Chapter 11

Resource Development Planning

Contents

Table

Chapter 11

Resource Development Planning

HIGHLIGHTS

- Greater use of resource development planning could help sustain tropical forest resources. The potential application is good in tropical countries where large tracts of forest land are under the custody of the government.
- The usefulness of planning techniques can be improved by: 1) increasing the timeliness and focus of analysis, 2) improving the data base, 3) encouraging public participation, 4) adopting a more interdisciplinary approach, and 5) improving communication of findings.

RESOURCE DEVELOPMENT PLANNING TECHNOLOGIES

Most conversion of forest land to other uses occurs without adequate consideration of whether the natural and human resources available will sustain the new land use (20). The success of resource development projects is impeded by unforeseen (but foreseeable) natural resource and socioeconomic constraints. The problem is to match land development activities to the specific capabilities of the site.

Where intensive land uses are compatible with natural and human resources at a site, conversion to those uses may be sustainable and result in greater long-term benefits than keeping the land in natural forest cover. Sites that cannot sustain intensive development can be identified for reforestation or for protection of natural forest cover. These sites can be managed for watershed maintenance, nonwood products, preservation of biological diversity, outdoor recreation, or closely regulated timber harvest.

Some tropical countries have begun to use resource development planning techniques to help match land capability with land use. Resource development planning has four components: 1) biophysical assessment, 2) financial and economic analyses, 3) social assessment, and 4) monitoring and evaluation, Development planning is best viewed as a continuous, iterative process that produces information as needed rather than as a one-time, preproject activity resulting in a blueprint for development. Having a flexible project design is especially important in development projects where the risks are large and the approaches may be innovative or experimental.

Biophysical Assessment

A biophysical assessment provides one dimension of information for effective land-use management. The techniques are straightforward and relatively efficient. They can be carried out at different levels of detail with varying requirements for monetary resources, staff expertise, and available data.

Many factors affect the biophysical suitability of a site, including:

- climate—precipitation, temperature, wind, droughts, floods, storms, fire potential, and air pollution potential;
- geomorphology and geology—slopes, location and uses of surface water and aquifers, mass movements of earth, depth to bedrock, unique features;
- soils—nutrients, structure, depth, erodability; and
- flora and fauna—biological diversity, val-

uable species, ecosystem fragility, and pests and diseases.

Resource development planning techniques are most often used to select a site for a particular land use. After identification of the desired land development, the planner identifies constraints that could inhibit that land use and looks for sites where the constraints do not exist or are manageable. The other, less often applied, use of planning techniques is "land classification''—identifying the most appropriate types of development for all sites within a geographic area. Planning techniques are seldom used fully in tropical nations for either site selection or land classification (42). The latter approach has special potential as a technology to help sustain the long-term productivity of forest resources.

Land Classification

Land classification categorizes land in terms of its suitability for various uses (table 31). The objectives of land classification are to identify the resources of a given area, determine appropriate management practices for existing land uses, and predict the consequences of proposed changes in land use and policies (36).

Classifications may be at the microlevel for managing local parcels or at the macrolevel for establishing national or regional priorities. The most immediate need in developing countries is for macrolevel land classification (9,19). Microlevel analyses subsequently will be necessary (32).

In macrolevel land classification, overlay mapping techniques are often used to select

Table 31.—Common Land Classification Methods

1. ***Australian Land System.***–The Australian Land System (10) uses aerial photos to survey large areas for agricultural, forestry, and recreational potential. A "site" is defined as a uniform land form with common soil types and vegetation. A "land unit" is a collection of related sites with a particular land form. A "land system" is a group of geomorphologically and geographically associated land units, usually bounded by a geological or geomorphogenetic feature or process.
2. ***Ecological Series Classification.—The*** Ecological Series Classification (37) describes forest habitat types in bioclimatic terms: a plant community's soil, water, and nutrient regimes; soil surface characteristics; and undergrowth plant distribution. The technique produces site indices for each habitat type that vary with the productive capacity of the trees, natural regeneration capability, the appropriate species for tree-planting, fertility requirements, and engineering properties.
3. ***Holdridge Life Zones*** System.—Holdridge Life Zones (24) are broad bioclimatic units defined by mean annual precipitation, mean annual biotemperature (air temperatures adjusted to eliminate negative values), and potential evapotranspiration. These broad units can be subclassified by soil, seasonal rainfall distribution, drainage, and mature vegetation associations.
4. **Canadian Biophysical** System.-The Canadian Biophysical System (30) is a-hierarchical classification. The basic unit used is "land type, " characterized by a homogeneous soil series and sequence of vegetation. Land types are subdivided into "land phases" according to their stage of vegetative succession. "Land systems" are groups of land types with a recurring pattern of land forms, soils, and a sequence of vegetation. The next broader unit, the "land district," has a distinct pattern of relief, geology, geomorphology, and a sequence of vegetation. Finally, there are "land regions," distinct climatic zones associated with a particular climax vegetation.
5. ***Webb% Structural Classification of Humid Forests.—This is*** a classification system for humid forests based on vegetation structure and physiognomy including such factors as forest structure, composition, canopy closure, type of emergents, species growth forms, and leaf size (54). The system correlates vegetation, structure, and physiognomy with rain, altitude, cloudiness, temperatures, soils, drainage, and wildlife habitat.
6. ***Krajlna's Biogeoclimatic Zonation*** System.—Krajina's Biogeoclimatic Zonation System (29) is based on forest habitat types, Each zone is characterized by a climatic climax vegetation, climate, and soil type. However, "climatic climax" might be deflected into an "edaphic climax" due to poorly or excessively drained soils or a "topographic climax" on steep slopes or alluvial flats.
7. ***USDA Soil Conservation Land Capability*** System.—The USDA Soil Conservation Land Capability System (28) uses soil survey mapping units grouped into eight classes according to the capability to sustain cultivation, grazing, forestry, wildlife, and recreation without erosion. The classification system indicates the degree of limitation to intensive uses.
8. ***California Soil* Vegetation** Survey.—The California Forest and Range Experiment Station (5) developed a classifica-t ion system predicated on the assumption that soil types are correlated with differences in vegetation on undeveloped lands. Aerial photos are used to observe the type, age, density, and structure of the vegetation.

SOURCE: Adapted from: L. Hamilton, "Land-Use Planning Technologies to Sustain Tropical Forest and Woodlands," OTA commissioned paper, 1982.

sites for particular land uses. One such technique is to produce a separate map for each of several biophysical attributes, using white, black, or shades of grey to show the suitability of locations for a specific type of development (33). The suitability ratings are combined by laying the maps over each other and examining the distribution of shading intensities. This procedure assigns an equal weight to each biophysical attribute, The "METLAND" technique (15), an extension of the map overlay approach, uses computers to manipulate data and generate alternative plans. Thus, variables can be given different weights to reflect their relative importance and more variables can be included.

Both these techniques assume natural system relationships are determined by land physiography, They are not well-suited for analyzing indirect or cumulative impacts of land uses, Unless combined with simulation modeling, these techniques do not reflect changes in the magnitudes or types of impacts over time.

Other techniques reveal site potential for specialized uses, such as the Habitat Evaluation Procedure, which assesses the impacts of land use changes on the quantity and quality of habitat for selected fish and wildlife species (51), The procedure relies on aerial photos or field work and modeling, Since a proposed action often results in gains for some species and losses for others, the Habitat Evaluation Procedure has a provision for calculating relative value weights for the indicator species,

Wadsworth's watershed value index (53) is a numerical scoring system that can be used as a rule-of-thumb in deciding where forest cover should be retained for watershed protection. The index accounts for slope and critical environmental factors.

Land classification systems can be helpful in resource development planning, but they have limitations. Some systems are oriented toward a particular land use such as agriculture or forestry and therefore tend to assess suitability for that use rather than overall land suitability (31,35,42). No single land classification system measures land productivity directly; the cost would be too great and the activity too time-consuming. Some techniques are more appropriate for use in ecological studies than for helping decisionmakers answer land management questions (6). None of the techniques identifies the direct or indirect biophysical impacts of land use conversions. Moreover, the techniques neglect gradual changes in biophysical factors that can eventually limit various land uses (31).

Applications of Land Classification

Malaysia has one of the best tropical 1and capability planning systems. The system includes geological surveys, regional soil surveys, and forest inventories, combining the approaches of the Canada Land Inventory and the U.S. Soil Conservation Service. It has been particularly useful in designating areas for tin mining; large-scale oil palm, rubber, and wood plantations; and resettlement projects. One reason for the effectiveness of the Malaysian system is that it is carried out by a national economic planning unit that is able to ensure that its provisions are implemented (22,34).

Resource planning techniques have been used in a number of other tropical nations, though not often as a regular planning process by a government agency or private firm in control of a large area of land. For example, the techniques have been researched and demonstrated in Venezuela (21) and Mexico (32). Organizations promoting conservation have worked out ways to integrate several of the major techniques to determine optimum locations for parks and protected areas in Venezuela and Brazil (4).

Development assistance agencies have sponsored resource development planning for river basin development programs. For example, the planning for development of the Mekong River basin, sponsored by the united Nations Development Programme, the Agency for International Development (AID), and several other bilateral agencies, uses many of the planning techniques.

AID has a number of projects involving resource development planning in tropical countries. For example, the AID-funded "Benchmark Soils Program" in Brazil, the Philippines, Indonesia, and Cameroon identifies soil types and tests similar soils for crop yields under different agricultural practices. The Government of Nepal, with AID assistance, has completed a national land inventory that includes topography, geology, vegetation, climate, and soils (l). Some land classifications have been attempted in Indonesia (45), Pakistan (43), and the Philippines (49). AID also has undertaken a major effort to help Sri Lanka plan the resettlement and watershed management associated with the Mahaweli reservoir (41).

An AID project in the Eastern Andes (the Central Selva Resource Management Project) was completely redesigned as a result of land capability analysis (23). The original project was to resettle large numbers of households for farming corn. A Holdridge Life Zone analysis involving aerial photos and field work showed that the land would support only natural forest. Consequently, the project was changed to resettle a smaller number of people who are to harvest 2 hectares of natural forest per household per year over 30 years.

Financial and Economic Analyses

After the biophysical suitability of a site has been determined, the next step is to analyze financial and economic benefits and costs. The purpose of these analyses is to provide information on: 1) how to maximize the values obtained from natural resources while conserving resources for the future, and 2) how to obtain an equitable distribution of income.

A financial analysis considers the anticipated cashflows to the owner or users of the land. An economic analysis is made from the perspective of society. The financial and economic impacts of land conversion depend on the previous land uses; capital, labor, and energy-intensiveness of the technologies; existence of markets and infrastructure; income levels; and site location, accessibility, and size. Conflicts often exist between decisions made by individuals on the basis of their own financial cash flows and the decisions that would be preferred from a societal perspective.

Financial and economic analyses can provide an additional quantitative dimension on the desirability of land-use changes and offer a systematic way to organize information for decisionmaking. Marketable goods and services are easiest to value in benefit-cost analysis. Thus, this technique is most applicable in assessing agricultural, industrial, or residential development. It is most appropriate where decisionmakers agree on values and goals (including production and the distribution of income) and where unintended effects offsite are likely.

The fundamental limitations of benefit-cost analysis are:

- imperfections that tend to distort prices observed in real markets, *
- inability to assess the distribution of costs and benefits among segments of the population and across generations,
- inadequate techniques to measure benefits or damages associated with environmental effects and insufficient empirical information on cause-effect relationships,
- de-emphasis of long-term effects due to discounting,** and
- inadequate treatment of risk and uncertainty.

Within the past 15 years, a variety of techniques used to assign value to environmental impacts for benefit-cost analysis have been developed and refined. Four basic types are:

1. Revealed preference measures examine actual consumer behavior and estimate prices for extramarket goods and services by examining expenditures to avert damages, replacement costs to repair damages, travel costs to recreational facilities, property values, and wage differentials;
2. Hypothetical valuation methods rely on direct questioning, bidding games, use-estimation games, or tradeoff analysis to

*In many cases, estimated values ("shadow prices") must be used where market prices do not exist or are presumed to reflect societal values poorly, However, the use of estimated values can increase the potential for political manipulation of an economic analysis (55).

**Discounting is based on the time value of money–i.e., the presumption that a dollar's worth of consumption now is worth more than a dollar's worth of consumption in the future. The time preference is separate from the effects of inflation.

elicit the maximum amount that consumers are willing to pay for a gain or minimum amount of compensation that they are willing to accept for a loss;

3. Human capital methods are used to place values on human mortality and morbidity; and
4. Threshold analysis asks how large the benefits of preserving land in its current state would have to be in order to outweigh the benefits of conversion to other uses.

However, careful attention must be paid to the assumptions behind these techniques and their susceptibility to problems of validity, reliability, and biases. Many of the techniques tend to underestimate environmental values. This is not a severe problem where decisionmakers only need a minimum estimate to support conservation decisions (18), such as in cases where some preservation values clearly exceed the value of a proposed land-use conversion. For example, an analysis for the Peruvian Amazon showed that wildlife values exceeded wood product values (14). But since many situations are not so clear-cut, more sensitive techniques are needed. The most important constraint on economic evaluation of environmental benefits is not the inadequacy of the techniques but the dearth of scientific data on cause-effect relationships for various land uses (8).

Another problem arises because most economic analyses determine the environmental value of forest resources "at the margin" which can be significantly different from the average value of forest resources. For example, if the value of genetic resources in any small piece of a forest is not large, economic analyses may justify clearing the forest piece by piece until it is all converted to nonforest uses, without ever accounting for the overall loss of genetic resources (18).

Establishing monetary values for the multiple benefits of forests can be useful in making decisions on the choice of outputs, production techniques, regulatory policies, fees for concessions and leases, compensation for eminent domain or offsite damage, and priorities for industrial or social forestry projects (18). The potential users of this information include the private sector, multilateral development banks, U.N. agencies, bilateral assistance agencies, and tropical governments.

The influence economic analyses have in decisions about resource development depends on how well they address the issues important to decisionmakers, Generally, economic analyses are used to justify decisions that already have been made on other grounds (18). Furthermore, economic analyses rarely consider how benefits and costs affect distribution of income within or across generations.

Social Assessment

The social dimension increasingly is acknowledged as an essential part of resource development planning, The extent to which social assessments are carried out varies among projects and among organizations. However, such analyses can contribute greatly to the success of development projects. In the past, multilateral development banks viewed large-scale forestry operations for their economic impacts alone. The poor records of many of those projects have led to an awareness of the importance of the social and institutional dimensions of land-use decisions (39).

Some proposed development activities are not feasible because the necessary human resources are unavailable or cultural values preclude implementation. Variations in the success rates of projects often can be explained by differences in the capabilities of local institutions. " The most common problems are the: 1) lack of strong leadership accepted by the community and willing to take the initiative; 2) domination of decisionmaking by elites for their own special interests; and 3) factionalism or segmentation by socioeconomic, ethnic, or religious groups that makes it difficult to build a consensus or get people to work together (52). Government laws and policies also can have unintended effects on people's decisions to par-

"Institutional capacity includes the framework of laws and policies in the forestry sector and the ability of national and local governments, cooperatives and associations, or private voluntary organizations to carry out a project.

ticipate in projects. In particular, land tenure and commodity pricing policies are important.

A development project that involves local people is more likely to be successful if the intended beneficiaries are brought into the planning process. Otherwise, 1) the intended beneficiaries might be unwilling to participate in the project; 2) the benefits may be captured only by people with relatively high incomes, social status, and advanced educations; or 3) tasks may be planned with unrealistic assumptions about the participants' skills, capital, or access to inputs.

Culture-specific information is needed on how incentives should be structured to: 1) encourage two-way communication between technology transfer agents and local people; 2) reduce risks facing innovators (e. g., adopters of new techniques); 3) encourage activities that provide offsite benefits not captured by individuals undertaking the activities (e.g., reduced soil siltation); and 4) give landless people a stake in resource conservation. For example, one common reason why social forestry projects fail is that the local people are not interested in the species of seedlings that are distributed or are unfamiliar with their growth requirements or products (2).

Most negative impacts of reforestation or social forestry projects on communal lands fall on the previous users of the land. Little land—even that labeled uninhabited—is totally unoccupied by people. Forest reserves in most tropical countries contain farmers, hunters and gatherers, and livestock herders. Communal lands that at first glance appear to be useless scrub forests frequently are used for raising crops, grazing animals, or the collection of fuelwood, polewood, grasses, and a wide variety of nonwood products. Land tenure is particularly important to consider in a social assessment where much of the land remains untitled or under communal status because large landholders or the landless poor may have appropriated these lands.

Good social assessments can help planners avoid or mitigate some of these problems or suggest ways to compensate the people who bear negative impacts. If the interests of past users are not considered, they may undermine the success of proposed development (25).

U.S. AID conducts some social assessment for its projects (including analysis of impacts and absorptive capacity) but the amount and type are variable. There are written guidelines to prepare a "social soundness analysis" as part of each project paper (50). However, these guidelines do not provide detailed, operational guidance on ways to conduct the analysis (44).

The World Bank's ***Operational Manual for Project Analysis*** is being revised to incorporate social assessment procedures (39). written guidelines have been prepared for Bank projects affecting tribal groups or involving resettlement of populations. All project officers are directed to consider social factors as part of their regular activities (16).

Monitoring and Evaluation

The preproject planning phase is when least is known about development problems to be solved and about the biophysical and human resources of the site, Yet, for many projects this has been the only time when a substantial effort is made to determine how the project's products and services will contribute to larger development goals.

Monitoring is a continuous process of collecting, measuring, recording, analyzing, and communicating information on projects regarding 1) timely and appropriate provision and use of inputs, 2) operation and management logistics, and 3) production of outputs. Monitoring takes place during implementation and is intended to meet the needs of day-to-day project management. It can indicate a need to change the timetable, scale, geographic location, resource allocation, or staffing of activities.

Evaluation measures a project's outputs and impacts on intended beneficiaries and assesses the project's unintended impacts. Evaluations emphasize performance, rather than operation and management, and analyze reasons for attaining or nonattaining objectives. Evaluations performed before implementation is completed can be used to formulate recommendations for changes in objectives, strategies, techniques, institutional arrangements, priorities, and government policies. Their effective use depends on the project's flexibility-i. e., whether it can respond to recommended changes. Such evaluations have a secondary purpose of facilitating communication among project staff, project management, local people, and external organization. Evaluations conducted after a project is complete can:

- identify a need to compensate people adversely affected by environmental impacts,
- suggest followup or complementary projects that build on the original project,
- assist in reformulating broader policies and strategies, and
- provide lessons for planning other projects elsewhere.

Monitoring and evaluation produce very different measures of project success or failure. Monitoring may indicate that a project is successfully reaching its targets, while evaluation of the same project may show that the problem has been incorrectly identified.

For example, planners working in the preproject period may identify reforestation of private lands as the appropriate objective for an area experiencing rapid deforestation and a lack of freely available seedlings as the problem hindering this reforestation. Thus, they may recommend establishing nurseries to produce seedlings for distribution to local farmers. Monitoring may show that the nurseries are operating successfully and producing the desired number of seedlings. Evaluation, on the other hand, may show that the problem was misidentified, that lack of extension programs for landowners and not seedling availability is the actual constraint to reforestation.

The distinction between monitoring and evaluation has been recognized only recently by development assistance organizations. U.S. AID and the World Bank, among others, are emphasizing the importance of both. Comprehensive monitoring and evaluation systems are a planned component of social forestry projects in Nepal (3) and Tamil Nadu in India (46). However, the development assistance agencies are only beginning to learn how to use the information from evaluation to improve projects.

Even where continuous evaluation is made a part of the project, the resulting information may not lead to a project change. One reason for this inflexibility is that persons administering resource development projects are usually rewarded when they achieve certain targets (e.g., seedlings distributed per year) from the original project plan, regardless of whether those targets prove to be unimportant. Moreover, the usefulness of final evaluations can be compromised by agencies' reluctance to discuss why their projects were not entirely successful.

Multiobjective Planning Methods

Once information is available on the likely biophysical, economic, and social/cultural aspects of a development project, decisionmakers need some way to judge the relative importance of the various findings. Too frequently, decisionmakers avoid confronting tradeoffs among conflicting objectives and only consider the most obvious and serious effects. But considerable progress has been made in the past two decades in developing multiobjective planning techniques that address these tradeoffs (12,38). These techniques have been applied mainly in water resource planning, but with adaptation they are applicable to tropical forest land-use planning as well.

Multiobjective planning is broader than more traditional single-objective approaches to planning. Single-objective planning techniques such as benefit-cost analysis require that all the effects of alternate projects be measured in terms of a single unit, usually money. Multiobjective planning attempts to compare effects within categories, but does not force all effects into the same measurement units. The techniques also provide formal means for decisionmakers to assign relative values to each category account (e.g., income, numbers of people employed, reduction in peak waterflow).

25-287 0 - 84 - 17

Using multiple objectives in the planning process can improve resource development in at least three ways. First, value judgments are determined by decisionmakers rather than by the analysts. Second, a wider range of alternatives usually is identified, and the relationship between alternatives can be described clearly. Third, the analyst's perceptions of a problem will be more realistic if the full range of objectives is considered (12).

CONSTRAINTS AND OPPORTUNITIES

Insufficient appreciation by decisionmakers. Many decisionmakers do not understand resource development planning techniques or their potential utility. Consequently, they may make decisions on the basis of political feasibility or intuition rather than planning (3 I). Resource development planning often is not used until after resource use decisions have been made. Furthermore, decisionmakers often have the misperception that planning leads to permanent land-use dedications.

Limited availability of land use data. Problems associated with collection have led to a dearth of land use data. Ground surveys are slow, expensive, and sometimes inadequate. Aerial photographs can only cover a small area and are relatively expensive. Remote-sensing images from orbiting satellites are becoming more widely used. However, with the technology generally available in tropical countries, interpretation of Landsat can be inaccurate. New optical enhancement techniques improve the quality of the Landsat images and computer analyses can increase interpretability. These refinements are expensive, but minicomputers are lowering the cost.

Governments in tropical countries have been able to purchase satellite images at low prices because the fixed, capital costs have been borne by the U.S. Government. This policy may change, however. The U.S. Government has proposed selling Landsat to the private sector.

Scarcity of expertise. Effective resource development planning requires expertise in many disciplines: geology, hydrology, climatology, ecology, geography, agronomy, forestry, economics, sociology, and planning or public administration. Even if sophisticated methods such as remote sensing and computer analyses are cost effective, the lack of trained government staff can preclude their use. The scarcity of expertise is a principal constraint to resource development planning (35).

Cost. Detailed resource development planning activities can require a high initial investment because large land areas are involved. At the same time, the benefits often are diffuse—spread among large groups of people in present and future generations rather than among a few identifiable individuals who would be willing to bear the costs. Thus, it is likely that major resource development planning efforts in poor countries will require substantial foreign assistance.

Dominance of decisionmaking by interest groups. In some countries, there is little actual governmental control over public lands because of the influence of large logging, mining, or agricultural interests and the inability to enforce sanctions in remote locations against large numbers of illegal forest occupants, nomadic grazers, or tribal groups with customary rights. Even where the government has effective control over public lands, self-interest still can be a constraint. Prerogatives over government lands often are jealously guarded by key decisionmakers (47). Forestry departments may resist any analyses that could result in land classifications that remove land from forest reserves (40). In some cases, short time horizons, personal favoritism, influence of special interests, and opportunism may characterize decisionmaking.

Increasing the timeliness and focus of analysis. An analysis will be of most use to decisionmakers if it is timely and geared to their needs. If the scope of the analysis is too narrow or superficial, decisionmakers will not obtain the information they need. On the other hand, if the scope is too broad, delays will occur. The usefulness of the techniques can be improved by clearly defining the specific objectives of the analysis and setting priorities for study. For some uses, techniques that are relatively less precise and less expensive will be satisfactory.

Improving scientific, economic, and social data. Although the basic techniques to analyze scientific, economic, and social data for resource and development planning are reasonably well-developed, the inadequacy of baseline data and the limited understanding of cause-effect relationships have hindered application of these techniques. Much existing information on the connections between biophysical factors and land uses is derived from studies of temperate zone countries (42). The degree of transferability of this information to the Tropics is questionable. It also may not be appropriate to transfer information obtained in one part of the Tropics to other parts (13).

Encouraging public participation. Inadequate social assessment is a weakness suffered by most resource development planning efforts (35). Greater public participation in the planning process could improve social assessments and increase the ability of local people to solve their own problems.

However, this can be difficult to obtain. For the most part, foresters have not been trained to facilitate a dialogue with local people to determine their needs, priorities, and resources or to convince them of the desirability of better land-use management (47). Furthermore, in some cases the rural poor do not speak openly for fear of retaliation or simply because they speak a different language from the project staff. Sometimes, individuals with vested interests can dominate participation, while the general interests of the local population are underrepresented (26). Where the rural poor are excluded from political participation in government, it is unlikely that they will be allowed to participate effectively in the design or operation of development projects (27).

Adopting an interdisciplinary approach. Many government agencies conduct activities that affect land use, especially those concerned with agriculture, forestry, military operations, water resources, mining, human settlements, transportation, and wildlife. Yet, there is little coordination between agencies with different responsibilities, and each agency concentrates on its own relatively narrow mission. Forestry departments in many tropical countries, particularly those that retain the model set up under British and French colonial rule, remain detached from other sectors of public administration (11).

But an interdisciplinary approach using the skills available in the various agencies is the most effective way to plan resource development. Alternatively, forest departments could hire expertise in a broader range of disciplines and train existing staff. Rural sociologists and anthropologists, in particular, should have a larger role in resource development planning (11), The United States offers substantial expertise in the various disciplines related to resource development planning.

Improving the communication of findings. Scientific information needs to be presented in a simple, yet realistic, form that decisionmakers can understand. Key assumptions should be stated explicitly and tested. Sufficient budget and staff time should be devoted to communication of the fundings or the plans are likely to receive little attention.

CHAPTER 11 REFERENCES

1, Ackerson, K., U.S. Soil Conservation Service, personal communication, 1982.
2. Arnold, J. E. M., Food and Agriculture Organization, personal communication, 1982.
3. Bhattarai, T., and Campbell, J. C., ***Monitoring and Evaluation System for Community Forestry Development in Nepal,*** Kathmandu Government of Nepal, HMG/UNDP/FAO Community Forestry Development Project Field Document No. 4, 1982.
4. Burley, F. W., "Sharing the Heritage Concept," *Nature Conservancy News 32(4), 1982,* pp. 23-25,
5. California Forest and Range Experiment Station, ***Soil Vegetation Surveys in California*** (Sacramento: Department of Natural Resources, 1958).
6. Cameron, D., "Problems of Forest Land Classification in Tropical and Subtropical Australia." ***In:*** Carpenter, 1981.
7. Carpenter, R. (cd.), *Assessing Tropical Forest Lands: Their Suitability for Sustainable Uses* (Dublin, Ireland: Tycooly Press, 1981).
8. Carpenter, R., East-West Center Environment and Policy Institute, personal communication, 1983.
9. Catterson, T., U.S. Agency for International Development, personal communication, 1983.
10. Christian, C., and Stewart, C., "Methodology of Integrated Survey s," ***Proceedings, Toulouse Conference on Aerial Surveys and Integrated Studies*** (Paris: UNESCO, 1968).
11. Cleveland, D., International Agricultural Programs, University of Arizona, personal communication, 1983.
12. Cohon, J. L., ***Multiobjective Programming and Planning (New*** York: Academic Press, 1978).
13. di Castri, F., and Hadley, M., "A Typology of Scientific Bottlenecks to Natural Resources Development, " ***Geographic Journal*** 3:513-522, *1979.*
14. Dourojeanni, M., ***Animales Sobre—ExpZotados y Sub-Utilizados en la Amozonia,*** 1974. ***In:*** Gregersen, 1982.
15. Fabos, J., Greene, C., and Joyner, S., Jr., ***The METLAND Landscape Planning Process: Composite Landscape Assessment, Alternative Plan Formulation, and Plan Evaluation*** (Amherst, Mass.: University of Massachusetts Agricultural Experiment Station, Research Bulletin No. 653, 1978).
16. Fisher, H. B., World Bank, personal communication, 1983.
17. Green, K., U.S. National Zoological Park, personal communication, 1982.
18. Gregersen, H., "Valuing Goods and Service From Tropical Forests and Woodlands," OTA commissioned paper, 1982.
19. Hamilton, L., "Some Unbiased Thoughts on Forest Land Use Planning—From an Ecological Point of View. " ***In:*** Carpenter, 1981.
20. Hamilton, L., "Land-Use Planning Technologies to Sustain Tropical Forest and Woodlands," OTA commissioned paper, 1982.
21. Hawes, R., and Hamilton, L., ***A Method of Watershed Land Classification and Assessment for the Tropics: A Case Study of Rio Guanare, Venezuela*** (Ithaca, N. Y.: Cornell University International Agriculture Mimeograph *77, 1980).*
22. Hepburn, A., "The Forest Resources of Sabah and Their Development in the Light of Land Capability Classification," ***The Malaysian Forester*** 37(1974):215-223.
23. Hester, J., U.S. Agency for International Development, personal communication, 1983.
24. Holdridge, L., ***Life Zone Ecology*** (San Jose, Costa Rica: Tropical Science Center, 1967),
25. Hoskins, M., "Benefits Foregone as a Major Issue for FLCD Success," *Proceedings of the **U.S.** AID Workshop on Community Forestry,* Washington, D. C., 1982.
26. Huizer, G., ***Preliminary Guidelines for Participation Monitoring and Ongoing Evaluation of People's Participation Projects*** (Rome: Food and Agriculture Organization, 1982).
27. Joslyn, D., U.S. Agency for International Development, personal communication, 1983.
28. Klingebiel, A., and Montgomery, P., ***Land Capability Classification*** (Washington, D. C.: Soil Conservation Service, Agricultural Handbook 210, 1961).
29. Krajina, V., "Biogeoclimatic Zonation as a Basis for Regional Ecosystems," ***Symposium on Planned Utilization of Low Land Tropical Forests,*** Cipayung, Bogor, Indonesia, 1973.
30. Lacate, D., "Discussion of Biophysical Land Classification in Canada." ***In:*** Carpenter, 1981.
31. Lee, Peng Choong, "Forest Land Classification in Malay sia. " ***In:*** Carpenter, 1981.
32. Marten, G., "A Landscape Approach to Regional Land Use Planning in Tropical Mexico." ***In:*** Carpenter, 1981.

33. McHarg, I., *Design With Nature (New* York: Natural History Press, 1969).
34. Moss, M., "An Evaluation of Some Existing Biophysical Land Classification Schemes in the Context of the Felda Land Developments in Malaysia. " *In:* Carpenter, 1981.
35. Mounkeila, Goumandakoye, Assistant Director of Forests for Niger, personal communication, 1983,
36. Mueller-Dombois, D., "The Ecological Series Approach to Forest Land Classification." *In:* Carpenter, 1981.
37. Mueller-Dombois, D., and Ellenberg, H., *Aims and Methods of Vegetation Ecology (New* York: John Wiley & Sons, 1974).
38. Nichols, R., and Hyman, E., "An Evaluation of Environmental Assessment Methods," *Journal of the Water Resources Planning and Management Division, American Society of Civil Engineers 108,* No. WR1 : 87-105, March 1982,
39. Noronha, R., *Sociological Aspects of Forestry Project Design* (Washington, D. C.: World Bank, 1980).
40. Pandey, J., "Problems of Forest Land Classification for Sustainable Uses in India. " *In:* Carpenter, 1981.
41. Philley, M., U.S. Agency for International Development, personal communication, 1983.
42. Qadri, S., comments on the paper by Hamilton (20) prepared for the Office of Technology Assessment, 1982.
43. Quereshi, A., "Forest Land Classification and Capability Assessment in Pakistan. " *In:* Carpenter, 1981,
44. Runge, C. F., U.S. Agency for International Development, personal communication, 1983.
45. Sandy, I. M., "Land Classification System for Land Use Planning in Indonesia." *In:* Carpenter, 1981.
46. Sida, —, *Social Forestry in Tamil Nadu: Appraised Project Document* (Stockholm: Swedish International Development Assistance Organization, 1981).
47. Stevens, M., U.S. Forest Service, personal communication, 1983.
48. Umali, R., "The Application of Remote Sensing to Forestry in Developing Countries, " 1981. *In:* Carpenter, 1981.
49. Umali, R., "Forest Land Assessment and Management for Sustainable Uses in the Philippines, " 1981. *In:* Carpenter, 1981.
50. U.S. Agency for International Development, "Social Soundness Analysis," *AID Handbook 3, Appendix 3F* (Washington, D. C.: U.S. AID, 1982).
51. U.S. Fish and Wildlife Service, *Habitat Evaluation Procedures* (Washington, D. C.: Government Printing Office, Documents ESM 101-104, 1980).
52. Van Heck, B., *Participation of the Poor in Rural organizations* (Rome: FAO, 1979].
53. Wadsworth, F., "Techniques for Surveys and the Ecological Exploitation of Tropical Forests, " *Anals. Acad. Brazil Ciene. 41* (Suplemento: 101-109), 1969.
54. Webb, L., et al., "Structural Classification as a Method to Predict Site Potential in the Development and Conservation of Tropical Humid Forest Lands, " *Transactions International MAB-IUFRO Workshop on Tropical Rain Forest Ecosystems Research,* E. Brunig (cd.), Hamburg-Reinbeck, University of Hamburg, 1977.
55. Wisdom, H., comments on the paper by Gregersen (18) prepared for OTA., 1982.