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Preliminary Evaluation

OXFAM MICRO-CATCHMENT PROJECT

Ouahigouya,

Upper Volta

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SUMMARY

The report's introduction describes project purposes, major variables of the micro-catchment technique, resulting constraints on technique extension, character of participating villages and officials contacted (1-11).

A second section reviews the evaluation process (11-13).

Findings are presented in a third section, which first analyzes villagers' experiences, perceptions and attitudes concerning micro-catchment operations, and probable levels of support for continuing the project in the several communities visited (14-22). It then does the same for officials (22-25).

Implications are considered next (24-37). In this context micro-catchment techniques are treated as exercises in appropriately adapted environmental management. Arguments assume villagers' willingness to do "barefoot science" and to assume risks associated "with it. Feasibility of barefoot science, it is argued, depends on a development strategy emphasizing autonomous, local, individual or collective participation.

Conclusions recommend maintaining OXFAM's commitment to the micro-catchment project while attempting to interest other organizations in spreading the OXFAM version of the technique (38-41). Also considered are risks and advantages of efforts to promote the idea among other organizations, in terms of strengthening the fundamental orientation to micro-catchments as barefoot science activity to be carried on by autonomous local units.

Introduction

An experimental micro-catchment program launched during the spring of 1979 under OXFAM auspices in eight Yatenga villages around Ouahigouya in Upper Volta's Department of the North embodies two important developments. The first is the attempt to devise a new technique of Sahelian reforestation. The second, significant because of its politico-economic implications, might be summed up in the concept of "barefoot science". The program suggests how those interested in Sahelian reforestation, environmental management and development generally might feasibly induce peasants to become applied scientists committed to constructively manipulating their own environments.

The Technical "Trick"

Micro-catchment basins create tiny hospitable environments for tree-raising (and food crop production, and possible viculture) in hostile, arid terrain characterized by relatively impermeable soils. Without the micro-catchment dikes and pit basin, and the latter's deliberately heightened absorptive capacity, rain water moves immediately from the field, often eroding precious topsoil as it does so. Instead of infiltrating, moisture disappears as surface run-off. Without sufficient water, intense heat and extreme aridity sear ground cover. Particularly where, as in the contemporary Sahel, population pressure, over-cultivation and overgrazing compound effects of these harsh natural factors, environmental degradation follows inevitably

unless counterbalancing water management techniques are brought to bear on the problem.

The micro-catchment trick consists simply in corralling rain before it gets away. One then drains enough inadequate rainfall from a much larger area into the pit basin where the accumulation makes plant life possible. To manage water thus, three conditions must be met:

1. ground surface within the diked area must be highly impermeable, e.g., baked clay or lateritic soils;
2. either similar soils or rocks must be available to construct and maintain dikes (these materials can often be had from trenches dug uphill from the dikes to drain surface waters into the pit basin); and
3. it must be possible to dig a pit basin and nearly refill it with improved soil sufficiently porous to soak up and hold moisture drained from the catchment surface (top soil from the pit or elsewhere mixed with cinders, manure and vegetable matter will do nicely).

Micro-catchments are thus not a technique for all times and all places. They won't work in sandy terrain very well, but in many local environments across the Sahel they have a role to play. Micro-catchments can be used in isolation on cultivated fields or played-out hardpans by groups or individuals. They can be associated with slightly more sophisticated contour diking or terracing schemes designed to stem soil erosion and heighten agricultural productivity. Where mechanical earthmoving equipment is available to shape dikes or terraces, micro-catchments can be integrated into the overall scheme from the beginning as part of planned development, or later as an afterthought embellishment to enhance benefits of water control.

When heavy equipment is not available, local hand tools almost always suffice. Timing construction for the early post-harvest period, before the baking sun has hardened clay soils, makes the job easier, but with perseverance those same soils can be worked throughout the dry season. Laterite pans pose a more difficult problem, but many are only now forming. The process can be reversed or appropriately manipulated to maintain in productive uses large amounts of land otherwise irreparably lost.

The Major Variables

Run-off agriculture technology has existed for perhaps three thousand years. For the past twenty it has been used in the Yatenga area of Upper Volta. In 1978, OXFAM initiated a multifaceted experiment with the technology, in hopes a workable "package" might be perfected and then spread throughout Yatenga and comparable regions by extension methods. The experiment involves five different technical variables:

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

Site and Soil Types. The project began trials in eight villages located within 20 kilometers of Ouahigouya, traditional center of the Yatenga region. Sites proposed by villagers were soil-tested. Frequently, lesser quality, or even the poorest

fields villagers offered were chosen, on the assumption such sites would be easier to come by than rich fields in an area experiencing declining soil fertility and deficit food production.

Sites may also be chosen as a function of slope, workability and availability nearby¹ of rocks needed to anchor dikes where slopes are steep enough to promote high velocity run-off.

Varieties and Combinations. Villagers eventually planted a total of some twenty-five indigenous and exotic tree, bush and vine species in hand-dug catchments. Rice was sown in some basins which became heavily inundated. Millet and sorghum sprouted in others, accidentally introduced there via manure used to increase basin soils' water retention capacity. Rice deliberately introduced permitted profitable use of excess water and reduction of basin moisture levels to the point local (Carid-area adapted) species could survive without drowning.

Results. The first rainy season food crops did extraordinarily well. Areas devoid of other vegetation and written off by villagers as unfarmable produced burgeoning sorghum and millet stands which I personally observed in later October 1979. These plants had massive heads comparable to the best in adjacent fields.

Trees were mixed. A few exotic fruit trees drowned. Others did enormously well, putting on two meters of growth and an abundance of foliage in the four months after an early July planting. Others merely established themselves quite adequately. Survival rates across all species were extremely high through

the first three months of the dry season (from nine to as little as five months after planting, depending upon planting dates).

Some trees of various species have since died. The Project director's records suggest explanations for a number of these die-offs (and, for some species, ways they can be avoided in future by manipulating micro-catchment variables). Species' viability over the entire year's cycle has not yet been established. Nor do data as yet show how much viability and productivity can be improved across the whole range of food, tree, vine and bush species tested. Appropriate combinations have not been fully identified, although some hypotheses about mutually productive relationships are already tentatively confirmed as far as some village participants are concerned. However, other variables also remain to be manipulated in experimental adaptation of micro-catchment technology to different local milieux.

Catchment Sizes. Initially, micro-catchments eight by ten or ten meters square were used exclusively. Variations were then introduced. Six-meter squares reduced water harvested to accommodate lower requirements of some indigenous species. Open "V's" nearly halved labor input required to construct catchments. In two villages, squares and "V's" of various dimensions were built just uphill of fifteen-year-old erosion control dikes, basins sited in rich soil accumulated behind the dikes. Results of these trials appear promising, but again are subject to multiple influences and inconclusive for the present.

Planting Dates. In an effort to integrate tree-planting with field-crop cultivation some sites were planted just after field crops had been sown following the first good rains. Other catchments were planted as late as mid-September, when rains normally taper off in Yatenga. Despite high water retention in catchment basins, trial results suggest late planting provides an insufficient start for most trees to survive the seven-month-long dry season. They need more time to establish viable root structures, etc. Experiments in 1980 should provide more precision about feasible planting times, and likely effects on tree survival rates of extreme dates, either precocious or tardy.

Fencing Trials. The potential threat hungry Sahelian livestock pose to saplings dictated introduction of another variable into the micro-catchment experiments: diverse forms of fencing. These ranged from expensive (locally unavailable) barbed wire, alone or in combination with interlaced branches, to simple teepees of local shrub branches reinforced with interwoven metal packing bands. The latter can be purchased in Ouahigouya market for minimal sums.

With the mean part of the Sahelian dry season still ahead it is impossible to say now whether fencing is indispensable for reforestation in these local sites, and if so, what kind and how much. Fencing trees becomes more imperative as livestock pressure and animal hunger mount. These conditions change from area to area. But they often differ from year to year in a single area with variations in local and transhumant herd sizes and

drought conditions locally and elsewhere. Thus what may suffice nicely one year to protect micro-catchment greenery may be quite inadequate the next, at least during the critical 'short' years of a tree's life. Once the sapling establishes itself and trunk growth lifts foliage out of livestock reach, protection becomes a much less significant problem.

In summarizing this brief review of variables involved, it should be pointed out that experiments to date have by no means rung all possible changes on relevant technical variables. Workable approaches for the sites involved can be identified, but honing the most productive strategies of associated food/tree/bush/vine combinations will require on-going experimentation.

Constraints on Extension

It follows from the complexity of local environments within which the project is or might be tried eventually that experimentation must remain an integral part of the program. A single micro-catchment "package" which could be mindlessly replicated across the entire vast range of Sahelian micro-environments will probably never be discovered. But variations on the technique might well facilitate reforestation and conservation of soils in Sahelian environments already under heavy pressure. Thus the technique must be presented as a range of possibilities, some of which won't work in any one site, others of which will render mediocre performance, and others of which will come close to achieving project goals.

Risks associated with experimentation can be reduced through experience and careful record-keeping; they cannot be eliminated. If this is made apparent from the beginning, it need not impede peasant willingness to adopt and adapt the technique. Failure to make the experimental aspect clear, on the other hand, will likely sound a death knell for micro-catchments if the package solution presented turns out to be inappropriate. The whole idea will easily be rejected by peasants unaware that the essence of the technique lies in experimentation, playing around with species combinations, sites and soils, catchment shapes and dimensions, fencing strategies and planting dates, and seeking, through trial and error, solutions adapted to circumstances of this or that village's terrain, this or that peasant's field.

Participating Villages

The eight villages represent only two ethnic groups but a range of political organization. The six communities initially chosen were selected for their reputedly high level of interest in development activities. These were: Gondologo, Rapougouma, Sissamba, Nogo, Gourga and Goulagou. Subsequently, two groups, drawn respectively from the Mossi Sawadogo and Ouegraogo populations of Barelogo, were formed and included at their request in the project. Thus there are eight groups but seven villages. Some groups draw their members from a single quarter in a village and include most resident family heads [*i.e.*, not absent from the village for labor migration or other purposes) CGoulagou,

Barelogo I). Others draw on as few as two quarters (Barelogo II). The remainder typically count members from many or all of the quarters in a village, but do not include majorities of family heads in the community*

The micro-catchment project is typically piggy-backed onto an existing organizational framework. Two major variants are Regional Development Organization (CORD) "groupements villageois" (GV's) and local "Jeunesse" (youth) organizations. The latter, as elsewhere in Africa, include members from 20 to roughly 50 years of age. Many are married. Labor migration among young Mossi skews group members' average age to the high end of that range.

Groups in the program function with varying degrees of local autonomy. Youth groups appear to be local operations, not directly supervised by overriding regime officials. ORD GV's may be closely controlled by extension workers or relatively free agents having little if any contact with their nominal extension worker/supervisor.

Excepting the Goulagou Foulse, the groups are all Mossi in ethnic origin. Within the Mossi communities, relations between ruling lineage Ouegraogo and commoner (Sawadogo, Zorome, Ganema, etc.) quarters can range from cooperative to highly competitive (Barelogo I and II, apparently).

Finally, villages involved are multi-confessional in composition, counting adherents of some or all faiths prevalent in Yatenga: animism, Islam, Roman Catholicism and Protestantism.

Officials Contacted

The writer discussed the micro-catchment project with Mr. Sahr Tongu, AFRICARE/Ouahigouya (credit specialist for an integrated rural development program operating in Seguenega Subprefecture of the Department of the North, a potential area for project extension); Mr. Ouedraogo Abdoulaye, Director, ORD du Yatenga/Ouahigouya (ORD/Yat extension workers frequently shoulder tasks of diffusing new techniques, and some are already involved in micro-catchment operations); Mr. Ouedraogo Moumouni, ORD extension agent/Kalsaka, Seguenega Subprefecture (an individual with a firm reputation for reliable extension work who operates in Kalsaka, a community with a history of self-help projects and indigenous soil erosion control techniques which fit nicely with the micro-catchment concept); Mr. Zorome Kogada, Head of the Environmental Service/Ouahigouya; Mr. Jonathon Landeck, Peace Corps Volunteer Forester/Koumbri (involved in micro-catchment projects in Koumbri Subprefecture, Department of the North). Earlier conversations with Mr. Ouedraogo Sylvestre, Director General of Environment/Ouagadougou; Mr. James Seyler, Associate Director for Forestry, Peace Corps/Upper Volta; and Mr. Ouedraogo Salam, Head, Reforestation Section, ORD du Yatenga/Ouahigouya provide somewhat dated but still valid information about their perspectives on the micro-catchment project.

Evaluation Process

This evaluation:

1. reviews peasants' perceptions of the project;
2. reviews officials' perceptions of progress to date and possibilities for continuation;
3. presents a theoretical framework for conceptualizing project activities; and
4. offers recommendations for continuation.

Terms of Reference

Terms of reference include questions directed to peasant participants and designed to reveal:

1. their sense of proprietorship concerning micro-catchments and trees growing therein;
2. organizational problems concerning socio-political structure of the project now and in the foreseeable future;
3. extent to which a spread effect from collective to individual operations has or is likely to occur;
4. extent to which peasants conceive the project as a series of experiments implying certain risks in the search for workable reforestation techniques;
5. possibilities of continuing the project without physical inputs from outside sources;
6. villagers' suggestions for improvement; and
7. other relevant inquiries which might arise in the course of the investigation.

Other questions concerned possibilities for project continuation and potential framework (or frameworks) within which such extension might occur.

Evaluation Time and Procedures

The consultant initially spent two days analyzing conceptual aspects of the micro-catchment technique and its extension. He

then spent a day interviewing the Project director. A morning of interviews with officials in Ouahigouya was followed by two days of interviews with officials in Seguenega Subprefecture and Kalsaka, a village where the consultant has some prior research experience. Interviews, particularly in Kalsaka, focused on feasibility of group and individual frameworks for micro-catchment extension. After two days of interviews in project villages the report was prepared in one and a half days. [The current document is an edited version of the report.]

Village investigations involved impromptu group discussions with as many project participants as could be collected. Questions noted above were addressed to each set of interviewees through an interpreter (a French-speaking Mossi employed earlier by the consultant as a research assistant in Kalsaka). Significant replies were explored as they arose in conversations.

Villages Investigated

Field investigations began in Gourga (March 14, p.m., ten individuals). March 15 we saw Rapougouma (a.m., six members) and Gondologo (p.m., five members); March 16 Goulagou (a.m., fifteen members) and Barelego I (a.m., two members, including the president, and the president of Barelego II). The Project director believes these villages span the range of enthusiasm and involvement in the project: high (Gourga, Goulagou, Barelego I), medium (Rapougouma) to low/problem (Gondologo).

Findings

Villagers

Findings are based on the village interviews described above. They must be taken with a grain of salt for the usual reasons (extreme rapidity of visits; possibilities of incomplete or inaccurate translations; restricted size of interview groups; context in which interviews were conducted - an assessment of project results to date and a search for ways to improve activity - which to some extent invited requests for food and material aid previously refused in all but one village by the project director; and general desire to be polite to an "important" visitor).² However, certain threads run through replies which appear reasonable approximations to reality. Some in particular represent positions counter to direct, immediate interests of peasant participants, e.g., in receiving food or material aid. Across the sample of five villages, furthermore, interesting variations occur, suggesting responses accurately reflect local differences.

1. Who owns the woodlot? In all villages either the village chief or one or two group members provided land. Any micro-catchment products (wood, fruit, food crops, etc.) are to be sold for the benefit of groups' common funds. This is consistent with the manner in which products of other group activities (farming collective fields of peanuts or food crops for sale and occasionally, paid cultivation of individuals' fields by the [youth] group's members [Gondologo]) are added to joint resources.

2. Who controls the micro-catchment operations? Group presidents exercise control under the Project director's supervision, except in Gourga. There a literate peasant heads activities rather than the group's illiterate president. Control exercised by various presidents in the Project director's absence, in organizing work sessions, monitoring work quality, repairing enclosures, etc., varies significantly. But participants everywhere believe the project is theirs to control if they want to. In Rapougouma, Gondologo and Barelogo I group members consider micro-catchments an experiment, now collective in organization but designed to permit eventual application by individuals on their own fields. Gourga and Goulagou share this perception, but conceive long-run application, assuming successful adaptation, as a group activity even though it will be carried on at discrete sites in individuals' fields.

Gondologo is the only community where no one expresses interest in continuing the experiment as a voluntary collective activity without pay.

3. Who does the work? Group members constitute the bulk of the work force. Their children occasionally assist them. As noted above (p. 9), in some communities groups include all resident family heads. In consequence exposure to the technique attains the saturation point. In others, group membership amounts to a sampling only of local family heads so exposure to practice with the technique is more limited. Technical aspects are so simple, however, that extension should prove no problem.

4. Have difficulties arisen with local project organization?

Respondents note groups pre-existed the project in almost all villages. Since group leaders were present at all except the Gourga interview, possible dissensions were probably not aired openly. In Gondologo, with group support, the leader asserted great difficulty in getting members to participate in work not immediately rewarded, if organized on a collective basis. Nobody foresaw such problems (assuming technical success) preventing application by individuals on their own fields however.

5. Has the project proved worthwhile given risks participants must assume in testing the technique? The consensus is a provisional yes. Interviewees expressed satisfaction with survival rates to date (concluding those villages - Gourga and Rapougouma - where participants estimated survival rates at around fifty percent). With the sole exception of Gourga however, no village reported members or others already engaged in applying the technique on their own fields. Even in Gondologo the most "recalcitrant" village, the same wait and see attitude dominated. This seems perfectly appropriate since results to date are not definitive: plantations have not even survived a single season thus far, and only the 1980 rains will reveal whether apparent advantages associated with micro-catchments are in fact real ones.

In all villages visited, some individuals present had planted various trees (baobab [*Adansonia digitata*], shea butter [*Butyrospermum parkii*], nere [*Parkia biglobosa*], neem [*Azadirachta indica*], cassia [*Cassia siamea*], mango [*Mangifera indica*] and guava [*Psidium guajava*]). Some continue to do so, either

individually or in groups (ORD plantations in particular). Individuals thus have either direct knowledge or local information about what has and has not worked in the past. Many such trees have been planted in fields, without benefit of irrigation. Villagers know success rates are relatively low (rarely better than 50 percent with most species and falling now because of reduced rainfall/increased run-off/lowered water tables). Local interest in reforestation is clearly evident. It seems highly probable that an efficacious reforestation technique will be widely adopted.

Work inputs required to establish a micro-catchment are reported to be substantial (three to ten days per catchment for a single individual, estimates well in excess of the Project director's calculations of labor inputs required to create the existing set of catchments [from a maximum of five person-hours for a fully-enclosed ten-meter square to a minimum of about three-quarters of an hour for an eight-meter-long "V"-type catchment] - the disparity perhaps reflecting leading questions and peasants* perception of a chance to extract payments for project extension). But nobody asserted the technique was so onerous as to preclude extension to individuals' fields if it proves a successful reforestation method.

Participants can be expected to carefully calculate returns to effort invested, especially since many already have experience with orchards, in-field plantings and collective plantations. Typically they will be sensitive to species characteristics

(hardiness, by-products, growth rates, crop competitiveness, etc.), and may decide to use the technique selectively. But they will also be judging it against possibilities offered by neem plantations of the traditional type. In Barelogo I, for instance, neems planted next to the micro-catchment site in simple unimproved holes initially died, but were twice replanted with little effort. These trees had in the end done quite well according to the local president: 122 of 130 are still alive.³ Villagers are aware neem is a resistant species, useful only for restricted (but very important) purposes. If the catchments facilitate reforestation with other desirable species, the two techniques might well be used simultaneously.

6. Have participants or others tried the technique on their own fields? As reported above, only one individual has done so. He is a brother of the Gourga earth priest, which may be a good sign... Many other individuals in villages visited reported they either intended to this year (Gourga) or planned to if micro-catchments prove successful. While actions speak louder than words, these statements reflect substantial if provisional acceptance of the concept. It suggests individuals see no serious impediments to individual use, assuming technique efficacy. This, as will be argued below, is indispensable to widespread and effective adoption and adaptation.

7. Do villagers see the project as an experiment, in the sense that they would like to, plan to, or have manipulated variables outlined above (pp. 4-8)? Answers range from a lock-

step "The Project director told us to do it this way" (ten-meter squares) to a clear perception of manipulation possibilities along the Goulagou/Barelogo I/Barelogo II corridor. There three different types of plantations exist within several kilometers of each other, illustrating several different possibilities for participants.

Probing/leading questions revealed participants' general awareness that some trees need more water than others and therefore might require larger catchments. Many participants also realized different types of food crops can be associated with various tree and shrub species, and that planting dates influenced survival rates as did catchment sizes. Perceptions of fencing variations and their consequences are colored by (a) the prestige of barbed wire and (b) knowledge that traditional fencing practices have worked on individuals' fields and will probably continue to do so.

One might summarize the "experimental awareness" of villagers as moderate to good in most communities (exception: Rapougouma, but there individuals expressed confidence they could easily apply the technique without further supervision). Willingness to tinker with the technique is critical: it should be fostered and encouraged everywhere.

9. Could the project be continued without external aid?

Barbed wire was repeatedly requested as a condition for extending collective plantations. Gondologo participants insisted they would have to be given food aid as well. Many interviewees also

asserted extension to individual fields would be contingent on provision of some or all of the following: pick-axes, shovels, wheelbarrows, carts, barbed-wire fencing. But subsequent discussion strongly suggested fencing would nowhere pose an insurmountable problem. Traditional techniques (teepees or woven cylinders encircling saplings) are seen to be adequate, and materials (tree or shrub branches) are conceded to be available in all communities visited.⁴ This availability may decline in the future, depending upon environmental degradation. However for the moment fencing materials pose no serious problem.

Tools would be nice to have, but it is highly probable peasants will arrange to apply the technique if it proves itself even without "indispensable inputs" such as tools. In fact, the local hoe ("daba") will probably suffice just about everywhere. Shovels can be purchased (for about 1,000 CFA) if necessary.

In those few sites where rocks might turn out to be indispensable to catchment construction because of steep slopes, and where no supply is locally available, transport might have to be provided. Local communities are however, more often than not, capable of making their own arrangements for transportation (donkey or ox carts in many Yatenga areas), and should be left alone to do so (or pick different, less sloping sites) rather than mortgaging project extension to provision of outside transportation.

In conclusion, the technique can be used on individuals' fields without outside support. Whether collective plots can be

extended on an autonomous basis is problematic, but much less relevant in any case: the technique will only be judged a success when and if it is widely adopted as a technique of reforestation/environmental management/food production by individual peasants.

10. If the project were to be continued, would it be better to use the existing collective organizational format, replace it by some other collective group (e.g., quarter committees or small associations of neighbors) or rely on family units?

Goulagou and Gourga (the former already a single-quarter group; the latter a multi-quarter association) expressed a desire to proceed with the existing format for purposes of constructing catchments on individuals' fields; Rapougouma, Barelogo I and Gondologo all expressed firm desire to go "individualistic".

This reflects different local orientations towards the value of collective action; these differences should be accepted by the project now and in future as givens to be accommodated. No time or effort should be wasted imposing organizations people find unsuitable. Considerable leeway should always be left for local decisions on this issue. Barelogo I for instance, reported members would work together for the experimental period, but thereafter collective organization would be hard to sustain. Goulagou, by contrast, concluded the project could be continued on individuals' fields through collective action so long as each got catchments he was entitled to in the same year as everyone else. Asking some to wait another year for their turn was

seen as placing too great a strain on collective organization. Gourga saw individualistic activity as distinctly inferior to collective continuation on private fields. Rapougouma and Gondologo, finally, saw no sense in continuing with collective action beyond the experimental stage (Rapougouma) or "the present (Gondologo).

11. Can the Project be improved, e.g., by integrating other soil erosion control measures, introducing local nurseries, etc.? Responses here were cautious, a continuation of the "wait and see" attitude referred to above. Nobody volunteered suggestions. Some communities agreed a local nursery "might be nice", but discussion generally concluded individuals could either acquire sufficient seedlings from local natural regeneration or could raise what they needed in individual nurseries sited in residential wash areas. Several individuals reported they already raise papaya trees at home in this manner.

Officials

"Interested but cautious" would sum up the range of responses. Most are - reasonably - waiting to see what outcomes look like after a year or two of project operation. Few appear to spontaneously grasp the experimental character of the undertaking or the necessity of building that in as an indispensable part of future operations. Similarly, few have any sense of the project's value in promoting locally-autonomous environmental management operations. Instead, they seem by and large (With the exception of PCV Jonathon Landeck and PCD James Seyler, and the probable

exception of Director General of the Environment Ouedraogo Sylvestre) to be searching for a "package" technique which can be promoted by a top-down approach (extension efforts emphasizing respect for a specific catchment "formula" rather than for experimentation, and coupled with externally-financed inputs, particularly fencing but foodstuffs as well).

Officials justify their insistence on fencing support by reference to the already denuded Yatenga environment. They argue individual or perimeter fencing of catchments using traditional materials (thorn and thornless branches, etc.) will strip the landscape of already established vegetation to try to generate more by an as yet unproven technique. This critique may be valid under certain circumstances, i.e., when a particular area really is practically bare of ground cover (some areas in Yatenga begin to approximate this condition), and when slow-growing species are abusively cut back. On the other hand, some shrub species in particular, but some tree species as well, both grow rapidly and thrive on selective trimming.⁵ Area residents can be trusted to know these species characteristics.

If catchments demonstrate their usefulness., they will open up vital possibilities for autonomous, local-level reforestation which will be seriously undermined if extension depends on externally-provided fencing. This represents a potential threat to local-level diffusion - of critical importance if sustained yield management of the Sahelian Woodstock is ever to become a reality. This threat must not be underestimated in future

assessments of appropriate extension measures should the technique prove successful.

The same holds true for purchasing participation in micro-catchment experiments through provision of food aid or direct payments: the threat to self-sustaining propagation is again great. It must be counteracted by demonstrating to officials that micro-catchments can spread on their own merits, given only village organizational frameworks through which to introduce and multiply them.

Presenting micro-catchments as a package rather than as a reforestation procedure always requiring local adaptation is perhaps even more pernicious than tying extension to externally-financed inputs. As already argued, variables involved and potential combinations thereof are too complex to permit single-minded-simple-minded application.

Officials seem interested in micro-catchments but will probably themselves require much education before they comprehend the essence of the concept, and dangers inherent in their misconceptions. Moreover, officials now committed to inappropriate extension strategies may be so despite perfect comprehension of arguments favoring local autonomy and much personal experience with development activities. Their preferred options may reflect pressures to spend money or to acquire control over resources which will strengthen existing bureaucratic positions. Where such is the case their perceptions are unlikely to be modified by argument since for them, such perceptions are the right ones regardless

of their negative impact on environmental management potential in the Sahel. Caveat OXFAM.

Since the technique has not been proven yet, few officials have moved to plan how it might be integrated into existing programs. But ORD extension networks will likely be perceived as obvious vehicles by Africare and ORD/Yat. The Environmental Service also indicates willingness to incorporate micro-catchment operations as part of their own field-level activity; this would certainly fit with formal plans to convert field agents from forest guards engaged mainly in policing to extension workers able to provide valuable new reforestation information to interested peasants.

Some Implications

Micro-Catchments and Environmental Management

The vital importance of local autonomy in Sahelian reforestation activities arises from three basic causes:

1. variable climate (especially spacing and amount of annual rainfall;
2. variability of soils; and
3. variability of human communities superimposed on the soil; different to begin with, they change and evolve, as do sizes of herds they hold and their arrangements to keep them.

Local Sahelian environments vary greatly. Many are experiencing rapid evolution - not a lot of it good in the sense of improving chances that local places can go on supporting current

populations indefinitely. This kaleidoscopic variability imposes a major and powerful constraint, often underestimated, on any plan to centrally manage the Sahelian environment, either on a state-by-state basis or on some sub-state, regional basis.

Most or all Sahelian milieux of course share some common characteristics: generalized aridity, unpredictable rainfall, low standards of living, etc. But any reforestation strategy's margin of success or failure lies unquestionably in how effectively it accommodates local differences embedded in the background of these commonalities.

It requires little brilliance and less courage to say no one strategy will work everywhere. What will succeed in any village setting cannot, repeat cannot, be known before trial and error tests permit assessment of specific strategies to put trees on local land. Remote sensing can help, as can better information gathered across the range of environments about "appropriate technical packages" in the context of specific settings. But before that information can improve odds for successful reforestation anywhere, it must be made available to those who do site preparation, planting and subsequent care. The information must be comprehensible to peasants. But even if it is, it will only be useful if forestry rules as locally applied create incentives for peasants to do reforestation and other forms of environmental management.

Communication systems in this as in other parts of the Fourth World, analysts never tire of remarking, are notoriously

poor. Physical infrastructures - practicable roads and low-cost telecommunications - are being created but are thus far largely urban and interurban developments. They will not much modify realities of contact with many rural places for years to come.

Furthermore, human infrastructures often aren't there to exploit new opportunities created by physical advances. Efficient coordination necessary to operationalize plans by increasing central control over events requires highly trained personnel. But training alone will not suffice, even if it can be provided. To enhance central control technicians must work within institutions which provide them strong and unambiguous incentives to do the coordination jobs which flow from the plans.

People are being trained to man "development" bureaucracies: ministries, agencies and state or quasi-public companies charged with implementing national, or regional, or departmental, or other, smaller-scale plans. But everyone recognizes the paucity of qualified cadres at sub-national levels throughout much of the rural Sahel. Moreover, the existing institutions often do not create incentives necessary to insure civil servants will really serve their formal clientele, the populations, rural as well as urban, of Sahelian states.

The result - fitful starts of "development" interspersed with long periods of inactivity, ineffective or counter-productive actions - imposes a serious constraint on the problem at hand, Sahelian reforestation. Centralized efforts to mobilize popular support for putting trees back on the landscape will likely be

under-manned. They will tend to discourage villagers' interest by unreliable performance. For various reasons they will probably also fail to engage villagers' creative potential.

These two constraints - extreme environmental variability across space and through time, and low capacity to impose productive central control on that variability - establish a presumption in favor of bottom-up organizational strategies in the area of environmental management.

Costs of Solutions

When people have authority to break a problem down to its lowest common denominator, so to speak., to organize solutions involving only persons affected by the issue, costs of action will usually drop off. Assuming most people in the group are similarly affected, they share a common incentive to do something about the problem when it gets serious enough. Therefore costs of achieving consensus are lowered, and informal policing to encourage behavior required by the solution will more likely occur.

Small groups have a distinct advantage in this sense, because their information costs are substantially lower than those experienced by large groups. People in small voluntary groups with high rates of interaction usually know more exactly what other group members are doing than do those in large groups. Other things equal, they can more easily enforce respect for regulations by informal social pressure brought to bear on members

by members.⁶ In large voluntary groups, by contrast, non-compliance is easier because social control mechanisms function less effectively. Then when one or a few people refuse to abide by common arrangements, pressuring them to conform becomes very hard. If short-term incentives to break rules outweigh short-term incentives to observe them, controls will break down. Eventually even committed supporters will concede defeat, breaking rules because observing them costs and/or money now, seems hopeless in light of others' defiance, and costs of ignoring them are more remote.

An obvious way to avoid this dilemma is to authorize groups concerned to legitimately force violators, in accord with fixed procedures, to comply with rules or suffer penalties. But most Sahelian villages can not now do this. Rule enforcement is typically a prerogative of civil servants down to bottom echelons of the national administration, e.g., subprefects, gendarmes, etc. But if administrators have difficulty getting to villages, conversely villagers facing problems solveable under current legislation only by administrators often have difficulty getting to the latter. Frequently long, hard distances must be traversed, and since decision-making centers are few - often a single administrative post for several hundred thousand people living in hundreds of separate villages - access to decision makers is almost always rationed. Rare are those who go right in to see a subprefect. Petitioners may pass a full day or two in line waiting to see an official for an indispensable decision. Costs of waiting

mount up and not infrequently, discourage people. They conclude the candle of environmental management isn't worth the game required to get it.

While local autonomy is no panacea for this problem, anything strengthening local-level informal organization (including formal local autonomy] will enhance capacity to confront and resolve problems by reducing costs of action necessary to sustain reforestation efforts.

Micro-catchment experiments in Yatenga can strengthen local organizations by giving them meaningful, feasible activity. Such experiments can be started by any outsider who has a little knowledge of forestry, a bit of organizational skill, contact with villagers, can grasp the scientific method (controlled trials, errors and successes accurately noted on a regular basis as tests of hypotheses about workable solutions to problems - here, of reforestation), and is willing to use a little initiative in starting experiments and involving people in some framework of local organization. Volunteers from a number of countries, technical assistants, civil servants, local businessmen and simple peasants have all demonstrated these qualities.

Once the project is operational, the idea can be spread by informal extension techniques. If villagers can operate their own nurseries, as limited reports suggest they can, then individual villagers or village groups can run their own experiments with micro-catchments, and gradually define the right "package" of (1) catchment size and shape, (2) planting dates, (3) species

combinations and (4) protection procedures which will work on this or that field under their control in light of its soil and site characteristics. Information sharing within and between communities can cut experimentation costs by excluding some hypotheses about possible combinations of these variables on the basis of failures under similar circumstances elsewhere.

The basic need for experimentation will persist, however, the more so if villagers succeed in reversing environmental degradation so that new opportunities become available.

Organizational Scale

When larger-scale organizations are unnecessary, they should be avoided. But when is that? Very briefly, one can say domain and scope of any problem help determine appropriate scale.

Domain defines the geographical area within which the problem can be localized. Trees, for instance, can be grown in many parts of the Sahel by families or quarter groups using micro-catchment techniques. By starting enough small groups or families on tree-planting projects, the entire Sahel can in principle be reforested.

But livestock controls - and possibilities of controlling overgrazing - may involve quite another order of organization. In principle, each family or quarter could control its own animals. However, local rules let animals roam freely during the dry season, making it difficult to exclude others' livestock from "controlled"

areas. Transhumant herds passing through the area may further complicate things. Effective grazing controls probably imply a series of organizations, ranging from extremely local to a unit much more extensive in domain.

Scope concerns people affected by a problem. Grazing controls to protect reforestation efforts must go beyond the village community to encompass a much wider group of people. Some - local herders - will be continuously involved in the problem, others only intermittently so when their herds pass through a controlled area. This suggests the changing scale of problems facing those interested in Sahelian reforestation. Local autonomy, for reasons now to be set out, seems indispensable to solving many of these.

Is one local level more appropriate than another? Should effort focus on nuclear or extended families, lineages localized in single quarters, quarter groupings or entire villages or, at the other extreme of local organization, village federations? No pat answer can be automatically recommended. Conditions, of local organization are as complex as local soil and climate environments. They demand the same detailed attention in tailoring appropriate fits to locally-varied circumstances as do technical solutions to reforestation. There is no reason to expect a single scale of organization - e.g., the village or the family - will work everywhere and for each form of environmental management problem. Any one solution will probably work at some times, in some settings, when it happens to happen that the solution blindly accommodates

constraints inherent in the problem. But in most other cases, just like trees imperfectly adapted, local reforestation efforts will be stunted or die because costs of a particular solution will outweigh perceived benefits to be derived from it. Villagers can estimate total costs to them of an activity at least as well as any outsider. Unless one assumes they are irrational, they can be expected to withdraw from activities which do not promise to leave them better off.

Any organizational effort involves costs. It may also involve benefits. Distribution of benefits will obviously shape particular individuals' assessments of what collective action is worth to them. The problem then becomes rigging organizational structures so participation appears attractive to as many potential members as can be expected to usefully participate.

The last sentence requires elaboration. We're seeking appropriate scales on which to organize local activities. In principle, there is a right size for each. It can be thought of as the break point where addition of another person begins to reduce rewards of the activity because costs of securing his adherence outweigh benefits he contributes to the group enterprise.

An example may clarify the point. A project proposes to promote village-level reforestation. The organizational question is "what scale?" Shouldn't the village do the project as a unit? Not necessarily.

First, what is the scale implicit in the project itself? Can it be handled by nuclear families on individual peasants' fields?

To answer this one must know labor inputs required for site preparation, planting and protection. If techniques employed permit single adults to plant trees without outside assistance, family operations are indicated on that score. If protection is not a problem, families seem appropriate units. If it is a problem, and economies of scale can be realized by fencing larger areas, then assuming land tenure rules make site acquisitions possible, supra-nuclear family units offer a lower-cost solution.. But how "supra"? Will extended families do? What about quarters? Groups of quarters? Or entire villages? And so on.

These question all have quite specific local answers, shaped by rates of interaction and levels of consensus within and between various units. "Working rules" of these units govern group-controlled conduct and individuals' areas of freedom. As a practical matter these arrangements can probably only be found by local political entrepreneurs. This appears likely if one assumes such organizations must be developed throughout the Sahel in almost all villages to assure reforestation. No outside organization, national or international, could finance the sort of detailed, on-the-ground explorations to produce required information which local people already possess. Thus it is cheaper and more efficient to allow villagers a range of options, and freedom to experiment with new forms and processes of reforestation if they so choose. Data from the five-village investigation undertaken for this report amply confirm this proposition (pp. 21-22).

Second, do villages ever function as units? If so, residents may have prior experience with village-wide organizations. It is important to know, in turn, for what purposes such organizations have functioned. Are village leadership elites clearly identified, or will organizing things at that scale unleash protracted infighting as political entrepreneurs struggle for control of reforestation operations (Goulagou)? Can those struggles be expected to frustrate activity while they last? Perhaps villages then aren't the best units? (Barelogo I and II provide cases in point.)

Third, are there other levels of organization within communities which are (1) competent and (2) authorized to tackle the job? If so, what are they?

Fourth, if reforestation is a new activity, can leadership authority be transferred from one or more traditional activities to the new enterprise, so pre-existing expectations about how organizations will run can be "imported" to the new arena of activity? Here again, it may be relatively cheap to start the operation on that scale. If not, some people are going to have to learn how to lead in the new arena. This involves establishing authority to do so (the problem in Rapougouma?). Consensus building typically takes time, and is often costly. Too costly?

In organization as in research efforts for adapted reforestation species and techniques, potential costs can in principle be expected to fall at first as the scale of operations increases and the domain controlled grows in size. Eventually, returns to

scale will be exhausted. But this ideal curve may be modified sharply by communications difficulties already discussed.

Expected returns to scale may never be realized if larger-scale organizations fail to make the right research information available to the right parties at the right time.

Social Control for Environmental Management

In terms of organization, one must also pay attention to costs of social control in most Sahelian contexts. Where traditional hierarchies are still respected - some communities in Yatenga - much activity can be funnelled through such forms at low cost if leaders are interested in cooperating and promoting. But a nuanced approach would draw attention particularly to limits of social control.

Individuals whose authority is respected within their own families or quarters may not exercise much sway over other village quarters. Where that is so, expanding scale of reforestation efforts from family or quarter levels, where they may be quite feasible, to an entire village, may simply frustrate the project because required control structures do not exist at that level. The same may be true of efforts to go from village to village federations: the control structure operational at one level may be much weaker or non-existent at the higher level.

Concern has been expressed in some quarters about advocating techniques - in this case, the micro-catchment concept - before they have demonstrated high success rates. While ill-suited

techniques - solar cookers which heat cooks more than porridge? - are clearly silly expenditures of time and money and a waste of peasants' good will, micro-catchments give sufficient promise of feasibility that they can be advocated in perfect good faith... if, each time, the message is clearly communicated that the idea is no more foolproof than any other hypothesis, and that its successful application implies, indeed requires, a continuous process of experimentation. Such experiments, like any other scientific experiments, are attempts to understand relations... in this case, what form of reforestation will work in any particular villagers or farmer's environment.

Experiments always involve risks of failure. They also involve possibilities of success, which is often rewarding emotionally as well as economically. Those who want to push local, autonomous participation in Sahelian environmental management, particularly in reforestation, need to be sensitive to this aspect of experimentation. The villager who tries out the idea and has some success with it, like village gardeners before him who did vegetables or fruit trees by learning the necessary techniques and then taking the irreducible risks involved in farming, is likely to develop a certain sense of commitment to the idea of reforestation. After all, he was the one who did it on his own land. Or his quarter did it, or his village. The act of taking responsibility not infrequently generates a taste for responsibility...which is likely to be an important factor influencing outcomes of struggles for environmental management in the Sahel.

Recommendations

From the foregoing discussion and data flow certain specific recommendations.

1. The "barefoot science" aspects of micro-catchment operations must always be kept up front, both in dealings with peasant practitioners and in promoting propagation of the program via development agencies other than OXFAM.

Village or individual demonstration plots should be designed to expose villagers from the very first to a range of possible catchment dimensions and shapes, as well as sites, fencing types, planting times and species mixes. Peasants should be invited to make comparisons and to suggest adaptations which seem appropriate to them in light of their local knowledge. Villages where the most "scientific" approach to catchment construction was noted (Goulagou, Barelogo I and II) were exactly those villages initially exposed to a range of possibilities. They realized from the start that no solution was perfect, that trial and error would be the essence of the game if guided by an informed series of hypotheses about what would and wouldn't go locally. Two new villages included in the 1980 project operations have demonstrated an interest in scientific aspects of the problem immediately, and the Project director has properly encouraged this attitude wherever possible.

It would appear appropriate to gather as much data as possible to test this assertion. If it stands the test of experience, then

discussions about extension with other organizations should heavily emphasize the indispensable, integral role of experimentation in appropriately adapting catchments. The fact that OXFAM personnel now involved with the project are extremely sensitive to this aspect, whereas other officials interviewed did not find the point self-evident justifies a continuing OXFAM role to preclude the probable "derailment" of the experimental orientation by set-piece solutions. This appears likely if other organizations move into the gap a precipitous OXFAM withdrawal would leave.

2. OXFAM should plan on supporting the project as a joint experiment/extension operation over the next five years.

This extended period of support is necessary for the simple reason that trees grow slowly while people have a tendency to jump to conclusions. Most officials and most peasants have expressed caution about the value of the project, not yet even through its first year. Reasonable success in the summer of 1980 will likely lead to a bandwagon effect. This need not be discouraged, but someone should take responsibility for continuous monitoring and establishment of longer timeframe data series as a basic tool for later evaluations.

3. The micro-catchment project requires qualified personnel to accomplish these tasks of experimentation and extension, and the associated job of public relations/on-site teaching.

Micro-catchments are no longer a one-person show in Yatenga. The operation requires a varied though small staff. Included

should be the following (all of whom should share responsibility for building the scientific base of the project):

- a. a project coordinator competent in public relations (contact with Voltaic organizations and individuals, governmental and private, who might influence project success and extension possibilities if the technique proves worthwhile), able to read and write respectable French and versed in forestry and environmental problems and micro-catchment techniques to the extent that discussions with outsiders can be handled with authority;
- b. a field agent capable of working in the Mossi language, familiar with Yatenga forestry and environmental problems, and able to train extension workers employed either by OXFAM or other organizations;
- c. up to three extension workers responsible for carrying the OXFAM version of micro-catchment technology (experimental; locally-autonomous operations) into other parts of Yatenga as well as (eventually) the rest of Sahelien Upper Volta; and
- d. support personnel (chauffeurs, secretary and main d'oeuvres).

Materials (mainly vehicles, but possibly hand tools and some fencing as well) must also be provided.

4. To spread the OXFAM (supple) version of micro-catchment techniques the project should be prepared to (a) deal with as many other organizations as possible and (b) provide short-course training sessions which will help impress on potential extension agents why's, and how's of the scientific, experimental orientation

to catchment technology.

By working with many organizations OXFAM will reduce probabilities of any one (ORD?) gaining exclusive control of the operation. This will increase likelihood a variety of approaches will be adopted, encouraging competition and continuing experimentation. This in turn should improve OXFAM's chances of retaining residual authority over micro-catchment strategy in the area and its capacity to dissuade less desirable approaches and promote those deemed supportive of continuing experimentation by locally-autonomous units.

The potential range of organizations which might become involved in catchment extension includes confessional communities (Islamic, Catholic, Protestant), the Environmental Service, ORD of Yatenga through its extension workers (drawing probably on Africare support services) "6S" units, youth groups, CFJA, and Fonds de Développement Rural projects as well as French, American and other volunteer foresters and water environmental management specialists. CILSS also offers a potential framework for inter-state contacts and communication.

Providing training sessions for other organizations' personnel cannot guarantee the scientific orientation will be respected and material, food and money hand-outs reduced to a minimum. However, it improves chances of these outcomes, particularly if the scientific monitoring side of OXFAM's operation can generate data from repeated experiments which validate importance of experimentation and local autonomy.

Footnotes

¹The Project director comments rocks are usually not necessary as a component of catchment dikes and where they are, villages can usually supply transport. Clearly, transportation may be no problem in village collective projects where resources are pooled. But a great many Yatenga farmers lack means to transport large amounts of rock over long distances. Lack of rocks near steep sites may thus partially constrain extension of the project in areas where farmers construct catchments on an individual basis.

²Short term consultancies of the sort on which this report is based can produce quite useful information. But peasant reticence about outsiders as well as other factors cited usually reduce data quality below that obtainable through more extended field research. While this will be obvious to most readers, the caveat about information quality is included in the text on the assumption that this report like any other will find at least one unwary reader. Comments already tendered concerning this report amply confirm validity of that assumption.

³The Project director comments that the total was 178 trees, not 130. Figures cited in the text were provided by the Barelogo I president.

⁴This was true even in "recalcitrant" Gondologo, the village located closest to Ouahigouya. Gondologo people had earlier complained about a lack of wood for collective plot fence poles, but conceded they could still find wood to enclose trees on their own fields.

⁵The Project director pointed out the fallacy of a blanket condemnation of cutting existing vegetation to protect new growth in catchments: "...cutting a branch or many branches from a tree or shrub does not kill the plant and has only negligible effect on the root system. The critique [i.e., that it is short-sighted to cut existing shrubs to protect catchment trees] is, thus, not well founded." While this rejoinder does not address issues of overall ground cover and growth rates of various species, the point is certainly well taken - particularly in light of the risks noted in the text of dependence for fencing on outside donors.

⁶Other things will likely not be equal. Political power is a complex phenomenon. Local individuals who hold administrative or political offices, well-to-do peasants and others may all be able to influence play of the game locally. Often this is used to justify establishing control over local political arenas on grounds that outsiders are likely to be impartial. Quite as often they

[fn. 6 con't.] turn out to be not impartial but merely more powerful - and therefore more difficult for local villagers to control if they engage in abuses of power. While it would be nice to have both recourses - local and outside - in cases of questionable uses of power, there seems to me to be no presumption favoring outside over local control at this point.