IMPROVING THE COMPETITIVE POSITION OF NORTHEAST AGRICULTURE —A CONCEPTUAL FRAMEWORK—

M. C. Hallberg and J. Patrick Madden

The competitive position of agriculture in a region is determined by a mosaic of interacting forces. The physical, capital, and human resources available to the sector set technical limits to production possibilities. The pressures exerted on the use of these resources by the region's nonfarm sector help establish economic limits. The production characteristics of the agricultural sector of other regions also, of course, impact a region's competitive position.

Another important force affecting agriculture's competitive position is producer access to factor and product markets. Builders of models designed to examine the competitive position of agriculture or to study resource adjustment issues typically assume ubiquitous and unlimited factor and product markets. In much of the Northeast, however, many agricultural activities are no longer (or never have been) viable because the infrastructure needed to support such activities does not exist and is prohibitively expensive for the individual producer to obtain. Roads or rail lines are in many instances inadequate to support needed transport activities. The volume of production of some commodities is too small to support efficiently functioning and accessible markets, both for inputs and farm products. Some food processing firms that are part of large regional or national chains do not purchase inputs from local sources because of scale economies associated with purchasing, processing, storing, and transporting the volume and quality of product needed by the entire chain.

To date there has been only limited research dealing directly with the impact of such forces on the agricultural sector. In a recent report, French and Carman discuss in detail some of the important links alluded to here between primary agriculture and the marketing system. Davulis, Andrews, and Frick examined a related issue in their study of the effect of the number of dairy producing units and the spatial density of dairy production on the cost of delivering feed in the New Hampshire-Vermont-Connecticut area.

We are aware of no attempts, however, to examine the impact of such forces in a systematic or comprehensive way. Researchers using the perfect competition framework typically argue or imply that the indicated forces can easily be handled in our traditional models by a judicious choice of input and/or product prices reflecting such market forces. While the practicality of this approach is well established by past research, it appears to us that such an approach leads to the development and reporting of models that are of limited value to the policymaker concerned with furthering regional agricultural development, with increasing agricultural self-sufficiency, or in general with understanding the nature of agriculture's competitive position.

Professors of Agricultural Economics at the Pennsylvania State University.

Such a policymaker would be interested in knowing such things as (1) what policies might be adopted to modify institutional constraints or infrastructure characteristics that now inhibit the development of a particular type of farming in the region? (2) how much would society have to pay for such policies? (3) would such policies be worth the cost? (4) can policies be adopted that will permit so-called "small" farmers to coexist with "large" farmers (assuming this is a valid societal goal) and not only earn a respectable living but also contribute positively to rural employment, regional self-sufficiency, etc.? We do not believe questions such as these can be addressed effectively with models that *a priori* ignore the feasible production alternatives and assume away the bottlenecks to important production alternatives.

The aim of this paper, then, is to suggest an approach intended to be more constructive than previous efforts in its potential application to the study of Northeast agriculture's competitive position and related issues. The core element of our approach is a quantifiable model that considers the parts in relation to the whole, that specifies aggregate, feasible production possibilities, and that explicitly recognizes existing market or institutional constraints to production possibilities and/or resource adjustments. As will be seen, the analytical technique for making this model operational is quite straightforward and familiar to agricultural economists. Specification of the model, however, will require much effort and perhaps some nonconventional approaches. In the final section of the paper we outline one such nonconventional approach that seems to us to offer much potential.

THE ANALYTIC FRAMEWORK

We envision the region's agricultural sector being composed of several subregions, each having a unique set of basic resource and market characteristics. Thus some subregions will be more technically efficient in the production of certain activities than will other subregions. Similarly some subregions will have more ready access to certain input and/or product markets than will other subregions.

Each subregion can (1) sell products on the open market (if an open market exists), (2) export products to any other subregion (if transportation facilities are available), or (3) use locally the output of one activity, say corn, as an input in the production of another activity, say dairy.

The leading societal objective is assumed to be to maximize aggregate value added by the agricultural sector in the region, conditional upon resource availabilities, institutional barriers, market attributes, and perhaps other societal objectives. Value added here is defined as the revenue earned from the sale of products on the open market and from the export of products to other subregions, less expenditures for production expenses, and transportation. All input and output prices are initially assumed to be constant within each subregion, independent of the volume of inputs purchased or output sold. This assumption is in turn based on the assumption that the volume of inputs required and of output produced in any subregion is not great enough to have any influence on subregional price. Relaxation of this assumption, of course, does not invalidate our approach; it merely complicates our model (e.g., makes our model quadratic instead of linear).

The analytical approach proposed to make this framework operational is mathematical programming. In a recent study done for Pennsylvania using this approach, Seeley[1] found integer programming to be quite adequate for dealing with the nonlinearities involved in modelling the investment in physical resources and in capturing special market constraints. The activities in such a model would consist of all production activities (present and potential) for all regions, all purchased inputs for all regions, and the interregional transportation of intermediate products.

The constraints of the model would include:

1 - land available to each subregion,

2 - energy available:

a - diesel fuel

b - heating fuel

c - electricity,

3 - plant nutrients available to each subregion in the form of:

a - nitrogen

b - phosphate

c - potash

d - lime,

4 - animal feed available to each subregion in the form of:

a - metabolizable energy

b - crude protein

c - roughage,

5 - labor available to each subregion for each of the four seasons of the year,

6 - capital available to each subregion,

7 - transportation available to each subregion for interregional shipments of intermediate products, and

8 - market constraints in each subregion.

The first seven of these constraint categories are fairly standard and thus need little discussion. It should be noted, however, that (1) manure produced in a subregion will supply some of the plant nutrients available to that subregion, and (2) feed grains produced by the region will supply some of the animal nutrients available to the region.[2] It should also be clear that other features may have to be added to specify completely the agriculture of the region. For example, additional constraints relating to societal goals, alternative technologies for producing a given product, etc., may be needed. Some of these features will be revealed by basic research and others will be revealed through discussion with policymakers or others.

The last two constraints listed here deserve special attention since they are of utmost importance to the concerns of this paper.

Transportation Available

Intermediate products (corn grain, wheat, oats, hay, straw for bedding, etc.) are assumed to move within the region for the most part by truck. Imports of these products from other regions will most likely be made by rail. Sale of final products on the open market will require local transportation services. Clearly, the presence or absence of such services will materially affect production possibilities in the region. It may well be that under certain circumstances, it may prove economical for the region to subsidize transportation services so that one or more of the production activities of the model can become viable. Major conceptual, analytical and/or political barriers may have to be overcome, however, before such actions could be effected.

Output Markets Available

In any given period of time there would appear to be limits to the aggregate expansion of most agricultural activities. The meat packing industry or the vegetable processing industry, for example, cannot increase processing capacity overnight. Similarly, the support services available for livestock production or vegetable production may be so limited that any expansion in excess of say, 30 percent is infeasible.

Of even greater significance is the fact that for a production activity to be viable at all in a subregion, it must be undertaken on a scale large enough so that support services and processing capacity can be provided at an economically justifiable scale. Given the scale econ-

1 Seeley's application involved solving a five-region linear program with 189 rows, 331 real activities, and 9 integer variables.

2 The capital account requires special treatment since the sale of existing physical assets presently employed in agriculture is a possibility, and this activity would result in additions to the amount of capital available to the sector. For one treatment of the capital account see Seeley.

omies in fluid milk processing, for example, a plant processing less than 50,000,000 pounds of milk per year is not likely to be competitive. This means that a minimum of about 4,500 good producing cows must be raised in the subregion(s) supplying this plant. Similarly if broiler production is to be viable in a subregion(s), a minimum of 10-15 million broilers must be produced per year. Given the character of the market for commodities like processing vegetables, berries, amaranth, or sunflower seeds in the Northeast, market constraints of the type being considered here might more interestingly be applied to the latter commodities.

A third type of market constraint to resource adjustment relates to the motivation of farmers. The Northeast has a substantial number of "small" farmers. Some of these "small" farmers lack the expertise to manage a new (to them) type of farming as would be required to shift their resources out of, say, wheat production and into vegetable production or berry production. Others have off-farm earning opportunities that are of such a magnitude (relative to their on-farm earnings potential) that there is little incentive for them to consider alternative uses of their resources. This lack of motivation for resource adjustment may well aggravate the problem of developing the minimum scale of production of a certain commodity in a subregion needed to make that commodity a viable enterprise.

Quantification of these types of constraints is not likely to be an easy task and it may never be a very exact science. The benefits from attempts to do so would seem to outweigh by far the costs, however, and the potential inaccuracies, while disturbing, would seem to be tolerable. Constraints of the type suggested here might be handled as bounds on the activity levels of the model, or as inequality constraints in conjunction with integer variables.

MODEL ANALYTICS

If a model such as outlined above were available, it could be used to examine a variety of interesting issues relating to optimal resource use under alternative input and output prices, and under alternative resource availabilities, production technologies and market institutions. The findings could, if presented in a popularized medium, be useful to policymakers by increasing their understanding of the general character of the region's agricultural sector and of the impediments to resource adjustment.

Of particular interest would be the shadow prices on the market constraints discussed in the previous section. These shadow prices could be used to indicate which constraint is most limiting and how much a public or private agency could afford to pay for the development or enhancement of markets or market facilities. The costs and potential returns from creation or expansion of a certain activity (such as the processing vegetable enterprise) could also be analyzed through selective use of the model proposed here. Technological and market-size barriers to such an activity could be identified, and needed research and development could thereby become apparent.

Armed with such information, a systematic approach could be recommended for meeting the desired goals relating to agricultural development in the region. The recommendation might involve designing new institutions (e.g., cooperatives) for providing needed inputs and services including market information. It might involve such long-term projects as new machine development or plant breeding activities. It might involve new Extension programs for assisting with dissemination of relevant information and individual farm resource adjustment. Since the Northeast has many small farmers, it would most likely involve finding ways in which small farmers could coexist with large, commercial farmers.

In summary, we suggest that a model such as outlined above is necessary for (1) understanding the structure of agriculture in the region as it presently exists, (2) identifying deterents to further development of the sector, and (3) suggesting steps that might be taken to improve the sector's performance or to enhance its development.

FARMING SYSTEMS RESEARCH AND DEVELOPMENT

The utility of the analytical framework described above will be dependent on how "satisfactorily" it represents the existing situation, and on the extent to which it incorporates realistic and feasible, alternative production possibilities or alternative production technologies. To represent the existing situation "satisfactorily" should be relatively straightforward since most of the information needed is readily available from budgets that have been prepared. To incorporate alternative production possibilities or technologies that are particularly relevant to small farmers, on the other hand, will require considerably more thought and effort. The systems approach known as "farming systems research and development" holds promise of being much help in this area.

The farming systems research and development approach to agricultural development evolved primarily from efforts by various institutes to increase crop productin in Southeast Asia, Central America, and a few locations in Africa (Shaner et al., 1981). Recognizing that the technologies advanced by the "Green Revolution" were not suited to the needs or resource endowments of traditional peasant farmers, field personnel and researchers in developing countries began to seek new approaches to small-farm development. Increased awareness of the decision-making behavior of peasant farmers resulted in the development of a "farming systems" (Gilbert et al., 1980) or "farming systems research and development" (Shaner et al., 1981) approach (FSR&D).

Definition of FSR&D

As defined by Shaner et al. (1981), FSR&D is a process whereby researchers and extension specialists seek to help farmers increase agricultural output, income, and welfare by indicating how farmers should vary their choices of enterprises and management practices under given environmental conditions. In the context of Northeast agriculture, FSR&D would emphasize those aspects of the socio-economic environment that encompass markets for inputs and products, processing and transportation facilities, and the policy milieu in which regulations and program provisions are established.

FSR&D, as practiced by certain institutes in developing nations, is conducted by an interdisciplinary team (Shaner et al., 1981). The FSR&D team:

*Studies the farming system as a whole, including the physical, biological, and socioeconomic environment.

*Identifies farmer goals, constraints, and opportunities under different environments.

*Sets priorities for research and supportive action that are reflected in these overall studies.

*Recognizes the linkages of subsystems within the farming system and takes them into account when dealing with any part of the system.

*Considers these linkages; farmers' goals, constraints, and opportunities; and society's broad interests when evaluating and implementing the results.

An essential aspect of FSR&D is its systems emphasis that distinguishes FSR&D from the typical disciplinary research conducted in universities. FSR&D emphasizes a broad analysis in which the parts of the system are seen in terms of the whole. Also, the reasons for carrying out the research and the evaluation of the results are in terms of farmers' and society's goals. These two aspects contrast FSR&D with more conventional research wherein (1) a system is separated into progressively narrower subject areas and studied more or less independently, and (2) research results are then judged by standards within the academic discipline of the principal investigator, and not by their contribution to the whole.

Shaner et al. (1981) illustrate the contrast between the FSR&D approach versus conventional uni-disciplinary research projects. Examples of the latter type have been reported in which breeders have sought to obtain the highest physical yield for a single crop through variety and fertilizer trials. In contrast, and FSR&D approach considers more objectives and means of improvement. For example:

*An earlier maturing variety might be sought that allows time for planting a second crop, even though the yield from such a variety is less than others.

*Net profits from fertilizer application could be increased by reducing the rate of application relative to that which produces the maximum physical yield.

*Recognizing farmers' aversion to risk could suggest a second crop that is less profitable but whose yields are more stable during unfavorable growing conditions.

*Social and cultural studies could explain why some farmers accept improvements and others do not, so that the resulting technologies could find broader applicability than otherwise.

The FSR&D approach focuses on the interdependencies among the components under the farmer's managerial control and between these components and the environment. In the process, improved technologies, institutions, or policies are identified, generated, tested and implemented. As applied to Northeast agriculture, the FSR&D approach would include grass-roots attention to the problems and opportunities of farm operators and their marketing channels; research designed to unlock the secrets of overcoming these problems and capitalizing upon the opportunities; a flexible administrative system that encourages and rewards researchers for effective inter-disciplinary efforts; functional integration of research with extension and cooperating businessmen (both farmers and marketing entrepreneurs); and a comprehensive systems approach designed to analyze and monitor the causal forces determining the profitability, and important ecological and societal impacts of specific trends and features of regional agricultural development.

REFERENCES

Davulis, J. P., R. A. Andrews, and G. E. Frick. "Effect of Dairy Farm Size and Spatial Density on Regional Marketing Costs and Supply Firm Resource Use." New Hampshire Agricultural Experiment Station Research Report 36, May 1974.

French, B. C. and H. F. Carmen. "The Influence of the Product Marketing System on Farm Size," in Farm-Size Relationships with an Emphasis on California. California Agricultural Experiment Station, Giannini Foundation Project Report. December 1980.

Gilbert, E. H., D. W. Norman and F. E. Winch. Farming Systems Research: Improving Farming Systems in the Humid Tropics. Boulder, Colorado: Westview Press, 1979.

Rohrbach, David D. "A Discussion of Issues Relevant to the Development and Implementation of a Farming Systems Research Program." Washington, D.C.: Background paper prepared for USDA/OICD Conference on farming systems research, December 1980.

Seeley, Ralph M., III. "Resource Adjustments in Pennsylvania Agriculture in Relation to Structural Factors and Changes in Input Supplies." M.S. Thesis. The Pennsylvania State University, 1980.

Shaner, W. W., T. F. Philipps and W. R. Schmehl. Guidelines on Farming Systems Research and Development for Small Farmers in Developing Nations. Tucson, Arizona Consortium for International Development. Forthcoming, 1981.