THE INSTITUTIONAL FRAMEWORK FOR SAHELIEN REFORESTATION: MICROCATCHMENTS, EXPERIMENTS AND LOCAL AUTONOMY

James T. Thomson
Assistant Professor
Dept. of Govt. & Law
Lafayette College
Easton, Pa. 18042

This paper has been prepared for presentation April 21, 1980 at the Workshop in Political Theory and Policy Analysis, Indiana University, 814 E. Third St., Bloomington, Ind. 47401.

THE INSTITUTIONAL FRAMEWORK FOR SAHELIEN REFORESTATION: MICROCATCHMENTS, EXPERIMENTS AND LOCAL AUTONOMY*

James T. Thomson

Introduction

This essay treats issues Sahelien and expatriate foresters, Sahelien governments and foreign aid donor organizations now concede to be crucial to implementation of successful environmental management programs in the Sahel, that much-abused band of territory along the Sahara's southern fringe. Among these issues are: (1) development of effective techniques of reforestation and woodstock management; (2) involvement and active participation of Sahelien peasants in reforestation and woodstock management; (3) identification of appropriate institutional frameworks within which such actions can occur.

The author considers points (2) and (3) ~~of primary importance~~. Their realization conditions possibilities of achieving point (1), reforestation and woodstock management ~~but goes~~ well beyond environmental problems to lay the groundwork for provision of a broad range of public goods, soil conservation, and watershed management, including replenishment of groundwater tables; road maintenance; health and sanitation; education, etc.)

---

*Materials for this essay were collected in Niger and Upper Volta (January 1979 - March 1980) during fieldwork authorized by the two governments and funded in part by the Rockefeller Foundation, Lafayette College, USAID and OXFAM. Appreciation for both authorization and funding is here expressed.

not now readily available in many Sahelien communities. By contrast, practitioners - foresters, governments and donors - often assume by and large that techniques of reforestation are the critical issue. Institutional design considerations interest them only, if at all, as a means to reforestation.

In deference to the practitioners' perspective, the analysis below begins with the question of reforestation technique, after some very brief comments about the assumptions upon which the analysis rests. It focuses on the device of microcatchments as a technique of arid land reforestation, emphasizing the extent to which success of the technique hinges upon continued experimentation in adapting it to particular and highly varied Sahelien microenvironments. In a third section, the need for experimentation is taken as a constraint, and paired with a second, the variability of local-level political environments in the Sahel. These constraints define the characteristics of the institutional arrangements within which participatory reforestation and woodstock management would be feasible in the Sahel, set out in a fourth section. Implications of these arrangements are considered in a concluding section.

Assumptions

The people whose behavior is here analyzed and who must implement any eventual solutions to reforestation problems in the Sahel are assumed to be self-interested, rational maximizers who make decisions under conditions of uncertain information (and therefore often satisfice rather than maximize). They do so within a basic legal framework which varies from place to place but establishes in any local context parameters of their decision-making processes. People are also assumed to be capable of learning over time as new information becomes available to them [V. Ostrom, 1974: 50-52].

Reforestation: Technical Problems and Solutions

Contemporary Sahelien Reforestation Efforts

Since the Sahelien drought, ~~(1968-74),~~ ~~interest in~~ environmental management in the Sahel zone has increased enormously [Copans, 1975; Dalby, Church and Bezzaz, 1977; Glantz, 1977]. Reforestation projects have been launched as part of this undertaking in many Sahelien areas.[2] They vary widely in type, from industrial greenbelt and firewood plantations sited around cities, to village woodlots, dune stabilization efforts and natural regeneration programs.

With the exception of industrial plantations, conceived and implemented without popular participation, these projects

all share a common weakness: they fail in greater or lesser degree to involve rural people in project design and execution [Hoskins, 1979; Thomson, 1980a]. In some parts of the Sahel, family woodlots have fared better because they avoid costs of collective action.

A second weakness, less widely shared among these projects, nonetheless accounts for a considerable amount of peasant disillusionment with woodstock management possibilities. planting techniques and species "packages" advocated by foresters and sponsoring agencies have frequently been ill-adapted to the task at hand. Survival rates after a single year, to say nothing of several, are miserable, and tree growth stunted to the extent that firewood production, for instance, is negligible.

These two weaknesses appear interrelated and mutually reinforcing. They reflect the top-down, authoritarian attitudes inherited from the colonial era Sahelien forestry services and perpetuated by most of today's foresters [Thomson, 1977]. Individual peasants have apparently felt very little commitment to externally-controlled reforestation projects. and therefore have made very little attempt to involve themselves with program implementation or to experiment with variations on new techniques of reforestation. Yet such local involvement in the search for better methods is probably indispensable to effective environmental management, given the budgetary and staffing constraints under which most Sahelien area

forestry agencies operate.

Problem: Finding Workable Reforestation Techniques

Foresters particularly have focused on the second weakness mentioned above. Some donor organizations have likewise invested funds in identifying improved techniques or species which might facilitate Sahelien reforestation [Thomson, 1980a; Thomson, 1980b]. Foresters and organizations evidently assume peasants will voluntarily participate in reforestation once a viable technical package of planting methods and appropriate species is worked out. Of course many foresters are aware of other constraints impeding reforestation. The surplus or deficit resource situation in an area [Thomson, 1980c], land and tree tenure regulations, tenure enforcement problems, local collective action capabilities, protection possibilities concerning browsing livestock and wood-collecting humans, etc., appear to sharply influence villagers' willingness to become involved in woodstock management efforts [Thomson, 1980d]. Nevertheless, foresters' training leads many of them to concentrate on technical issues.

Microcatchments: A Solution?

Microcatchments for reforestation, a variation on ancient run-off agriculture techniques [Evenari et. al., n.d. (1976?)], appear to offer some promise as a wood-producing technique for the Sahel zone. Microcatchments are deliberately constructed to

create tiny hospitable environments for tree-raising (and food crop production, and possibly viniculture) in the middle of hostile, arid milieux characterized by relatively impermeable soils. Unless caught in the small, diked squares (or V's formed by little wing dams) and pit basins with their artificially heightened absorptive capacity, rain water moves immediately from such fields, often eroding precious topsoil as it does so, and disappears as surface run-off. Without sufficient water, intense heat and extreme aridity sear ground cover. Particularly where, as in the contemporary Sahel, population pressure, overcultivation and overgrazing compound effects of these harsh natural elements, environmental degradation is a sure consequence unless counterbalancing water management techniques are brought to bear on the problem.

The trick in microcatchment technology consists simply in corraling rain before it gets away. One then "stacks" enough inadequate rainfall from a larger area by draining it into the pit basin. There the moisture accumulation makes plant life possible. The technique will work with average annual rainfall of as little as 100 mm. [illegible]

Three technical constraints condition applicability of the technique in any particular environment.

1. Soils must be highly impermeable, e.g., baked clay or laterite, to promote run-off drainage.

2. Similar soils or rocks must be available to construct dikes around the catchment areas. Material for dikes can

usually be had from the drainage trenches dug just inside the catchment perimeter to guide water into the basin.

3. It must be possible to dig a pit basin in the downhill angle of the catchment and fill it nearly full with improved, highly porous soils (mixing cinders, manure and vegetable matter with site soils is usually sufficient to do the trick). Since they are spongy rather than impermeable, pit soils suck up and hold run-off moisture.

While the technique won't work everywhere, e.g., in sandy soils, many local environments across the Sahel are technically appropriate for reforestation by this method. Microcatchments can be used by individuals or groups in isolation on cultivated fields or played-out hardpans. They can be associated with slightly more sophisticated contour diking or terracing schemes designed to stem soil erosion and heighten agricultural productivity. Where mechanical earthmoving equipment is available to shape dikes or terraces, microcatchments can be integrated into an overall watershed management/soil conservation scheme initially as part of planned development, or as an afterthought embellishment to enhance benefits of water control.

Even without machines, local hand tools almost always suffice, given perserverance and a bit of astuteness - which any peasant can manage - in timing construction for the post-harvest period. Clay soils are then normally still friable, having not yet hardened under the baking sun. Laterite pans pose a more

difficult problem, but many have not yet solidified. The process of formation can be reversed or appropriately manipulated to maintain in productive uses large amounts of land which would otherwise be irreparably lost.

Microcatchment Major Variables and Field Experiments in Yatenga

In 1978 OXFAM, a private voluntary organization engaged in development assistance, initiated a multi-faceted microcatchment experiment in eight villages of the Sahelien Yatenga region of northern Upper Volta [Thomson, 1980b]. It was hoped a workable reforestation "package" might be perfected and then spread through extension work elsewhere in Yatenga and comparable Sahelien regions.

The experiment involves manipulation of five different technical variables under the kind of field conditions typical of Yatenga rural life:

1. soil and site types;
2. appropriate varieties (and combinations) of trees, bushes, food crops and vines;
3. catchment shapes and dimensions;
4. planting dates; and
5. fencing trials.

Efforts were made, on markedly different soils (soil quality, extent of soil degradation) and site types (slopes, drainage characteristics), to test local and exotic species in square catchments ranging in size from ten by ten to six by six meters. Varying catchment size and dimensions will modify water harvesting

capacity. Thus the amount of water collected can be varied to fit the requirements of different species. Furthermore, the simpler the construction job (smaller catchments or open V's rather than closed squares), the less effort required to complete it, and the greater the attractiveness of the investment. Planting dates were also manipulated; results to date, six to nine months after planting, generally suggest most species fare better when planted earlier. The Sahelien dry season is so brutal vegetation not well established when it starts has little chance of surviving the parching heat which precedes the next rainy season seven to nine months later. Finally, fencing trials sought to assess feasibility of traditional methods of protecting trees from browsing livestock and extent to which project success might depend on manufactured inputs (barbed wire, hog wire, fence poles).

One significant conclusion can already be drawn from the first year's experimentation: there is very little likelihood that a reforestation "package" can ever be perfected for mindless replication across the entire range of Sahelien micro-environments. These are too varied, both in physical terms and in the kinds of uses human and animal communities make of them. On the other hand, variations on the technique might well facilitate woodstock management in quite diverse areas already seriously deforested.

The critical importance of local flexibility in Sahelien reforestation activities flows from three causes:

1. variable climate (especially spacing and amount of annual rainfall);
2. variability of soils and terrain generally; and
3. variability of the human communities superimposed on those soils. Different to begin with, they change and evolve, as do sizes of the herds they hold and their arrangements for keeping them.

Common characteristics do of course occur across most or all milieux of the Sahelien zone: generalized aridity, unpredictable rainfall, low standards of living, etc. But the margin of accuracy or error, success or failure of any single reforestation strategy lies unquestionably in the extent to which it can effectively accommodate local differences scattered across the backgrop of these commonalities.

Local Sahelien environments vary greatly. Many are experiencing rapid evolution - not a lot of it good in the sense of improving chances that local places can go on supporting current populations indefinitely. This variability imposes a major and powerful constraint, often underestimated, on any plan to centrally manage the Sahelien environment, either on a state-by-state basis or on some sub-state, regional basis.

Varied Political Environments

Assuming experimental adaptation to local environments must be an integral part of any future attempts to employ microcatchment technology in Sahelien reforestation ventures, is it possible to do so without popular participation?

Sahelien forestry services, by all accounts, are not terribly efficient producers of public goods. Analysts suggest a number of reasons.

1. These services operate within physically difficult terrain once they leave urban headquarters and move into rural areas where most Saheliens live. Communications are poor. With relatively few exceptions, roads are unpaved and frequently nothing more than dirt tracks, sometimes impassable during the summer rainy season when many important forestry activities occur. Telecommunications are also extremely limited. Contact with rural populations is thus expensive and intermittent.

2. Sahelien bureaucracies often lack funds for supplies. This is particularly true of Sahelien forestry services, which have traditionally taken a back seat to other more directly productive rural development agencies (e.g., agriculture services) in terms of budgetary allocations.

3. By the same token forestry services are frequently understaffed and inappropriately trained. Foresters focused until very recently almost exclusively on industrial plantation techniques and forestry code enforcement procedures. They lack the sort of background in rural, local-level experimental forestry which would make them effective extension workers.

4. Sahelien forestry services, like Sahelien government bureaucracies generally, do not provide employees with strong incentives to make the kind of consistent efforts necessary to produce public goods, e.g., reforestation or environmental

management [Thomson, 1977]. Sahelien foresters frequently find occasions to extract benefits from their official positions without being compelled in any way to render equivalent services to the public whose tax monies largely support them.

5. The above factors combine to vitiate the typical sort of centrally-initiated reforestation activities now characteristic of the area. Even when adequate information is available to supervisors at the top of forestry service bureaucracies, it is extremely difficult to communicate that information to the local level and have it effectively utilized there. Thus the typical top-down approach to Sahelien woodstock management has come in for increasing criticism, not only among donor agencies and governments interested in environmental management problems, but among Sahelien chief foresters who have primary responsibility for solving those problems. They find they cannot induce their subordinates to effectively manage the woodstocks under their control.

Local Participation in Reforestation

Is it possible to convert peasants from by-standers passively observing degradation of their environment to "barefoot scientists" actively engaged in a search for better techniques of woodstock management? The answer to this question involves automatically the problem of local political organization.

Sahelien local communities, and not infrequently levels

below (quarters, families and voluntary associations) and above (inter-village ad hoc associations for specific purposes, government-created institutions for inter-village cooperation) vary dramatically in their collective action capabilities. Yet attempts to impose a single organizational format for reforestation activities from the center are quite common. All risk aborting the programs they are trying to promote by assuming all villages fit standard organizational patterns.

Thus attempts to induce Sahelien peasants to seriously commit themselves to microcatchment experimentation while at the same time dictating the formats within which such experimentation must proceed will almost certainly produce suboptimal results in terms of woodstock management. Some communities will probably respond readily to an imposed organizational format because it (accidentally, in most cases) corresponds to realities of local political structure. It may correspond to the only organizational possibility, e.g., a village collective woodlot project will likely prove successful in a village accustomed to functioning as a common unit for all public good purposes. It may on the other hand correspond to one of the local repertory of organizational possibilities, e.g., the same project might well be successful in a community where villagers are accustomed to working in large scale local collective enterprises as well as in smaller (quarter or voluntary) groups and individually.

By contrast, the same project would predictably fail in

communities which lack the capability of getting together to realize common objectives.

The OXFAM experimental microcatchment project nicely illustrates the point [Thomson, 1980b: 20-21]. The project was initiated on the assumption that a collective format would be adviseable. However the project director did not blindly assume all Yatenga villages would be equally appropriate locations for the experiment. Instead, she requested advice from extension workers resident in the Yatenga regional capital, Ouahigouya. They directed her to six villages which had reputations as being highly motivated and collectively organized. Each of these communities agreed to participate. Subsequently two quarters of a seventh village requested to be included as separate units in the program. This was done, making a total of six villages in which some members of all or most quarters participated collectively, and two quarters of the seventh village participating as distinctive units.

The experiment then proceeded. Various kinds of micro-catchments were created through voluntary self-help at the eight sites proposed by participating villagers. OXFAM's contribution was limited to technical advice and minimal material inputs (hand tools and, in several communities, barbed wire or metal packing bands as fencing components). Villagers did all the work of constructing the catchments, planting, and maintaining and fencing. They provided fence poles and, in some cases, traditional woven or teepee enclosures for trees.

Representatives of five of the eight groups involved were interviewed approximately eleven months after the projects were initiated to gather information about their perceptions of the experiments. Of these groups, four were ethnic Mossi and one was Foulse. Striking variations appeared in their opinions about the most appropriate organizational format for the project.

Four approved the collective organization of the supervised trial period in which trees were planted on a common plot.

1. One of these villages, a Mossi community, intends to continue the project autonomously both on a collective plot and by collective labor on individual fields over a period of years. This group will plant some members' fields a first year, some a second, still others a third.

2. A second village, Fulse, expects to continue the project autonomously, if the technique proves successful, only on individual fields. They will do so by collective labor exchanges, but these will all occur within single years. All group members must have the same amount of work done on their fields each year. Asking some to wait another year for their turn is perceived as placing too great a strain on collective action capabilities.

3., 4. The third and fourth villages, Mossi, expect to continue the project autonomously, if successful, only on individual fields and only with family labor.

5. The fifth village, Mossi, refuses to continue with the

supervised collective trial phase on a common plot unless paid to do so. However, if the technique proves successful, individuals expect to introduce it gradually on their own fields using family labor exclusively.

All of these five villages are located within thirty kilometers of each other, in comparable Sahelien environments. All are situated within one traditional Mossi kingdom, Yatenga. All currently lie within a single Voltaic subprefecture, that of Ouahigouya. All operate the same sort of mixed farming-herding economy. Labor migration is substantial in each community. Religious differences do exist, and differences as well in the extent of local participation in the Ouahigouya commercial center. But these latter do not, however, correlate with pronounced individualistic orientations concerning reforestation activities.

A second illustration is provided by a village woodlot program in Zinder Department, Niger, financed by the Canadian International Development Research Centre (IDRC) [Thomson, 1980a]. Implementation of the program was entrusted to the Nigerien Forestry Service. A collective format was imposed. Of approximately twenty villages investigated, residents of all but one reported a strong preference for ~~would have preferred to see~~ the project carried out within an individualistic framework. This reflects local political realities in the region, where village collective action capacity has withered is extremely limited. The result of an inappropriate organizational format here provoked was large-scale popular

disaffection with the enterprise, a total lack of local initiative in experimenting with improved planting techniques or better species packages, and a dreary disregard of even the most minimal maintenance operations, e.g., repair of fallen fences universally judged to be indispensable to protect planted saplings from browsing livestock.

Appropriate Institutional Formats for Sahelien Reforestation Projects

These examples (and many others [Hoskins, 1979]) strongly suggest successful reforestation and woodstock management projects in the Sahel will build into project designs from the initial phases a very strong local option component. This is dictated by a number of factors.

First, certain scales of organization are implicit in any project. One must ask whether a given reforestation technique can be handled at the level of the nuclear family on an individual peasant's fields? To answer this one must address issues of labor inputs for site preparation, and planting, and of post-planting protection. If techniques employed mean a single adult can successfully plant trees without outside assistance, family level operations are indicated on that score. But the local political culture may involve a preference for collective organization, as in the first Mossi village cited above (p. 15).

If protection is not a problem, the family seems the

appropriate unit. If it is a problem, and economies of scale can be realized by fencing larger areas, then assuming land tenure rules make site acquisition possible, some supra-nuclear unit offers a lower-cost solution. But how "supra"? Will the extended family do? What about the quarter? A group of quarters? Or the entire village? And so on.

These questions all have quite specific local answers, shaped individually by rates of interaction and levels of consensus within and between various units. "Working rules" of these units govern what conduct can be group-controlled and where individuals' areas of freedom lie. These answers can only be found in working rules, by local political entrepreneurs. This appears likely if one assumes such organizations must be developed throughout the Sahel in practically all villages in order to assure effective reforestation operations. No outside organization, national or international, could finance the sort of detailed, on-the-ground explorations necessary to produce the required information which local people already possess. It is cheaper and more efficient to allow them villagers a range of options, and freedom to experiment with new forms and processes of reforestation if they so choose. Data from the five-village investigation cited above amply confirm this proposition.

Second, local collective action capabilities vary. There may be prior experience with autonomous, village-wide organizations. If is important to know, in turn, for what purposes

such organizations have functioned? Is the village leadership elite clearly identified, or will organizing things at that scale unleash protracted in-fighting as political entrepreneurs struggle for control of reforestation operations? Can those struggles be expected to frustrate activity while they last? Perhaps the village then isn't the best unit.

Third, other levels of organization within the community may be (1) competent and (2) authorized to tackle reforestation projects. If so, it might be very useful to encourage participation through them.

Fourth, if reforestation is a new activity, leadership authority may not be easily transferable from one or more traditional activities to the new enterprise. This implies questions about whether pre-existing expectations about how organizations will be run can be "imported" to the new arena of activity. If so, fine. If not, some people are going to have to learn to lead in the new arena. This involves establishing authority to do so. Consensus building typically takes time, and is often costly. Too costly? Only local people can know.

Conclusions and Implications

Conclusions will by now be fairly obvious. Sahelien reforestation, industrial plantations excepted, depends on careful tailoring of projects to local physical and political

capabilities. This cannot be accomplished, on any reasonable estimate of the present organizational and information-gathering capacities of Sahelien forestry services, from the top down. Therefore much greater attention must be devoted to creating project structures which will permit local definition of institutional frameworks appropriate for particular milieux. Only then will the popular participation and popular experimentation necessary for project success be forthcoming.

Implications

Currently, relationships between foresters and peasants are strained in many parts of the Sahel. This follows from the essentially repressive orientation still pursued by most Sahelien foresters in execution of what they define as their principal duties. Very few engage in extension work, although this is now beginning to change.

It is imperative to modify foresters' approach if peasants are ever to engage in willing and cooperative research with Sahelien foresters for solutions to woodstock management problems. So long as peasants see foresters as policemen they will avoid interactions with them to the extent possible. When interaction is unavoidable, they will confine themselves to submissive obedience to foresters' instructions so long as foresters remain on the spot to enforce them. Once they leave, those instructions will be honored in the breach only.

Such relationships are not conducive to the kinds of information flow implicit in extension work. Peasants who are afraid to discuss forestry problems with foresters are not likely to improve their knowledge of reforestation possibilities. Even less are they likely to take the risks involved in any kind of experiment. In consequence, the Sahelien environment is likely to erode totally from overuse, abuse and neglect.

In effect, cooperative relationships between peasants and foresters will only arise when foresters become dependent upon peasants for career rewards. Otherwise, the old domination relationship with all its negative consequences will persist. Some Sahelien political leaders apparently are becoming aware of the necessity for change. President Seyni Kountché of Niger is advocating a program of local autonomy which may do much to restructure official-peasant relations in favor of greater cooperation among the two groups. Monumental problems nonetheless remain to be overcome before this policy can be implemented in Niger: presidential speeches will not alone change bureaucrats' perceptions of their own self-interest. Other Sahelien states face similar dilemmas, made perhaps more intractable by smaller budgets and a less bountiful endowment of natural resources.

Footnotes

COPANS, Jean. 1975. Sécheresses et famines du Sahel. Paris: François Maspero. 2 vols.

DALBY, David, R.J. Harrison Church and Fatima Bezzaz, eds. 1977. Drought in Africa/Sécheresse en Afrique, 2. London: International African Institute in association with the Environment Training Programme/UNEP-IDEP-SIDA.

EVENARI, M., U. Nessler, A. Rogel and O. Schenk, eds. n.d. [1976?] Fields and Pastures in Deserts; A Low Cost Method for Agriculture in Semi-Arid Lands. Darmstadt, FRG: Eduard Roether, Buchdruckerei und Verlag.

HOSKINS, Marilyn W. 1979. "Community Participation in African Fuelwood Production, Transformation, and Utilization." Discussion paper prepared for Workshop on Fuelwood and Other Renewable Fuels in Africa; Paris, November 29-30. Overseas Development Council; Agency for International Development.

OSTROM, Vincent. 1974. The Intellectual Crisis in American Public Administration (rev. ed.). University, Alabama: University of Alabama Press.

THOMSON, James T. 1977. "Ecological Deterioration: Local-Level Rule-Making and Enforcement Problems in Niger," in Michael H. Glantz, ed., Desertification: Environmental Degradation in and around Arid Lands. Boulder, Colorado: Westview Press. pp. 57-79.

_____. 1980a. "Bois de Villages (Niger); Centre File 3-P-72-0093/Report of an Investigation Concerning Socio-Cultural and Political-Economic Aspects of the First Phase of the Project and Design Recommendations for a Possible Second Phase." Easton, Pa., February 5.

_____. 1980b. "Preliminary Evaluation: OXFAM Micro-catchment Project, Ouahigouya, Upper Volta. Unpublished report, Ouahigouya, Upper Volta, March 15.

_____. 1980c. "Rapport préliminaire de fin de mission ; Les programmes nationaux et internationaux pour l'aménagement des forêts, des pâturages et des bas-fonds sahéliens : les influences sur la mise en oeuvre des structures locales au Niger et en Haute-Volta." Unpublished report, Easton, Pa., January 25.

_____. 1980d. "How Much Wood Would a Peasant Plant? Public Choice Analysis of Institutional Constraints on Firewood Production Strategies in the West African Sahel." Forthcoming.