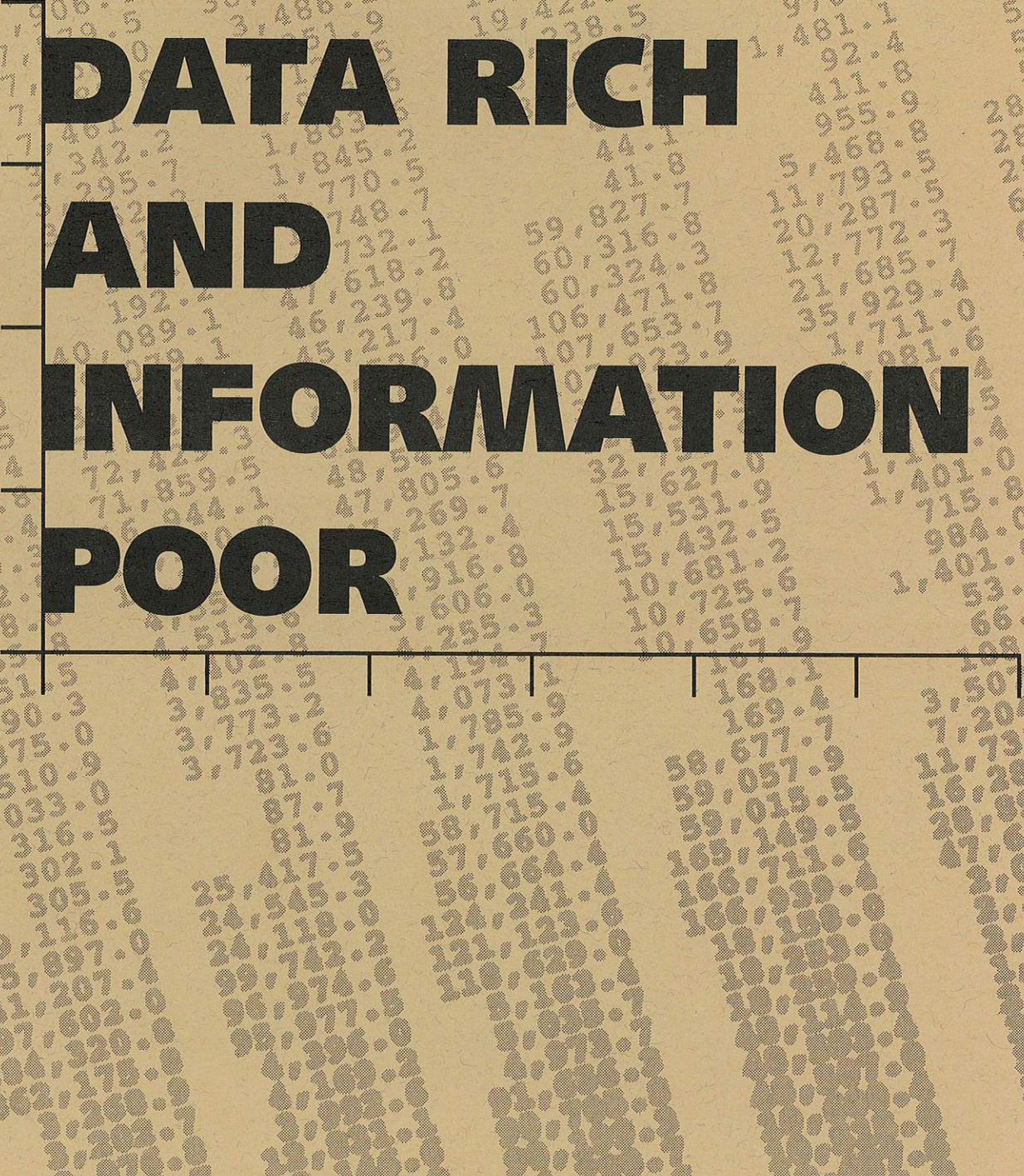


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A report to the Chief of the  
Natural Resources Conservation Service  
by the Blue Ribbon Panel  
on Natural Resource Inventory  
and Performance Measurement



**DATA RICH  
AND  
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POOR**

November 1995

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# EXECUTIVE SUMMARY

**T**HE Blue Ribbon Panel on Natural Resource Inventory and Performance Measurement was created at the request of Chief Paul Johnson to examine all aspects of data and information collection, analysis, and dissemination within the Natural Resources Conservation Service (NRCS).

Historically, NRCS has collected and disseminated a great deal of data and information about natural resources, primarily soil resources. In recent decades, however, the agency's mission has broadened, and its information needs and those of its clients have changed rapidly. Today, NRCS is an information-based agency that must more effectively and efficiently collect and analyze data and disseminate information based on those data. Unfortunately, the changing role of information in achieving the agency's mission has not been recognized by many NRCS personnel.

Members of the blue ribbon panel were drawn from a wide range of technical and policy backgrounds and different levels of knowledge about the agency. The panel met five times between March and July 1995. Chief Johnson met with panel members at the outset of their work to articulate his charge to the panel, and he met with them again as they completed their work to receive the panel's findings.

Panel meetings were intense, but productive. Almost all panel members attended all meetings, which allowed for considerable continuity in our deliberations.

The panel received information and suggestions from numerous people, both within and outside NRCS. In addition, nearly all panel members interviewed NRCS district conservationists and others who provide conservation information and technology to the agency's clients.

Two types of issues competed for the attention of the panel and for recognition at NRCS. One type revolved around management and agency cultures—questions about roles of different levels of the agency, priority-setting, decision-making processes, and the

influence of personal values and views. The second type revolved around technical and technology topics—questions of hardware and software compatibility, use of commercial software, frequency of technology upgrades, and staff responsibilities in applying modern technologies. Both types of issues are important and related, and one of the major challenges facing NRCS is to weave them together rather than address the issues independently.

The panel was briefed well on the major data and information activities at NRCS, particularly natural resource assessment activities. Unfortunately, there was neither the time nor was it the mission of the panel to examine all agency activities and responsibilities. Panel members acquired a much clearer idea of the agency culture in which data and information collection, analysis, and dissemination occur. They also became aware of recent, ongoing, and planned changes in those activities during the period in which the panel was meeting.

The panel concluded its deliberations by reaching consensus on six general recommendations. Those recommendations are accompanied by numerous sub-recommendations, along with findings and summary comments.

Readers of this report will note considerable relation and integration among the recommendations and accompanying sub-recommendations and, thus, some overlap. Panel members accepted the fact that some duplication was necessary if each of the six general recommendations was to stand alone.

The panel recognized that NRCS works to serve simultaneously at least three distinct client groups who depend to varying degrees on NRCS for data and information management: (1) the local users of services, mainly private landowners and units of government; (2) users of information for broad policy direction, members of Congress, for example; and (3) users within NRCS and the U.S. Department of Agriculture who support the workings of the agency.

Following are the panel's recommendations:

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## **RECOMMENDATION 1**

**Elaborate the NRCS mission (including the strategies, goals, and performance measures necessary to accomplish that mission), recognizing that data collection and analysis are of increasing importance to the mission, and articulate the multiple roles of information at national, regional, state, and local levels of NRCS in achieving the mission.**

### **Sub-Recommendations**

1a. NRCS must clearly define its mission to include the following goals:

- Ensure that information about natural resource condition and management practices is in an appropriate, usable form and accessible to individual landowners and other local users at scales that range from fields to farms to watersheds or ecosystems.
- Ensure that policymakers and citizens have reliable, timely regional and national information on natural resource status and trends.
- Ensure that NRCS has the information necessary to assess its own needs and accomplishments and to evaluate the performance of its programs.

1b. NRCS must articulate how accessibility to information supports the NRCS mission of helping people to conserve and enhance natural resources.

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## **RECOMMENDATION 2**

**Develop an integrated data collection and information management plan and implementation process to drive all data and information management activities at NRCS.**

### **Sub-Recommendations**

2a. Develop immediately an organizational structure and operating procedure that will allow a coordinated approach to identifying and meeting the data and information needs of the agency's client base.

2b. Designate an internal coordinating group and instruct it to develop—within six months—an integrated data management plan that can be implemented incrementally and will satisfy data and information needs at all levels within the agency and in all regions of the country.

2c. While implementation of the data management plan should be based on the specific recommendations of the coordinating group, the panel strongly believes the following actions by NRCS leadership will be critical to the long-range success of this effort:

- Express the strongest possible commitment to implementation of the plan.
- Create an organizational structure to implement the plan that includes information management specialists, geographic information system specialists, statisticians, analysts, computer specialists, natural resource specialists, data collection specialists, among others, and represents all types and levels of data-related activities.
- Establish standards for information design, data collection, data dissemination, data sharing, and data release for the agency and make recommendations on data structure, management, and appropriate analysis.
- Establish a schedule for major data collection and analysis activities, and set priorities for the limited resources available.
- Convert data bases from tabular form to spatial form and structure them so data can be aggregated, analyzed, and published at different geographic levels, as appropriate, given statistical characteristics of data.
- Develop metadata for archiving, data documentation, and data sharing purposes in line with acceptable standards.
- Identify and aggressively explore opportunities for marketing and franchising information products.

### **RECOMMENDATION 3**

Fully implement "networked" communication between and among all levels of NRCS, and ensure that external clients have ready access to all NRCS products and that NRCS has ready access to products of external clients.

#### **Sub-Recommendations**

- 3a. Establish immediately an internal e-mail system of networked computers in every office throughout the agency, supporting remote access to file servers and use of such Internet-based applications as the World Wide Web.
- 3b. Make published results of national data efforts accessible to regional, state, and local NRCS offices, in part to gain recognition of natural resource assessment throughout the agency as a critical component of the NRCS mission.
- 3c. Improve vertical communication throughout NRCS, particularly with respect to the Chief's vision of the agency's future, by removing cultural and other barriers to effective communication.
- 3d. Establish policies and procedures, along with feedback mechanisms, that enable all staff to provide requested informational services expeditiously to their clients, and launch training of all personnel on new ways of doing business.
- 3e. Publicize widely the availability and content of data bases accessible to interests outside the agency by publishing a descriptive brochure and developing World Wide Web and file transfer protocol services that describe agency products, services, and capabilities.
- 3f. Assign sufficient, well-equipped, dedicated staff to service the information needs of policymakers.
- 3g. Document the use of NRCS data in terms of types and frequency of use, the demographics of users, and the benefits accrued; initiate a process for systematic recording of customers' data use; and periodically analyze usage data so the results can be used in prioritizing NRCS data acquisition and analysis activities.

### **RECOMMENDATION 4**

Reexamine the NRCS role in overall natural resource assessment and information management, acknowledging that many organizations have natural resource management and information collection responsibilities, and aggressively pursue partnerships with other agencies and the private sector.

#### **Sub-Recommendations**

- 4a. Recognize the National Resources Inventory (NRI) as a vital measurement tool in support of a broader, more germane natural resource assessment activity in NRCS and evaluate its utility in achieving the resource inventory goals of natural resource assessment.
- 4b. Establish a permanent Natural Resource Assessment Advisory Committee, with representatives from the user and scientific communities, that, on a continuing basis, advises NRCS leaders and the internal coordinating group (recommendation 2b) about natural resource assessment goals, data needs, data collection methods, analytical techniques, areas of mutual collaboration, timing of inventories, and screening and quality control of data and results.
- 4c. Strengthen natural resource assessment activities within NRCS and expand those activities where necessary through the following actions:
  - Articulate clearly natural resource assessment needs at the local, state, regional, and national levels, in each case recognizing the specific role of NRCS.
  - Define NRCS natural resource assessment goals, determining what tools are needed to attain those goals, and then separate which goals are better met as part of NRCS's progress reporting or status review activities and which goals are best achieved through resource inventory using tools like NRI.
  - Evaluate, in resource inventory, issues related to primary sampling units as a point versus an area.
  - Establish standards for evaluation of measured variables that clearly discriminate real change from natural variation and measurement error.

- Develop a well-conceived policy within NRCS for compliance monitoring and enforcement as it affects the agency's efforts in natural resource assessment.
  - Develop assessment tools and environmental indicators that quantify changes in range health, forest health, soil quality, wetlands, wildlife habitat, and urban/suburban health, keeping in mind linkages to air and water quality.
  - Allow for regional and watershed collection of natural resources data over and above a minimum national data set.
  - Expand the utility of data, taking advantage of newer statistical techniques, such as small-area estimation and rare population sampling methods.
- 4d. Integrate NRCS natural resource assessment activities with assessment activities of other agencies and organizations, both public and private, through the following actions:
- Pursue the merger of the NRI and the Forest Service's Forest Inventory and Analysis, and study linkages with other natural resource assessment activities, as needed, to achieve stated goals.
  - Link natural resource assessment data collection activities with National Agricultural Statistical Service data to quantify the impacts of conservation programs on people's behavior and to collect participation and practice data on government programs.
  - Develop compatible definitions and techniques with other resource assessment activities.
  - Georeference resource assessment data as the linkage to other data sets.
  - Examine the unique contributions of NRCS geospatial data in the multiagency environment of natural resource assessment through active participation in interagency committees created to coordinate such activities.
- 4e. Make natural resource assessment a continuous process with dedicated staff both within and external to NRCS (Forest Service, National Agricultural Statistics Service, Environmental Protection Agency, Economic Research Service, Geological Survey, etc.) through the following actions:
- Develop ongoing data analysis and interpretation capabilities within NRCS in association with client groups.
  - Improve resource inventory data collection techniques by using "dedicated" crews.
  - Investigate the utility of continuously sequenced NRI data collection.
- 4f. Improve the relevance of natural resource assessment in NRCS through the following actions:
- Make the availability of natural resource data and information more timely relative to national policy issues.
  - Devise unique goals for each assessment cycle relative to short-term issues.
  - Achieve a statistical reliability in the NRI below the major-land-resource-area level, for example, at the eight-digit hydrologic unit or multicounty level.
  - Evaluate resource assessment activities continuously to ensure their relevance to emerging natural resource issues.
- 4g. Proactively seek out useful data bases from sources external to NRCS and link them with agency data bases.

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## **RECOMMENDATION 5**

### **Position NRCS in the mainstream of information technology.**

#### **Sub-Recommendations**

- 5a. Establish procedures within the agency to monitor changing technologies and levels of technical sophistication, and report annually to the chief on the position of NRCS relative to the mainstream of technology.
- 5b. Conduct periodic system design and operation evaluations, ensuring that a majority of all evaluation groups established be end-users of

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NRCS services, (especially farmers, representatives of the business community, and other nongovernmental agencies).

- 5c. Develop system design and procurement procedures that shorten the cycle between technology procurements and reflect a rapidly changing technological environment, emphasizing use of commercial, off-the shelf solutions that provide ease of use, interoperability, and flexibility.
- 5d. Move the agency's computing environment to a distributed, networked client/server architecture with a distributed and networked data base.
- 5e. Convert data bases and user interfaces to commercially available, user-friendly, graphic-user interfaces that are easily programmable and run on fully supported platforms.
- 5f. Equip field offices with geographic information system (GIS) mapping capabilities, and create an infrastructure in field offices to exchange data with farm and ranch operators and other local constituencies in a variety of formats to facilitate on-farm/on-ranch use of computer systems in such site-specific technologies as used in precision farming.
- 5g. Accelerate development and acquisition of digital orthophotos, digitized soil maps, and remotely sensed data bases and, in the process, consider increased cooperation with other agencies and organizations to provide a national land information data base (see recommendation 4g).
- 5h. Redefine the roles of information resource management professionals within the agency to reflect the present role of natural resources information within NRCS, and train staff in the use of information and information systems, using models to evaluate alternatives in the decision-making process.
- 5i. Improve the educational, technical, and training services available to field offices to ensure that field personnel are (a) able to meet their program management objectives of providing

technical assistance, reliable data, and appropriate advice to farm and ranch operators and other land managers and (b) possess the ability to analyze data and monitor the impact of their programs at the farm or ranch and county or watershed levels.

- 5j. Ensure that technical support to field offices is increased to appropriate levels in relation to mainstream information technology while minimizing the bureaucracy involved, which could otherwise reduce budgets and technical support for field operations.

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## **RECOMMENDATION 6**

**Identify the objectives of each NRCS data collection effort, and articulate its role in meeting the agency's mission and purpose.**

### **Sub-Recommendations**

- 6a. As an integral part of the data management and planning process (recommendation 2), develop an inventory of all NRCS data programs that includes for each objectives, costs, conditions of access, and primary users.
- 6b. Establish logical links between the detailed characteristics of each data collection program, such as mapping scale and sample size, and the program's objectives.
- 6c. For all major data collection programs, establish how each measured variable contributes to the program's objectives.
- 6d. Monitor the use of NRCS data by external users, and incorporate such information into the evaluation of each data program (see recommendation 3g).
- 6e. Improve the quality of the soil survey program to meet the needs of comprehensive farm planning, ecosystem-based assistance, and precision farming through the following actions:
  - Clarify the contribution of each component of the soil survey program to the agency's mission.

- Pursue quality improvements in the soil survey using detailed data and precision technologies, including GIS, sensors, and global-positioning-system devices.
- Reexamine the agency's policies with regard to digital soil survey data and digitizing standards to ensure these do not restrict the ability of field offices to provide their users with access to the widest possible data resource, including data digitized by state and local agencies.
- Undertake an examination of the entire process of soil survey to ensure that digital technology provides the most efficient communication possible between the field soil scientist and the eventual user of soil data.
- Investigate the costs and benefits of adding new variables or themes to the soil survey program that are not available from other sources or of dropping existing variables. For example, might the soil survey program provide a cost-effective source of land use/cover information?

Members of the panel realized from the outset how difficult it would be to examine all phases of data and information collection, analysis, and dissemination within NRCS. Time would be a constraint, as well as the task of understanding the sheer breadth and complexity of agency activities. Panel members chose to focus their investigation and analysis on those aspects of the agency's data-collection and information-generation activities that seemed most relevant to the agency's future mission.

While the report contains some criticism of the agency and its data- and information-related activities, panel members believe that NRCS is the nation's premier conservation agency with respect to private land resources. No other agency, for example, has mapped soils or measured changes in the land and its use to the extent that NRCS employees have, or done so as well.

Despite the agency's strengths, the panel observed important shortcomings that members believe NRCS must address if the agency is to maintain its position of preeminence in natural resource conservation on private land at the federal level. Much data currently collected and disseminated by NRCS is in response to congressional

mandates or the needs of specific clients. While the agency has a great deal of data, therefore, many of those data are oriented toward the specific purpose for which they were collected, with little or no relation or integration to other data. This has resulted in a number of anomalies and embarrassments for the agency. More importantly, it prevents the agency from truly fulfilling its mission because it does not recognize the role of information in doing so. The panel found that NRCS has not been able to convert those data to the information needed both internally and externally for policy and operational purposes. The panel's recommendations are intended to guide NRCS in collecting the data needed to fulfill its mission and to convert those data into information that can be provided to clients within and outside the agency. The panel also suggests that NRCS use whatever means are available (partnerships with other agencies and the private sector) to collect those data the agency needs to accomplish its mission.

The six recommendations and accompanying sub-recommendations, if fully implemented, will require important changes in the agency's structure, procurement procedures, training of employees, and other traditional ways of doing business. But the agency may have little choice. Monetary and human resources are becoming ever more limited, and demands from users of NRCS data and information threaten to outstrip the agency's capacity to deliver the anticipated services. Moreover, other public and private-sector interests have or may soon assume the roles and functions traditionally belonging to NRCS. To remain relevant, panel members agreed, NRCS must rethink its data and information activities in a way that will allow the agency to use its rich data resources in far more information-effective ways than it has in the past.

# INTRODUCTION

**T**HE Blue Ribbon Panel on Natural Resource Inventory and Performance Measurement was created at the request of Chief Paul Johnson to examine all aspects of data and information collection, analysis, and dissemination within the Natural Resources Conservation Service (NRCS)—a 60-year-old agency within the U.S. Department of Agriculture (USDA) that has as its mission to create “a productive nation in harmony with a quality environment.”

NRCS is the nation’s premier conservation agency with respect to private land resources. To achieve that status, NRCS historically has collected and disseminated a great deal of data and information about natural resources, primarily soil resources. In more recent decades, however, the mission of NRCS has broadened well beyond the concern about protecting the nation’s soils. Similarly, the information needs of the agency and its clients have changed rapidly. NRCS has become more of an information-based agency, an agency that must more effectively and efficiently collect, analyze, and disseminate that information. Unfortunately, the changing role of information has not been recognized by NRCS personnel, and that role has not been fully articulated in the context of the agency’s current knowledge-intensive position.

Members of the blue ribbon panel were drawn from a wide range of technical and policy backgrounds and different levels of knowledge about the agency. The panel met five times between March and July 1995. Chief Johnson met with panel members at the outset of their work to articulate his charge to the panel, and he met with them again as they completed their work to receive the panel’s findings.

Panel meetings were intense, but productive. Almost all panel members attended all meetings, which allowed for considerable continuity in our deliberations.

The panel received information and suggestions from numerous people, both within and outside NRCS (see appendix A). In addition to hearing those presentations, nearly all panel members interviewed NRCS district conservationists and others who provide conservation information and technology to the agency’s clients. Both the presentations and the interviews enabled panel members to become sensitive to

the impacts on agency employees of downsizing and reinvention activities that were occurring during the course of the panel’s work.

Two types of issues competed for the attention of the panel and for recognition at NRCS. One type revolved around management and agency cultures. This encompassed primarily questions of roles of different levels of the agency, priority-setting, decision-making processes, and the influence of personal values and views. The second type revolved around technical and technology topics. There were questions of hardware and software compatibility, use of commercial software, frequency of technology upgrades, and staff responsibilities in applying modern technologies. Both types of issues are important and related, and one of the major challenges facing NRCS is to weave them together rather than address the issues independently of each other.

The panel was briefed well on the major data and information activities at NRCS, particularly natural resource assessment activities, including the National Resources Inventory (NRI), and the Field-Office Computing System (FOCS), all of which require substantial commitments of money and manpower. Unfortunately, there was neither the time nor was it the mission of the panel to examine all of the activities and responsibilities of NRCS. Panel members did acquire a much clearer idea of the agency culture in which data and information collection, analysis, and dissemination occur. They also became aware of major recent, ongoing, and planned changes in those activities during the period in which the panel was meeting.

The panel concluded its deliberations by meeting in executive session to develop recommendations. It reached consensus on six general recommendations. Those recommendations are accompanied in this report by numerous sub-recommendations, along with findings and summary comments, as appropriate. Each discussion was drafted by a subcommittee of panel members and reviewed by all members.

Readers of this report will note considerable relation and integration among the recommendations and accompanying sub-recommendations and, thus, some overlap. For example, recommendation two, which addresses the need for an integrated data collection and information plan, very much depends on completion of recommendation one,

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which calls on NRCS to clarify its mission in a way that acknowledges the importance of data collection and analysis in achieving that mission.

Ultimately, panel members accepted the fact that some duplication was necessary, given that each of the six general recommendations was intended to stand alone to a certain degree.

In developing its recommendations, the panel recognized that NRCS works to serve simultaneously at least three distinct client groups that depend to varying degrees on NRCS for data and information management. Those groups include (1) the local users of services, mainly private landowners and units of government; (2) users of information for broad policy direction, members of Congress, for example; and (3) users within NRCS and USDA who support the workings of the agency. The panel's recommendations recognize the distinct and varying needs of each group and repeatedly reference them within the report.

**1 Elaborate the NRCS mission (including the strategies, goals, and performance measures necessary to accomplish that mission), recognizing that data collection and analysis are of increasing importance to the mission, and articulate the multiple roles of information at national, regional, state, and local levels of NRCS in achieving the mission.**

### Sub-Recommendation

- 1a. NRCS must clearly define its mission to include the following goals:
  - Ensure that information about natural resource condition and management practices is in an appropriate, usable form and accessible to individual landowners and other local users at scales that range from fields to farms to watersheds or ecosystems.
  - Ensure that policymakers and citizens have reliable, timely regional and national information on natural resource status and trends.
  - Ensure that NRCS has the information necessary to assess its own needs and accomplishments and to evaluate the performance of its programs.
- 1b. NRCS must articulate how accessibility to information supports the NRCS mission of helping people to conserve and enhance natural resources.

### Findings

Information has always been at the core of the NRCS mission. When a district conservationist sits down with a farmer, rancher, landowner, or local government official, the three most important NRCS products that the conservationist can offer are personal expertise, information in many forms, and access to financial assistance. When citizens and government leaders debate issues about natural resources, they turn to NRCS for reliable informa-

tion—maps and data—about environmental conditions and trends and about the use of conservation practices on private land.

Yet NRCS sometimes seems to take information for granted. The NRCS vision, mission statement, and guiding principles outlined in "A Productive Nation in Harmony with a Quality Environment: Soil Conservation Service Strategic Initiatives for the 1990s," for example, speak about "help[ing] people conserve, improve and sustain our natural resources" and "lead[ing] people to a greater understanding." But not one of these expressions explicitly states the NRCS role in developing or providing information. Moreover, the panel repeatedly heard comments from NRCS employees suggesting that many of those employees view the collection of data about natural conditions as a bureaucratic burden that reduces the amount of time they have to work with clients rather than as building NRCS's key assets. This view was especially prevalent when the collected data and resulting information were seen as unlikely to help in assisting agency clients.

The capacity to produce computer-based information about natural resources and the ability to use this information intelligently are both changing rapidly as technology becomes more sophisticated and less expensive. New technological tools, such as geographic information systems (GIS), are now commonly used by NRCS's partners and clients through commercial vendors and at reasonable cost. Armed with those tools, people are asking new questions and reasking old questions of NRCS—questions about how to protect natural resources while continuing to manage a farm or ranch for profit; questions about the interrelationships among a wider variety of natural resources; questions about biodiversity; and questions about entire watersheds, ecosystems, or regions.

Furthermore, many agencies and private businesses other than NRCS are building capacities to gather and provide this information. Although farmers still turn to NRCS for soil maps, the small but growing number of farmers who practice the techniques of precision farming are using new technologies to gather far more detailed information about their land than NRCS can offer. And NRCS has no mechanism to become a customer of these farmers and to capture the information that they gather. While officials in other agencies still rely on

NRCS for soils and snow survey data, as well as on NRCS information systems that bring together a wide variety of other natural resource information, those other agencies also are developing their own data bases and geographic information systems to integrate multiple kinds of information for measuring and managing watersheds, ecosystems, and other environments. In many cases, NRCS is challenged to make use of data from other agencies.

In short, the mission that NRCS is actually carrying out is changing rapidly as the information capacities and needs of farmers, local officials, agency managers, and policymakers change. No NRCS documents or statements provided to the panel acknowledged these changes. NRCS must re-examine the role of information in its mission if it is to keep pace with the needs of its "clients" and with the capabilities and services offered by other agencies and private businesses.

In this, NRCS is not unique. Private businesses and agencies in many other fields, from automobiles to personal services, are redefining their mission to include the responsibility of providing information and redefining their products as knowledge-intensive services as well as physical things or activities. As the pace of change accelerates, the ability to respond quickly to change becomes more important. The penalty that might result from self-created obsolescence in these times of constrained federal budgets could be high.

In conjunction with updating its mission and its understanding of how the agency can achieve its goals, NRCS must take practical steps to ensure that its field staff, technical experts, and managers have the hardware, software, and skills to use modern information systems effectively. This means new approaches to training, agency support services, management, and accountability to the public and to Congress. These needs are discussed under other recommendations.

One of the most important aspects of the changing role of information is the rising concern with demonstrating agency performance in understandable terms—measuring how government agencies, like NRCS, are contributing to real achievements that are important to citizens. A clear understanding of agency contributions will promote acceptance by the public of NRCS activities and exert positive impact on the resources—people, money, and sup-

port—made available to the agency through the budget process. The Government Performance and Results Act of 1993 (GPRA) responds to this concern by defining a process where federal agencies will promote accomplishments through measurable results—not processes (like meetings held) or activities (like acres mapped, plans written, or miles of terrace constructed), but real improvements in natural resource condition. These assessments will go well beyond traditional program evaluations. Agency managers are expected to hold their staffs responsible for contributing to these goals.

All federal agencies are experimenting with how to meet GPRA requirements as the 1997 deadline for submitting a strategic plan to Congress and the Office of Management and Budget (OMB) gets closer. GPRA is forcing NRCS to address many tough issues—both technical challenges and conceptual problems. Even if the broad goals of an agency were relatively stable, policymakers in both the executive and legislative branches keep asking new questions, as well as old questions in new ways. They may want answers with a different level of detail than do agency managers. In the case of NRCS, those goals have been changing rapidly over the past decade. Complying with GPRA, therefore, is far more complex than building a single, massive hierarchical system to track all activities, costs, and accomplishments for each major budget category.

Fully and effectively implementing GPRA will support the mission of NRCS, as any worthy self-appraisal does, and ensure that Congress, OMB, USDA, and NRCS managers at all levels have the kind of information that each of these different parties need to hold the agency accountable for contributing to real achievements in the conservation of natural resources. This support can be amplified by developing goals, performance measures, and performance indicators at each level of NRCS. In this way, local, state, and regional offices and other entities know what it is that they plan to accomplish and how they will measure that accomplishment. Specific environmental or other performance measures will be established for every program prior to its implementation as well.

The goals, performance measures, and performance indicators of NRCS should also reflect the various information needs of the three distinct client groups of the agency. Local users of NRCS

services need "ground-level" information, including technical data, maps, soil survey data, watershed data, GIS-layered information, and the information required to measure performance at local offices. (This assumes that goals will have been established at the local level against which performance can be measured.)

Users of information for broader policy purposes need to measure and assess performance at all levels of the agency. Those needs center on information about the health of soil and other natural resources. This information prepares NRCS for presentations to Congress and other policymakers and benefits interested federal, state, and local agencies and private citizens as well.

NRCS also needs information for internal uses, including administrative and management information. Such data are used to assess program and employee performance and to develop budget recommendations.

As the panel members considered their charge, they identified a number of issues that might be reflected in the NRCS mission statement and supporting documentation. Those issues seem to be key, both because of the milieu in which the agency currently operates and because of efforts to position itself for the 21st century. The panel offered recommendations that address many of those issues now, but NRCS should consider reflecting periodically on the following as a basis for self-analysis.

How can NRCS:

- Balance its roles of collecting data and disseminating information in support of field staff and local land managers, regional resource assessments, and congressional decision-making?
- Provide value-added information and analytical services?
- Coordinate its various information sources to enhance the extent of their usage?
- Provide quality control over information sources and consistency?
- Adopt information sources from other entities instead of collecting the data internally?
- Provide meaningful feedback to field-office personnel?
- Hasten completion of the national soil survey?

Addressing these topics has major implications for the agency and the clients it serves. For example, NRCS should recognize and provide for differing regional and local information needs within an overall framework of consistent, reliable, useful national information. This could be accomplished, in part, by ensuring that field staff are conversant with the changing capabilities of GIS and other modern information systems; with their changing use in agriculture, management of watersheds, and interrelationships within ecosystems; and with the changing role of NRCS in the "market" for providing such information to all potential users.

## 2 Develop an integrated data collection and information management plan and implementation process to drive all data and information management activities at NRCS.

### Sub-Recommendations

- 2a. Develop immediately an organizational structure and operating procedure that will allow a coordinated approach to identifying and meeting the data and information needs of the agency's client base.
- 2b. Designate an internal coordinating group and instruct it to develop—within six months—an integrated data management plan that can be implemented incrementally and will satisfy data and information needs at all levels within the agency and in all regions of the country.
- 2c. While implementation of the data management plan should be based on the specific recommendations of the coordinating group, the panel strongly believes the following actions by NRCS leadership will be critical to the long-range success of this effort:
  - Express the strongest possible commitment to implementation of the plan.
  - Create an organizational structure to implement the plan that includes information management specialists, geographic information system specialists, statisticians, analysts, computer specialists, natural resource specialists, data collection specialists, among others, and represents all types and levels of data-related activities.
  - Establish standards for information design, data collection, data dissemination, data sharing, and data release for the agency and make recommendations on data structure, management, and appropriate analysis.

- Establish a schedule for major data collection and analysis activities, and set priorities for the limited resources available.
- Convert data bases from tabular form to spatial form and structure them so data can be aggregated, analyzed, and published at different geographic levels, as appropriate, given statistical characteristics of data.
- Develop metadata for archiving, data documentation, and data sharing purposes in line with acceptable standards.
- Identify and aggressively explore opportunities for marketing and franchising information products.

### Findings

NRCS collects substantial data and information (see appendix B). This is not surprising, given that so much of the agency's work must be based on the data that it collects and analyzes and that its information activities are held in such high regard, both within the agency and beyond. NRCS operates in an environment of riches. The richness of its efforts includes the following, as identified by NRCS staff:

- NRCS operates at least 12 distinct data programs.
- Data are collected primarily but not entirely at the field level.
- Data are compiled in state offices, regional offices, or national headquarters.
- Cost estimates for data activities exceed \$235 million annually.
- Clients and uses of agency data vary widely.

Information about data collection efforts suggest, and the panel meetings with staff confirmed, that those efforts have become expensive, unwieldy, and fragmented. No individual came before the panel who exhibited knowledge about all of the data collection and analysis activities within the agency. In fact, some panel members believed that certain staff members may have attended panel meetings to learn more about activities in other parts of NRCS. This lack of communication and coordination is an increasing liability in an era of

declining financial and staff resources, rapidly changing technologies, and added demands at the field level.

That communication and coordination are lacking is not surprising because there are many different purposes for which data are collected and analyzed. The agency maintains a strong commitment to an extensive effort with broad capability, and the evolution of data collection and information analysis activities has been incremental and cumulative.

This problem is especially apparent in several areas. One is where information is collected but not used extensively, unavailable for timely analysis or evaluation, or analyzed insufficiently to be useful. The NRI suffers from this problem. The second is where information is collected by other entities, but NRCS has few or no mechanisms to incorporate that information internally. A third is the inability to use large data collections, such as NRI and the soil survey, to address program evaluation and program measurement needs, though the panel did hear of one attempt underway to use the NRI as a means of evaluating the conservation technical assistance program.

The data management plan's objectives should be to serve better and more efficiently the agency's client base—users of local office services, users making natural resources policy decisions, and users evaluating agency programs—with consistent, reliable, and timely information. Panel members observed, for example, that local client needs were very much focused on information for conservation plans for individual landowners. In the case of precision farmers, those needs reflect the desire of operators to use information in conservation plans in GIS form with information they have derived. For all clients, NRCS information increases in value when it can be integrated with other necessary information. Similarly, data on ecosystems and watersheds have become more sought after by state and national planners and policymakers. NRCS data provide part but not all of the information needed for resource planning and evaluation on private land; these extensive data needs cut across federal and state agency responsibilities and require coordination.

The scope of activities within NRCS should include data collection, data management, data analysis and interpretation, data and information delivery, and evaluation. The panel offered the following comments on each of these activities:

#### **Data collection—**

The task of data collection includes statistical design and quality control. It is important that NRCS recognize the various forms of data it now collects on natural resource use and condition, assess what data should be collected and how, and coordinate data collected at various levels within the agency with data collected by other natural resource agencies and private organizations.

#### **Data management—**

While NRCS has developed considerable data management capability within its information resource management division and elsewhere, NRCS must develop a data management plan that integrates natural resource data management throughout and external to the agency.

#### **Data analysis and interpretation—**

NRCS does not realize the full value of its natural resource data, and it does not maximize use of those data because it does not possess sufficient capability for data analysis and interpretation (statistical and otherwise) within the agency. This is an important, clearly identified component of the Forest Service's Forest Inventory and Analysis (FIA) program, for example, which provides important feedback on design and data collection techniques used in the FIA (although the FIA is seriously underanalyzed also, in the opinion of many people).

#### **Data and information delivery—**

The value of data and information is found in their use. Panel members were informed that important NRCS information is not available to users. Moreover, data and information from other sources are not recognized by NRCS and thus not integrated with those from NRCS. Digitized soil survey information in NRCS, for example, is far from complete and not generally available, while state efforts to digitize soil surveys are considerable but unrecognized in most cases by NRCS. Congressional staffers reported to the panel that

while needed data existed those data were not packaged in a useable form for members of Congress. Effective data and information delivery systems must emerge quickly within NRCS if the agency is to regain its preeminence in natural resource information and assessment. Information from such surveys as the NRI can likely be made more useful as well at the county or watershed level.

### **Evaluation—**

Evaluation is a cornerstone of success in natural resource assessment. The panel found evaluation in NRCS to be limited, particularly with regard to the need for performance measures in all categories of resource assessment. This was reflected in questions asked of the panel by NRCS staff: "Are the numbers we get via the NRI good numbers?" "Are we measuring the right things, in the right way, at the right time?" "How do we measure outcomes instead of outputs?"

Based on observations, combined with members' knowledge of similar efforts by other agencies and organizations, the panel strongly recommends that the internal coordinating group be asked to include in the data management plan the structural organization needed to implement the plan, the status of all current data and information collection activities, types of information and relevant variables needed for NRCS decision-making, current and desirable data base structures of the information, lists of decisions that depend on the information and potential information users, and relationships of these data to data and information collected and compiled by other organizations (see recommendation 6). Also, it should contain or make reference to specifics concerning sampling methods and procedures, data collection, processing, summarization, and analysis; frequency and geographic level of collection and publication; formats for release and/or access; other necessary standards, including map and remote data scales; and costs to obtain information. The plan should lay out schedules for major collection and analysis activities; set priorities for the limited available resources; and identify opportunities to work with USDA and other agencies, especially where particular expertise is not available internally. It should include a schedule for periodic updates. It should also include processes for moni-

toring the type, nature, and volume of external data and information use and for ascertaining the utility of that data and information.

Technological advances are changing how data are collected and disseminated. Organizations are using more computer-assisted collection procedures, geographic-positioning devices, precision-farming technology, electronic data submission, voice- and touch-tone data transmission, and similar technologies. Electronic communication has opened the door for timely release of information. Uncoordinated efforts will introduce problems with incompatible technology and systems. These will have adverse cost and operational implications. Part of the challenge for NRCS, like all public agencies, will be to seamlessly couple the rapid pace of technological advances with the slower pace at which agencies can respond to these new opportunities.

## **3 Fully implement "networked" communication between and among all levels of NRCS, and ensure that external clients have ready access to all NRCS products and that NRCS has ready access to products of external clients.**

### **Sub-Recommendations**

- 3a. Establish immediately an internal e-mail system of networked computers in every office throughout the agency, supporting remote access to file servers and use of such Internet-based applications as the World Wide Web.
- 3b. Make published results of national data efforts accessible to regional, state, and local NRCS offices, in part to gain recognition of natural resource assessment throughout the agency as a critical component of the NRCS mission.
- 3c. Improve vertical communication throughout NRCS, particularly with respect to the Chief's vision of the agency's future, by removing cultural and other barriers to effective communication.
- 3d. Establish policies and procedures, along with feedback mechanisms, that enable all staff to provide requested informational services expeditiously to their clients, and launch training of all personnel on new ways of doing business.
- 3e. Publicize widely the availability and content of data bases accessible to interests outside the agency by publishing a descriptive brochure and developing World Wide Web and file transfer protocol services that describe agency products, services, and capabilities.
- 3f. Assign sufficient, well-equipped, dedicated staff to service the information needs of policymakers.
- 3g. Document the use of NRCS data in terms of types and frequency of use, the demographics of users, and the benefits accrued; initiate a

process for systematic recording of customers' data use; and periodically analyze usage data so the results can be used in prioritizing NRCS data acquisition and analysis activities.

### **Findings**

NRCS employees are part of two broad and important communication networks. One is an internal, agency-oriented network, consisting of employees in national, regional, state, and local offices. The other is a more extensive and complex external network that features multiple client groups, including farmers, ranchers, and others who own and manage private land; policymakers; and federal (including the Department of Agriculture), state, and local government agency personnel, among others. During their deliberations, panel members heard numerous times about serious "disconnects" in both networks.

Effectively moving information up or down in a widely dispersed, "line-based" organization, like NRCS, can be a substantial challenge. Simply getting information to everyone within the agency who should have it can be a problem, depending on the available communication technology, and effectively communicating what message that information is intended to convey is not always assured. Information moving in traditional channels can also be filtered, which, at best, often inhibits effective communication and, at worst, distorts or even short-circuits it.

The term "networked" has multiple meanings, of course, and in the panel's view, NRCS must get connected by acquiring the proper hardware and software—electrical communication—in the form of voice mail, Internet, and similar technologies and also by connecting the various levels of the agency through the removal of cultural obstacles to networked communication of all forms. Internet, for example, is of little use if field employees are out of the communication loop by virtue of the policies and culture of the agency.

Numerous NRCS employees also commented to panel members about not being connected in more ways than simply by telephone or computer. The progress reporting system, for example, was said to have little relevance to the field staff who fed information into the system, and employees in various sectors of NRCS commented about being out of the conversation loop with regard to many aspects of

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agency activities and reporting. A good example of the latter problem had to do with a widespread desire for more information about the chief's vision for the agency's future, which a number of employees said they had heard some but not nearly enough about.

From the standpoint of the external network, the agency's task is equally challenging. Throughout its history, NRCS has disseminated information and knowledge to its customers through such services as conservation planning and data products, including published soil maps, water supply forecasts, and NRI reports. The agency's strategy of gathering and managing data independently of others was successful when the agency was the sole or prime collector of the data and information and when this information was difficult to obtain, manage, and interpret. Today, digital data on soils, land cover, and the like are readily available to those people who have historically relied on NRCS for this information. NRCS's customers, as a result, are demanding ready access to a variety of data and information products, most of which are managed by the agency. Those same customers are also gathering digital data that could be extremely useful to NRCS's ecosystem-based assistance and comprehensive conservation farm planning missions.

NRCS must, therefore, make a cultural shift. Historic modes of operation will limit and eventually marginalize the agency as a resource to farmers, ranchers, and other clients. The agency must move rapidly to foster a system that will allow easy access to its databases by all potential users, both within and outside the agency. It must also create a system of communications that is "web-based" rather than "line-based" for both its staff and its customer base. Clients accustomed to obtaining information immediately by logging into the Internet will quickly grow disillusioned with a system that requires hours or days to produce an answer to a simple question or data request. The agency must also encourage its employees at every level to seek answers wherever and from whomever they can be obtained.

At some point, NRCS might even investigate the potential for franchising portions of its information resources. The agency is likely to possess considerable information that it might logically sell to certain clients.

## **4 Reexamine the NRCS role in overall natural resource assessment and information management, acknowledging that many organizations have natural resource management and information collection responsibilities, and aggressively pursue partnerships with other agencies and the private sector.**

### **Sub-Recommendations**

- 4a. Recognize the National Resources Inventory (NRI) as a vital measurement tool in support of a broader, more germane natural resource assessment activity in NRCS and evaluate its utility in achieving the resource inventory goals of natural resource assessment.
- 4b. Establish a permanent Natural Resource Assessment Advisory Committee, with representatives from the user and scientific communities, that, on a continuing basis, advises NRCS leaders and the internal coordinating group (recommendation 2b) about natural resource assessment goals, data needs, data collection methods, analytical techniques, areas of mutual collaboration, timing of inventories, and screening and quality control of data and results.
- 4c. Strengthen natural resource assessment activities within NRCS and expand those activities where necessary through the following actions:
  - Articulate clearly natural resource assessment needs at the local, state, regional, and national levels, in each case recognizing the specific role of NRCS.
  - Define NRCS natural resource assessment goals, determining what tools are needed to attain those goals, and then separate which goals are better met as part of NRCS's progress reporting or status review activities and which goals are best achieved through resource inventory using tools like NRI.
- 4d. Integrate NRCS natural resource assessment activities with assessment activities of other agencies and organizations, both public and private, through the following actions:
  - Evaluate, in resource inventory, issues related to primary sampling units as a point versus an area.
  - Establish standards for evaluation of measured variables that clearly discriminate real change from natural variation and measurement error.
  - Develop a well-conceived policy within NRCS for compliance monitoring and enforcement as it affects the agency's efforts in natural resource assessment.
  - Develop assessment tools and environmental indicators that quantify changes in range health, forest health, soil quality, wetlands, wildlife habitat, and urban/suburban health, keeping in mind linkages to air and water quality.
  - Allow for regional and watershed collection of natural resources data over and above a minimum national data set.
  - Expand the utility of data, taking advantage of newer statistical techniques, such as small-area estimation and rare population sampling methods.
- 4d. Integrate NRCS natural resource assessment activities with assessment activities of other agencies and organizations, both public and private, through the following actions:
  - Pursue the merger of the NRI and the Forest Service's Forest Inventory and Analysis, and study linkages with other natural resource assessment activities, as needed, to achieve stated goals.
  - Link natural resource assessment data collection activities with National Agricultural Statistical Service data to quantify the impacts of conservation programs on people's behavior and to collect participation and practice data on government programs.
  - Develop compatible definitions and techniques with other resource assessment activities.
  - Georeference resource assessment data as the linkage to other data sets.

- Examine the unique contributions of NRCS geospatial data in the multiagency environment of natural resource assessment through active participation in interagency committees created to coordinate such activities.
- 4e. Make natural resource assessment a continuous process with dedicated staff both within and external to NRCS (Forest Service, National Agricultural Statistics Service, Environmental Protection Agency, Economic Research Service, Geological Survey, etc.) through the following actions:
- Develop ongoing data analysis and interpretation capabilities within NRCS in association with client groups.
  - Improve resource inventory data collection techniques by using "dedicated" crews.
  - Investigate the utility of continuously sequenced NRI data collection.
- 4f. Improve the relevance of natural resource assessment in NRCS through the following actions:
- Make the availability of natural resource data and information more timely relative to national policy issues.
  - Devise unique goals for each assessment cycle relative to short-term issues.
  - Achieve a statistical reliability in the NRI below the major-land-resource-area level, for example, at the eight-digit hydrologic unit or multicounty level.
  - Evaluate resource assessment activities continuously to ensure their relevance to emerging natural resource issues.
- 4g. Proactively seek out useful data bases from sources external to NRCS and link them with agency data bases.

### **Findings**

NRCS has made a substantial agency commitment to the task of natural resource inventory. It was clear from the information presented to the panel and from subsequent discussion that many NRCS employees view the National Resources Inventory

(NRI) as "the real core of resource inventory" and they are "proud of NRI." Agency leaders fully recognize, however, that the NRI is not perfect. There are concerns about its relevance to other agencies, the extent to which the NRI duplicates other resource assessment efforts, the content and quality of the data collected, and the ability of the NRI to provide information on such emerging issues as water quality, soil quality, range health, forest health, urban/suburban health, and global climate change. There are strong supporters of the NRI who laud its value and demand that it be expanded. There are also strong critics of the NRI who call for its demise.

Panel members ultimately chose to focus on the broader, more germane issue of natural resource assessment within NRCS rather than simply critique the NRI. We believe it is important to understand the functional aspects of the agency's resource assessment activities and how those functions may be changing. From this, the extent to which the tools chosen by NRCS have fulfilled and will continue to fulfill those functions can be assessed. In this context, our interest as a panel was the degree to which the NRI did or did not perform its function in the past and, more important to our task, the appropriateness of the NRI in future resource assessments. The question is not whether the NRI is right or wrong, but whether the NRI will achieve the agency's functional goals for resource assessment in the future.

To our knowledge, NRCS has not adequately articulated its goals in natural resource assessment, particularly with regard to the relevance of those goals in fulfilling the agency's mission. Following are several important observations by the panel regarding natural resource assessment generally and the NRI specifically:

- The agency's natural resource assessment goals are changing. NRCS is being asked, for example, to quantify how conservation on the land affects soil quality, water quality, range health, forest health, and urban/suburban health and what impacts conservation has on global climate change issues, like greenhouse gases. The NRI includes no specific measures that relate to these important issues.

- Natural resource assessment involves other agencies and the private sector; therefore, partnerships are required. The credibility of NRCS data has been questioned in light of disagreements or disparities between NRCS assessments and those of other agencies, for example, wetland inventories compiled by the Fish and Wildlife Service and forest inventories completed by the Forest Service.
- The panel recognized four functions for natural resource assessment within NRCS. One is to establish base inventories of the quantity, quality and distribution of selected natural resources and their use (e.g., soil surveys, wetlands inventory). Another is to provide management options and advice for the protection of natural resources (e.g., whole-farm planning, ecosystem-based assistance). A third is to develop and apply methods to monitor and account for changes in the use and condition of these and related resources (e.g., NRI). And the fourth is to assess agency performance in terms of resource conservation outcomes.
- NRCS has not recognized the multiple sources of natural resource data within the agency. This has led to conflicting assessments associated with the data source within NRCS. Of note are reports featuring considerable differences between estimates made in the NRI and those made using other data collected on the Conservation Reserve Program and the adoption of conservation tillage. It appeared to the panel that NRCS acquires data about resource condition and use in five major ways: (1) resource surveys characterized by data on distribution, extent, and quality (soil survey, wetlands survey, snow survey, digital orthoquad photography, hydrologic units, remote sensing); (2) inventories that assess resource condition at specific times or over time (formal, science-based inventories, like NRI, and more informal, enumeration-based inventories, like the Conservation Technology Information Center's tillage survey); (3) program evaluation, including status reviews; (4) progress reporting, including accounts of assistance provided to landowners and land managers; and (5) special studies resulting from congressional mandates or internal agency directives.
- Some question the appropriateness of the NRI as the tool of choice to achieve natural resource assessment goals. As a tool, the NRI has the following limitations: (1) content—partly related to changing goals and partly related to inconsistency with other data sources; (2) timeliness—the NRI seemingly is not synchronized with major policy issues in the federal government; (3) definitions and standards; (4) consistency in data collection; (5) quality-control procedures; (6) lack of data analysis within NRCS and limited dissemination of the resulting information both inside and outside of NRCS; (7) an inability to integrate NRI data with other natural resource data; (8) the role of geospatial data in natural resource assessment relative to NRI; and (9) design—sample size, for example.

In the context of natural resource assessment, the matter of partnerships also came up time and again in the panel's deliberations. In the panel's view, NRCS must actively seek to develop constructive partnerships with other federal agencies, with state and local agencies, with its customers, and with other public- and private-sector partners. Many of these potential partners themselves collect data—effectively and efficiently—and there is little reason for NRCS to duplicate their efforts. In some instances, NRCS may not have the technology, resources, or other know-how to even collect certain types of data gathered by other partners. Such collaborations could add considerable value to the data and information of all the partners for resource assessment and other purposes. Cooperation of this sort will require common data collection standards to ensure the comparability of data bases, but common standards should not be insurmountable. In some cases, NRCS may have to relax its own standards so the work of other agencies can be fully utilized, however.

## 5

### Position NRCS in the mainstream of information technology.

#### Sub-Recommendations

- 5a. Establish procedures within the agency to monitor changing technologies and levels of technical sophistication, and report annually to the chief on the position of NRCS relative to the mainstream of technology.
- 5b. Conduct periodic system design and operation evaluations, ensuring that a majority of all evaluation groups established be end-users of NRCS services, (especially farmers, representatives of the business community, and other nongovernmental agencies).
- 5c. Develop system design and procurement procedures that shorten the cycle between technology procurements and reflect a rapidly changing technological environment, emphasizing use of commercial, off-the shelf solutions that provide ease of use, interoperability, and flexibility.
- 5d. Move the agency's computing environment to a distributed, networked client/server architecture with a distributed and networked data base.
- 5e. Convert data bases and user interfaces to commercially available, user-friendly, graphic-user interfaces that are easily programmable and run on fully supported platforms.
- 5f. Equip field offices with geographic information system (GIS) mapping capabilities, and create an infrastructure in field offices to exchange data with farm and ranch operators and other local constituencies in a variety of formats to facilitate on-farm/on-ranch use of computer systems in such site-specific technologies as used in precision farming.
- 5g. Accelerate development and acquisition of digital orthophotos, digitized soil maps, and remotely sensed data bases and, in the process, consider

increased cooperation with other agencies and organizations to provide a national land information data base (see recommendation 4g).

- 5h. Redefine the roles of information resource management professionals within the agency to reflect the present role of natural resources information within NRCS, and train staff in the use of information and information systems, using models to evaluate alternatives in the decision-making process.
- 5i. Improve the educational, technical, and training services available to field offices to ensure that field personnel are (a) able to meet their program management objectives of providing technical assistance, reliable data, and appropriate advice to farm and ranch operators and other land managers and (b) possess the ability to analyze data and monitor the impact of their programs at the farm or ranch and county or watershed levels.
- 5j. Ensure that technical support to field offices is increased to appropriate levels in relation to mainstream information technology while minimizing the bureaucracy involved, which could otherwise reduce budgets and technical support for field operations.

#### Findings

Panel members heard a number of presentations about computer systems, software, and the intended delivery of information to end-users. These presentations contained a great amount of detailed information that was technically sound. Individuals making those presentations articulated a clear but not always consistent vision, and it was apparent to all members of the panel that NRCS has a level of technical expertise in this area that the agency has not begun to utilize fully.

A major problem currently is the age, variety, and operating condition of computer hardware and software available to NRCS field staff. The limitations imposed by this equipment seriously affect the delivery of information at the field-office level to agency clients. Even more significant is the lack of a network to link field offices to state, regional, and national offices.

The consequences of this problem are serious. Data collected and stored as maps, as well as survey questionnaires and reports, remain in county offices. Investment in data collection has been significant, but after a number of years, the bulk of this data is overwhelming. Data are lost through physical deterioration of the paper on which they are recorded or simply discarded after 10 or 20 years to create storage space for current project information. Natural resources do not respond instantly to changes in management practices, and a 20-year time scale may be a valuable time over which to document change. Data files of this nature cannot easily be summarized for state, regional, or national reports, and access to specific case studies for the purposes of documenting agency activity is virtually impossible.

At present, data cannot flow easily or smoothly from the field to NRCS headquarters, and the reverse flow is also impeded. Planned data systems that are capable of delivering suitable information to the end user will require five years or more to become a functional reality nationwide. Panel members were sympathetic to the technical demonstration that such a system is indeed possible, but the rate of change in both hardware and software capability is so rapid that a five-year interval will leave NRCS with a newly installed system that is obsolete.

The panel thus concluded that NRCS does indeed require a new computer system as a matter of great urgency. It is not realistic for NRCS to attempt to be a leader in software development or in the design of information systems, however. This is not within the scope of the NRCS mandate or the agency's structure or budget. At the same time, NRCS cannot accomplish its mandate without a suitable information system to support technical assistance to farmers, ranchers, and other clients and maintain suitable records. Also, the system must be able to provide agency clients with the information they need in a form that is compatible with their own computer systems. NRCS cannot operate successfully unless it maintains an adequate computer system supported by appropriate databases.

Appropriate information technology for NRCS must support a variety of services in the field office of the future, which must be a focal point for action if the agency is to accomplish its mission (see

appendix C). The field office is where many constructive partnerships can and should be formed—with other USDA agencies and additional public- and private-sector clients—and where many value-added services can and will be delivered. The extent of those services must be within the NRCS mandate and address two distinct needs. One of these is the need for data to support technical advice to farmers, ranchers, and other clients—to map information at county and local levels and to provide field-office personnel with the map support they require. This support should include detailed digital maps as demonstrated to the panel. Digital orthophoto quads are a valuable resource for this work also. Such technologies would have wide applicability to land management activities in other agencies, including the Forest Service, Bureau of Land Management, Fish and Wildlife Service, and Geological Survey.

To deliver this service, two forms of computer systems used together would be appropriate. One component would be a large-capacity, high-speed network of work stations operating in a UNIX environment and serving data files from regional and national centers. This network would have the power and capacity to support analysis of spatial data and provide a sound system to support a major GIS activity. A system of this type should reach all state offices and a number of important county offices.

To provide technical advice to farmers, ranchers, and other clients in the coming decades, NRCS will require an ability to offer data products in computer-compatible form. Most requirements will be for personal computer use. Equipping every field office with suitably configured personal computers would permit every district conservationist to provide personal computer-compatible data to clients. The computers should also be connected to the Internet for efficient communication throughout the agency and access to the rapidly expanding computer information services now available through the Internet.

Panel members concluded that compatibility between two such systems can be achieved. Data can be accessed through the main UNIX system, then processed and output as generic files for use in a personal computer environment. This can become an effective way to deliver data from a state, regional, or national center to field offices or other users. The system can also function to provide

information to state-, regional-, or national-level management. It would be possible to manage soils data in this way, as well as NRI data and other data sets maintained by NRCS.

Panel members feel, therefore, that a mainstream position in information technology is important for NRCS to achieve. By "mainstream" we mean a system that uses commercial, off-the-shelf software appropriate to user needs. If farmers, ranchers, or other clients are using Map Info software, Atlas GIS software, or ARC/INFO software, the software available to NRCS personnel should be robust enough to handle multiple data formats. Generic data formats to download from the work-station environment to personal computers should be available, and software tools to facilitate this should be provided. Similarly, tabular data processing should adopt a standard data base (the Forest Service, for example, uses ORACLE), and various types of reporting should, where possible, be configured to use this system.

Because commercial software is frequently revised and up-dated, NRCS would, with a suitable contract, be kept in the mainstream of information technology by those revisions and provided with support services by vendors also. There is an urgent need for a procurement procedure that would permit an appropriate level of upgrade for computer hardware to accommodate the changing requirements of vendor software. The result would be an agency-wide system that could serve many important needs for data transfer and data processing.

NRCS has a further need to define and refine its data collection, reporting, and distribution system. This will require a comprehensive look at the needs of users, and a significant number of end users must be represented in the design and evaluation of the information system.

Panel members also considered the NRCS proposal for FOCS (Field-Office Computing System) in detail. While the panel was not able to understand fully the complexity of FOCS as presently conceived within NRCS, members recognized that FOCS is clearly a comprehensive, wide-ranging system that will be costly, customized, and slow to implement. Although NRCS will have to make its own judgment on the FOCS concept, panel members, after considerable discussion, elected to offer the following comments:

NRCS must implement data and information management strategies to improve its performance in serving its three primary client groups. In its implementation, however, FOCS appears to address administrative needs first and foremost, and only in a more limited way does it address the needs of field offices or national resource analyses. A majority of panel members came to this conclusion after interviews with field-office employees, presentations by NRCS staff involved in the development and implementation of the system, and panel members' own experience with systems outside USDA.

The panel examined this issue from various perspectives and devised comments in each of the following areas: concept, data bases, hardware/software architecture, staffing, and data/information processes and procedural activities that may be impediments to achieving agency goals.

### **Concept—**

The agency has invested substantial resources to identify the data and information needs of its user community and to develop the integrated FOCS to satisfy those needs. It would appear, however, that most input for this activity came from the national headquarters office and the agency's technology center in Fort Collins, Colorado, and far too little from field offices or the agency's user community. Only recently have GIS and aspects of precision farming been added to FOCS, for example. It is, consequently, not surprising to see that FOCS satisfies the needs of staff members in the national headquarters and is technology-driven rather than being the system all field offices are anxiously waiting for.

The agency must aggressively implement an action plan to better integrate field-office needs into FOCS. The following in particular need serious attention: ease of use; user support; e-mail capability; flexibility to adapt to local requirements, interoperability with the computer systems of farmers, ranchers, and other clients; interoperability with home computer systems of local agency personnel; mapping and GIS capabilities; and hardware availability.

### **Data bases—**

By investing technical expertise, experience, time, and resources, NRCS apparently has done an excellent job in designing and implementing the data

bases that will populate the FOCS shell in the medium and long term. The choice of a UNIX operating platform for FOCS and a fair amount of centralization to service and maintain those data bases are probably the appropriate strategy. Also, the network servers the agency will use to create its networked environment will perform well on the same UNIX-based machines.

The problem is that in the current implementation plan the same UNIX platform was chosen as the operating system with which to access the data bases from the field office. Unfortunately, most users are working in a personal computer environment, which creates a heavy burden on agency computer specialists to write many interfaces. This burden will increase as the data bases become more populated in the future, and the agency will have to set new priorities for a shrinking employee pool in the face of further anticipated budget cuts.

Another immediate challenge is the rapid penetration of precision farming. This means the agency must rapidly convert from tabular data bases to spatial data bases and develop the enabling, integrated GIS software, hardware, and network capabilities. To achieve this will, in the panel's view, require accelerated development and acquisition of digital orthophotographs, digitized soil maps, remotely sensed data bases, cropping records, and irrigation records.

The agency must also structure the new and improved spatial data bases for FOCS so that data can be aggregated, analyzed, and published at different levels (local, state, region, etc.) while maintaining the statistical integrity of the data.

### **Computer hardware/software/network architecture—**

At the field-office level, NRCS must create the infrastructure that will enable those local offices to exchange data with farmers and other clients in different formats (paper, electronic files, maps, pictures, graphs, etc.). This capability will facilitate the adoption of site-specific or precision-farming techniques and other environment-enhancing measures. Field offices must also be equipped with a suitable hardware/software infrastructure that will support GIS analysis and mapping.

NRCS must also convert user interfaces to commercially available, user-friendly, graphic-user interface, running on easily programmable and supportable platforms, especially in those areas where the agency is in direct contact with its customers. The agency must also convert as soon as possible to more user-friendly and widely supported alternative GIS software and platforms. This will liberate resources currently involved in the support of GRASS and allow those resources to be reallocated to implementing GIS throughout the agency. FOCS, as currently planned for implementation, will require training and support costs that will be large and difficult to justify. Efforts should start immediately to convert the implementation of the goals, objectives, and functionality of FOCS to more long-term, cost-effective, and sustainable software platforms at the field-office level using commercially available, off-the-shelf software wherever possible.

### **Staffing and data/information processes and procedures—**

NRCS must develop an organizational structure and operating procedures that provide for a coordinated approach to identifying the data and information needs of different agency clients and developing an integrated data management plan to satisfy those needs. This will require that the agency empower employees and provide the appropriate training as well as hardware/software infrastructure to enable local offices to exchange data with each other and with farmers, ranchers, and other clients in different formats (paper, electronic files, maps, pictures, graphs, etc.). It will also require that NRCS improve, throughout the organization, the knowledge, skill base, and practice of spatial analysis. Field staff in particular must attain the ability to analyze data and monitor the impact of agency programs at the farm or ranch and county or watershed levels. Moreover, the agency must fine-tune and complement its ongoing reorganization by creating and specifying the role of dedicated, customer-oriented support teams in the areas of statistical analysis, data collection methods and technologies, and GIS capabilities.

NRCS might also contemplate the cessation of certain activities. This would allow the agency to liberate the resources necessary to implement some of the new initiatives described above. There could

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be other activities as well that the agency will be obliged to stop because they would impede the new initiatives. In the panel's view, the following activities may be of greatest importance to stop: custom development of basic software, and the use of GRASS as opposed to a commercially available and widely compatible GIS software. NRCS should also cease use of a closed, proprietary, and customized UNIX-based development environment for user interfaces and adopt the widely available and easily supported industry standards in a much more open system design. Mainstream programs, such as word processing or data base software, are commonly understood by computer-literate employees. Using these skills and similar mainstream competence in GIS rather than retraining individuals to the customized NRCS software and then re-converting this to mainstream formats for users is important both for its efficiency and the credibility of NRCS.

## 6

### Identify the objectives of each NRCS data collection effort, and articulate its role in meeting the agency's mission and purpose.

#### Sub-Recommendations

- 6a. As an integral part of the data management and planning process (recommendation 2), develop an inventory of all NRCS data programs that includes for each objectives, costs, conditions of access, and primary users.
- 6b. Establish logical links between the detailed characteristics of each data collection program, such as mapping scale and sample size, and the program's objectives.
- 6c. For all major data collection programs, establish how each measured variable contributes to the program's objectives.
- 6d. Monitor the use of NRCS data by external users, and incorporate such information into the evaluation of each data program (see recommendation 3g).
- 6e. Improve the quality of the soil survey program to meet the needs of comprehensive farm planning, ecosystem-based assistance, and precision farming through the following actions:
  - Clarify the contribution of each component of the soil survey program to the agency's mission.
  - Pursue quality improvements in the soil survey using detailed data and precision technologies, including GIS, sensors, and global-positioning-system devices.
  - Reexamine the agency's policies with regard to digital soil survey data and digitizing standards to ensure these do not restrict the ability of field offices to provide their users with access to the widest possible data resource, including data digitized by state and local agencies.

- Undertake an examination of the entire process of soil survey to ensure that digital technology provides the most efficient communication possible between the field soil scientist and the eventual user of soil data.
- Investigate the costs and benefits of adding new variables or themes to the soil survey program that are not available from other sources or of dropping existing variables. For example, might the soil survey program provide a cost-effective source of land use/cover information?

#### Findings

In trying to understand the various data collection efforts of NRCS, through the presentations made to panel members, the documentation provided, and our questions as a panel, we often observed that while data collection was, in each case, either broadly mandated by Congress or generally designed to meet some evident or perceived need either within the agency or externally, it was much more difficult to identify the logical arguments that led from the broad mandate or need to the specifics of the program. For example, while NRI is broadly mandated by Congress as an assessment of the nation's natural resources, we could not determine the arguments that led the agency from that broad mandate to the specifics of sample design or choice of variables. The broad mandate may also have little to do with the actual uses of NRI data and the data's value to a wider user community. In general, the presentations were dominated by details of process, as if the agency's primary concern lay in continuity and procedure rather than in meeting the needs of its various clients.

The transition to digital data has already led to major changes in the ways data are collected, stored, analyzed, and disseminated. In the past, much NRCS effort was concentrated in the production of paper-based information, in the form of maps, tables, or books. In a digital world it is possible to achieve a much clearer separation between the various functions associated with the production of information. The agency that collects data need not be the agency that analyzes the data or adds value to the data by reformatting or interpreting them for certain purposes. We must ask what that means for each of these roles if NRCS seeks to be the nation's premier agency for natural resource

data. In the panel's view, NRCS should focus on what it does best, while building open channels of communication with other agencies, governments, corporations, and individuals to bring all data resources, not just its own, to bear on the achievement of its mission. It should do this at all levels, and be as concerned with empowering field offices to build linkages at the local level as it is with inter-agency linkages in Washington.

NRCS is best known for its production of soils data, and in this area it enjoys an international reputation for excellence and leadership. Because of its access to private agricultural land through its network of field offices, it is also able to play a unique role in collecting data on the state of the nation's agricultural land base, particularly with regard to soil loss and soil quality. In other areas, such as the snow monitoring program, it performs a unique and valuable service in a highly specialized area. Other agencies have unique expertise in other areas of natural resource assessment, and here the appropriate role for NRCS is as a broker between those who collect data and the users who rely on NRCS as their major data source. The ability of NRCS to play this role in the future will derive mainly from the quality of service it is able to provide.

NRCS must deal with three broad categories of geospatial data: framework data, maps, and sample surveys. Framework data are needed as a base for other data, to establish geographic position. In this area, NRCS makes heavy use of the products of the Geological Survey, and partners with that agency in the production of digital orthophoto quads, which are rectified, one-meter-resolution images of the earth's surface. The resolution and positional accuracy of digital orthophoto quads are appropriate for many local and farm-level activities. Map data are collected and used at a range of scales. Because scale is the primary determinant of cost, it is essential that it be matched to the needs of each application. Finally, sample surveys must be used in cases such as the NRI where results at the national level must be derived from locally detailed observations at reasonable cost. Ideally, details of sample size and scale should be established for each data collection program through an analysis of costs and benefits.

In the end, panel members believe NRCS must know its data and its data needs better. The agency apparently does not know in every case what it has or what it may need in the way of data and information.

# IN CONCLUSION

**M**EMBERS of the panel realized from the outset of their deliberations just how difficult it would be to examine all phases of data and information collection, analysis, and dissemination within NRCS.

That time would be a primary constraint was readily apparent, as was the task of understanding, even in a rudimentary way, the sheer breadth and complexity of agency activities. With such limitations in mind, panel members chose to focus their investigation and analysis on those aspects of the agency's data-collection and information-generation activities that seemed most relevant to the agency's future mission.

While the foregoing pages contain some criticism of the agency and its data- and information-related activities, panel members firmly believe that NRCS is the nation's premier conservation agency with respect to private land resources. No other agency has mapped soils or measured changes in the land and its use to the extent that NRCS employees have, or done so as well. No other agency has employees with the capacity to interact on technical natural resource management issues as effectively with landowners and managers as NRCS does.

In spite of these strengths, however, the panel observed important shortcomings that members believe NRCS must address if the agency is to maintain its position of preeminence in natural resource conservation on private land at the federal level. Much of the data currently collected and disseminated by NRCS is in response to congressional mandates or the needs of specific clients. While the agency has a great deal of data, therefore, many of those data are oriented toward the specific purpose for which they were collected, with little or no relation, or integration, to other data. This has resulted in a number of anomalies and embarrassments for the agency. More importantly, it prevents the agency from truly fulfilling its mission because it does not recognize the role of information in doing so. The panel thus found that while NRCS has significant amounts of data, the agency has not been able to convert those data to the information needed both internally and externally for policy and operational purposes. The panel's recommendations thus are intended to guide NRCS in collecting the data needed to fulfill its mission and to convert those data into information that can be provided to

clients within and outside the agency. At the same time, the panel suggests that NRCS use whatever means are available (partnerships with other agencies and the private sector) to collect those data the agency needs to accomplish its mission.

The six recommendations and accompanying sub-recommendations, if fully implemented, will require important changes in the agency's structure, procurement procedures, training of employees, and other traditional ways of doing business. But the agency has little choice, in the panel's view. Monetary and human resources are becoming ever more limited, and demands from users of NRCS data and information threaten to outstrip the agency's capacity to deliver the anticipated services. Moreover, other public- and private-sector interests have or may soon assume the roles and functions traditionally belonging to NRCS. To remain relevant, panel members agreed, NRCS must rethink its data and information activities in a way that will allow the agency to use its rich data resources in far more information-effective ways than it has in the past.

## Who the Blue Ribbon Panel Listened to

### March 5-6, 1995 Meeting

Panel Charge and Perspectives on the New Natural Resources Conservation Service

*Sherman Lewis & Rich Duesterhaus, NRCS*

Government Performance and Results Act

*Kathy Gugulis, NRCS*

Geospatial Natural Resource Information Coordination and Overview of Activities

*Gale TeSelle, NRCS*

Natural Resources Inventory Program and Database

*Jeff Goebel & Jerry Harlow, NRCS*

Progress Reporting

*David Doss, NRCS*

Program Evaluations

*Jim Lewis, NRCS*

Soil Survey Program

*Dennis Lytle, NRCS*

Natural Resource Strategic Database Initiative

*David Anderson, NRCS*

### April 21-22, 1995 Meeting

Reinventing NRCS

*Gene Andreuccetti, NRCS*

The Resources Conservation Act Process and National Policy Support

*Peter Smith, NRCS*

Demonstration of GIS and Other NRCS Capabilities and Products

*Gale TeSelle, NRCS*

Information Needs: Administration and Congressional Perspectives

*Tom Hebert, Natural Resources and Environment, USDA*

*Stuart Kasdin, Office of Management and Budget*

*Luther Atkins, General Accounting Office*

*Ed Linderman, Office of Inspector General, USDA*

Information Needs: The Economic Research Service Perspective

*Tim Osborn, Economic Research Service, USDA*

Information Needs: Private-sector Perspectives

*Ken Cook, Environmental Working Group*

*Margaret Maizel, National Center for Resource Innovations*

The Role of the Progress Reporting System and Other Data Collection and Analysis Activities from NRCS Program and Budgeting Perspectives

*Tom Weber & Bob Reaves, NRCS*

The Panel's Charge

*Paul Johnson, NRCS*

### May 11, 1995 Tour

Fort Collins, Colorado Technology Center:

Overview of NRCS Application Development

*Owen Unangst & Team Leaders, NRCS*

FOCS Demonstration and Discussion

*Jack Carlson, NRCS*

FGI-FOCS Geospatial Interface & Common Land Unit Tool

*Kevin Wickey, NRCS*

Hydraulic Unit Water Quality

*Frank Geter, NRCS*

National Soil Information System

*Ken Harward & Russ Kelsea, NRCS*

PLANTS Database

*Wendall Oaks, NRCS*

**Fort Morgan, Colorado Field Office:**

Overview of Field Office Operations

- NRCS Business Applications
- InfoShare

Overview of Field Office Use of Geospatial Tools

Geospatial Data Applications (precision farming)

*C.J. Scott, NRCS*

**May 12-13, 1995 Meeting**

Implementation of the Field Office Computing System-FOCS

*Gene Renken, NRCS*

GIS and InfoShare: A Field Office Perspective

*Jeff Hart, NRCS*

Creation and Use of Information for Resource Analysis, Conservation Planning and Program Management at State and Local Levels

*Duane Johnson, NRCS*

Data and Information Needs: A Nonfarming Perspective

*Bill Broderick, Denver Council of Regional Governments*

Data and Information Needs: A Conservation District Perspective

*Glen Anderson, Colorado Association of Conservation Districts*

Data and Information Needs: A Precision Farming Perspective

*Chris Johannsen, Purdue University*

A Remote Sensing and Global Positioning System Update

*Dorsey Plunk, NRCS*

Status Report on GIS and Other NRCS Data Collection and Information Activities

*Gale TeSelle, NRCS*

Status Report on the Forest Inventory and Analysis

*Hans Schrueder, Forest Service*

**June 13-14, 1995 Meeting**

The Oregon NRI Pilot: An Update

*Jeff Goebel, NRCS*

Conservation Technical Assistance: An Evaluation

*Jim Lewis, NRCS*

Ecosystem-based Assistance and Whole-Farm Planning: The NRCS Perspective

*Marc Safley, NRCS*

Information Needs: A Congressional Perspective

*Craig Cox, Senate Agriculture Committee*

Discussion with Deputy Chiefs and Regional Conservationists

**July 13-14, 1995 Meeting**

Executive Session and Discussion of Findings and Recommendations with Paul Johnson, Chief, NRCS, and Pearlle Reed, Associate Chief, NRCS

# APPENDIX B

## Natural Resources Conservation Service Data

Name of the data	What is in the data	Why we collect it, including the legal basis	How we collect it and who collects it	Where is data repository and in what form is it technically available	What it costs per year	Who are the primary customers	Who are the secondary customers	Frequency of annual requests	Use and function from a legal basis
FSA status and quality reviews	HEL acres, FSA compliance determinations, erosion rates, erosion reduction, residue levels, and FSA practices (for 1995)	Internal accountability document, FSA accomplishments and progress	Stratified random sample of HEL compliance plans for producers requesting USDA benefits	National Computer Center ASCI	Field data collections, \$7 million; Processing, analysis, and administration, \$200,000	Congress, OMB, USDA administration, agency policy officials, agency program, managers at State and national levels, Environmental groups, conservation districts	Producers, academia, public, and press	States queried biweekly for summaries. Aggregated nationally 200 requests/year	<ul style="list-style-type: none"> <li>Federal managers</li> <li>Financial Integrity Act</li> </ul>
Progress Reporting System (PRS)	Accomplishments at the field office, including: services, conservation planning, conservation practices, FSA activities, and conservation effects	To respond to inquiries and report to the Congress, OQC, USDA, GAO, OMB, and other interested groups. To manage the agency's resources. To track progress towards achieving goals and objectives.	At the field office through manual form to electronic data input. Aggregated at each area, State, and NHQ for summary reports.	Data aggregated to area, State, and NHQ Prelude	\$4.2 million	Program managers at all levels of the agency; Other NRCS staff and individuals	Congress, OMB, USDA, OGC GAO, special-interest groups	1 national report Quarterly reports for FSA	Public Law 46
CTA	Land use and land management data	To support conservation planning at the farm and community level	At the field level, conducting field inventories, by resource conservation specialists	At the field office as part of conservation plans	\$130 million	NRCS, public	Anticipate many, specifics forthcoming (scheduled completion 3/96)	1,000+	Public Law 46
Soils	Physical and chemical properties and proportional composition of delineation	To assist in resource management and planning	Selective on-site sampling and remote sensing	National GATT-ARC GRASS	\$70 million	NRCS, farmers, and planners	Model developers, resources consultants	1000+	<ul style="list-style-type: none"> <li>USDA Appropriations Act for FY 1996</li> <li>Soil Conservation and Domestic Allotment Act 1935</li> <li>Soil Information Assistance for Community Planning and Resource Development Act.</li> </ul>

Water	Annual, monthly, daily and peak stream discharge, reservoir elevation and storage, water quality parameters	Water supply forecasting, irrigation water management, short-term phenomenon (floods and droughts), hydrologic analysis and design, and NRCS natural resource modeling support	Shared and exchanged with other governmental and private data bases through a variety of media	Climate Data Access Facility (CDAF), Portland, Oregon	\$400,000	NRCS client services, NRCS engineering design, water managers, and agricultural forecasters	NRCS scientists, government agencies, research community, and academia	26,000+ remote access of DB in 1994 to all of CDAF data resources.	Public Law 46 memorandum 870. Assists in wetlands, HEL, FSA, water treaty activities
NRI	Over 100 elements collected per site sample fields: irrigation, erosion, rangeland, cropping history, type of land ownership, and land use	To assist in program assessment and policy evaluation	On-site and remote sensing	National Cartography and GIS ASCII, CD	\$8.4 million	Congress, USDA, GAO	Private environmental and resource consultants, academia	100 national CDs sold Numerous requests at State, regional, and national levels	1972 Rural Development Act Soil and Water Resources Conservation Act 1977 RCA
Snow	Snow water equivalent, snow depth, snow density	Water supply forecasts, snow management, design characteristics (snow loading)	On-site manual, automated sensors— SNOTEL (meteor burst technology)	Climate Data Access Facility (CDAF), Portland, Oregon	\$3.1 million (total program cost)	NRCS client services, water managers, agricultural forecasters	NRCS scientists, government agencies, research community, and academia	26,000 remote access of DB in 1994 to all CDAF	USDA administration regulations IAR180, Chapter 2
Wetlands	Wetland delineation	Food Security Act	On-site and remote sensing	Maintained at State and aggregates to national DB.	\$? million	CFSA, public, NRCS	Local planners, other federal agencies, and academia		FSA Farm bills RCA
Climate	Temperature (air and water), precipitation (annual, monthly, daily, hourly, 15-minutes), evaporation, wind speed and direction, solar radiation, humidity, and visibility (PM10)	Natural resource conservation applications needing spatial data (PRISM), NRCS natural resource modeling requiring value-added point data, wetland determinations, engineering design, soil and water quality, soil erosion prediction, wind erosion prediction.	Digital data sets from the National Climatic Data Center, regional climate centers, other Federal agencies, State and local governments	Climate Data Access Facility (CDAF), Portland, Oregon	\$500,000 (total program cost)	NRCS, NTC, State and field offices, NRCS cooperators, public and private clients	Department of Agriculture: FS, ARS, ERS, NAASS, FCIC. Other Federal and State agencies: USGS, NWS, BIA, BOR, BPA, COE, EPA	26,000 remote access to CDAF in 1994 for all of CDAF data	Public Law 46, Memorandum 870, assists in wetlands, HEL, FSA, treaty forecasts

# Natural Resources Conservation Service Data Continued

Name of the data	What is in the data	Why we collect it, including the legal basis	How we collect it and who collects it	Where is data repository and in what form is it technically available	What it costs per year	Who are the primary customers	Who are the secondary customers	Frequency of annual requests	Use and function from a legal basis
River Basins	Status, area extent, purpose of projects, conservation practices, geographic location, cost	Budgeting, targeting of projects, informing staff and public, program evaluation	Compiled from field office information and state reports	NHQ Prelude	\$4 million	NRCS, Congress, OMB	Other government agencies, partners, academia	50+	<ul style="list-style-type: none"> <li>Public laws</li> <li>Executive order</li> </ul>
RC&D	Individual measures of each district activity including cost, practices, and partnerships	Program management and oversight	On-site by RCD offices	State offices Official, NHQ Prelude	\$2 million	Congress, NRCS, RCD program managers	Partners, Forest Service	NHQ reports twice/year, 4+ congressional requests, Occasional public requests	<ul style="list-style-type: none"> <li>Public Law 9798 Subtitle H, Section 15733, used for progress reporting</li> </ul>
Watersheds	Status, Area extent, Practices, Cost, and Location	Budgeting, targeting of projects, informing staff and public, program evaluation	Compiled through field office input and report review	NHQ Prelude	\$5 million	NRCS, Congress, OMB	Local planning groups	200+	<ul style="list-style-type: none"> <li>Public Law 46 and 566</li> <li>Executive orders</li> </ul>
Digital Orthophoto-Imagery	Datum, Geographic extent, pixel reflectance values	Assist in conservation planning at field level, support compilation of soils information, support framework efforts	Remote sensing by private contractors; USGS produces final product	USGS, National Cartography and GIS Center	\$5 million	NRCS, partners	Ag. consultants, area planners, academia	Varies on product: Digital, MOSAIC, hardcopy 20,000 DOQ in progress	<ul style="list-style-type: none"> <li>Soil Information Assistance for Community Planning and Resource Development Act.</li> </ul>
Tillage (CTIC)	Amount of conservation tillage by type and county	Estimate trends and adoption of conservation technology	Drive transects	CTIC West Lafayette, Indiana	\$800,000 (total CTIC budget)	CTIC, ag. community	Ag. consultants, implement designers, ag. chemical companies, academia	300+ estimate	
Wind Erosion Survey	Data collected for 10 Great Plains States, including: land damaged, crops destroyed, condition to blow, occurrence of wind storms, planned treatment, WEG, and controls taken	To determine land/crop damage as a result of wind erosion	On-site and remote sensing	State offices	\$? million	NRCS, conservation districts	Academia, local governments, planners	100+ estimate	<ul style="list-style-type: none"> <li>Land inventory and monitoring: Memorandum TX-4, 1978</li> </ul>

*In drafting a final report, panel member Michael Goodchild described his perceptions of an NRCS field office of the future. Panel members later agreed that his narrative should be included in this report.*

## The Field Office of the Future

**A**LTHOUGH NRCS has traditionally provided something approximating a uniform level of technical advice and service in each of its offices, we encountered a range of facilities in our work as a panel, particularly in the area of technology. Some field offices are clearly adopting technology more rapidly than others, and they have found ways to explore new models of operation.

### Specialization

In the future, we see the pressures of a diminishing NRCS budget, the growing importance of state and regional offices, and the potential of electronic communication technologies leading to a geographic restructuring of the number and locations of field offices, as the traditional face-to-face interaction with the customer may become less necessary. With agency support, it will be possible for field offices to concentrate their expertise in particular areas and to offer advice over a much wider geographic range than previously. This will require careful planning by NRCS as it tries to balance each of these trends with its sense of its own mission. It also implies greater flexibility vertically within the agency because it will permit field-office functions to be co-located with state and regional office functions, while retaining contact with customers as a defining characteristic of the field office.

It may be desirable, for example, for field offices to move away from a geographic basis of operation to a system in which service is specialized by the dominant issues of each ecoregion, or by the needs of distinct socioeconomic groups—family farmers, agribusinesses, municipal water districts. The extent to which this is desirable remains to be seen; our point is simply that it is now technologically possible.

### Data

The field office of the future will need to take a more general view of data than at present. Of major importance to farmers high on the technological curve will be data sets that provide a geodetic framework to which other data can be registered. Framework data sets include the geodetic control network and the digital line graph data of USGS; of particular importance to resource conservation are the digital orthophoto quads, which are one-meter-resolution images with high positional accuracy. Commercial versions of these images are also likely to become available in the near future. We see the field office of the future as playing an increasingly important role in facilitating the provision of such framework data to customers; advising on suitable sources, both commercial and public; and perhaps even assisting in the use of these tools. Field offices might offer services that add value to such standard data sources, such as software for vectorizing field boundaries from digital orthophoto quads or for classifying use practices from multispectral data.

The agency will also need to be able to provide thematic data, such as soil surveys. At present, the lack of funding and the rigorous quality control standards adopted by NRCS appears to have greatly reduced the acquisition of new digital soil survey data. We suggest that a relaxation of standards and a reorientation of the program away from nationally determined priorities and toward the regional offices, field offices, and the needs of NRCS customers may help NRCS provide better service in this area. In particular, we urge NRCS to rethink the concept of the soil survey to be more consistent with the other elements of our technological vision for the field office of the future.

In the reverse direction, the field office of the future should expect to be able to receive and process data collected by many of its traditional customers, including farmers, ranchers, and local agencies. In some cases it may add value to those data, through programs that obtain and synthesize complete coverage of watersheds or ecosystems from many sources, to satisfy some specific programmatic objectives.

Whether data are produced by NRCS or acquired through partnerships with customers, we believe the field office of the future should possess the technologies necessary to allow customers direct access to

databases. There are technical problems to be overcome, of course, in dealing with security and the maintenance of data integrity. But there are also exciting returns in improved service, and we envision the field office of the future as a shared data resource for all parties in its service area concerned with resource conservation. We believe data sharing is a powerful mechanism for helping communities reach common goals and for improving the participation of communities in the decision-making process.

### **Software and hardware**

To be effective in this environment, it will be necessary for the field office of the future to be technically operational across a much wider range of software and even hardware than currently. It should offer advice to its customers on their own acquisition of hardware and software and have the ability to accept and distribute data on a range of formats. It should develop new analytical capabilities and take the lead among its customers in exploiting technologies, like geographic information systems and global positioning systems, to support conservation objectives. The potential also exists to partner with customers in generating data collection activities relevant to resource management.

### **Training**

This vision of the field office of the future assumes a level of technical expertise on the part of field office staff that goes far beyond what is currently available. Because education is a slow process, we believe NRCS should plan now, by reexamining the job descriptions of field office staff, developing training programs geared to its vision of the future, and partnering where appropriate with educational institutions to provide the necessary courses.

Training may also be one of the most useful functions the field office of the future can provide to its customer base. The emphasis in NRCS field offices has always been on the provision of technical advice. As conservation technology changes, it makes sense for the advice provided by NRCS to change with it and for the agency to ensure that its advice is always of the kind likely to provide the most cost-effective outcomes. Training should take advantage of new technologies; for example, NRCS could develop a series of training modules for its customers and make those modules available on the World Wide Web. Possibilities also exist for NRCS

to engage in some level of privatization with respect to resource management training and program implementation.

### **Institutional economies of scale**

We commented earlier on the potential for rethinking the relationship between field, state, and regional offices as communication technologies become more powerful. Similar comments can be made about the potential for co-location with other federal outreach agencies, including the Farm Services Agency, Rural Economic and Community Development, and Extension Service. In the first instance, sharing of space, hardware, software, expertise, and data may help each program move up the technological curve more rapidly; the efforts in Osage County, Kansas, are an example of the potential here. In the longer term, we urge the agencies to work together as each struggles with the same issues of declining resources and changes in the significance of geography in programs that have traditionally provided face-to-face interaction with customers.

### **Customers**

NRCS has built its reputation on the level of technical advice its field offices provide to traditional customers. The field office of the future should be given the opportunity to address the needs of new communities of customers, as this becomes possible through new technologies, or as it is deemed appropriate to the NRCS mission. Each new community will have its own needs and levels of expertise, and we envision the field office of the future to be much more flexible than in the past in accommodating the expanded range of potential customers and in measuring progress against the mission of the agency.

### **Responsiveness**

Underlying many of these suggestions is our belief that much of the strength of NRCS derives from its close relationship to its customers, particularly private landowners. As technology changes and exerts impacts on many aspects of our lives, it is essential that NRCS maintain its credibility as a source of technical advice. To do so it must possess the right skills and be responsive and adaptable, and the agency must, therefore, make every possible effort to ensure that its field offices operate with as much flexibility as possible within the constraints of good management.

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