Research Review

Future Agricultural Technology and Resource Conservation

Burton C English, James A. Maetzold, Brian R Holding, and Earl O. Heady (eds).
Ames: Iowa State University Press, 1984, 604 pp, $26.65.

Reviewed by Roger W. Hexem*

Nearly 300 academicians, business people, farmers, scientists, and technicians participated in a 3-1/2-day symposium in December 1982 to discuss and project the state of America's agriculture in the years 2000 and 2030, the associated impacts on resource use and productivity, and the possible changes in environmental quality This monograph is a compilation of papers presented, remarks by discussants, and deliberations by work groups—53 papers or reports—viewed as state-of-the-art discussions of agricultural technology and resource conservation

Heady, in his keynote address, asks "Given the demand prospects for our agricultural commodities and the resources which produce them, is the permanent base of our productivity threatened and are our stock resources being depleted too rapidly?" He also provides a more specific focus by stating that results from the symposium can provide inputs for large-scale modeling by the Center for Agricultural and Rural Development (CARD) at Iowa State University and the Soil Conservation Service (SCS) for USDA to use in making periodic appraisals of the country's agricultural resources and in developing a national soil and water conservation program. So, participants made little effort to integrate assessments and projections of components of production and consumption processes This integration would be addressed in the model development phases

In his summary and synthesis, Tweeten states that solutions to resource conservation problems do not respect disciplinary boundaries and that technical problems of production and resource care are more tractable than economic, social, and political problems Specialists at the symposium present optimistic scenarios for continued growth in agricultural productivity which, if past trends continue, will increase output and, through substitutions for natural resources, will conserve land and water resources However, serious conservation problems will likely persist

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The symposium was organized around nine subject areas—soil management technology, tillage, and crop rotation practices, land use, water resource technology and management; adoption and diffusion of soil and water conservation practices, crop technology, crop nutrition technology, pest management technology, machinery technology, and red meat, dairy, poultry, and fish technology Given the range of disciplines and the large number of participants, the papers are rather uneven in their scope, level of detail, and authors' adherence to purpose Readers will benefit from discussions of a wide range of subjects, rather extensive bibliographies, and identification of research needs

Larson and others describe recent trends in land use, consequences of soil erosion, and needs for better soil management Young expands the discussion by examining the effects of soil erosion on crop yields and critiquing current modeling efforts to estimate these relationships, particularly the usefulness and limitations of the USDA's Erosion Productivity Impact Calculator (EPIC) model

Castle and Batie provide general discussions of land use issues, including those related to resource conservation They do not, however, make any projections of land use trends As discussants, Sampson and Raup remind us of difficulties in anticipating unexpected circumstances when we project land use and agricultural production. The members of the Land Use Work Group focus on conditions influencing land use conversions, they also decline to project such conversions

Jensen and Rogers identify current water uses and issues related to irrigated agriculture Rogers states that the United States does not face a crisis in providing water for agriculture over the next 50 years However, serious dislocations and disruptions may occur locally Rogers also formulates four scenarios of irrigated acreage in the year 2000 Martin and the Water Resource Work Group stress that water supply-demand conditions must be based on economic relationships The agricultural sector used about 83 percent of U S water consumption in 1975 There is substantial potential for improving the efficiency of water consumption, particularly in the East According to the work group, most increases in acreage of irrigated cropland will be in the Midwest and East

In the chapter dealing with crop technology, Heichel states that genetic improvements have accounted for 50-60 percent of yield increases for the principal crops in the past 50 years The rest has been due to improved management and cultural practices No startling increases in productivity are expected by 2000 or 2030 Heichel cites studies supporting either a gradual deceleration of productivity or, conversely, a continuing increase in capacities for improved yields. These contradictory trends result from differences in procedures used by researchers, crops studied, and time periods covered Frey asserts that significant progress can be made in developing stress-tolerant cultivars so that some lands currently on the margin of profitability can be farmed profitably There is also potential for reducing worldwide production losses of 10-20 percent annually caused by diseases and insects The work group projects percentage changes in yields for major U S crops by 2000 and 2030 The highest "most probable" yield gains are expected for rice, the lowest, for alfalfa and cotton Soybean yields, for example, are projected to be 60 and 120 percent higher by 2000 and 2030, respectively About two decades are now required to move technologies from research stages to widespread implementation

Several participants examining crop nutrition technology stress the increasing importance of nutrient management in increasing crop yields, especially because of rising costs for fertilizer and growing concerns about nutrient movement in soil runoff and percolation which affects environmental quality Both Randall and Englestad cite the importance of soil testing and the need for more awareness of nutrient availability in the subsoil Randall states that the key to the long-term success of using reduced tillage, at least in much of the Corn Belt, is the proper management of soil fertility Nutrient cycling of crop residue is becoming more important The associated work group projects yield changes for major crops to 2000 and 2030 in the 10 production regions Projections reflect several changes in technology and management such as expansions in supplemental irrigation, shifts to no till, and improvements in fertilizer formulation, placing, and timing Yield increases are projected for all regions Highest increases for corn and soybeans, for example, are projected for the Delta and Southeast where current yields are relatively low

Leeper and Andaloro emphasize that man's disruption of a seemingly stable ecosystem results in parts of the system reacting violently Integrated Pest Management (IPM) promises to reduce or subdue such reactions through more discriminating use of pesticides They stress the need for knowing more about crop-pest relationships for individual crops IPM must also be profitable to users

Frisbie focuses on pest management in conservation tillage Such tillage basically alters the structure of the agroecosystem, especially the microclimate at and near the soil surface Frisbie reviews changes in the management of weeds, diseases, insects, and other pests that have come about with adoption of conservation tillage

The Pest Management Technology Work Group estimates that preharvest losses of production to pests are around 30 percent for field crops and as high as 37 percent if we include fruits, vegetables, and specialty crops where losses are most severe Current IPM practices can reduce pest control costs by 10-25 percent or by as much as 90 percent in a few situations where pesticides are currently used intensively Most progress in improving IPM during the next 20 years will benefit production of high-value, specialty crops. The work group also estimates changes in yields resulting from improvements in pesticide technology Increases of up to 10 percent can be obtained for most crops if current technology is used more widely An additional 5- to 15-percent increase in yields is predicted as farmers adopt technological improvements in pest control About 7-10 years are required to discover new chemicals and to make them widely available Totally new strategies based on development of basic biological information require more than 20 years before practical applications are realized

In his assessment of machinery technology, Twist does not anticipate any great changes in basic design of tillage tools by 2000 Hunt emphasizes that the evolution of farm machinery technology has been continual rather than revolutionary Farm machines are currently operated at about 95 percent of efficiency Technology required in 2000 and 2030 mostly seems to be available already However, more knowledge of the efficient application of the technology to a changing agriculture is needed According to the Machinery Technology Work Group, better applications of pesticides should increase productivity by 2 and 5 percent by 2000 and 2030, respectively Improvements in fertilizer placement should increase yields by 2 and 7 percent, respectively, in 2000 and 2030

Three speakers address recent and projected changes in animal agriculture and in consumption of animal products Touchberry reminds attendees that application of existing technology could markedly increase the efficiency of production as well as total production He sees a "colossal" potential for improving food production with aquaculture Hansel believes that increased production per animal will be achieved largely through discoveries in forage production and utilization, animal reproduction and genetics, and animal physiology and nutrition He sees a trend toward fewer ruminants and the utilization of improved forages, industrial byproducts, and even waste products as significant portions of ruminant diets Van Arsdall points out that the historical complementary relationship between livestock and crop production is being disrupted by technological improvements which create gains from specializing in crop or livestock production and by economies of size Work group members also recognized this relationship, they believe that a strong animal agriculture is essential to resource conservation and is complementary with good conservation practices Work group members developed projections of productive efficiencies for producing animal products They also identified possible regional shifts in production

Rates and timing for adapting or adopting existing and emerging technologies affect the structure and performance of the agricultural sector The rates are conditioned by several personal, economic, and institutional factors Several speakers discuss and critique the adoption/diffusion model as applied to adoption of conservation technologies

Nowak distinguishes between "item" and "system" innovations System innovations diffuse much more slowly, but most future technologies discussed are of the item type Existing institutional arrangements are usually sufficient to promote adoption of item, but not system, innovations Nowak adds that future technologies will enhance the potential to farm currently marginal land in an economically viable manner, but that rates of soil and water degradation will likely increase He provides several strategies to promote adoption of soil conservation practices

Van Es discusses the differences between private and public costs and benefits associated with adopting conservation measures He also addresses the issue of mandatory controls for reducing soil erosion

Heffernan questions several assumptions of the adoption/diffusion model as they relate to soil conservation issues He states that the greatest utility of the model may be in suggesting new areas of research

According to the work group members, the symposium is probably the first formal recognition of the need for good interaction between the technological and socioeconomic aspects of resource conservation They identified the following issues new approaches are needed to help farmers identify the nature and magnitude of conservation problems, solutions to problems are needed that include alternatives from which individuals can choose those most appropriate to their operations, more local involvement is needed (a "bottom-up" approach involving communities, organizations, and individual farmers rather than a "top-down" approach), and a package of options including cross-compliance, cost-sharing, technical assistance, tax incentives, and others is needed to solve or ameliorate resource conservation problems

Some readers will be disappointed to see relatively little discussion of future economic conditions—demand, trade, economic policy, and cost/return scenarios But, specific discussions of such issues were beyond the symposium's objectives

Economies of Scale, Competitiveness, and Trade Patterns within the European Community

Nicholas Owen Oxford, England: Clarendon Press, 1983, 193 pp., $39 00.

Review by Stephen W. Hiemstra*

Seldom is theory integrated with empirical efforts so as to excite the imagination Nicholas Owen's study of European Community (EC) integration is such a work Throughout the book, theory and statistical study yield strikingly compatible conclusions The result is fodder for the mind—a fulfillment of an instinctive yearning for simplicity and justification The appeal of this work accordingly extends beyond the fraternity of European analysts Owen's work is the dissertation we all wish we could have written

Owen's proposition is this the benefits of EC integration have been underestimated because theorists have focused on marginal rather than on longrun average costs Ex post facto, the theorists' focus on marginal costs is intuitive because high-cost producers have exited the market and no measurable benefit from integration beyond the trade created by tariff reduction is evident Ex ante, the process of structural change in regional markets and the incentive for low-cost producers to expand production is extensive In this case, the focus on longrun average costs, borrowed from Wonnacott,[1] more closely matches an industry's experience over a period of years

This proposition is founded in the observation that trade within the EC in goods, such as automobiles, has grown at a rate four times the rate of growth in production Europeans, as Owen further observes, trade different styles of clothing and different makes of cars, but not clothing for cars The high growth rate of trade and its composition are inexplicable in terms of traditional notions of comparative advantage because the factor endowments of EC member states are almost identical In their chagrin, theorists have more typically attributed this trade to consumers' preference for variety and have neglected possible cost advantages accruing to specialization and economies of scale

Two further observations lend credence to this proposition. First, Owen provides convincing evidence to support the hypothesis that wage and productivity advantages held by the United States over the EC member states are closely associated with market size and plant economies of scale Second, in a statistical testing of European census data, trade performance (measured as exports minus imports divided by total trade) is significantly correlated with relative plant size, relative industry size, and average labor productivity This statistical test was interesting because it showed (1) one-seventh to one-half of trade was related to scale economies, (2) economies were more important at the plant than at the firm level, and (3) the effect was more pronounced in the long than in the short run As expected, larger plants were the most important contributors to this effect

Having made a general case for his proposition, Owen set his computer printouts aside and turned his attention to case studies of three EC industries cars, trucks, and consumer durables In each case, the effects of integration were (1) to accelerate product specialization and the adoption of technologies having significant scale economies, (2) to eliminate regional price differentials and product idiosyncracies, (3) to extend the market shares of low-cost producers at the expense of high-cost producers, and (4) to lower unit costs in both the importing and and exporting member states A doubling of a firm's output was estimated to result in cost reductions ranging from 10 percent (cars) to 20 percent (trucks and washing machines) Horizontal and vertical integration of firms yielded meager economies relative to the economies associated with increased plant scale Nontariff barriers were reported to be the primary impediment to a more rapid integration of regional markets

In wrapping up his analysis, Owen used several interesting performance measures The first was a ratio which measured resource savings due to trade This ratio measured the difference in the value of trade before and after integration and

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[1]Ronald J and Paul Wonnacott, *Free Trade between the United States and Canada* (Cambridge, MA Harvard Univ Press, 1976)

divided that difference by the value of trade following integration Values for this ratio ranged from 48 percent for trade in trucks to 54 percent for trade in washing machines

A second measure of interest was a method for calculating the increase in competitiveness due to integration This measure was derived from the observation that production cost performance improves naturally over time because of on-the-job learning, new investment, and improvements in technology In separate markets, cost performance will differ and will improve at differing rates With the integration of markets, by contrast, we expect to see a convergence of these learning curves One can accordingly measure the improvement in competitiveness by projecting the rates of improvement in cost performance before integration These rates can then be compared with actual performance The difference is attributed to market integration Adding the induced cost savings to the resource savings due to trade measured above, Owen reported a resource benefit of 135 percent of the trade value for refrigerator trade between Britain and Italy

In assessing the overall impact of integration on economic growth in the EC-6,[2] Owen divided trade benefits into two categories of cost reductions those due to better utilization of capacity and those due to scale effects From his case studies, he noted that costs could be reduced up to 20 percent because of a doubling of volume He took this figure and attributed the other 80 percent of cost reductions to scale effects measured by direct and indirect resource savings (that is, a conservative assumption relative to the 135-percent reduction reported for refrigerators) Drawing on other studies, Owen assumed that the integration increased trade in the EC-6 by 40-50 percent of its 1962 level, and he projected this rate of increase to obtain an estimate of 100-125 percent of the 1962 level for 1980 Taking the value of this trade and allocating it between better utilization of capacity and improved scale, he estimated that EC integration had added 5-12 per cent to the growth of the manufacturing sector in the EC-6 by 1980 By similar methods, he estimated that integration had added 3-6 percent to EC-6 GDP growth by 1980 This estimate compares with 0 7-percent added growth obtained by concentrating wholly on the effects of tariff reduction

Albeit well executed, Owen's approach suffers from the weaknesses inherent in the case study approach Arguments from the specific to the general are usually lengthy The author is compelled to make numerous assumptions which are difficult to assess, and reliance on previous work is necessary In this study, we are not, for example, told why the automobile, truck, and consumer durable industries were selected for analysis or the degree to which they are representative of the manufacturing sector An important consideration in this respect is how representative are the levels of pre integration tariffs, capacity utilization, and previous export levels? If each of the countries studied maintained large export markets prior to integration, then market integration could have done nothing more than diverted trade from these export markets to EC markets It is also conceivable, if export subsidies were removed with integration, that overall capacity utilization would have actually declined In either case, Owen's focus on longrun average costs rather than on marginal costs would lose its appeal Nevertheless, Owen's judgment appears sound in discussions we observe, and it is fair to assume that it is sound in areas not observed

I recommend this book to readers interested in trade, market structure, and integration The book reads well and is occasionally quite humorous to Americans unaccustomed to British euphemisms and parlance The price of the book is high and, fortunately for the reviewer, reflects its value

[2]Belgium France, Italy Luxembourg Netherlands and West Germany

Federal Price Programs for the American Dairy Industry: Issues and Alternatives

Jerome Hammond and Karen Brooks Department of Agricultural and Applied Economics, University of Minnesota for the National Planning Association and the Food and Agriculture Committee, 1985, 36 pp., $4.50.

Reviewed by Richard F. Fallert*

This well-written, easy to read report gives a general history of current dairy programs, describes the basic features of these programs, gives some insights into their economic impact, and examines the likely effects of some periodically proposed modifications and alternatives The report should be useful to many people interested in a quick review and background of dairy programs and their effects

The report is organized into four parts basic features of the Federal dairy price programs (the price-support program, Federal milk marketing orders, and the interaction of price supports and orders), effects of dairy industry regulations (price supports and Federal orders), import controls, and policy alternatives

The price-support alternatives include a purchase program with producer assessments for some program costs, simple reduction in the support price, price supports through deficiency payments, payments for reducing milk production, return to the basic dairy program under the 1949 Agricultural Act, and complete elimination of all dairy price supports

The Federal milk marketing order provision changes addressed in the report include abolition of classified pricing and pooling of returns, nationwide pooling of returns from classified pricing, and elimination of exclusionary features of Federal orders such as "down allocation" and "compensatory payments"

All the effects of alternative dairy regulations are based on research at the University of Minnesota, only one other reference is cited One runs the risk then, especially in the evaluation of the Federal milk order program, of presenting effects of alternative Federal order provisions and of generalizing on the merits of a national milk marketing order by presenting conclusions based on only limited analysis

The report traces the history of the price-support program from World War II Two basic problems associated with the program are highlighted. First, the price range provided for by the law did not always allow the Secretary of Agriculture to choose a price low enough to prevent large accumulations of surplus dairy products by the Commodity Credit Corporation Frequently, the support price, especially in the early eighties, was too high and production exceeded commercial demand, Government stocks and costs consequently expanded Another problem cited by the authors is that price supports have kept consumer prices higher than they would otherwise have been, thereby reducing commercial demand and encouraging sales of alternative fats and imitation dairy products

The report traces the history of Federal milk marketing orders from the early thirties A major problem cited in the report is that the classified pricing system acts to increase prices to producers in some fluid markets and reduce prices to others Producers in the upper Midwest and possibly the Chicago market are probably adversely affected Orders also have provisions that favor local milk supplies over distant sources and that stifle adoption of alternative technologies such as reconstituted milk. The authors describe the complex mechanisms of marketing orders and present the effects on manufacturing grade (Grade B) producers Under the marketing order program, handlers must pay a specified Class I price for milk used in fluid milk products, and the difference between that price and the lower price of milk used to produce manufactured dairy products is the Class I differential Class I prices differ among the 44 marketing orders now in existence However, the price of manufacturing milk is determined in a national market because manufactured dairy products are storable and transportation costs are low compared with raw milk as much of the water is removed in the manufacturing process

Class I prices currently differ among marketing orders, generally increasing with distance from a

*The reviewer is an agricultural economist with the National Economics Division, ERS single basing point in Eau Claire, WI. Minimum Class I prices per hundredweight are now equal to $0 90 more than the Wisconsin base price of manufacturing milk plus $0 15 per 100 miles distance from the basing point. Because actual transportation costs are more than twice the amount on which intermarket Class I prices are based, over-order premiums are negotiated between producer cooperatives and handlers to cover the added costs of interorder milk movements

Although not originally designed to act in concert, the interactions between the Federal milk marketing order program and the dairy price-support program have important effects on the industry. The authors suggest that there is substantial textbook or theoretical price discrimination in the classified pricing system which discourages fluid milk product consumption, increases Grade A milk supplies in high-cost areas, and increases Grade A milk use in manufactured dairy products which drives down manufacturing grade (Grade B) prices. They further suggest that one way of compensating producers in low-cost areas is to maintain a relatively high support price under the price-support program Without the support price, producers in the low-cost areas would probably be more concerned about marketing order provisions that adversely affect their markets

The authors do not point out that price enhancement through pure textbook price discrimination under Federal orders has been reduced over the years by holding the minimum Class I differential constant since 1968, whereas the manufacturing grade milk price has tripled The average minimum Federal order Class I differential in the overall system declined from 33 percent of the average Federal order Class I price in 1968 to about 14 percent of the Class I price in 1984 Meanwhile, costs of transporting milk and servicing the fluid milk market have increased, primarily because of energy costs and inflation The allowance for transportation on intermarket shipments built into the Federal order price structure is probably less than half the current cost of shipping raw milk. However, transportation allowances are curently figured from a single pricing point in Eau Claire, WI, and, with the large buildup of excess Grade A milk, a number of price basing points closer to fluid milk demand areas would likely evolve under competitive conditions

Another point not mentioned by the authors which concerns the equity of returns among producers in different regions is that the weighted-average price received for all milk marketed in Minnesota, as a percentage of the U S all milk price, increased from 82 percent in 1968 to 95 percent in 1984. In contrast, this price relationship decreased from 133 percent to 120 percent in Florida over the same period.

The authors emphasize the economic distortions of the classified pricing system, but fail to recognize the overriding distortions of marketwide pooling of producer returns and the associated lack of incentives for delivering milk to the fluid milk market—the original primary purpose of orders Under marketwide pooling, the minimum average (blend) price received by producers is calculated on a marketwide basis, combining into one total the utilization of all handlers and the total receipts from all producers in the market Under this pooling system, any additional revenue (except revenue from over-order charges) from Class I sales by a handler is shared among all producers in the market The overall effect is a reduced incentive to service the fluid milk market and a reduced incentive to shift milk into products with the highest use value Marketwide pooling also reduces the incentive for optimal location of manufactured dairy product plants because the cost of milk used in hard manufactured dairy products is the lower Class III price regardless of plant location.

The authors seem more concerned about distributive equity of returns among regions than about incentives for efficient milk flows among markets when they suggest that nationwide pooling of returns from classified pricing could resolve some of the producer inequities resulting from classified pricing They do not recognize the location value of milk, and they ignore problems of intraorder pricing that would arise under nationwide pooling They also erroneously indicate that administration of a nationwide pool would not be difficult In reality, the current problem of getting milk needed for fluid use away from manufacturing would worsen Manufacturers of butter, nonfat dry milk, and cheese would have even less incentive for