AGRICULTURAL ECONOMICS

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Summary

Agricultural economics is the study of decision making, at the individual level, in the context of agricultural production, consumption and marketing of agricultural products and resource use within agriculture, and as affected by the existence of agriculture. The theory underlying agricultural economics and the methods used in empirical analysis of agricultural issues are similar to the theory and methods used in economics or industrial economics. The outcomes of decision making within agriculture are often of key importance to government and policy makers because of the magnitude of land use associated with agriculture, the political importance of food as a primary agricultural output in many countries of the world and the implications of agriculture for environmental quality and vice versa. The field of agricultural economics can be subdivided into four major areas of study – production economics, consumer theory and behavior, agricultural marketing and resource economics.

In **production economics**, a field of microeconomics, the theory of the firm is studied. In traditional production economics, firm level decision making, production, and risk are studied. A number of theoretical concepts are used to understand production economics including profit maximization, cost minimization, marginal cost, and marginal physical product. In recent decades production economics has examined competitiveness, efficiency, productivity and other related issues. More recently production economics has evaluated emerging issues such as the impact of agriculture/environmental interactions on the production of farm firms and regulatory reform such as government support programs. The overall objectives of production economics are to improve the optimal allocation of resources in the agricultural production process which in turn leads to increased wealth or individual welfare as well as improved policies directed towards the firm.

In much the same way that production economics deals with the study of decision making related to the allocation of scarce resources by firm managers, **consumer theory** relates to optimal decision making by individuals who are faced with allocating their scarce income across consumption and savings. Consumers choose bundles of goods and services that maximize their utility or satisfaction based on their own individual preferences. Consumer theory tries to capture this behavior in a systematic way that will allow analysis across groups of individuals and also provide the ability to forecast behavior for the future or in changed circumstances.

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The study of **agricultural marketing** focuses on the activities and institutions involved in transforming raw agricultural products that are produced on farms into the food and fiber products that are desired and purchased by end-consumers. Thus, agricultural marketing is concerned with the functions, the institutions, and the behavior of the individuals and institutions involved in locating, assembling, buying, selling and pricing, processing, transporting, storing and distributing food and fiber, through the marketing chain from the farm-gate level of production, to the end-consumers and users of the finished products that result from this process. Interest in agricultural marketing arises because farm products are produced by many different farmers, because their products vary due to regional variations in climate, soil, and geography, causing the adoption of different breeds of animals and different crop varieties, because primary agricultural production typically occurs at long distances from major markets, which serve urban consumers located in many different cities, and because of the special problems of quality and food safety that are associated with raw and perishable farm products. These characteristics lead many of the problems and issues for agricultural marketing to be different from those involved in the marketing of industrial products and consumer durables.

Resource economics is one of the major sub-disciplines within the economics of agriculture. Although resource economics had its historical roots in land economics, it has evolved since the 1960s to include major dimensions of environmental economics. The field of resource economics relating to the agricultural and rural sectors focuses predominantly on renewable (or flow) resources such as many features of land and water, rather than on non-renewable (or stock) resources such as minerals and fossil fuel energy. The field is noted for its applied nature, given its heavy empirical and policy emphasis. Three key areas of resource economics relating to agriculture will be highlighted: general resource conservation considerations, the economics of land use and conservation, and the economics of water.

1. Production Economics

Production economics is the study of decisions and decision-making related to optimal allocation of resources in the production of goods/services, given technology, resource constraints, and output demand. As such it arises from the section within the field of microeconomics that deals with the "theory of the firm".

1.1 The "Production Problem"

Production economics is concerned with decisions and outcomes for one or more "producers"; that is, individuals who are responsible for managing the production process within firms. An underlying assumption of production economics is that these producers have one or more objectives that they are trying to achieve. Typically it is assumed that producers behave so as to maximize profit or wealth.

The production problem is defined within the context of the assumed behavioral objective. In particular, producers choose optimal combinations of inputs and outputs in order to achieve objective(s). In making these decisions, the producer is constrained by a number of factors, including technology (i.e., the biophysical process of converting inputs into outputs), availability of fixed resources (e.g., capital, labor, etc.) and markets and market structure (i.e., reflected through output and input prices). Mathematically, the producer problem may be simply represented as follows (assuming profit maximization as the behavioral assumption):

$$Maximize: \pi = py - \sum_i w_i x_i - FC$$

Subject to: $x_1, x_2, ..., \frac{x_m}{x_F}$

where y is the level of output and xi is the level of the ith input chosen by the producer; p and wi are the output price and ith input price, respectively, FC is the cost associated with fixed resources (x_F) and f() is the technology represented by a production function.

1.2. Traditional Production Economics

Production economics has its roots in farm management and has its core in the study of firm-level decision making. Traditional analysis in production economics involved the use of farm management tools such as budgets. A budget is a summary of revenues and costs associated with a particular product or enterprise. Budgets may be constructed using historical information, in which case they are used to assess performance. Alternatively, they may be constructed using projected information when they are used for planning purposes. Also arising from farm management origins is the use of tools such as linear programming to identify optimal input and output levels.

Another aspect of production economics that has arisen from its roots in farm

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management is the study of risk and production; that is, the effect of uncertainty in one or more aspects of the production problem (e.g., uncertain prices or production) on production decision making or resulting performance. The analysis in this area includes examination of sources and magnitudes of risk and the consideration and measurement of risk attitudes for producers. This area of production economics also often involves the study of risk management strategies (e.g., diversification) and policies (e.g., production insurance).

Production economics can be extended to handle time and provide forward looking analysis of individual firm decisions. One approach, net present value, is the extension of budgets to multiple periods to estimate projected cash flows. The cash flows in the future are discounted to adjust for risk and time to provide estimates of the wealth impact of major firm decisions.

Production economics is also used to examine the behavior of firms in the aggregate. Based on the underlying profit maximization problem, output supply and input demand relationships (and associated properties) may be derived as functions of relevant prices (both output and input). These supply and demand functions are then sometimes estimated to represent aggregate firm behavior. Supply and demand functions are often used in policy analysis, with own-price and cross-price elasticities being calculated to measure responsiveness of producers to changes in prices.

The field of production economics also has an extensive history in examining changes in productivity of agricultural producers. Productivity is generally measured as the ratio of output(s) produced over input(s) used. Larger ratios represent greater productivity. Comparisons between firms at a point in time have traditionally been attributed to scale effects (i.e., impact of scale of production). Differing returns to scale, reflecting the proportional increase in output relative to the change in scale of input use, can contribute to inter-firm differences in productivity, although over the last few decades there has been a growing literature that examines the impact of efficiency differences in terms of contributing to productivity analysis (see below for further details).

If examined over time, productivity changes are often attributed to technical change (i.e., a change in technology leading to a shift in the production function). There has been extensive study of technical change by production economists, with emphasis being given to the impact on relative input use. If technical change results in relatively less (more) of one input being used relative to other productive inputs, the technical change is said to be biased away (towards) that particular input.

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1.3 Production Economics Concepts

Production economics, given the nature of the decision problem, is linked to the technical or biophysical processes that act to convert inputs into outputs. The mathematical representation of this technical process is called a production function, typically written as $y = f(x)$ where x is a vector of inputs in production of y and f() is the functional relationship between inputs and output. A variety of technical concepts or measures are often calculated or estimated by production economists because of the link between technical properties and economic decisions of production. These measures include Marginal Physical Product (MPP), elasticity of factor substitution, elasticity of scale, etc. Further discussion and explanation of these concepts and their calculation can be found in any microeconomics or production economics reference.

The mathematical representation of the producer problem (above) can be interpreted as being constrained optimization; that is, to maximize profit subject to a constraint on technology. Following the rules of mathematical optimization theory, the resulting conditions that must be satisfied in order to have a profit maximizing production play, or marginality conditions, may be expressed in one of two ways. From an input perspective, optimal input use occurs at the point where the extra value of production resulting from an extra unit of input use (i.e., Value Marginal Product or VMP) is just equal to the extra cost of that unit of input (i.e., Marginal Factor Cost or MFC). From an output perspective, optimal level of output production occurs at the point where the extra revenue generated by an extra unit of output (i.e., Marginal Revenue or MR) is just equal to the extra cost of producing that unit of output (i.e., Marginal Cost or MC).

Two short-run versions of this profit maximization problem can be generated, if it is assumed that either output level or input levels are assumed to be known and constant. In the former case (i.e., constant output), profit maximization simplifies to minimization of cost subject to the requirement of generating the given output level. In the case of known and fixed input levels, profit maximization simplifies to maximization of revenue subject to use of the given input levels. Corresponding marginality conditions may be derived for these short-run variants of the profit maximization problem.

1.4 Contemporary Production Economics and Economic Issues

Over the last couple of decades, agricultural production economics has found a role in examining a number of different types of problems or issues. These include a) the analysis of sector competitiveness through an examination of productive efficiency, b) regulatory reform and production, and c) environmental policy and agriculture. Each of these is briefly reviewed in turn in this section.

1.4.1 Efficiency and Competitiveness

With continuing efforts to reduce or remove barriers to interregional trade, there is an increasing interest in the competitiveness of production within various agricultural sectors. Policymakers are concerned with efforts to improve competitiveness through research, extension, education, etc. However, in order to design effective policy it is necessary to have insights into the likely benefits associated with alternative instruments. Often this is investigated through an examination of productivity changes and the factors contributing to those changes. For example, if larger firms are shown to be more productive, then competitiveness may be improved by encouraging growth in firm size within a sector. Alternatively, if better educated producers are more productive, then efforts may be best directed towards providing more education opportunities for producers.

Productivity analysis is one of the traditional areas of study within production economics, typically considered in terms of Total Factor Productivity (TFP).

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Traditionally, TFP has been examined over time to assess the impact of changing technology on the agricultural sector (i.e., technical change). However, TFP may be decomposed into three parts; scale effects, technical change and efficiency. Consideration of efficiency is a natural extension of TFP analysis, involving a cross-sectional examination of firms or sectors.

Efficiency may be considered in technical terms; that is, getting the most output from a given set of inputs or using the minimum amount of input required to achieve a certain level of output. This concept is referred to as technical efficiency. If economically optimal production levels (i.e., profit maximization or cost minimization) are incorporated into the analysis, then efficiency may also be considered in “allocative” terms; that is, the degree to which producers respond appropriately to market price signals. Combining technical and allocative efficiency results in economic (i.e., overall) efficiency. A variety of empirical tools are used in estimating or calculating the degree of efficiency for individual firms. These include econometric estimation of stochastic frontier functions, mathematical programming techniques such as data envelope analysis (DEA) or index numbers.

1.4.2 Regulatory Reform and Production

WTO negotiations and agreements have resulted in some countries reducing the degree of domestic support for agricultural sectors, thus providing less protection for producers from market risks. This extends beyond interregional trade to areas such as risk management. Such shifts in policy place increasing pressure on producers to take greater responsibility for ensuring competiveness and viability. This in turn has an impact on the decision making environment for producers (i.e., both in terms of the level and volatility of market prices).

Production economics contributes to the discussion of this issue through analysis of productive efficiency (outlined above) as well as risk analysis. The investigation of the impact of risk on production decisions typically begins with an adjustment in the assumed behavioral objective for agricultural producers; specifically, it is assumed that producers maximize Expected Utility (EU) of profit or wealth and that these producers tend to be risk averse. Expected utility theory forms the basis for much of the conceptual and empirical analysis of risk within agricultural production economics. Conceptually, the impact of risk and risk aversion on production decisions is that producers tend to be more conservative with optimal input and output levels being lower than would be the case with less (or no) risk. Typically, there is a consequential loss in productivity, thus reducing viability and competitiveness. An examination of alternative forms of risk management available to producers (e.g., diversification, hedging) is therefore often included in the economic analysis.

1.4.3 Agricultural/Environment Interaction

An emerging field of interest within production economics is the study of the interaction of agriculture and agricultural practices with environmental attributes (e.g., water, soil and air quality). As society places increasing importance on environmental quality, there is a need to examine the relationship between agricultural production and the

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environment. This relationship reflects a two-way interaction. Agricultural production practices have an impact, both good and bad, on environmental quality. For example, the adoption of zero tillage within crop production systems helps to maintain or improve soil quantity and quality. Conversely, extensive use of agricultural chemicals contributes to deteriorating water quality due to runoff. However, environmental "attributes" also have an effect on agricultural production potential. For example, the quantity and quality of water available affects the ability of agricultural producers to effectively and efficiently produce crops and livestock.

Policymakers are under increasing societal pressure to implement policy instruments designed to manage and enhance environmental quality. However, in order to do so it is necessary to have estimates of the costs and benefits for relevant stakeholders (including agricultural producers) of alternative policy options. Production economics has a role to play in this discussion by providing tools that can be used to estimate the private costs and benefits (i.e., those attributable directly to producers) associated with adoption of alternative production practices that will impact on environmental quality. These estimates may then be compared to societal values for environmental quality that arise out of environmental economics research. Within this area, production economists may use simulation techniques that integrate biophysical and economic relationships in order to estimate the costs and benefits from changing crop and/or livestock production practices in response to alternative policy instruments.

1.4.4 Quantitative Production Economics Tools

A variety of empirical tools are used by production economists, some of which have been mentioned in the above discussion. Extensive use is made of econometric estimation procedures, for example, in a variety of production economic applications. Statistical regression procedures are used to estimate production functions, output supply and input demand relationships, cost and profit functions, etc. More advanced econometric methods are used to estimate frontier production functions which are used in assessing technical, allocative and/or economic efficiency for individual firms, for example.

Mathematical programming (i.e., constrained optimization) has a rich history of usage in production economics. Simple linear programming models have been used extensively to investigate optimal producer behavior given technical and other types of constraints. Mathematical programming has been "extended" for use in analyzing risk (i.e., risk programming) through incorporation of non-linear considerations (e.g., utility functions, variance of returns). Mathematical programming has also been used to undertake TFP and efficiency assessments, through applications of Data Envelope Analysis (DEA).

Finally, **simulation methods and modeling** have been used to quantitatively model a variety of production economics scenarios. Simulation allows researchers to replicate the behavior of biophysical and economic systems that tend to be very complex and non-linear. Unlike mathematical programming, simulation techniques are not bound by formal structures but instead are flexible in terms of the types of relationships that may be incorporated in construction.

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2. Consumer Theory and Behavior

Consumer decision making is concerned with the decisions of individual consumers (in some cases assumed to be representative of the wider population). The outcome of consumer decisions is the quantity of goods and services consumed at given prices and income levels. In a conceptual sense consumers act to maximize utility (their satisfaction level) subject to a budget constraint. One complexity of consumer theory is that it implies that every individual's actual preferences for unlimited goods can be known. In fact that is an impossible task so theorists assumed only that consumers are able to rank their preferences (ordinal utility) or recognize that a particular bundle of goods and services is preferred to another bundle with different combinations of goods and services. Assuming that consumers are rational and that they can rank goods and services in order of preferences then the consumer choice problem can be expressed as:

Maximize $U = U(q_1, q_2, \ldots q_n)$

Subject to: $Y = p_1q_1 + p_2q_2 + p_3q_3 + \ldots p_nq_n$,

where U represents consumer utility, q1, q1…qn represent quantities of goods and services consumed, p1,p2 … pn represent prices of goods and services. In agricultural economics, this theory is used to explain consumer purchases of unprocessed and processed foods, fibers, renewable energy and other agricultural outputs.

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Bibliography

B. Weirenga, A. van Tilburg, K. Grunnert, J-B. Steenkamp, M. Wedel (Editors). *Agricultural Marketing and Consumer Behavior in a Changing World.* Kluwer Academic Publishers, Boston/London/Dordrecht. [Applies interdisciplinary concepts to modern marketing issues].

Beattie, B.R., and C.R. Taylor. 1985. *The Economics of Production.* John Wiley & Sons, Inc. New York, NY. [Good discussion of standard production economics at a senior undergraduate level]

Bromley D.W. 1991. *Environment and Economy.* Oxford, Basil Blackwell Ltd. [An excellent discussion of property rights regimes for natural resources].

Chambers, R.G. 1988, *Applied Production Analysis: A Dual Approach.* Cambridge University Press. Cambridge. [Graduate level discussion of production economics, taking a duality approach]

Ciriacy-Wantrup S.V. 1968. *Resource Conservation: Economics and Policies*, 3rd ed. Berkeley, CA: University of California Division of Agricultural Sciences. [Classic text in resource economics and resource conservation].

Coelli, T., D.S.P. Rao and G.E. Battese. 1998. An Introduction to Efficiency and Productivity Analysis. Kluwer Academic Publishers. Boston, MA. [Good discussion of productivity and efficiency analysis applied to production economics]

Hardaker, J.B., R.B.M. Huirne and J.R. Anderson. 2004. Coping with Risk in Agriculture. 2nd Edition. CAB International. Wallingford. [Theory and applications for risk analysis as applied to production decisions]

Hazell, P.B.R. and R.D. Norton. 1986. Mathematical Programming for Economic Analysis in Agriculture. New York: MacMillan. [Linear and non-linear programming methods applied to agricultural economics problems]

Henderson, James M. and Richard E. Quandt, 1980, Microeconomic Theory: A Mathematical Approach 3rd edition, McGraw –Hill Book Company, New York. [Classic introduction to basic microeconomic theory]

Hudson, D. 2007. Agricultural Markets and Prices. Blackwell Publishing. Malden, Oxford, Victoria. [Introduction to analysis of the behaviour of agricultural prices].

Intriligator, M.D. 1971. Mathematical Optimization and Economic Theory. Englewood Cliffs: Prentice-Hall, Inc. Chapter 5. [Classic text on optimization theory, at a senior undergraduate level]

Ivanic, Maros and Will E. Martin. 2008. Implications of Higher Global Food Prices for Poverty in Low-Income Countries, World Bank Policy Research Working Paper WPS 4594, accessed at http://econ.worldbank.org , 54 pages. [Excellent overview of determination of prices in food markets]

Kohls, R. and J. Uhl. 2002. Marketing of Agricultural Products. 9th edition. Prentice Hall, Upper Saddle River, NJ. [Classic introductory North American text on agricutural marketing]

Paris, Q. 1991. An Economic Interpretation of Linear Programming. Ames: Iowa State University Press. [Good introduction to linear programming, both concepts and applications]

Pearce, D.W. and J.J. Warford. 1993. World Without End: Economics, Environment, and Sustainable Development. New York, Oxford University Press. [Excellent discussion of the economic and environmental aspects of sustainable development]

Robison, L.J. and P.J. Barry. 1987. The Competitive Firm's Response to Risk. MacMillan Publishing Company. New York, NY. [Senior undergraduate text dealing with risk concepts related to production decisions]

Tietenberg T. 2006. Environmental and Natural Resource Economics, 7th ed. Boston, Pearson. [Excellent recent undergraduate text]

Tomek, W. and K. Robinson. 1999. Agricultural Product Prices. 3rd edition. Cornell University Press, Ithaca, NY. [Classic intermediate-level text on the behaviour and analysis of agricultural prices].

Veeman, M. 2001 "Understanding Local and Regional Markets for Forest Products." Chapter 3 in B.M. Campbell, and M.K. Luckert (eds.) Uncovering the Hidden Harvest: Valuation Methods for Forest and Woodland Resources. London: Earthscan. Pp 66-102. [(Explains concepts of markets and marketing for products of woodlands].

Veeman, M. 2002. "Marketing Boards: An International Overview." Article in Encyclopedia of Life Support Systems [EOLSS], theme section: Management of Agricultural, Forestry, Fisheries Enterprises. Oxford, UK, [http:www.eols.net]. [Focuses on the wide variety and changes in agricultural marketing boards in an international context].

Veeman T.S. 2008. Development, Productivity, and Sustaining Natural Capital. Canadian Journal of Agricultural Economics 56, 13-25. [Overview of concepts and policy dimensions of development,

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productivity and natural capital].

Veeman T.S. and J. Politylo. 2003. The role of institutions and policy in enhancing sustainable development and conserving natural capital. Environment, Development, and Sustainability 5, 317-332. [Focuses on property rights and pricing in conservation].

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Ellen W. Goddard holds her Ph.D. in Agricultural Economics from the La Trobe University, Melbourne, Australia. She holds an MSC degree (1979), and a Bachelor of Science (Agriculture) degree in Agricultural Economics from University of Guelph (1976).

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Michele M. Veeman holds her Ph.D. in Agricultural Economics from the University of California, Berkeley (1972), a Master Degree in Economics from the University of Adelaide, South Australia (1967), and a Bachelor degree in Agricultural Science from Massey University, New Zealand (1964).

She is Professor Emerita, Department of Rural Economy, University of Alberta, Edmonton Alberta, T6G 2H1, Canada. Veeman's research currently focuses on policy issues related to food quality and people's attitudes and perceptions of food risks as these relate to food quality.

Dr Michele Veeman is a Distinguished Scholar of the Western Association of Agricultural Economics (2007), a Fellow of the Canadian Agricultural Economics Society (1995) and an Honorary Life Member of the International Association of Agricultural Economists (2006).

Terrence S. Veeman has a PhD in Economics from the University of California, Berkeley (1975); completed the BA in Philosophy, Politics and Economics (1964) from the University of Oxford (where he was a Rhodes Scholar), and holds a Bachelor degree in Agricultural Science from the University of Saskatchewan (1962).

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Dr Terrence Veeman's main teaching areas included development and resource/environmental economics. His continuing research interests include agricultural and forest productivity, sustainable development, and renewable resource policy, especially for water. He has been actively involved in Canada's Sustainable Forestry Network, served as President of the Canadian Agricultural Economics Society in 1995-96 and was elected a CAES Fellow in 2003.

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