ERS provides economic information on the near-term agricultural outlook and on long-run projections. Here is an overview of efforts to improve such information through comprehensive quantitative models. The various models incorporate intercommodity relationships within agriculture, aggregate farm price and income levels, interactions between the farm and nonfarm economies, natural resources, environmental considerations, and foreign markets.

Keywords: agricultural outlook, projections, forecasting, econometrics, models, systems.

“As for those economists who ... have taken the stand that mathematics cannot possibly serve to elucidate economic principles, let them go their way ... They can never prevent the theory of the determination of prices ... from becoming a mathematical theory” (36, p. 47). This observation by Leon Walras in 1874 applies to the forecasts and projections of agricultural prices and quantities by the Economic Research Service (ERS). It helps to explain why ERS, in its outlook and long-run projections programs, depends heavily on mathematical and statistical models. This article provides an overview of ERS efforts to improve its agricultural forecasts and projections through comprehensive econometric models. Other important forecast and projection efforts are also underway, but they are not the focus here.

ERS provides information on the near-term agricultural outlook and on longrun projections both to public and private decisionmakers. ERS specialists forecast prices, production, domestic use, and exports for individual commodities; and they make estimates for aggregate, such as farm income, the farm and retail price indexes, and food consumption. Commodity and aggregate agricultural sector forecasts and projections serve as the basis for the outlook program and as a major information source for public and private decisionmakers.

Recently, efforts have been made to improve the methodology used in agricultural forecasts and projections. The need stems from the continued difficulty of sorting out all interrelationships in U.S. agriculture and translating them into an accurate set of quantitative forecasts. The emergence of foreign markets as a dominant influence on U.S. agriculture has compounded the problem, and awareness has grown of the need for comprehensive models of the agricultural economy that include both domestic and foreign sectors. Another difficulty: longrun projections models generally fail to pick up shortrun variations, just as shortrun forecasting models usually do not pick up longrun trends. Shortrun cycles and longrun trends sometimes appear to conflict; thus, all researchers must be aware of the total activity. However, the two types of models do share common data sources and theories and they are complementary.

SHORTRUN AGRICULTURAL FORECASTS

Though shortrun forecasts are supported by modeling efforts throughout ERS, most of the work is concentrated in the three divisions in Food and Fiber Economics (FFE): Foreign Demand and Competition (FDCD), National Economic Analysis (NEAD), and Commodity Economics (CED) (fig. 1). Overall planning is done by the Deputy Administrator of FFE, the outlook and situation officer, and staff from CED, FDCD, and NEAD. This group is purposely composed so that it cuts across the administrative organization (shown in figure 1) to perform the forecasting function. The administrative organization has other purposes than forecasting. But to explain the forecasting function, we show the organizational setup as a background. The forecasting setup can be explained by showing how it differs from the organizational setup. Figure 2 indicates some of these cross-organizational linkages. Emphasis of this overview article is on function rather than organization. The three-division group reviews the current situation and makes basic assumptions for the forecast analyses. The assumptions usually involve the outlook for the general economy...
and alternative levels of world production and demand, and they sometimes involve estimates of U.S. crop production. Once the assumptions are specified, the analysis begins.

The area of responsibility for each division and the flow of forecast information are outlined in figure 2. Within ERS, FDCD has responsibility for export forecasts. The division's country and commodity analysts provide the primary information used to generate aggregate export forecasts for feed grains, food grains, soybeans, and cotton. These forecasts depend on the outlook and situation assumptions and on macrolevel forecasts of world population, income, and agricultural production. The import estimates made for countries are aggregated into exports for U.S. agricultural products.

Specific commodity forecasts are the responsibility of CED. Export forecasts from FDCD, situation and outlook assumptions, and macrolevel forecasts of the U.S. economy are used to develop domestic forecasts of prices, production, and for major commodity sectors: beef, pork, dairy, poultry, tobacco, fibers, oil crops, feed grains, and food grains.

NEAD has responsibility for aggregate agricultural forecasts. These are made for farm income, prices received by farmers, retail food prices, and per capita food consumption. CED's commodity price, production, and use forecasts provide part of the basis for NEAD's aggregate forecasts. However, aggregate models are also used. After results of the two approaches are compared, revisions may be made in some commodity forecasts as well as in the macrolevel forecasts for agriculture and for nonfarm income and consumer demand.

Outlook information is then coordinated, evaluated for overall consistency, and disseminated in ERS reports (fig. 2).

Underpinning the work described above is the Data Services Center (DSC) (fig. 1). Its primary function is to increase the use of computer technology to speed the flow of data into and throughout ERS. The Center acquires data used in ERS in automated forms, develops a data management and analysis system, and provides support through general systems analysis, programming, and scientific applications. DSC also helps to identify data gaps and to plan for filling these, and it helps articulate these needs to statistical agencies, other data suppliers, and other parts of the Federal statistical establishment.

**Aggregate Forecasts**

Forecasts of aggregate measures for U.S. agriculture, such as realized net farm income and prices received by farmers, depend on interrelations (1) between specific commodity forecasts and the U.S. economy and (2) between U.S. agriculture and the world economy as well as (3) among subsectors within agriculture. Accounting for these interrelations is essential in short-run forecasting.

**Earlier models.** In this overview, we chose to discuss aggregate models that treat agriculture as a subsector of a larger system. This focus eliminates some related and highly interesting work \(4, 18, 23\). A brief glance at earlier aggregate agricultural models will help in presenting the models currently used. The first agricultural sector model to interface with a macro model was that of Cromarty \(2\). Linkages to the macro-economy were direct; commercial demand for each commodity was a function of its own price, prices for substitutes, per capita disposable income, and the general price level. Feedback was likewise direct, because disposable income included net farm income after adjustments for taxes and transfers. Policy variables could be introduced through the Government demand equations, such as the equation for the amount of commodities going under loan or purchase agreement.

The Brookings quarterly model of the United States, as originally published \(3\), contained a submodel of the agricultural sector developed by Karl Fox \(6\). The agricultural sector submodel, with 15 equations, estimated domestic consumer demand for foods derived from crops and livestock, retail value of the market basket for crops and livestock, and farm-retail spreads. Identities determined the farm value of the market basket for crops and livestock. A final equation estimated the level
of prices received by farmers. Other endogenous variables included gross and net farm income, production expenses, depreciation, and net change in inventories. By the time the full Brookings model was operational, the agricultural sector had been reduced and reformulated from (7, p. 12). This reformulation is similar in linkages and structure to the Wharton model described below.

The Wharton model. ERS subscribes to the forecasting services of the Wharton Econometrics Forecasting Associates (WEFA). The Wharton Mark IV model has nearly 400 equations and identities and 17 sectors. The agricultural subsector is treated as any other industrial subsector would be; and several variables—fixed investment, an implicit price deflator, output originating in the sector, compensation per manyear, employment, and net proprietor’s income—are all endogenously determined. The subsector setup allows for little alteration for the exploration of policy alternatives. Output originating in agriculture is seen unrealistically as a direct (same period) response to changes in consumer expenditures for food and beverages only. Agricultural output, in turn, helps determine employment, wage compensation, and investment in the total economy. The prime movers of the deflator for the agricultural sector and farm income are seen as prices received and paid by farmers, both of which are exogenous to the system.

However, the Mark IV linkages between the agricultural subsector and the remainder of the model are direct. Output originating in agriculture is a portion of aggregate supply, wage compensation and employment serve to determine the wage bill in agriculture, agricultural income is added in to arrive at national income, and investment is a component of aggregate demand. The implicit price deflator for agriculture enters into the estimation of the Consumer Price Index (CPI) and the Wholesale Price Index (WPI).

The feedbacks are also direct: interest rates in the economy help to determine agricultural investment; consumption expenditures for food determine output originating in agriculture; and the civilian unemployment rate and the CPI influence the rate at which manyears are compensated in agriculture.

ERS models. Two aggregate models were recently developed in ERS. In the first, described by Dale Heien in (14), a four-subsector (livestock, feed grain, food grain, and all other) annual agricultural sector is estimated as a submodel in a larger macroeconomic model that contains 47 equations and identities. This model has several limitations. Supply is considered fixed in any year after production, for example. Yet the results explicitly take into account the effect of changes in
macropolicy instruments (such as interest and income tax rates) on a variety of agricultural sector variables: cash receipts, prices received, farm income, employment, and the like. Gerald Schluter takes another approach, quite different in concept (29, 30). After assuming answers to questions of final demand, he estimates the value of agricultural output required, using as much commodity detail as is desirable or available from an input-output (I/O) table. Schluter adjusts these output estimates to compensate for the fact that I/O tables, with fixed coefficients, do not allow for technological change or shifts in relative prices. These adjusted estimates are clearly superior for forecasting purposes to unadjusted estimates of agricultural output.

Both the behavioral and I/O approaches have their advantages. The behavioral approach better captures short-run variations while the I/O approach proves to be more suitable for examining long-run trends. And it can also be incorporated in the longrun projections models discussed in a later section. Current efforts in ERS use both approaches: behavioral for shortrun forecasting (3 months to 2 years) and I/O for intermediate-term forecasting (2-5 years).

Two projects are underway in ERS to model the agricultural-macroeconomic interface. In the short-term behavioral project, economists are developing a more complete disaggregated submodel of the agricultural sector than is currently in use which can be substituted into the Mark IV model. Work should be completed and a report on it released soon.

The second project involves forecasting of income, prices, and other variables in the agricultural sector for the intermediate term (2-5 years). This effort uses the Wharton Annual and Industry Forecasting Model. Again, the main focus is on the interrelation of the agricultural sector and the macroeconomy; specifically, the impacts of macronomic policy on the agricultural sector and the effect of changes in the agricultural sector on the national economy. The WEFA annual and industry model has only two agricultural subsectors out of a total of 63 subsectors for the economy. Economists on the project are disaggregating these 2 subsectors into 16. In addition, nondurable manufacturing is being disaggregated further to identify the food processing subsectors. Final demands in the economy are disaggregated to separate out demands that are relevant to agriculture. Linking this macro-econometric model with an I/O model (with more detail in the agricultural and food processing subsectors) will allow forecasts of the effects of various macronomic scenarios on U.S. agriculture. Similarly, we will be able to forecast how changes in the agricultural sector will affect the macroeconomy. People on the intermediate-term project are using the 1967 I/O tables. Currently they are waiting for the Wharton staff to update its annual model with the newly published National Income and Product Account benchmark revisions (33).

Disaggregation Among Agricultural Commodities

The following models emphasize forecasts of commodity prices and quantities, but they can also be linked directly to the macroeconomy. Some obvious overlaps exist between the aggregate and disaggregated models; some aggregate models show commodity detail and some commodity models interact with the macroeconomy. But the commodity modeling discussed below emphasizes development of a system to provide consistent forecasts on individual commodities.

The Cross-Commodity Forecasting System (CCFS) in ERS provides a comprehensive analytical framework to support the outlook and situation process for which CED has responsibility. Basic components of CCFS are annual econometric models of the economic structure for individual commodities or commodity groups. CCFS is referred to as a system to distinguish it from the basic structural model components. These components are equilibrium models which contain—either explicitly or implicitly—demand, supply, and stock relationships and identities. The structural parameters are estimated individually for each commodity model. Once a commodity model is operational, it can be used separately to explain and forecast phenomena related to that commodity; it assumes answers to questions about other commodities are exogenous. The individual models are linked together via common variables which become endogenous in the linking process. The combined system of structural models is solved for the implied reduced-form system.

A Gauss-Seidel procedure (15) is used to obtain the combined model solution and impact multipliers.

CCFS will eventually include:

- beef
dairy products
- barley
cotton
- pork
- eggs
soybeans
- wool
- chicken
- corn
- wheat
- tobacco
turkeys
- grain sorghum
rice
- peanuts
- lambs
- oats
rye
fruits & vegetables

The current focus is on the feed grain-livestock-protein complex, in which a relatively strong economic interdependence exists. CCFS takes explicit account of the interdependencies.

Figure 3 illustrates the current composition of CCFS. It shows a decreasing level of aggregation—from system to sector to component to models. The approximate number of equations, including identities, appears in parentheses at each level. The figure also shows the progression of exogenous variables according to the level of disaggregation. For example, population is exogenous to the entire system. Feed price is exogenous to the livestock sector but endogenous to the system. Chicken prices are exogenous to the red meat component but endogenous to the livestock sector. Pork price is exogenous to the beef model but endogenous to the red meat component.

The livestock sector of CCFS, currently operational, contains models for beef, pork, chicken, turkey, eggs,
and dairy products. Individual commodity models are linked to form the sector. The information is used in the CED forecasting process and in various impact analyses.

The grain sector includes a model for feed grains—corn, sorghum, oats, and barley. This model is currently used to support the outlook and forecasting process. The wheat model is based on previous models, and it is the least developed of the models discussed thus far. For oilseeds, a soybean model has probably had the longest period of development and use. It is being reestimated and is currently operated separately. The livestock, feed grains, and soybean models are used, to a limited extent, in an iterative forecasting procedure. Plans are to link these three and the wheat model together. A previously estimated model for tobacco is being evaluated, and specification and estimation of a model for cotton is underway. Additional commodities will be added to CCFS.

When CCFS is completed, the system will comprise a comprehensive model of the agricultural sector with the capability of generating implied aggregates such as cash receipts, volume of marketings, prices received, and, given estimates of production expenses, farm income. In addition, because of the initial design of the overall agricultural sector framework, largely the work of Heien (14), the comprehensive model can be readily linked to a macromodel of the domestic U.S. economy, such as the Wharton (annual) model.

Forecasting Models of World Agriculture

FDCD is currently developing short-term forecasting models for world agriculture to help in this division’s forecasting function. Such models, with their associated data base and explicit assumptions, help identify the important factors affecting foreign production, consumption, and trade. A primary concern is to develop objective forecast models that analysts will find not only helpful but also easy to use.

FDCD shortrun modeling efforts currently concentrate on forecasts for the grain-oilseed-livestock sectors of France, West Germany, Italy, the Netherlands, and Belgium-Luxembourg. These models are focused on wheat, several coarse grains, oilseeds, beef, veal, dairy, pork, poultry, and eggs. The models are recursive. Quantities are functions of prices, which are assumed to be set primarily by policies of the European Economic Community.

Each country model contains three submodels: production, feed consumption, and food consumption. The production submodel forecasts acreage and livestock numbers as well as productivity per unit. Total production is calculated by an identity. Major efforts are made to incorporate intercommodity relationships and price responsiveness. Feed consumption is forecast as a derived demand. Given feed conversion factors, the models calculate the feed required to support the forecasted number of animals. Food consumption is based
on food demand equations used to estimate a matrix of price and income elasticities. This matrix, with exogenous price and income assumptions, is used to forecast food consumption.

Nonstructural forecast modeling is being experimented with. ERS staff members are evaluating autoregressive time series models for U.S. agricultural commodity exports. In addition, models built outside ERS are being examined for use in world agriculture forecasts. Our first such effort involves use of the Project LINK macroeconomic models and forecasts (1). These models provide a set of internationally consistent forecasts of macroeconomic variables for the major countries as well as a consistent set of aggregated world trade forecasts. This consistent set of forecasts can be used for variables treated as exogenous inputs in FDCD models. LINK includes the Wharton Mark IV model discussed earlier.

Modeling will become increasingly important in FDCD; it will involve continual updates and analyses of sets of integrated models. These modeling efforts will provide user-oriented, comprehensive data bases for foreign agriculture. It is envisioned that the models will be integrated with related work in other ERS divisions.

Some of the forecast modeling capabilities in other divisions already embrace the world situation. For example, CED has developed a national-level behavioral model of world rice trade. The model incorporates the following elements:

- Linear production and consumption functions containing both endogenous and exogenous variables
- Price relationships relating types of rice, marketing stages, and geographic locations
- Variables reflecting government policies.

The basic conceptual framework is a set of national and regional production and disappearance functions with price relationships to reflect those existing within and between countries. The world rice economy is divided into 38 countries or regions. (The United States is separated into long-medium grain and short-grain rice areas.) Using econometric techniques, analysts developed for each country a set of equations for estimating production, disappearance, and external and internal price relationships. Equation sets are solved with a linear programming algorithm (11, 22).

In time, a family or hierarchy of models may be developed, such as in Project LINK, to integrate information from existing models of the macroeconomy, each region's agriculture, world agricultural commodities, aggregate U.S. agriculture, and U.S. agricultural commodities. Access to Project LINK and the Wharton model is one step in this direction. Some shortrun forecasting capability may be provided by the world grain-oilseed-livestock model, discussed later, with some modifications. Lastly, a series of market demand studies has been initiated to develop agricultural market sector models for regions and commodities.

Related Models
ERS has other models that support the aggregate and disaggregated forecasting models described in preceding sections. Also, there are techniques used in the ERS forecasting process that resemble accounting frameworks more than analytic models. With these tools, the analysts relate individual forecasts of prices and quantities for agricultural commodities to aggregated forecasts of income and price levels.

One such tool is POLYSIM, a comprehensive computerized model of the agricultural sector of the economy (25). Used in policy analysis rather than forecasting, POLYSIM leaps from the assumptions which begin the forecasting process directly to the conclusions. In other words, it provides a shortcut method for assessing likely impacts of certain changes in assumptions. POLYSIM measures changes in commodity supplies, domestic use, exports, prices, farm income, and consumer expenditures—at the national level. Commodities covered are feed grains, wheat, soybeans, cotton, beef, hogs, lamb, turkey, broilers, eggs, and dairy products. The data are "baseline estimates" of the economic situation most likely to prevail over the next 5 years. The complex interactions of commodity loan rates, target prices, set-aside acreage, export controls, and Commodity Credit Corporation sales activities as policy instruments form an integral part of POLYSIM. The economic impacts of changes in these variables can be traced through important economic indicators in the agricultural sector.

POLYSIM has been used extensively during the past year to supplement other more traditional approaches to policy questions that need to be answered quickly. Analysts gain an integrated approach for measuring impacts among commodities in an internally consistent dynamic framework for several years into the future. Additional commodities are being incorporated into the model and a stochastic version of it (using probability distributions on yields and exports) has been developed. The model structure is documented and users' manuals are available (26, 27). Other policy oriented models are used in ERS, for example, the one discussed by Nelson (23). Such models are less closely allied than POLYSIM to the shortrun forecasting focus of the ERS models discussed earlier.

ERS is experimenting with a model to estimate the competitive equilibrium situation resulting from U.S. domestic and export food and fiber requirements, with technology, resource availability, and methods of production and marketing as given assumptions. The model's universe is the U.S. food and fiber industry, including farm input supplies, the farming sector, and the marketing and export sectors. Demand relationships express price as a function of quantity, and cross elasticities are included. Production and marketing activities are expressed in a linear programming format. The model estimates the competitive equilibrium by finding
solutions in terms of prices and quantities that maximize net social benefits (27). When it becomes operational, the model will supplement other comprehensive models discussed earlier because its consistent estimates of prices and quantities for farm inputs and outputs can be used to estimate net farm income and prices received by farmers.

The Aggregate Income and Wealth (AIW) simulator model developed by Penson, Lins, and Baker (24) is another short-term model consisting of 53 ancillary statement for the farm sector. The model takes as input accounts, balance sheet, and sources and uses of funds model developed by Penson, Lins, and Baker (24) used to estimate net farm income and prices received by farmers. It forecasts components of the income accounts, balance sheet, and sources and uses of funds statement for the farm sector. The model takes as input the forecast of (1) prices received and (2) output for crops and livestock. Basic forecasts of aggregate income and wealth from the model are published in the annual Agricultural Finance Outlook of ERS. In addition, the model is used to compare basic forecasts with alternative policy situations.

Other related ERS models, such as the dairy policy model (12, 13), are less comprehensive and may focus on a single agricultural sector. A cotton-textile model is being developed. The Feed and Livestock Evaluating System (FALES) incorporates several models of the feed-livestock economy in a consistent fashion (35). A stochastic simulator of wheat and feed grains (STOCS) examines issues related to price stability and to grain reserves (32). A grains transshipment model primarily focuses on price differentials among regions (17). Finally, the Aggregate Crop Response Estimating model (ACRE) estimates regional supply response (5).

LONGRUN AGRICULTURAL PROJECTIONS

Longrun projections models for agriculture exist in most ERS divisions, though the major effort is concentrated in these: National Economic Analysis (NEAD) Foreign Demand and Competition (FDCD), and Natural Resource Economics (NRED) (fig. 1).

NEAD has overall responsibility for coordinating projections across ERS, and the division's Economic Projections and Analytical Systems Program Leader is the ERS Coordinator for Projections. The Agency program includes (1) a network of projection teams composed of analysts from ERS, other USDA agencies, universities, and foundations; (2) a centralized and automated National-Interregional Agricultural Projections (NIRAP) system; (3) a routinely revised set of core projections of alternative futures for U.S. agriculture; and (4) a series of publications: Agriculture The Third Century.

FDCD has an operational grain, oilseed, and livestock (GOL) model for projecting production, consumption, and trade of major agricultural commodities in and among major world countries and regions. The GOL model is used to provide constant price export projections for the NIRAP system and to conduct special studies on different aspects of the world food situation and the U.S. farm export market.

NRED uses a variety of models, including the NIRAP system and the Iowa State University’s and various river basin linear programming models to generate projections to use in evaluating public investments in natural resource development and resource programs and policies.

The NIRAP System

NIRAP is a computerized simulation of U.S. agriculture that can be used to project and analyze alternative futures for U.S. agriculture based on differing scenarios and policy decisions. Through analysis of alternative futures, the range of possible adjustment paths for agriculture can be bracketed, an early warning of potential difficulties provided, and possible solutions to potential problems and tradeoffs between policy goals evaluated. These projections are revised periodically and analyzed to provide a check on major issues relating to the world food situation, agricultural productivity, the economic viability of the farm production sector, adequacy of land and water resources for food production, domestic food supplies and prices, agriculture and energy, and the environment.

The NIRAP system will never be fully developed; additional components will be added and existing components revised over time. For a specified scenario, the currently operational NIRAP system projects the following:

Agricultural productivity growth at the national and regional levels by aggregate farm output and crop and livestock aggregates;

Prices paid and received by farmers at the national level;

Gross farm income, production costs, and net farm income at the national level;

Individual commodity production, prices, and use at the national level (30 commodities);

Crop and livestock production, crop yields, and land use, by irrigation and nonirrigated practices at the national and regional levels;

Fertilizer and fuel input requirements by commodity and in the aggregate at the national and regional levels;

Environmentally related variables such as soil erosion and the use of pesticides and chemical fertilizers at the national and regional levels;

The consumer food price index at the national level;

Per capita food consumption, by commodity and in total, at the national level; and,

The percentage of per capita disposable income spent on food at the national level.

Figure 4 illustrates components of the NIRAP system and its use to project relevant relationships and indicators of change in food and agriculture for analysis of questions relating to the issues studied.
ENERGY AND ENVIRONMENTALLY RELATED INPUTS

CROP YIELD SIMULATOR

Comparing aggregate farm & commodity output, prices paid and received, production costs, productivity growth, and gross and net farm income under different scenarios permits a systematic analysis of questions relating to the farm production sector issue.

ENVIRONMENTAL CONTROLS RESEARCH and EXTENSION EXPENDITURES

PRODUCTIVITY SIMULATOR

Comparing the levels of environmentally related inputs & controls under each scenario permits a limited analysis of questions related to the environmental quality issue.

AGGREGATE FARM OUTPUT

Comparing the levels of irrigated and non-irrigated cropland and consumptive irrigation water requirements to expected irrigation water and cropland availability and conversion potential permits analysis of the issue of the adequacy of our natural resources.

REGIONAL DISTRIBUTION OF PRODUCTION

Comparing the levels of energy inputs under each scenario permits an analysis of the energy and agriculture issue.

SOIL EROSION

Comparing agricultural exports and a cursory summary of world food production and population growth under each scenario permits an analysis of the world food situation.

CONSUMPTIVE IRRIGATION WATER REQUIREMENTS

Comparing per capita food consumption, food prices and the proportion of per capita disposable income spent on food permits an analysis of the national food issue.

ATTRIBUTES of GROWTH in POPULATION and GNP

WORLD AGRICULTURAL TRADE (GOL)

MARKETING MARGINS

FOOD PRICES

GENERAL ECONOMY

SCENARIO DEVELOPMENT

NOTE: Dots on flow lines indicate lines connect. —— means no formal endogenous model. ——— means a formal endogenous model.

FIGURE 4
Modified Delphi workshops are conducted for scenario development. On the supply side, scenarios differ with respect to research and extension expenditures by the Federal and State governments, input price inflation, and environmental controls. On the demand side, scenarios differ with respect to domestic population and income growth, changes in tastes and preferences, and world trade. Quantified values of each scenario attribute provide shifts in the supply and demand functions in the aggregate farm output and commodity production and utilization components via scenario assumptions and the productivity simulator, world agricultural trade, and general economy components.

Farm prices and food consumption projections from the aggregate and commodity supply-demand models and marketing margins provide a basis for projecting food prices.

The crop yield simulator, cropland availability, and commodity production and utilization provide inputs for the regional distribution of production and land use components. National and regional commodity production, land use, and prices paid and received by farmers are used to project energy and environmentally related farm inputs. Land use projections are also determinants of projected soil erosion and consumptive irrigation water requirements.

Indicators projected by each NIRAP system component under appropriately paired scenarios are systematically analyzed to provide information for issue analysis as indicated at the bottom of figure 4. The issues are studied comparatively through the year 2025.

The world agricultural trade component is actually FDCD’s GOL model rather than an integral NIRAP component, and the general economy components consist of scenario-determined exogenous population and GNP projections. All other components in the figure are endogenous NIRAP components in some significant stage of econometric development, and they are operational.

The OBERS Program
A major model requirement in NRED is development of agricultural output and resource use projections as part of the OBERS program. OBERS is an acronym which was devised when the Office of Business Economics (OBE) and ERS joined forces on longrun projections for use by the Water Resources Council (WRC). OBE, a unit in the U.S. Department of Commerce, was subsequently renamed the Bureau of Economic Analysis (BEA). NRED and the Regional Economics Analysis Division (READ) of BEA prepare periodic OBERS projections for the Council. Current plans call for a three-level set. The basic projection represents a continuation of current programs and policies. High and low projections related to such factors as restrictive environmental programs or expansionary export policies provide the two additional levels. NRED plans to use a national linear programming model to relate future demand and supply conditions in these projections.

Interagency planning teams use OBERS projections to prepare substate and regional resource development plans. The OBERS projections incorporate changes such as shifts in population, technology, land treatment, and interregional production, but not public resource development projects, such as irrigation, drainage, and flood protection. The linear programming framework was not available for use in the projections previously published (34) but plans call for its use in subsequent efforts. The OBERS projection model depends on information from NEAD, CED, or FDCD, including:

- Baseline per capita consumption projections
- Regional variations in consumption patterns
- Price elasticities for all commodities
- Cross elasticities where appropriate
- Exports
- Enterprise budgets

The NRED projection system explicitly recognizes interregional comparative advantage and resource availability at various product price-input cost levels. Regional level estimates from the national model are based on economic efficiency criteria and they are used to determine national implications of regional resource development plans (8, 9, 10, 19, 20) and to evaluate interregional impacts on commercial agriculture of policies and programs related to natural resources, including environmental issues. To measure primary interregional project and policy impacts, analysts use a constrained optimizing model, one that is consistent with the NRED regional projections models and compatible with the OBERS projections requirements. The system used for this purpose is a cost-minimizing model that meets a fixed national demand and does not allow price effects to influence demand. The NRED system projects for the following variables: commodity production, value of commodity output, costs of producing each commodity, land use by land class, water use, conservation tillage practices used, resources used in production, soil loss, and marginal unit costs.

FDCD Model
For longrun projections for the rest of the world, FDCD has developed a model of the world grain-oilseed-livestock economy. So that longer term world food prospects can be assessed, emphasis is placed on integration of the grain-oriented food sectors of the more developed regions. The model incorporates both intercommodity and interregional relationships. In the current version of the model, the focus is on a supply-demand equilibrium situation, solved by linear programming methods (31). The model does not contain spatial equilibrium elements. No projections are made concerning specific trade flows but evaluations of the net trade positions of regions can be made.
The model incorporates information on population and income growth rates, demand and supply elasticities, physical input-output rates, and assumptions about underlying economic trends and policy constraints. Based on this information, the model projects equilibrium values for production, food and feed consumption, net trade, and prices for each commodity. Eleven commodities (wheat, rice, coarse grain, oilmeal, beef and veal, pork, lamb and mutton, poultry, milk, butter, and cheese) and 27 regions of the world are included. This work continues and expands the model reported on in (28). Analysts have used the FDCD model to provide broad alternative future scenarios as well as to evaluate the long-term impact of specific policies.

AN ONGOING TASK

Since its reorganization in 1973, ERS has refocused and increased its modeling capability for forecasts and projections, and it will continue this work. In this overview article, we have attempted to inform people outside ERS of ongoing efforts in this area. This article can be considered the parent of a planned series of articles for this Journal which will provide a detailed look at the projections, and it will continue this work. In this overview article, we have attempted to inform people outside ERS of ongoing efforts in this area. This article can be considered the parent of a planned series of articles for this Journal which will provide a detailed look at the

REFERENCES


