RURAL CHANGE

The Challenge for Agricultural Economists

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Micro-Level Accomplishments and Challenges for the Developed World

There has been a somewhat uniform trend among micro-oriented agricultural economists over recent decades. This trend has been in deep training and abilities in economic theory and related quantitative methods. The micro agricultural economic fields are supported by a strong body of economic theory and a rather wide range of advanced quantitative methods. It is now common to find a newly finished PhD in agricultural economics as well trained in these tools as is the general economist.

Going back a half century in world agricultural economics, however, this degree of homogeneity did not prevail so generally. Agricultural micro analysts came from a diverse set of backgrounds and training. Many originated as technical agriculturists and added an agricultural economics layer to become teachers and research workers in farm management, farm marketing or farm finance. Each was somewhat a specialist in the source of the data he analysed or the analytical approaches he used. Some built their analyses and communications around farmer-kept records. Others used farm surveys subjected to several forms of cross classifications relative to farm profits. A few were applying farm budgeting as a forerunner of mathematical programming. Rather than tabular cross classification of variables which might explain the magnitude of farm profits, a few statistically oriented persons were using multiple regression with some quite general models for similar purpose. Also a number were beginning to group around the central theory of production economics. Training thus extended over emphases ranging from accounting, descriptive, institutional and foundation economics. How one viewed the field largely depended on the data he used, where he worked and where he had graduate training. This diversity was expected in a field which was completing only two decades of existence. With no previous inventory of trained people, the profession had to draw people from related fields where they were available and where their interests or training encouraged them to pursue economic problems of farms, market firms and financial institutions. With so little previous research to draw on, it perhaps was best that the profession of the time was made up by persons with varied training, backgrounds and approaches in their

research and education but who knew agriculture well. A major accomplishment of these diverse micro economic analysts was an ability to bring economics problems of farming, marketing and financing into sufficient focus to attract financial resources and the attention of administrators, so that greater funds were available for developing the profession. Also their results were of sufficient relevance and use that farmers demanded them.

As mentioned previously, a relatively small number of institutions provided advanced graduate training in these early times and it was diverse and of varying content. In recent years, however, there has been a great convergence in the types of graduate training providing the core tools of agricultural economists, and particularly those with emphasis on micro economics. Possibly this training has become too homogeneous with respect to emphasis on neoclassical economic theory, mathematical economics and statistical and quantitative methods. While there still are ample grounds for philosophical debate, it sometimes appears that we are on the verge of producing a class of economist clones. However, this homogeneity of training need not be dangerous. What is important is that the array of theoretical and quantitative tools available be applied in the context of "here is a relevant real world problem, what is the most efficient tool for its solution", rather than ask "here is a shiny tool, where is a problem to which I can apply it". If the tools are used in the context of the former, analysis is likely to stay in touch with real world clientele and research will be conducted on its behalf with tools which are best adapted to it. If the latter approach dominates, analysts will insulate themselves from urgent problems and their solutions. To an extent, the somewhat tight orientation to illustration of tool application over recent decades has been in this direction.

In any case, a large and highly refined set of economic concepts and quantitative tools are available for analysis of the micro problems surrounding agriculture and its related sectors. No other field of agricultural economics has better backup in basic theory and quantitative method. These theories and quantitative methods have allowed analysts of the last three decades to make great progress in a more systematic collection and application of data for decision-making at the firm level. Too, these theories and methods have allowed them to process and apply much more data and larger data sets than did the tools of a half century back. Early micro analysts for agriculture made a quantitative quest for those factors which determine farm profits. Later analysts, using neoclassical firm theory, knew the conditions under which profits were maximized and ordered their search for data accordingly. Concepts of marginal and other cost functions led them to engineering syntheses and budgeting approaches which allowed estimation of cost functions relevant to decision making or knowledge of cost economies relating to firm size. Marginal concepts and their potential application in profit maximizing led agricultural economists to interdisciplinary studies with physical and biological scientists. A large range of crop and livestock production

functions have been estimated and used in extension recommendations to farmers, in classroom teaching and to further research designs. These trends have enough momentum that biological and physical scientists now can carry most response research by themselves.

Production economists and farm management specialists were quick to put computers, mathematical programming, simulation and related methods to use in analysing the potential structure of farms and in guiding farm decisions. Of course, much larger models and greater farm coverage were possible than with less formal budgeting techniques. Application of these approaches has progressed so rapidly that extension specialists now offer farm planning and analysis systems by means of programming models, computerized record systems, farm simulation models and programmable hand calculators. There has been a general growth in the demand for advanced systems information and in the ability of clientele to absorb it. This is not only true at the farmer level but also courses in linear programming and simulation models of farm and market firms are taught to undergraduates in most agricultural colleges of developed countries. The high level of education of farmers in developed countries will cause these trends and possibilities to continue.

Perhaps greatest advances in micro analysis and communication have been in a normative setting where certain assumptions prevail with respect to the objective function, the farmer's knowledge of production and price parameters, capital levels and tenure conditions. The optimizing tools such as conventional theory and mathematical programming have facilitated this progress. However, as is detailed later, important progress was made over recent decades in positive analyses and in predicting farmer response behaviour. True, these time series analyses have been aggregations of quantities for a nation, region or state. But the models which underlay them are based on postulates of firm behaviour. These positive analyses have been useful in policies and market outlook work in developed countries, but especially in proving farmer responses in developing countries to favourable commodity and input pricing policies.

Some progress was made on problems of decisions under conditions of risk and uncertainty, the real world environment of farm and market firm decision and management. The need for progress in this area has been emphasized continuously for three decades.[1] Some refinement of concepts and development of empirical procedures extended over this entire time span. Generally, problems of decisions under uncertainty were recognized but given limited space in books written on farm and market firm management. Only in the last decade have entire books been devoted to agricultural decisions under uncertainty. Hopefully this modification and extension of decision theory, and some parallel empirical applications by various persons, will gain greater momentum and have more resources devoted to it in the future. Our progress in this realm, especially in availability of useful risk management procedures for application in firm decision-making, has been too small in the last thirty years.

Farmers have indeed used decision procedures adapted to uncertainty. But they, rather than the professional agricultural economist, have constructed the models. One finds literature which micro analysts have written mainly for each other in illustration of decisions under risk, but one finds very little written or in a form to explain these procedures to farmers. Is this void due to a gap in communication between research and extension workers or to a still existing inability to communicate modern decision theory to farmers? If it is the latter, some reallocation of resources is justified – with a greater proportion going into translation of these procedures for farmers.

Agriculture in developed countries has gone through mammoth structural change since World War II. These structural changes have arisen because of the favourable real prices of capital relative to the price of labour and a flow of technologies giving rise to extended cost economies. Except where institutional conditions restrained them, these are resulting in a vast decline in the number of farms and people employed in agriculture. Some farm families decide to stay and enlarge operations; others seek employment elsewhere. Decisions on these changes are made in micro units. The extent to which they are aided by micro economists is unknown and varies among countries and states depending on the magnitude of public investment in agricultural economics research and extension. The emphases of agricultural micro analysts have probably been biased towards large farms and farm enlargement. Hence, more assistance has been given to those who stay and enlarge, than to those who give up and leave.

THE FUTURE

With large technical, financial and size changes still going on, we are challenged to determine who our relevant clients are, and the consequences of emphasizing different clients. By restricting ourselves to one set of clients, we are likely to work ourselves out of employment. The computerized record systems, on-line programming models to help select crop and livestock systems and similar services of extension education so far have been directed at the larger farm. What incentives can be developed to encourage similar efforts on behalf of small farmers, part-time farmers and beginning farmers?

With the larger-scale power and machinery units of high capital costs now available, a further leap in farm size, specialization and industrialization is in sight. Prospects are that while a ragtag collection of small and part-time farms may prevail in market economies, a small number of large industrial farms eventually will dominate the supply of food commodities in developed countries. These steps are nearly accomplished in Eastern Europe and are progressing rapidly in the West. What should be the micro analyst's role in this process? Should he help to hurry it – through the problems and clients he selects and the techniques he uses?

Agricultural economists in developed countries seem highly concerned about small farms and their progress in developing countries, but more oriented to work with big farms in their own countries. As stated previously, economic research, extension and teaching directed at farmers over recent decades generally have had the large commercial farm as their focus. Even the concepts and the tools encourage this emphasis. If one is to keep in style his research should be of an orientation entailing computerized models with some degree of mathematical sophistication and fair sized computer applications. Large farms provide these potentials better than do small farms. Also, the persons who can best use the results of sophisticated models are well educated farmers operating on a large scale with a continuous quest for knowledge to help optimize, satisfice, finance and expand their operations.

These farmers will have a growing demand for agricultural economists who can aid them in their quest. This opportunity and prospect excites many micro analysts because it calls for more complex models and computer applications. And while it is an intellectually exciting opportunity, it also has its pitfalls. Eventually, as farms grow large enough, there may be so few of them that public support of analysts to service them may decline. Under technology now available, the state of Iowa could be farmed by a tenth of its present or 13,000 large-scale operators. When this time arrives, as it eventually will, how many farm management specialists and production economists should the public supply to aid farmers' decision processes? Or should it supply any, letting these large business firms pay for management services from private consulting companies as is done by medium sized firms in other sectors of market economies?

An interrelated problem of size, client served and capital relates to long-run inflationary tendencies and related levels of land prices. Under the high prices for agricultural land which have arisen, investing in land for purposes of returns from farming *per se* gives an extremely low return. Investment is profitable only in terms of further inflation in land prices and prospective capital gains. Mainly it is the wealthy farm families which can pay these high land prices and buy for these purposes. Hence, with continued land price and general inflation, the financial sieve eventually retains only wealthy farmers to serve as clients of the farm management or production economics specialist.

Other questions arise in this complex: should micro analysts continue to focus their efforts on this sector of large farms and aid them in becoming larger? Or should they turn their efforts to effective means of restraining growth of large farms and stimulating small farms? The answers to these questions will vary by country and the values different societies attach to traditional farming versus industrialized agriculture. Legislation in Saskatchewan province of Canada emphasizes aid to the beginning small farmer.

In the same philosophical framework, we may ask: when the stage of development becomes so high that only a very small percentage of a

nation's population and work force remain in agriculture and farms become very large, will society abandon its long-held unique concern for traditional farmers? If so, does or should the public's role in supplying economists to analyse and solve problems of agriculture revolve more nearly around its own interests in reasonable and stable food supplies and prices, or in improving the efficiency of the marketing and processing sectors whose components dominate the price of food at retail? Is the function of the farm management, production economist and credit specialist then to serve the interest of farmers or consumers?

Some economists suggest that agriculture has lost its uniqueness as an industry and as an institution, and that policy for it now has drifted away from the traditional concern over farm prices and income. A large number of issues and factors are now focused on the farming sector and have interest in programmes and policies for it. Consumers are interested in the drugs and chemicals used by farms and their migration through the system as residuals in food. Environmentalists are concerned with the pollution impacts of pesticides, fertilizers, livestock production systems, cropping systems and other farm technologies which produce sediment. The energy intensiveness of developed agriculture will be of increasing concern in most countries, as will competition for water in some. As mentioned elsewhere, the structure of farms has importance to rural communities and the amount of nonfarm employment and income which is generated in them. Other issues relate to nutrition, tax equity and land use. This complex of concerns represents another reason why the focus of many micro analysts may need to shift from being mainly the servant of the farmer in aiding him to increase income and asset values, to analyses directed toward the external interests in farm technology as it relates to food contaminants, the environment, energy and water use, etc. For the latter focus, farm research will need to measure and emphasize alternatives to, and the real costs of, resource uses required or prohibited in meeting these external interests. These outward interests are important, and may become dominant, in societies where no more than 10 per cent of the population is in agriculture, as many developed countries are or will soon be. In the future perhaps micro analyses of farms should have major objectives of helping policy makers who must administer regulations and social goals in the use of agricultural resources. These programmes and decisions on them are implemented at the firm level of action.

Vertical integration of farm production and growing linkages of farm decisions and management to financial services and input suppliers has caused agricultural economists to coin new designations for agriculture and its related sectors. Some suggest that we should no longer look upon farming as a distinct industry but as part of a continuum making up the national food system, or as part of a continuum denoted as the agribusiness complex. If we consider these systems, rather than their components, to be the dominant concern of agricultural economists, then does the micro analysis concentrate on (for example) the integrating or central firm, with the farm component simply being a linkage to it? Instead of

building systems models of farms, should we build them of this larger complex with the farm as simply one "box" in the overall system?

EXTERNALITIES

Where farm decision results on technology and size give rise to negative externalities, it can be questioned if micro economic research is sufficiently complete in all cases if it is concluded at the boundaries of the farm or market firm. This negative spillover of farm adjustments and change is unique in some countries. It falls on people in rural areas who are especially disadvantaged in education, spatially separated from labour markets, females with meagre employment opportunities and others. As a minimum compensation, groups bearing the negative incidence of the technologies employed by and the large adjustments of farms are owed as much research and guidance as goes into research and extension education for the farms that erode their economic opportunities, institutions and environment. Hence, to each micro analysis with implied negative externalities there should be attached an analysis directed at restoration of the welfare of its victims.

ONGOING AND UPDATED MODELS

In earlier times each micro research project was a discrete activity. Data were gathered and analysed, and a manuscript was published. A completely new study then was initiated. Under current research technology, there is the tendency to develop models with continuous updating so that new data for a farm, or data of different farms, can be plugged into it to provide a stream of solutions or results over time. Once the setup costs of developing the model have been met, this can be an economical means of continuously supplying extension specialists, farmers and marketing or other firms with information for decisions. For models directed at repeated use to aid farmer decision making, the question can be asked: does the continued application of the model with additional data for other farms, or the same farm in another year, represent research? There now is a much greater need than in previous times for joint appointment of extension personnel to some research time. The research portion might be used for developing models, updating and extension of developed models, with the extension portion allocated to their continued application as aids in farm decisions. This total activity, which has started, has room for much greater development and application.

INTERDISCIPLINARY OPPORTUNITIES

In earlier times agricultural economists worked long and hard to enlist

physical scientists in co-operative research which would provide data of more appropriate form for decisions. This situation is changing rapidly and as often as not, the physical scientist now searches out the economist. The interest of highly commercial farms in economic outcomes and analyses had caused animal scientists, agronomists and others to attempt to understand and apply what they term systems analysis. To an extent, what these groups term systems analysis is more or less a synonym for economic analysis. They sometimes embrace orthodox marginal analysis or linear programming as readily as conventional systems simulations. Add these resources to the growing number and capabilities of farm production economists and further impetus is provided to highly capitalized and large farms which wish to accentuate these characteristics. However, it also provides a widening opportunity for co-operative activity between economists and technical scientists. This generation of technical scientists generally has studied economics and mathematics, at least at the undergraduate level. They have abilities to move ahead rapidly in team efforts. The complexity of agricultural systems and decisions in highly developed agricultures will need more of this interdisciplinary activity in the future. Economists can contribute to estimates of the payoff from developing different characteristics in animals and plants for different market and financial environments; physical scientists can identify the restraints and possibilities in these developments. Together, too, they need to design experiments and analyse them in a manner to reflect the risky responses of the real world.

Although there are some outstanding exceptions, economists dealing with micro problems of agriculture have insulated themselves from co-operative endeavours with other social scientists more than with other technical scientists. We need to assess the possibilities of greater aid from and interaction with other social scientists in tackling ongoing and upcoming facets of highly commercialized agricultures. Evidently the values and objective functions of these decision makers is changing rapidly. Today's able young managers have occupational goals greatly different from those of their grandfathers. Many prefer to compare their goals of income and living styles with those of a medium sized corporation president. Then there also are questions of the values of society towards farm structure. If, as some suppose, societies of developed countries are now interested in farms only as links in a food system, in contrast to a decade back when they paid heavy public subsidies to keep farms solvent for the sake of the farm family *per se*, the micro analyst is given a licence to work only with and to rapidly incorporate the most commercial of commercial farms, so that they more rapidly grow fewer in number and larger in size – as long as he cleans up the impacts on other social groups resulting from externalities created by adjustments to larger farms. This licence will not exist under other values relating to farms and their families.

While decisions under risk should draw more attention in the future, refinement and extension of the theory may require little participation of other social scientists. However, quantifying models in the real world

(e.g., in measuring utility and risk aversion and in establishing the components of multi-goal objective functions) and making them of actual widespread use stand to benefit greatly from participation by psychologists, sociologists and anthropologists.

FORWARD PROBLEMS

We need to look ahead to major problems which will emerge and have research answers forthcoming when they arrive. Much of the progress made by developed agricultures over the last fifty years has been linked to a growing use of cheap energy. During the next fifty years energy will play an equally important role, but more because of its relative scarcity and high price. Completely new technology sets and farming systems may be required. Biomass harvested for energy production could become important in the product mix of farms. For problems which are going to become so major as those revolving around future energy supplies and prices, research should run ten years ahead of the time these problems actually embrace farms. We need an increasing proportion of our research devoted to these problems of the longer-run future.

A large effort has gone into the quantification of the returns from public investment in agricultural research and education over the last two decades. It has been proven several times that "agricultural research does pay off" and that the "returns are quite high as compared to other investment alternatives". These findings have been replicated for numerous commodities in several developed countries; they have been repeated in several developing countries. From the results, it seems only that research administrators need go blindly forward and invest in research. Still, the "sorting out" has not been completed. Not all research in agriculture gives the same marginal return to investment, as past studies nearly imply. Given present states of technology, what should be the priorities for further investment? For which commodities and which technologies will the marginal return from research investment be high or low? It seems more challenging to answer these questions, and thus supply better guidance in allocation of research resources, than simply replicate more studies that show "in general, agricultural research pays a handsome return". Being close to agriculture, as many farm management and production economists are, they seem excellently experienced to provide this guidance. But can they do so any better than their physical and biological counterparts? It is a challenge for the future, both in avoidance of more duplicating studies and in guiding investment to those points where return is the greatest.

THEORY AND OPTIMIZATION

Some extreme propositions have been made about the theoretical

framework within which farmers operate and the implied utility of this theory. Schultz supposes farmers are active optimizers and refined marginal tuners in his statement:[2] "Farmers the world over, in dealing with costs, returns and risks, are calculating economic agents. Within their small, individual allocative domain, they are fine tuning entrepreneurs, tuning so subtly that many experts fail to see how efficient they are. . . ." Johnson supposes that optimization theory has to be highly qualified and may even have impaired the work of farm management workers in North America and Europe.[3] So, what theory should micro-level workers use in the future?

Concentration of graduate study in theory at most major training universities is in conventional static theory of the firm where it is supposed price and production function parameters are known with certainty, and production functions are continuous. While this optimization paraphernalia is considered to provide useful concepts and, where used appropriately, has been employed as useful background for quantitative analysis of agriculture, it also has been long known that real world decisions and adjustment to changing price, technical and other parameters is conditioned by risk aversion, utility maximization, adjustments in distributed lags, capital restraints, equity, multi-goal objective functions, firm-household interactions and related phenomena.

Perhaps conventional optimizing theory was used more widely in recent decades because theory related to time and stochastic phenomena was not yet sufficiently operational. A sizeable number of commodity supply or resource demand studies have been made and suggest with quantitative success how farmers do respond to changing technology and market values and which implicitly assume that farmers are profit motivated and adjust in the direction of increasing returns or lessening losses (even if they don't have in mind the first and second order conditions which define a maximum or minimum).[4] At somewhat early times, a number of studies incorporated distributed lags, lagged variables, interyear restraints on responses (flexibility restraints), and cautious optimizing, in recognition that farms do not make instantaneous, pure and complete shifts for each incremental change in price and technology parameters. In general, these studies provided quantitative verification that farmers both (a) respond to price and technological change in the general theoretical manner expected, but (b) these responses are restrained in the short run, with greater elasticity quantified for the long run. For some time it has been supposed that farmers may maximize things other than profit, such as utility. For more than a decade, quantitative work has been underway to relate utility to decision-making. Recent efforts include attempts to incorporate risk and risk aversion considerations directly into the estimation of supply response.[5]

A major complex of problems for developed countries in the decades ahead will be a better understanding of the process and goals of change in agriculture. Unless the world develops offsets to fluctuating weather, wide shifts in international grain trade and rapid inflation, farm decisions

will continue to be made under great uncertainty and high resource prices. While progress has not been as rapid as we might have wished, considerable progress was certainly made over the last two decades in quantifying this change as it is modified by alternative decision strategies for uncertainty, resource fixity, multi-goal objective functions, maximization of utility as related to level and variance of expected income, distributed lag and recursive types of responses and other constructs and phenomena which depart from the static theory of the firm. In some cases, such as *Agricultural Decision Analysis* and *Decisions Under Uncertainty*,[6] some large forward leaps have been made in theory and initial applications. We need more of these focused and concentrated efforts to modify theory, measurement and empirical method where they are too weak to explain farmer behaviour or to provide him guidance in a relevant real world decision framework. The present "assessment of the state of the arts" suggests that we have a considerable distance to go in (a) meaningfully measuring risk preference, utility curves, subjective probability distributions and related phenomena, and (b) using them either better to understand decision-making under uncertainty or applying them in manners useful to farmers in the actual decision-making process.

So while micro analysts are better supplied with theoretical tools and quantitative methods than other fields of agricultural economics, they are challenged to fill voids where they exist. To inventory the voids is a useful activity but at some point it becomes more urgent to develop or adapt the theory needed to fill them. Never has the profession been better manned to do so. It has a large number of extremely well trained young people who not only know the theory and can adapt it but also can apply it quantitatively. It is even possible that the firepower of these "soldiers" is entirely superior to the target which they need to attack. If so, the need is to get an appropriate number of them directed to developing and adapting the theory needed to fill the voids.

NOTES

[1] For example, see: Heady, Earl O. "Elementary Models in Farm Production Economics Research", *Journal of Farm Economics*, Vol. 31, pp. 201–25, 1948; and Johnson, G.L. et al. *Managerial Processes of Midwest Farmers*, Iowa State University Press, Ames 1961.

[2] Schultz, T.W. "Economics and Politics in Agriculture" in *Distortions of Agricultural Incentives*, Indiana University Press, Bloomington 1978, p. 4.

[3] Johnson, G.L. "A Critical Review of Selected Studies of Agrarian Change Done Prior to TACAC," *European Review of Agricultural Economics*, Vol. 3–213, p. 188, 1976.

[4] Examples include: Johnson, G.L. *Burley Tobacco Control Programs*, Kentucky Experiment Station Bulletin 580, 1952; Judge, G.G. *Econometric Relationships of The Demand and Supply Relationship for Eggs*, Connecticut Experiment Station Bulletin 307, 1954; Hildreth, C. and Jarrett, F.G. *A Statistical Study of Livestock Production and Marketing*, John Wiley and Sons, New York 1955; Mundlak, Y. and McCorkle, C.O. Statistical Analyses of Supply Response in Spring Potatoes *California Journal of Farm Economics*, Vol. 38, pp. 553–69, 1956; Grileches, Z. "The Demand for Fertilizer; An Economic Interpretation of Technical Change", *Journal of Farm Economics*, Vol. 41, pp. 591–606, 1958; Nerlove, M. *The Dynamics of Supply – Estimation of Farmers' Response to Price*,

John Hopkins Press, Baltimore 1953; Dean G.W. and Heady, E.O. "Changes in Supply Elasticity and Response for Hogs", *Journal of Farm Economics*, Vol. 40, pp. 845–60, 1953; Heady, E.O. et al. (ed.) *Agricultural Supply Functions*, Iowa State University Press, Ames 1961; and Heady, E.O. and Tweeten, L.G. *Resource Demand and The Structure of The Agricultural Industry*, Iowa State University Press, Ames 1963.

[5] Hazell, P.B.R., Norton, R.D., Malathi, P. and Pomeroda, Carlos *The Importance of Risk in Agricultural Planning Models*, World Bank Staff Working Paper No. 307, Washington, 1978; Boussard, J.M. "The Introduction of Risk into a Programming Model: Different Criteria and The Actual Behavior of Farmers", *European Economic Review*, Vol. 1, pp. 92–121, 1969; Just, R.E. "Investigation of Importance of Risk in Farmer's Decisions", *American Journal of Agricultural Economics*, Vol. 5, pp. 14–25, 1974; Len, W. "Measuring Aggregate Supply Response Under Instability", *American Journal of Agricultural Economics*, Vol. 59, pp. 903–7, 1977.

[6] Anderson, J.R., Dillon J.L. and Hardaker, B. *Agricultural Decision Analysis,* Iowa State University Press, Ames 1977; Halter, A.N. and Dean, G.W. *Decisions Under Uncertainty*, Southwestern Publishing Co., Cincinnati 1971.

DISCUSSION OPENING – ARNE LARSEN

A considerable part of Professor Heady's paper relates to the scope of work undertaken, or the scope of work which should be undertaken by the micro-level agricultural economists. Consequently it relates to the training of the agricultural economist. It underlines that the agricultural economist now generally is well trained in economic theory and in quantitative methods, and that the training gives a large homogeneity. There can hardly be any doubt that the training in economic theory has been very beneficial and has greatly enhanced the credibility of the agricultural economist. When it comes to the training in and application of quantitative methods there is probably reason for more scepticism. While quantitative methods are essential tools for the economist, has there not been a rather one-sided emphasis on these tools at the expense of training concerning the institutional and human framework within which the tools are used? Sometimes one even has the feeling that the emphasis on quantitative methods is a convenient escape from real life realities. Not least at the micro-level sophisticated quantitative methods have often failed because of the predominant importance of individual managerial skills in a family-farm dominated agriculture. While complicated quantitative tools may be important for gaining new knowledge, they still have to be reasonably understandable for the users in order to avoid a credibility gap. The question is whether there is a reasonable balance between emphasis on the tools used and knowledge of the changing society in which they are used.

A number of challenges for the future, as mentioned by Heady, is closely connected with the remarks made on the training of agricultural economists. Within the agricultural production sector further work on inflationary, interdisciplinary and uncertainty aspects is needed. The inflationary aspect does not only influence the farmer's investment decisions, but it also influences his decisions concerning output-mix, when for instance pensionable farmers hang on to the farm in order to reap additional capital gains. Surprisingly little research has been carried out

on the effect of capital gains and most farm level economic analyses are still carried out without consideration of the influence of expected capital gains. There also seems to be plenty of scope for interdisciplinary work with the technical disciplines. Particularly in establishing the framework for investment decisions the economist should take the lead in bringing together the involved disciplines. Concerning uncertainty aspects for the farmer, there is clearly a need for a systematic framework usable at the farm level.

In his paper, Heady returns several times to areas of work which have not traditionally involved the agricultural micro-level economist. While this is somewhat related to the shrinking number of farmers, it is also a response to public demand, on the one side, for larger considerations of environmental, food quality and other less tangible technical aspects, and, on the other side, for more consideration of the social problems appearing in the wake of continuous productivity increases and an ever increasing farm specialization and farm capital concentration. While these areas provide plenty of opportunities for agricultural economists, the question is whether we are prepared to take up the challenge. Agricultural economists and agricultural researchers in general are occasionally accused – and undoubtedly with some reason – of being too inbred with the farm – food sector. Such questions of credibility must not be allowed to arise when agricultural economists become heavily involved in research concerning agriculturally related areas.

As the general economic outlook for the coming years is probably not too bright for most of the world, the increasing demand for establishing stricter priorities for research investments is likely to be further underlined. Agricultural economists should help in establishing these priorities by estimating the likely returns in different research areas. The process of priority setting would also provide the researchers with an opportunity to explain the value of research to politicians and interest groups.

While further micro-level work on agricultural production aspects could give plenty of scope for discussion, I suggest that the discussion here might concentrate on whether the training of the agricultural economist is sufficiently wide in scope, particularly to cope with the challenge raised by "new agenda" problems.

GENERAL DISCUSSION – RAPPORTEUR: LARS BRINK

Several points were raised in the discussion. The possibility of using models of medium and large farms as components of a Leontief type model was indicated, but a concurrent concern about the usefulness of such an undertaking was voiced. Dr Heady stressed that he did not argue for the use of any particular model, but wanted to make the point that fewer agricultural economists may be needed if farms are fewer.

The priority to be put on work with small farms, as compared to large farms, was discussed. This priority would depend on the particular country in question. Farm size projections for the US Midwest made thirty

years ago have now become true. The question of whether agricultural economists should work with small or large farms could have been asked and discussed already at that time in the same vein as today.

The role of agricultural economists working in developing countries, but trained in developed countries, was discussed. Reference was made to Collinson's paper (page 43). The interface between agricultural economists with a macro perspective and those with a micro perspective, as well as farmers themselves, was seen as a possible problem (such as relating farm level decision making to demand and supply projections). Extension activities in some countries are dealing with this problem.

Participants in the dicussion included Edmund A. Nightingale, John R. Raeburn, Ramesh C. Agrawal and R. Thamarajakshi.