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MODELS FOR WINDBREAK MANAGEMENT:
INSTITUTIONAL ANALYSIS AND DESIGN

by

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Introduction

In 1974, in the Majjia Valley of south-central Niger, West Africa, the Nigerian Forest Service, with financing and counsel from CARE, an American private voluntary organization, launched a windbreak project. The purpose of the project was to develop windbreaks in the valley bottom to protect productive farmland from fierce wind erosion. Peasant farmers were initially told the trees would belong to those on whose fields the windbreaks were planted. Subsequently, as the windbreaks spread through the valley over the next decade, the rules changed: peasants were simply informed that the windbreaks would be planted on their fields, by them, under Forest Service supervision. Protection for the young trees from browsing animals was provided by local guards hired and controlled by the Forest Service, again with CARE financing.

By 1984, the total length of the windbreaks exceeded 200 miles. As they matured, they performed their on-site, environmental protection function with increasing effectiveness. Peasants came to appreciate the windbreaks because, by their own evaluation, they increased agricultural productivity. However, two problems arose: CARE wished to terminate its funding of the project to shift efforts elsewhere, and the windbreaks were producing wood and other products which could be harvested without disturbing their environmental protection role.

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This paper, based on a four-month field investigation conducted by a team of social scientists during April-August 1984, provides an institutional analysis of the Majjia Valley Windbreak Project, in a first section, and then outlines three different designs for institutionalized, participatory windbreak management in the second.

Physical-Technical Nature of the Good

From the foregoing description, it is clear that windbreak trees cannot easily be categorized as public, private, or common property goods. Instead, they embody public good elements, and either private or common property aspects, or some of each. The public good element is generated by the trees as windbreaks: they reduce wind velocity, increase turbulence, and so create a microclimate within the protected area which is more favorable to field and garden agriculture. Anyone who farms land within the breaks thus benefits, whether or not trees grow on the land any given individual cultivates. Muddling wind currents is, be it noted, a nonconsumptive, on-site use.

Common property/private property aspects concern consumptive uses. The windbreaks now produce a series of consumables: heavy timber (if coppiced); building poles (if pollarded); firewood; Acacia scorpioides seeds, which contain significant amounts of tannin, used by local artisans to convert hides into usable leather; long, mean thorns excellent for fencing; and browse, neem leaves which, though sheep and cattle will not eat them, goats and especially camels will consume. If other species were planted, additional minor products could be produced, e.g., fruit (mangoes, guavas, palm nuts, cashews,

etc.), gum arabic, medicines, etc., weaving materials for mats and rope, etc.).

Enclosure and exclusion using only locally available materials (live hedges composed of thorny acacias reinforced with pruned thorny branches of A. scorpioides) appears technically feasible, given the increasing favorable growing conditions on the valley floor as the microclimate progressively improves. If the valley were fenced using such means, it would facilitate privatization. However, the windbreaks themselves cannot be enclosed with hedge rows apparently because the additional vegetation would consume too much agricultural land. Barbed wire fences are prohibitively expensive by local standards, and solar-powered electrical fences, while perhaps feasible, are still too high-tech for valley residents, as well as expensive.

For this reason, the windbreaks must now be considered common property goods.

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Existing Decision-Making Arrangements

Legally, the Majjia Valley windbreaks are currently treated in the main as public goods. The on-site, environmental protection use far outweighs any consumptive uses. However, that will rapidly change in the next few years. The oldest windbreaks, planted in 1974, are ready for harvesting. Experiments to determine the best approach are now underway. The trees will either be coppiced (cut off at ground level and allowed to regenerate in pole form from the stump) or pollarded (cut off at the base of the crown, some 10 to 12 feet above

ground level, and allowed to regenerate in a dense, thickly-branched crown form). What remains uncertain is the timing and spacing of the cuts (one row, both rows, every other tree, every other windbreak, etc.). Whatever the technical character of the harvesting regime, it is clear that a good deal of wood will be produced. In addition, some windbreaks are now producing tannin, which people seem to collect on a first come, first served basis. Thorns could now be harvested for fencing materials, but are not at present. In any case, these products will be harvested. How exactly they will be distributed poses a dilemma in the context of existing institutional arrangements. These must now be detailed.

As noted, trees planted in the first two or three years of windbreak action, by oral agreement between the forester who entrepreneured the operation and the farmers who participated, were to belong to the farmers in whose fields they were planted. However, no more specific arrangement was made. Subsequently, when the first forester was replaced by a second, the oral commitment to privatization disappeared. Farmers who lost land to the windbreaks were simply presented with the fact that the entire valley would be improved eventually. They really had no choice in the matter.

Windbreak lines were laid out by the forester and his assistants. Line placement reflected technical factors only (wind direction, assumptions about break density, intra- and inter-break spacings). No attempt was made to accommodate land tenure patterns. As a result, the amount of land individual farmers lost to windbreaks varied dramatically. Foresters then organized villagers to dig holes for the nursery stock and, when the rainy season was well started, supervised

villagers as they planted trees. This effort involved principally young men and women, but it often became a sort of community festival. Those who helped usually received "food for work" payments (sorghum, powdered milk, sardines, etc.) which amounted to about half the going rate for field labor. The entire effort each year required about three days work from each of the villages involved. Windbreaks were completed for most villages within two years.

[Table 1 About Here]

From the perspective of farmers in all but the first few villages, they had been paid to do a job the foresters wanted done, on villagers' land taken for the purpose by fiat decision of the official involved. This strongly influenced villagers' perception of windbreak property rights; in their view, the foresters own the trees. This perception was and still is strongly reinforced by protection measures adopted from the first year the windbreaks were established.

The Nigerian foresters and CARE officials opted for a paid guardian system. Two men were hired from the Garadoume villages, where the project was initiated. They eventually became foremen, supervising some ten valley men who patrolled the windbreaks to protect them against stock damage. Empowered to impound animals found in the break areas, and to fine owners when they came to claim their goats, camels, sheep, and cows, the hired guardians effectively put the valley crop residues off limits to foraging animals. (However, stock owners were allowed to collect residues and take them out of the break areas, especially if they remembered to leave a share with the guardians who owned horses.) Fine amounts were increased until they practically equalled the value of any small stock caught. Different

groups of stock owners reacted in light of the possibilities available to them. These are discussed shortly.

The trees were protected for some six years or longer, until they grew so tall that only camels could do them real damage. When animals were allowed back into fields in the northern end of the valley in the early 1980s, camels began browsing on lower branches and gradually raised the foliage line up some 12 feet above the ground. Foresters consider this far too tall a ground-to-branch gap to provide crops proper protection from the wind. In consequence, they banned camels. Cows, goats, and sheep have been permitted to forage in fields where windbreaks have matured, and so the entire valley will in the end be reopened to herders unless some new arrangements are made. Interestingly, most farmers seem content with the ban on grazing. With the exception of the Tuareg and their dependents, few have many animals. However, many engage in dry-season gardening in their fields, drawing water from shallow wells to irrigate onions, tobacco, etc. When animals are prohibited from entering valley fields, dangers of stock damage are sharply reduced.

As things stand now, the public good value of the windbreaks outweighs their value as a common property good producing several consumable products. The public good aspect of the windbreaks has been judged, through a purely bureaucratic decision-making process, to outweigh the value of crop residues which animals could consume as bulk forage. People are allowed to collect crop residues and feed them to their animals outside protected areas, but they must not move animals into the fields if the herds will threaten the windbreaks.

Interactions

Valley residents have generally respected the rules as enforced by forest service guardians. Trees show some evidence of minimal surreptitious cutting, especially out towards the ends of the break lines. Most villagers, however, limit themselves to collecting fallen dead wood from beneath the trees. Acacia scorpioides seeds are collected when ripe by anyone who cares to, since the guardians permit this behavior. Overall, most villagers have simply lived within the framework of imposed rules concerning cutting.

Reactions to rules prohibiting grazing have been varied. Hausa women in valley villages slowly sold off their flocks of small ruminants, as windbreak lines spread down the valley, because they could not work out a strategy to pasture their animals elsewhere: in effect, the crop residues on valley fields constituted the bulk of the forage available to resident herds.

Tuareg agro-pastoralists, based in the Majjia for the last century, generally moved their animals out, either under the control of a youth in the family or by placing them under the care of relatives elsewhere with easier access to pastures.

The Fulbe transhumant herders, some of who also claimed home (dry-season) pastures in the valley, moved their stock operations elsewhere, but not before many of them worked through the valley at night, putting their animals into fenced gardens when the guardians were not abroad. Some of the latter admitted they feared Fulbe herders would do them physical harm if they tried to stop them.

Outcomes

Several user groups, and at least two nonuser groups, have been affected in significant ways by the windbreak project.

Valley residents using fields in protected areas have expressed solid satisfaction with the effect of the windbreaks on agricultural output. Both field owners and other Majjia residents credit the windbreaks with improving agricultural output in protected fields. Indeed, as the trees mature, they significantly reduce wind erosion in the valley during the dry season. They also improve the microclimate of protected fields during the growing season. Initial evidence suggests output may have increased 15-20 percent despite a loss on an average of 15 percent of arable land in the valley bottoms to windbreak lines.

[Table 2 About Here]

Haousa women in the valley seem by contrast to have lost access to a critical source of dry-season forage, i.e., crop residues. This is only a temporary loss. But because women appear unable to provide for their animals through other means, they are forced to liquidate their herds. It is not clear that other investment strategies available to them are attractive. However, as fields are reopened to small ruminant grazing, women can be expected to reestablish their herds.

Other herders - the resident Tuareg agro-pastoralists and the transhumant Fulbe pastoralists - likewise regain access to valley crop residues as a source of fodder for their animals when fields are reopened. Camel owners constitute an exception in this respect

however: their presence in the valley seems flatly incompatible with the windbreaks because the camels, as tall browsers, can destroy the positive environmental effect of the trees.

All of these groups benefit from the fact that wind erosion has been controlled in the valley. Without the trees, crop yields and therefore edible crop residues would have continued to decline. It is now conceivable that the valley's mixed farming/gardening economy can be placed on a sustained yield basis.

Two (currently) nonuser groups likewise place very high value on the windbreaks. The Nigerian Forestry Service considers the Majjia Valley project one of its most important success stories. CARE likewise views the project as a significant success, despite difficulties with distributing the harvest from mature trees, rather limited participation, and a perplexing problem of recurring costs. CARE, as well as the Forestry Service, now faces a difficult problem: shifting the burden of protection to those who benefit from the windbreaks. Once the entire valley has been provided with windbreaks, CARE would like to direct its attention to other problems in the valley, or to other regions in Niger. But so long as people might pose a threat to the windbreaks and camels continue to do so, simple withdrawal of guardians' salaries without proper provision for a local system of rule enforcement will almost certainly end in windbreak destruction.

The first half of this paper presented an institutional analysis of a complex renewable resource management problem. The institutional issues are about to become more complex as a result of technical successes with resource management: certain consumable products can

be produced by the Majjia Valley windbreaks, in addition to the on-site, environmental protection services the trees provide. The second half of the paper therefore proposes three different institutional designs which might provide satisfactory frameworks for largely self-supporting windbreak management systems based on local participation.

Institutional Design Alternatives

This section first notes the goals which institutional designs for Majjia Valley windbreak management systems should seek to achieve. It then lists the actors — user groups — involved in use and management, and outlines several design criteria which proposed institutions must respect if they are to be successful. Three different designs are then detailed: (1) User-Managed/Pure Collective; (2) User-Managed/Mixed Collective-Individual; and (3) Joint Forester-User-Managed/Mixed Collective-Individual. Considerations underlying each design are discussed, and intra-design variants are suggested where potential disadvantages of the basic designs might be avoided or potential opportunities exploited. None of these proposed designs has yet been subjected to field testing.

The Nigerian Forest Service and CARE/Niger should consider comparative field testing of the designs within the Majjia Valley as part of an effort, during a transition phase from top-down to more participatory approaches to resource management, to gather data about most appropriate designs for different local sociopolitical contexts.

Design Goals

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Four goals orient this discussion of management models:

1. Preserve the major on-site use — protection against wind erosion — now produced by the windbreaks.
2. Extract the maximum amount of consumable forest products from the windbreaks, consonant with preservation of the major on-site, nonconsumptive use.
3. Convert the management system from the existing externally-financed, imposed type to a financially self-sustaining, locally run operation.
4. Provide, if possible, financing through the sale of products from existing windbreaks for windbreak extension, and for other forms of environmental management within the valley, e.g., terracing and reforestation of valley sides to reduce run-off, maintain flood recession agriculture options on the valley floor, and replenish valley aquifers which facilitate windbreak establishment and dry-season gardening.

Institutional Actors

Discussion in the first part of this paper suggests five potential sets of institutional actors, all of whom may also function in some measure as user groups. They are:

1. Owners of fields on which windbreaks are sited.
2. Owners of fields protected by trees located on others' fields.
3. Residents of villages having windbreaks.
4. Transhumant herders whose animals might forage in valley fields.
5. Foresters representing the Nigerian Forest Service.

Design Criteria

Design criteria flow from the four goals outlined above. A successful design will both permit and encourage relevant actors to manage the windbreaks for sustained yield of forest products consonant with continued environmental protection. Management costs must be principally supported by major beneficiaries, i.e., the user groups noted above. If possible, part of the surplus from the management operation should be allocated to furthering other environmental management activities in the valley.

Designs must meet the following criteria:

1. Authorization and empowerment of users to define and enforce use controls.
2. Generation of information indispensable to use rule enforcement.
3. Resolution of equity problems, particularly those occasioned by certain individuals' disproportionate loss of valley land to windbreaks, and temporary loss of easy access to traditional sources of stock fodder in the valley, i.e., crop residues and browse. Camel owners are particularly disadvantaged in regard to loss of browse resources.
4. Definition of and compliance with technically appropriate windbreak harvesting regimes.
5. Strengthening of local organizations which are now - where they exist at will - generally weak and lacking in resource management skills.
6. Replacement of the still-prevalent local view that any valley woodstock resources not protected effectively by government foresters constitute unregulated common property goods available on a first come, first served basis by a consensus that windbreaks at least must be managed and exploited in accord with use rules which guarantee sustained yield of on-site services and consumable forest products.

Windbreak Management Models

General Considerations

User Groups

Models I and II, based entirely on local management options, will both involve two types of user groups: valley residents and transhumant herders who customarily consider the Majjia as their dry-season home pasture areas. In Model III, which provides for joint management by local people and foresters, the latter will represent a third user group, the larger Nigerian public, in addition to the two local groups.

Residents of each village in the windbreak area will be considered a separate user group. While the majority of groups will thus be composed of Hausa peasant farmers, some will involve instead Tuareg agro-pastoralists.

Transhumant herders - mainly Fulbe but possibly some Tuareg - will be organized as user groups only after additional investigations indicate the best basis for organization. It may be that transhumant groups rove over the entire valley area in search of forage for their animals. It is more probable, however, that the valley is subdivided into a number of dry-season pasture areas. If specific pastoral groups work the same or neighboring areas, they probably offer a more reliable organizational base for user groups. If such units can be established, and associated with one or several valley villages in windbreak areas they regularly frequent, repeated contacts between group representatives on both sides may well create a framework for

relationships based on reciprocity principles. In any case, sustained-yield management of the breaks will require collaboration among members of the two kinds of user groups.

User Group Constitutions

User group constitutions can either be imposed or generated locally. Each option merits consideration.

Local Constitutions

User group members — villagers and possibly transhumant herders — will be allowed to develop local decision-making bodies to deal with all windbreak-related issues (harvesting, protection, planting, distribution, rule enforcement, etc.).

Under such circumstances village chiefs will almost certainly be involved in management activities. How many other local people will take an active part will be a function of a given community's existing decision-making structures for public problems. Some will rely on the chief to handle everything. He will be allowed to delegate work as he sees fit. Others will encompass a broader decision-making group, in a more public process. Some villages may find it easiest to organize management activities by quarter, or by several quarters at once, to build on existing relationships of confidence within given groups smaller than the full village community. Some may decide to organize windbreak management activities through the newly-established "Development Society" local councils. At the moment these appear to

be yet another stillborn attempt by a military government to create a political framework for controlled participation. In some villages, however, they may offer a convenient ready-made solution to the constitutional problem.

Imposed Constitutions

This approach could be used to promote a standard format for windbreak management. Villagers could also be allowed to choose among several boiler-plate constitutions. In either case, constitutions could be used to restrict organizational variety within limits acceptable to overriding governments. The imposed model constitution or range of constitutional options could determine conditions for selection to and continuation in office. Rapid turnover might be designed into the constitution, in order to build up a group of locals familiar with windbreak management problems. Imposed constitutions might also be used to rig the game against corrupt combinations of local officials intent on exploiting the windbreaks for short-term personal gain.

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Operational Rules

However their constitutions are developed, user groups must be clearly authorized to deal with windbreak issues. CARE and the Forest Service, working together, should help local committees develop management rules. The first order of business would be to define the territorial jurisdiction of each user group. Then management rules must be clearly defined. They can be subdivided into three categories:

1. Rules Governing Windbreak Creation. Who may/must work on windbreak planting activities, how much work can each be required to furnish, during what time periods and on what terms (free labor; paid in kind from village sources; claim of a share to windbreak harvests; etc.).
2. Rules Governing Windbreak Maintenance. Under what terms can various types of livestock (goats, sheep, cows, camels, horses, and donkeys) graze on crop residues in the windbreak areas? Answers will be formulated as rules governing:
 - a. season(s) when each type of animal can frequent the valley, and during which periods, if any, a species must be entirely excluded from the valley;
 - b. degree of control to be exerted over animals legally foraging in the windbreak area (always herded; herded at night only; herded during the day only; constantly herded during certain seasons only, e.g., the growing season through the end of the harvest; allowed to roam at will always; etc.); and
 - c. penalties for rule infractions.
3. Rules Governing Harvesting and Distribution of Windbreak Products. This set of rules must specify harvesting procedures between major cuts and during major cuts, in terms of authorized harvesters, methods, timing, and distribution of products.

- a. Major cut harvesting, on a multi-year rotation, poses some interesting technical questions, but should be fairly easy to organize and control. Rules must first specify who organizes the technical aspects of the cut (timing, types of harvesting to be undertaken, instruments to be used in harvesting, etc.). This will involve decisions about the individuals or groups qualified to set harvesting rules. Such rules could be a matter of local option, or they could provide for local choice among options established by overriding jurisdictions.

Some examples of the latter could include a "no damage to nonconsumptive uses" clause; a provision tying harvesting to replacement, whether in terms of new plantings or regeneration from coppiced or pollarded trees; or harvesting could be conditioned on inter-row plantings of "x" numbers of specified tree species (e.g., Acacia albida)/year/kilometer of windbreaks.

Finally, harvesting rules could be set entirely by officials of overriding regimes, i.e., foresters, on the grounds that technical considerations are too complex,

and windbreak survival too delicate, to permit experimentation by amateurs.

Distribution rules raise the same sorts of issues. These could be: (1) solely a local affair, (2) partially a local matter, or (3) totally governed by regulations established by officials of overriding jurisdictions. Options (2) and (3) would involve establishing some technical guidelines to be applied at the local level.

b. Inter-cut harvesting will, by comparison with major cut operations, be less challenging technically and far more difficult to organize.

Technical questions will concern permissible harvesting rates for dead wood, browse, fencing, seed pods, medicinal products, etc.; permissible and required harvesting techniques; and timing. Political issues will turn on the identity of those authorized to harvest products. The list might be limited to the field owner and his family members. The list might be widened to include, e.g., nonfamily members authorized by the field owner, or all villagers, or all comers, including transhumant herders who are not members of Majjia Valley pastoral user groups. Another important political issue concerns the organization of windbreak harvesting (species, timing, and techniques).

The related political issue of distribution formulae for different products may interfere with or reinforce harvesting techniques and access provisions. A first come, first served rule might be appropriate, whatever the identity of authorized harvesters, so long as techniques (harvesting methods, timing, and amounts) are respected. This would be especially true in cases where supply exceeded demand.

Another possibly appropriate rule or set of rules would focus on systematizing inter-cut harvesting among user group sub-units. This approach might, for instance, provide for a monthly culling of dead wood from a specified section of windbreak by a named and known group of individuals. Organization on such a basis would involve costs of coordinating harvesting dates and times. On the other hand, the public, controlled character of the operation would make respect for technical rules more likely, and might serve to generate public pressure against "unorganized" harvesting. This principle could be easily extended to provide an organizational framework for several windbreak consumptive products. Cutting could be organized as a function of plant cycles (sprouting of new growth, ripening of seed pods), of agricultural and gardening

necessities (tools, fabrication, and fence construction), or of pastoral rhythms (need for browse, particularly during the latter part of the dry season).

Rule Enforcement

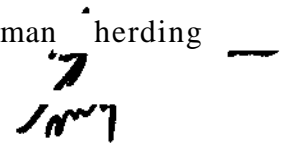
Under any system for imposed or locally-created windbreak management units, provision will have to be made for enforcement of constitutional and operation rules. It would be possible, when villages express a desire to control their windbreaks, to allow them free rein, i.e., to transfer control over the resources without further ado. But the amount of effort and money invested in creating the windbreak resource capital makes it unlikely that either CARE or the Nigerian Forest Service would accept such a procedure as a general rule. Risks are simply too great that trees will be destroyed to realize a short-term gain for some individuals or groups. (However, it would be worthwhile to allow one or two villages to attempt to handle management entirely on their own, to compare that approach with one based on forester guidance.)

A minimum standard will therefore be set as a condition for localization of control over parts of the overall Majjia windbreak system. This will be a pro forma requirement that the user group devise a rule enforcement system for windbreak management regulations which promises to function reasonably. Users must indicate who within the group will be responsible for rule enforcement. They must also stipulate how infractions will be punished (e.g., labor contributed to replanting, extent of fines for different violations, etc.) and the procedures they propose to adopt for resolution of disputes relating to infractions. Villages can devise their own dispute resolution

systems. They can rely on local authorities (headmen, DS council members, local religious leaders, special arbiters, etc.), or on outsiders (foresters, canton chiefs, etc.).

Model I: User-Managed/Pure Collective Option

Model I would shift control over windbreaks from the Nigerian Forest Service to Majjia Valley residents and transhuman herding groups.



User Groups

Each village in the windbreak area will be constituted as a user group. Included here will be both Hausa farming populations and Tuareg sedentary agro-pastoralists. Fulbe transhumant pastoral groups which consider the Majjia as their home dry-season pasture will also be encouraged to organize as user groups if enough of them return to the valley.

User Group Constitutions

User groups will be allowed to develop constitutions in light of local considerations. Villages which request help in developing appropriate organizational formats will be provided assistance.

Operational Rules

Within the limits of technical considerations required to maintain sustained yield of windbreak products, as well as on-site environmental protection aspects, user groups will be permitted to

devise their own sets of rules governing windbreak creation, maintenance, harvesting, and distribution. However, the user group will undertake these activities as a group. Whoever is determined to be a member of the group can claim an equitable share in the results of group management activities.

Enforcement Procedures

User groups will organize enforcement at the local level in accord with their means and mores. Recourse in disputes which cannot be resolved at the local level will lie either to administrative superiors within the Bouza Arrondissement system (canton chiefs, sub-prefect), or to Muslim clerics providing dispute resolution services to a supra-village, informal jurisdiction within the valley.

User group constitutions, operational rules, and enforcement procedures will be allowed to develop as a function of local conditions. Different approaches will evolve. Conflicts between or among approaches will be worked out, where necessary, by user groups negotiating with each other or through the judicial process.

Model II: User-Managed/Mixed Collective-Individual Option

Model II shares with Model I the total transfer of authority over windbreak creation, maintenance, extension, and exploitation from the Forest Service to villagers.

User Groups

As in Model I, user groups will be established on the basis of residency in the valley or membership in a pastoral group which regularly uses the valley as a dry-season pasture area.

User Group Constitutions

Model I provisions apply as well in Model II.

Operation Rules

Model II differs from Model I in this respect. Owners of fields where windbreaks are located must help manage them and are encouraged to do so through their vested claim to x (25 ?) percent of the products harvested from the windbreaks during major harvest cuts.

Inter-Harvest Rules

During inter-harvest periods, field owners may be vested with control of all minor products taken from windbreaks on their fields. Such products include browse, fallen wood (and, at local discretion, dead wood still in trees), seeds, thorn branches (if pruning of thorny species in windbreaks is authorized by the local user group), etc.

This system will provide interesting incentives for field owners to maintain windbreaks on their lands. The quarter share should convince field owners that they have a stake in helping manage the resource for sustained yield, even in the face of pressing short-term demands. Full control of all windbreak products during inter-harvest periods will provide field owners with steady motivation to control exploitation of the common property resources. Easy access to

firewood, extra money from the sale of A. nilotica seed pods, more manure for their fields in exchange for browse rights accorded herders willing to stable their animals on fields during the night, would constitute valuable goods in the context of Majjia Valley production systems.

It might be judged appropriate by a local user group to vest specified shares of consumable products only from major harvests in windbreak field owners. This would avoid creating resentments on the part of group members who own no windbreak fields, and the associated risk that the latter would engage in illegal raids on the windbreaks.

Such a mixed windbreak product system, i.e., one which vested community and individual shares, would fail immediately if launched on a first come, first served basis, because it would be impossible to monitor product allocation by vested share. An appropriate solution, noted above, would be to organize periodic collection of windbreak products between major harvests. Timing of such activities could be organized by product in terms of plant cycles, agricultural necessities, or pastoral rhythms.

Depending on labor inputs required in each case, sub-village level organization might be appropriate. Owners of adjacent fields might arrange limited, joint "graze-ins" during two or three days with stockowners interested in access to browse for their animals. A user group representative would have to monitor activities to ensure village interests were represented, but this would not demand mobilization of a large-scale enforcement group. Seed and firewood collection could be organized on roughly the same basis. If collections were programmed in a regular cycle, specified sub-units

within the user groups could harvest and then divide products among themselves in accord with some mutually agreeable formula, perhaps after according the field owner a special larger share so long as a family member helped with the harvest.

If carefully designed, such harvest systems could reinforce public sentiment in favor of abiding by rules designed to ensure sustained yield and casual policing — co-production — to discourage poaching.

Model III: Joint Forester-User-Managed/ Mixed Collective-Individual Option

Model III differs from I and II because villagers share windbreak management responsibility with foresters.

User Groups

User groups will be, in large part, village-based. But the Forest Service will be accorded a fixed share (one fifth?) in major harvest products. Service representatives — the Bouza Arrondissement forester or his subordinates — will thus be ex officio members of the resource management units in valley villages.

User Group Constitutions

The constitution for user groups will be standardized. It will attribute votes to user group member classes — windbreak field owners, village residents, and foresters — as a function of the shares in major harvesting windbreak products accorded each class.

Foresters and field owners will each control one fifth of the windbreak products collected on any given field at a major harvest. The remaining three-fifths will be allocated to village residents as user group members for distribution in accord with predetermined rules. Each share will be translated into two votes, with the exception of the Forest Service share, which will be accorded a single vote.

Representatives to the user group management committee will be elected by all adult members of their class. Field owners will thus vote twice, once as members of that class, and once as villagers and members of the user group. Again, the Forest Service representative constitutes a special case. The senior forester in Bouza Arrondissement will appoint the Service representative to each user group. By majority vote, however, user group members can reject a nomination. This provision will allow villagers to exercise some leverage over that choice.

The Service representative can serve no more than three years in any local user group. Villagers will be elected to the management committee for staggered two-year terms.

Operational Rules

The exact nature of operational rules to be evolved depends in part on the role Service representatives are to play in the windbreak management system. If foresters bear responsibility for technical integrity of the management system, it might be appropriate to assign them veto authority over critical activities, e.g., timing and extent of major cuts, organization of the enforcement system, etc. The

potential disadvantages in dampening villager incentives to participate in all aspects of the management system must be noted.

If Service representatives establish monopoly control over all technical decisions, they will probably parlay it into full control over the management system. Villager participation will remain weak because most members will conclude that foresters still run the game, and villagers merely execute their commands. It will thus be appropriate to limit foresters' power within the management system.

Major Harvest

Forest Service representatives play a controlling role in this activity under Model III conditions. They propose timing of major cuts subject to village veto (because, e.g., of conflicting labor demands). They determine technical guidelines for the harvest, organize the cut, and enforce technical guidelines.

Enforcement

This issue merits reflection. Given the history of the project, and the dominant role Forest Service agents played in directing the work of the CARE-financed windbreak guards, perhaps the Service should supervise rule maintenance activities. But, CARE will cease to finance guardians' salaries shortly. To deal with long-term enforcement problems, foresters should set up user-group-run rule maintenance operations. This system might be based on mandatory labor contributions provided by village families on a rotating basis, or on hired guards paid for by village funds (presumably derived from the

sale of windbreak products). Service personnel will have relatively little time to devote to this activity. The system will have to be truly village-based to succeed.

Approaches with a stronger local orientation, of the sort outlined under Models I and II, may be more effective. If such approaches are adopted under Model III, foresters will play at most a back-up role, counselling local enforcement system officials when the occasion arises and, if necessary, passing on or supporting their enforcement decisions.

TABLE 1

FIELD AREA LOST TO THE WINDBREAKS

<u>Area</u>	Percent of Valley Men in the Project Area Reporting They Have Lost This Much of their Fields
None	27%
Quarter or Less	49%
Quarter to Half	21%
Half or More	3%

Sample Population = Valley Men in Villages Affected by
Windbreaks. Sample Size = 168.

TABLE 2

PERCEPTIONS OF THE IMPACT OF WINDBREAKS ON YIELDS:
THE VIEWS OF VILLAGERS WITH FIELDS IN THE WINDBREAK AREA

<u>Perceived Impact</u>	<u>Frequency of Response</u>
No Change	12%
Slight increase in production	19%
Large increase in production	60%
Slight decrease in production	2%
Large decrease in production	2%
Respondent unsure	5%

Sample population = men and women reporting fields in the
windbreak area. Sample size = 248.