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Centralized vs. decentralized management
of small hydropower

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Small decentralized hydropower program

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Preface

The Small Decentralized Hydropower (SDH) Program, of the National Rural Electric Cooperative Association (NRECA), and its contractors have developed materials to enhance the effectiveness of personnel engaged in small decentralized hydropower projects in developing countries. This guide summarizes and focuses conclusions from these materials for use by practitioners. It is intended to be used by consultants and managers with prior experience or training in water resource development and/or power generation, to call their attention to key issues and problems associated with the planning and development of small decentralized hydropower facilities in rural areas. The guide is designed to stand alone, but it also introduces and represents other materials produced by NRECA which include--

A comprehensive analytical review of English-language materials on small decentralized hydropower and related topics

A compendium of case studies of SDH projects and programs

A series of methodological studies, country surveys, and special reports.

Establishing a small hydropower generation facility in even one remote rural community can be a challenge. In the planning, implementation, or maintenance of a complex national SDH program, practitioners are confronted by a great array of unknowns. Key questions are sometimes overlooked. This guide identifies issues that must be considered in a national SDH program and suggests ways to address them. These issues are discussed under five broad headings: decentralization vs. centralization, host country conditions, technological choices, program objectives, and managerial strategies.

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Centralization vs. decentralization

Centralization and decentralization refer to the two major alternative organizational forms for national SDH programs. These alternatives have implications for--

Economic development
Technological sophistications, and
Styles of decisionmaking.

In characterizing these approaches, we stress their differences in order to highlight their basic features. See figure 1. In practice, most nations have sought to combine the better aspects of both models.

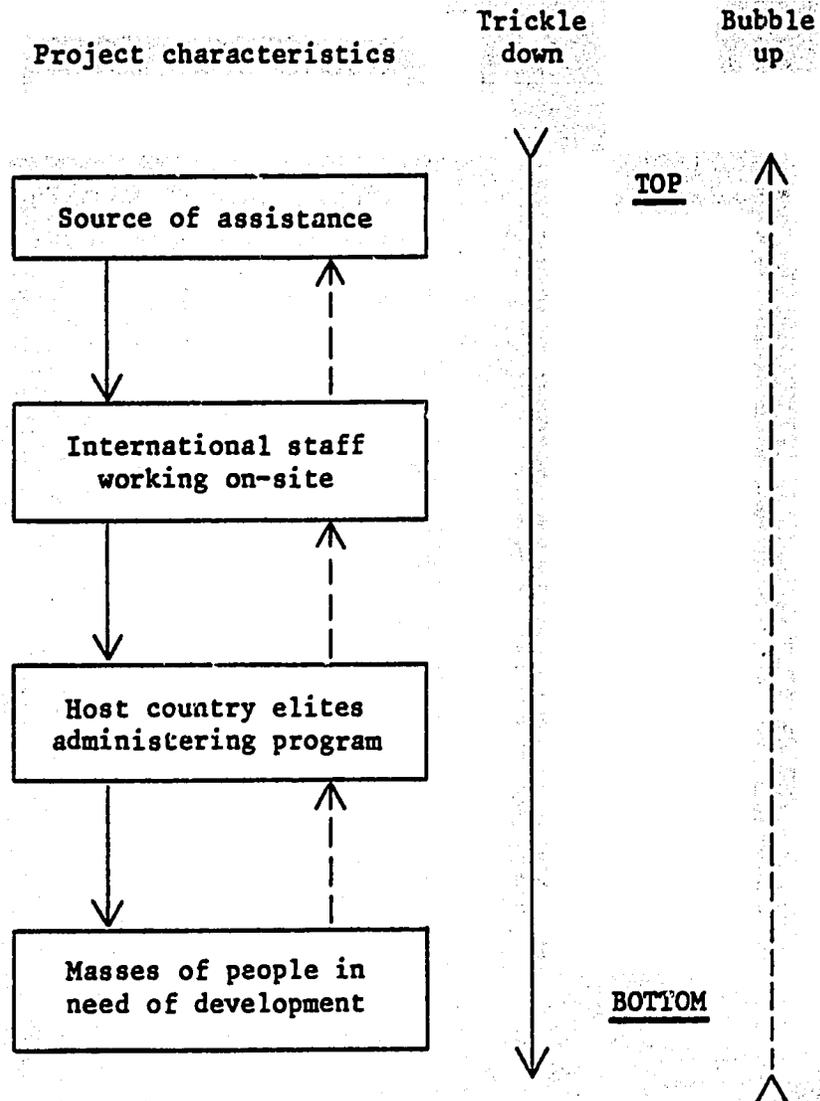
Is the general strategy for economic development a "trickle down" or a "bubble up" strategy?

"Trickle down" planners see the central problem of poor countries as their shortage of resources. Third World economies, in this view, are tied to a subsistence standard of living, based primarily on agricultural production. They need to get themselves moving up the ladder of development. To sustain genuine economic growth they need capital-intensive industrial projects. Financial and technical resources for these can only be obtained through aid from abroad. The solution for political and economic elites of developing nations is large-scale sophisticated projects, implemented with foreign capital and technology, that will eventually generate enough prosperity to trickle down benefits to the average citizen.

"Bubble up" strategists oppose this dependence on foreign assistance as an obstacle to the development of genuine self-reliance. They question the effectiveness of the trickle down approach, on the grounds that the benefits rarely reach the masses of people. Bubble up advocates support a strategy of many widely dispersed projects geared to the capital, technical, and organizational resources of the people. They hope that the impacts of actions initiated at the local level will bubble up the rungs of the national hierarchy. This approach often meets resistance not only from the upper echelons of the host country society, but from international agencies. Within the developing country, opposition may take the form of outright rejection or may be presented in populist, socialist, or other terms.

Figure

SDH projects and alternative economic development strategies



Should the technology be simple and labor-intensive or sophisticated and capital-intensive?

On the whole, centralists tend to favor capital-intensive, sophisticated technology, while decentralists tend to prefer labor intensive, simple technology.

Centralists argue that programs with capital-intensive technology are responding correctly to the need to exploit fully the potential of each site so that this potential can provide a foundation for long-term economic growth. More sophisticated technology requires more centralized coordination, because of the larger size of projects and the need to assemble and deploy a large group of highly specialized personnel. This coordination and control will need to be concentrated at a high enough political and economic level to ensure elite backing and to facilitate international funding. For central administrative staff, it provides heightened prestige and a sense of contributing to the national good.

Decentralists often favor simpler technologies, at least in part because they need less top-down administration. Decentralists stress the social and political advantages of less sophisticated systems. Such projects offer local persons an opportunity for participation in management that if successful, enhances local self-sufficiency. Simpler, more labor-intensive systems may not fully utilize the theoretical capacity of a site, but may lower start-up costs, especially for materials and equipment.

Each approach has both strengths and weaknesses. The centralist may overlook the chance to involve local people, thus forfeiting a crucial element in the process of national development. In addition, servicing and repairs may suffer at a later date from a shortage of qualified personnel. The decentralist position, while incorporating local participation, runs the risk of encouraging the construction of systems that break down more easily or may fail to provide sufficient electricity after some period of community growth.

A trickle-down strategy of economic development is more compatible with an emphasis on sophisticated technology; both require more centralized coordination than a bubble-up strategy, which is more compatible with a labor-intensive, simple technology. A centralized program provides leadership and a point of orientation for local communities and secondary agencies, while concentrating the efforts of professional staff on what they know how to do best.

Is a deterministic or an open-ended style of decisionmaking most compatible in the host country?

A deterministic style implements a program as though every facet of it could be predicted by experts operating under a centralized

executive structure. This approach can be appropriate where the political and social context is relatively stable, where agreements between central and local units are well established, and where the central authority controls the needed resources. It permits careful record keeping, reporting, and analysis, and concentrates the impact of scarce human, material, and financial resources. Further, it allows national elites the opportunity to build constituencies, as well as cementing alliances between these elites and international organizations that supply financing, technology, and managerial expertise. But this approach ignores the potential for unforeseen positive developments, and can become rigid in the face of unanticipated problems. It is a powerful means for building support, but can invite nepotism, corruption, empire-building, and excessive dependence on foreign resources.

In situations that require negotiation, mutual consent, and building cooperative working relationships, a more open-ended procedure can be extremely effective. An open style of decisionmaking focuses on making the most of opportunities in fluid situations where risks cannot be avoided. It can be responsive to the particularities of regions and communities. It offers local residents a chance to join in, to provide feedback during project implementation, and to develop the necessary skills to carry on after the program personnel have gone.

This open-ended approach can also backfire. It may ask too much of SDH personnel. It may over-respond to local concerns and lose touch with the objectives of the national program. If local residents do an effective job, they may become too powerful in the judgment of national elites, leading to a backlash from the central authorities.

A trickle-down economic development approach that employs centralized, capital-intensive technology and focuses on the end product will often adopt a deterministic style of decisionmaking. A bubble-up economic development strategy, emphasizing decentralized, labor-intensive technology and focusing on social process, will generally tend toward open-ended decisionmaking. (See figure 2.)

Figure 2

Characteristics of centralized and decentralized
development programs

	<u>Centralized (trickle-down)</u>	<u>Decentralized (bubble-up)</u>
Economic development	Problem of LDCs: Lack of resources (can be remedied through aid).	Problem of LDCs: Dependence (can be remedied through growth toward self-reliance).
Technology	Capital-intensive; as sophisticated as possible; prefer a few large projects.	Labor-intensive; as simple as possible; prefer many smaller projects.
Style of decision-making	Deterministic; emphasis on product, hardware; more hierarchical.	Open; emphasis on process, people; more egalitarian.

Host country conditions

One of the first tasks for a manager or consultant of SDH programs is to distinguish what is given from what is changeable.

What factors in the environment are subject to intervention? The "given" factors constitute the framework within which the practitioner works. The focus of design or consultation is on factors susceptible to change. Once those factors have been identified, the practitioner's attention can be concentrated where there is likely to be the greatest response. (See figure 3.)

The SDH practitioner is interested in--

The physical and demographic characteristics of the country
Social and cultural variables, and
The political and institutional infrastructure.

Where are the people and the water?

The worst case for SDH is when the population is highly concentrated in major centers, with very few if any people in remote rural areas. Then a non-SDH energy technology may be more appropriate. If the country has virtually no falling water, the basic resource for SDH is missing. These are usually flat, arid regions--the Kalahari region of Southern Africa, the "outback" of Australia, the steppes of central Asia, and the countries of the Sahara.

The best case situations for SDH are amply watered areas in which the population is relatively dispersed. In Nepal, for example, the population is almost entirely rural, living in a multitude of small villages that are difficult of access, separated from each other and from the capital by mountains, and watered by numerous steeply falling mountain streams. In the Philippines the separation is caused by sea rather than mountains, and water is

Figure 3

Host country conditions: How fixed are they?

<u>Very fixed</u>	<u>Relatively unchanging</u>	<u>Possible room for change</u>
Physical/demographic:	Social/cultural:	Political/institutional:
Geology	Language	Degree of political
Hydrology	Religion	modernization
Meteorology	Customs	Key leaders
Ecology	Family organization	Relevant institutions

provided by rainfall instead of snowmelt. In situations like these, SDH will yield high output of power and use per unit of investment.

In a new assignment, the first step is a prefeasibility study of these basic geographic and demographic characteristics. If the worst case is found, the role for small hydropower if any, should be that of a supplement to other forms of power generation. If the best case is found, an SDH program could become the basic approach to power generation. In intermediate cases, small hydropower might best be designed to hook up or coordinate with a national or regional grid.

What forms of organization will fit local social and cultural patterns?

Local social and cultural patterns are usually not amenable to direct change by the SDH practitioner. Instead they must be taken as part of the context, the framework, within which SDH programs can be designed and mounted. Language, customs, family organization, and economic and social institutions are all resistant to change, but highly variable from country to country. Any practical assistance given as part of an SDH program must be geared to the cultural values and social conditions of the country in which it operates.

For example, in Peru the basic unit of rural action programs has been the village. The highland village has great homogeneity and forms a natural social unit. It is an appropriate focus for the SDH program. In rural India, by contrast, the caste groupings are the important ones; different castes in the same village may be virtually prohibited from working together.

In the Philippines, the government thinks villages are the important unit, but anthropologists report that they may have little to do with the operational networks of socioeconomic relations. In some areas there may not be any effective organizational structures at the village or community level and few integrating forces other than the shared poverty of the lower class.

It takes more than falling water and good engineering to make an SDH program work. Existing grassroots traditions and social organization are important too. The flexibility of local customs is limited. In some countries, local conditions may be so exploitative that any meaningful rural development may be energetically opposed by local elites. Even regimes with a revolutionary ideology and a willingness to employ totalitarian techniques have found that culturally embedded attitudes and social patterns are best used as a vehicle, rather than allowed to become an obstacle to rural development. The practitioner has to find out what the local culture and traditions are and design or guide the program so as to make the best use of them.

How modern is the society?

The more "modern" a society the more familiar it will be to the Western consultant and the more likely plans and programs designed along the conventional lines are to succeed. By contrast, the more traditional the society is the more it will be necessary to work through local patterns that may be quite strange to Westerners.

In assessing the degree of "modernness," the consultant should keep in mind as a diagnostic tool some features of modern, pluralistic societies:

They have separate and almost innumerable political structures for performing complex and extensive functions;

They can mobilize national energies on a massive basis without being very vulnerable to control by one man or a clique;

Personal attitudes are optimistic and oriented toward achievement;

Relationships tend to be instrumental and rational, governed by norms such as functional utility and efficiency.

The distinction between traditional and modern is broad, subsuming cultural and social patterns such as language, religion, customs, and the like that can combine in many permutations. What is needed, then, is an in-between concept that links the infinite range of cultural diversity with the simple distinction of traditional vs. modern. A region may combine several cultural areas into a single economic and geopolitical unit. The nations of Asia are a region, even though they mix Indian, Chinese, and Western cultural influences. These nations fall somewhere between our models of traditional and modern political systems.

For example, there is a tension between the old and new political forms in Indonesia and in Malaysia. The roles of the sultans and old nobility in Malaysia and of kinship groups in the Indonesian bureaucracy, are still significant. But Malaysia does possess, at least officially, a competitive civil service; and Indonesia, until the Indonesia Communist Party was destroyed some years ago, was strongly influenced by this disciplined, mass-based, modern political party. The conflicting currents can be observed throughout the region:

Inherited status vs. individual achievement

Personal loyalties vs. impersonal civic values

Hereditary office and recruitment based on family ties vs. individual advancement based on objective standards of performance

Paying back a favor vs. competitive bidding for contracts or equality before the law.

While this distinction between modern and traditional drastically over simplifies matters it does not allow one to array nations on a single spectrum according to the degree of development of political institutions generally associated with Western industrial societies. Asian nations are so arrayed in figure 4.

Placing modern Western-style programs into pre-modern political contexts can be disastrous. In traditional societies, a simpler managerial approaches are more appropriate--that is, procedures calibrated to the needs and skills of the host country environment.

Who are the key leaders?

Identifying and coming to know the key personnel is especially important in traditional societies. Even in more modern societies, bureaucratic organization charts do not completely describe the actual structure of power and authority through which the SDH practitioner must work. The person who holds the official decisionmaking role is sometimes not the person whose interests and opinions shape the actual direction of the program.

The support of the (sometimes unofficial) leaders is vital in securing the adoption of technical or institutional innovations. Leaders are usually themselves directly involved in program activities. But this is not always so. Instead, the real leaders may be party or religious leaders, heads of powerful clans, tribes, or caste groups, or senior officials in other ministries.

Can existing institutions be used for SDH development?

Can others be created?

Rural development programs have sometimes unnecessarily and wastefully created entirely new institutional structures that use up scarce local leadership talent, create competition between old and new programs at the local level, and require large scale managerial and technical inputs from abroad.

Generally speaking, it is preferable to advance an SDH program through institutional structures that already have local familiarity and trust. For example, in Papua New Guinea, the legal recognition of traditional tribes or lineages as corporate groups would enable these traditional organizations to assume such modern functions as trading, holding real property, or sponsoring SDH projects. Creating a new organization may require new legislation and more government workers, while use of the traditional organization can often capitalize on existing knowledge, patterns of leadership, and entrepreneurial skill.

Figure 4

A scale of "modernity"

<u>Modern</u>	Australia and New Zealand Japan
	Korea
	Singapore
	Pakistan
	Thailand
	Philippines
	Taiwan
	Malaysia
	India
	Peoples Republic of China
	Vietnam
	Ceylon
	Indonesia
	Cambodia
	Burma
	Laos
<u>Traditional</u>	Afghanistan Nepal

Technological choices

The choice of a technological system is a complex task. It involves decisions regarding penstocks, turbines, and generators. But it also depends on geographic, political, economic, social, and cultural factors. The consultant must consider--

Geography

Mechanical components, and
Political and economic constraints.

Are there good sites?

Fixed aspects of geography, hydrology, and meteorology must be taken into account. Mountainous regions with heavy rainfall or snowfall such as Nepal, Tanzania, Papua New Guinea, and Northern Pakistan provide the best settings for SDH, but in every case one must assess the head and flow of the available water supply and work within the constraints of the general terrain. The consultant will need to view these in a seasonal perspective, since the construction, productive capacity, and operation of a system may vary according to the water available at any particular time of the year. In Tanzania, for example, many projects have diesel standby units in case of emergencies. The terrain may affect the need for an earthen dam or barriers and may also affect the length and shape of the penstock, which in turn will affect the costs of the project.

Is the central government able and willing to supply capital and other resources?

Political and economic factors also enter into determining the optimal technical size of the system for a given site. What can be constructed physically may or may not be feasible financially and administratively.

The government may not be able to assist SDH projects if it lacks the necessary bureaucratic and technical infrastructure. Such an infrastructure does not exist for instance in Upper Volta. Even if the government is able, it may not be willing. It may be indifferent to the fate of remote rural areas because its priorities are directed toward large cities. Or it may only be willing to make a small, short-term contribution that may get much publicity but mean little in the long run.

If a central government is able and willing to invest in rural electrification, consideration must be given to the potential impact on technical choices of such a centralized form of management. The willingness to assist SDH projects may stem from

a desire to assert a form of class, ethnic, or religious control over local interests that are perceived as threatening to the government's interests. In such a case, it is not likely that there will be much local participation in the selection of the system and, accordingly, little attention will have been paid to the question of appropriateness of that system vis-a-vis local needs and abilities.

What are the needs and capabilities of the project area?

If the local inhabitants have a high level of political, economic, ethnic, or religious organization, and if the central government is willing to allow them some independence, then it may make more sense to put the bulk of the management of the project into the hands of the local authorities. Both the Chinese and smaller Pakistani systems have been successful in this, as was the Huayla system in Peru. Technical systems that invite local management and control also can foster a more equitable distribution of benefits among the residents of the project area. The community will need access to resources. There are three options: appropriate technology which the community itself can finance; joint financing by local authorities and the regional or national government; compromise on a less-than-optimal system which the community can afford.

In all cases the costs of both the technical system and the additional infrastructure it may require must be considered. The local area also must have the skills to manage a project effectively. If the area doesn't have them, some form of joint management with a higher level of government, or a local training program, is needed. Such training has been carried out successfully in Papua New Guinea, Pakistan, China, Indonesia, Nepal and the Philippines. The cost of such arrangements must also be considered.

In summary

The fixed realities of geography, mechanical components, and political/economic factors require careful scrutiny in making technological choices. Crucial decisions can and must be made. The technical choices and the tradeoffs that they imply strongly influence the potential success of management during the life of the project.

What seems good to one level of government may appear less so to another. Consequently, the potential for conflict is great. A consultant must try to avoid being caught in the middle of such disputes by knowing as much as possible about the forces at work.

Program objectives

There are many economic, political, and social objectives that commonly are pursued by means of rural electrification projects. Some of these are conducive to centralized administration; others fit better with a decentralized approach. SDH program objectives should be made clear and explicit. This also facilitates post-project evaluation.

What are the economic objectives?

Economic goals may include:

Increasing productivity and employment in the project area
Increasing real income and the use of currency
Stimulating commerce and trade
Providing adequate storage and refrigeration for agricultural goods

Introduction of an appropriate rural electrification system can stimulate each of these. More productivity will mean more income, which in turn will prompt more consumer demand and more business, employment will increase to meet that demand, and so on. Something like this has occurred in locally initiated projects such as Tarabuco, Bolivia; Huaylas, Peru; Andes, Colombia; and small sites in Tanzania and Pakistan.

In such cases there is no reason why the management of the project could not be independent and locally based, except where a stridently egalitarian pattern of decisionmaking would have a bad effect on traditional social patterns.

In practice, of course, this desired course of economic development may be obstructed by any number of factors, from an excessive worker preference for leisure rather than increased income, to a general lack of division of labor that interferes with a viable money-based economy or introduction of specialized types of industry. In these cases it may be very difficult for a consumer-oriented cooperative, which is sensitive to its own membership, to initiate the policies most needed. Often only regional or central authorities, at the considerable risk of local resentment, can implement subsidies for producers, compensatory domestic rate hikes, or new nonbarter forms of exchange. These kinds of measures have been applied successfully, for example, in Bolivia and the Philippines.

Without such actions, economic development may never get seriously underway. If the actions succeed, the benefits will most likely outweigh the costs. Industries processing raw materials, for example, may be able to supply them to local producers who can

then sell them profitably and thus increase trade, employment, and real income. Particularly in the case of storing agricultural goods, often only the central government has the expertise and emergency backup equipment needed to do the job or train others to do it.

What are the political objectives?

Political objectives include such disparate goals as--

Supporting the independence of the project area
Fostering dependence of the project area
Encouraging democratic participation, and
Creating a base of popular political support.

The first and second of these are seemingly contradictory. To support local independence, the central government may be willing to step aside, allowing local managers to accumulate an economic surplus the proceeds of which could then be allocated in part to strengthening locally controlled political and administrative institutions. Santa Cruz in Bolivia and the Hauylas, Muquiyauyo, and San Pedro de Cajas sites in Peru have gone through something of this kind. Such a process could potentially lessen the burden of the central government and perhaps add to the sense of national as well as local unity.

But a government interested in ensuring the dependence of local inhabitants may also seek to improve the quality of the community. By imposing "benevolent" programs that require local compliance without local control and that depend on expertise available solely from the national level, the central government acquires leverage. An example of this was the repossession of the locally managed Sevilla Caicedonia project in Colombia by the regional power company when residents and staff protested excessive rate increases. As long as the benefits (that is, low rates) continue, it is hard for local people to generate the momentum needed to overturn such policies.

Democratic participation requires some independence. The creation of this area of independence may be encouraged by national or international contracts that stipulate that the projects to be constructed shall be cooperatively managed. AID has done this, for example, in Costa Rica, Colombia, Bolivia, and the Philippines.

To stimulate mass political support through highly visible projects requires a substantial contribution of expertise and training from the central government. At the same time, however, local inhabitants often must be entrusted with many of the key investment and operational decisions if they are not to perceive national intervention simply as an attempt to "buy them off." Egypt, India, the Philippines, and Bolivia provide examples of programs where central governments have tried hard to walk this

thin line. The results in each of these cases is a balance, however, fragile, of centralized and local-based management, a balance somewhat different for each region or country. Such an arrangement is often necessary for SDH programs to optimize their various political objectives.

What are the social objectives?

Social goals commonly specified for SDH and similar projects are--

Contribution to an improved general standard of living
Better health for project area residents
Reduction in migration to urban areas, and/or
Reduction in birth rates.

If the objective is to attack a particular social problem in a specific community, generally it makes more sense to entrust the management of a technologically appropriate system to those local persons who know the problem best. If the focus is on several problems through a coordinated campaign that involves many ministries and spans the nation as a whole, a more centralized management strategy, in which SDH plays only a part, may be necessary.

With respect to the general standard of living, there are illustrations of both types of assistance. When local authorities have been in charge, as in Ecuador, Baliguian in the Philippines, Tarabuco in Bolivia, and in Colombia, they have been able to make decisions concerning which public services they would promote, such as communications, roads, and religious institutions. Conversely, central government initiative has made a substantial difference in North Yemen and China, and the same can be said for centralized provincial authorities in India, and Santa Cruz, Bolivia.

Evidence suggests that some action by central governments usually is necessary to make significant progress with health, migration, birth rates, and other complex social problems. In the area of health, with all its attendant specialization, complete local self-direction may not be practical. Migration and birth rates may be more susceptible to control through local campaigns, but there is as yet little hard evidence either to sustain or refute this.

What objectives are being pursued? For and by whom?

In any SDH program there are multiple actors. Each (including the consultant) may have explicit or implicit goals. Each may in fact have multiple goals. There are alternative ways to pursue each goal. Figure 5 summarizes possible program objectives for SDH.

One way to reduce to manageable size this bundle of alternative objectives is to ask, "By whom are various objectives pursued?"

Figure 5

A summary of possible program objectives

Economic

Increasing productivity and employment
in the project area

Increasing real income and use of
currency

Stimulation of commerce and trade

Adequate storage and refrigeration
facilities for agricultural goods

Political

Support for the independence of the
project area

Fostering of dependence of the project
area

Encouragement of democratic participation

Creation of a base of popular political
support for the government

Social

Contribution to an improved general
standard of living

Better health for project area residents

Reduction in migration to urban areas

Reduction in birth rate

**What are the most important practical objectives
of the central government program?**

One goal may be increasing productivity and real income in the project area. The government could, for example, pursue this goal by enlisting local labor in the exploratory mining of raw materials previously thought to be inaccessible.

What are the primary practical goals of the local inhabitants?

They may be social goals, for example, improving the standard of living and reversing urban migration.

If the purposes of all major actors are more or less congruent, as in this hypothetical case, it suggests that a centralized approach may be acceptable to all concerned, especially if there are genuine long-term benefits from the participation of the national government and international organization(s).

But which objectives take precedence in a situation of conflicting priorities?

In a given country, the local inhabitants may wish for two or more not altogether harmonious objectives: say, an increase in real income (which may necessitate central government involvement, since the local economy is stagnant) and political independence (since they are tired of having their local institutions controlled from the national capital).

In the same country, the central government may be primarily interested in creating a base of popular political support. In a relatively weak regime, the central government may perceive that rural electrification can improve life in rural areas and at the same time advance its political designs. Consequently, it would embark on a campaign to install domestic hookups throughout the countryside, supplying expertise, personnel, and extensive credit to local areas from agencies in the national capital. At the same time, however, the central government may itself be strapped for cash and technicians.

The potential for conflict between these actors is clear. Can it be mediated?

Assume that an international organization enters at this point, having as its primary goal an increase in rural employment opportunities; but also willing to shore up a weak regime against internal forces of opposition. The international organization could delay its assistance while it reasons with the government over the latter's emphasis on domestic instead of productive hookups. Many local residents may prove unwilling to cooperate with what they see as oppressive central government; others may lay aside their protests and buy light bulbs. Hookups may however, be too few to realize adequately even the goal of domestic use of electricity.

On the other hand, something more positive could happen in this situation if the international organization is able to persuade the central government to pay attention both to employment (the international objective) and real income (one of the local concerns) in rural areas. The organization can argue that this

can be done without sacrificing the bureaucratic apparatus developed for the national campaign, by shifting the focus to offer equal publicity and encouragement for productive as well as consumer uses of electricity. This could lead to new opportunities for employment and income as well as increased political support. A certain amount of local political independence may have to be foregone for the time being, but in the long run the productive hookups would help community members to be more economically self-sufficient and hence more independent. They will have sacrificed something but not everything.

These examples are drawn from real life to illustrate that a practitioner/consultant must clarify the diverse economic, political, and social purposes at work, identify the actors pursuing them, and anticipate the probable outcome of various conflicts. In this way, one is more likely to steer a safe course through the uncertainties related to SDH development programs.

Alternative management approaches

Management means getting things done through people. The competent manager must clearly envision--

The objectives

The tasks necessary for their accomplishment

The skills and resources necessary for those tasks

Ways to recruit, train, and motivate the appropriate people, and

How to coordinate and keep on track all of the persons and activities.

In a national SDH program these functions of management are complicated because of the multiplicity of levels of management involved--from remote rural villages to international lending institutions halfway around the world. Even within a country, there are likely to be large differences in language, customs, and social organization between various levels and groups participating in the program. A well-planned executive performance by management remains a key to a successful operation.

Functions of management can be grouped under three broad categories:

Finance

End-use planning and operations

Construction, operation, and maintenance.

These major functions subsume other functions of training, customer relations, personnel and promotion.

Finance

Management tasks with regard to finance include--

Securing investment capital to cover the initial startup costs

(almost always in the form of a grant or loan)

Preparation of budgets and cashflow projects

Setting rates and collecting tariffs

Keeping records.

What are the implications of alternative sources and types of initial funding? The level of sophistication of all financial functions depends greatly on the source and nature of the initial funding. If the system is wholly subsidized by government, there may be little motivation on the part of local managers to sign up more users in order to increase revenues and reduce per unit costs. Because no payback is necessary in such a situation there will be little incentive for local people to maintain good records and to develop bookkeeping skills.

If the initial capital comes from a credit cooperative, a rural development bank, or a commercial bank, whether local or international, and if this loan must be repaid, there is more likely to be a real effort to develop efficient systems for bill collection, recordkeeping, and accounting of energy use. A financial incentive to sign up more users is built into the program. If levels of use are high enough, rate collection might be done through a meter system. The decision about initial funding will have a strong after-life in all other areas of financial management.

In an area where the source of startup capital has not already been established, the SDH practitioner should consider three basic alternatives:

Community participation--that is, a cooperative or some form of subscription

Entrepreneurial risk capital--either through local investors or through a commercial bank

A governmental extension service--either one specifically for SDH or a general fund for rural development.

If the SDH practitioner is advising the borrowers, he should caution them concerning interest rates, period of amortization, etc. If he is advising lenders, he should examine the local economy and judge the skill and wage levels of labor, the potentials for job generating industries, and the existence of a cash or export economy for clues to the ability of users to pay.

How will the price of electricity be determined?

The rate structure usually depends on whether the system is centrally or locally planned and managed. Centrally planned systems establish general rates in terms of the national goals of the program. If energy import substitution is a major goal, the cost of imported petroleum may be a factor in setting prices for electricity. Or rates may reflect a subsidy to rural areas; such rates normally are lower than urban rates, even though the per unit cost of electricity usually is higher.

Rates set by small, locally developed projects are generally more responsive to the issue of equity within the community. Even if pricing decisions are made at the local level, however, they should take into account national needs. If national priorities entirely submerge local desires, the program may have trouble generating support at the village level; conversely, a stiff tariff policy that responds only to local desires is unlikely to encourage monetary and technical support from the national government.

What effect will the sophistication of the technology have on pricing policies? The installed cost per kilowatt of the technical system will strongly affect the net return needed to make the system financially viable. Cost per kilowatt is a rough indicator, since it can be measured with a wide range of alternative assumptions. Moreover, the cost of labor and materials is highly variable between countries and even between regions within a country. Nevertheless, as a general rule, the more expensive the system is to install in relation to the kilowatts generated, the more expensive should be each unit of electricity to the purchaser. Sometimes therefore a less sophisticated system that fails to optimize the output potential of a given site, but uses more labor and simple materials, is preferable to a more sophisticated, capital-intensive system. By making greater use of relatively cheap labor and local materials, the simpler technology may be cheaper per kilowatt for potential users.

Scale also influences financial management. Generally, the bigger the technical system, the more elaborate must be the accounting system. For a small system, a local accountant can sometimes be borrowed from a large landowner for an afternoon or two per week; in a large system, a full-time bookkeeper might be necessary.

Planning and promoting end use

End-use planning and promotion are important because--

The more users there are, the cheaper will be the unit cost of electricity for each user, until capacity is reached

The more users, the more proceeds for payback or expansion flow to the program, and

The more citizens to reap the benefits of SDH.

How can end use be anticipated and promoted? Promotion of end use is complicated by the cultural distance between Western change agents and local participants. The practitioner should--

Keep the site or promotion close to the site of use

Cast the presentation in terms of the felt needs of potential users

Be sure the promoter is from the same general cultural program as potential clients, and

Solicit the involvement and support of local opinion leaders first.

Excessively modest plans for end use can mean that demand exceeds the supply of electricity, so that an expanded or supplemental system has to be installed later at high cost. Excessively ambitious projections of user hookups can mean higher costs to fewer users, unused generation capacity, and fiscal instability.

Construction, operation, and maintenance

Preparation for construction of the system can be the most difficult step in the implementation process. Mistakes of design at this stage will last the entire life of the project.

What are the most important considerations in choosing equipment? The long-term viability of the system and the program objectives should determine the appropriate approach to construction. A top-of-the-line generator can be imported, or one can be made by a local welding shop. Equipment should be scaled to the resources and competencies of the people it must serve.

The SDH practitioner, in sum, should focus on social appropriateness rather than technical optimization. Excessively sophisticated techniques can have a negative impact. It can sometimes be very difficult to find replacement parts in an isolated village. In some countries, import licenses are as difficult to obtain as replacement parts. In other areas, local skills at maintenance and repair may be better matched to simple rather than to complex technology.

What kind of training program is necessary? The key to successful operation and maintenance is personnel training. Plant personnel must be trained in several areas. Most importantly, someone (preferably several people) must be trained to maintain and repair the system. Another function that requires training is end-use promotion to keep energy demand at an optimal level. Such training can be--

On-the-job training

Workshops in the field

A formal program in a regional technical institute, or

By apprenticeship at existing SDH sites.

Training is particularly important in settings of political instability, or of high career mobility, where the lack of continuity of personnel requires managers constantly to regenerate their staffs. One good rule for such settings is: no promotion until one trains one's replacement. Such a rule will not help when staff turnover is at the senior level, which may happen because of changes in the national leadership group. Countries where such changes are frequent also tend to be characterized by a lack of middle-level technical and administrative personnel. In such situations, it is all the more important to build training into the basic structure of the program so as to develop the infrastructure and professional cadre necessary for the success of a national SDH program and to provide for its continuity in times of political change.

The type and level of training will vary with the level of personnel to be trained. Training programs in developing countries, especially those for senior personnel, often are

sponsored by a donor country agency or conducted by a large firm. One high quality and self-sustaining program, in Peru, uses an expatriate to train Peruvian nationals in Lima. For the training of field and village personnel, training should be conducted at or close to the point of use. Trainees should be already accustomed to the time and discipline necessary to their jobs.

Training is not only a tool to get a job done but also a means of building a constituency. Training is a means of bestowing credentials; those who have received training have an enhanced professional or occupational status. The socially sensitive SDH practitioner will find ways to use the goodwill thus engendered to strengthen the program.

More information is available

As the SDH practitioner moves into the field, it is our hope that this Introduction will have alerted him to some crucial issues. In the last event, an SDH consultant works with--

The available human resources and materials

Within the social and cultural conditions of the host country, and in the light of the program objectives--a vision of the task to be accomplished.

Within the limits of these realities, the SDH practitioner makes significant choices based on assumptions about the meaning of economic development. The issues discussed in this guide can help the SDH consultant or manager in making his everyday labors a clear and genuine contribution to international development.

In 2 years of assisting developing countries and AID missions in small decentralized hydropower planning and development, NRECA has developed simple, pragmatic methodological approaches and compiled information and case histories which are made available to other SDH planners, managers, and consultants. The publications listed below (and other materials not yet published) provide descriptive detail and documentation for the general discussion of issues in this document. The reader is invited to contact NRECA/IPD or U.S. AID for further information.

Publications completed

Small Decentralized Hydropower (SDH) Program--brochure describing the SDH Program history and activities; also available in Spanish and French.

Small hydroelectric powerplants: An information exchange on problems, methodologies, and development--proceedings of the small hydropower workshop held in Quito, Ecuador, August 19-21, 1980, sponsored by the SDH Program (in cooperation with USAID), the Instituto Nacional de Energia and the Instituto de Electrificación; available in English and Spanish.

Methodology for country assessments of mini-hydropower potential--from a country's physical characteristics, conclusions can be drawn on the need and feasibility of a national mini-hydro program; also available in Spanish and French.

Methodology for prefeasibility studies of candidate mini-hydro sites--for analyzing specific sites to assure that there is sufficient hydraulic and economic potential to justify more detailed investigations; the methodology can be used to rank a

group of sites under consideration; also available in Spanish and French.

Hydrologic estimates for small hydroelectric projects--for estimating streamflow duration and peak flows in regions where very little data is available.

Directory of sources of small hydroelectric turbines and packages--descriptions of U.S. and developing country manufacturers and their equipment lines as well as information on packaged units; second edition now available; also to be available shortly in French.

"Thinking small: When the oil crunch hit, Pakistan turned to small hydropower," Agenda, January-February 1982 issue.

"Rural power schemes in Pakistan," International Water Power and Dam Construction, November 1981 issue--article summarizing the work of the Appropriate Technology Development Organization in implementing micro-hydropower schemes in Pakistan.

"A case study: Micro-hydropower schemes in Pakistan"--discusses the unusually low-cost approach used to install hydropower plants in remote regions in northern Pakistan.

Requirements to finance small-scale hydroelectric projects--transcription of proceedings from the March 10, 1981, NRECA workshop on financing small hydropower projects.

"Use of alternative energy technologies by U.S. rural electric systems," ELETRORURAL, November 1981 issue--article outlines efforts of U.S. rural electric systems in renewable energy technologies (wind, solar, hydroelectric, biomass, peat, and geothermal).

Small hydro potential in developing countries--paper presented at the UNITAR Conference on Small Energy Resources, September 10-18, 1981, in Los Angeles, California--outlines potential for small hydropower development in developing countries.

NRECA's small hydro activities in developing countries--paper presented at the UNITAR Conference on Small Energy Resources, September 10-18, 1981, in Los Angeles, California--outlines efforts by SDH Program staff in developing small hydro potential in developing countries.

Developing small hydro sites: Process for REA borrowers--paper describing the sequence of events for processing the front-end activities of a small hydroelectric project.

Small hydro for rural energy--paper presented at OAS Energy Conference, September 1980, Sao Paulo, Brazil.

Environmental issues and site selection criteria for small hydropower projects in developing countries--an evaluation of environmental issues in selecting small hydropower sites.

Publications underway

Micro-hydro sourcebook--to provide a wide range of information useful in implementing micro-hydropower schemes.

Report on the NRECA Private Sector Participation Project--analyzes potentially viable approaches to encourage the U.S. private sector to participate in the development of hydropower sites in developing countries.

The contribution of legislative initiatives such as PURPA toward involving the private sector in the development of small hydroelectric powerplants in developing countries--analyzes effects of PURPA on the private sector's involvement in developing small hydropower plants in developing countries.

Environmental methodology--outlines environmental considerations that must be taken into account in developing small hydropower sites.

Management--analyses of issues of centralized versus decentralized control, including successes and shortfalls.

Considerations, sources, and requirements to finance small-scale hydroelectric systems--examination of plans and policies of international lending institutions and their effectiveness in small-scale, isolated energy development.

Evaluating electrification experience: A guide to social evaluation of small hydroelectric units in lesser developed countries, and the results of the AMARU study of social factors in local electrification lessons from the literature--development of criteria from which to build a methodology for evaluating small-scale energy systems.

Small decentralized hydropower for Asian rural development--proceedings from a regional workshop held in Bangkok, Thailand, June 8-12, 1981, on small hydropower sponsored by the SDH Program in cooperation with USAID, the Asian Institute of Technology, and the National Social and Economic Development Board of Thailand.