RESEARCH REVIEW

IN THIS ISSUE

"No single instrument of youthful education has such mighty power, both as regards domestic economy and politics, and in the arts, as the study of arithmetic," says Plato in Book V of the *Laws*. "Above all, arithmetic stirs up him who is by nature sleepy and dull, and makes him quick to learn, retentive, shrewd, and aided by art divine he makes progress quite beyond his natural powers." Plato never said that the arithmetic methods used had to be particularly complicated. Presumably he would concur that relatively simple procedures are capable of stirring us to make progress both as regards domestic economy and politics.

Two of the articles in this issue, the second and the third, depend on a traditional arithmetical research technique known as budgeting. Authors of one article use budgets to show that a relatively new distribution system for fabricating and retailing beef is not as cost effective as some have thought it to be. The new handling system is familiarly called "boxed beef" because the packer prepares smaller cuts at a central place and ships them to the retailer in boxes. The second example of budgeting shows that the new, powerful, four-wheel-drive tractors frequently are purchased for use on farms which are too small for the tractors to be cost effective. Both budgeting examples demonstrate that simple arithmetical procedures can be powerful instruments for upsetting popular beliefs.

Relatively simple arithmetic aspects of probability and chance are used in the first and third articles. In the first, the authors, through normal distribution and probability, estimate the variations in Government payments to farmers that might be expected under current disaster insurance programs. Payments made in 1974 were found to be unexpectedly large while those in 1975 came closer to expectations. The second example of probability analysis involves random moves that individuals might make among feasible alternatives. The method, known as a Markov Chain, is applied to growth in farm size. It shows that, while farms are expected to grow, the enlargements are not occurring fast enough to absorb efficiently the number of large tractors being sold to farmers.

The fourth article elicits a disquieting and paradoxical conclusion: Even those of us who dislike arithmetic and large-scale, high-speed computers, who only want to read agricultural economics literature written in plain English, must turn more and more to computers to locate what it is we want to read.

Clark Edwards

FOOD AND AGRICULTURE

A Scientific American Book, W. H. Freeman and Co., San Francisco, 154 pages. 1976. $9 ($4.95 paperback).

Eminent biological and social scientists (mainly economists), on the disciplinary end of the disciplinary/practical problem spectrum, contributed the 12 articles in *Food and Agriculture*, originally published in the September issue of *Scientific American*. At the disciplinary end, the articles are relevant and important for agencies and persons concerned with food and agriculture. But the articles' authors treat collectively, and hence in a multidisciplinary way, only *part* of the information necessary to solve problems in these areas. Solving most such problems requires more than uncoornated knowledge from the biological and social sciences.

The infinitely numerous, complicated problems making up what is simplistically called *the* (singular) food and agriculture problem have many other facets, including political, military, medical, and demographic dimensions, which are neglected in this set of articles. Most problems and their solutions have institutional and human dimensions as well as technological dimensions. Yet these articles involve primarily the technology (including nutrition), the economic consequences of changes in technology, and, occasionally, the simple institutional changes needed to get modern inputs produced, distributed, and used. People are treated mainly as alimentary systems and maximizers (as guts and utility grabbers). Sex drives, population control, ethics, values, military power, health, political aspirations, and, even, energy are among the essential but neglected subjects.

The real income generated by food producing resources cannot be redistributed without acquiescence, altruism, or the exercise of moral, political, police, and military power. Significantly, the need for redistribution results from actions of those who do not accept equal responsibility for population control while demanding equal access to food for themselves and their progeny. The inappropriate mix of disciplines presented in this book means that the question posed in the foreword cannot be answered. That question was: "How will the world feed the three billion additional people who will join the population between now and the end of the century?" Indeed, if the problems involving food are as serious as some envision, the extra three billion may never survive or even be born.

This is not the only "food and agricultural effort" which has suffered from inappropriate disciplinary mixes. Others include the May 1975 issue of *Science* (*1*); The *World Food and Nutrition Study* by the Board of Agriculture and Renewable Resources (BARR) of the National Academy of Science (NAS) (*8*); *Agricultural Production Efficiency* also by BARR, NAS (*7*); *Crop Productivity—Research Imperatives*, sponsored by Michigan State University and the Charles F. Kettering Foundation (*2*); and *African Agricultural Research Capabilities*, NAS (*6*).[1] The current phase of the NAS World Food and Nutrition Study continues the same pattern.

[1] Italicized numbers in parentheses refer to items in References at the end of this review.

Two separate world conferences have been held—one on population in Budapest and the other on food in Rome. Inappropriate combinations of disciplines and the separation of food from population make it difficult to consider these two conferences as parts of an integrated system. This brings us to the second general difficulty with efforts of the type reviewed here. Most of them fail to take a systematic view of food production, utilization, and nutrition. This failure occurs for the farm level as well as for local, national, and international levels.

General models of food, population, and income distribution systems are not new. There is the Malthusian model and the more complete model of J. S. Mill in Book IV of his *Principles of Political Economy (5)*. The Mill model was updated in 1945 by T. W. Schultz in *Agriculture in an Unstable Economy* (*9*). Schultz's model has been used to analyze farm production, food, nutrition, and income situations in separate individual countries but not globally. Hence, the physical, economic, political, and military heterogeneity of the world has not been neglected though, of course, worldwide models and conclusions have not been produced.

The heterogeneity of the world must be recognized in any assessment of world food and agricultural priorities. Though modern technology has shrunk the world in terms of travel time, and many idealists speak of *one* world, the food and nutrition world is in fact highly fragmented. China is a separate world. Anglophone African countries are more closely tied to England than to their Francophone neighbors which are tied to France. The international transportation systems of Africa and South America are only rudimentary. Europe has just succeeded in creating a common market. Mexico and Central America are not integrated into the North American market. Man exists in food and nutrition ecological communities isolated from each other by transportation costs, trade regulations, and migration restrictions—all enforced with highly unequal distributions of political, military, and market power in space.

Recent global modeling efforts by the Club of Rome did not take this world heterogeneity into account though they did interrelate food production, population, and nutrition. They *missed* the stabilizing effect of international heterogeneity. That heterogeneity has led to regional, national, and subnational disasters in time and space, rather than to massive collapses of world populations. The real world displays greater stability than the homogeneous *Limits to Growth* models of the Club of Rome (*3*). Subsequent attempts of Pestel and Mesarovic to remedy this flaw by regionalizing the model have not added enough heterogeneity (*4*). Their models have not been addressed to political, military, and economic (market) power distributions and redistributions as these bear on the incidence of malnutrition, starvation, disease, and military casualities, and, hence, on changes in both population and incomes, which influence the demand for production and, finally, prices of food.

Clearly, there is need of a "systems understanding" of food production, population growth, changes in food technologies, institutional changes, and changes in human quality and numbers. This understanding must be global, with due attention to the heterogeneity of the real world. Chapter 1 in the *Scientific American* text by Wortman and Chapter 12 by Hopper were based on models. Similarly, efforts to develop a broader world understanding of food and nutrition will require models—but models much broader than Wortman's and Hopper's. Whether or not these broader models are computerized as is the Club of Rome model is of no real intellectual consequence, although computerization is of obvious practical consequence.

Building broader, more realistic models cannot be done by members of any one discipline if such models are to reflect appropriate disciplinary mixes. Food and nutrition, on a global scale, are too complex and important to be done by or left to agricultural specialists, nutritionists, economists, systems scientists or any other academic specialty. On the other hand, no specialty can be omitted, *a priori*.

Administration of priority assessments involving broad conceptual efforts is obviously difficult. This explains why most such exercises have not involved appropriate disciplinary mixes and have not dealt with total systems. Most food and agricultural assessment efforts have tended to concentrate on preselected topics and projects, mainly those of biologists, nutritionists, and economists. The concentration is on the disciplinary (or fundamental) basic interests of biologists and nutritionists, rather than on practical problems specific to time and space. The economists are mainly asked to run cost/benefit analysis and to help mobilize research money to support preselected projects. The preselected biological and nutrition projects probably reflect priorities within those disciplines fairly well, at least on the disciplinary end of the scale. However, relative priorities are not well established between one set—the biological and nutritional projects—and another set—research on policies and programs (international and local), and redistribution of power (market, political, military), which affect the supply and demand for food via starvation, malnutrition, disease, and war.

To establish these priorities requires us to start with questions about the *systems* in which real-world problems (*plural*) involving food and nutrition exist. After answering such questions, we can then proceed, via attention to broad priorities, to detailed priorities within such categories as biology, economics, demography, and political science.

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THE FARM CREDIT SYSTEM: A REVIEW

W. Gifford Hoag. *The Farm Credit System, A History of Financial Self-Help*. The Interstate Press, Danville, Ill. 1976. 292 pages. $6.95.

Agricultural economists generally, and those with interests in agricultural finance especially, will find *The Farm Credit System, A History of Financial Self-Help* an informative, interesting book. W. Gifford Hoag, who knows the System intimately, brings together considerable material that has been available only in separate publications, and he melds this with information that has not been readily available. However, he omits some contributions to the System by the Federal Government. Thus, in addition to being a review of his book, this note contains an exploration of some of the Government's contributions to the Farm Credit System.

Hoag treats the significance of the Farm Credit System to farmers and the economy, basic principles followed in its development, and the System's relationships with other organizations and groups. The book includes a chronological listing of relevant events. A more detailed table of contents or an index would have been helpful, particularly because a topic is often discussed in more than one place, and some duplication thus exists.

The author emphasizes the role of farmers as financiers, the focus of the Farm Credit System on people rather than profits, and the System as an essential link between financial markets and farmers. He points out improvements in farm loan practices initiated by the Farm Credit System, such as amortized loans, budgeted loans and the line of credit, intermediate-term loans, the future payment fund, and variable interest rates.

The author brings out the early enthusiastic accept ance of the Federal Land Bank System by farmers as indicated by the large number of National Farm Loan Associations (now Federal Land Bank Associations) which were organized, subsequent problems caused by these small associations with overlapping territories, and steps taken in reorganizing and rehabilitating the associations. Hoag outlines problems faced by the Federal Land Banks and Federal Intermediate Credit Banks in the twenties and conditions leading to creation of the Production Credit Corporations and Production Credit Associations and the Banks for Cooperatives in the depths of the Great Depression of the thirties. Subsequent changes are treated too, including the merger of the Production Credit Corporations into the Federal Intermediate Credit Banks. The question is asked, "Why so many separate organizations?" A good, although brief, answer is given, together with discussion of efforts by System banks and associations to better serve farmers.

The relationship of the Farm Credit System to various other agencies and organizations is explored, as are political pressures affecting the System and its development. The discussion on adverse political pressures is perhaps the most useful, since such information is not generally available elsewhere. We learn about the politics involved in transfer of the Farm Credit Administration to the U.S. Department of Agriculture in 1939, "political overtones" in some appointments, and other pressures during the "Department of Agriculture years." Also examined are pressure by the U.S. Treasury on the System during the credit crunch of 1966, and a small cut by the President of the United States in one Bank for Cooperatives' debenture issue during the credit crunch.

The use of names of many people involved in the history of the System adds interest. The author gives the positions that many of these people held both within and outside the System. The use of photographs is an asset: there are pictures of governors of the Farm Credit Administration, various Presidents of the United States signing farm credit acts, and district Farm Credit Bank buildings.

The chapter and section headings are excellent, but readers may wish, as this reviewer does, that more "meat" had been provided. For example, Chapter 22, "Before the Land Banks - 1620 to 1916", probably was included to portray the mounting need for credit in agriculture and the forceful pressures that developed; that is, the economic conditions justifying creation of the cooperative Land Bank System, and, a few years later, the Federal Intermediate Credit Banks. However, only about four pages of the chapter are devoted to this long period. The section, "Pressure for Credit Increases," includes only 10 lines comprising 5 sentences. Yet, history indicates the gravity of the agricultural situation which developed during the late 19th and early 20th centuries was second only to that of the Great Depression. Albert S. Goss, who played a major role in development of the land banks and of the whole Farm Credit System, particularly in the thirties, experienced firsthand the problems which confronted farmers, particularly the prevalent 3- to 5-year term real estate mortgage. When a young man, he purchased a "good" farm with a 5-year term mortgage, but subsequently was forced by "due dates" to trade 4 times. Years later he said:[1]

[1] From an unpublished address of A. S. Goss, then Master of the National Grange, Washington, D.C., before a meeting of stock-

When I was a kid I got chased by a turkey and was nearly scared to death; and I have been chased by a bull, but if you ever want to get a real case of being chased by something that's tough, it's being chased by a due date. That due date chased me around in four or five different counties between Washington and Oregon and I finally landed with a farm with a $6,000.00 mortgage and almost no equity, but the due date at least was five years off. I made up my mind that time that if ever I got out of debt I'd never get back in again, and I made up my mind that if I ever got in the business of lending money, or dealing in credit, which I considered the most hard-hearted business on earth, I hoped some kind friend would shoot me.

The book would be of considerably greater value had it been written with less bias in favor of the Farm Credit System and more objectivity. The System is large, it has stature, it is well accepted in the financial community, and it provides a large proportion of credit extended to farmers and ranchers. The System can stand on its own. Therefore, an objective analysis recognizing and considering all factors involved, including the full financial contribution of the Federal Government, would have provided a more valuable history.

In portraying the history of the Farm Credit System as one "of financial self-help," Hoag does not recognize the extent of the financial help provided by the Government. Webster's New World Dictionary defines self-help as ". . . taking care of oneself without outside help . . .". Hoag does recognize the initial capital provided by the Government without which the System would never have been created. He includes information on paid-in surplus and some other financial assistance provided the Land Banks by the Government in the thirties to help them to survive the Depression. However, a number of financial contributions by the Government are not discussed.

For example, the bid price on land bank bonds dipped to 71 in September 1932, and practically no bonds were issued from 1929 to 1934 for public sale. Those which were issued were usually sold to the Federal Reserve Banks or to the Reconstruction Finance Corporation.[2] The System made use of the revolving funds provided by the Government for such emergencies.

The Farm Credit System obtained financial benefit from a Government appropriation of $2 million in 1933, and from interest-free capital provided by the Government. Arnold reports that the $2 million was used by the Washington office for administrative expenses in connection with establishment and supervision of the Production Credit Corporations and the Production Credit Associations from 1933 to June 30, 1942.[3] The interest-free capital, together with income generated from operations, provided the funds from which the banks and associations paid their expenses. The earned net worth of the banks was, in effect, given to them by the Government.

The Farm Credit System has benefited substantially over the years from favored tax treatment. The Federal Land Banks, Federal Land Bank Associations, and Federal Intermediate Credit Banks have never been subject to taxation, except on real estate. The Production Credit Associations are subject to taxation except "for any year or part thereof" in which the Governor holds any of their stock, in which case they enjoy about the same exemptions from taxation as the Credit Banks. The Production Credit Associations benefited from similar treatment prior to 1957, when Government capital was held by the Production Credit Corporations. The provisions for the Banks for Cooperatives are similar to those for the PCA's.

Until passage of the Public Debt Act of 1941, the bonds and debentures sold by the Federal Land Banks and the Federal Intermediate Credit Banks and the derived income were exempt from all taxation. The Public Debt Act of 1941 took away the Federal income tax exemption, making the income from notes, bonds, debentures, and other obligations issued by the banks exempt from all Federal, State, and local taxation other than Federal income tax liability of the holder thereof. Banks for Cooperatives' debentures and the income derived therefrom are exempt from State, municipal, and local taxation, except surtaxes, and estate, inheritance, and gift taxes. Interest on such obligations was free from Federal income taxes until passage of the Public Debt Act of 1941 but has been subject to Federal income taxes in the hands of the holder since that time.

Other ways in which the Farm Credit System benefited from Government financial assistance include free use of office space in Government buildings and Government payments to the Civil Service Retirement Fund. The Farm Credit Administration was housed free in the U.S. Department of Agriculture in the District of Columbia until 1972, as required by law.[4] The Farm Credit Act of 1971 provided that the Farm Credit Administration should either pay rent or provide its own quarters (Sec. 5.15 and Sec. 5.17).

Full-time employees of the Farm Credit Administration have always been covered by the Civil Service Retirement System. Employees of the Farm Credit Banks were brought under Civil Service retirement coverage in 1941 and given credit for service before that year. All bank employees continued to be covered until January 1, 1960, when the Farm Credit Act of 1959 provided that only those on the rolls as of that date could continue to be covered. The Civil Service Retirement Act which became effective in July 1957 required, for the first time, that employing agencies contribute amounts to the Civil Service Retirement and Disability Fund matching the deductions withheld from the salaries of their employees. Previously, the Government provided appropriations to supplement deductions withheld

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holders of the Federal Land Bank of Houston, in Houston, Texas, February 24, 1950. A copy of this talk can probably be found in the files of the Farm Credit Administration or of the System.

[2] American Institute of Banking. *Farm Credit Administration.* New York, N.Y., Nov. 1934, pp. 154-59.

[3] Arnold, C. R. *Farmers Build Their Own Production Credit System—organization and first 25 years.* Farm Credit Admin. Circ. E-45, Aug. 1958, pp. 84-85.

[4] *Laws Administered by the Farm Credit Administration as Amended to January 1, 1957.* Farm Credit Admin. Circ. 20 Rev., Jan. 1957, p. 4.

from employee salaries, necessary to finance the retirement fund.[5]

An analysis of Government assistance provided the Farm Credit System would not be complete without recognizing that the System was established to provide credit to agriculture throughout the country, which involves serving some uneconomical lending areas. Moreover, while the System serves large farms, it also serves many smaller farms where the per dollar cost of making and servicing loans is relatively high. As Hoag brings out, the System has helped improve the credit service of other lenders and, therefore, it has benefited farmers throughout the Nation. In turn, the population generally has benefited from a higher level and quality of agricultural production.

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TECHNOLOGY AND AGRICULTURAL DEVELOPMENT: A REVIEW ESSAY*

Since World War II, the earth's nations have experienced unprecedented economic advance, increasing interaction and interdependency, and population growth. Despite the positive impacts of these postwar changes, some 40 percent of the 2½ billion people living in lower income countries remain in abject poverty, obtaining incomes of less than $150 annually. Income and wealth gaps within poorer nations, and between developed and developing societies, seem to be increasing rather than decreasing despite both indigenous efforts to promote economic development and an historically unique era of magnanimity by developed nations. If the intensity of development efforts is beginning to wane, what hopes remain for the one billion persons left behind?

Explanations for the failure of postwar efforts to assure development fall into five broad classes. One set of arguments holds that the development effort is insufficient, that developed and developing nations are not trying hard enough, that the infusion of more resources would push the various sectors and nations over their current limiting thresholds and permit steady advances. A second set of critics argues that development efforts are misguided. It is not so much the level of effort but rather the *type* of development effort which is crucial, so the failure to aid in the right way (rather than the failure to aid enough) is held culpable for the "absence" of development. A third set of critics espouse a "villain theory"; development can never proceed until groups or institutions benefiting from current arrangements are extirpated. A fourth approach is to question our knowledge of the development process, to argue that without a cogent understanding of it, indigenous and foreign efforts are as likely to produce unfavorable as favorable results. The fifth approach to the development process adopts a different perspective; limited development reflects the intractable nature of the problem more than reliance on misguided theories or efforts. This school views development as a complex process requiring time; it counsels patience and avoids overexpectations rather than advocating new directions in development efforts. Each of the approaches (except the last) prescribes a policy *change* to expedite or alter the mode of socio-economic development.

This essay reviews several recent criticisms of past and ongoing development efforts. First, a recent contribution to the "villain" school of criticism and an earlier example from the "misguided" school are discussed. Next, the propositions of those arguing for labor-intensive development efforts which utilize appropriate technology are examined. The essay concludes with a brief survey of persisting development problems and an assessment of the likely impacts of the criticisms reviewed.

Villains and Misguided Development Efforts

The school of thought that identifies villains who block progressive changes and expose well-intended but fallacious strategies enjoys a long tradition in development criticism. E. Vallianatos' *Fear in the Countryside* adopts both perspectives to demonstrate the "failure" of current development efforts and to illustrate the changes necessary to assure progress (*13*).[1] The key to economic development is, in Vallianatos' view, a labor-intensive, locally adapted agriculture. Economic theories of development are summarized in a brief reference to Rostow's "stages of growth" and then denounced for their "criminal neglect of agriculture." Development efforts have been misguided because they stress the formation of capital-intensive industrial projects and will not change until the bond linking the multinational corporations of developed nations and the elites in developing nations is broken. "The thesis of this book . . . advances the proposition that the transfer of agricultural technologies to the underdeveloped countries has rarely been successful because of forbidden (sic) constraints" (*13*, p. 13). These constraints include biological specificities which limit direct technological transfers and institutional arrangements which ensure that the agricultural technology provided will not benefit the mass of peasant farmers. Rather than adapting technology to the needs of peasant farmers, profit-seeking entrepreneurs will cater to the needs of agricultural elites who already possess the land, credit, and education necessary to use existent technology without adaptation. The resulting development process accentuates intrasocietal income and wealth differences, allowing the developing societies to fall farther behind the developed, since the energies of the peasant masses remain unused or misguided.

[5] Information on the Civil Service Retirement Act and the Civil Service Retirement and Disability Fund was provided by the Civil Service Commission by letter dated March 15, 1977. Other information in the paragraph was provided by the Farm Credit Administration.

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[1] Italicized numbers in parentheses refer to items in References at the end of this essay.

The solution is to redirect the development process so that it is structured around the needs of the peasant: "the peasant farmer is the backbone and victim of both economy and poverty in the underdeveloped countries" (*13*, p. 14). Only when new technologies and institutions favoring the peasant farmer are introduced can the productive potential of peasants and rural workers be unleashed finally to solve the problem of poverty in the developing nations. Emphasis centers on the interdependency between man and technology, not man and man: "human survival will depend largely on man's ability to shape his technology to the environment" (*13*, p. 8).

Vallianatos' book is "a manifesto—a book of passionate advocacy" (*13*, p. xv); assertions abound. While it may be true that "the effort of the West to make the big landowner the main food provider of the underdeveloped countries has clearly failed," little evidence is adduced in support of this contention, since "some of my findings are not rigorously supported by extensive data" (*13*, p. 17). Although Vallianatos cautions that "the purpose of this book is to probe, not to prove" (*13*, p. 19), many readers, especially development economists, will not agree with the premises which permit conclusions to be drawn. For example, not everyone would agree that "agricultural research and institutions in the poor countries are basically irrelevant to local needs" (*13*, p. 146), precluding agreement on the need for "a veritable renaissance in appropriate agrarian technologies" (*13*, p. 161) as a panacea to the development problem.

Vallianatos' book consists of three introductory chapters, three chapters illustrating the failures of past technological transfers in Colombia, and four chapters which argue for a new type of technology and an alternative means of diffusing technology in developing nations.

Although development economists will fault Vallianatos' methods, assertions, and conclusions, the book is part of a burgeoning literature on intermediate, alternative, or appropriate technology. With the publication in 1973 of E. F. Schumacher's *Small is Beautiful: Economics as if People Mattered* (*11*), the appropriate-technology movement discovered an intellectual font for the idea that technological diversity is superior to uniformity. Rather than encouraging the production and distribution of capital and energy-intensive machinery, the appropriate-technology school contends that development efforts are misguided due to an insensitivity to differences between geographic areas. Personal and environmental changes (often deleterious) accompany the acceptance of a uniform new technology. The solution posited is to adapt technology to its local milieu, to stress labor- rather than capital-intensive technologies, and to "restore dignity to manual labor."

The interactions of technology's diffusion and socioeconomic development concern the processes by which choices are made. Given a range of technological alternatives, why do developing nations choose a particular set of inputs? Economic theory holds that choices are contingent on tastes and relative prices. Despite tastes for the new and modern, a "correct" (market-determined) set of relative factor prices ensures that the technological choices made are economically, rather than merely technically, efficient. A long literature on agricultural development finds that, for the given set of relative prices, peasant choices are economically efficient (*10*, *2*).

The appropriate-technologist school goes beyond choice decisions *given* relative prices by averring that the prevailing set of factor prices is distorted. For Vallianatos, relative prices favor capital-intensive development because multinational corporations and local elites combine to prescribe a situation in which rational choice dictates a mutually advantageous outcome; for example, machinery sales for the multinationals and pressures for land consolidation to use the machinery efficiently. Schumacher faults the relative price set for a different reason. Rather than identifying a cognizable set of villains, he argues that misguided choices result from bad values, that price-dictated choices neglect "meta-economic" values. Although meta-economic values are not explicitly defined, it is clear that their adoption would result in an alternative choice set.

Choice decisions influenced by distorted relative prices are not a discovery of persons supporting appropriate technology.[2] Development economists have long recognized the capital-using bias of policies of developing country governments which provide artificially low interest rates, price subsidies, tax credit for capital investments, and overvalued exchange rates or differential tariff structures. But developed nations have promoted capital intensity by tying aid to the purchase of certain (domestically produced) products, by ensuring that technical aid is given by those familiar with capital-intensive techniques, and by assisting salesmen who seek to distribute a technology developed for technologically advanced nations. Multinationals contribute to recognized capital-distorting practices by relying on familiar technology which can be used without adaptation. Thus, it has long been recognized that there are factors which distort relative prices and therefore choices; appropriate technologists have merely called attention to new distorting considerations.

The Schumacher school of appropriate technology identifies three sets of issues. On moral and ethical grounds, less happiness is derived from consumption of more high-energy material goods; maximizing consumption is inherently unsatisfying. A second set of arguments involves the restructuring of society to conserve nonrenewable resources, to discourage the drive for scale (bigness), to use more labor-intensive production processes, and to make work more satisfying. These arguments concern the nature of the power and decisionmaking structures which can reverse current propensities. A final set of issues is philosophic; should economic growth be the goal of a society? What rate of growth? Who should determine optimal "smallness?" The theme underlying Schumacher's arguments is a Waldenesque wish for rustic rural life, modernized by the distinction between renewable and nonrenewable resources.

The appropriate-technology school has flourished.

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[2] Some critics contend that technological choices in agriculture are wrong from yet other perspectives. Perelman, for example, criticizes American agriculture for using more energy inputs per food calorie produced than Chinese agriculture, making the set of caloric input-output ratios a basis for comparison (*8*).

The U.S. Agency for International Development has established an intermediate technology program; the United Nations has initiated multiple research and diffusion programs, including several wind, solar, and bio-gas energy projects under its environmental program; and the Organization for Economic Cooperation and Development (OECD) has sponsored a series of seminars and discussions on the subject (*3*). The London-based Intermediate Technology Development Group stresses the need for adapting technology in local developing areas while the American National Center for Appropriate Technology emphasizes the need for "self-reliant and quality-of-life improving" technologies in the United States. Given its recent origins, the diffusion of the appropriate-technology ideas has been very rapid, providing evidence of a strong undercurrent of popular desire for a return to local autarky, even in the United States (*14*).

If intermediate technologies are to be encouraged, who should bear the burden for their development and diffusion? Bhagwati assigns the task to the developing countries: "It is really up to the labor-abundant, developing countries to direct their scientific research to turning out superior, labor-intensive techniques" (*1*, p. 193). Others argue that the donor nations should direct developing nation strategies by specifying how foreign aid is to be used. Sweden, for example, demands that its aid monies have employment-increasing impacts, and the European Economic Community has embraced labor-intensive project proposals even if the total cost of the project escalates (*7*). If donor nations continue tying their aid to specific projects, fewer funds are then available for the relatively risky research on intermediate technology, a risk compounded by the limited spatial and duration characteristics of the market for such innovations. Intermediate technology, as with many other development ideas, is as much a strategy developed and advocated from the affluence of donor nations as an outgrowth of indigenous efforts.

Technology and Persisting Development Problems

Development is a relative concept; across time and space, its "stage" or "level" is held to be assessable against objective benchmarks. The presence of societies at different levels of development has two important implications: (1) the existence of both advanced and less advanced societies makes the strategy of imitation omnipresent and (2) the search for objective benchmarks to compare development across time and space leads to the use of quantifiable development indicators.

The fact that role models exist, that the "end" is visible and mensurable, permits the imitation strategy to adjust means more than ends and reduce the time necessary to reach a given development end. The dominant objective benchmark has become the level and growth in GNP, permitting the *definition* of underdevelopment to be translated into a monetary criterion. As with many such complex processes, definitions of the problem are important, since the definition often contains within it the seeds of a solution; for example, develop by increasing the level and growth of GNP.

Making the level and growth of GNP the *denouement* of the development process obscures related but intermediate problems. Development economists often identify three pressing concerns: (1) unemployment and underemployment, especially in urban areas as a result of rural-urban migration;[3] (2) failure to move toward income and wealth equality; and (3) population growth (*9*). A development strategy centered on aggregate output growth implicitly assumes that these intermediate problems will be solved as a byproduct of growth.[4] Despite a concerted 30-year effort, the intermediate development problems remain, partly because their presence has been obscured by the definitions used.

Rural-based, small-scale, labor-intensive development strategies have refocused attention on intermediate problems rather than final solutions. Intermediate technology is seen as one way of assuring more rural employment and of limiting the income inequalities introduced by capital-intensive technologies available only to the few. The recent criticisms have a common thread—development efforts must concentrate on the small farmer and the agricultural sector, not the more visible capital-intensive industrial sector. The population problem is not explicitly addressed; as with other theorists, the implicit assumption is that increased economic security will naturally reduce fertility. Even measured against its own criteria, the appropriate-technology strategy must be seen as incomplete.

Deflection from GNP targets and concentration on an employment-increasing agricultural strategy has both benefits and risks. To improve life for the masses, the fraction of total income in the hands of the rural and urban poor must be increased, either by measures which increase employment or via income transfers. The advocacy of rural-oriented, employment-increasing policies is not confined to those espousing appropriate technologies (*4, 5*); but the technologists often neglect the economic and political risks which accompany such strategies. If the income elasticity of demand for food is high, then much of the additional income transferred to the poor will be spent on food.[5] If the extra income available to the poor is diverted from those with higher savings propensities, then the rate of investment and capital formation may slow, especially if additional food imports are necessary to meet the additional food demands.

An even greater risk for the domestic development planner is that strategies can be irreversible; once set in motion, a strategy aimed at ameliorating conditions for

[3] The urban unemployment resulting from urban industrialization and rural-urban migration provides yet another illustration of the complexity of the development process. Too often, interdependencies and linkages are not well understood, permitting "unanticipated" problems (urban unemployment) to follow from desirable strategies (increased domestic production). Todaro has documented the extent to which such linkages have worked in Africa (*12*).

[4] The relationship between population and per capita income permits the limiting of population growth to equal an increase in per capita income *if*, for example, additions to population have zero (or even negative) marginal productivities.

[5] Mellor has estimated that the marginal propensity of consumption for food is about 0.85 for the lowest income quintile in India and 0.02 for those in the top decile (*6*), indicating that income and wealth transfers *will* tend to increase food consumption and lower savings.

the masses can be reversed only at great cost. While the long term goal may remain equality and affluence, planners may argue about the *timing* of new policies designed to achieve that end. Although more choice in development strategies may be available than is often supposed, the choice process must still involve a myriad of benefits, costs, and risks.

The technology-development debate is not settled. What the appropriate-technologist school has done is to question the implications of long-dominant economic theories. The theory of international development and trade argues that a given set of world and domestic prices will permit each nation to maximize production by selecting those outputs in which it has a comparative advantage. But the theory assumes "market-determined" prices; if markets are manipulated, then a country's "comparative advantage" may be artificially maintained by particular foreign or domestic actions. Such an artificial comparative advantage may promote inequality within societies; for example, the oft-asserted dictum is that peasants produce luxury foods (coffee, sugar, and the like) for foreign consumption under relatively capital-intensive conditions, ensuring excess labor and low wages, but these peasants must purchase foodstuffs (such as rice) which are imported from countries where very different capital-labor ratios prevail. Even if such arrangements make the peasant better off by some absolute consumption standard, the inequality engendered may leave him worse off in a utility framework.

Technology affects development via its influence on product design, production facilities and processes, organization and marketing techniques, and its broader impacts on skill and educational levels and priorities, profit and power potentials, and international interdependencies. Technology is either acquired, adapted from exogenous sources, or indigenously developed. Since the developed societies do virtually all research and development work, it is natural that the resulting innovations are generally directed toward meeting such societies' needs. But the *creation* of technology differs from its *transfer*; the issues raised by those who favor appropriate technologies are much more an indictment of current modes of transfer rather than a condemnation of technology's creation. What is required is more sensitivity to local needs rather than a reorientation of science.

Development literature often tends to adopt a messianic aura; given a desperate problem, it identifies (a set of) culpable factors responsible for persisting poverty and comes up with means for their dissolution. Development consultants often appear as sacerdotal savants waging theological wars over degrees and levels of intervention which can eliminate poverty and misery. But poverty and misery have been universal in both time and space. Efforts to eradicate poverty (or at least mitigate its consequences) antedate modern technology and economic theory. The appropriate-technologist school injects a needed evolutionary perspective into the debate; while technology often "overpromises" because of its ability to perform tasks at superhuman speeds, appropriate technology stresses the link between human understanding and human technology. Which mode of development is "better" is not a realistic question, but the introduction of another view can only be welcomed as a counterweight to dominant theories which have enjoyed limited success.

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MICROPOLITAN DEVELOPMENT

Luther Tweeten and George L. Brinkman, Iowa State University Press, Ames. 456 + ix pages. 1976. $20.

Luther Tweeten and George Brinkman are ambitious scholars. They have tried to produce a book that "can be used as a classroom text, a book of readings, a reference, or a guide to rural development practitioners and decisionmakers." Such a goal is admirable, but it must be regarded as terribly naive when the subject is the development of nonmetropolitan areas in the United States. Hundreds of scholars have bent their attentions to this theme. Only a few have been able to comprehend the

problem in more than one or two dimensions.

Micropolitan Development, though a book with many dimensions, does not define a comprehensive set of ideas or theories related to its primary subject. Instead, it represents a collation of results, reviews, and opinions generated by many authors and scholars who have worked at micropolitan development in recent years. The book is a reference book and nothing more. But it is a very good reference book because it comments on scores of contemporary researches, theories, and ideas. It will find a useful place on the shelf of any teacher, researcher, practitioner, or serious student of micropolitan, rural, or community development.

The book is organized in a familiar way. The problem is defined and placed in context, the goals of problem solving and public policy are presented, then the work of the theoreticians is described. When theories are well in hand, the authors turn to specific classes of problems—human resources, community services, and industrialization. The final chapters are devoted to institutional problems, organizing for development, and planning. On the surface the book seems to cover the right subjects in the right order. Though honest in what they achieve, the authors mislead in promising readers more than they deliver.

Every land grant university has at least one instructor who needs a textbook to use in the proliferation of courses on rural development, rural community development, human resource development, or even micropolitan development. Tweeten and Brinkman have named the subject that a text should cover, but they have not written a textbook.

A text must start with a single thread and hold to that thread throughout. Authors cannot claim to be presenting a subject and then discuss only what impinges on the subject or results from the subject's problems. There is neither theory nor a well-defined practice of micropolitan development in *Micropolitan Development*; thus, the book becomes a compendium, not a text.

The chapter on theory alone is worth the price of the book. Tweeten and Brinkman, by adding a special twist, come to grips with the heart of the problem. Many authors of specialized books in economics, particularly in the subfields of agricultural economics, devote an early chapter to theory then turn to other matters without ever returning to use the theory. In *Micropolitan Development*, the chapter is correctly titled "*Theories* of Micropolitan Economic Development" (emphasis added). It contains a list of theories available for use in analyzing the special problems that may arise in certain micropolitan areas. While one might question the choices (Why are the Harrod-Domar models included? Why are the Innis theories omitted?), the level of treatment is acceptable and the inclusion of theories of public involvement, commendable.

Given the authors' previous involvement in research, it is not surprising that they devote much space to human resources. Even though this topic should be of special interest, devoting one-fourth of the book to this subject seems too much. True, the labor force (Chapter 4), education (Chapter 5), and poverty (Chapter 6) are important characteristics of micropolitan areas, but the treatment need not be so exhaustive and repetitive. One wishes there were more on causes, effects, and interrelationships; less on documenting the obvious. While it is useful, for example, to know that poverty exists, it is also useful to know the origins of the poverty and the relative success of alternative programs designed to alleviate poverty. It is characteristic of the book that problems are overdocumented; analyses, solutions, and public policies, underdocumented.

The chapters on organizing and planning are at best disillusioning and at worst possibly dangerous. Despite the authors' continuous admonitions, some practitioners—especially those who embrace the process approach to development—will use these chapters in a cookbook fashion. They will follow each step in a rigid sequence that identifies problems, generates interest, specifies goals, develops plans, then calls for sitting back to watch while improvement marches into the area. This is as much the readers' fault as the authors', but it underscores the naivete of all who are involved in the process of development. Development can *sometimes* be planned, but caprice and whimsy remain important elements. The authors could have done a service by including a chapter on coping with failure. Perhaps such an apology or warning is beyond the pale of economics, but someone who is learned and intensely involved with rural development should be awakening the diverse clienteles to the fact that the odds are stacked in favor of failure rather than success and that even the best of plans and efforts may go unrewarded. This conditioning theme cannot be found in Tweeten and Brinkman's book.

In sum, Tweeten and Brinkman have provided a useful piece of work. It is not as general as they would have readers believe, but it will be helpful to many people. In its role as a compendium, it has few competitors. It replaces A. F. Wileden's *Community Development* (The Bedminster Press, Totowa, N.J., 1970) in providing immediate access to and commentary on the results of hundreds of researches, papers, and articles.

The book does not, however, come close to an analysis of the micropolitan development problem. For this, we will continue to depend on Vidich and Bensman's, *Small Town in Mass Society*, revised edition (Princeton University Press, Princeton, N.J., 1968) and its indepth look at the problems of "Springdale." For showing the relationship between the national economy and the regional economies, Niles M. Hansen's *Rural Poverty and the Urban Crisis* (Indiana University Press, Bloomington, 1970) remains the superior book. However, Tweeten and Brinkman set out to study the studies of others. They did this well and for this effort they are to be thanked. They should, though, be encouraged to rethink the book they wanted this book to be. They should unleash their considerable analytic prowess to find the threads that can be woven into a *text* relating to the development of nonmetropolitan areas.

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THE NEW ECONOMICS OF GROWTH: A STRATEGY FOR INDIA AND THE DEVELOPING WORLD

John W. Mellor, Cornell University Press, Ithaca, New York. 335 + xv pages. 1976.

John W. Mellor's new strategy for alleviating poverty in the developing countries aims at employment; the major stimulus to growth comes, from cost-reducing agricultural technologies. The poor, Mellor argues in *The New Economics of Growth*, can only participate in the development process if the demand for their labor increases. Poverty, in other words, is a function of the structure of economic growth; it cannot be readily eliminated by increasing public welfare expenditures or redistributing income.

Substantially raising the incomes of the poor, however, will increase their effective demand for food. Unless food can and will be massively redistributed, putting people to work will require rates of increases in food production in most countries far in excess of those achieved under previous growth strategies. Increased food production, Mellor concludes, must be a prime component of any program designed to increase the welfare of the poor.

The necessary increases in food output, Mellor argues, must be obtained through technological innovations. Unless cost-reducing agricultural technologies can be developed, agricultural production costs will rise and the productivity of labor and other nonland resources will decline as output rises. More capital and other resources will have to be transferred to agriculture to achieve a given growth in production, slowing down the rate of growth in other sectors. Higher production costs will also lead to higher food prices, discouraging more labor-intensive development throughout the economy. As a result, the additions to national income from agriculture will, in the long run, be offset by the losses in potential income from other sectors of the economy.

Rising food costs could be prevented by resorting to food imports or food rationing. Developing cost-reducing agricultural technologies is the superior alternative, Mellor argues, but not a costless one. Technological advances in agriculture require expenditures on research. Massive investments will also be required in rural physical infrastructure (such as irrigation systems and rural transport and communication systems) as well as in the institutional infrastructure for servicing agriculture (for example, research, education, credit, input and product marketing systems).

When the necessary increases in food production come through the application of cost-reducing technologies, the resulting increases in rural incomes will set in motion a sequence of multiplier effects, according to Mellor, which will stimulate expanded production and employment in other sectors of the economy. The unique twist in Mellor's argument stems from his recognition that this multiplier process can continue to work even though the initial benefits of these technologies may be captured by the more prosperous rural people. For example, cost-reducing agricultural technologies will enable the wealthier landowning classes to produce and market more food. The extra cash they receive will be spent primarily on nonagricultural commodities. Since the consumer goods which they purchase are relatively labor intensive, more people will be employed as a result of their increased incomes and expenditures. The newly employed, lower income, laboring classes, who spend most of their incomes on food, will provide the demand for the additional food produced. The circle must be completed for this strategy to work. If the number of lower income people employed does not increase sufficiently, for example, demand for the increased agricultural output will be inadequate and agricultural prices may decline sufficiently to discourage continued growth in agricultural production.

Mellor tests this strategy in India—the stronghold of the capital-intensive approach to development. He looks at the sources of current development in India, diagnoses the successes and failures of the capital-intensive approach, and projects what might have happened to employment under alternative assumptions about rates of growth in food grain production, technologies, and population.

While emphasizing the agricultural sector, Mellor also stresses the interrelationships among agriculture, industry, trade, aid, social welfare programs, and the planning process itself. The relative importance of consumer goods and other small-scale decentralized industries will have to increase under Mellor's employment-oriented strategy as rising rural incomes bolster demand for their output. Additional supplies of capital will be needed both to develop agriculture and to expand the consumer goods industries, but now each unit of capital invested will have a greater impact on employment because such industries are relatively more labor intensive. A combination of factors will also encourage the decentralization of production to rural areas. Rural demand will be higher. Higher rural incomes and increased production will also encourage investment in rural transportation, communication, and electrification—all important to the development of rural, small-scale industries. Higher rural incomes should also provide additional sources of capital for investment in local, small-scale industries.

Larger quantities of intermediate products produced with highly capital-intensive processes will have to be imported to support the development of agriculture and the consumer goods industries—fertilizers and pesticides for agriculture and steel, petrochemicals and synthetic fibers for industry. Domestic manufacture of these products would divert capital from agriculture and consumer goods industries which must provide the bulk of the employment. "Fortunately," as Mellor points out, this same strategy will help expedite exports of labor-intensive products by raising the supply of wage goods (food and consumer goods) and thus of relatively low cost labor.

Four types of changes must occur, Mellor concludes, for India to shift to an employment-oriented strategy. Priority must be given to agricultural production by investing in new technology. Capital requirements per employee in the industrial sector must be reduced and new sources of capital tapped through decentralization of production. Export and import growth rates must increase to expedite the decrease in capital intensity. And planning and administrative procedures and institutions must be decentralized and the emphasis switched from regulation to facilitation.

Mellor, more than most economists, not only recognizes the importance of administrative and political factors but he also can tell us what his economic strategy will require in the way of changes in institutional structures and administrative styles. Central determination of resource allocation and a system of restrictive licenses and controls designed to prevent the distribution of resources perceived as undesirable was consistent with India's capital-intensive strategy. If an employment-oriented strategy is adopted, India's administrative structure will have to become much more decentralized, Mellor concludes, and more attention given to facilitating rather than controlling development. Agricultural development, because of great variations in production conditions, must be a considerably decentralized process. Consumer goods industries and other small-scale enterprises, such as agriculture, are more likely to prosper with more decentralized decisionmaking and public provision of credit, transport, marketing, and technical and other services.

Whether this strategy is relevant to the rest of the developing world, as Mellor's title claims, is open to serious question. Everything depends on who gets the extra income from the new technologies and what they do with it once they get it. If a small group of very wealthy landowners are the initial beneficiaries, and they spend their increments in income on imports and/or capital-intensive goods, the multiplier effects will be initially different than if other groups benefited. Growth measured in GNP may be stimulated but not employment or equity. If employment and equity are also objectives, the old but politically difficult solutions still seem to apply—redistribution of assets or income or both.

Mellor argues that, in the peasant agricultures which predominate in Asia and Africa, the expenditure patterns of the initial beneficiaries of agricultural technologies will encourage the expansion of labor-intensive consumer goods industries. Latin American countries are conspicuously absent from this list. Mellor has evidence from India to back up his contention. A recent analysis of rural consumption patterns in Sierra Leone found that rural consumers did purchase primarily labor-intensive goods.[1] This analysis also provides support for the hypothesis that low-income groups purchase more labor-intensive products than do high-income groups. Until more evidence is gathered, however, Mellor's hypotheses are just that—hypotheses.

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[1] Derek Byerlee, *et al. Rural Employment in Tropical Africa.* Working paper 20, Dept. Agr. Econ. Mich. St. Univ., East Lansing, Feb. 1977.

INTERCROPPING IN SEMI-ARID AREAS

J. H. Monyo, A.D.R. Ker, and Marilyn Campbell, eds., International Development Research Centre, Ottawa, Canada. 72 pp. 1976.

Intercropping is the mixing or interplanting of a number of different crops on the same piece of land, at the same time. It is almost universally practiced by small farmers in most tropical countries, but, in spite of this, agricultural research workers in the tropics have generally tended to neglect the complicated intercropping systems and to concentrate on research on one crop at a time, as is done in temperate regions. Recommendations based on the results of this research were then made to the small farmers so that they might improve their crop yields. The farmers almost invariably rejected these attempts to impose alien single-crop systems on them, and continued their own traditional intercropping practices.

A symposium on intercropping to share the results of agricultural research to correct for this lack of relevant knowledge was held at Morogoro, Tanzania, in May 1976. The 30 papers presented are summarized in this interdisciplinary report. They cover: soil management and fertility; crop combinations; plant breeding and crop physiology; pests and diseases; experimental methods; and economic and social aspects of intercropping.

The traditional agriculture inherited by the peasant farmer was designed to raise sufficient food for himself and his family in a situation where very little else was required. There were no taxes, no school fees, no goods for purchase, low population levels, and little pressure on the land.

Death control, costs of a country-wide government organization, education, and material needs of Western civilization have changed all this. The farmer now has to produce a lot more from continued use of the same piece of land.

As researchers, we have to ask ourselves: Is the intercropping technology that we have developed thus far sufficiently superior to that already used by the farmer? We need to look at what the farmer is doing, and why he is doing it.

The farmer has tried many possibilities during the last thousand years, but we may be able to bring in new crops, new crop varieties, new ideas of cropping patterns from other countries. The main possibilities for improvements are new varieties, oxen power and improved implements, fertilizers, and weed control.

Improved varieties often involve a redistribution of total dry matter production so that much more of it is grain. This gives the farmer an immediate yield increase without additional inputs. On this can be added simple agronomy practices, provided the new varieties are responsive, which they must be. Only then can we think in terms of farming systems.

However, population pressure is increasing and time is running out. Increased production per unit is essential, and governments will be faced with the hard decision on whether these changes can be induced by persuasion or whether state control is necessary to make the farmer adopt new ways.

[Extracted from the report.]

VILLAGE WATER SUPPLY: ECONOMICS AND POLICY IN THE DEVELOPING WORLD

Robert J. Saunders and Jeremy J. Warford. Published for the World Bank by the Johns Hopkins University Press, Baltimore and London, 279 pages. 1976. $15 ($6 paperback).

Water-associated diseases are related to the availability of water and sanitary facilities. Yet most people in developing countries do not have "reasonable access" to a "safe" water supply or adequate means of waste disposal, according to the World Health Organization. Thus, investment in rural water provides both economic and human benefits. Robert J. Saunders and Jeremy J. Warford present several: An increase in overall economic activity if funds come from outside the country; an improved infrastructure which will attract more investment; availability of water for fish farming, irrigation, and livestock; an increase in property values; reduced human mortality and morbidity, more time for productive work, especially among women and children who draw the water; fewer medical expenses; improved tourism; and, "if it is assumed, first, that carrying water requires more calories than the substitute activity," there will be a decrease in the cost of personal consumption. The last observation may seem trivial, but it illustrates the authors' thoroughness.

Saunders and Warford present a regression analysis that attests to economies of scale in water supply and waste disposal. However, per capita cost, they say, is not enough of a criterion for establishing priorities. One also needs to consider growth-point strategies, "worst-first" strategies (which could easily give the nod to urban areas), community enthusiasm, and quality of the existing water supply. Sometimes the decision that sets a priority is political, the authors point out; other times it is based on mathematical formulae. The criteria suggested above are at best only screening devices, since it is extremely difficult to measure benefits. Willingness of consumers to pay, at least in excess of a basic minimum, represents a more rigorous method of setting priorities, according to the authors.

Underemployment and overvalued currencies tend to characterize rural areas of developing countries, and development funds are available at interest rates below opportunity costs. Therefore, the authors believe, a major job of the economist is to value the factors of production so that a clear choice can be made between labor and capital among alternative projects. For example, the quantity of water consumed can be more important than the quality in the incidence and prevalence of some diseases; money spent on "absolutely safe" water for a few people might be better spent on "reasonably safe" water for more people. Another example which the economist's work can help to solve is whether to install household connections, which cost more but increase per capita consumption, or to have village standposts and fountains.

Poor operation and maintenance of existing systems is widely believed to be the single most important obstacle to rapid improvement in village water supply. Saunders and Warford visited two countries where the "systems were actually failing at a more rapid rate than they were being constructed." A survey in another country "showed that 69 of 79 rural water supply systems had some difficulties in operating their plants." Many countries lack facilities to train bill collectors, bookkeepers, pump operators, and community promoters. Engineers do not want to live in backward rural areas. Low wages can mean that many people must take a second job or they may resort to considerable pilferage. Finally, there are frequent subsidy cutbacks by the central governments in these countries.

The authors conclude with a discussion of methods for regulating water consumption, such as marginal cost pricing, metering, social pressures, and physical restrictions in valve design and reservoirs. The book is mainly for policy planners and sanitary engineers but persons in related fields, such as health care and foreign service, should also find it useful. The book contains an excellent current bibliography of 23 pages.

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THE JOURNAL'S NEW LOOK: AN ASSESSMENT

Agricultural Economics Research (AER) has been under "new management" since January 1976. Time enough has elapsed to begin to form an impression of the "new look" in what has heretofore been one of the profession's more obscure publications.

Substantial progress has been made on several fronts. First, distribution. After more than 14 years of trying, I seem to have succeeded in getting my name added to a distribution list. Moreover, it is less difficult to find copies of the journal within ERS. And the outside world is being better notified of the existence of AER and provided a workable subscription system.

What of the publication itself? The cover has been brightened and the Research Review section is a lively, if unusual, mixture of well-edited book reviews and brief notes. The body of the journal, the articles, are also well edited, and the graphics quality of the figures and tables has improved appreciably. At only $3.85 a year, it is clearly a "best buy."

Alas, however, the articles continue to be rather heavily quantitative in orientation and/or presentation. In the April 1976 issue, one of the two editors, Clark Edwards, acknowledged that the three articles "depend heavily on mathematics, statistics, and computers" (p. 75). And in the January 1977 issue it was stated that "the three articles in the issue explore ways to become more rigorous" (p. 19); rigor was associated with mathematics.

This orientation may meet the recommendation of the AER review committee that "emphasis continue to be on technical articles and that articles reflect major research in the Department" (January 1976, p. 34). Yet one can't help but hark back to editor Edwards' question in the April 1976 issue (paraphrasing Sir William Hamilton) as to "whether these articles are evidence of dullness in ERS elevated to a talent, talent degraded into

an incapacity, or neither of the above" (p. 75). The recent selection of AER articles suggests that this question may not have been entirely rhetorical.

To harbor such thoughts may, of course, be considered heresy by some, and is at least unfashionable. Editor Edwards has observed (darkly?) that there are those "with an antimathematics or antiquantitative bias" (January 1977, p. 19). Lest I be readily dismissed as such a crank, let me hasten to suggest that there is a middle ground, that composed of agricultural economists who recognize the importance of mathematics but who also think that English can be a vehicle for rigorous thought and a useful medium for communication.

Yet the artful use of English in agricultural economics has declined to the point where there are only a few notable practitioners (T. W. Schultz is one). A recent book by Harold Breimyer moved R. J. Kohls to comment in AER that "It is refreshing to receive the communication of stimulating ideas from a craftsman who can creatively use the language in other ways than as footnotes to tables, graphs, and computer printouts!" (January 1977, p. 25).

All of this could lead one into a tedious discussion of the role of quantitative techniques in economic analysis and communication. But this subject was thoroughly discussed at annual meetings of the American Farm Economics Association over a decade ago and comments appeared in the *Journal of Farm Economics.*[1] I do not propose to hash it over again, but I can't resist citing the following statement which suggests how little one side of this issue has changed over the past 300 years:

> . . . an effective, though unrecognized limitation of the field of seventeenth century science was due to this preoccupation with mathematics. Those parts of experience that could not then be reduced to mathematics tended to be left out, and even those parts which were not suitable for mathematics tended to be treated mathematically, with somewhat ridiculous results.[2]

Even if one thinks that the article balance or article content in the AER might shift a bit more to the literary side, there are several constraints. One is the total space limitation of 160 pages per year. Over the past 5 issues, the space devoted to articles has averaged only a modest 26.6 pages per issue; in January 1977 it was only 18. Mathematical/quantitative articles tend to be relatively shorter than more literary works. A second problem is that editors are largely prisoners of submitted material. If they receive only mathematical/quantitative articles, they don't have much choice in what they print.

The latter point raises a question concerning the motivations and desires of the research author. One rather uncharitable editor has said:

> Do researchers want to write clear literate papers, instantly crystal clear to all readers? They do not. They want to get a paper published that will impress their peers. And if nobody else understands, so much the better.[3]

Joseph Willett of ERS contends that "economists *can* say things to ordinary people, but tend to use technical jargon to show the profession they're with it."[4] One would hope that ERS economists would have higher motivations.

Where does this leave us? The answer depends in part on the purpose of AER. If it is principally intended to communicate with other economists, particularly those with a quantitative bent, then perhaps the AER article balance is satisfactory as is. But if a wider audience is desired, even among economists, one might suggest that contributors and editors give further attention to reducing dependence on mathematical symbolism in articles, and that prospective contributors be notified that more literary contributions, and in fact articles largely devoid of equations, would not be scorned. Alternatively, perhaps another journal reporting ERS research but aimed at a more general audience might be established.[5]

Such steps could help improve the communication of the results of research conducted by the Economic Research Service without seriously reducing rigor or inducing rigor mortis.

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RURAL TRANSPORTATION SYMPOSIUM

Concern has developed about trends in the cost of rural relative to urban transportation. Recent events have helped stir up this concern, among them the oil embargo of 1973, appropriation of several billion dollars for urban rapid transit in 1974, the exclusion in 1976 from CONRAIL of several thousands of miles of rural rail lines, and the action in 1976 making rural minor collector roads not eligible for Federal aid (resulting in decline of the Federal Secondary Highway System by about 170,000 miles). Demands for publicly sponsored research on these and other aspects of rural transportation have grown substantially.

ERS staff members early in 1976 discussed the research needs with persons at the Washington and Mississippi State Universities, among others. Out of these discussions came the suggestion for what became

[1] December 1963, pp. 1386-1407; December 1965, pp. 1479-1503. I would particularly recommend the papers by Don Paarlberg on "Methodology for What?" (December 1963, pp. 1386-1392) and by R. J. Hildreth on "Have We Gone Too Far?" (December 1965, pp. 1497-1503). Several other papers are also relevant: Don K. Price, *Government and Science*, Oxford Univ. Press, 1962, Chap. VI ("The Structure of Policy"), pp. 160-189; Bernard R. Hoffnar, "What Did Our Readers Mean?" (contains a delightful quote from Pigou), *J. Farm Econ.* Feb. 1965, pp. 150-151; and Axel Leijonhufvud, "Life Among the Econ," *West. Econ. J.*, Sept. 1973, pp. 327-337.

[2] J. D. Bernal. *Science in History. The Scientific and Industrial Revolution*, Vol. 2, 3rd ed., MIT Press, 1971, p. 490.

[3] John H. Wilson, Jr., "Better Written Journal Papers—Who Wants Them?" *Science*, Sept. 5, 1969, p. 986.

[4] Cited by John C. Roney in "Problems in ERS Information Dissemination: Inside Perspectives." ERS Forward Look Contributed Paper, Sept. 1, 1976, p. 10.

[5] The recent *Agricultural-Food Policy Review* (January 1977) issued by ERS was a step in this direction. But some readers may have found even it a bit heavy in spots.

the National Symposium on Transportation for Agriculture and Rural America, held in New Orleans, La., Nov. 15-17, 1976. Joint sponsors were USDA's Economic Research Service and Cooperative State Research Service (CSRS), the U.S. Department of Transportation (DOT), State agricultural experiment stations, the Farm Foundation, and the Upper Great Plains Transportation Institute. By and large the 230 attendants came from public and private organizations having a strong interest in rural transportation research and/or action programs. The overall objectives were to evaluate the state of knowledge and to identify additional knowledge needed about planning, policy, and impact analysis for transportation for agriculture and rural America.

Four keynote and five issue sessions were held. The keynote sessions were devoted to (1) the role of economists in transportation policy, (2) the need for impact assessments in a total systems context, (3) the organizational form needed for planning and making transportation policies, and (4) the need for ensuring equity for rural areas in future transportation investments and adjustments. The four keynoters, respectively, were John R. Meyer, Professor of Economics, Harvard University; Ann F. Friedlaender, Professor of Economics and Civil Engineering, Massachusetts Institute of Technology; Honorable William V. Alexander, U. S. Representative from Arkansas; and James W. Giltmier, Professional Staff Member, Committee on Agriculture and Forestry, U.S. Senate.

John Meyer concluded that economic analysis in transportation has served principally as an "early warning"system on basic trends and forces. Some areas in which he deemed economic knowledge is inadequate for guiding policy decisions include: the extent of cross subsidy in transport rate structures; the stability of current financing; and the relative efficiencies of mixed public and private systems, such as CONRAIL, versus totally public or private systems.

Ann Friedlaender discussed traditional views about transportation and its regulation, and assessed the state of knowledge about the validity of these views. In most cases, she found the knowledge to be inadequate for either accepting or rejecting the views. Friedlaender presented and discussed four linked models which can be used to examine transportation policies, and efficiency and distribution variables:

- A regional transportation model that determines costs, revenues, profits, outputs, shipment characteristics, rates, and factor demands by firm, mode, broad commodity type, and region.
- A regional income model that determines factor prices, consumer prices, incomes, outputs, and employment by broad commodity types.
- A national interindustry model that determines interindustry coefficients, commodity prices, commodity outputs, and factor employment by broad commodity types.
- A small-scale, national macroeconometric model that determines factor prices, final demands, and consumer prices.

Congressman Alexander discussed the lack of knowledge shown by planners and others about impacts from adjustments in rural transportation infrastructure. He stressed the importance of bringing broad experiences and diverse interests into the process of planning national transportation systems.

James Giltmier noted that program funding focuses much of the Federal, State, and local governmental revenues into solutions of urban problems. He called DOT's attention to the analytical capabilities available in USDA and land grant institutions for planning and impact analyses in connection with rural transportation. He also described the decisionmaking apparatus of the Senate with respect to transportation.

The five issue areas, for which each session included six or seven papers, were:

- Transportation of agricultural commodities for international trade
- Impacts of transportation regulation on agriculture
- People, commodity, and service transport in rural America
- Economics of freight transportation in low-density rural areas
- Impacts on rural transportation from changes in the energy situation and transportation policies

As it was a symposium drawing on broadly dispersed researchers and program managers, indepth analytical papers were not required. Nonetheless, several participants did report basic, indepth research. A paper by Andrew Daughety and Frederick Inaba of Northwestern University was titled "Modelling Service-Differentiated Demand for Freight Transportation: Theory, Regulatory Policy Analysis, Demand Estimation." The authors used a dynamic model of demand for freight transportation to analyze the feasibility of flexible (unregulated) rates. Differences in the quality of service provided by different modes were shown capable of generating stable intermodal competition, even when one mode has increasing returns to scale.

Phillip Baumel of Iowa State University, James Cornelius of Montana State University, and Arvin Bunker of ERS, among others, reported the results of indepth studies. Baumel examined rail rationalization for the State of Iowa; Cornelius assessed economic performance of the agricultural exemption in interstate trucking; and Bunker analyzed the impacts likely to accrue from waterway user charges.

Several authors presented situation and outlook assessments of various aspects of agricultural and other rural transportation. A panel of five transportation research users led a discussion of the state of knowledge and needs for further research. Divergence of views about the state of knowledge was probably greatest for the impacts of regulation; but opinion diverged considerably as to the research needed in the area of people and service transport—equity versus efficiency.

The symposium initiated useful interchanges among land grant and other researchers active in the area of rural transportation, and among researchers and research users. A proceedings including all formal papers and substantive discussions will be published by the Department of Transportation.

John O. Gerald
Leader, Transportation Economics
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NATIONAL CONFERENCE ON NONMETROPOLITAN COMMUNITY SERVICES RESEARCH

In summarizing the National Conference on Nonmetropolitan Community Services Research at The Ohio State University, anchorman Jim Hildreth, Managing Director of the Farm Foundation, failed to elicit final answers to his question: "So what? Where do we go from here?"

That is probably as it should be.

The Farm Foundation, the Economic Development Division of ERS, and the North-Central and Northeast Regional Centers for Rural Development sponsored the conference held Jan. 11-13, 1977. Their aim: "to improve the quality of nonmetropolitan community services research for public decisionmaking at local, State, and Federal levels." This included identification of emerging problems, along with discussion of new theoretical approaches and findings.

The agenda focused on resources for and organization and delivery of nonmetropolitan community services. They were outlined in the opening taxonomic paper by Jerome Stam, leader of the ERS State and local government program area. There was emphasis in the conference on the interrelationships between researchable subjects and the disciplines studying them. There were papers on financing, intergovernmental revenue, current tax theory and policy for smaller governmental units, public choice theory and coordination of services, service cost-quality-quantity relationships, measuring output and consumer satisfaction, and needs assessment.

Research in community services calls for a broad disciplinary approach. Although the majority of attendees were agricultural economists, most of the nearly 30 papers were presented by economists, political scientists, public administrators, and sociologists. This mixture of disciplines created some problem in communication. But the program planners had allowed almost as much time for discussion as for presentations, and they kept the ratio of attendees to speakers close to 3:1. Their plan payed off. It often engendered heated debate that kindled light in dialog. Some—but not all—of this may be recreated by reading the proceedings, published by the Senate Committee on Agriculture and Forestry. They provide an overview of the current state of research in the broad field of nonmetropolitan community services research.[1]

Ron Powers, director of the North Central Regional Center for Rural Development, commented after the conference that:

> A multi- or pan-disciplinary approach is essential . . . The conference brought together a mix of people who began to understand each other, become interested in other approaches, and set the stage for further work . . . From feedback received after the conference, it appears that some social scientists in our region are interested in forming multidisciplinary research teams.

Donn Derr, a Rutgers University agricultural economist, pointed out that planning and funding for interdisciplinary research go together. Commonality of concerns is a necessary, but often insufficient factor in bringing about interdisciplinary research. It usually boils down to "buying their time," as Helgeson put it. Derr also said that he picked up an idea for further cross-sectional analysis of data already gathered for a Northeastern regional study. An analagous Great Plains Project, reported at the conference by Lonnie Jones, Texas A&M agricultural economist, was the catalyst.

Tom Hady, deputy director of ERS's Economic Development Division, observed:

> Five or ten years ago, a similar group would have been applying theory from marketing studies, etc. We are now developing theory which applies squarely to community services. At the same time, we now have a good range of applied studies on relevant problems. These studies are as important as the theoretic breakthroughs, both to guide the development of new theory and to make what we learn useful.

This latter point was reinforced by Lee Day, director of the Northeast Regional Center for Rural Development. "Elected representatives find it difficult to find what the people really want," he said. "New techniques with mail and telephone surveys can make preference surveys cheaper and more timely. New designs can avoid many of the pie-in-the-sky answers of previous surveys."

The proceedings reflect a blend of applied and theoretical strategies for research. "One [strategy] focuses on the problem of a specific unit of government with a pragmatic approach. The other develops a general set of relationships about a specific item for decisionmakers in a number of units of government. It is likely that both are useful," Jim Hildreth said in summary. He added:

> Establishing data series would have very high returns for community service researchers, and thus to users of their research. However, careful definition of the series and their uses will be needed . . . Measuring output of public services is complex and difficult. We need multiple indicators of output. Citizens *are* knowledgable about the quality aspect of public services. Thus, we can obtain useful and valid opinions from them.

After complimenting the planners of the conference, Alvin Sokolow, associate director of the University of California (Davis) Institute of Governmental Affairs, raised two caveats:

> The conference ignored the area of overlap between political science and sociology that I would label "political sociology" and which considers the processes whereby authoritative bodies make important decisions at the community level . . . No mention was made of the classic study of American rural politics—Vidich and Bensman's *Small Town in Mass Society*.

Don Dickson
Public Information Specialist
Information Division

[1] Committee on Agriculture and Forestry. *National Conference on Nonmetropolitan Community Services Research*. U.S. Senate Committee Print, for sale by Sup't. Docs., U.S. Govt. Print. Off., Wash., D.C. 20402. 1977. (Price not yet determined).

FORECASTING U.S. EXPORT UNIT VALUES *

To forecast the value of U.S. farm exports, USDA analysts use unit values rather than prices. The export unit value is the total reported value of a specified commodity exported divided by the reported quantity, and it represents a weighted average export price. Monthly export unit values are published by the U.S. Department of Commerce, normally about a month after the actual exports. Spot prices can be used to predict export unit values 1 to 2 months in advance.[1] But predictions of export unit values are needed for the fiscal year (October-September) as early as the previous September. In addition, these estimates are usually made in December, March, and June. In ERS, these estimates are reflected in quarterly analyses and in the *Outlook for Agricultural Exports*.

Futures prices and cash prices have been tested in ERS as exogenous variables on which to base needed forecasts. Regression estimates of export unit values for fiscal years 1966-76 are presented here for wheat, but models were also tested for corn and soybeans.

Futures prices reflect traders' expectations. Prices at the beginning of a crop year—July for wheat—are typically at their seasonal lows. Thereafter, prices tend to increase, reflecting accumulated storage costs. Futures prices for the later months of a crop year tend to match anticipated cash prices. To the extent that futures prices reflect distant cash prices, they should be useful inputs to ERS forecasts of export unit values.

Cash prices might also serve as predictors of export unit values. Until 1972, cash prices and export unit values did not change drastically during the course of a crop year. Moreover, cash prices are closely linked with futures prices by the cost of storage.

The dependent variables in the forecasting equations examined here were the export unit values obtained from monthly U.S. export data for fiscal years 1966-76. The export unit values excluded U.S.-Soviet trade because the United States made long-term grain contracts with the USSR before the sharp rise in grain prices occurred. Also, the export unit value of wheat was adjusted to include subsidies that the U.S. Government granted to wheat exporters until August 1972, since commercial wheat exporters took these subsidies into account in their market transactions.

The independent variables were futures price quotations and monthly cash prices. The monthly futures prices were computed as simple averages of the daily closing quotations for a month which was a specified number of months prior to the closing date of the futures contract, as reported for the Kansas City Grain Exchange in the *Wall Street Journal*. Wheat futures were quoted for March, May, July, September, and December. The monthly cash prices were for No. 1 hard winter wheat, ordinary protein, at Kansas City.

Four alternative forecasting equations were considered:

1. Method 1—The estimated annual export unit value for the fiscal year (October-September) is set equal to the year—earlier value:

$$EUV_t = EUV_{t-1}$$

This is a naive approach, used as a benchmark for evaluating the alternative approaches. It explained about three-fourths of the variation in unit values (table 1).

2. Method 2—The estimated annual export unit value is a linear function of cash price:

$$EUV_t = a + b\ CP_m$$

where CP_m is the monthly cash price. The annual export unit value for wheat was regressed respectively against the September, December, and March cash prices (table 1).

3. Method 3—The estimated annual export unit value is predicted as a linear function of the futures price:

$$EUV_t = a + b\ FP_m^n$$

where FP_m^n is the monthly futures price that matures in month n. The annual export unit value for wheat was regressed respectively against the March futures price quoted in December and May futures price quoted in September (table 1).

4. Method 4—Estimates of the fiscal year export unit values are a function of futures contracts; the equation is described in the following paragraphs.

Estimates of these export unit values are required for

Table 1.—Equations for predicting annual export unit values for wheat (methods 1, 2, and 3)

Method	Estimator	R^2	*t* test for B = 1[1]
Method 1	EUV_{t-1}	0.742	
Method 2:			
Wheat			
EUV_t	= .383 + .918 CP September	.972	1.607
EUV_t	= .367 + .908 CP December	.949	1.329
EUV_t	= .233 + 1.004 CP March	.935	.045
Method 3:			
Wheat	May		
EUV_t	= .378 + .945 FP September March	.962	.949
EUV_t	= .392 + .911 FP December	.958	1.412

[1] At the 10-percent level of probability, none of the B values is significantly different from 1.0, based on the T ratio of 1.67.

[1] Economic Research Service. Selected Prices of International Significance. In *Foreign Agricultural Trade of the United States*, U.S. Dept. Agr., May 1975.

*The author gratefully acknowledges the expert advice given by Richard G. Heifner, National Economic Analysis Division, Economic Research Service on the preliminary draft of this paper.

ERS outlook reports quarterly in September, December, March, and June. During the fiscal year, actual export unit values progressively become known. Method 4 attempts to take advantage of the new information. For example, in December, export unit values for October and November become known. The known export unit values for these early months are combined with estimates for the remainder of the year. Weights are determined by the quantity distribution of wheat exports of the previous fiscal year. Estimated export unit values are a function of futures contracts. If one is estimating the FY export unit value in December, one has access to future quotes for contracts to expire in December, March, May and July. The December futures can be used to estimate unit values for December-February, March futures for March-April, May futures for May-June, and July futures for July-September.

The monthly export unit values were estimated from the equations from table 2 that applied respectively to the forecast intervals. For the December forecast, intervals are used of "within the month," 3 months, 5 months, and 7 months. These are based on the number of months between the December price quotation and the closing dates of the relevant futures contracts (table 3). Similar estimates of the fiscal year export unit values were made in September, March, and June using the scheme of table 3, the most timely known export unit values and futures prices available on those dates, and the estimating equations in table 2. The estimating equations are based on the historical (1965-75) relationships between monthly export unit values and futures prices.

Table 2.—Equations for predicting monthly export unit values for wheat (method 4)

Forecast interval in months	Intercept	B value	R^2	T test[1] for B=1
0[2]	0.24	1.004	0.884	0.083
1	.26	.993	.943	.205
2	.25	1.012	.952	.387
3	.22	1.025	.955	.806
4	.22	1.033	.937	.891
5	.30	1.007	.898	.149
6	.279	1.024	.874	.453
7	.319	1.007	.844	.118
8	.32	1.031	.806	.443

[1] At the 90-percent level of probability, none of the B values differs significantly from 1.0, based on the T ratio of 1.67. [2] Within the month.

The export unit value for a given month was regressed on the futures price quoted n-m months earlier (where n = date of closing and m = date of quotation). For example, to estimate the March unit value in December, the equation with a 3-month forecast interval (n-m=3) is used. That equation is based on five 3-month intervals in each year: December-March, February-May, April-July, June-September, and September-December. There are 11 years of data, so the total number of observations in each regression is 55.

Forecasts based on monthly cash or future prices (methods 2 and 3) generally provided the best estimates early in the fiscal year. Combining the monthly predictions of export unit values obtained from the regression with the already known export unit values was better later in the fiscal year.

In September, the best estimate for the fiscal year unit value of wheat exports came from the regression based on the Kansas City May futures price quoted in September (method 3). In December and March, combining regression estimates from monthly futures price data and already known export unit values data (method 4) provided estimates with the least average absolute error.

Analogous models were also tested for corn and soybeans. For corn, the results were generally the same as

Table 3.—Futures quotations used to predict EUV's method 4

Month prediction is made	Month predicted—											
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
September	Sept.(0)	Sept.(0)	Dec.(3)	Dec.(3)	Dec.(3)	Mar.(6)	Mar.(6)	May(8)	May(8)	May(8)	May(8)	May(8)
December	A	A	Dec.(0)	Dec.(0)	Dec.(0)	Mar.(3)	Mar.(3)	May(5)	May(5)	July(7)	July(7)	July(7)
March	A	A	A	A	A	Mar.(0)	Mar.(0)	May(2)	May(2)	July(4)	July(4)	Sept.(6)
June	A	A	A	A	A	A	A	A	May(0)	July(1)	July(1)	Sept.(3)

Key to items in field:
A = actual price.
Dec. = December future.
Mar. = March future.
May = May future.
July = July future.
Sept. = September future.

Note: The number in parentheses is the forecast interval in months representing the time interval between the price quotation and closing date of the contract, and it applies to the estimating equation in table 2 that would apply to futures contract that is quoted in month the prediction is made.

for wheat. That is, the regression analysis using the March futures prices quoted in September and December (method 3) yielded the best early forecasts. Forecasts in March based on combining the regression estimates based on monthly futures price data and already known export unit value data (method 4) provided the best fit.

For soybeans, the regression analysis using the September Chicago cash prices (method 2) yielded estimates with the lowest average absolute error for those months. In December, the price ratio between the current and previous year's December Chicago cash price for soybeans yielded the best results (a modification of method 2). The regression analysis using monthly futures prices combined with the already known export unit values yielded the best March estimate (method 4). These methods (table 4) have been chosen as the "best" methods for estimating fiscal year export unit values of wheat, corn and soybeans. Estimates from these methods are currently included in the ERS publication *Outlook for Agricultural Exports* and in quarterly ERS short-term projections of the value of U.S. agricultural exports.

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IMPACTS OF HAIL SUPPRESSION IN NEBRASKA

We have speculated for years on the possible effects of reduced hail damage on farm income, crop distribution, cost of production, factor suppliers, and community businesses. In the United States, technology that can be used to suppress hail is being applied experimentally—to improve techniques through basic research; and commercially—through contracts between a group of farmers and an applicator. It is important to weigh the likely costs and benefits.

A study by the Economic Research Service, in cooperation with the National Science Foundation, simulated and estimated the annual effects on crop production for different rates of hail suppression.[1] The study, limited to Nebraska, focused on analyzing shifts in location of crop production that might occur from changes in the comparative advantage of 10 substate areas. One working hypothesis was that hail risks would differ markedly from one geographic area to another, and that the impact of hail suppression on the competitive positions of geographic areas would be more significant than would changes in aggregate production and cost.

[1] To simplify this presentation, I have omitted most of the hard data. Further, detailed information can be obtained from William M. Crosswhite, Assistant Director, Natural Resource Economics Division, ERS.

Table 4.—Export unit values for wheat, actual and selected forecasts, 1965/66 to 1975/76

Fiscal year	Actual export unit value for wheat	Predicted export unit value for wheat based on—				
		EUV_t-EUV_{t-1} (Method 1)	May future quoted in Sept., Kansas City (Method 3)	Future prices quoted in Dec. and known export unit values for Sept.-Nov. (Method 4)	Futures prices quoted in March and known export unit values for Sept.-Feb. (Method 4)	Futures prices quoted in June and known export unit values for Sept.-May (Method 4)
Time information is available	Hindsight	Before year begins	September	December	March	June
			Dollars/bushel			
1965/66	1.90	1.72	1.80	1.84	1.83	1.85
1966/67	1.87	1.90	2.19	2.10	2.04	1.93
1967/68	1.68	1.87	1.91	1.80	1.81	1.69
1968/69	1.67	1.68	1.70	1.67	1.64	1.64
1968/70	1.69	1.67	1.65	1.66	1.66	1.66
1970/71	1.72	1.69	1.81	1.83	1.73	1.73
1971/72	1.79	1.72	1.74	1.75	1.75	1.75
1972/73	2.65	1.79	2.15	2.61	2.34	2.44
1973/74	4.66	2.65	4.64	4.94	4.97	4.62
1974/75	4.71	4.66	4.61	4.96	4.44	4.36
1975/76	4.29	4.71	4.43	4.07	4.28	4.22
Σd_i^2 *		5.03	.46	.28	.32	.18
$\sqrt{\Sigma d_i^2}$		2.24	.68	.52	.56	.43
			Cents/bushel			
$\Sigma d_i/N$		32.9	14.7	12.5	12.5	7.8

*d_i is the difference between actual and predicted export unit value.

Estimates of hail suppression costs varied from 3½ cents to about 6½ cents per acre. Compared with other production costs, differences in hail suppression costs were rather insignificant, so the suppression cost used in the analysis was 5 cents per acre. Three levels of hail suppression effectiveness were assumed: 10, 25, and 50 percent.

Constant prices received by farmers were used, reflecting an assumption that the aggregate demand and price situation is not affected by hail suppression technology. However, if such technology were widely used, it could influence production of some crops enough to change prices. The mix of crops after hail suppression is influenced by relative net revenues. The location of a crop is influenced by what happens to competitive positions of geographic areas for production and prices. Simulating annual changes in production expense by area (average cost per acre) permitted some tentative indications of the change in factor demand.

Results indicate that hail suppression will not affect aggregate levels of production and cost much in Nebraska. Eliminating as much as one-half the estimated hail loss for the areas studied would result in relatively small aggregate gains. The simulation provides insights at an early stage when such information should be of maximum value. The model examined increased production and demand for factors for a single crop in a single area. In addition, a simulation over several areas with several crops provides insights into interactions between crops in the same area as well as shifts in location of a crop between two areas.

Simulated changes in acreage among crops within geographic areas in Nebraska were generally minor but some shifts occurred among areas. In only two cases did any of the 10 areas gain or lose more than 1 percent of their total cropland, and none changed as much as 2 percent. Thus, hail suppression would cause neither massive shifts in location of production in the State nor large acreage shifts among crops within a region. Suppressing hail did increase total crop production. The distribution of the increase and the implications for the demand for factors were more significant than the acreage changes.

Reducing production costs per unit of output helps the grower, but it may decrease the demand for some farm inputs, thus having a negative social aspect. However, total changes in production costs were nominal in the Nebraska simulation. Changes in total factor demand varied considerably among regions where hail was suppressed, partly because of acre shifts but mostly because of changes in output. Total production costs (exclusive of land and management charges) ranged among areas from a reduction of about 4 percent to an increase of nearly 5.5 percent. If the Nebraska results apply in other areas affected by hail, even total factor demands in most rural communities would likely change little if hail were suppressed.

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