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Western concepts of environmental problems as they affect Africa have too commonly been symbolized by recurring photographs of starving children, relieved by the occasional factory chimney. As this environmental issue of *Africa Report* makes clear, things are not that simple, though they may sometimes be that dramatic.

The initial article starts with the basic question: What makes a situation into a problem? Discussing several different frameworks for basic definitions, it sets the overall perspective within which to consider individual issues.

One of these issues is that of technology. Is oil-power the answer, or can old-fashioned people power and new-fangled solar power better meet real needs? David French lays out some of the options. As Betsy Jones shows, recycling—a frill in the U.S.—is an African necessity and art.

If alternative power uses are issues of mostly future impact, the state of the cities is a problem for now. Roger Mann describes the realism with which several African countries are tackling slum clearance. Lastly Richard Deutsch takes a look at some lobbyists in Washington who are trying to change the U.S. government's mind on a wide range of issues in which aid and the environment are intertwined.

Meanwhile, the continent's political, social, and economic life goes on. Lansiné Kaba assesses the current state of the Republic of Guinea. Barbara Rogers takes a look at the effect of current assistance thinking on the life of women in Africa, and finds it in many cases actually regressive. And Roger Riddell, examining the economic alternatives that will face an independent Zimbabwe, comes to the conclusion that moderation in all things is not always best.

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The cover picture—a modern windmill of a type in experimental use in the Cape Verde Islands—is from Rede Corporation of Providence, Rhode Island.

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Energy for Africa's Future

By DAVID FRENCH

In much of Africa, energy and the environment are one. Beyond muscle power, "energy" above all is the sun to dry clothes and food, the wind to scatter chaff, and wood and dung for cooking.

The importance of these traditional sources may escape the visitor, for whom Africa can seem a high-voltage mosaic of impassioned lorries, spidery power lines, and air-conditioned hotel rooms. Yet only one African in five lives in the cities where such wonders abound; and even there, it is wood or charcoal that cooks most evening meals. In many countries — Tanzania, Ethiopia, Uganda, and Sudan are examples — more than four-fifths of all the energy used comes from those sources that industrial nations label away as "noncommercial."

Despite this, life in Africa continues: water is lifted from the ground; food is grown, transported, cooked; goods and people are moved from place to place; wounds are bound and spirits lifted; clothes are made; minds are formed. These are the major tasks to which energy must be applied in any culture. If Africans do such jobs noncommercially, they do them just the same, often in ways from which we ourselves have much to learn.

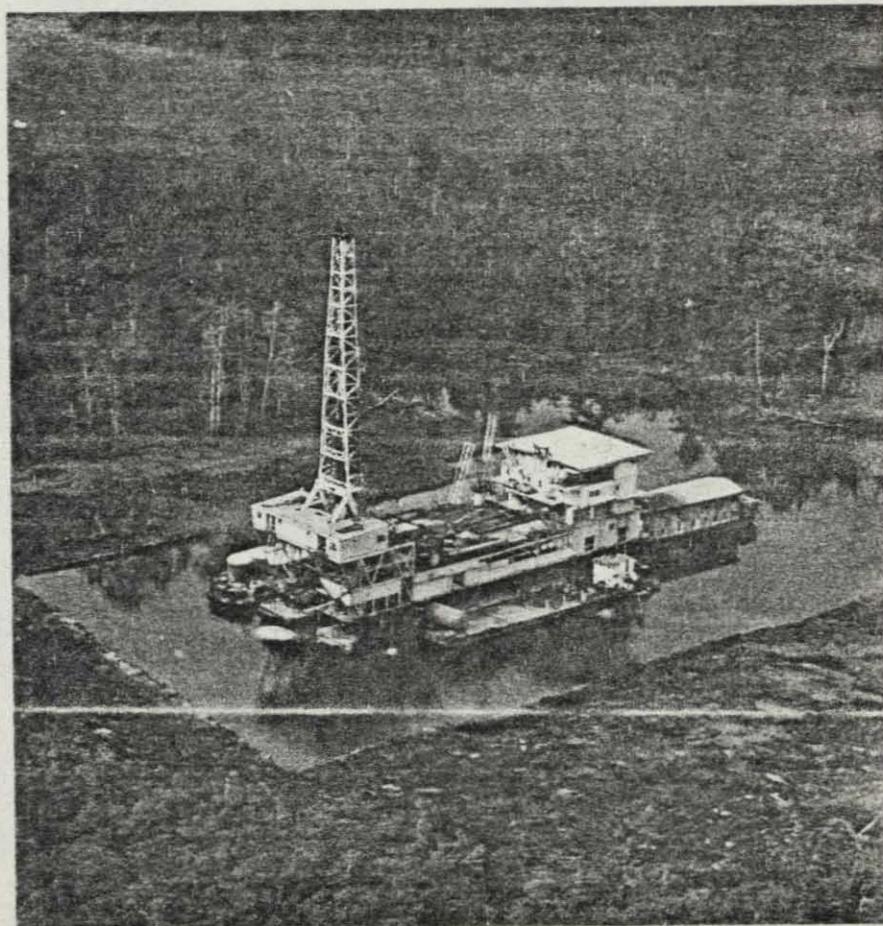
David French is a consultant in economic development working with the U.S. Agency for Development, Development Alternatives, Inc., the American Council on Education, and others. He is the co-author of *Working Communally: Patterns and Possibilities* (Russell Sage Foundation/Basic Books, 1975).

Yet that is not enough. Too many dead phrases suggest the fragility of African life: infant mortality, postharvest food loss, endemic disease, deforestation. What a Sahelian drought makes inescapably vivid is but daily reality for millions of less visible people. A slackening of rains, a surge in the incidence of minor illness—and people die. The work of life must somehow be done better, if only to create tolerances within which people can survive the unexpected.

We are talking here of energy, which

must be made more abundant and be applied more efficiently if life is to improve. And yet the pool of noncommercial energy on which most Africans depend is actually growing smaller. To the extent that energy use and welfare are bound, much of Africa is now busily undeveloping.

At the heart of this slide is a firewood crisis of near unimaginable degree. Outside of Ouagadougou, the land has been stripped of trees for 45 miles in all directions. In Accra and Lagos, people in search of fuel tear the scaffolding



Drilling rig in Nigeria: Is oil really Africa's "black gold," or a white elephant?

Alan Hutchinson Library

from construction sites. Many Gambian villagers now leave home at midday to return by nightfall with the evening's firewood. At present rates of deforestation, Senegal will be bare of trees in 30 years, Ethiopia in 20, Burundi in seven. In energy terms alone, we bear witness here to potential catastrophe.

Under the circumstances, it might seem prudent to plant more trees. Yet there are other responses, the "modern" ones, resplendent far beyond their merits, constantly tempting away the resources that could give people what they want and need. According to one estimate, more than 96 percent of all energy aid to Africa between 1970 and last year was used to promote large-scale generation of electricity. Thus, \$700 million or so have been spent to produce power accessible to perhaps one African in 50, and the richest one at that.

To be sure, statisticians can relate increases in a nation's income and its use of commercial energy: oil, coal, electricity, gasoline. By 1980, for

example, the lower-income developing countries will expend 30 percent more commercial energy per dollar of national output than they used in 1960. Yet this is observation, not cosmic law. There are many ways to improve energy use. A reliance on large-scale, commercial sources is only one approach, the one which in Africa assures the least benefits for the greatest number of people.

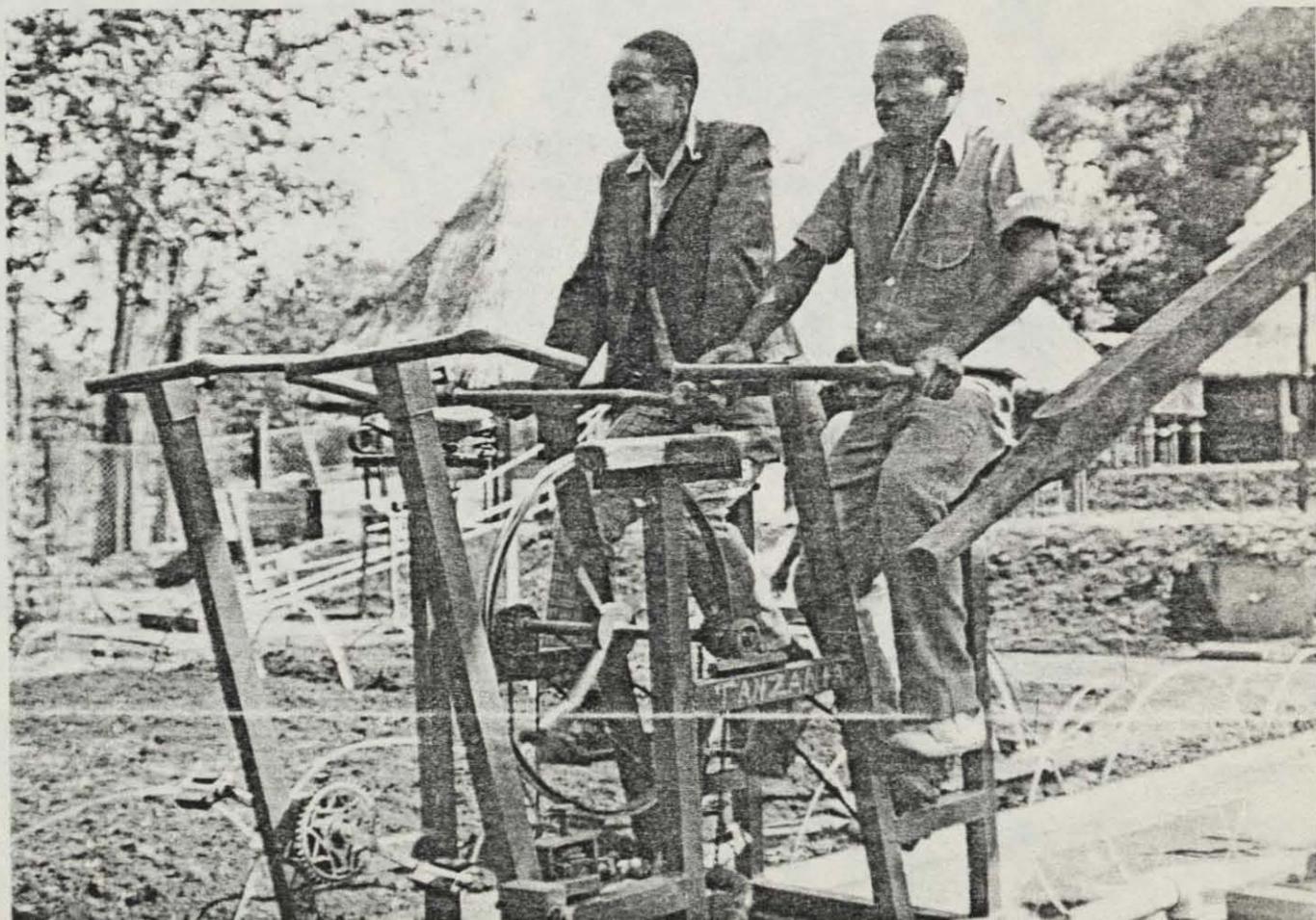
There is a further issue: To what extent will the "modern" energy model even continue to be an option for Africa?

The most potent visual symbol of a modern energy system is the **electric grid**, webbing its way through every inhabited space. According to the World Bank, however, fewer than 10 percent of "village-rural" Africans will be served through these grids by the mid-1980s. And there is considerable question as to whether electricity, even when available, is the appropriate form of energy to apply to dominant tasks: cooking food, pumping water, grinding grain, planting and harvesting

crops. Electricity has its uses, but it will continue for some time to be a marginal energy source for practically everyone in Africa.

In nearly three out of every four African nations, **petroleum**-based liquid fuels now account for 90 percent or more of all commercial energy. Africa's modern sector, in other words, is dependent on an energy dinosaur. World oil production is expected to peak in another two decades, and total output should be well below today's by the year 2020. Even Nigeria, sub-Saharan Africa's one significant oil producer, may exhaust its known resources by the turn of the century. In general, Africa's oil future makes its firewood future look rosy.

Little more than 1 percent of the world's **coal** reserves is in Africa, almost all in South Africa and Zimbabwe. Even where they exist, these reserves are difficult to extract, expensive to transport, and environmentally hazardous to use. Clearly, coal cannot be a significant means of powering African development.



People power: A bicycle-driven irrigation pump devised by the Kenyan Village Technology Unit



Beryl Goldberg

Africa's major fuel crisis is a firewood shortage so acute that Upper Voltans like these sometimes have to travel 20 miles in search of it

If nuclear power plants made sense anywhere, it would not be in Africa. All the standard problems apply: waste disposal, plant decommissioning, core meltdowns and low-level radiation. In addition, Africa simply does not now have electricity markets large enough and sufficiently well-integrated to use even the smallest reactors. Where such markets may arise, hydroelectricity will almost always be available at lower cost. Anyone unfriendly enough to try peddling nuclear energy in Africa should be given 24 hours to leave the continent.

None of this is to deny that the use of "modern" power in fact will spread through Africa. As long as there are World Bankers and oil companies, dams and drilling rigs will speckle the continent. At least a little coal lies below the soil of perhaps 15 African countries, and we can assume that someone soon will look to see for sure. The momentum to do these things is enormous, regardless of their sense.

Yet two points continue to disturb. First, on balance, Africa faces resource limitations that simply preclude it from following the Western, coal-oil-electricity path for any distance. Second, even if such an approach were possible, little of benefit would result for the vast majority of Africans, whose urgent problem is to cook the evening meal, not to fire the furnaces of industry. To meet human need, we must start from where most Africans will live for generations, in villages low in access to "modern" energy, but high in the desire to do familiar work in better ways.

Since Africa will long continue to depend on trees for fuel, the prime tactic for increasing energy must be reforestation. But this is more easily prescribed than carried out. To be accessible to those who need them, wood lots must be scattered widely across countries, straining technical and administrative capacities at all levels. Unless extraordinary efforts are made to protect the trees, saplings fall victim to

cows, goats, or people long before they mature. Perhaps most important of all, reforestation lacks the kind of sex appeal that commands the attention of development agents in Africa and abroad. These are formidable obstacles, but ones that must be overcome if human and environmental disaster is to be averted.

Equally necessary is to use available resources more efficiently. Typically, for example, more than 90 percent of the energy released when wood is burned for cooking dissipates uselessly into the air. At least in theory, redesigned stoves and utensils could substantially reduce these losses.

More significant still are opportunities to enhance human or animal energy through intermediate technologies: improved hand tools, animal-drawn implements, simple pumps, pedal-power. There are energy costs in making these things. But once made, they serve to magnify traditional energies that would be expended in any case.

Finally, there is need to find new ways to tap those resources which Africa will always have in greatest measure: sun, plants, water, wind. Although they pose problems of their own, technologies exist to do this job. In no special order, here is a sampling:

Solar Water Heaters These systems transfer heat to water as the sun's rays are absorbed by metal sheets or tubing. Use of such systems is already widespread in Japan, Israel, and Australia. In Africa, prototypes will soon have been tested in Niger, Upper Volta, Botswana, and Mauritania. Especially in cities, the potential for solar water heating in Africa seems great.

Small-scale Hydropower Both hydroelectric generators and water wheels for grinding can be made to village scale. Most of China's rural communes rely on electricity produced in this way, and there is no technical reason why many of Africa's villages and towns could not do the same. A number of small-scale units have already been installed in Africa, and the International Institute of Tropical Agriculture is investigating further applications.

Solar Drying Crops and fish have always been dried by the sun. The use of simple solar collectors can speed the process while protecting the food from wind, rain, insects, rats, and birds. Research into solar dryers is now begin-

ning in Senegal, Mali, Zambia, and Kenya.

Solar Cells Among other things, the space age has given us the solar cell, which makes electricity straight from sunlight. To produce a watt of power from midday sun requires solar cells which should cost but 50 cents by 1985, bringing electricity for high-value uses within reach of every village in Africa. Already, experiments in using solar cells to pump water are being carried out in Upper Volta, Mali, and Cameroon.

Pyrolysis This process "burns" organic materials in the absence of oxygen, turning them into charcoal, gas, and oil. Pyrolysis can therefore make



Sun power: A solar heater built in Kenya's Village Technology Unit

useful energy from wastes having no alternative use. A demonstration pyrolytic converter using sawdust as its raw material is now being tested in Ghana.

Solar Cooling There are various techniques for using the sun to cool space for living or for storing food. Although these technologies are less well developed than other devices listed here, they have considerable promise for the future. On a pilot basis, solar air conditioners are being planned for use in buildings in Khartoum and Ouagadougou.

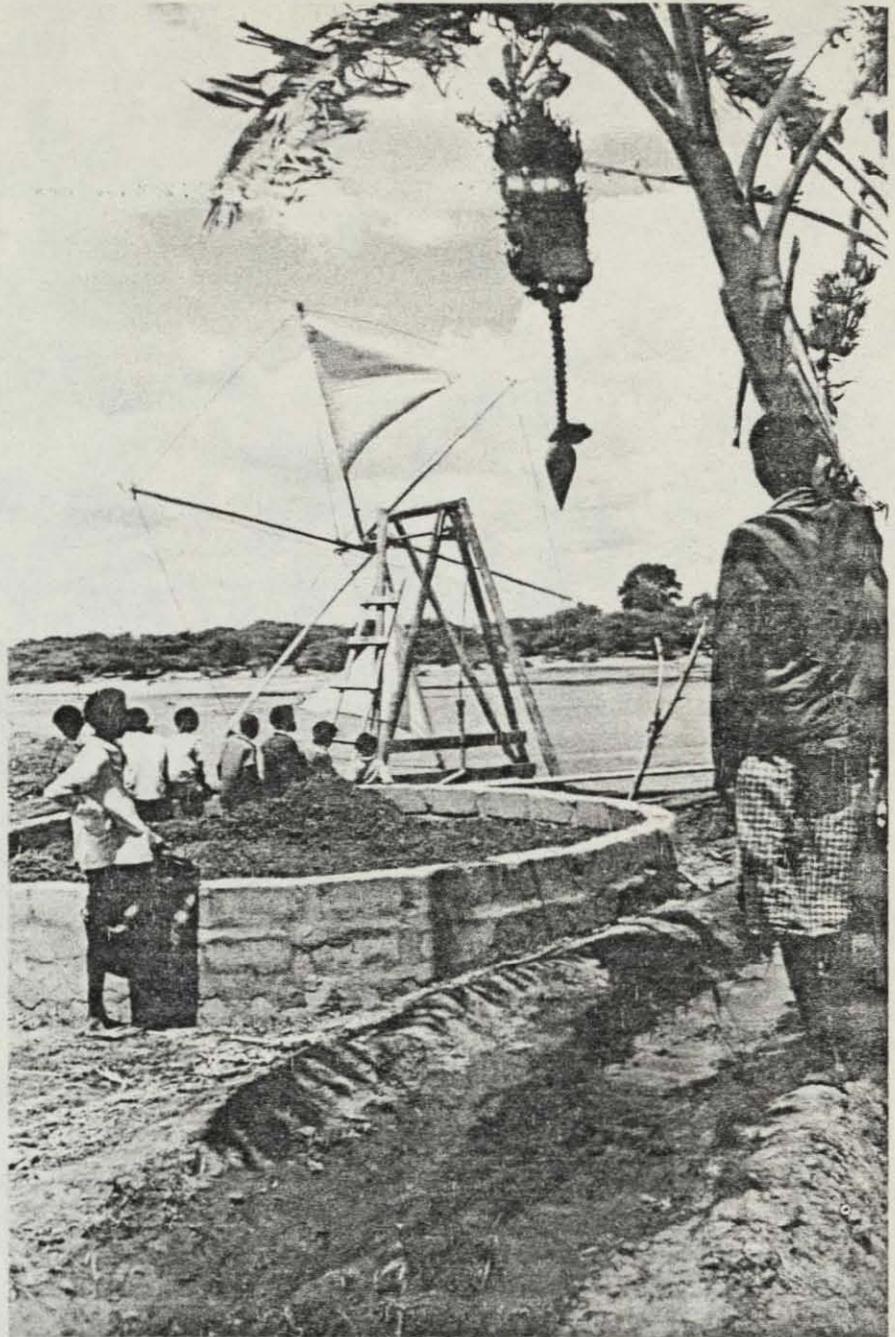
Wind Power Wind machines can be used to grind grain, pump water, or make electricity. Although not all of Africa has winds of sufficient force for these machines to be worthwhile, groups in Senegal, Ethiopia, Kenya, and Tanzania are currently working on prototype wind pumps.

Solar Pumps By boiling liquids, the heat from solar collectors can be made to turn turbines and pump water. Although currently quite expensive, such systems have been used to provide irrigation and drinking water for villages in Mali, Mauritania, Chad, and Cameroon.

Biogas Through a fermentation process, organic wastes from humans, animals, and other sources can be converted to liquid fertilizer and methane gas for cooking. Extensive experience in China suggests that family-scale methane systems can be constructed for as little as \$15. Although still at the prototype stage, biogas units have been built in Ethiopia, Tanzania, and Upper Volta.

All of these devices provide aid in kicking the petroleum habit, an essential part of anyone's long-term energy strategy. As opposed to oil, the energy used by these systems is infinitely renewable. In addition, most such technologies can be made equally available to people wherever they live, in remote village as well as urban centers. At least in theory, renewable energy systems are democratic, decentralized, and lasting.

In passing, we should take note of the degree to which this line of thought has been embraced by groups throughout



Wind power: This Kenyan pump effectively irrigates up to three acres

the world. A study prepared last year for the National Science Foundation discovered that renewable energy solutions for the United States are being pursued by roughly 500 American organizations: small businesses, university laboratories, community action agencies, backyard tinkerers. Other groups are doing comparable work in India, Sri Lanka, Canada, Haiti, Barbados, Indonesia, Holland, England, and many other countries, including at least a dozen in Africa itself. Practically everywhere, work on energy futures is increasingly focused on renewable energy technologies.

For Africa, some cautions are nonetheless in order. For one thing, we as yet know little about the economics of these systems as they would be used in African villages and cities. Such calculations would have to show the costs and benefits of particular devices, as weighed by their potential users in specific places. So far, nobody has even tried to do this job, and we are left for the moment to suppose that such systems *must* make economic sense, for tomorrow if not today.

One thing we do know. Windmills, solar pumps, water heaters, solar cell arrays, pyrolytic converters, solar

CONSERVING THE AFRICAN ENVIRONMENT

In their eagerness to adopt technological advancements on a global scale, many of the developing countries have become somewhat careless in handling their environmental problems. The infrastructure of the world's ecosystem, which spans the continents, has been weakened by the environmental mistakes that have been made in the name of progress, resulting in severe deforestation, soil erosion, and pollution of air and water. Africa cannot afford the duplication of these mistakes *ad infinitum*, but rather should refrain from the mistakes made by many developed countries. The continent should take advantage of its late start in technological development and make use of the relatively clean slate that it is enjoying as a result of historical circumstances.

Nonrenewable resources in Africa today are being used up with amazing rapidity, and various estimates indicate that within the next 40 years or so, most of these resources may be depleted or deteriorated to an alarming degree. To counterbalance this trend, it is obviously the renewable resources which Africa should be aiming to develop to their fullest potential. Using the vast array of forest trees, well organized programs could be developed to sustain a continual demand for firewood as an energy source.

The biological treasure house of Africa will provide many underutilized plant species which can add proteins and vitamins to a preponderantly starchy diet, and also supply new herbal medicinal plants. Similarly, fish and game animals, serving as rich sources of protein, can be used to augment diets. Intensive agricultural practices will require attention to postharvest losses and spoilage of the carefully nurtured crops, both old and new.

The positive beneficial impact of new hydroelectric schemes on the African economy must be carefully weighed in advance so that increased power, transportation, and fishing capabilities are not outweighed by the spread of water-borne diseases and choking weeds into the newly man-made aquatic environments.

Developed countries are already locked into using conventional nonrenewable energy sources such as oil and coal. In Africa, the advantage of a later start in the energy field can be used in the careful development of solar energy. African nations can attain a leadership role in investing in the development of solar energy, and be in the forefront of expanding the horizons of this "new" energy source. Due to its unlimited supply, increased use of solar energy will account for decreased expenditures and save much money in the long run.

The rapid development of the continent has mandated the conservation of our natural, renewable resources, the plants, animals, and the sun. While some progress is being made, we must acknowledge that current technological handicaps and limited trained manpower supply can be overcome by joint cooperation with the sizable number of people who have specific good will and purpose for Africa.

To date we have not been exploiting our natural resources as efficiently as we should, and the time has come to develop better organizational capabilities to handle the complicated yet useful procedures required in manipulating these resources for the eternal well-being of the continent.

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coolers, hydropower units: all of these things, whatever their value, are simply too expensive to be owned independently by most African families. What is required are groups able cooperatively to buy, operate, and maintain new technologies. Such groups commonly do not exist, and they will not be simple to create.

In fact, renewable energy technologies raise a host of social issues. For example, biogas units based on dung require that animals be penned, in defiance of local practice almost everywhere. In some cases, new energy systems will displace workers for whom no alternative employment exists. Unless energy devices are very cheap, their ownership may be restricted to local elites least in need of them. Historically, many small-scale development technologies have foundered for just these reasons.

There is a lesson here. Renewable energy for Africa is in few important ways a technical issue. Instead, place by place, the significant questions will be cultural ones. It follows that the people to work on such programs will have to know as much about social realities as they do about technology. The skills required are those of listening, adapting, teaching, collaborating at the village level.

These are not skills the development community has in abundance, or knows well where to find. Yet America alone has several groups experienced in building energy technologies with poor communities: Volunteers in Technical Assistance, Domestic Technology Institute, Inter-Culture Associates, the National Center for Appropriate Technology. Counterpart organizations exist in Europe, Asia, and Africa itself. If we outsiders wish to assist Africa with renewable energy programs, we will have to rely on groups like these.

To help build significant parts of Africa's future on renewable energy systems is a task both inescapable and awesomely complex. The venture is one that many Americans will simultaneously be pursuing, however, since our own energy future must move substantially in the same direction. With good will and a little luck, we may all help each other find ways to do the job right. □