Using Scientific Input in Policy and Decision Making

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Policy decisions increasingly involve scientific or technical issues.

Policy making usually is more art than science, creating policies from a shifting palette of social, political, legal, economic, and environmental concerns. However, policy decisions increasingly involve scientific or technical issues. Technology has grown more complex and pervasive, and planning has become more widely employed and systematic.

Policies and laws have come under scrutiny in the courts, and scientific input has been sought as a basis for fair decisions. For example, legal challenges to forest management practices in the Monongahela National Forest led to creation of the National Forest Management Act. Today, national forest management and policy decisions often involve computer models and detailed analyses of alternatives—complex treatments seldom seen before this Act.

The increasing use of science is seen at all levels of policy making and in many different roles. Scientists testify before state and federal legislatures, local zoning boards, planning commissions, and resource management agencies. Scientists work on committees to define problems and develop solutions for all these policy-making bodies. Scientists prepare reports and analyses of policy options and recommendations. Special

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interest groups bring in scientists to support their preferred position. A scientist may be making policy decisions as an elected or appointed official.

Unfortunately, attempts to improve policies by applying scientific information often are less than successful. There are many contributing reasons. Scientific literature often has not been understandable to people outside the specialty and may be relatively inaccessible. Information might have been extended beyond its context when the policy was made. Policy makers may have learned only part of the relevant research, particularly if experts presented partial or biased information. The scope of technical input often has not included the full range of social, legal, institutional, or economic concerns relevant to the policy decision.

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This publication offers some concepts that policy and decision makers, as well as concerned citizens, may find useful when dealing with technical issues. It highlights a methodical approach to the policy process, discusses sources and attributes of scientific information, and provides guidance for identifying and using reliable information.

The Policy Process

Policy development seldom entails only a single decision on an issue. Effective policy formation is a process that begins with searching out the real issue and continues through adjusting policy to new conditions or knowledge. Science has benefited from a systematic approach to problem solving; so too can policy development.

Potential steps of a comprehensive policy process are:

- Identify and describe the key issues.
- Clarify root causes (not blames).
- Define the problem, deciding on focus for action.
- Identify policy constraints (e.g., legal, physical, economic).
- Develop alternative policy responses.
- Evaluate consequences of the alternatives.
- Make policy decision and implement policy.
- Evaluate implementation and results achieved.
- Adjust policy as needed.

Scientific input may be useful at any of these steps. The critical point is to fully evaluate the problem and follow through the process, realizing that a policy decision does not necessarily lead to adequate implementation or that it may need adjustment over time.

It also is important to outline the scientific information relevant to the issues. Relevant information for a land-use decision might include site-specific components such as land-use history, vegetation, soils, and topography, often obtained from specific land records or basic resource maps. Other relevant information may be based on general principles from scientific research, such as likely impacts of a management practice or role of the area in regional wildlife or fisheries habitat.

Seeking scientific or technical input early in the process helps both the policy makers and scientists obtain a clearer idea of goals and possible implementation strategies. Scientists studying a topic may be aware of impending problems long before the general populace; for example, spotted owl researchers had information in the 1970s about declining populations and suitable habitat, although policies were not changed enough to prevent escalation of the situation into the 1990s. Scientists can clarify misconceptions (e.g., forest preserves remain the same forever), allowing discussions to proceed more productively. Social scientists may help identify some of the root causes of problems, including people's preferences for outcomes and processes for making decisions.

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Involving stakeholders—groups or individuals significantly affected by the policy—from the beginning also is worthwhile. Developing the contacts and organizing involvement may require a slow start, but this may be compensated by fewer misunderstandings and greater information exchange.

Involvement of scientists and stakeholders is valuable past the policy decision through implementation and evaluation. A sound idea can be presented and incorporated in a policy, but inadequate implementation may produce poor results. Going through these steps in a systematic manner can be helpful in consistently forging effective policy.

Issue Identification and Refinement

The first step of identifying the problem and its causes is crucial, yet often dismissed as obvious. A stream sedimentation problem on forest land, for example, may originate not from logging, but from poor road maintenance practices. Without such clarification, policies focused on timber harvesting may be ineffective and costly, addressing the symptoms and not the disease. It may be impractical to address the underlying causes every time; the problem may be too large to approach with the resources at hand, or the cure may be worse than the problem. Nonetheless, the decision to sidestep part of the problem should be explicit, and should consider how proposed policies might affect the more fundamental problem and underlying causes.

The issue must be defined in a way that can be resolved, where different sides perceive a common concern. Rather than defining issues in a way that encourages divisiveness, issues should be defined around a shared concern that allows problems and constraints to be addressed from different viewpoints. For example, public concern may be expressed about wetlands protection, but limiting the issue to delineating set-asides excludes concerns of landowners and alienates them from productive discussion. Including constraints of land ownership and an array of options for protection will not eliminate contention, but it may promote a realistic solution.

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For any situation, there may be several issues involved. Exploring the different types and facets of the issues provides background to define the problems. Types of issues include those of substance (distribution of physical resources), procedures (whether fair and inclusive), and relations (changes in status, power, respect). Procedural issues—how the public is informed of and involved in decisions—may be a key source of disagreement in one situation. Another situation may have agreement on procedures, but disagreement on a substantive issue, such as acceptable timber cutting levels.

An expressed concern also may be a symptom rather than the root cause. Preventing development of wetlands may be a goal, but it also could be part of an overall desire to limit urban sprawl or exclude additional development from a neighborhood. Invest time at the beginning of the policy formulation process to establish the true nature of the problem and the extent to which public policy can affect it.

Alternatives and Consequences

Consider a range of policy approaches. Options include education, research, technical assistance, market forces, incentives, and regulation. Regulation may seem like the most effective approach, but it may not build toward the desired long-term behavior or goal. In situations where regulation may be needed, a complementary policy of targeted education to explain the reasoning and goals of the regulation may increase overall effectiveness. Regulations perceived to address a commonly accepted positive goal can be easier to implement and enforce.

The development of alternatives and their associated consequences is important for any decision making, especially for public policy. Exploring the results of alternatives as "consequences" rather than as "pros and cons" is helpful in keeping discussions objective and issue-focused. Table 1 shows a brief example. This tool also helps bring out premature or implicit value judgments, and helps prevent decisions based on the absolute number of entries in lists of "pros and cons." Development of policy alternatives may require educational as well as technical efforts. Public education on the technical subject may be vital for accurate judgments about problems and solutions. Survey research or approaches from social science may be as applicable to the policy process as the more traditional scientific information. Public policy education should clearly present a description of the problem, limitations or scope of policy solutions, and direct and indirect consequences of policy alternatives.

Table 1.—*Examples of some alternatives and consequences for addressing natural resource concerns on heavily grazed public rangelands.*

Management alternatives	Consequences
Stop grazing	• vegetation and wildlife changes likely • lose production, income, and tax revenue • resources impacts may shift to other regions or private lands
Reduce number of animals	• lower production, income, tax revenue • vegetation changes related to number reduced
Fence streams	• costs of fencing and alternative water sources • streamside vegetation recovery • improvement in stream habitat and water quality
Alter seasonal use	• administration more complex and costly • potential animal weight loss from transfers • improvement varies in response to weather patterns (wet or dry year)
Restore fire regime	• bunchgrasses likely to increase • time delay to use area for grazing • public concern over smoke and fire hazard
Use supplemental feed	• higher costs for feed • labor and equipment needed for delivery • weight gain from better food and reduced animal movement • vegetation improvement likely
No action	• vegetation may decline in ability to support current grazing intensities • water and habitat quality remain reduced or may decline further

Risk Assessment

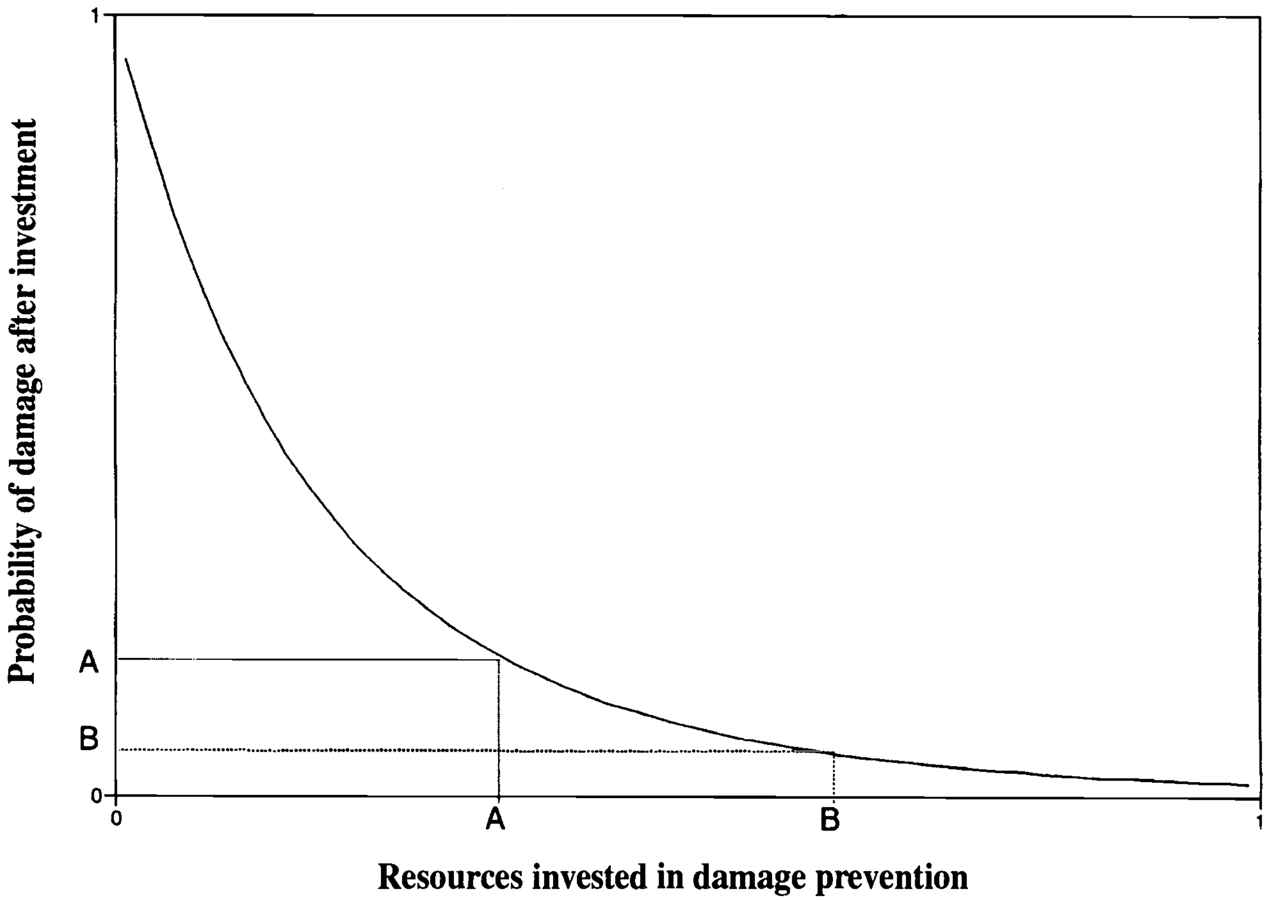
Many policy decisions inherently involve an assessment of and decision about risk to the public or a resource. This assessment may or may not be explicitly recognized and treated in the policy process. Risk assessment basically involves two factors: 1) probability of an undesirable occurrence, and 2) severity or degree of impact. A large storm and flooding may be very likely in a certain area, but if there is little in the floodplain to be damaged, the risk is perceived as low. In an area with many houses in the floodplain, the risk is much greater and could trigger concern for action.

Risks can be catastrophic, like a flood, or pervasive, like air pollution. Risks can be voluntary, like skiing, or involuntary, imposed upon a captive population. Involuntary risks are usually the most unpalatable to the public, and catastrophic risks often get the most attention. Airplane crashes, infrequently killing hundreds, generate perceptions of greater hazard than auto accidents, even though in total more people die in cars.

A policy normally cannot eliminate risk, but it can manage situations to achieve the lowest risk at the lowest cost (Figure 1). Scientific information is often couched in terms of probabilities or certainty of results, which is a good basis for obtaining information on relative risk. However, the policymaker must take the challenging step that blends science with real world concerns to make a value judgment on acceptable levels of risk for the situation.

The policy maker must take the challenging step that blends science with real world concerns.

Figure 1.—***Example of risk assessment. (Note that investment A reduces probable damage about 80%, but twice the investment, case B, further reduces probable damage only a small amount.)***



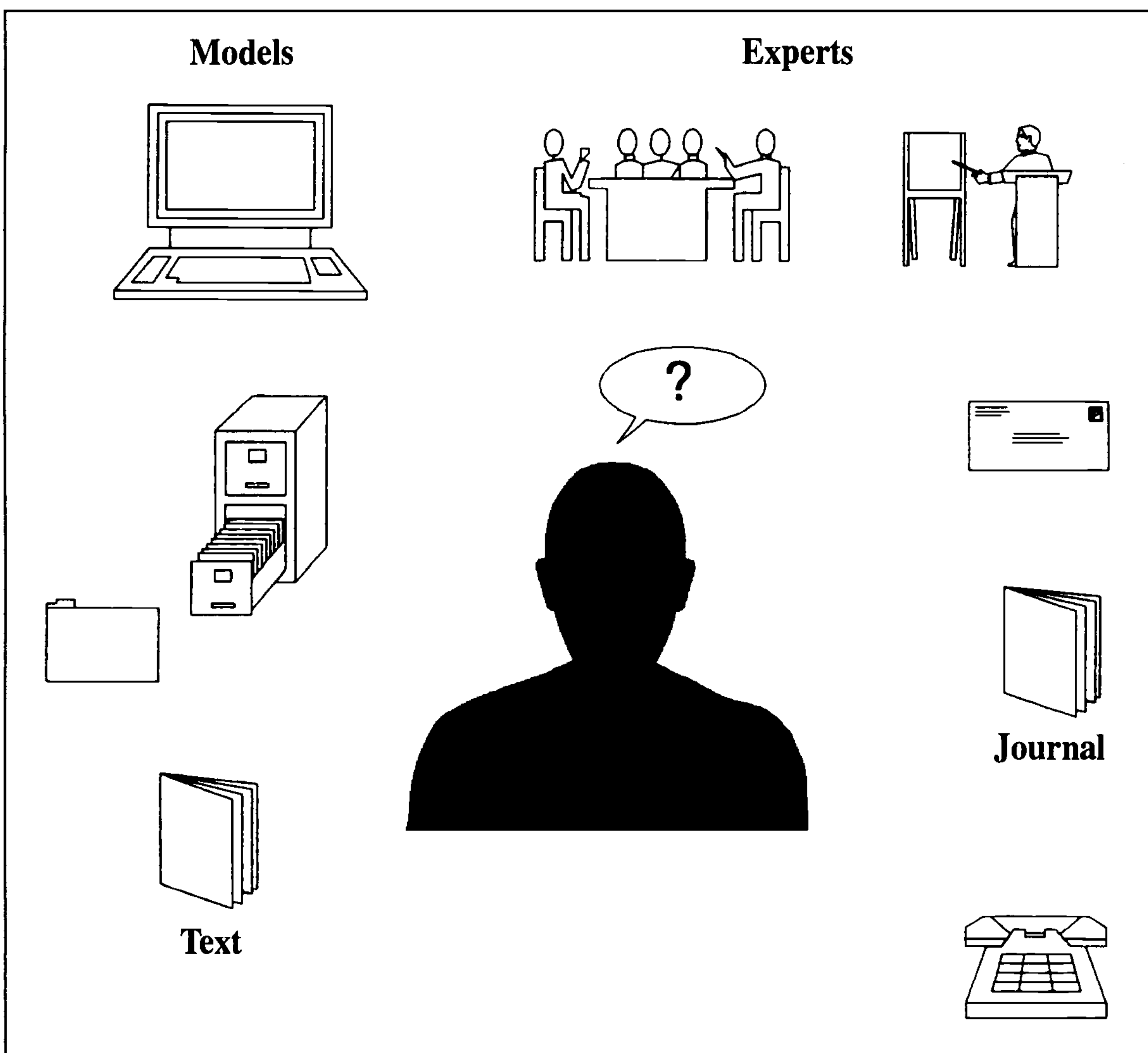
Implementation

Evaluating policy implementation and effectiveness are critical steps, and remind us that effective policy is an ongoing process, typically needing periodic reinforcement or adjustment. This step sometimes is forgotten, or is conducted with limited resources, which detracts from long-term effectiveness. Explicitly monitoring and evaluating results of implementation can be an invaluable tool for learning about the nature of the problem. It also can identify promising directions for adapting the policy. The expertise of scientists can contribute greatly to the development of monitoring and evaluation efforts.

Sources of Scientific Information

There are countless sources of scientific and technical information: textbooks, published scientific papers, conference proceedings, computer models, position papers from professional or advocacy groups; and government agency staff, industry employees, consultants, or people with practical experience and "conventional wisdom" on the issue. The abundance and tremendous volumes of information can be overwhelming (Figure 2), although any one source may have only marginal relevance to the policy problem. All these sources can give valuable information, but they should be evaluated with an awareness of the origin, possible inherent bias, and other limitations.

Figure 2.—***Sources of information.***



Experts

Policy makers often draw in people to serve as experts and interpreters of complex scientific knowledge on a particular subject. Experts are commonly used, as individuals or a panel, because they can quickly synthesize technical information relevant to the situation at hand. Scientific experts also can provide access to the latest ideas in the research community, although this advantage must be balanced by the risk of using information without external review or with incomplete analysis.

Finding initial contacts for reliable expertise in unfamiliar fields can be baffling, but several sources are available (Table 2). Even if initial contacts are not suitable or available to serve as experts, they often can be a link to the spectrum of other experts available in the specialty.

Table 2.—*Some sources of experts.*

Source	Comments
Information databases	• may or may not be objective, comprehensive • few now exist, but number expected to grow
Professional societies	• promote professional standards, credibility • often can access diversity of perspectives
University research or Extension program	• public education and research mission • relatively independent and objective • may lack experience in policy implementation
Government agencies	• public service mission • specific mission or organizational culture could affect perspective, objectivity • may lack perspective of non-agency groups or individuals
Affected or regulated group	• organization or personal goals can affect perspective, objectivity • may have practical experience related to policy implementation
Associations (trade or issue-based)	• depending on charter, goals can affect perspective • expertise may vary

Evaluating Expertise

Points to consider when involving experts in policy decisions include likely perspective or possible bias of the source and the basis of expertise. "Experts" can represent a variety of experience, knowledge, and perspectives. Many types of experts can be used constructively, but it is critical to assess the reliability and context of information provided. The employer, financial support, or type of professional training can influence an expert's position.

When expert witnesses are used in legal or administrative proceedings, experts present proof of their expertise—both education and experience—that can be questioned by either side and examined for suitability. In other roles such as committees, scientific experts are often heard without a full evaluation of their expertise. Although cross-examination is unnecessary, people presenting information as experts should be asked for information on their education (both formal and informal) and nature and scope of experience (Table 3). Data or studies that support particular positions or opinions also could be requested.

In establishing reliability of experts, several criteria can be used: education, experience, professional certification and associations, licensing, and credibility with peers. Look at the formal educational background. Does it relate to the topic under discussion? How is it likely to affect the expert's perspective? Is the experience in the same geographic area (especially if information on local effects is being sought)? Is the expert have familiar with the legal and political aspects of the issue as well as the scientific information?

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Table 3.—*Questions to ask scientists and technical advisors.*

- What educational background and training do you have in this field?
- What types of work have you done in this field and for how long?
- Do you have direct experience in resource management or policy applications of technical information?
- What specific data or studies are the basis for your statement or position?
- Have these been evaluated by other scientists (e.g., peer review)?
- Do other scientists share your views? Who doesn't? Why?
- Are you or is your employer concerned about the implications of this policy (the precedent) beyond the particular project or decision? What are the concerns?

Even a consultant may have a personal opinion or bias that affects the information presented.

Not every expert needs to have comprehensive and local experience to be valuable. Keep in mind that the time and effort needed to be an expert in one field can lead to profound gaps in awareness and knowledge of other areas. Panels or committees provide a greater depth and breadth of information than a single expert, but this approach typically requires a greater time investment and schedules may be more difficult to organize.

Policy makers should consider the role of experts within their organization. Are they simply representing the agency or industry position or can they directly influence or establish the position? Even a consultant may have a personal opinion or bias that affects the information presented. An expert who will be unaffected by the outcome (e.g., no contingency fees or local relationships) may have less personal interest or organizational bias.

If the profession has licensing or certification (e.g., engineering), check to see whether the expert is licensed. Licensing establishes a minimum level of competence or knowledge, and usually provides ethical standards for truthfulness and completeness in statements or results presented. If the professional is unlicensed, you could check into membership in professional organizations. Most professional organizations have a code of ethics, although this does not carry the accountability of licensing.

The reputation of a scientist among peers can be a good basis for judging reliability and objectivity if a number of candid opinions are available. Use caution, however; name recognition is often mistaken for appropriate expertise. The most visible personality, or the most vocal, is not necessarily the most well-informed source, nor the most objective. Many outstanding scientists work "quietly" and do not often venture into the policy arena.

Experts in Implementation

In addition to scientific experts, people with practical experience and personal knowledge can be used. Their insight is valuable, but this should be evaluated in a different manner than comprehensive scientific research. Keep in mind that results observed in one situation may not necessarily extend to others. This problem can be severe in natural resource issues, where different regions or land types may respond very differently to similar practices. However, the knowledge of field personnel and landowners may be invaluable for developing practical and effective methods of implementation.

Technical versus Policy Input

When an expert is directly involved in policy formation, he or she may go beyond the originally intended role of providing objective facts. An expert has a certain authority or power from specialized knowledge that policy makers may mistakenly extend to areas outside the particular field of expertise. The expert is essential for providing information on the technical subject. However, this expertise should not overshadow the skills of experienced policy makers in balancing social, legal, political, and economic perspectives.

Technical specialists often lack knowledge about the policy process, and they should not be presumed to be policy experts. Scientists may be unfamiliar with the bureaucratic infrastructure and limitations for implementing public policy, and they may propose solutions that may be impractical. Even those commonly identified as policy experts may be highly specialized in areas such as economics or law, and may be less knowledgeable about other areas important to policy. The evaluation of perspective and role should be applied to policy experts as well as technical specialists. A scientist may offer what he or she considers the best solution, but the policy makers often are left to assess whether the solution is technically, economically, or institutionally feasible, or whether any legal or social changes needed to implement the option can be made.

The evaluation of perspective and role should be applied to policy experts as well as technical specialists.

Experts may play one or more roles in the policy process. These include policy advocate, policy analyst, policy entrepreneur, or policy educator (John Garland, OSU Extension, personal communication, 1993). By identifying general roles, policy makers can relate roles to potential bias and establish a context in which to evaluate the information provided. They also can use this understanding to pursue more effective ways to obtain scientific input.

A *policy advocate* has a stake in the policy outcome and tends to selectively define the issue and offer only supporting evidence for a preferred alternative. A *policy analyst* thoroughly treats a selected policy response in a scientific manner, but typically focuses on only that alternative. A *policy entrepreneur* offers solutions that will advance him or her in a policy role. A *policy educator* has no direct stake in the outcome and attempts to consider a wide range of policy options and identify the consequences to aid the policy decision. Other roles are possible, but these four highlight some key differences in how an expert relates to an issue. Input should be evaluated in the context in which it is offered. For example, just because a policy analyst has focused on a solution preferred by an employer does not mean that the decision maker should.

Experts may be presenting a mixture of objective truths and personal or organizational values.

The Impartial Ivory Tower

A common misconception is that scientists are disinterested, or impartial. Science seeks objective truths, but, as in policy making, reality ranges around the ideal goal. Scientists usually are capable of understanding and detecting bias, but this doesn't preclude expression of their own strongly held values, especially outside the confines of peer review. Experts may be presenting a mixture of objective truths and personal or organizational values, and may be selectively transmitting facts in favor of a particular outcome.

Publications

Experts often provide scientific findings in publications. Several forms of publications are commonly available, each with its own limitations (Table 4). Scientific journals contain the core of printed technical knowledge, but most are targeted to the scientific community and often are difficult to locate and interpret by people outside the particular field. Most conference proceedings and advanced textbooks suffer from the same limitations. Technical jargon developed within every specialty is a barrier to understanding, along with the authors' assumptions of readers' familiarity with fundamental concepts and techniques.

Table 4.—*Publications as sources of scientific information.*

Type	Peer review	Time to publication	Technical jargon
Professional journals	usually yes	1–3 years	yes
Conference proceedings	usually no	6–18 months	yes
Textbooks	varies	1+ years	yes, but may be defined
Newspapers, popular magazines	no	days to weeks	seldom

Evaluating Publications

The major process for evaluation, improvement, and quality control of scientific publications is peer review, which usually occurs when an article is submitted to a journal. One to several scientists with relevant expertise review a potential publication for errors, validity of methods, connection between data and conclusions, and scientific merit of the problem.

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Peer review is a valuable mechanism, which promotes, but does not guarantee, quality and objectivity of information. Review standards and editorial discretion vary widely, even among different sections of a single journal. The number, anonymity, and choice of reviewers can greatly affect the intensity of the review. Reviewers disagreeing with the conclusions or method are more likely to scrutinize for errors. Theories challenging conventional wisdom may receive more unfavorable reviews and may be less likely to be published. Nonetheless, peer review administered by a journal's editor or other "referee" remains the primary process maintaining the credibility of published findings.

Another guide for evaluating reliability may be the reputation of the author's research institution—but this is valuable in some cases and overrated in others. The most dependable approach, though not the quickest, may be to treat all sources with skepticism and use diverse sources to find out the widely accepted ideas.

Limitations

Publication includes some time delay. This can be 1 to 3 years for a professional journal that uses peer review. Conference proceedings may offer the latest findings, but peer review usually is not provided and data analyses may not have been thoroughly completed. Newspapers and popular magazines often try to feature the latest scientific findings of general interest, but quality of the information and presentation varies widely.

For people located far from research institutions and major libraries, technical journals and books usually are difficult to find quickly. Completing a comprehensive search is even more difficult. Time and money often limit the gathering and evaluation of scientific information for policy applications. The narrow scope of many scientific publications excludes substantive considerations of social, economic, or operational considerations crucial for policy decisions.

Computer models

Computer models can be useful in synthesizing large amounts of detailed technical information, and the production of numerical results seems satisfyingly concrete. Model designs and results have been invaluable in many planning processes. However, it is easy to misuse model applications and results, especially where important assumptions required by the model are not met. For example, a soil erosion model may assume uniformity of soils for simplicity or may be based on data from broad soil types. When applied over a large area where the variability averages out, the model may give a good average estimate, but when applied for a single farm field, the estimate may be poor. Using the model to regulate compliance of individual landowners in controlling erosion would not be effective, although it might be acceptable for regional assessments of potential results of regulation.

Good model results also depend on good information going into the model.

Good model results also depend on good information going into the model. Where "guesstimates," or subjective observations, provide the input data, expect substantial uncertainty in the results. Particularly as policies involve a broader array of resources such as wildlife, air and water quality, and recreation, our limited ability to quantify these resources often leads to educated guesses and rough estimates. In these cases, model outputs should be used with great caution.

If a model is being used in a new location, it should be validated for the area, i.e., the model results should be compared with actual data collected locally. Models are calibrated to fit an original data set and should be further tested, or verified, with an independent data set in the same area. Both of these processes, validation and verification, can be used to evaluate a model's performance outside the original data set.

Facts, Values, Myths, and Unknowns

An expert's testimony or a scientific publication often contains much more than simple factual material. The separation of facts, values, or opinions can be more difficult than we realize. Blending these becomes particularly problematic in the policy arena, where decisions incorporate both scientific information and social values. The boundary of technical fact and value can be blurred by a natural inclination to suggest favored policy recommendations or to present only data that supports a preferred outcome. It is not necessarily incorrect to seek integrated knowledge represented by a technical expert when making social or political decisions, but be aware that the integration often intentionally or unintentionally includes value judgments.

It's important to learn to distinguish underlying values from clearly factual material.

To help clarify this distinction, consider statements by scientists and others as falling into one of four categories of information: fact, value, myth, or unknown.

Fact: objective, verifiable truth

Value: preferred view or outcome

Myth: untruth or misconception presented as a fact

Unknown: ambiguous or uncertain statement

Values may seem so obviously right to the possessor that they intuitively seem like facts. Myths may be so widely held that they are seldom questioned. Unknowns may be events that we cannot predict well or do not happen uniformly. Sometimes an unknown will be presented as truth also; for example, if a statement is based on a single observation, it is impossible to determine if there is significant variation. Science often is perceived as generating facts, but even a peer-reviewed scientific paper may express values or unknowns (and maybe myths), particularly in the problem statement, interpretation of the data, conclusions, or recommendations.

When evaluating information, you can use these categories to discern actual facts from apparent facts, which are really expressing values, myths, or unknowns. This exercise can reveal both subtle and striking imbalances in the factual content of technical information. Consider the following paragraph.

> *Oyster stocks have declined in the Chesapeake Bay over the past 50 years (Fact), due solely to overharvesting (Myth). Greater populations of oysters will improve water quality because the larger population will filter greater proportions of the Bay water, restoring the cleansing function provided historically (Unknown, only a hypothesis). This paper identifies areas in the Chesapeake Bay with the greatest reductions in oyster populations from historical levels (Fact). These areas should have moratoriums on oyster harvesting (Value).*

Introductions or discussions in many scientific papers often include a mixture of facts, values, unknowns, and sometimes even commonly held myths. The value statements may reflect the author's perception of the importance of the study or the problem. This may not be inappropriate, but it's important to learn to distinguish underlying values from clearly factual material. Scientific experiments are designed to minimize the extent of the unknowns, framing questions so that answers can be found. Experiments still may contain large areas of uncertainty that are ignored or minimized to strengthen the apparent confidence of conclusions. Papers that clearly identify what is known and what remains uncertain can be especially useful.

Finding Facts Through a Range of Sources

Try to use more than one scientific source to get a broader, more accurate perspective or to reveal whether the information is commonly accepted. For example, if you choose a source from a government agency, also inquire into the perspectives from an interest group and affected industry. Agencies may be perceived as more objective because they exist to serve the public, but their perspective still may be strongly shaped by the leadership, goals, history, or politics of the agency. University scientists may have the least direct stake in the policy outcome, but still have their own unique perspectives and convictions.

Science often is represented by a diversity of opinions rather than a consensus, especially in new areas of research.

Another unsuspected pitfall in using scientific information or experts is the assumption that the information presented represents a uniform consensus of the scientific community. Science often is represented by a diversity of opinions rather than a consensus, especially in new areas of research. The expert may be giving the best information available based on what he or she thinks is correct, but other opinions often are available within the scientific community. You also may have to distinguish between the position presented by a representative of an industry or agency and their position based on personal experience or opinion. A representative may not feel free to diverge from an official position because of administrative, political, or legal considerations, even if it may result in better "science." A range of perspectives can be used to establish the bounds of the issue and to identify common areas of agreement or uncertainty.

We emphasize an important caution: avoid making major or relatively permanent policy changes before relevant research or detailed analysis has been conducted. The political immediacy of policy issues often seems to demand a rapid response, and policy decisions cannot always wait for exhaustive research. However, broadly implemented or irreversible decisions made to achieve technical goals normally should not be made on supposition. It can lead to an undesirable legacy and loss of credibility. The policy process includes evaluation after implementation, a crucial step that must be undertaken explicitly and repeatedly to promote improvements and responsiveness in the policy.

One example is the stream cleaning of the 1960s and 1970s in the Pacific Northwest. Problems with excessive woody debris in streams after logging and severe storms prompted many agencies to promote or require its removal, intending to facilitate fish passage and to minimize debris torrent hazards and reduction of dissolved oxygen. With implementation and further research, the difficulties of the policy became apparent. Later research revealed the utility of large woody material for aquatic habitat, and the physical impacts of removing large debris. Concerns and recommendations for fisheries have changed. The policy now includes retaining large in-stream debris while still protecting streams from excessive additions of fine debris. However, many stream reaches have little woody material after application of the earlier well-intentioned policy, and costly rehabilitation is being undertaken in some places to restore woody debris.

Avoid making major policy changes before relevant research or detailed analysis has been conducted.

Summary

Scientific or technical information often is essential when making policy decisions that involve technical issues. The policy steps described can be used to maintain a systematic approach to help create effective policy. Some other general suggestions can improve the success of incorporating science into policy:

- Consider the value of scientific input throughout the policy process.
- Use multiple sources or experts, with a range of perspectives to identify widely accepted science and areas of agreement.
- Evaluate each source and possible bias or institutional limitations. Distinguish individual opinion from a group statement.
- Look first for facts, but also identify pertinent values, unknowns, and myths.
- Use available policy expertise to identify acceptable risks found from scientific information.

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