Why Economists and Scientists Find Cooperation Costly

J.D. Mullen*

1. Setting the Scene[1]

Recently the American Agricultural Economics Association commissioned a report with the title 'Why scientists should talk to economists: the role of economics in enhancing the value of publicly funded agricultural research'. When published in *Choices* for a wider audience the phrase 'and vice versa' was tastefully added to the title and the phrase after the colon deleted (Antle and Wagenet). The call for greater cooperation between economists and scientists, a subset of the more general call for multidisciplinary research and policy teams, has the status of a pious mantra - often repeated, rarely queried and always most pertinent to others.

These calls to cooperation sometimes have undesirable connotations.The potential contribution of economics, particularly with respect to being able to unambiguously rank alternatives without making undisclosed value judgements, is sometimes overstated and the cost of cooperation is almost always ignored[2].

In organisations like State Departments of Agriculture, cooperation between agricultural economists and agricultural scientists in jointly formulating policy positions and assessing the impact of technology, while routine, is still very often an occasion of frustration and conflict.

Conflict arises from the predilection of economists for market based solutions which in recent times has extended from traditional concerns such as statutory marketing to areas such as the provision of research and advisory services and solutions to externalities arising from agricultural technologies. Scientists doubt, in general, that economics is a rigorous science and, in particular, they doubt the ability of the market and more so, economists, to appropriately value the benefits and costs of basic research, non-market solutions and externalities of many forms. Scientists often resent the position of economists as unconstrained scrutineers of their research proposals and programs. From the viewpoint of economists, agricultural scientists often appear to have fundamentalist attitudes to agriculture and science and even to be advocates for the industry or research area in which they work. Particularly when engaged in policy work, scientists sometimes appear to disregard the techniques that they would normally apply in research to gather and critically appraise evidence supporting their positions.

This difficulty of cooperative work between agricultural scientists and economists is somewhat surprising given their common interest in agriculture and the common faculties from which they graduate, but particularly because both camps often claim that they adhere to scientific method.

One explanation for this difficulty may be that economists are different from non-economists in that they behave more in accord with the rational/self interest model. Some evidence supporting this view can be found in a paper by Carter and Irons[3] but the evidence is slim. Another explanation is that the methodologies of science and economics 'are autonomous with their own internal standards' (Hoover, p.715). The view taken here is that the differences between economists

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[1] In preparing this paper I have received many helpful comments from David Kemp, Don Vernon, David Godden and Scot Davenport but I doubt if they will take any responsibility for the paper's final form. Nor will NSW Agriculture.

[2] MacAulay has discussed some of the research management issues that act as disincentives to cooperative research in agricultural economics between institutions. No doubt some of these issues are important for multi-disciplinary cooperation as well. However the focus in this paper is more on fundamental differences between economics and science that impede cooperation.

[3] Those agricultural economists from UNE who observed rural scientists submitting themselves to 37 hours per week in the classroom against 13 in agricultural economics would not be at all surprised by this finding.

and scientists are less fundamental and consequently, by understanding these differences cooperative work may be facilitated.

The objective in this paper is to offer some explanations as to why this conflict and frustration might arise. The call for interdisciplinary work is as strong as ever. In areas where agricultural technologies result in environmental spillovers, it is difficult to conceive of much progress without interdisciplinary efforts. Yet there seems to be a lack of a common understanding about what is meant by sustainability and about the merits of alternative policy prescriptions to ameliorate externalities. Perhaps a greater understanding by economists of how scientists 'do' science and vice versa would lead to more productive cooperative work.

Two reasons why economists and scientists encounter difficulties in cooperative work are:

- Economists routinely operate in an environment requiring tradeoffs to be made between multiple objectives whereas for agricultural scientists the choice environment is much more limited with the focus being on agricultural productivity subject perhaps to environmental or quality constraints;

- Agricultural scientists still find the techniques of logical positivism powerful for their purposes whereas economists have had to supplement these techniques with the tools of literary criticism and rhetoric.

These two issues are explored in more detail below. Following that, one issue, the role of government in the provision of research and advisory services, has been explored to demonstrate how a gradual evolution in the perceptions of economists about this role has resulted in a divergence of views from those held by the science community.

2. The Different Choice Environments in Economics and Science

As already noted, agricultural science now operates in an environment that has far broader concerns than the enhancement of productivity[4]. The dimensions of this environment and the possible contribution by economists has recently been described by Thompson in the following terms:

> Over the next 30 years, global demand for food is expected to double due to population and income growth. The world's farmers will be challenged to satisfy this demand without damaging the environment. At the same time, consumers are demanding more safety and nutrition in the food supply. Agricultural markets are becoming more global, and many previously centrally-planned economies are adopting market systems. Technology is changing rapidly and the size of farms and agribusinesses is growing. The input of agricultural economists to help private and public decision makers understand the trade-offs implicit in these changes is desperately needed.

Economists employ a benefit/cost framework to allow some assessment to be made of these trade-offs. Usually not all, and sometimes not many, benefits and costs can be explicitly valued using market prices. Because of this scientists often appear to be reluctant to use this framework.

It is not clear how scientists make these trade-offs. Whenever some policies are preferred to others or some research projects are funded ahead of others, an implicit benefit/cost judgement is being made. Economists would argue that these judgements be made within an explicit benefit/cost framework despite the subjective way in which some benefits and costs are valued. Within this framework the significance of these more subjective valuations can be assessed and more importantly, the opportunity cost of alternatives is made explicit.

David Godden (*pers. comm.*) has suggested to me that this environment of choice in which economists operate is a more fundamental difference from science than I have suggested to date. It is not so much that science has ignored these other issues in the past because the weights attached to them by society in making tradeoffs have been lower than now. Rather he suggests that science operates in a far more determinist environment where choice does not arise or at least is highly circumscribed. The concept of choosing different levels of productivity growth and environmental degradation as society alters the relative values it places on these two outcomes is foreign to science in which the environmental outcome is either given zero value or infinite value.

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4 Technical efficiency might be a more exact term than productivity.

Perhaps this different attitude to choice explains why scientists become more specialised during their professional careers seeking an ever more detailed explanation of plant leaf growth for example, while economists often seem to develop expertise in a range of areas. Perhaps the difficulty of transferring such specialised human capital is why scientists are threatened by program reviews whereas economists are more amenable to sudden changes in direction.

Less fundamentally, the charge of operating within too narrow a choice environment is also levelled against economists by policy makers when they fail to consider the political impact of their proposals. I am not going to discuss this area of conflict here except to note that it leads into public choice theory and that my interpretation of the confusing charge that economists are rationalists is that we are seen as being concerned with total efficiency gains without acknowledging that the dollars of those who gain and those who lose sometimes have different weights attached to them by politicians if not by society.

3. Differences in Methodology

As already noted, one reason why conflict between scientists and economists is to some degree, unexpected, is that economists have often claimed to follow scientific method. Agricultural science has traditionally used a methodology[5] based on logical positivism. In this it is similar to other branches of science. Johnson (1986) argued that, at least in America, agricultural economics developed in the agricultural schools of land grant universities and, at least initially, applied the same positivistic approach to its research.

Positivism was developed in the biological and physical sciences and was based on the view that value free knowledge can only be obtained from observation or experience by the senses. Logical positivism used logic to develop theory from past observation. Popper proposed that the essence of good science was the formulation of hypotheses that can potentially be refuted. Hence the cycle in this methodology, to which agricultural science was well suited, was the formulation of testable hypotheses from existing theory and then the use of controlled experimentation in an attempt to falsify these hypotheses. If the hypotheses were falsified then theory was adjusted in a logical manner to account for this knowledge and new testable hypotheses were formulated and tested.

Logical positivism has had its adherents in economics. Johnson (1986) listed economists and organisations such as, J.N Keynes, Robbins, Friedman, Leontieff, T.W. Schultz and the National Bureau of Economic Research. In using data to test economic theory, econometrics has had a strong logical positivistic stance.

The hope for logical positivism was that it would demark the boundaries between science and non-science or, to use Randall's terminology, that it would serve as a demarcationist prescriptive methodology (DPM). Randall noted the following three problems which in his view, make it unlikely that a DPM will emerge:

- It is not possible to unambiguously test an hypothesis because it is usually supported by a number of untested maintained hypotheses - the Duhem-Quine thesis;
- 'Falsification tells us what not to believe, but it does not tell us what to believe, even tentatively' (Randall, p.51);
- Competing theories are difficult to compare because they use different types of evidence.

The first of these has been a particular problem for economics. Assumptions made by economists in generating testable hypotheses include:

- people seek more wealth;
- law of diminishing returns[6];
- producers are profit maximisers or at least cost minimisers;

[5] Methodology is 'a study of the relationship between theoretical concepts and warranted conclusions about the real world; in particular, methodology is that branch of economics where we examine the ways in which economists justify their theories and the reason they offer for preferring one theory over another' (Blaug, 1992, p.xii).

[6] This law says that the increments to crop output from increments in fertiliser become smaller holding other inputs in the production process at a constant level.

- consumers and producers do not suffer from money illusion[7];
- markets are competitive.

While these assumptions range from being unexceptional at the top to the list to being doubtful for many markets at the bottom of the list, they are all tendencies rather than laws and do not hold universally. In empirical work we often make further strong assumptions about the shape of demand and supply curves and the extent of substitution possible in consumption and production. In economics, 'experiments' to falsify these basic laws, or hypotheses deduced from them, maintain other hypotheses so that it is unclear whether a rejection is a rejection of the hypothesis being tested or of one of the supporting maintained hypotheses. Recent years have seen the development of experimental economics to test some of these postulates (Smith).

Clearly economics doesn't meet the exacting standards of logical positivism. Friedman attempted to overcome these difficulties by asserting that the objective of science is prediction rather than explanation and hence that whenever a theory is providing good predictions, whether the assumptions underlying the theory are 'realistic' is irrelevant - 'a theory cannot be tested by comparing its "assumptions" directly with "reality" (p.41)..

Few economists follow this methodology. Perhaps time series modellers, with their emphasis on letting the data 'speak' and their disdain for structural models, come closest to practising this approach. Again the predictions of widely accepted theories have not always been accurate and yet the theories have not been abandoned. Not only is it important to most economists to be able to explain movements in economic variables but even if the emphasis is on prediction, it is helpful if the theory's assumptions are realistic. To quote Hausman (p.121) '..there is no good way to know what to try when a prediction fails or whether to employ a theory in a new application without judging one's assumptions. Without assessments of realism (approximate truth) of assumptions, the process of theory modification would be hopelessly inefficient and the application of theories to new circumstances nothing but arbitrary guesswork'. Often economists work in situations where it is impossible or impractical to measure the accuracy of forecasts and hence rely on the realism of their assumptions and the logical consistency of their models to engender confidence in their untested predictions.

The inability to apply logical positivism or identify an alternative DPM, has meant that economists have become quite eclectic in their choice of methodology. Hausman argued that while the philosophy of science makes a valuable contribution to judging the methodology of economics, it does not provide a recipe. There is no one standard for assessing economics. Hence how economic methodology is assessed depends in part on the context of the study being undertaken. Hausman (p.122) concluded that 'Although there is still a great deal to learn from the judicious study of contemporary philosophy of science, those interested in economic methodology must use their own judgement and their knowledge of the practice of economists to formulate and to defend rational standards for the practice of economics'. As a consequence economists have used a range of approaches in addition to positivism including deductive[8] approaches and literary criticism[9] and rhetoric[10].

The deductive approach is closely identified with John Stuart Mill and Hausman suggested that it is still used by many economists. In this approach some basic laws or tendencies such as those towards the top of the list above are derived or induced from observation. From this set of assumptions economists deduce implications which sometimes may be subject to empirical verification. These implications are the bases of analyses of policy or technology. While this process of empirical verification is important in providing some evidence for implications drawn and in defining the conditions under which the implications may hold and identifying other causal factors, the underlying set of assumptions or laws are not themselves subject to verification. The process of drawing implications and verifying these implications is conducted subject to a set of maintained hypotheses. Often the cost of empirical verification is high and economists rely on the

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[7] If prices are all doubled, relative quantities consumed are unchanged.

[8] Deduction is a form of inference in which, granted the truth of the premises, the conclusion must be true. Induction involves asserting or establishing (a proposition about a class of phenomena) on the basis of observations on a number of particular facts (Macquarie Dictionary).

[9] The act or art of analysing and judging the quality of a literary or artistic work (Macquarie).

[10] The art of influencing the thought of one's hearers (Macquarie).

persuasive way in which deductions are made as a measure of the quality of economic analysis. Hausman concluded that the deductivist approach is what is used by most economists.

Gerrard .pointed out that there is a parallel debate in econometrics between positivism and deductivism. He argued that the approach of most econometric textbooks is deductivist. Economic theory is presumed to give clear guidance about the specification of the model. This approach 'immunises economic theory from empirical criticism by interpreting anomalous evidence as an estimation problem, not as a potential falsification of the model specified by economic theory' (p.230). The atheoretical time series approach is also classified as deductivist because while it intensively analyses the properties of the data, structural parameters implied by economic theory are never estimated. The econometric approach most closely allied with positivism is the London School of Economics or Hendry's general-to-specific approach. In this approach theory suggests a long run relationship but the exact structure of this relationship is determined from the data using extensive diagnostic testing.

In response to the lack of one scientific standard and in particular, to the failure of positivism, McCloskey has suggested that the work of economists can best be understood by using the tools of literary criticism and rhetoric, the art of argument. Good economics is economics that is persuasive to economists. However as Randall (p.49) pointed out ' A common reaction among practitioners is that it is one thing to recognise the problems with the prescriptive standards that emerge from positivism and scientific objectivity, but quite another to embrace a methodology that seems to impose no standards at all'.

Rosenberg's views are succinctly captured in the title of one of his papers - 'Economics is too important to be left to the rhetoricians' (Rosenberg, 1988). In a more recent paper, Rosenberg (1993, p.15) argued that 'Unless economics recognises an external, independent standard of knowledge beyond persuasiveness to economists, it will have no more claim on the attention of those entrusted with the choice of policies - public or private - than does astrology'. He went on to quote at length Leontief's criticism that 'economics seeming indifference to its predictive weakness....threatens to deprive the discipline of any claim to be an empirical science'(1993, p.15). Like Leontieff he argued that agricultural economics escapes to some degree the criticisms levelled at economics because many of the assumptions of economics are closer to reality in the agricultural sector.

Randall proposed what he termed reasoned discourse which integrates rhetoric and critical rationalism with a body of useful precepts generated during the search for a DPM. Randall envisaged local provisional methodologies (LPMs), in areas such as econometrics and contingent valuation of nonmarket goods. These local methodologies use all the tools of reasoned discourse to develop guides to good practice. To be influential these local methodologies 'must be permeable to stimuli from the larger scholarly community' (p.58).

Randall concluded that 'there is little reason to lament the demise of the DPM. The failure of demarcationist methodology to establish a sharp boundary between science and non-science tends to unify scholarship by bringing science into the fold. This is a blessing for agricultural economics which was always an uncomfortable fit in the science box' (p.58). Randall has provided many useful insights into the research process but I am not sure that Hausman would change his view that most economists still rely heavily on Mill's deductive approach.

Because of this lack of one standard as to what constitutes good economics research, considerable resources are devoted to discussing what constitutes acceptable methodology for economics. This eclectic approach to methodology in economics has led to an extensive literature in the area.

A quick survey of the Journal of Economic Literature over the last five years revealed that there are at least four journal articles each issue listed under the research methodology classification. Research methodology is a compulsory unit in graduate programs in economics and often in undergraduate programs. This literature is not the preserve of methodologists or philosophers of science but is important to 'practical' economists as they justify their findings about economic behaviour and proffer policy advice. Paraphrasing Keynes, Hoover (p.733) concluded that 'Practical economists, who believe themselves to be quite exempt from any methodological influences, are usually slaves of some defunct methodologist'.

While logical positivism, at least at a philosophical level, has failed science too as a DPM, it seems to me that much of the research in developing agricultural technologies has fallen within what Kuhn refers to as a paradigm where the logical positivist approach still

has strong appeal. Hence it seems to me that agricultural scientists have been far less introspective about methodology than economists. As evidence of this, the Agricola database listed only four articles in total under a research methodology classification back to 1990 and some of these appeared to be more of a prescriptive nature than a reflection on what constitutes good science. It is perhaps tempting to build a straw man here. However Laudan (as quoted by Yeager) calls it 'an enormous mistake ..... to imagine that scientific progress and rationality consist entirely in solving empirical problems'. Grappling with conceptual problems 'has been at least as important in the development of science as empirical problem solving'.

A number of consequences are likely to flow from this reliance on positivistic methods by scientists. First, it might explain why scientists question the rigour of the eclectic approaches of economists and more fundamentally, the value judgements embodied in the assumptions behind economic models. This perception of lack of rigour is exacerbated when economists make inappropriate assumptions about biological systems. Second, a reliance on positivistic approaches is likely to be inadequate when dealing with policy issues or even research evaluation issues where tradeoffs are required between multiple objectives. A similar issue arises in a research setting where, for example, tradeoffs are required between productivity and quality. As noted by Randall (p.48) the perception of economists is that scientists when faced with this complex choice environment, sometimes abandon 'scientific objectivity' and turn to fundamentalist views of science and agriculture 'in the service of mankind'.

From another angle, the problem could be described as a situation in which economics and science have developed a number of independent LPMs which causes an immediate problem of communication. Perhaps more fundamentally, the problem of noncomparability identified by Randall emerges in that what passes for evidence in these LPMs differs between them.

If groups of scientists and economists wish to be persuasive or successful in attracting community and industry support for research in an area such as sustainability, they are going to have to develop a LPM, to use Randall's terminology, comprising a range of skills in experimentation, logic and rhetoric.

4. The Role of Government in the Provision of Research and Advisory Services to Agriculture

One area that is currently a source of disagreement between scientists and economists concerns the role of government in providing research and advisory services to agriculture. This is an interesting example to examine more closely because it is only in the last ten years that a significant divergence in views has occurred. While economists have always questioned the practice of providing individual advice to farmers, there seems to have been general acceptance that the public sector both funded and provided the great majority of research and advisory services. This uncritical view of the role of the public sector was based on the assumption that rural research had the characteristics of a public good[11] to such an extent that the market would fail to supply the flow of this service demanded by the community.

Mullen *et al.* have noted that real expenditure (constant $1953) on production research in Australian agriculture increased fourfold from $9m in 1953 to $40m in 1994. It grew strongly until about 1970 but since then the rate of growth of expenditure has been slow. This growth was much faster than the growth in total government expenditure over that period.

In reviewing science policy over this time they found little criticism by economists of this predominant government role. The IAC Inquiry in 1976 recommended little fundamental change in rural research. Harris and Lloyd accepted the view that there had been underinvestment in rural research in Australia, a view later challenged by Mullen and Cox (1995), but did not critically examine the predominant role of government.

In the last fifteen years the role of the public sector in all areas of the economy including rural research has been subject to much greater scrutiny. All major in-

[11] Public goods have two important characteristics. First it is difficult for those who fund the provision of the service to exclude free riders - those who do not pay - from using the service. Second the consumption or use of the service by one person does not reduce its availability to others. It is non-rival in consumption. RDCs are one way to ameliorate both these aspects of 'publicness'.

stitutions providing rural research services have been subject to at least one review. However there has not been a common conceptual framework for these reviews. Initially this scrutiny seems to have been driven by budgetary pressures in the public sector caused by a public preference for a lower tax, smaller government environment. The response to pressure of this nature has been to introduce more stringent accountability procedures and to raise revenue from the rural sector through strengthening the Research and Development Corporation mechanism, fees for service, and the imposition of external funding targets on organisations such as CSIRO. In some States, such as South Australia, the identification of potentially profitable investment opportunities has seen expenditure by the corporatised South Australian Research and Development Institute increase strongly since 1990. An outcome of this type of response has been that the share of rural research that ABS categorises as being of a basic or strategic nature has fallen from more than 20 to fifteen percent over the last twenty years (Mullen *et al.*).

In some reviews, notably that conducted by ACIL of the NSW Department of Agriculture, and in the 1995 Industry Commission Inquiry into Research and Development, there has been a more fundamental scrutiny of the public good nature of rural research. The recommendations of these Reviews focus on:

- refining mechanisms whereby the public good characteristics of applied research can be ameliorated providing greater incentives for research to be funded by rural industries themselves through RDCs for example;

- the need for public institutions to move back towards basic research which is likely to have larger spillovers to the rest of the community;

- increasing the level of competition in the research industry by requiring public institutions to cost research funding submissions in a competitively neutral way and to more clearly separate the functions of funding and undertaking research services. The implications of Hilmer competition policy are similar.

Alston *et al.* (forthcoming) note that in countries such as the Netherlands, America, New Zealand and the United Kingdom, this more limited view of the extent of market failure in rural research has had some impact on science policy. In these countries there has been an increase in basic research conducted by public institutions and in the latter three, independent research institutes have been established which compete for both public and private funding.

In Australia this reassessment by economists of the role of public institutions in rural research has in general not been accepted by agricultural scientists and producer organisations as evidenced by submissions to the IC in response to its draft report. Nor has it had much impact on science policy although there is some evidence that this narrower view of the role of the public sector may become influential in guiding how public institutions respond to reduced public funding in the future. The Director-General of NSW Agriculture, Dr K. Sheridan noted that 'More and more the role of government is to provide those services where there is market failure or where the private sector is unable or unwilling to meet the need'.

One question that arises is what process or methodology have economists used to arrive at this view of the extent of market failure and the role of the public sector in rural research which is much narrower than the view they previously held and which puts them in conflict with many policy advisers with a science background. Clearly the reassessment has not resulted from empirical analyses of issues such as the cost of 'crowding out', demand and supply conditions for research services and the extent to which there are community spillovers from agricultural research.

Rather this reassessment has resulted from a process of 'reasoned discourse'. This discourse has taken place within the community of economists particularly interested in the role of government not just in the agricultural sector but in the economy as a whole. This discourse community has responded to external influences such as community desires for lower taxation driven perhaps by perceptions of government failure. In areas such as banking, telecommunications, and transport, it has been able to persuade large sections of the community that government should withdraw from these areas in favour of the private sector. In most of these sectors, there was already a strong private component and their products had fewer public good characteristics. To say that society is better off as a result of this withdrawal of the public sector involves a value judgement as some redistribution of income has occurred in all cases.

As already noted, economists in Australia have had less success in persuading the science community that

government should change the nature of its involvement in providing research services particularly to the agricultural sector. A number of factors contribute to this. First, research and advisory services have the characteristics of public goods to a greater extent than the products of say the banking and transport sectors. Second some have difficulty seeing that benefits to industry are not necessarily benefits to the community. Perhaps this stems from this fundamentalist view of science and agriculture referred to above. Perhaps there is a language problem in that terms like public good and spillovers are not well understood by the science community. Third, we are not dealing with pure public and pure private goods. The product of any research program, however applied, is likely to have the characteristics of public goods to some extent. Hence the boundary between what is appropriate for the public sector and what is appropriate for the private sector is always going to be arbitrary.

A final issue is that the private sector undertakes only about ten percent of all rural research in Australia. The Industry Commission pointed to the difficulty of ensuring that producers fully reveal their willingness to pay for research through broad industry bodies such as RDCs and this would appear to be a particular problem in a transition period[12]. Hence it is difficult for the science community to conceive of a major change in the present research environment that would not endanger capital embodied in research scientists and institutions.

To be persuasive, economists need to directly confront some of these issues. In particular economists need to work with the science community to devise a transition strategy to a more competitive research environment that would minimise unnecessary adjustment costs in the form of a loss of human and institutional capital. Returning to Randall's terminology, scientists and economists, with an eye to community views, need to engage in reasoned discourse to develop a LPM that would be useful in identifying compelling arguments about the roles of the private and public sectors in rural research, about financing mechanisms, and about the level of public and private investments. The incentive for this to happen may be that in the face of continuing budget pressure, a gradual realignment of the activities of public research institutions more in line with broader community interests may be more successful in maintaining funding and preserving human capital than traditional defences of the profitability of these investments and the political power of the rural sector.

6. Conclusions

Agricultural economists and scientists are often advised to work closely together and who could argue against this. However in practice cooperative work is often a frustrating and expensive process. I have suggested two main reasons for these difficulties. First, the different choice environments in which economics and science work and second, the different methodological approaches taken. These two issues seem to be related. Logical positivism, the methodology that still forms the basis of much rural research, is a powerful methodology in a limited choice environment.

There is no easy prescription to reduce conflict between science and economics. However as the demands placed on agriculture extend beyond being an efficient user of resources in the production of undifferentiated products to concerns about quality, food safety and sustainability issues, scientists and economists need to cooperate in developing arguments based on empirical research, literary criticism and rhetoric if they are to persuade rural industry and the community in general that they have adequately considered the opportunity cost of their research programs and hence deserve continuing support.

[12] In fact they argued that because the activities of RDCs were never likely to be coincident with their own priorities, producers were never likely to fully reveal their willingness to pay for research services.

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