

"HOW MUCH WOOD WOULD A PEASANT PLANT?"
PUBLIC CHOICE ANALYSIS OF INSTITUTIONAL CONSTRAINTS ON
FIREWOOD PRODUCTION STRATEGIES IN THE WEST AFRICAN SAHEL.

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Introduction

This essay presents a public choice policy analysis of firewood production possibilities in the West African Sahel, the arid southern fringe of the Sahara Desert.

Demand for firewood has outstripped supply in much of the contemporary Sahel. Arid areas and urban hinterlands now face the worst pinch, but population growth will soon create scarcities in many regions where supplies remain temporarily adequate. Since firewood will almost certainly continue to be the staple cooking and heating fuel of most Sahelian families, sustained severe shortages will sharply reduce many Sahelien's living standards.

The pertinent problem thus becomes identification in particular settings of best strategies to prevent serious firewood shortages. Using standard public choice assumptions about human nature, this analysis highlights technical, legal, political and economic impediments to reforestation and then suggests several strategies to reduce or overcome them. Drawbacks as well as advantages of individualist, collective and mixed approaches to woodstock management are considered.

Arguments and analysis are presented in the following sequence: (1) assumptions and an outline of seven problems to be considered; (2) a partially fictionalized account of one individual's frustrating attempt at fuelwood production, which illustrates some of these problems in a Sahelian local context; (3) consideration in detail of each problem; (4) conclusions.

Assumptions and Problems

Model of Man

The people whose behavior is here analyzed and who must implement any solutions are assumed to be self-interested, rational maximizers who make decisions under conditions of uncertain information (and therefore often satisfice rather than maximizing). 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 [V. Ostrom, 1974: 50-52].

Seven Problems Constraining Firewood Production

Assume a Sahelian state wants to promote local participation in firewood production. Assume home and market demand suffice, all else equal, to encourage peasant production. Certain constraints may nevertheless hamper sustained-yield management of the local woodstock. Major problems are:

1. Availability of seeds and/or seedlings, whether nursery stock or natural regeneration, of appropriate species.

In land-scarce and food-short areas, "appropriateness" will reflect species' compatibility with crops, effects on soil fertility and valuable by-products.

2. Land tenure, tree tenure and associated residential patterns which may:
 - a. blunt farmers interest in wood production if they don't own land they farm, and
 - b. affect ease of protecting trees and thus choices between woodlot and on-field production schemes.
3. Feasibility of protecting trees from foraging live-stock.
4. Feasibility of protecting trees from unauthorized cutting by humans.
5. Enforceability of property rights in land, which affects risk and adviseability of going into such a slow-maturing crop as trees.
6. Enforceability of property rights in trees, i.e., damage remedies when protection fails.
7. Collective action capabilities at the local level, given distribution of political (rule-making) authority there and in overriding regimes.

Each of these issues may affect African peasants' calculations about whether tree farming can fit in with his and others' goats and crops, i.e., the desireability of agro-sylvo-pastoralism in any particular Sahelien setting. The following illustration highlights some relevant constraints.

Hedging the Law: A Bad Example by Way of Elucidating Wood Production Problems

Abdu Issa runs a peasant farm on ten arid acres of West African Sahel. One recent dry season he decided to start a fuelwood plantation/windbreak through the middle of his sandy field, reducing wind erosion by planting the break counter to

prevailing east-west winds.

Abdu put in Commiphora africana, a small tree often used for live fencing because it can be started in the dry season without irrigation from cuttings off existing stock. Trimmed hedges become dense and grow up without shading out adjoining crops. Modest nutrient requirements further reduce competition with crops. Trimmed branches burn nicely and, though slow growing, the wood is hard enough for saddle making. Finally, C. africana is not on the protected species list in Abdu's country. He could cut it without fear of being fined by a forester, as he might be were he to opt to plant Acacia albida or any of fourteen other species on the list. Nor would he need permission, available for a fee (or a small bribe), each time he wanted to trim the hedge.²

As his field lies close to his village home, Abdu figured the hedge would make life easier for his wife: she gathers all household firewood.

Unfortunately other villagers at first took too little, then too much interest in the hedge. Livestock roam freely here after the harvest. Once fields were bare goats browsed the C. africana leaves and tender twigs in the daily struggle to fill their stomachs, thereby stunting the little trees. Many villagers saw animals chewing on the hedge, but no one shooed them away: after all, local rules allow animals to rove freely during the dry season.

Local interest picked up however when the hedge put out

burnable branches. Village women, too busy to comb surrounding fields for fuel, lopped off many for firewood. They all knew Abdu had planted the hedge but rationalized their actions by saying they were local residents at liberty to cut any unprotected species. These are by national law unregulated common property unless title has been established to specific trees. Those who didn't cut Abdu's hedge never told him trimmers' names for fear of being labeled trouble-makers.

Abdu's wife complained; he finally got angry, caught a woman "trimming" his hedge and called a case against her before the canton chief. Since he lived in the same town, time and court costs were minimal. Had Abdu lived ten miles from the canton seat in a village with no local moot, such court action would have been much more expensive in time and money.

In court Abdu presented his complaint. In reply the woman's husband publicly ridiculed him for being so petty as to haul an honest housewife to court over something so minor as a piece of wood. Moreover, he asserted, there really was no law preventing local people from trimming unprotected trees.

The canton chief, as judge, tried to decide after hearing the parties. The case perplexed him: what did Abdu expect? The woman had taken wood all right, but it was worth practically nothing. Did he want two cents' worth of compensation? Embarrassed, Abdu said he didn't care at all about that piece of wood, but he did want an end to unauthorized trimming of his hedge. He asked for a two-dollar fine. The chief declined. He had no legal authority to impose such a fine. Nor could he

legislate new rules, even were they to apply solely within his canton. Only his administrative superiors at the national level could make such decisions; at most he could merely conciliate the parties.

True, he might have let Abdu pronounce a Quranic oath to prohibit further hedge trimming without permission. But penalties violators would face (leprosy, poverty, etc.) were too draconian for the value involved. Moreover, he knew his superiors would rebuke him if he consented to the oath. It really offered no solution to Abdu's problem.

The chief's admonitions finally convinced the husband his wife should give Abdu fifty cents in damages. She did; after all the fuss, Abdu had to accept. For his troubles, he made himself a laughing stock of village gossips. Damages did not even cover court costs, to say nothing of his loss of face. Worse still, the amount would not deter future trimmers, the more so because everyone knew Abdu could not afford, in personal terms, to call another such case. Nor were others likely to, after this debacle.

Later somebody cut two good trees out of the windbreak. Abdu ignored the incident (though he could have used the wood) but the hole channeled strong air currents through the trees and severely eroded topsoil on both sides of the opening.

Fuelwood windbreaks have not become popular items in Abdu's village. Implications of this example for firewood production using other unprotected species are only too clear.

On the other hand, to raise protected species for fuelwood would require the regional forester's written consent. Otherwise a standard permit would be needed to authorize cutting or even trimming above the three-meter level.

This account suggests some of the social, legal political and technical constraints which may affect firewood policy and production schemes. Systematic examination of these and other obstacles to sustained-yield management is now in order.

Seven Technical and Institutional Constraints on Fuelwood Production

Appropriate Tree Seeds or Seedlings

To pervert a proverb, great oaks from little acorns grow only. Seeds, seedlings or saplings, from natural regeneration, direct seeding or transplanted private or government nursery stock constitute the starting point of reforestation. Without them, it won't happen. They must be adapted to the job at hand, i.e., reproduction must be technically and economically feasible, survival rates adequate in rainfed (or irrigated) plantings, and wood must be adequate as fuel. All else equal, where demand is strong, faster-growing species will be preferred. But other things are not equal. Species vary. Some produce good construction as well as firewood, or valuable by-products such as foods, medicines, gum, tannin and fibers.

Non-consumptive uses served by various species also vary markedly, and these may sharply influence a farmer's decision

to grow one rather than another, or to grow trees at all. In land-rich areas, crop-competitive characteristics - space, light, nutrients and water requirements - may be immaterial. But in infertile, land-scarce areas villagers will be extremely sensitive to these aspects: fuelwood for cooking is a basic necessity only if there is food to cook. Thus species which fertilize crops through nitrogen fixation or reduce wind or water erosion or act as nutrient pumps in bringing soil chemicals leached below the reach of crop roots to the surface again as leaf mulch or manure [Poulsen, 1979a: 4; Poulsen, 1979b: 9-10] offer undeniable advantages. These on-site uses as well as growth characteristics will influence farmers' decisions to go into fuelwood or stick exclusively to crops.

Improved varieties could tip the balance in favor of more wood production if disseminated to farmers. Greater cash income from tree by-products and replacement of market by home-grown items might well compensate for less cropland. In this regard much remains to be done in appropriate species research, development and dissemination.

Land Tenure, Tree Tenure and Residential Patterns

Land Tenure. Land tenure can be succinctly defined as: "those legal and contractual or customary arrangements whereby people in farming gain access to productive opportunities on the land" [Dorner, 1972: 17]. Land tenure systems allocate productive opportunities. Those who firmly control land they farm can plan accordingly. But the tenant who expects his

landlord to evict or shift him to another plot after several years to prevent him establishing title by prescription can't plan improvements with the same security. He may be perfectly aware that terracing, live fencing or windbreaks eventually improve land and yet certain he will gain nothing thereby. Thus he may rationally opt for short-term investments in greater fertility. Manure or chemical fertilizer promise return to investment at the next harvest, assuming he gets a reasonable share of the crop produced. Although such attempts to maintain soil fertility are probably inadequate in the long run given undiminished wind or sheet erosion, the farmer who expects to move on will find them preferable to longer-term, more fundamental improvements.

This logic applies with equal force to wood production schemes, since trees take at least four or five years to reach useable size. The potential fuelwood farmer whose view of the long-term is cluttered with land tenure-related risk factors cannot be faulted for hesitating to go into trees.

Tree Tenure. Sahelian tree tenure terms often add another risk inhibiting investments in fuelwood production. Land ownership and tree ownership don't automatically go together. In pre-colonial times he who planted a tree usually owned it. If he also owned the land under the tree, either might be sold without parting with the other. Trees growing wild in the bush by contrast often counted as "free goods" (or "bads," since they had to be cleared before cultivation).

Saheliens Indifferent to Woodstock Management While Supply Exceeds Demand. It seems probable few rural Saheliens were initially disturbed by deforestation. Accustomed for centuries to slash and burn agriculture, they judged woodstock levels by availability of free bush land.³ So long as forested lands remained for colonization a frontier mentality prevailed. When farmland and surrounding bush failed, migration/colonization commonly offered the easiest way out. Under such circumstances it made little sense to actively manage renewable resources. Positive conservation measures to permit continuous use - windbreaks, sheet erosion control terraces and dikes, etc. - demand sustained effort. They require more labor input than clearing forested, fertile lands which can be fallowed when worn out while the farmer opens new fields elsewhere. Given sufficient land, passive conservation - fallowing fields well before they were totally exhausted - served quite adequately to restore soil fertility and trees to the landscape. Saheliens knew this.

Colonial Forestry Measures. The colonial conquest brought a European-style forest service to most Sahelien areas by the 1930's. Modifications in tree tenure followed. Colonial officials, fearing deforestation, imposed forestry codes. These generally tried to freeze demand rather than promoting sustained-yield management. Particularly in the French colonies codes restricted use of valuable species by establishing a protected species list and creating extensive

forest reserves, without regard to customary African land and tree tenure rights [Raeder-Roitzsch, 1974]. Upholding these regulations against popular resistance required suppressive police action, ever since a hallmark of Sahelian forestry. With foresters spending the lion's share of their time chasing illegal cutters, opportunities for a cooperative approach to forestry were few indeed.

Much Wood Remains Unregulated Common Property. In many Sahelian states today deadwood and unprotected live species remain effectively unregulated common property. In supply-tight situations of the sort increasingly common in the Sahel this arrangement, often underwritten through local-level misinterpretation of national forestry codes, discourages wood production. Where wood is available for the taking, wood ownership is established by appropriation, not by investment in planting, nurture and protection. Despite urgent need for reforestation, working rules of tree tenure in such cases render the activity virtually pointless from the perspective of individual conservers. Significantly, deadwood is becoming increasingly privatized in the evolving common law of many African locales (e.g., Zinder Department, Niger and Yatenga Department, Upper Volta). This development reflects peasant dissatisfaction with forestry code rules as locally (and often incorrectly) interpreted. Research to determine villagers' perceptions of this situation should be a priority item in programs focusing on incentives and deterrents to increasing

fuelwood supplies.

Critical Issue: Changing Attitudes about Conservation?

Do shrinking firewood supplies make conservationists of peasants? If so, policy implications are far-reaching. Popular readiness to innovate, to experiment and to do added work necessary to use new techniques successfully may sharply reduce efforts needed to "sensitize" people. Peasants who want to reforest because they foresee shortages should make a willing audience for forestry extension workers. Conversely, premature efforts to make active conservationists of villagers not yet convinced by personal observation of a resource crunch may merely waste everyone's time and money. Scattered fragmentary evidence suggests this is the case [Thomson, 1979a; Thomson, 1980b], but more research on the question is indispensable. In the meantime, a caveat is in order.

New Attitudes Don't Guarantee Reforestation. Pro-conservation attitudes by no means lead automatically to conservation activity. Intervening variables shape farmers' final estimates of feasibility of sustained-yield management, whatever their desire for same. Three of these - availability of appropriate stock, effective land and tree tenure rules - have just been examined. The remainder of the essay analyzes others outlined above (p. 3).

Residential Patterns: Close-Settled versus Dispersed.

Some Sahelien peasants live in villages at the center of the community's fields. Others live in dispersed family units,

each on its own field. If trees have to be protected - as seems likely - from livestock pressure and illegal trimming, dispersed settlement cuts surveillance costs for scatter-sited trees (windbreaks, live hedges, trees interplanted with crops). Close-settled communities, with many more eyes and ears, can better patrol village woodlots located close to population centers. But such sites are often hard to come by: the richest fields constantly fertilized by compound sweepings, manure and nightsoil lie in the first circle of land around the village [Raynaut, 1978].

Assume only protected seedlings survive. Then raising them in sites beyond range of costless surveillance implies either hiring a guard, enduring unauthorized depredations or giving up. Because most locations in dispersed-settlement communities can always be seen by someone, such localities may enjoy a tactical advantage in wood production over close-settled villages.

The First Protection Problem: Trees Versus Livestock?

Many knowledgeable observers maintain Sahelian reforestation is feasible only if trees receive adequate protection from browsing livestock, particularly goats. Others argue the contrary [Poulsen, 1979c: 6-8]. The issue is thus problematic; research should seek data to help decide when and where what species must be fenced to prosper. Given cross-Sahelian variations in grazing pressure and tree species auto-

defense mechanisms (thornless, thorn types, etc.), few sweeping generalizations about fencing are likely to be valid.

Major Interdependencies in Traditional Sylvo-Agro-Pastoral Systems- Symbiotic relationships between highly productive herding, farming and tree-growing activities unquestionably exist [cf., e.g., Funel, 1979; Nicolas, 1962; Souleymane, 1979; Swift, 1976; Thomson, 1976]. Trees, crops and livestock in properly balanced relationships enrich and protect each other to the great benefit of the managing human community. To maintain this system of mixed farming under a tree canopy at peak productivity, interrelationships must be managed in mutually-reinforcing ways. When antagonistic competition replaces harmonious complementarity, the ensuing negative dynamic degrades the productive capacity of the system to the point of sterility. Desertification may well result.

Controlling Grazing Pressure. If livestock can destroy natural regeneration of trees, reforestation depends on control being exerted over livestock movements. In most Sahelian countries animals forage during the rainy season only under guard. But after the harvest livestock often roam at will. This cuts feeding costs: investments in herding, enclosures or fodder stocking are avoided.

Tragedy of the Commons. Treating dry-season fields as a common property encourages overstocking. Each additional animal means more profit for the owner. But when pasture carrying capacity is exceeded each additional animal marginally

reduces food supply for every other animal. Hunger drives them all from the lush to the rough grasses and eventually to saplings, curtailing natural regeneration of the woodstock. This is the classic tragedy of the commons, in which a once valuable renewable natural resource is reduced to dust or hardpan laterite by uncontrolled overgrazing [Hardin, 1968; Hardin, 1977].

Solutions to Avoid Tragedy of the Commons. Two kinds of solutions to overgrazing exist: privatization, to encourage each owner to take account of the full costs of overstocking his own land; or political controls, to keep grazing pressure at or under carrying capacity. Both involve problems.

Controlling Livestock Movements. Short of privatization or grazing controls, fuelwood resources can be protected from livestock by regulating livestock movements or somehow protecting trees, whatever happens to pastures.

Herding. Herding requires pasturage, herders and returns to investment to support the latter. Full-time transhumant herders, e.g., Fulbe and Twareg, are harder to control in terms of protecting the woodstock from abusive cutting of woody browse than are sedentary herders who have a greater incentive to respect local regulations concerning exploitation of tree forage. For herders, keeping hungry animals from gardens and woodlots is easier than protecting scattered natural regeneration. Local goats however often aren't herded: their limited

value doesn't justify the labor input.

Enclosure of Animals. Fencing is difficult because expensive, and traditional fencing materials - thorns, mats and live hedges - may be scarce, either because protected by forestry code provisions [Thomson, 1977: 64-65; Felker, 1978: 118-19] or because population pressure has largely eliminated free bush lands. Enclosing larger areas reduces per unit cost, as some ethnic groups who maintain consolidated forms of land tenure have found [Nicolas, 1962; Souleymane, 1979; Thomson, 1976: 261-64]. Typically however this cannot be achieved when fields are small and scattered.

Stabling and Tethering. Stabling requires substantial labor inputs to collect fodder. Generally this is feasible only during the growing season, when grasses and foliage are plentiful near at hand. Tethering on pastures is again only feasible when forage is plentiful, i.e., when trees need no particular protection from livestock.

Guarding Trees. Where lack of appropriate sites precludes informal policing (above, pp. 12-13), seedling survival may depend upon active guarding. Local funds (rates or voluntary contributions), money from overriding governments or international aid donors may permit hiring guards. Or, assuming adequate political organization, guard duty might be shared on a rotating basis within the village.

Enclosing trees. Woodlots can be fenced given sufficient traditional materials or units large enough to reduce wire

fencing costs to acceptable levels. Reusing materials on other sites once trees have outgrown stock pressure will further reduce costs.

Scatter-site, in-field wood production may also be possible using browse resistant species or on a fenced basis if tree growers are committed to protecting saplings and if they have legal access to enough thorns from mature trees.

The Second Protection Problem: Trees Versus People

Doubts may exist about when, where and how much foraging animals threaten wood production. But people unquestionably destroy unnumbered trees looking for fuelwood and other forest products. In principle this destruction is acceptable because wood is put to beneficial uses. In practice too destruction is acceptable...just as long as supply continues to exceed demand. But when supply dwindles the crunch comes. Human communities whose welfare depends on the environmental management and consumptive uses trees serve face drastic changes when the woodstock deteriorates.

Whether the woodstock will be run down or not depends on institutional incentives to balance supply and demand. As suggested, Sahelian trees may be private or common property, or a mix of the two. Theoretically, if trees are private property a wood shortage should stimulate individual investment in supply. Evidence from rural Niger and Upper Volta suggests this in fact happens. Indeed, Forest Service heads in Niger,

Upper Volta and Mali are all currently interested in exploring this option along with collective approaches to reforestation.

By contrast, where trees are common property, wood will be harvested on a first come, first served basis [Thomson, 1977]. This reduces incentives to produce, since the tree planter has no guarantee he will reap the benefit of his investment. To overcome this dissociation between investment in supply and reward inherent in all common property systems, special management capabilities must be developed. Some political community must control use and promote supply. Conceptually this is always possible; practically it is often difficult and costly...often, but not always.

Trees as Private Property: Protecting and Producing to Guarantee Supply. Where trees are private property, tree owners either protect them or bear losses occasioned by theft.

Conservation-Facilitating Ethic. Two consequences flow from privatization: first, a "do to others as you would have them do to you" ethic is implicit, i.e., don't steal wood if you don't want yours stolen. Second, tree owners and their dependents function as an informal local police force. Community members thus help enforce tree tenure rules instead of leaving the entire job to foresters. Perfect policing will not result. Some, preferring to avoid "meddling", will not report observed wood thefts to owners. But the incentive to do so is there: to protect one's own trees, one protects others' and hopes for reciprocity.

Wood Production Incentives. Privatization of trees also motivates individuals to produce trees for their own use. Where all trees are privately owned, he who doesn't provide for his future wood needs by growing now will later pay the going price for lumber and firewood. Because trees cannot be harvested on a first come, first served basis, the option to stave off investment in wood production no longer exists. Privatization brings home directly to the individual consequences of non-conservation, and so encourages planting and protecting future firewood supplies. While maturing, trees protect the environment.

Unregulated Common Property Trees: Consumption without Production. The first come, first served rule governing exploitation of unregulated common property woodstocks promotes consumption but not production. Demand can exceed supply without automatically pressuring individuals to act in their enlightened self-interest by investing now in supplies to meet future needs and thus avoid total deforestation and environmental degradation.

Environmental Destruction through Peasant Stupidity or Inappropriate Rules? People often admonish Sahelian peasants to become aware of environmental degradation. By implication ignorance or plain stupidity underlie peasants' current failure to take better care of land and trees that support them. But it is highly unlikely that peasants fail to see ecological break-downs occurring around them. They may be aware, concerned

and yet simultaneously immobilized by inappropriate rules.

What pushes an individual to insure regeneration of an unregulated common property woodstock threatened by excessive demand? Very little, in fact. The peasant who values trees on his field as windbreaks, forage sources, soil fertility regenerators and the like will at most try to get his firewood elsewhere. If free bush exists nearby he will use that. But once bush goes, desire for trees on his own field goads him to harvest those on his neighbors' fields to meet his own construction and firewood needs [Thomson, 1979b]. Given excessive demand, the unregulated common property system leads to a "cut anywhere but home" ethic of forest exploitation. Instead of encouraging each landowner to invest in future supply, this ethic leads peasants to cut their losses by not investing in regeneration of common property woodstock which somebody else will most likely consume. Instead, people spend more time, energy and money meeting daily needs from the ever-dwindling supply.

Spontaneous Privatization of the Woodstock. Assume the woodstock is formally unregulated: any tree is legally fair game for anybody. Given resource scarcity, will privatization replace the first come, first served rule? Economic theory argues the commons will be parceled into private units when it is both technically feasible to enforce property rights and economically advantageous to do so [Demsetz, 1967]. Field data from a rural region of Upper Volta not patrolled by the

national Environmental Service support the prediction. Parallel developments - privatization of formerly common property crop residues (peanut vines, millet stalks, etc.) - in parts of Niger and Upper Volta where destruction of bush has made livestock forage a scarce commodity likewise support the prediction. This change lays one kind of groundwork for greater individual investment in wood supply. But other alternatives exist.

Common Property Woodstock: Formally Regulated, Effectively Unregulated. Assume a woodstock is formally but not effectively regulated because of inadequate enforcement. Even though demand exceeds supply incentives here still discourage better wood supply management through informal privatization. Everybody is in the same boat: all have to cut protected species illegally to satisfy urgent needs for wood. It is therefore difficult for anyone to protect his "own" trees by preventing others' cutting on his own land.⁴ Worse, nobody can morally afford to assist foresters in protecting trees except where such "collaboration" is the only way to avoid unjust punishment for others' illegal cutting on one's own land.

This leaves the forest service with total responsibility for defending the woodstock. Even assuming foresters manage adequate policing with minimal peasant support, individual investments in regenerating the woodstock still will not occur. This conclusion follows from the continuing lack of direct

connection between investment in new supply and expected reward, so long as the permit system effectively authorizes regulated cutting of protected species anywhere: tree planters still have no assurance they will harvest wood they grow.

Reducing Disincentives to Invest in Supply of Common Property Woodstock. Disincentives to producing common property trees can be reduced by subdividing common property trees into exclusive units allocated to specific user communities. Formalizing local control should encourage village investment in policing and increasing the woodstock by explicitly allocating management responsibility to village residents. This strategy seems especially attractive where some fields are already treeless: reducing potential hardship some would suffer through privatization of trees currently maldistributed on village lands should ease transition to sustained yield management.

Village governments or quarter committees could regulate access. Local management units would be empowered to exclude non-residents.⁵ By reducing information costs and facilitating consensus required to maintain a local regulation system such units might well cut policing and investment costs involved in building collective supply

Information Costs. Adequate collective management decisions depend on accurate knowledge about who's doing what with the woodstock. Wood must presumably be distributed under

some locally acceptable formula which would equitably apportion supply and hardships associated with short supply. Details of distribution formulae appear an intimately local matter, defined by each village's consensus about what is right and proper. Two general conditions hold, however. First, such formulae must be enforceable to be effective. If those who run short are permitted to raid the collective woodstock, the now inappropriate first come, first served rule will replace group management.

Second, a formula will only work if it is seen by villagers to achieve equity. Arrangements that don't will be violated by aggrieved peasants pressed for fuel. Accurate information gathered in ways local people consider reliable can avoid this. Considerable room for local experiment exists here, but the smaller the user group and the greater their daily interaction the lower will be information costs [Olson, 1965]. It may only be possible to control use of guarded woodlots: monitoring wood gathering from on-field trees may be simply too expensive. If so, privatization of trees not in woodlots may be the only workable way to manage them on a sustained-yield basis.

Achieving Consensus. Consensus on distribution formulae and investment in new wood supplies will be easier where the quarter or village is accustomed to taking collective decisions, if the same process and persons can handle woodstock management. Otherwise organizational difficulties must be surmounted before

local collective management will be feasible; this may be both expensive and time-consuming. Given a consensus, users have some incentive to help with policing as a means of protecting their own shares. But the incentive is weakened because losses are spread over the entire group rather than being borne only by the one who sees illegal harvesting. To overcome this handicap, consensus will have to be very solid.

New Supply Increments. Local collective management for sustained yield assumes sustained investments in new supply. Planting trees and protecting natural regeneration require labor, perhaps money.⁶ Management units thus require authority to impose user charges, labor service or taxes on group members. In many parts of the Sahel, such authority does not now exist, at least for purposes of collectively producing trees.

User Fees. User fees might provide a way to sensitize users to the social impact of their individual demands on the woodstock. They could promote conservation by adding a price to the time and energy invested in harvesting fuelwood. They could also generate funds to pay for more supply in the form of woodlots or by protecting natural regeneration (fences, guards' or herders' remuneration). Again, adequate information and effective enforcement would condition feasibility. If total reliance on user charges would strain budgets of the poorest it might be advisable to adopt either graduated fees (to tax heavier users disproportionately more) or a mixed

system coupling fixed-ration distribution of the indispensable minimum amount of firewood with user charges for any additional amounts. Again, what will work depends on local institutions.

Enforcement of Property Rights in Land

This section treats the critical problem of rule enforcement. It builds on earlier discussion of protection problems, particularly arguments about informal policing mechanisms and local collective action organization. Analysis of land tenure enforcement problems here will lay groundwork for briefer comments in the next section about enforcement of property rights, collective or individual, in trees.

Enforcement: The Indispensable Minimum. Laws are man-made artifacts designed to organize human conduct for certain ends. Effective laws, by restricting choices open to individuals, raise odds that desired actions will occur. Collectivizing management of a common property woodstock when demand exceeds supply illustrates the process. Individual users' choices about where to harvest are reduced by the management unit, and investments in supply promoted. If rules are effective, sustained yield results instead of resource degradation.

Interdependence. When demand exceeds supply, the usual problems of common property management arise [Hardin, 1968]. Users become interdependent: what each takes marginally reduces capacity of all others to satisfy their demands. Without some rule promoting management either collective or

individual, each exerts himself ever more to satisfy his demand to the inevitable detriment of all other users. Intense rivalry among individuals ensues as each tries to get his from a dwindling resources

Short-circuiting destructive rivalry requires that stabilized relationships replace uncertainties of competitive interaction to permit coordination Privatization of the woodstock involves the minimal degree of coordination: users organize their behavior only to the extent of not harvesting each other's trees. Collective schemes of woodstock management require greater coordination. Either way, if effective, laws can create stability necessary to render rational resource renewing investments.

Laws however are not self-enforcing. Formal laws only become effective when individuals and officials uphold them in cases of dispute or violation. Absent enforcement, laws remain mere formal orderings, paper rules, without capacity to shape realities of human conduct.

John R. Commons' concept of the working rules of going concerns [1959/1924: 65-142] provides a useful framework for analyzing enforcement issues. For Commons, any institution can be viewed as a going concern. Members' conduct is patterned by working rules - effective laws, which reflect officials' decisions to enforce or not enforce formal rules. Any set of working rules creates both opportunities, in the form of rights and liberties which encourage certain actions,

and deterrents, duties and exposures, which discourage other activities (V. Ostrom, 1976).

Rights and liberties however are only desirable, duties and exposures only onerous if they are enforced when challenged. Whether officials command the necessary power is problematic. Assuming they do, whether they will use it to uphold formal laws depends (a) on whether their decisions are subject to review by superior officials (and if so, how those officials exercise their powers); and, if their decisions are not subject to review, that is, if they have the last word, (b) whether they consider a particular law should be upheld in light of their own analysis of the situation. Where an official has the last word, or determining power, danger always exists that the indispensable capacity to enforce laws by legally imposing bads on individuals and so coercing them to act in desired ways may be abused to promote the official's interests at the expense of at least some members of the going concern.

Where abuses are possible one can be sure officials and other members of the concern will find ways to manipulate the legal process to their mutual advantage. In the Sahel as elsewhere land tenure laws often become prime objects of manipulation as uncontrolled officials seek to promote their own interests in greater income, control over more land and power over peoples Information about working rules, and the enforcement process that underlies them, is thus indispensable

to accurate understanding of why people act as they do.

Legal Costs. Legal costs include time and energy necessary to litigate, official and personal costs of coming into court, lawyers' fees and illegal payments to court personnel

Configurations of working rules are frequently much influenced by costs of legal action. All else equal, the lower these are the more vigorous one can expect litigants to be in protesting rule violations and perceived unjust rulings. Officials' exercise of determining powers will thus face greater scrutiny, diminishing abuses

Village moots to resolve disputes and maintain local rules probably offer the most efficient, low-cost solution to enforcement problems. Village moots by no means guarantee a just legal process. Yet appeals are usually possible to overriding regimes. This provides a partial check on local court-holders and makes rule manipulation less attractive in their eyes if superiors consistently correct abuses. However appeals, though necessary as a control measure, can threaten integrity of the local legal process if used too frequently. They may then make village-level rule enforcement impossible [Thomson, 1976].

Enforcement of Property Rights in Trees

The problem this section addresses may be simply stated: where excessive demand threatens the woodstock, are trees valued enough by somebody so rules promoting sustained-yield

management can be upheld by enforcement when necessary?

Immediately follows another question: what are costs, and therefore likelihood, of enforcement?

Land disputes usually don't face this cost deterrent to effective litigation because land is so obviously important as a factor of production most peasants will jump to defend it, whatever the price of litigation. Trees are another matter. Where supply exceeds demand peasants will not likely complain about cutting: who cares? There's enough left for everybody. Even when the balance changes, it may be some time before people perceive the loss of a tree as one they suffer. Sooner or later however lack of wood will bring the point home. Once people become aware of the loss, fundamental questions of tree tenure and enforcement processes become pertinent Who owns what? What kinds of policing deter violators? When formal rights are violated, what kinds of recourse are available at what costs?

Policing: A First Order Solution. Policing is an indispensable start towards management. It demonstrates somebody's direct concern with trees and puts potential violators on notice they are illegally infringing collective or individual interests in the woodstock.

State control and policing of the woodstock to the exclusion of all local involvement in management is a major weakness of many contemporary Sahelian reforestation schemes. It dissociates policing and harvesting interests: foresters

police alone and everybody else harvests on the sly. Financing now available to Sahelian forestry agencies is insufficient to permit massive staff increases. Therefore exclusive state policing as a control system seems doomed to severely sub-optimal performance, and sustained-yield woodstock management by such means unlikely.

Local policing, where trees are collectively owned by local units or held by individuals, appears to offer a useful alternative. However it must resolve the enforcement problem or witness a return to the working rule governing unregulated common property woodstock exploitation: "cut anywhere but home."

Local Enforcement: Calculations. Incentives to demand enforcement of tree tenure rules will be heightened if clear remedies exist when illegal cutting occurs. Restoration in kind or cash of wood value taken seems essential to indemnify community or individual owners. If user fees are in force (above, pp. 24-25), violators should pay the appropriate fee for wood taken. Punitive damages also seem advisable, both as an added deterrent and to compensate owners for loss of non-consumptive uses they suffer when live trees are felled.

Note that combined sanctions must be adequate to deter but not so draconian as to hinder application. Only the local sense of equity can set appropriate standards. Local autonomy in this respect is a necessary element in effective local management, as is authority to modify penalty structures in

light of changing definitions of equity.

Judicial Costs. As with land tenure enforcement, judicial costs to the litigant will affect his willingness to prosecute violators of tree tenure rules for restitution and punitive damages. Judicial costs - time to get to court and have the case heard, court costs legal or illegal, lawyers' fees - all represent outlays which somebody has to support. Unless they are minimal, wood owners aren't likely to bother litigating. Again, through their proximity, availability and informality, village moots will tend to cut costs - a great point in their favor. Individual owners may then have enough incentive to defend their part of the woodstock and so contribute to overall management.

Collective ownership, because it spreads any loss sustained over all group members, probably means the management unit will have to designate an enforcer to represent the community in proceedings against violators. He should not be expected to shoulder the task on a voluntary basis: self-sacrifice for community good is fine, but expecting one person to bear the entire burden of providing community benefit - maintenance of woodstock management rules - is asking a bit much.

Issues of Collective Action

For sustained-yield woodstock management to occur supply and demand levels have to be balanced. Certain control measures noted above are indispensable to achievement of this

goal. Even privatization involves local collective action in fixing and upholding tree tenure rules; otherwise enforcement costs will likely dissuade peasants from investing in wood production. Collective approaches to wood production, harvesting and distribution require correspondingly more elaborate local government capabilities.

Many villages in contemporary francophone sahelien areas lack legal authority necessary to sustain local management activities. Governments or external donors funding woodlot programs often "solve" problems of collective organization associated with running such woodstock management projects by simply assuming villages will handle them. Some villages indeed can. Residual traditions of collective action, maintained by social pressure, permit them to impose necessary constraints. Many others cannot; traditions have eroded, informal collective action capability has greatly weakened or expired, rules governing use cannot be upheld locally over the long run, and without collective discipline, costs of management are simply prohibitive. Programs fail for lack of attention to critical issues of local government organization.

Note also that erosion of traditional forms (and their replacement by informal modern alternatives in some instances, e.g., religious communities, voluntary associations and the like) is extremely variable across, but also within ethnic groups. Organizational capacity is a village specific (or

quarter specific, or village group specific) phenomenon: dramatic differences manifest themselves within villages and among quarters as well as among communities of the same ethnic group located in close proximity.

While project designers may ignore such problems, peasants cannot afford to. Nigerian Hausa proverbial wisdom on the point is succinct: "Voluntary community action is difficult: while some are farting with effort, others get new shirts." As many Hausa see it, those who voluntarily contribute money or effort for the public good (whatever the specific good) will find others "free-riding" on their sacrifices. Absent enforcement free-riders will not bear their fair share of costs of producing goods. Hinging development efforts on willingness of people to "get together" for the community good will only work well where villages or groups within are effective going concerns capable of organizing requisite efforts through a working system of rules. But where there exists no going concern - or one whose membership is limited to a small subset of the community population - costs of "getting together" may be prohibitive and people may have to opt for "getting separately" even though they know such a strategy may leave them worse off in the long run.

Projects should be designed to take account of this local complexity, by drawing on villages' organizational strengths where possible and respecting others' limits by not arbitrarily imposing collective forms on those which now lack such capacity.

Designs should build in local options to choose reforestation strategies from a range of possibilities. For certain kinds of reforestation programs it will be necessary in certain locales to invest time and energy in reconstituting or creating local autonomous government capability.

Collective Action Costs. One can identify two kinds of costs associated with collective action: (1) costs of taking collective decisions, e.g., acquiring land for woodlots or imposing user fees; and (2) costs flowing from decisions taken, e.g., land loss sustained by group members whose fields may be expropriated for community woodlots or user fees which people may be required to pay [for a more formal treatment of these concepts, "opportunity" and "deprivation" costs, E. Ostrom, 1968, and literature there cited].

These costs vary with degrees of effective local autonomy and organization in any particular community. Where local structures can achieve consensus and uphold decisions with or without official authorization to enforce rules, time and effort required to establish a woodstock management structure may be relatively low. But in consequence some people may bear substantial costs. They may lose land, or have to buy wood, or invest in new supplies when they would prefer to do other things with their time or money.

On the other hand, where local government is weak, consensus may be extremely difficult to achieve and decisions impossible to impose. In consequence, people may escape immediate

costs associated with decisions they don't like. It is probable however that failure to manage woodstock for sustained yield will lead ultimately to desertification in the Sahel, costs of which are probably incalculable.

If to manage their woodstock local communities require authorization from higher government levels, e.g., district, county, state or national jurisdictions, in general one can expect costs of getting authorization will rise as the authorizing level becomes more remote. As jurisdictions increase in size, problems they deal with typically become more numerous. Since officials only have as much time as anyone else they typically cannot deal with all problems presented, but only with those they consider most important. A village petitioning for permission to manage its own woodstock (in the absence of special enabling legislation) is likely to face great difficulty acquiring the requisite authority. Thus one can expect villages to be uninterested in formulating and presenting such petitions. The problem will be dealt with, if at all, in a top-down manner by officials who view it as serious enough to merit their attention.

Conclusions

This analysis of firewood production problems in the West African Sahel has addressed technical and institutional problems which may impede woodstock management once dwindling wood supplies commit local residents to active conservation

practices [Thomson, 1980a]. Clear possibilities exist in the region for greater tree production and sustained-yield woodstock management, but realizing these will depend on awareness of and ability to overcome problems discussed.

Technical advances - more appropriate species, production techniques, etc. - remain critical: peasants already hard-pressed to survive will shun species and projects they know to be unproductive or threatening to short-term crop production possibilities.

Land and tree tenure rules, and political organization capabilities sharply influence the kind of woodstock management strategy appropriate for any particular user community, as do judicial process and woodstock protection possibilities. Some villages or village quarters can master both individual and collective approaches to wood production. Others, lacking appropriate local institutions, are restricted to individual enterprises. Probabilities that either will succeed can be greatly heightened by legal changes, particularly in Sahelian national forestry codes. Reforms should give villagers greater incentives to participate in woodstock management by authorizing local communities to make and enforce management rules necessary and relevant in light of local conditions. Reforestation project designs should likewise address these critical issues as the most efficient way of promoting effective reforestation and environmental management in Sahelian states.

Footnotes

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² The forestry code in this country in fact vests ownership of planted trees in those who planted them. But peasants are often reluctant, for a variety of reasons, to formally establish title. Many forestry guards see there an illegal opportunity to increase fines or bribe income...and take it.

³ Political boundaries drawn along ethnic or state lines clearly put some "available" lands off limits to aliens of the political communities involved. Such humanly-imposed land shortages induced active conservation practices in many areas [Ware, 1977: 174-7S].

⁴ Given a formal permit system an individual could in principle acquire one and then legally cut trees on his own land. But since foresters are thin on the ground (a) it is expensive in time and energy to find them, at which point one

must pay for the permit, and (b) since they are thin on the ground it is usually possible to get away with illegal cutting. When this becomes everybody's least-cost solution, unregulated deforestation proceeds apace.

⁵ Where scattered quarter or village land holdings interpenetrate each other, interesting boundary problems can be expected. If they are sufficiently intractable and collective management is considered a must, special woodstock management districts not necessarily contiguous with existing villages or quarter boundaries might offer a solution. Each district would regulate wood on a group of contiguous fields no matter where field owners resided or were registered for census and tax purposes. The approach is not without problems; they will not be explored here.

⁶ Acquiring access to woodlot sites poses fascinating problems. Location of sites terms of cession (sale? loan? rent? conditions of reversion to owner?), possible effects on distribution of product must all be examined...but not here. Local political authority seems indispensable. Overriding regimes should offer a dispute resolution process only to settle intractable local deadlocks.

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