot be covered, but students could get a feel for the breadth and diversity of what is involved in modern humankind meeting what has been called our most basic need—food.

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