Chapter 6

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Much of the success of American agriculture is attributable to the creation of its agricultural research and extension system (Ruttan, 1982; Cochrane, 1958). For well over a century, the public has invested substantial sums of money (currently about $3 billion annually) in agricultural research and extension at Federal and State levels. This investment has been no accident. Several important events have helped make the agricultural research and extension system an integral and longstanding part of U.S. agricultural policy—the first Federal appropriations to agricultural research in 1856, the establishment of the land grant university system in 1862, and the creation of the Federal-State-local extension partnership in 1914 (Knutson, et al., 1983).

The agricultural research and extension system continues to be an important contributor to a plentiful and low-cost food and fiber supply, as well as to the positive U.S. balance of agricultural trade. For the period 1945-79, technological innovations brought about by the system increased agricultural output 85 percent, with no change in the level of agricultural inputs (USDA, 1980).

Agriculture's entrance into the era of biotechnology and information technology raises several questions about the impact of technical advances on the performance of the research and extension system and about how that performance will ultimately affect the structure of agriculture. For example:

- Who gains and who loses from the process of technological change in agriculture?
- Is agricultural research and extension structurally neutral or does it favor the growth of large industrialized farms?
- What are the roles of the various components of the agricultural research and extension system as they relate to technological change in the biotechnology and information technology era?
- what are the implications of increased private sector involvement in agricultural research?
- what are the implications of patents being conferred on biotechnology and information technology discoveries for the social contract under which the agricultural research system was created?
- How is a proper balance to be struck between public and private sector components of the agricultural research and extension system?

These are the major issues that will be addressed in this chapter, The answers are based on previous OTA studies, on an extensive body of literature regarding the impact of technology on agriculture, and on papers commissioned by OTA regarding the status of the agricultural research and extension system as it relates to developments in biotechnology and information technology.

[1]Agricultural research and extension policy issues were identified and analyzed in papers prepared by the OTA research and extension policy workgroup. Authors of the papers were Ronald Knutson, Roy Lovvorn, George Hyatt, and Fred White. This chapter is based on an integration prepared by Ronald Knutson, of the workgroup's findings.

WHO PROFITS FROM TECHNOLOGY CHANGE

The point that technology is one of the driving forces behind structural change in agriculture has perhaps been most clearly argued by Willard Cochrane *(1983)*, who notes that the first adopters of new technology are also the immediate beneficiaries in that their costs per unit of production are lowered and their profits are thus increased. The profits of those firms supplying the products of new technology also increase. In addition, higher profits for the farmers encourage the adopting farmers to expand output—even to the extent of increasing the scale of their farm operation. However, as output expands, prices decline; later technology adopters thus realize less profit. Those farmers who are the last to adopt new technologies may actually be forced either to adopt or to get out of agriculture.

Three important lessons arise from this description of the process of technological change:

- Those farmers who are most aggressive in effectively adopting and applying new technologies are the most likely to survive. Their size or scale of operation thereby influences the structure of agriculture. Likewise, structure is affected to the extent that research discoveries or extension programs favor farm operations of a certain scale. The significance of technology's role in fostering structural change makes it an important factor to consider when designing research and extension programs.
- Research and extension are vital to maintaining the competitiveness and comparative advantage of U.S. agriculture in international trade. Competition in export markets is becoming increasingly keen as countries strive to expand output and export to earn foreign exchange. Throughout the 1970s, exports were the driving force behind farm prices and incomes. A return to agricultural prosperity awaits a resurgence of exports. Growth in export markets cannot be maintained without the benefits of continuous adoption of cost-reducing technologies.
- The ultimate beneficiary of agricultural research and extension is the consumer—domestic and foreign. Larger supplies, lower food prices, and better quality have almost invariably been the main results of agricultural research. This does not mean that research operates contrary to the interest of all farmers; rather, research directly benefits the more progressive farmers. Research is also critical for expanding markets for farm products and for overcoming the constant threat of disease and other vagaries of nature.

The result of these gains and losses has been a handsome rate of return from public investment in agriculture. Rates of return on public investment in agricultural research typically fall in the 30 to 60 percent range (Ruttan, 1982). Rates of return for extension have been estimated to run even higher—particularly in the case of specific extension activities (White, 1984). The high rate of return indicates that agricultural research and extension services have been highly productive.

THE EFFECT OF AGRICULTURAL RESEARCH AND EXTENSION ON FARM STRUCTURE

The impacts of research and extension on farms, farm workers, agribusiness, and rural communities depend on the type of technology developed and the rate of adoption. Some technological innovations, particularly mechanical innovations, favor and hence foster larger farms, Other innovations could be applied on farms of any size, but are often first adopted by larger farms (Paarlberg, *1981;* Perrin and Winkelman, *1976;* White, *1984).*

The extent to which agricultural research and extension affect farm structure has become an item of increasing debate and concern, Jim Hightower (1973) focused and fueled the controversy by concluding that "Agriculture's preoccupation with scientific and business efficiency has produced a radical restructuring of rural America and consequently urban America . , . . America's land grant college complex has wedded itself to an agribusiness vision of automated, vertically integrated and corporatized agriculture, " Hightower's perspective appears to be that agricultural research and extension should be structurally neutral (i.e., not favor one farm size over another), but if it favors anything, it should favor moderate and smaller farms.

The impact of agricultural research and extension on farm structure can best be understood by considering the separate impacts of research, extension, and technological adoption on farm structure.

A research program that is structurally neutral would develop technologies that can be used by any size farm. There is limited evidence about whether the type of agricultural research being conducted by public institutions is structurally neutral (White, 1984). Biological-chemical technologies, the focus of most land grant research, are more likely to be structurally neutral than is mechanical research, which is primarily done in the private sector. Mechanical innovations such as the cotton picker, combine, and mechanical tomato harvester have favored large farms by reducing labor requirements and lowering costs on large farms (Schmitz and Seckler, 1970). The biological-chemical technologies over the past 50 years have accounted for about a doubling of output in most farm commodities–i.e., wheat, corn, rice, and cotton. However, mechanization and economies of size have accounted for a tenfold to twentyfold increase in output, and this has not been structurally neutral. In general, there has been no widespread public recognition of the consequences of such technological developments before their release and widespread adoption (White, 1984).

Dissemination that is structurally neutral entails dissemination of research results by research and extension staff to all farmers. Although the extension service disseminates research results through a wide range of publications, public meetings, and result demonstrations, these means are more readily accessed by the more knowledgeable and better educated farmers, who more often are the operators of larger, more progressive farms. Since the topics covered in publications and public meetings are heavily influenced by current research results, any bias toward larger farms in these results would be carried over into those publications and meetings. On the other hand, one of the criticisms of extension has also been that operators of the larger, more progressive farms are more knowledgeable about the state of the art than are extension staff. This claim is more likely true of county-level staff than of the State specialist staff.

Adoption that is structurally neutral involves the equal willingness and ability of operators of all farm sizes to adopt new technology. Adoption neutrality would be hampered if research and/or dissemination were not structurally neutral. But even when research and extension activities are structurally neutral, adoption may not be neutral because adoption of new technology is dependent on many factors, including the potential profitability of technology, the capital investment required, the natural resources controlled by farmers, the economic environment within which farmers operate, and the technical skills of the farmer.

The structural trend in agriculture is quite clearly toward a bimodal distribution—small and large farms surviving, with moderate farms struggling to exist, Small farms are surviving and even increasing in number because they have off-farm income against which to offset farm losses. Large farms are increasing in number because their operators are more efficient and can purchase inputs at lower prices, sell their products at higher prices, obtain more farm program benefits, and therefore have higher incomes (Smith, et al., 1984].

Considering the number and complexity of these factors, it would be difficult to achieve a farm structure that maintains the moderate farm simply by focusing more research and extension resources on producing and disseminating technologies specifically oriented toward the moderate farm segment. Instead, research and extension activities would have to be integrated into other targeted policy tools to achieve the desired structural goals.

Since dissemination and adoption would appear to be more important than research to structural change, the emphasis in a program to achieve greater neutrality would logically fall on highly applied research and extension functions targeted toward the competitiveness and survival of moderate farms. Such a program would have to:

- Increase public research efforts aimed at developing farming and management systems that allow moderate farms to achieve the same technical or production efficiencies as their larger scale counterparts.
- Provide higher levels of support for farmer cooperative research and educational activities aimed at serving family farm agriculture, With proper orientation, farmer cooperatives should be able to allow moderate farms the same input economies as larger farms.
- Increase emphasis on the use of modern marketing and management tools by operators of moderate farms. An understanding of contracting, futures markets, options markets, and committed cooperatives will be critical to the future survival of the moderate farm system. In addition, moderate farms will have to use state-of-the-art computer information and financial systems. Public research and extension will play the major role in seeing that this knowledge base is developed and reaches farmers.

Reorienting the research and extension system in this manner carries some risk, The competitive position of American agriculture in an open world economy could be jeopardized if, while concentrating on improving the competitive position of moderate farms, technological advances for larger farms stagnated. Therefore, while directing more efforts toward moderate farms, research and extension must continue to foster improvements in production, marketing, and management systems for all farm sizes. Accomplishing such changes would require additional staff, retraining of existing staff, more resources, and a reorientation of existing resources.

RESEARCH, PRIVATE SECTOR, AND EXTENSION ROLES

One of the most important contemporary issues that the agricultural research and extension system has had to deal with is that of establishing both the broad priorities for research and extension and the roles of the components of the research and extension system. Since the passage of the 1977 farm bill, considerable progress has been made in establishing roles and priorities in the various components of the agricultural research system. The Joint Council and the Users Advisory Board, given sufficient time and encouragement to perform, have the potential for dealing effectively with the priorities issue. Positive progress is indicated by the recently reIeased Joint Council Needs Assessment for Food and Agricultural Sciences.

The primary question regarding the roles issue involves the line of demarcation between the U.S. Department of Agriculture (USDA) anci the land grant programs. This issue has been treated quite differently by research and extension. OTA'S agricultural research system study concluded that USDA research should concentrate on those agricultural problems that are important to the Nation and for which no one State or private group has the resources, facilities, or incentive to solve (OTA, 1981).

Such a role can logically be assigned to the USDA Agricultural Research Service and the USDA Economic Research Service. Concentrating only on national and regional problems would represent a marked shift by the Agricultural Research Service from its past decentralization policies involving increasing emphasis on research having a State or local focus.

Private Sector involvement

The land grant university system was established largely because it was concluded that in a decentralized competitive structure, the private sector would not have the economic incentive to provide the level of funding needed to maintain an efficient, viable agriculture. Despite many changes in the structure of agriculture since the founding of the land grant system, this premise went largely unchallenged until the 1970s.

As a result, private sector grants for agricultural research have historically come primarily from foundations such as Ford or Rockefeller and from a small number of grants for university developmental research associated with the introduction of new products. With the advent of biotechnology, the interest of private firms in agricultural research increased sharply. While much of this interest appears to be a spinoff of biomedical human research, substantially expanded resources have also been committed to plant and animal reproduction designed to produce new varieties or to expand the rate of genetic improvement. In addition, increased interest is being shown in developing disease- and insect-resistant plants as well as in more organic methods of pest control.

One of the major reasons for this expanded, private sector interest in agricultural research has been the extension of patent rights to plant varieties and other biological discoveries. These rights, in turn, gave rise to increased private sector interest in supporting university research that could result in profitable, patented discoveries.

The current magnitude of private sector commitment to agricultural research is largely unknown. Studies suggest that it may approach $3 billion (National Agricultural Research and Extension Users Advisory Board, 1983). Approximately half of the amount is spent on production agriculture and half on food production or postharvest technology research. Private sector research resources are obviously devoted to those areas having the highest short-run profit potential. Also, despite recent large increases in private sector agricultural research, questions remain about the long-term willingness of private sector firms to invest large sums of money in agricultural research and about the breadth of such research. As noted previously, private firms have tended to cut back on research first in times of adversity.

The private sector also plays a role in education. For most agribusiness firms, this role is pursued in conjunction with their efforts to promote the products and services that they market. The educational value of these promotional activities relates more to alerting farmers to the availability of new products than to evaluating objectively the performance of those products.

The burden of new product evaluation then falls either on the farmer (through trial and error) or on the extension service (through result demonstration); extension involvement is more efficient. However, the biotechnology era holds potential for increased antagonism between private sector firms and extension because the extension service evaluates the comparative performance of new biotechnological products, a role not always appreciated by firms producing products that have relatively lower levels of performance,

With a few important exceptions, such as integrated pest management (1PM) checkoff programs, the private sector's direct financial support for agricultural extension programs has been limited, but appears to be growing. It might be argued that limited private sector funding is essential for keeping extension education programs objective. Greater dangers may lie more in increased private sector funding of extension than of research. In the funding of both, it is critical to maintain the objectivity and availability of information flows.

Research Involvement

Land grant universities were created to serve the public. The agricultural component of the land grant universities has unique responsibilities to conduct and extend the results of research for the public benefit. Traditionally, those research results have been readily and freely available to the public, since they have no private property or exclusivity rights attached to them. Research results that were to be held in confidence or had proprietary rights attached to them were frowned upon. Policy changes that have occurred over the past 15 years hold the potential for substantially changing this traditional concept of ready and free access to land grant university research. Some changes have already occurred; others may occur very rapidly. In other words, changes in property rights and exclusivity rules may have also changed the very concept of the land grant system.

Questions of how the land grant universities might adjust to the new concept of research property rights and the related opportunities for increased private sector funding have been the subject of extensive study. However, the impact of these factors on the unique nature or "social contract" of the land grant system has received little attention.

Policy changes regarding property rights in agricultural research had their origin in the enactment of the Plant Variety Protection Act of 1970. Previously, patent protection in plants was limited to asexually reproduced material—mainly orchard fruits and ornamental flowers. The Plant Variety Protection Act provided that a breeder of a new, stable, and uniform variety of sexually reproduced plants could prevent other seedsmen from reproducing and selling that variety for 17 years.

Of possibly greater significance was the 1980 landmark U.S. Supreme Court decision, Diamond v. Chakrabarty, which held that the inventor of a new micro-organism, whose invention otherwise met the legal requirements for obtaining a patent, could not be denied a patent solely because the innovation was alive. This decision opened the door for patenting potentially all new products of the biotechnology era.

Since the passage of the Plant variety Protection Act and the Chakrabarty decision, private sector interest in agricultural research has mushroomed. OTA, for example, found that in 1983 there were 61 companies pursuing applications of biotechnology in animal agriculture and 52 companies applying biotechnology to plants. Most of these firms have developed their own in-house research capability, employing molecular biologists, biochemists, geneticists, plant breeders, and veterinarians.

Relationships are also developing between universities and many of these firms. For example, Monsanto has a 5-year, $23.5 million contract with Washington University under which individual research projects are conducted. At Stanford University, five corporate sponsors (General Foods; Koopers Co., Inc.; Bendix Corp.; Mead Corp.; and McLoren Power and Paper Co.) contributed $2.5 million to form the for-profit Engenics and the not-for-profit Center for Biotechnology Research.

Such relationships are not limited to private universities. Michigan State University (a land grant college) created the entity Neogen to seek venture capital for limited partnerships to develop and market innovations arising out of research. The formation of Neogen points up a significant problem being encountered by universities in the biotechnology era. Neogen was formed, in part, for the purpose of retaining faculty members who are getting offers from biotechnology companies, In Neogen, faculty members are allowed to develop their entrepreneurial talent and gain financial rewards while remaining at the university, The formation of Neogen reflects the reality that biotechnology development is resulting in or might result in a substantial drain on university basic and applied research talent. If leading faculty members are not overtly hired away from universities, they may form their own companies or become consultants. The establishment of biotechnology property rights has substantially heightened scientists' interest in private sector employment opportunities. In the process, questions have arisen over who should maintain the property right—the university, the private firm, or the scientist.

In the Washington University-Monsanto case, the university retains the patent rights while Monsanto has exclusive licensing rights. In Engenics, Stanford likewise gets the patent rights while Engenics and its five corporate sponsors receive the royalty-bearing licenses. Neogen will buy patent rights from Michigan State University, while the inventor will get a 15-percent royalty or a stock option in Neogen.

It does not take much imagination to recognize the potentially profound implications of such developments on the land grant university system. While public sector-private sector arrangements were kept previously at arms length, private sector arrangements now integrate business into the university fabric. Questions develop over who controls the university research agenda, the allegiance of scientists to their university employer, the willingness of scientists to discuss research discoveries related to potentially patentable products, and potential favoritism shown particular companies by the university because of its research ties,

The advent of patent rights, exclusive licensing, and private sector investment in public sector research may change the distribution of benefits from land grant research discoveries. These changes warrant direct public discussion and consideration by policy makers. They occur for at least five reasons:

- By exclusive licensing or transferring of patent rights to private firms, the right to use discoveries is no longer freely available—even if information on the discovery itself is freely available.
- Certain individuals and firms are conferred the benefits of specific land grant research, to the potential detriment of others. Prior to the transfer of discovery rights, the benefits were available to anyone who adapted a land grant discovery to commercial usage.
- The costs of the resulting discoveries are internalized in the price of the resulting product. The price the public pays for the product also includes any monopoly rents associated with the conferral of the rights. Society thus pays twice: once for the cost of the research and again for its benefits. Without the conferral of property rights, rents are minimized by competition.
- Private sector-public sector inequities are virtually assured in any granting of research property rights to an individual firm. This occurs because a relatively small private sector investment brings access to a much broader range of current and prior research.
- The existence of patent rights, trade secrets, and confidential information has many potentially adverse implications for extension in terms of the increased burden for product testing, the potential lags in information, and the absence of research information that previously would have been readily available.

The argument does not, however, flow exclusively against the conferral of private sector property rights by the land grants. There are three main counterbalancing arguments:

- With the conferral of private property rights and the associated private sector investment, the quantity of research discoveries may increase. Robert Evenson (1983), for example, found a sharp acceleration in private plant breeding programs after the 1970 Plant Variety Protection Act was enacted into law. Over 1,088 patent-like certificates were granted by February 1, 1983.

- Without land grant university involvement in private sector-funded research, the universities may not be able to retain the top-quality scientists needed to conduct agricultural research on the frontiers of knowledge. In the process, the agricultural research, extension, and teaching programs would all suffer.
- Patent monopoly rights may be necessary to attract the capital investment needed to translate the scientific advances of land grant universities into commercial reality. Without such proprietary protection, new discoveries may not be able to compete for resources to develop marketable products or technologies. The public availability of such products could thereby be affected.

If policy makers want land grant universities to refrain from conferring property rights, it will be necessary for policy makers to provide the level of funding whereby land grant universities can compete with non-land grant universities that confer such rights. This basic decision may be the most important related public policy decision since the land grant system was created. Once the land grant system starts actively competing for private sector grants and conferring licensing rights, there will be no turning back.

Extendon Roles

Available evidence suggests that the progress of the agricultural research community in establishing priorities is more advanced than that of the extension community. The agricultural research community has been widely studied and critically evaluated within and without the system in a series of projects extending back to the mid-1960s. In light of these analyses, the agricultural research system has adjusted the distribution of its resources in recognition of potential advances evolving from biotechnology and information technology.

Similar progress is not apparent in extension. Extension administrators suggest that this is the case because most of the extension planning occurs at the local level through advisory committees. Yet such a system does not obviate the need for setting national plans and priorities. One major congressionally mandated extension evaluation project culminated in a series of reports that concentrated more on past benefits than on future needs, priorities, and required adjustments (Extension Service, *1983).* There is also relatively little reference to the functions or programs of extension in the reports of either the Joint Council or the Users Advisory Board.

Federal extension has also dramatically reemphasized its direct education role in the past 20 years (Hyatt, 1984). Although Federal extension specialists were generally viewed as having a vast subject matter base in their own right and were frequently called upon to engage in staff training and to conduct educational programs, these specialists are viewed today more as program leaders, coordinators, and facilitators. The education function is thus left to State specialists and agents. These changes were at least partially forced by reductions in personnel ceilings and limited appropriations. Regardless of the cause, this change in strategy has not been beneficial to the overall national extension education program, which is left to cope with a lack of progress in national planning and needs assessment and a deterioration in the quality of educational service to the States.

As in research, there are issues of national significance that the USDA Extension Service is better able to deal with educationally than are the States. While ultimately the States must still take the lead in extending educational programs to farmers, the USDA Extension Service can play an important role in making the information and related educational materials available on a timely basis. (For another perspective see Hyatt, 1984.) Currently, this role is being played on, at best, a spotty basis. A key mission of the Federal Extension Service should be to facilitate technology transfer between USDA research agencies and the State extension services as well as between States. If this function is not adequately performed, research agencies become motivated to develop their own outreach programs. The need then is for increased integration of the research and extension function—not greater fragmentation.

To add Federal extension national program leaders who are knowledgeable about the state of the art of technology would be substantially more expensive. Such staff would have to be recognized as national extension coordinators and be provided compensation consistent with that role. Finally, they would have to have access to resources whereby State specialists and researchers coordinated to develop state-of-the-art educational materials that could be used in all States.

The biotechnology era presents some very important challenges to the extension community—challenges that could determine extension's future usefulness as an educational aid to farmers. With renewed emphasis on basic agricultural research, substantial concern arises about whether a gap in applied research will develop, This could occur as applied scientists are attracted into basic research that offers higher rewards, leaving open the jobs in applied research. The potential for such a gap is reduced by increased private sector interest and involvement in biotechnology research and development (R&D). However, as the private sector performs a larger share of the applied research, extension may become even more involved in the evaluation of technologies and products flowing out of the private sector. Without such evaluation individual farmers and ranchers will incur the costs of experimenting to determine which combinations are optimum for use in production. These costs will be converted into a decline in the number of farms (for those who used the wrong input combinations), higher food costs, and reduced competitiveness in international commodity markets.

Substantial challenge is involved in extension's adjusting to this new role. While in some States technology and extension are already deeply involved in the evaluation of new products, in other States product evaluation has been primarily a function of experiment stations. In the future, experiment stations will likely be doing less of this work, and extension's responsibilities will correspondingly increase, Meeting this increased responsibility will entail a larger specialist staff with modern scientific training. Some States may be inclined to forego the responsibility of getting involved in conflict-oriented product evaluation programs. To the extent that this occurs, the usefulness of extension to the farmer will decline.

Many of the technologies on the horizon are exceedingly complex and foreign to many extension staff. In the foreseeable future embryo transplant technology may be as important to the dairy industry as artificial insemination has been over the past three decades. Growth regulators will increasingly be applied in minute quantities to plants to increase productivity. New strains of genetically engineered plants and animals will be entering commercial production channels. Extensive staff training and development will be required at both the specialist and county levels for extension to play an effective role in technology transfer during the biotechnology era. Without such training, extension will play an increasingly less important role in production agriculture. Technology transfer will occur less efficiently with more structural impacts—larger farms will benefit at the expense of smaller farms.

At current funding levels, the most difficult issue facing extension is whether to limit its role and coverage to those functions for which it has the greatest expertise. Without criteria for limiting the role of extension, extension activities might become so dispersed and out of focus that their effectiveness would be impaired. Regardless of whether the problem is related to agriculture or not, extension may be called upon to solve it. It is not possible for extension to be everything to everybody, particularly in times of limited resources.

The Joint Council has not given sufficient attention to the role of extension. As a starting point for defining that role, it must be remembered that the root of extension is research. Similarly, extension is a primary outlet for research, after an appropriate level of product development. Extension is, therefore, delimited by the scientific endeavors of the research components of the agricultural research system, including both the public and private sector components.

The core mission of extension is, therefore, one of developing, extending, and bringing about the use of research-based knowledge. The core source of that knowledge is the agricultural experiment station. Viewing extension in a broader context than this runs the serious risk of reducing its overall effectiveness. This is particularly the case when it is recognized that extension is likely to play an increasing role in filling a portion of the gap between basic research and extension, i.e., applied research. Another dimension of this role problem involves the tendency for the experiment station to become more involved in extension-type educational programs as a way of gaining public recognition and support. Considerable care must be taken not to foster such duplication of efforts.

The 1890 land grant universities have evolved into institutions that have a comparative advantage in studying problems that are unique to small farmers—particularly those that depend on agriculture for a majority of their income. Satisfactory performance of this function requires a recognition of this role and a closer working relationship with the 1862 land grant university in both research and extension programs (Lovvorn, 1984).

IMPLICATIONS FOR THE 1985 FARM BILL

- Granting of property rights and exclusive licensing of technological discoveries have brought the unique nature or “social contract” of land grant universities into question. These new rules may change the distribution of benefits from land grant research discoveries. These changes warrant direct public discussion and consideration by policymakers.
- Progress of the agricultural research community in establishing priorities is more advanced than that of extension.
- The agricultural research system has adjusted the allocation of resources in recognition of potential advances evolving from biotechnology and information technology. Similar progress is not apparent in extension.
- There is a need to address the following extension issues:
  —clientele and mission of extension,
  —organizational structure of the extension system,
  —role of Federal extension service, and
  —need for extension to conduct applied research.
- Research and extension policy is a critical component of agricultural structure policy. For moderate farms to be able to compete, for example, ways must be developed for making new technologies more available to moderate farms and for providing training in the use of these technologies.