SOCIAL IMPACT OF

THE TANGAYE (UPPER VOLTA) SOLAR ENERGY DEMONSTRATION:

A SUMMARY REPORT

Allen F. Roberts, PhD.

The Michigan Society of Fellows
Department of Anthropology
Center for Afroamerican and African Studies
University of Michigan
Ann Arbor, MI 48109

Submitted to the U.S. Agency for International Development, Office of African Development Resources/Sahel, in partial fulfillment of purchase-order number AID/afr-0000-00-1045-00, 30 July 1981.

TABLE OF CONTENTS

I. A SUMMARY REPORT OF EVALUATIONS OF THE TANGAYE SOLAR ENERGY DEMONSTRATION. 1

I.A. SUMMARY DESCRIPTION OF ORIGINS AND HISTORY OF PROJECT . . . 1

I.B. SUMMARY DESCRIPTION OF THE PHYSICAL AND TECHNICAL CHARACTERISTICS OF THE PROJECT 3

I.C. SUMMARY OF BASELINE STUDY PREPARED IN ADVANCE OF PROJECT INITIATION 4

I.D. SUMMARY OF CONTRACTOR'S INITIAL AND FINAL EVALUATIONS OF PROJECT 5

I.D.1. THE MID-TERM STUDY 5

I.D.2. THE FINAL STUDY 6

II. MAJOR SOCIO-ECONOMIC IMPACTS OF THE PROJECT 6

II.A. WATER USE 6

II.B. MILL USE 12

II.C. IMPACT OF THE PROJECT UPON WOMEN AND HOW THEY USE "RELEASED TIME". 17

II.C.1. THE SOLAR-POWERED WATER PUMP. 17

II.C.2. THE SOLAR-POWERED GRAIN MILL 17

II.C.2.a. UNDERLYING ASSUMPTIONS 17

II.c.2.b. TIME FREED BY MILL USE 19

II.c.2.c. HOW FREED TIME MAY BE SPENT 20

I.c.2.d. OTHER CONSIDERATIONS 22

III.A. HOW VILLAGE ORGANIZED TO MANAGE AND OPERATE THE PROJECT 22

III.B. HOW MILL EARNINGS WERE DISTRIBUTED 25

IV. OTHER FINDINGS 25

IV.A. EXPANSION OF THE STATION 25

IV.B. POSITIVE SPIN-OFFS: "DEVELOPMENT BREEDS DEVELOPMENT" 26

IV.C. THE FUTURE OF MANAGEMENT 27

IV.D. THE PARADOX OF DEVELOPMENT: THE TANGAYE CASE 28

TABLE OF CONTENTS (cont'd)

V. RECOMMENDATIONS 29

V.A. WHICH APPLICATIONS APPEAR MOST PROMISING? 29

V.B. LESSONS AND RECOMMENDATIONS REGARDING IMPACT OF THE PROJECT 31

V.C. PLANNING AND INTRODUCING TECHNOLOGY 32

V.C.1. INTRODUCING THE TECHNOLOGY 33

V.C.2. LOCAL MANAGEMENT VERSUS AN OUTSIDER AS STATION MANAGER 34

V.C.3. WOMEN AND MEN IN MANAGEMENT 34

V.D. RESEARCH AND EVALUATION METHODOLOGY 35

V.D.1. THE BASELINE STUDY 35

V.D.2. MID-TERM RESEARCH 36

V.E. OTHER POINTS 36

WORKS CITED 38

I. A SUMMARY REPORT OF EVALUATIONS OF THE TANGAYE SOLAR ENERGY DEMONSTRATION

The report to follow is a summary of three major field research papers (Hemmings 1978, Roberts 1979 and 1980), with reference made to a number of supporting memoranda and secondary reports. In any summary, declarative sentences must be substituted for lengthy discussion of qualifications; as a consequence, grey results are sometimes presented in a black-and-white fashion. It is requested that the nature of the present report be respected for the summary it is, and that the longer, more detailed documents be consulted before conclusions are drawn or plans made on its basis.

I.A. SUMMARY DESCRIPTION OF ORIGINS AND HISTORY OF PROJECT

The global energy crisis of 1973 dealt Lesser-Developed Countries (LDCs) a staggering blow from which most are still reeling. In the spring of 1974, Secretary Kissinger pledged before a U.N. Special Assembly to make available to LDCs the results and benefits of energy research and development in the U.S. In the course of discussions in February 1975, from which a "Strategy for AID Action on Energy" was produced, it was acknowledged that insufficient data concerning the interaction of energy and development was at hand. TAB was mandated to conduct regional studies to better understand fundamental "energy constraints to progress" (Bosken 1976: 4). At the same time, Congress amended the Foreign Assistance Act of 1961 to reflect American recognition of and sympathy for LDCs' version of the energy crisis, and our intention to study with the LDCs the extent of their plight and possible solutions from innovative technology. TAB chose to focus attention on determining the nature of "energy required to produce, distribute and prepare basic foods" in order to provide specific information that might be fed into immediate and direct applications by AID missions (ibid., 5-6).

The basic assumption underlying "Energy Needs in the Food System" (the TAB research project) was that energy utilization should be made more efficient and more abundant to food production and processing, as a primary means of approach to a wide array of related problems. The particular studies undertaken from the umbrella of this research program would seek "to identify any social and institutional factors that contribute to energy usage in the food chain and that, if proper changes occur, could be expected to have a major impact on improved energy usage and conservation" (ibid., 13). The Tangaye (Upper Volta) Solar Energy Demonstration would be one of four pilot studies worldwide, and would first address specific issues of women's allocation of time to food preparation, then once a "dependable source of power and the necessary implements to perform selected tasks such as grain grinding and water drawing" had been provided, modification of women's time and energy expenditures would be examined. AID/Ouagadougou was particularly interested in a study of this sort, as an important component to its on-going integrated rural development project with the Voltaic Regional Development Organization (ORD). This field study would not be "designed to test any particular energy source or to prove the cost effectiveness of any conversion technique," but rather its sole intent would be "to determine the social effects and the resulting economic effects to be expected if a reliable energy supply were available to perform specific tasks" (Bosken 1976: 23).

In the two years between formulation of the TAB project and of the Tangaye PID, other research interests were introduced. In April of 1976, AID received a proposal from the NASA Lewis Research Center (NASA LeRC) soliciting interest in an ERDA/NASA Photovoltaic Tests and Applications Project; the Tangaye project was a perfect opportunity for collaborative research. In mid 1977 the inter-agency accords were formalized (NASA LeRC 1977: 1-2). The AID Alternative Energy Technology Development Program would place emphasis on "programs of research, development, and use of small-scale, decentralized, renewable energy sources for rural areas . . . as an integral part of overall development efforts." As "a secondary goal the social and economic effects of replacing tedious manual labor in remote villages of developing countries with an alternate energy source" would be studied (ibid., 2-3, emphasis added).

The Tangaye PID reflected this shift in its very first sentence (Meyer 1978). This is worthy of note only because as the project evolved, some have understood the new first part of the strategy (the potential of solar energy) to have greater significance than the new second part (social and economic impact). The Tangaye Demonstration has proven important to an on-going program of photovoltaic technology development; but his should not overshadow its primary goal of social-science research.

Grace Hemmings (a graduate student of the Yale University Department of Anthropology already in eastern Upper Volta for three years conducting predoctoral fieldwork) was engaged by AID/Ouagadougou and began a baseline study at Tangaye in January, 1978. Her five-month field study was completed in the summer of the same year. Consultants from Practical Concepts Incorporated produced a paper, "Evaluation Planning for the Tangaye Solar Energy Demonstration" (Burrill and Popper 1978) in the fall; and Hemmings' "Base-line Study for Socioeconomic Evaluation of Tangaye Solar Installation" was submitted sometime thereafter.

NASA LeRC staff began installation of the photovoltaic power system at Tangaye in late January, 1979; by mid-February, the pump, mill and control system were operational. "Training" of villagers destined to assume management responsibilities for the station was accomplished over the weekend of February 27-8, and the system began functioning on March first. On March 29th, the Prime Minister of Upper Volta and many other Voltaic and American dignitaries came to Tangaye for the project's dedication.

The present author - an assistant professor of Anthropology and African Studies at the University of Michigan - conducted a mid-term assessment of the project in October of 1979, and a final social-impact evaluation over three months of the next summer. The formal demonstraton came to a close at the end of the summer of 1980, and responsibility for the facilities at Tangaye was handed over to the Voltaic Rural Engineering Authority (H.E.R.). However, for various reasons it was agreed among AID, NASA and the Voltaic government that NASA LeRC would provide two years' further technical and management support at Tangaye. As a component of the NASA LeRC Photovoltaic Development Support Program, an unsolicited grant was awarded to the present author to study "Social Aspects of Photovoltaic Applications" over eighteen months (1981 till November 1982); certain data from the research period (Fall 197 summer 1980) tangential to the concerns of the above mentioned reports, will receive consideration.

I.B. SUMMARY DESCRIPTION OF THE PHYSICAL AND TECHNICAL CHARACTERISTICS OF THE PROJECT

The "station" at Tangaye consists of a fenced-in array; a pump atop a cemented well; a large red water storage tank on a sturdy locally-fabricated support, with spigots underneath; a long building with mill and control cabinets in one room, the batteries in another; a second building facing, with one room for storage and another inhabited by the station manager; and a 2 1/2-room house behind the mill building, where the project anthropologist lived and which will be dedicated to some village-chosen community activity in future.

An array of 120 direct-current voltage (VDC) photovoltaic cells with a 1.8kW (peak) electrical output and 540 ampere hours of battery storage, combined with regulator, controls and instrumentation, was designed by the NASA Lewis Research Center. The array is within a protective fence, and power is conducted to a control cabinet via underground cable. Storage batteries are housed in a secure room; power is dispensed to the water pump by underground cable. A positive-displacement pump with a 1/4 hp, 120 VDC motor, can deliver 1457 liters/hour at a total dynamic head of 28 meters (92 feet). The improved well is not this deep (with a total head of about 8.5 meters), and motor current requirements have been lowered proportionately, allowing wat er-pumping to exceed design expectations by almost 75% (Ratajczak 1979). As of October 12, 1980, 4,623,000 litres had been pumped, in 3,700 hours of pumping. Water pumped from the well is stored in a metal tank made in Ouagadougou; a sensor within the tank automatically turns the pump on or off according to water level. The pump's being liked to storage batteries means that even in the dry season when demands are greatest and the water table at its lowest, pumping can continue throughout the night to accommodate villagers. Four spigots provide water.

A first burr mill was deemed inadequate, and replaced by a commercially-available hammer mill. As of October 12, 1980, 36,138 kg of grain had been ground over about one thousand grinding hours, this despite some difficulties with the PV system. By mid 1980, in 30% of the modules at Tangaye "thermal stress induced fatigue cracking of cell electrical interconnects due to an inappropriate choice of module substrate material" (Bifano 1981). Affected modules were replaced in September, 1980, and the system brought back to expected power; this had been a slow diminution, and never an abrupt interruption of power. With the approval of AID/Washington, in May of 1981 NASA LeRC staff oversaw the replacement and increase of modules in the Tangaye array, increasing peak power from 1.8 to 3.6 kW (peak). The hammer mill was also replaced with one more efficient.

The PV power system at Tangaye, despite the above-mentioned difficulty, has had on-line record of 96%. In other words, despite the diminished electrical output due to some modules misfunctioning, the system continued to work. According to NASA LeRC figures, the pump ran 96% of the time (i.e. was hardly effected at all) while the mill did 89% of the time, although for a reduced number of milling hours during the aforementioned weeks. Overall, NASA's experience has been that with twenty experimental terrestrial PV applications installed since 1976, more than half the modules have had less than a one-percent failure rate. "Outage rates for PV systems are generally lower than for U.S. central station electric utility power, and considerably lower than for electric utility in many developing countries" (Bifano 1981).

Data was collected by NASA LeRC both manually (by the station manager) and automatically through data logging devices. The manager recorded daily system data, daily water-pumping and milling data, and monthly solar cell panel (series string) data; the logging device sampled system data every twenty seconds and recorded hourly accumulations and averages on magnetic tape. This information, forwarded to Cleveland, was continuously reviewed by NASA LeRC personnel to identify potential difficulties. Planning for PV applications now in train has been upon the basis of this first-of-a-kind set of experiments.

I.C. SUMMARY OF BASELINE STUDY PREPARED IN ADVANCE OF PROJECT INITIATION

Grace Hemmings' eighty-seven page baseline study contains a wealth of data. Some is readily useful, some difficult to understand or inaccessible. As in any experiment or research project, difficulties encountered in formulating and implementing methodological strategy, once identified, become positive results of the effort - that is, shortcomings or pitfalls may be avoided in future work on the basis of past experience. Criticism of Hemmings' report in later evaluations should be considered in this light.

Of greatest use are discussions of the following:

a. the nature of village activity according to climatic, hence agricultural seasons. An understanding of such cycles should guide planners in their implementation of this and other projects in the region.

b. available water, the sorts of wells, who digs them and who is permitted access to them thereafter. Interesting social considerations include the kin-based responsibility for and use of particular wells, and the striking division between wells dug by and for male cattle herders, and shallow ones women may make. Conflicts arise between herders and women when water becomes scarce; women may be reduced to purloining water during moments the wells are left unguarded. Women's wearisome dry-season chore of fetching water, sometimes in the dead of night when competition is reduced, or their waiting long moments while water drips into vessels, is nicely illustrated.

c. food production and seasonal patterns of its preparation and consumption. The uses of various grains, and how each is prepared, are discussed.

d. diesel mills in the region surrounding Tangaye, their management and maintenance. The high cost of parts and maintenance, and the frequent down time of these privately-owned mills is made explicit. Mill activities are portrayed.

Ten pages of the report are devoted to a mill management plan, including suggestions made by Voltaic extension agents and an American counterpart, and others by Hemmings. The difficulties and lack of direction of existing women's co-operatives are outlined, as is the little enthusiasm they seem to generate. Finally, a research strategy for mid-term and final assessments is devised and sample questionnaires presented. This is the briefest section of the paper (1 1/2 pages), when the preceding sixty should have been building to its conclusion. Left unsaid are most of the assumptions which might allow easy replication of the author's preliminary surveys.

I.D. SUMMARY OF CONTRACTOR'S INITIAL AND FINAL EVALUATIONS OF PROJECT

I.D.1. The Mid-Term Study

A mid-term evaluation was conducted through three weeks' fieldwork by the present author, and a fifty-page report produced (Roberts 1979). By October of 1979, the station power system had run about seven months, and its effects were already apparent. During the most critical dry-season months (just after the solar-powered pump became operational), many people immediately exploited the more dependable and convenient station water system, and some shallow wells were said to be abandoned. The observation that in October when water was plentiful from the rains just ended, women would walk past the station tank to draw water from stream-side pits, led to an investigation of cultural preferences for water from streams versus wells.

The mill had been beset with a number of operational difficulties, and these led to some misunderstandings among villagers concerning the availability and nature of milling services. It was too soon to detect how much time might be freed for women using the mill rather than stone-grinding their flour, but suggestions were offered as to what they might be doing, or would once milling services became regularly available. The size and time given to kitchen gardens were expected to be increased by those using the mill (although it was later discovered that impressions gained from the central Voltaic ethnographic literature had led to an overemphasis of the importance to kitchen gardens in Tangaye). Producing for and participating in local markets - a social institution the importance of which transcends the mere economic - might be increased for women, as would opportunities for beer-brewing (again, an activity at the hub of most political, religious and social interactions).

The evolution of management was studied, as were the background, capacities and participation of the chief and his traditional political assistants, the station co-operative and its president, and the station manager. Divergences between the propositions for extensive management training outlined by Hemmings, and what did occur in a single brief organizational meeting attended by AID staff, were discussed, as were possible ramifications. Vignettes of management functioning (recognizing and solving problems) were presented; so was the difficulty villagers were experiencing in comprehending to what degree they were expected to assume responsibility for station maintenance.

Methodology for the months of research to follow the mid-term visit was outlined in nine pages. This included a discussion of the researcher's difficulties in interpreting data from the baseline study, and in understanding the inherited research assumptions and strategies. Questionnaires devised by Hemmings were left virtually unchanged, that the Voltaic research assistants (one of whom had worked with her) might have as little trouble as possible in understanding their purpose and implementation.

Other issues broached included a follow-up of an observation by NASA staff that people were building new houses around the station; would this become the center of a new town? The unlikelihood of this was couched in a discussion of social-structural reasons for the decentralized nature of Zaose villages (as collections of widely-spaced hamlets, composed of dispersed compounds). The understanding of technical difficulties (mill misfunctions) by the Voltaic station manager led to a brief discussion of technology transfer in the context of local cosmology.

I.D.2. THE FINAL STUDY

The social impact of the solar-energy demonstration was assessed over three months' fieldwork by the present author in the summer of 1980 (at project's end). A 120-page report resulted (Roberts 1980). The great majority of field time was spent analyzing and digesting the hundreds of pages of questionnaire forms completed in seven months (November 1979 till June 1980) by two locally-based, highly-dedicated Voltaic assistants. Much of the data collected was found to be outside the scope of the research as outlined in the contract; it proved fruitful to analyze some nonetheless, and more will be the focus of future scrutiny (under the aegis of the aforementioned grant with NASA LeRC, "Research on Social Aspects of Photovoltaic Applications").

Three main areas of concern were investigated: water use at or from the station, station mill use, and station management. Station water-users were identified by hamlet and the quantities of water and uses to which it was put discussed. Time spent and/or saved by those exploiting station facilities were investigated, as was the social nature of this activity.

Mill use and users were identified and studied closely. Because milling - as opposed to obtaining station water - is a service delivered against payment, elements of local social organization became relevant to an understanding of which women could and did have sufficient financial resources to use the mill, and which ones could/did not. The nature of women's wealth (their fields as a primary means of production) was touched upon in this context. Because women of one hamlet were found to avail themselves of milling services a disproportionate number of times, factors unusual to them were probed.

The matter and quantification of time saved by women using the mill were found to be vastly more complicated than one could expect from baseline or mid-term findings. Some of the assumptions basic to the overall study were re-examined in the light of field observation and interviewing, and of results from questionnaires on food preparation. Impressions of how much time per woman might be saved by mill use and how it might be spent were presented; these remain impressions, due to shortcomings in the preceding research strategy (which are discussed).

The history of management was pursued, and a series of eight case studies presented, that the reader grasp from this ethnography the complexity of decision-making, and how station management fits into the village context. The disbursement of mill earnings for station-specific and community-interest projects was discussed; this last included a contribution to a grassroots reforestation project, "Tangaye Arbor Day." A lack of understanding by villagers of their responsibilities and prerogatives vis-a-vis the solar-energy demonstration was studied, as the project period drew to a close.

II. MAJOR SOCIO-ECONOMIC IMPACTS OF THE PROJECT

II.A. Water Use

The station water system has worked well from its inception in March 1979. Figure Three shows water quantity and hours of pumping per week for October 1979 till June of 1980. Zeniths are at the height of the dry season, in March-April,

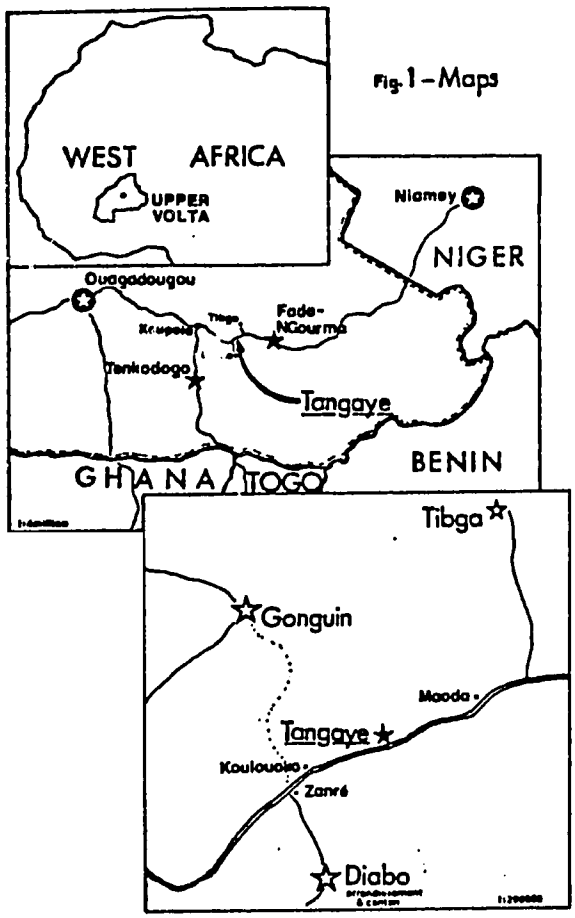


Fig. 1 - Maps

Tangaye village consists of sixteen hamlets, which in turn consist of various compounds within which there are commensal units.

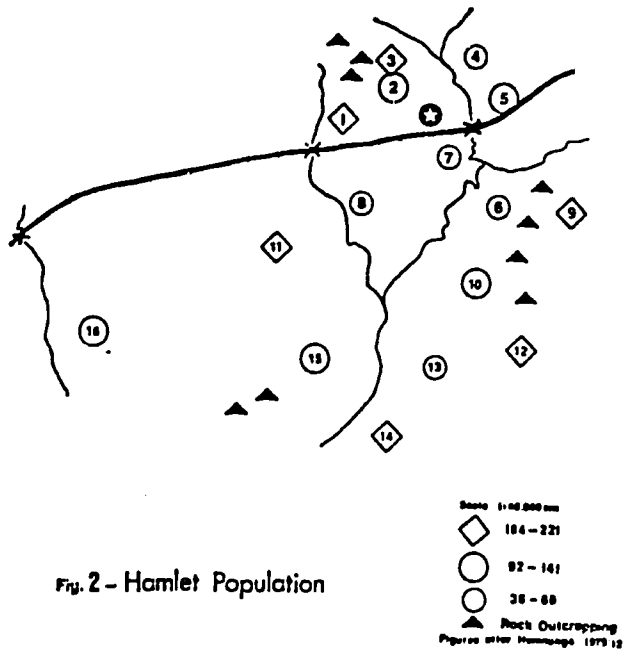


Fig. 2 - Hamlet Population

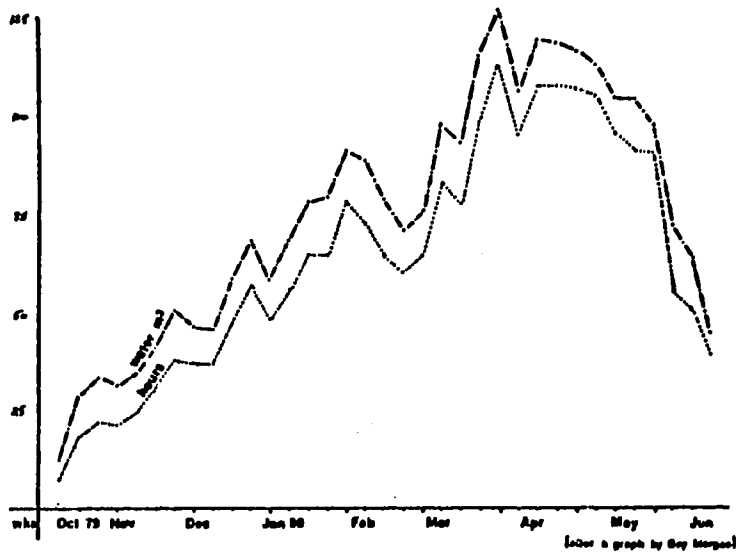


Fig. 3 -Station Water Quantities and Pump Hours

Station water quantities in cubic meters, and pumping hours over the weeks of observation. Peak use is during the height of the dry season

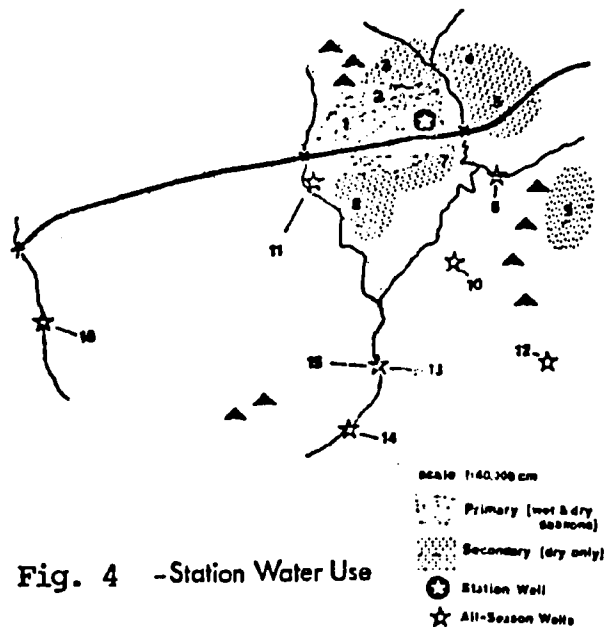


Fig. 4 -Station Water Use

Water use per hamlet of Tangaye village; primary users are those living in greatest proximity to the station facilities. Triangles indicate rocky outcroppings.

when 113 m^3 of water is pumped per week, or 16 m^3 daily. In comparison, Hemmings' estimated that a third or less of this amount was withdrawn from installation of the solar pump. Other wells drawing from the same water table are used less now, and there is a balancing effect in terms of total drain of the table. During the dry season, roughly the same amount of water for personal uses per person per day is used now as was two years ago, and in the summer of 1980 there were no visible effects of over-depletion of the water table.

Except during the peak months of the dry season, people of two hamlets (One and Two) make over ninety percent of all visits to the station well. During dry-season months, people of three others (Five, Nine and Three, in order of use) comprise the major secondary users, with a few more (from Seven, Four, Eight) regularly, but more rarely coming.

Primary station water users, then, are those living in greatest proximity to the facility, while secondary ones live just beyond these latter. Several hamlets are as close or closer than some of secondary users (Six, Ten, Eleven), but have important, all-season wells much nearer; and people employ the water of these instead. Individuals from hamlets farthest from the station (Twelve through Sixteen) rarely, if ever use its water.

A very rough estimate of quantity of water per person can be determined. The approximately 197 people of Hamlet One use about ten liters per person during the key dry-season months and about nine overall. The 141 of Hamlet Five use about nine and a half liters apiece during the months of their station visits. The 215 of Hamlet Nine, many of whom continue to use closer, hand-dug wells, fetch only about three and a half liters of station water per person. The numbers for Hamlets One and Five correspond to Hemmings' estimate of nine to ten liters of water per person used during the dry season.

Quantities of station water can be broken down into six basic categories of use at the facility itself (See Fig. 5). Clearly, people from Hamlets One, Five and Nine enjoy bathing at the station. Water carried long distances for bathing is a labor luxury few can permit themselves frequently. People depending upon other wells do not use as large a proportion of water drawn there for bathing at the site; those using station water tend to bathe more frequently, and many of those not using the water for household tasks, still come to the station to bathe.

Washing clothes is another important at-station task in which it is easier to bring the activity to the water source, than it is to carry the water to the activity. For cleanliness and as a social activity, people using station water wash their clothes more often than do those depending upon other wells; and people not using station water for household purposes, may come there nonetheless to do their laundry.

Small domestic animals - sheep and goats - are tended in flocks by youngsters during the dry season; often, at least the adult animals are tethered during the rainy season to prevent unwanted incursions into gardens and fields. A greater percentage of station water used by inhabitants of the three hamlets is given to small animals by persons of outlying hamlets

than is by those from Hamlet One, lying closest to the station. Flocks are driven to the station faucets. Those living about the station use more water from its tank, and may carry water the short distance to where animals are penned. Relatively little water is drawn from other wells for small animals in comparison to that given large ones; easily-driven sheep and goats are often brought to the station, where the water need not be drawn and where the gathering of friends and relatives makes the place one of constant merriment.

The category "large animals" is restricted to each hamlet's share of the sixty or so donkeys and the several horses of Tangaye. Cattle were brought to the station during the first months of plentiful water, but the station manager decided they required too much water and that their arrival was too disruptive to allow their being served beyond November of 1979. Donkeys and horses are easily - and singly - ridden by men or boys to the station to be watered, on their way to or from other labor or the compound in the evening. Cattle account for the largest percentage of total water drawn from other wells. Women now use station water who may have secretly drawn water from cattle wells in the absence of the herder who had dug them. Running conflicts between women and herders used to result; it is the impression of informants that there is less social discord of this sort with a reduction in competition among those obtaining water in the vacinity of the station. Disputes were again reported, however, in outlying hamlets.

The question was raised as to whether the easy availability of station water might not attract cattle-herders, which in turn might prove detrimental to the delicate dry season ecosystem. By banning use of the station water for cattle, this matter was ostensibly solved. Freeing cattle wells around the station for unique use by herders may prove beneficial (more water per beast), lead to a growth in herds (more born, less dying from dry-season rigors), and finally bring about an overtaxing of the ecosystem after all. A cattle survey was conducted. With an apparent increase of twenty-one percent, conditions seem more favorable for cattle, but other factors are undoubtedly more important than has been the presence of the station. Anthrax struck in 1979; sixty cattle died, and others were sold as quickly as possible. The rains of the 1979 wet season (available in the dry of 1980) were more substantial than those of 1978. The rains of 1980, too, have been abundant, and there was no anthrax at Tangaye; whether or not there are long-term increases in cattle numbers, and damage to the ecosystem as a result, should be monitored in years ahead.

Quantities of water used for house construction show a seasonal curve. Given the considerable quantities required and the necessity to make bricks as close possible to the construction site, men will opt for whatever water is nearest. People living in more distant hamlets complain that those around the station are spoiled by the ease with which they can procure water for building. It is likely that the hamlets around the station will receive more house construction than those where obtaining water during the dry-season building months never ceases to present problems.*

---

* The lack of probability that any - or at least many - will choose to move from outlying hamlets to within the vacinity of the station because of such convenience, is discussed at length in Roberts 1979: 36-39.

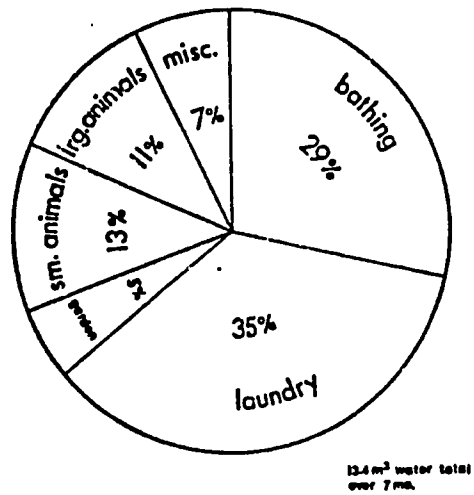


Fig. 5 - Hamlet no. 1, dry-season water use at the station; water for use within households (for drinking, cooking and the like) is not included here. Measures of this latter were done separately.

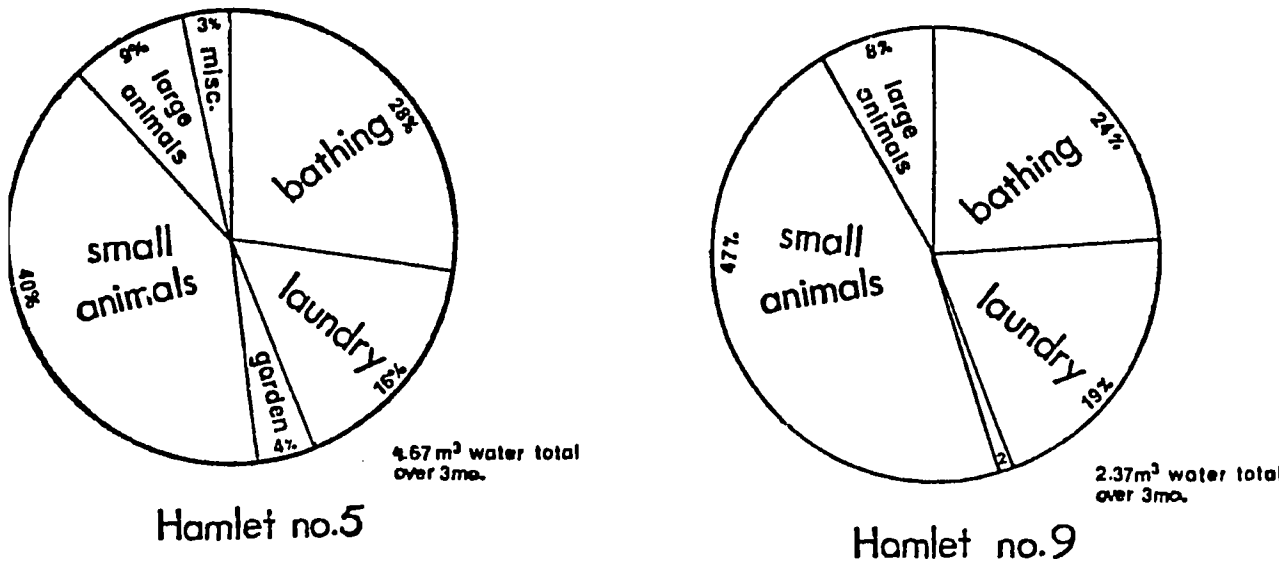


Fig. 6 - Hamlets 5 and 9, dry-season water use at the station.

Whereas house construction shows a seasonal curve, beermaking does not: The beverage is always popular! The process requires large quantities of water, sometimes several hundred liters over the course of eight or nine days' brewing. This has been a significant use of station water.

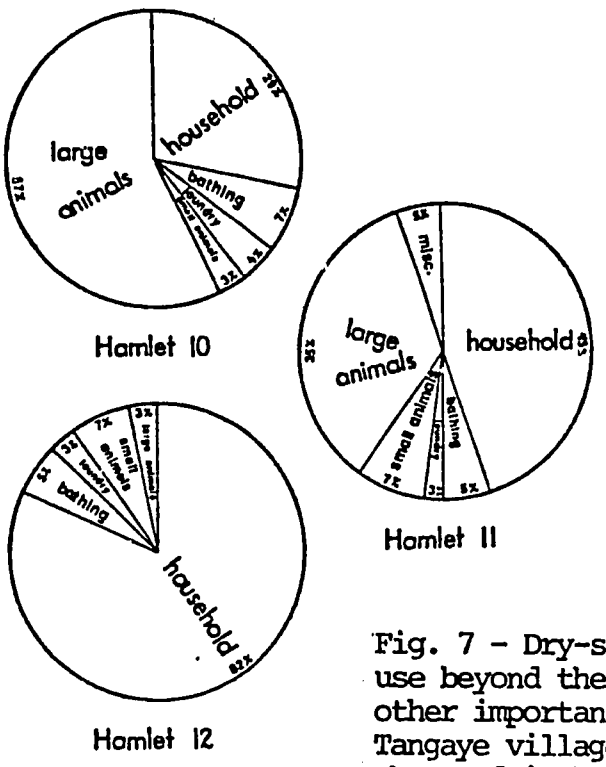


Fig. 7 - Dry-season wellside water use beyond the secondary sphere, at other important wells still within Tangaye village. The two wells observed in hamlets 10 and 12 are clearly of different sorts, the one primarily for cattle, the other for household uses.

II.B. MILL USE

The ups and downs of the station mill's functioning during the dry season of 1979-80 are shown in Figure Seven.* Modifications in the mill machinery and in the schedule for milling have allowed successful use of the facility throughout this period. In May 1980, technical difficulties with batteries and photovoltaic cells caused a radical reduction in mill service. After months of use some of the modules open-circuited, reducing electricity-production; in early September, 1980, new panels were installed to replace faulty ones.

Figure Eight indicates the first flush of enthusiasm as milling was offered free of charge and many were anxious to try its services; through the lean summer months, when agricultural activity is at its peak and many remained camped beside distant fields; to the dry season when milling was again a popular alternative to the daily labor of pounding and stone-grinding again by hand.

---

* Data variously presented in Figures Seven through Ten are drawn from the notebooks kept at the mill in which all customers, their hamlet of origin, and other information is recorded at each milling. Two dates present difficulties throughout the analysis: March 26th, 1980, when the research assistant became

All hamlets show the same roller-coaster curve over the sixteen months as do these four (Hamlets 1, 5, 9, 14), with the obvious difference in degree of the use of the mill.

The distribution of mill use is shown in Figure Nine. These figures are only to be considered relative, and not absolute. Inhabitants of four hamlets use the mill from eight to twelve percent of total visits, and with people of Hamlet One comprise the category of primary users. Those labeled secondary are from hamlets the people of which made three to five percent of total visits. One of the factors corresponding to the difference between these two sets is proximity; yet while station water use is influenced by little but proximity, mill use is more complicated because services must be purchased.

Interesting sociologically is that within each hamlet, and even within each compound, individuals use the mill at widely different frequencies. No one is coerced or required to use the mill, nor is anyone prevented from doing so by any outside force or rule. While there can be no one-to-one correspondence between some factor and mill use, there are interesting aspects of women's lives which seem to contribute to or coincide with a decision to use the mill that some women and not others make.

Zaose women or the girls who help them do almost all cooking in the household, and it is they who decide whether or not to use the mill. It is they who must supply the cash to pay for these services, on most occasions. Why some and not others do this, then, requires a better understanding of elements of the social organization of the Zaose people inhabiting Tangaye, and what the various financial resources of women may be.

Those individuals rarely if ever using the mill are among the most unfortunate of all the village's inhabitants. In large extended families there is a good deal of mutual support and assistance, both of a physical and of a spiritual sort. Within the extended family there is a significant division: the commensal unit - those who eat together. While this often corresponds to what some would call the "nuclear family" (a man, his wife and children), as often it does not, and the term is best avoided. Many Zaose men are polygamous, and their several wives usually form the work force of a commensal unit; but brothers may eat together, and their wives then join, alternating or sharing cooking responsibilities. Others as well - aged mothers, cousins, or outsiders - may eat with this core. It is at the level of this commensal unit that women pool their labors and resources as they co-operate in everyday life.

Women in polygamous marriages within large extended families may draw more support, and yet be forced to be more independent than their monogamous peers. A monogamous husband gives all the food he has for consumption to his one wife, while a polygamous one will divide this same among all; it appears that the extra produce from the larger fields a polygamous man can maintain is used as potential capital, and not as family food. The result is often larger fields per woman, and thus as a commensal unit, more labor and more surplus which may be translated financially into more opportunity to use the mill. Put even more explicitly, there seems a

---

ill and left the station without being able to find a replacement, and April 9th, when all work on the project was interrupted, the assistants requisitioned by David Sokal for a survey he conducted on the meningitis outbreak in the Tangaye area.

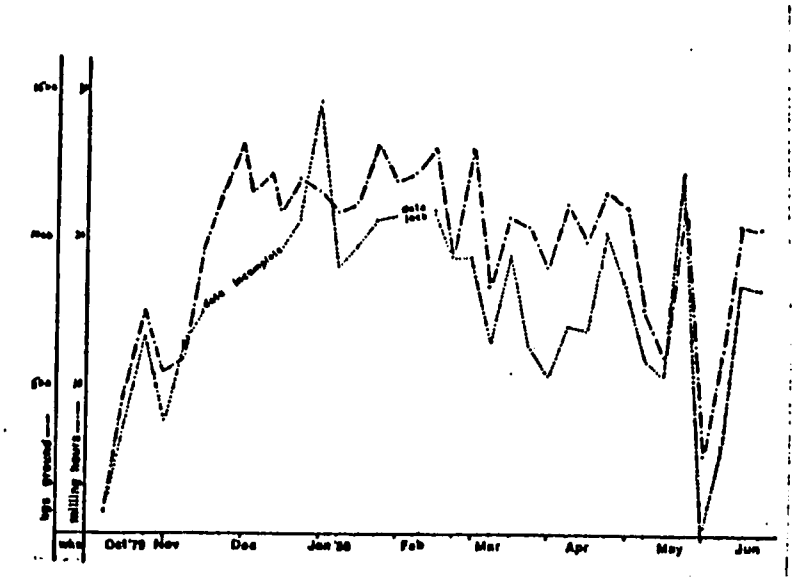


Fig. 7 - Milling hours and quantities milled in kilograms; note that despite PV module misfunctions, the system was shut down only once in May, for repairs.

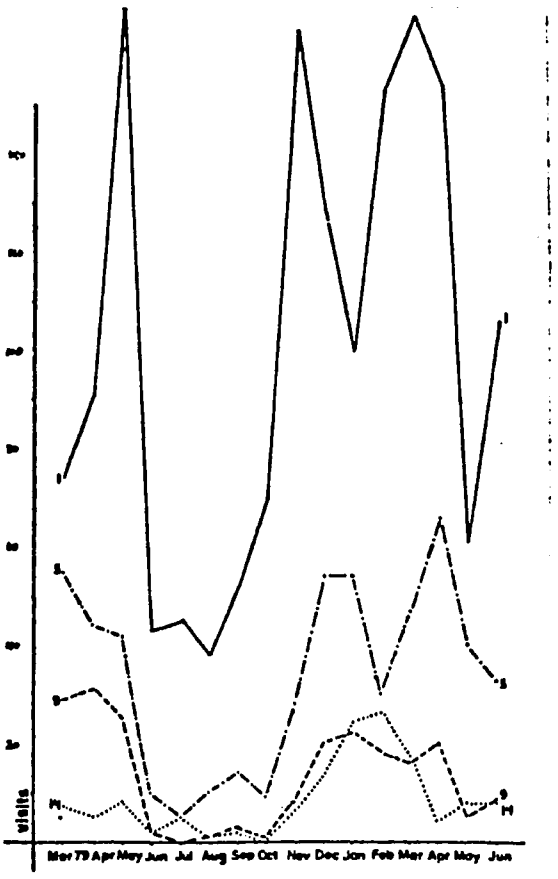


Fig. 8 - Seasonal mill use by women of Hamlets 1, 5, 9 and 14; the roller-coaster curve is roughly the same for each, with variance in intensity of use (number of visits). Dry-season use is greatest, wet-season least.

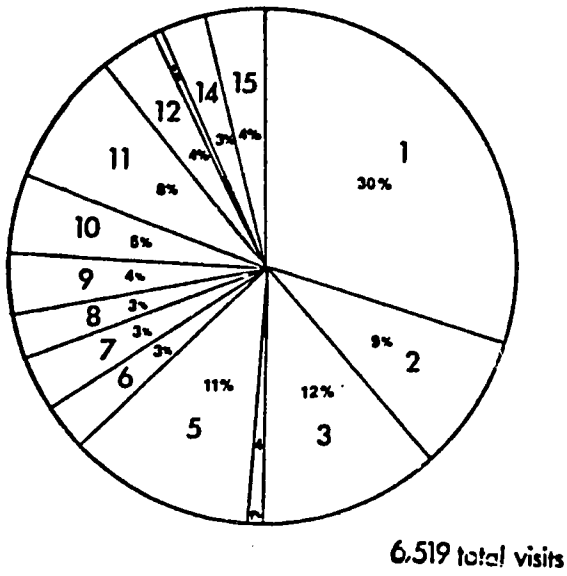


Fig. 9 - Mill use percentage per hamlet at Tangaye.

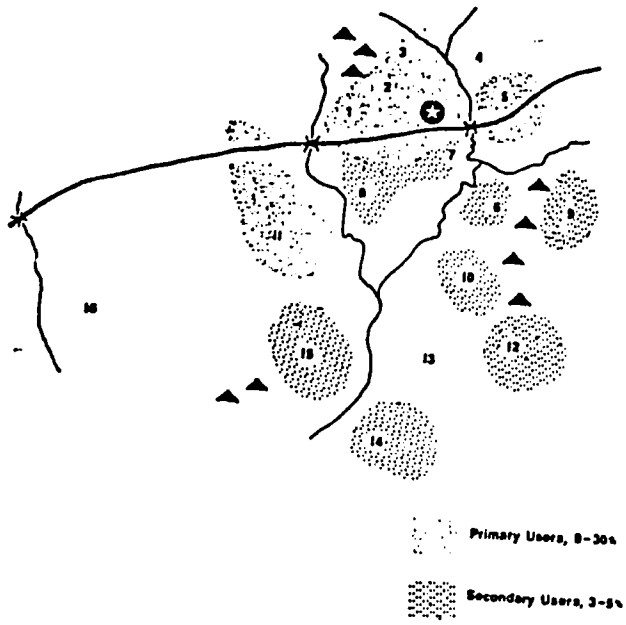


Fig. 10 - Hamlet mill use from the chart above.

correlation between large extended families and relatively greater mill use; and one between polygamy and higher mill use as well. Such findings are discussed in detail in the final evaluation (Roberts 1980: 57-67).

To understand and hope to quantify women's wealth, one must first know something of the means of production to which a woman has access: her fields. Zaose women often have a good deal of independence within a set of relatively rigidly-defined, dependent roles (e.g., marriage, co-wife hierarchy, age seniority among women). They maintain their own fields, and most grain they bring to the mill is from them, as is the cash to pay for the service of women's own earning.

To gauge what variation there might be in women's wealth, we measured the fields of all women in Hamlet Five. A few women have no fields of their own, others only very small ones; above the average there are industrious souls who have vast plantations of two to three acres. Surface cultivated per woman per commensal unit can be compared with the percentage of all milling days of women of that commensal unit. A ratio results of surface cultivated per woman, per percentage point of mill use. There is a cluster of twelve of the twenty figures for which an average (689 square meters of cultivated field per woman per percentage point of mill use) can be calculated. Within the cluster, there is a rough correspondence between size of field and mill use.

It is instructive to consider those cases which do not appear in the cluster. Most of these seven of the total twenty women have large fields, and one would expect them to use the mill more than they do. Three of the cases have elderly women assisted by two or four able-bodied, dependent women to help out in such chores as flour-preparation. The senior women are firmly in charge of their households, and their fields are tilled in large part by these same dependent women, to whom is conferred the gamut of household-upkeep duties. It is the dependency of these younger women that makes them different from those independent because of larger extended families and polygamous marriages (who do not have a late-middle-aged or early-elderly mother-in-law to obey).

The case of women using the mill more than one would expect, given their relatively small fields, is not difficult to explain. They are the great beer-brewers of the hamlet. Mill-ground flour is not used in the brewing itself, since sprouted sorghum is damp, and must be stone-ground before setting the mash to ferment; but use of the mill does permit women to direct their attention more whole-heartedly to the time-consuming task of beer-making; and brewers have the wherewithal to consider the ensuing cost as a part of their overhead.

Mill-use figures for Hamlet One are undoubtedly inflated, to a degree difficult to determine. Certain attributes make the hamlet's women unusual with regard to those of the rest of Tangaye, and assist in their greater-than-average use of the mill. Proximity is certainly the most obvious factor influencing mill-use frequency. The Commensal Unit whose women use the mill more than any others in Tangaye, is that of the village chief. The chief's five wives maintain large fields, able as they are to summon a large labor force and to finance well-attended work parties. A disproportionate number of the other women of Hamlet One who use the mill most frequently are beer brewers. This represents a hamlet-wide industry, and the concentration of brewers produce their product there where the demand is greatest. Beer-drinking and socialibility are synonymous, and brewing is an integral part of the

vibrant economy about the chief that sets Hamlet One apart from the others.

II.C. IMPACT OF THE PROJECT UPON WOMEN AND HOW THEY USE "RELEASED TIME"

II.C.1. THE SOLAR-POWERED WATER PUMP

An issue the significance of which outdistances the particular research project at Tangaye is whether or not time women spend seeking water - long hours per trip, during the dry season - might not be saved by providing more readily-available water, such as that of the station. Presumably, this time might then be spent in other productive pursuits.

The function of time versus distance traveled may be computed, to determine what time is saved or lost by people going to the station; for most household uses, women allow proximity to take precedence over all other factors. But water-fetching is not merely a pragmatic or functional task. Women do not rush about like automatons seeking water as quickly as possible so as to get on to the next productive chore (thus providing the researcher with the laboratory situation necessary to accurately measure change in time spent). Even if time is saved in not having to go so far or to wait so long beside a hand-dug well for the slowly-dripping water to fill one's vessel (in itself a not-altogether-unpleasant task, for the same social reasons); it may be that more time is spent socializing, bathing, and doing the like, to use up that time saved, perhaps quite unconsciously. The water source is an important social focal point.

II.C.2. THE SOLAR-POWERED GRAIN MILL

II.C.2.a. UNDERLYING ASSUMPTIONS

The assumption behind the social research component of the Tangaye Solar Energy Demonstration and, indeed, behind the greater conceptual context of which it is a part (viz. "Energy Needs in the Food System") is that the tedious, dulling chore of daily flour preparation is a use of time better spent on other productive activities. If a milling service can be provided, then such time may be freed; a significant part of the research mandate was to determine who saves how much time, and what they then do with it. There are several difficulties with such an assumption.

The "tedious" nature of such work as grain preparation may be examined. It takes several hours' hard work to produce the flour consumed daily. However, many women alone in a commensal unit grind enough to provide flour for the next two days; this is the same amount of time mill-ground flour usually lasts (as determined by the amount brought to the mill). Furthermore, except in those commensal units where a woman is alone without co-wife, teenaged daughter, sister-in-law, mother-in-law or other female companion; women share these chores, either working together on a given occasion, or alternating from meal to meal and from day to day. The false impression that all women engage in this work every day should be avoided, then.

The moment of stone-grinding, especially in early evening when all are back at the compound after the day's labors, is used by women to make social commentary through song. In a society observing strict segregation of sexual roles in many circumstances, a wife's proper self-presentation is to be retiring and silent. Should she have opinions of her own to offer or complaints to make, there are few opportunities to express herself. Singing while stone-grinding is one, when a wife's active labor is more crucial than her silence. As a husband waits for his dinner, he and the others listen to the woman's song; so do any living in compounds nearby or passing on the path. An offender is likely to mend his ways in the face of such pressure, which may vary in its degree of subtlety, sarcasm and explicitness. Women joining together to accomplish the task may gossip or joke, thus prolonging the time taken. The purpose of "flour preparation" is not limited to preparing flour, then.

In hoping to recognize and evaluate the benefits from a renewable-energy demonstration one must be careful not to approach the people receiving the benefits as less than the individuals they are. In other words, as was noted with regard to water-fetching, these are not automatons ruthlessly dedicated to saving time to be immediately applied to other tasks, the products of which we all will recognize as fruitful and productive. As the well-known Zaose proverb has it, "hearty laughter is better than a chicken thigh"; intangible often outweigh tangible profits.

The nature of cooking is also worthy of note. Zaose meals consist of two elements: a starch base and a vegetable or meat sauce prepared separately. The most common starch dish is a polenta or solid paste of flour and water (called tɔ̂). There are several stages in its preparation, the most labor-intensive being the pounding and stone-grinding of cereal to obtain flour. As do cooks and "eaters" everywhere, Zaose expect the starch dish to be ready and still hot when the sauce to accompany it is; in other words, several dishes are prepared concurrently. The sauces contain no flour and so are not directly related to or influenced by mill use. They do require time and effort to prepare, which must be included in estimates of total cooking time. Using the mill does not save or free this time; and it is my impression, based on too few cases to quantify, that in the dry season when time is not at a premium, women using the mill may spend more time preparing more elaborate or more sorts of sauces. The total cooking time, then, may be balanced by this and the social factors mentioned above; if so, little or no cooking time is saved or freed. The time may be used differently, but still for cooking. Time saved over and above total cooking time, then, may not amount to as much as might be presumed.

Another culinary fact cannot be overlooked: Only grain is milled. Many other dishes are prepared with whole rice or beans. These are easy meals to prepare, consequently very popular, and do not use milling. A woman's total cooking time includes that spent on these latter, as well as upon flour-based fare. In 1979, the harvest of beans was more successful than any other crop's. Taking Hemmings' figures for 1978 crop production, one would expect the ratio of flour-based to non-flour-based meals to be 4:1; instead, from the breakdown of the five hundred thirty meals observed by research assistants from November 1979 to June 1980, sixty percent of meals included flour, stone- or mill-ground, forty did not. Any discussion of the effects of mill use on women's allocation of time is only referring to sixty percent of dishes prepared during the period of the study, then.

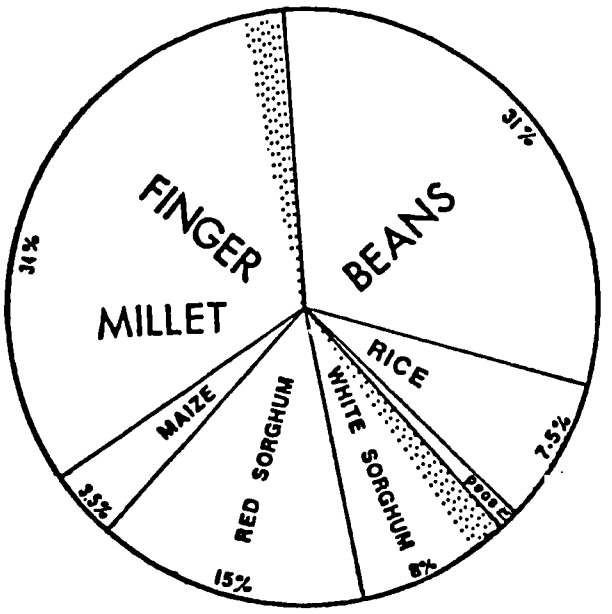


Fig. 11 - The major element of 530 meals observed being prepared by project assistants. Note that 60% of the meals have a grain base (and might include use of the mill), while 40% do not.

II.c.2.b. TIME FREED BY MILL USE

The great majority of Tangaye women use the mill infrequently. In Hamlet Five, for instance, the average number of visits to the mill during the research period per commensal unit was twenty, or eight percent of all millings. If one takes into consideration that only nine percent of all Hamlet Five visits to the mill were made in the five summer months, this leaves an average of about eighteen visits per commensal unit over the eleven heaviest months observed, or one visit to the mill per commensal unit every twenty days or so. Because this is an average, many women use the services even less frequently.

It was a matter of chance as to whether the particular day of the research assistant's visit to a targeted compound was one on which the women had availed themselves of the mill's services*; in effect, this happened in the cases of thirty-six of the three hundred eighteen flour-based dishes observed prepared over eight months' time, or about eleven percent of these latter. Despite the small sample generated by the questionnaire, an estimate of time saved can be made, with reservations. Cooking is not done where all variables can be identified, quantified and/or held constant; any but a general statement is an absurdity.

Using the mill eliminates most of the labor (although the grain still must be winnowed and sorted, usually a fifteen-to-twenty-minute task). Flour ground at the mill is most often of sufficient quantity to last two days or slightly longer. Women do not use their stock of it all at once, but

---

* This problem was recognized earlier (Roberts 1979: 29), but lack of time prevented action being taken to modify the research strategy. A different approach would have been to identify at some midpoint in data collection those women who used the mill most, and then to concentrate attention upon them.

intersperse meals prepared with mill-ground flour with rice or bean dishes, or with those made with stone-ground flour. This last spreads out the pleasure of an easy time cooking, or proves useful when unexpected guests arrive or circumstances happen. So is introduced yet another difficulty to determining total time saved and what is done with it.

II.c.2.c. HOW FREED TIME MAY BE SPENT

To understand how time freed by mill use may be spent, it is best to ask when it is freed. The dry season (November through May) is when the mill is used most frequently. During the rainy-season months (June into October), many women cease using the mill altogether, and all use it far less; yet this is when all are engaged in the most intense labors of the year: the various tasks accompanying the agricultural cycle, what may be defined most readily as directly-productive work. For most women, the presence of the mill has done little to free time for increased attention to these all-important chores. Food stocks are at their lowest just prior to the next harvest and money is as well, since that from sales of crops or their processed products, earned after the last harvest, has been spent or must be saved to purchase any food necessary to get through to the next harvest. Such factors diminish women's ability to use the mill, even should they so wish.

Their will to use the services may be lessened then, as well. Hemmings makes the interesting observation that women use less water in the preparation of "millet cakes" in the rainy season. This can be linked with a more recent finding, that women feel that tô made from finely-ground flour from the mill does not "stick to the ribs" as well as does that from coarser, stone-ground. People enjoy the feeling we would consider "heaviness" in the stomach when they have intense work ahead of them; less water and coarser flour provide this sensation, since the resulting polenta is harder to digest. A related notion is that mill-ground flour makes better porridge for infants, because it is so fine and easily digested, and does not "cause" constipation. Even should they have the financial means, then, women may choose not to use the mill during the agricultural months, despite its time-saving quality. The mill machinery can be regulated to produce coarser or finer flour, but this had not been done during the course of research; complaints about the first mill were that its flour was too coarse - the season must have been wrong! That millers do not take the initiative to change the finess is a function of management difficulties to be discussed.

The result is that most time freed is so in the dry season, when for the Western observer it is a more complex affair to identify productive uses to which it is put. The matter of what is deemed "productive" must be re-examined. Hemmings described each season's major work characteristics. Grossly categorized, the rainy season is almost wholly dedicated to agriculture (preparation of fields, planting, weeding, harvesting). One has the impression that "everything else" is accomplished in the dry months from November through May: crafts, celebrations, visits to and from kinsmen and friends, trips to the big city. From a certain perspective "directly-productive activities" may be considered those that allow entry to the greater money economy through earnings, or those which are fundamental to sustenance. If the rainy season is a time dedicated to directly-productive chores, in the dry indirectly-productive ones abound.

Attaching a value judgment to these terms, deeming directly-productive somehow "better" than indirectly-productive activities from some moral perspective, should be avoided as non-productive ethnocentric interference. During the dry-season month of April, 1980, (when mill use was at its highest), a virulent strain of meningococcal meningitis struck Tangaye and a few surrounding areas. With more than a score of fatalities, much time - whether freed by mill use or not - was spent in seeking traditional or other medical care, and for funerals and other mourning activities. Inversely, the unusual number of these ceremonies probably accounted for some of the intensity of mill use, the flour being prepared for funeral feasts. Such a use of time is an indirectly-productive one. Funerals for all societies are essential moments when people are brought together in a recognition of their mutual bereavement and the survivors' new balance and order resulting from the death. The funeral is a reaffirmation of the bonds and inter-responsibilities of social life that make all other activities, directly- or indirectly-productive, meaningful and possible. Other dry-season activities of greater regularity (e.g., feasts and celebrations, visits to and from kinsmen or affines) serve similarly to provide the structure allowing co-operation during the hectic months of intensive farming.

An impression of what the mill means to women, and a glimpse of what their lives are like, is best gained from the vignettes presented below, from the thirty-six times (of the five hundred thirty) meals assistants observed) when dishes were prepared with mill-ground flour.

December - heavy work in fields with last of season's harvests; quick meals of mill-ground tô and beans prepared, the women spending entire day in fields.

January - a) women use mill-ground flour for a fast meal after spending the day preparing beer; b) women resting all day or spinning cotton thread make mill-ground tô; c) a huge mill-ground tô is made for a threshing party.

February - a) women rest, not feeling well, and make mill-ground tô; b) beer-brewers prepare their meals from mill-ground flour; c) women engaged in spinning thread cook a mill-ground tô.

March - a) women off visiting all day prepare mill-ground tô; b) a woman doing nondiscript household chores cooks a mill-ground tô.

April - a) a woman doing housework prepares mill-ground tô; b) a woman visiting elsewhere all day returns in late afternoon and cooks mill-ground tô.

May - a) women doing household chores prepare mill-ground tô; b) a girl playing all day cooks a mill-ground tô; c) a woman planting in the morning cooks a quick lunch of mill-ground tô, then spends the afternoon preparing rice to sell at market later the same day.

June - mill-ground flour is taken to the fields where people engaged in farming are camped.

In these few cases, women use the mill, sometimes with the explicit intention of saving time for other recognizable, directly-productive labor, sometimes for no other apparent reason than "to take it easy" because they may not feel well, for the pleasure of the luxury this represents, perhaps for the status of conspicuous consumption; but certainly for no more tangible reasons than these. In other words, a woman may "take a breather." In effect, when asked the general question, "when do you use the mill?", women responded that they do so when visitors come, when especially busy or when ill; their most common reason for not using it, they said, is lack of money, or a reluctance to wait the three days it often takes to get flour back because of the backlog of grain waiting to be milled.*

I.c.2.d. OTHER CONSIDERATIONS

In the mid-term assessment it was speculated that time freed by use of station facilities might be spent making more beer than had been done prior to the installation of the pump and mill. However, in 1980 there is said to have been less beer made than the year before. Because of the poor harvest of red sorghum (the grain used in brewing) this past year, its price has risen; without overtly raising the price of beer, brewers find it less profitable an activity. While brewers do avail themselves of milling services, during this research year the station's presence has not been associated with a rise in beer-making.

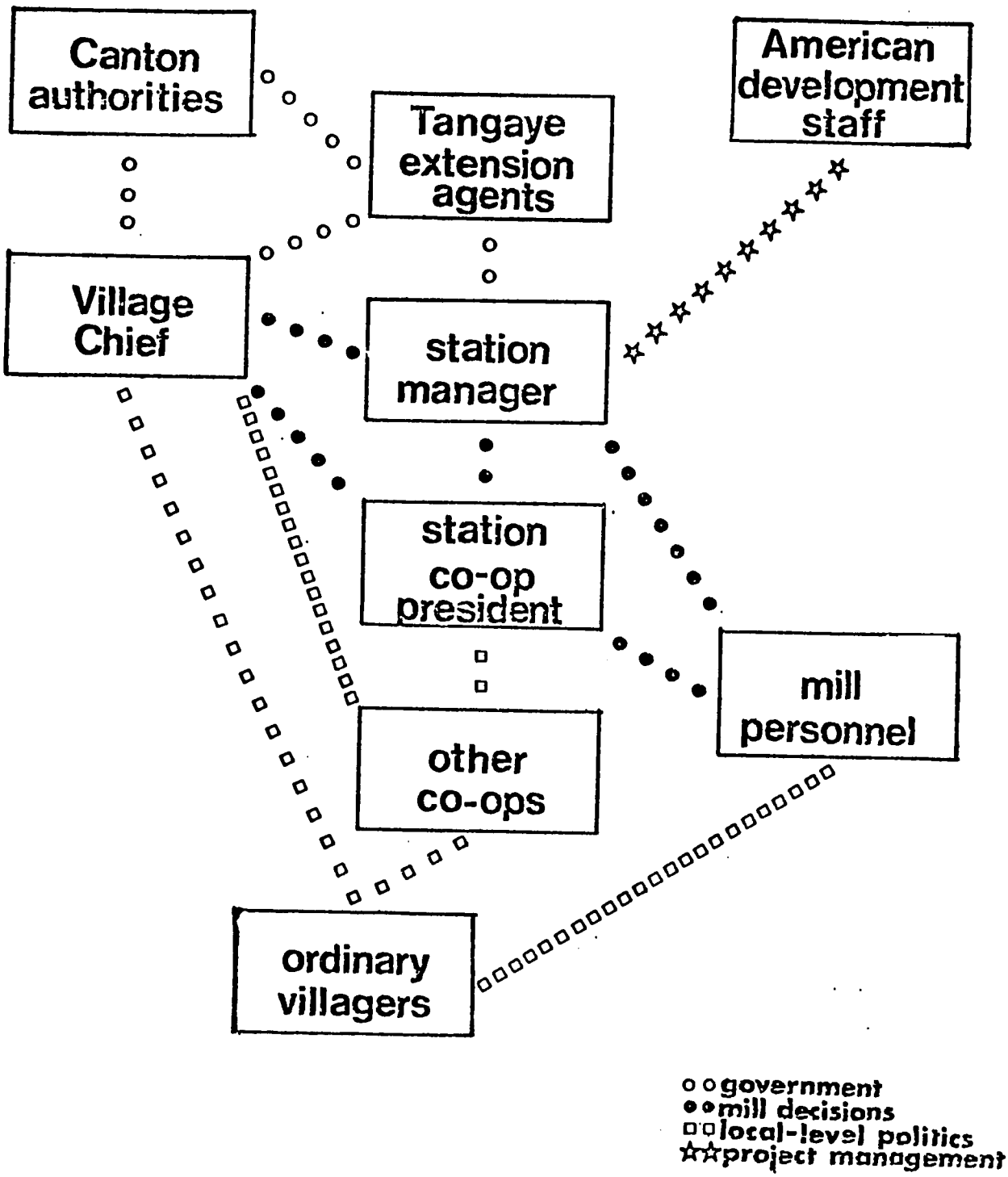
III.A. HOW VILLAGE ORGANIZED TO MANAGE AND OPERATE THE PROJECT

A co-operative to manage the station mill and facilities was formed from representatives of the fourteen existing agricultural co-ops. The fourteen are evenly divided by sex; the station co-op is the only one in which men and women participate in the same co-operative, although this anomaly has been rectified in the evolution of sub-groupings, each with its own leaders and structure. The president of the station co-op is a man in his sixties who has led cotton and soybean co-operatives introduced by the colonial and Voltaic governments. He is a kinsman of the village chief and defers to the latter when decisions are to be made or praise received. The station co-op is a subset of the overarching web of kinship, affinal, residential and amical bonds which is Tangaye. Despite some confusion at the outset, the chief has become overt sponsor of the project's village-level functioning, the proper role for "the father of his people." The co-op president is the liaison between the co-operative (and the wider circles of parastatal organization touching it) and the chief (hence, traditional socio-political organization). Millers were chosen by the station co-operative from among its members.

---

* This has been alleviated with the increase in electrical output - hence more milling hours - instituted by NASA LeRC in the spring of 1981.

Fig. 12- Power and Decisions



A station manager was named by AID staff to accomplish or oversee the everyday tasks of maintenance, and to collect regular data. Of a slightly different ethnic background from Tangaye residents, he was raised and completed the first cycle of secondary education in Abidjan. A bright, resourceful and diplomatic young man of twenty, he quickly turned his outsider's status to the project's advantage. On his own initiative, he became an "extension agent at large," and broached matters and made suggestions that might have caused or exacerbated community tensions had he been a party to local-level, family-based politics.

As his tenure progressed, the manager would identify any problem and secure its resolution, then explain both to the chief whose confidence he had gained, as a virtual fait accompli. With the chief's modifications and approval gained, the manager would call meetings with the millers and the station co-op to discuss a course of action. The latter parties might initiate discussion and the manager proved willing to heed their wisdom; but decisions seemed made along the chain described, except when matters of explicit political content were concerned.

Anyone with a sense for local-level politics will recognize the above for the gross simplification it is. The manager as an outsider had to establish his own power base, and was the liaison with the cosmopolitan world outside Tangaye, including its Voltaic and American agency representatives. The chief has his counselors, interests and intrigues. Co-op members are scattered among the various hamlets and each represents different lobbies and personal interests. The millers are three or four men working together, but not necessarily in perfect social harmony. Cases were outlined in the final evaluation, that readers gain a sense of the complexity of the project as one affecting a group of individuals, as opposed to one only understood through an abstract model. These included:

a. Special-occasion milling and the order of service: priority of services is given those organizing funeral or other feasts; millers must not give preference to kith, kin or concubine; and the chief will receive priority, but only with a signed note, to prevent abuse by others unbeknownst to him.

b. Residents were disabused of the notion that the millers steal grain left at the mill, when they daily remove a few cupfulls of unground kernels from within the machine.

c. Millers' workload and salaries were discussed, that the salary better compensate for losses in agricultural production from time redirected to station responsibilities.

d. Resolution was sought for personnel problems arising from a miller's adultery and resultant conflict within the community.

e. Difficulties were recognized in choosing villagers to bank mill receipts; who could be trusted, and was the money theirs in the first place?

f. Upkeep or station equipment was discussed (who can go to Ouagadougou to seek parts for a leaky faucet? Won't AID staff bring them?)

III.B. HOW MILL EARNINGS WERE DISTRIBUTED

The station co-operative, usually guided by the manager, makes decisions concerning fees to be charged for milling, and for their eventual disbursement. Through several months' discussion, prices were fixed, at first below those of mills in the general area (too distant to be considered competitors), then at parity with these latter (at 25 CFA per 4-litre container, or about $.03 per liter). Salaries for mill personnel were decided, 1500 CFA or $7.50 monthly for each of two millers and a cashier, 1000 CFA or $5.00 a month for the co-op treasurer; the station manager was paid 25,000 CFA or $125 a month by AID Ouagadougou. Other disbursements of the 172,770 CFA ($864) collected from September 1979 through August 1980 were limited to 4500 CFA for beer to encourage a work party clearing the station premises of a summer's weeds; 15,000 CFA back-payment for masons constructing mill buildings; 2500 CFA for paper supplies; and contributions of 15,000 CFA for Tangaye's Arbor Day and 500 CFA to a nascent soccer team. Capital of 99,500 CFA (about $488) remained in September 1980.

In general, it has proven difficult for villagers to feel revenues theirs, to be used at their discretion. They are not eager to make embarrassing errors, and are afraid that at some unspecified future reckoning, their financial management will be deemed incorrect by Voltaic authorities.

IV. OTHER FINDINGS

IV.A. EXPANSION OF THE STATION

Ideas were entertained at various times in the project period - both by American development agents and Tangaye villagers as a consequence - for the expansion of the station. A pharmacy, a general-purpose medical dispensary or a maternity clinic, and even a bar were discussed as possible uses of solar-produced electrical power from which the community might profit. It was reasoned at a January 1980 station co-op meeting that aside from the sorely-needed increased availability of medicines for residents, a pharmacy would attract money from outside Tangaye, and bring publicity, thus enhancing their chances for receiving further development assistance.

Two issues put the above in proper context. The first is available healthcare. With the nationalization of all local facilities, Catholic missionaries can no longer provide the assistance they did till recently. Now all living in a wide circle about Diabo - Tangaye residents included - must depend upon the government dispensary there; like similar facilities throughout Africa, it is plagued by lack of medicines. Local criticism became strident in August of 1980, when a nationwide strike closed the dispensary, a conflict from which villagers received only the most negative of effects.

The second issue is the attention AID has paid to Tangaye, through the solar-energy demonstration and related activities. While in more mundane relations with their government, villagers often feel neglected, the Prime Minister and a number of other dignitaries have visited them with regard to the station. Most important in terms of healthcare was a fortuitous event at the end of March 1980. Gay Morgan of AID-Ouaga happened to visit the station, and learned villagers were dying abruptly of a mysterious ailment

recognized to be meningoccocal meningitis by the authorities Morgan alerted. An American medical doctor took measures to diagnose the extent of the problem, and with the assistance of the Voltaic health service at Fada N'Gourma, a vaccination program was instituted. The people of Tangaye may not have been equipped to recognize and deal with this medical problem, but they immediately appreciated this intervention on their behalf - by the same friendly souls who had brought them the solar-energy station.

This series of events brought to life discussions held months earlier about the possible expansion of the solar-power output to furnish electricity to a small maternity clinic in Tangaye. Coincidentally, work began on the house just behind the station built with AID funds and villagers' labor for the project anthropologist to inhabit during fieldwork. What would become of this fine, solid building? Perhaps this was to be the maternity clinic, or could be converted into a pharmacy or dispensary. An AID staffer informed the village chief that once the anthropologist's project was completed, it would be a community decision as to what use the house would be put (with the stipulation that it not become the residence of a functionary, thus reducing the spread of its benefit to this sole individual's). At a meeting of AID personnel and the people of Tangaye (25/6/80) to discuss the transmission of responsibility of the station from AID to a Voltaic agency, the chief voiced the hope (as did Voltaic health officers on other occasions) that the house could be converted to a dispensary. What remained at the end of the research period was for some one or agency to co-ordinate all these like desires and energies, to create a service so obviously needed.

IV.B. POSITIVE SPIN-OFFS: "DEVELOPMENT BREEDS DEVELOPMENT"

The enthusiasm in Tangaye generated by the station's successes led to several grassroots development projects, notably "The Tangaye Fund" and Arbor Day at Tangaye. Whereas in surrounding villages there are few if any active co-operatives, in 1980 Tangaye boasted twenty-three (up from the 14 at the time of the station co-op's formation). This enthusiastic spirit was harnessed by the station manager, the Voltaic extension agent and the primary-school teacher in planning the Fund and Arbor Day.

The Fund had only just begun in September 1980, and was aimed at future micro-scale projects for the village, based on contributions from villagers. Some were reticent then, since the Fund meant the villagers' taking their own initiatives within the ordinary structure of Voltaic extension. Local cases are known of villagers being rebuked by local administrators and assemblymen for not going through the proper channels - cause for others to hesitate. Yet Arbor Day (July 1980) was a success, and hopes were high that other projects by and for Tangaye residents might be realized.

In February of 1981, the former station manager (who was transferred to another AID project elsewhere) wrote me describing the progress of the Fund, now called "The Tangaye Development Commission." The village chief was named honorary president, a retired soldier (who has figured in much of the local-level politics concerning the station) president, the anthropologist's cook vice-president, the station co-op president its treasurer. Donations were received, including ten percent of station mill revenues, ten percent of revenues from seventeen agricultural co-operatives in Tangaye, and sums from the "animists" led by the chief, the Catholics, Muslims and Protestants,

the retired soldiers and merchants as groups. Subscriptions were sought from Tangaye residents abroad, and at the writing, those in Abidjan had sent 100,000 CFA ($500). Provincial authorities had signed the Commission's livre d'or, as had U.S. Embassy and AID staff. The station manager promised to maintain his interest in Tangaye and its Commission.

The Commission is to continue the grassroots reforestation project begun in 1980 with Tangaye's Arbor Day. The station manager and others began planning Arbor Day early in the summer of 1980, and raised 63,000 CFA ($315) from villagers' personal donations (29,000f), the station mill revenues (15,000f) and from American Embassy and AID staff (14,000f). These funds purchased trees from a nursery and the gasoline for a vehicle to fetch them, beer, soda, a sheep, macaroni and sauce for the feast accompanying their planting. The Voltaic extension service sector chief was to have sought the trees, but failed to keep his promise; an AID vehicle fortuitously available was borrowed, its gasoline reimbursed. The sector chief and other honored guests helped plant the several hundred trees, speeches were delivered, food and drink consumed; it was an enjoyable event for all.

In July of 1981, I learned from some NASA LeRC people who had been through Tangaye shortly before, that villagers are discussing the means by which they might use mill receipts as collateral for a loan with which to purchase grain; it is my understanding that the Fund would be the organizational base for this activity. The grain would be stocked and resold. An old cement silo stands on the eastern border of the village, left from a similar project instituted by the French. This activity would be interesting to follow through some future study, since here is an example of enthusiasm from one project leading villagers to take the initiative to institute others, to their community's benefit.

IV.C. THE FUTURE OF MANAGEMENT

Villagers felt apprehensive about the future of station management, as they faced the turnover of responsibility for the demonstration from USAID to the Voltaic agency, Hydraulique et Equipement Rural, the H.E.R. They have many disappointments in their immediate past. In 1979, Tangaye was promised one of the AID-funded community centers of the Eastern ORD; nothing has happened since then, and some said that AID had never funded the center as promised, while others said they had (the innuendo being the funds have been misappropriated). The ORD womens' programs agent has not had a contract since last December; she has continued to visit Tangaye nonetheless, continuing her baby-weighing and women's-advice programs, without being paid to do so. Late in August word had it that she will be sent elsewhere, and no replacement appears expected. Other healthcare problems have been mentioned above. The greatest blow of all has been the decision to make the new, paved road from Ouagadougou to Fada N'Gourma pass to the north of Tangaye, isolating the villages along the southward bend that the old road took.

With all this as a backdrop, the fact that the one project they have received, that has brought them attention and benefits, is to be given over to the government that has not kept promises, makes people understandably anxious. This was very clear during the meeting of June 25th, 1980, when AID staff came to explain the transfer to the chief and people of Tangaye. People are

very proud of the station, which they refer to as "the first such installation in all of Africa"; its "secrets" only concern Tangaye residents, and need not be heard by others. The chief said he hoped the AID project manager would not "abandon" them. The station is like a bicycle given as a gift without a pump, one cannot travel far; so it is with the mill, they do not know how to repair it, and it will surely break down. As he poignantly concluded, "We don't even know how to stay healthy ourselves, how can we fix those machines?" He said he asked the AID project manager and God to allow the relationship with AID to continue. Again, such anxiety must be seen as a function of insufficient explanation of the demonstration at an early date, a process which should continue throughout a project's life.

The matter of the station manager being replaced by someone from Tangaye was broached at the same meeting. One man said that the manager's knowledge was not simply a hat that could be taken off and given another to wear, but required slow and deliberate training to acquire. The chief countered that just as when someone helps you to bathe by pouring water over you, you yourself must do the scrubbing; so must they now assume responsibility for station management. The chief continued that the person chosen would indeed need training, that like a father must teach his son how to weave cloth, this taking much time and patience; so did he hope that AID and the project manager would carefully teach the person over the course of months in how to manage the station as has the present station manager. People felt apprehensive concerning the future of the station; there was some jubilation as it was revealed that the NASA Lewis Research Center would prolong their technical support for another two years. The evolution of management beyond this point should be subject of further study.

IV.D. THE PARADOX OF DEVELOPMENT: THE TANGAYE CASE

To the solar-energy demonstration's great good fortune, both the AID/Ouaga project manager and an assistant from the same office had backgrounds in engineering and physics, respectively, and both took personal interest in the Tangaye project. The combination of their interest, special skills and dedication, in concert with the station manager's fortuitous resourcefulness, responsibility and enthusiasm, have given this project its success. Other projects may not prove as lucky, and may then fall into the statistical category of "failures" according to some measures, even though their design, planning, and general conception may have been as apt and innovative as were those of this "success." A paradox of development is that any given project is like an inverted pyramid resting upon the shoulders of a very few (often a single project manager). The apex of this whole pyramid meets that of another: that of those to benefit from the project, mediated again by one or a very few. The slightest "breeze" of misfortune may topple such a structure. Furthermore, this fortuitous element must be given close consideration when weighing possibilities for replication on the basis of one or a small number of pilot projects.

V. RECOMMENDATIONS

V.A. WHICH APPLICATIONS APPEAR MOST PROMISING?

The present milling demonstration, for reasons of financial constraint and a feeling that "local life should be disrupted as little as possible by the experiment (the project should be carried out on a modest scale)" (French 1977), was not of sufficient magnitude for many of the issues proposed for study in "Energy Needs in the Food System" and subsequent documents to be studied closely or quantitatively. Other factors as well, including some of the assumptions basic to the project, contributed to more questions being raised than answered - in many ways a healthy result.

The fundamental misunderstanding of the demonstration's history (mentioned in Section I.A.) - hence of its results - continues to cause difficulties. Essentially, the proposal had two parts, both of which were accomplished.

a) "Energy Needs in the Food System" proposed a study in which a black-box electrical source would provide an energy input to a studied system of food preparation; the research results would consist of a before-and-after socio-economic portrait of village work that would allow AID planners to consider options for intervention. This was achieved, with qualifications concerning its assumptions as discussed at length above.

b) NASA LeRC wished to test PV technology in the physical setting of Sahelian West Africa (e.g., for its insolation, dust, temperature fluctuations, etc.) and in the human setting of a village where people with little formal education would be called upon to provide its minimal maintenance requirements and receive and utilize its benefits. This, too, was achieved.

The two parts, however, have been misconstrued as halves of a whole by most observers, who then justifiably question the wisdom of installing a pump and mill "which no African village can afford to establish or maintain". Indeed, how could this be termed "a success as a 'development' project in terms of replicability or encouraging self-reliance"?

As an experiment, the PV system at Tangaye has incurred expenses future applications should not , now that certain engineering lessons have been learned. For instance, the modules first employed at Tangaye were standard ones already in use in a variety of contexts, over more than a decade; that it was discovered that long-term exposure to the remarkable diurnal temperature changes of the Sahel would cause open-curcuiting, is an important experimental result that will have global effects, as the new generation of standardized modules corrected for this shortcoming are deployed. Life-cycle costs of PV systems appear competitive with fossil-fuel systems in certain conditions which should dictate application choice.

Clearly, the project as it stands is not replicable (although it has encouraged some self-reliance, as in Section IV.B.); but just as clearly, as an experiment it was not meant - and does not need - to be. To my understanding, neither those framing the "Energy Needs in the Food System" research, nor those testing and demonstrating PV technology, intended or intend to dot Africa with solar-powered grain mills. A hand-driven mill could be substituted for the PV system and remain within the results and purview of part 'a'; and PV technology can be given other applications deemed socially/economically/politically "suitable" and be within those of 'b.'

Tangaye was chosen the site for a solar-energy demonstration according to the research plan outlined as "Energy Needs in the Food System". 'Choosing' is distinguishing, but also differentiating, separating, dividing -and ultimately - discriminating; as such, being chosen is primal stuff for local-level, factional politics. It is recommended that until such time as village power systems can be provided all villages fitting certain criteria such as size, need, distance from a grid and the like, applications be chosen which serve many across factional (lineage, clan, tribe, economic capacity, affiliation with central government, etc.) lines. This underscores the wisdom of AID's decision to turn to the upgrading of healthcare facilities in the next round of PV applications (with attention to educational or other general-welfare possibilities in the near future).

I. H. Usmani, Senior Energy Advisor for the U.N. Center for Natural Resources, Energy and Transportation, has insisted that rural electrification may "symbolize the LDC government's concern for the quality of life of its citizens." Rural electrification is "a tangible dramatic symbol of progress, a source of intense local and national pride." It is true that such issues may not receive sufficient consideration by US planners, and that "developing nations that purchase photovoltaic technology are also buying 'pride and progress'" (DOE/CS-0078 1979:1.14). It is recommended that socio-political aspects of "pride and progress" be considered on a case-to-case basis, however. Great care should be taken to situate even the smallest development project in all levels of politics, economics, even religions, that a total evaluation be possible; and to understand what these terms mean in the local idiom of each host group.

Nor is this to say that electricity, whether provided by a PV or other source, is needlessly newfangled in the Sahelian context. I would agree with recent suggestions by AID staff (made in conversation) that a lack of suitable, non-human energy is a fundamental constraint to economic and social development. While some consider such as hoeplessly idealistic, it does seem possible that dramatic changes may be instituted by upgrading (or providing a first, non-human or animal) energy source. This must be deliberated with great care, however, as particular projects are considered. A wholly mechanical intervention - hand-driven pumps or mills, for instance - might be more appropriate in certain circumstances.

This raises two questions. The first is a point made at the Africa Bureau staff meeting when parts of this paper were presented (on 10 July 1981 as a part of the present contract). A skeptic noted that many times Africans have not been able (or, I would say, willing) to maintain relatively simple hand pumps; how could they be expected to deal with complex machinery of the type in application at Tangaye, without intervention from some central agency? A familiarity with skills commonly demonstrated in the bicycle and moped repair sections of any African market should dispell the notion that Africans without formal training are unable to repair mechanical devices; often quite ingenious methods are used to "jerryrig" (a poor translation of the French bricoler) devices when particular parts are lacking. Whether or not they are willing to repair handpumps or whatever is often a matter of local and national

politics which require particular study.

Another side to the same issue is dependence upon foreign donors first, then upon some central agency to provide guidance, parts, and maintenance. Foreign assistance is meant to be catalytic to development, not to be development. By building a system in which villagers must rely on governmental agents to intervene in cases of breakdown, one immediately falls victim to the inefficiency and lack of resources that plague any bureaucracy. In the Tangaye case, would HER engineers have the gasolene and vehicle, staff and time to fix the system should it need it? Would doing so be of sufficient priority to assure its being done?' There is a thin line between a realistic view, and an overly pessimistic one. These are the sorts of conundra that face all development planners, yet there is no reason to dismiss or criticize out of hand a project's dependence upon a central authority simply because of the inconvenience AID staff may have experienced in past circumstances. Again, decisions of the sort need to be made on a case-to-case basis; that is, deliberate decisions should be made uninfluenced by insensitive - and unethical - pessimism (e.g., "West Africa Wins Again," and related, jaded perspectives).

V.B. LESSONS AND RECOMMENDATIONS REGARDING IMPACT OF THE PROJECT

It proved difficult to measure with any precision the impact of the project on village women who may use the mill as infrequently as once every twenty days or more. The greater electrical output from the array upgraded by NASA personnel in 1981 will allow more women to use the mill, or the same women to use it more frequently. In seeking to enhance benefits from a project such as this, it is recommended that implementors (AID staff in concert with host-country counterparts) make every small-scale project one integrated with other extension services. If time is freed by solar-powered milling, and it is hoped by planners that such time will be used "productively," then guidance and alternative activities within established extension programs should be available for women to exploit during freed time. No expressed attempt was made to enhance this linkage through publicity and efforts to make alternative activities attractive in this new context. Extension work was always separate from the research consideration and goals of the Tangaye project, and properly so; but the helpful input of the project on local as well as national levels could be improved with greater attention to integration with host-country--and probably international or religious aid agencies'--programs. (e.g., agricultural activities, infant care, cottage industry development, etc.).

A related point made by Burrill and Popper is that "villagers need to know (share information about) what new uses they make of the time that has been freed as a result of the pump and mill in order to: a) define the best uses of their time, and b) stimulate further use of the mill." (1978: III-2). This valid suggestion highlights the lack of integration of rural development with regard to the Tangaye project.

A case in point would be that of station water; it was found that in October, 1979, women walked beyond the station to the stream, to obtain water preferred according to culturally-defined criteria. As a part of an integrated project, Voltaic authorities might have been approached to clean and seal the well (as it is, debris occasionally falls in, around or through the loose wooden cover, and frogs, insects and other visible organisms can be seen in the water), and to institute an input to existing extension assistance to educate women concerning water hygiene.

The matter of training villagers to assume responsibility for the station's maintenance can be mentioned in the context of the project's impact, as well. Tangaye residents were worried about the future of the station, and their capacity to maintain it once AID's direct involvement came to an end. Some have interpreted this as indicative of the entire project's unsuitability, as one overly complex to begin with. Hemmings was very concerned about this matter, and made suggestions that might lead villagers to consider the project their own. While her idea of several months' training might be too great a commitment of time and funds to be practical, a compromise with more complete training than the one weekend's session that was provided might have alleviated some of the confusion from the start. In other words, I do not believe that villagers' anxiety at the end of the project, their fear of not being able to repair or otherwise maintain the station, is so much a product of the demonstration's inappropriateness, as it was of a failure to properly prepare villagers for this eventuality.

V.C. PLANNING AND INTRODUCING TECHNOLOGY

Although some host-country counterparts and other interested individuals were contacted at early stages of the project's inception, no systematic attempt was made a) to include these parties in the evolution of the project, or b) to maximally exploit the project by contacting host-country individuals immediately outside of the immediate sphere of "usefulness." For instance, the Rector of the University of Ouagadougou has training and interest in solar energy, and yet to my knowledge was only contacted after closure of the project period (by NASA personnel late in 1980). It is recommended that host-country officials and experts be contacted before project implementation, and that their participation be actively sought throughout the demonstration's evolution. "Cost-effectiveness" would therefore be increased. University physics classes, for instance, might use data from Tangaye in coursework, and might make field visits as a "laboratory" exercise. Diplomacy of the sort is useful on many levels, among the more pragamatic being the stimulation of wide interest and awareness of PV

technology as a viable base for rural development, hence creation of a market; and the increased capacity and willingness by local experts to assume later responsibilities for evaluation, data-collection, or other follow-up tasks beyond the first project period. Mission managers with concurrent responsibility for several projects may fear the loss of time from "real" concerns this may entail, and may consider any such suggestion as hopelessly idealistic; yet a disinclination for such diplomacy should be considered counterproductive to American development goals. While such activities may not be directly necessary from an engineering standpoint, they represent a public relations opportunity not to be missed. If, as some have suggested, PV technology stands a chance of enhancing rural development in a dramatic fashion, it will do so only if its total place in people's lives is recognized by all concerned.

V.C.1. INTRODUCING THE TECHNOLOGY

In early memos concerning the Tangaye project, it was stated that "rather than the village chief, . . . some more development-oriented unit capable of administering local development projects should be found, "for this demonstration unit to be as demonstrative as possible" (French 1977). It is true that existing strategies of host-country extension services should be followed; and that if there are village co-operatives, they should assume proper responsibilities for village projects. But the above position may be most "demonstrative" of our own biases of which planners should be aware. American ideology has anti-monarchist origins and propounds an egalitarianism scarcely or rarely achieved in its own society. It is recommended that planners (AID in collaboration with host-country) decide who should administer a project on a case-to-case basis according to prior scrutiny of village institutions. The well at Tangaye was considered the chief's prior to its improvement with the solar-powered pump. Tangaye was chosen because of its "discipline." Discipline depends upon some combination of common identification of benefits, a common desire to assist in attaining goals; and/or upon established authority organizing and directing efforts. In Tangaye, the balance of responsibilities between chief and co-operatives pre-existed the solar demonstration; the naivete of the chief's being made to feel excluded from the stage of station co-operative formation (when he had been instrumental to earlier process) was rectified by villagers.

This is a different issue from that of spread of eventual benefits of the station. Proximity to the station has dictated greatest benefits; the chief and his people live closest to the station, and they receive its input to their lives in a manner that other villagers do not. Might this be interpreted as AID's giving a plum to the chief, thus underscoring or lending support to his authority within the community? As one observer asked, didn't the existing power "absorb" the project? The answer to both would be affirmative, or at least could be, depending upon one's perspective. Planners should decide whose prerogative it should be to attempt to alter village social patterns of the sort. In all likelihood, had the station been located elsewhere within the community, as close to a different hamlet as it is to the chief's, then those others would have exploited its services much more, and the chief's people proportionately less. I heard no complaints about the chief's people receiving undue privilege in this manner (whereas I did hear them concerning other matters, as outlined in the management sections of this and earlier papers). Presumably, the recent upgrading of the facility through NASA LeRC's increasing the electrical output will increase the benefit spread for milling, although proximity to the station will remain all important. When social life centers about the chief, should a

project like the Tangaye demonstration be placed away from that physical and social center?

V.C.2. LOCAL MANAGEMENT VERSUS AN OUTSIDER AS STATION MANAGER

Despite considerable discussion during the earliest stages of the project's planning (outlined in the baseline study), village women or men were not given primary responsibility for management, either under the guidance of the women's extension agent (animatrice) or through the station co-op. Instead, by a combination of circumstance and his own charisma, the AID-funded record keeper became de-facto "station manager" and assumed most of the functions never taught station co-op members.

Placing even a small-scale development project in a village means that a new field is opened for old battles. A community coheres through tension: the positive sort of kinship and affinity, the negative of disputes and their resolution. Most co-operatives in the area have never gotten started, have had disappointing results or have failed altogether, in Tangaye prior to this project and in other surrounding villages now. Perhaps it takes an outsider like the station manager to organize people on the plane desired for station management; not being a part of local-level politics (at least at first) may be a boon to such work, an advantage no local person could have. On the other hand, one of the manager's first actions was to establish a bond with the village power base - the chief. Successful social management in such a situation does not mean rank imposition of ideas, but rather their insinuation, that they appear to come from within established ranks, but also retain the cachet of "outsiderhood." The manager proved very adept at this.

The obvious difficulty with such a perspective is that there are not many individuals like the manager in this world; one certainly cannot count on finding one just because a need exists. Voltaic village extension agents are supposed to possess just such qualities and to fulfill such functions, and yet their uneven performance attests to how hard it is to find a "good man." The definition of a "good man" depends upon who is doing the defining, and in what circumstances (historical, political, economic, soical) the candidate is allowed to demonstrate his capacities. There seems no ready solution to the dilemma of choosing between a totally grassroots organization versus the introduction of an organizer; this project has worked well with the latter, probably better than it could have with the former. The fear remains that unless people make their own mistakes and achieve their own solutions to problems, we shall never escape a Eurocentric perspective. To escape one, "inefficiency" and even "project failure" (as defined from Washington or by its representatives) may be the price.

V.C.3. WOMEN AND MEN IN MANAGEMENT

Third-World women have recently and repeatedly accused Western feminists of "cultural imperialism" and of condenscension vis-a-vis Third World women they may perceive to be in "bondage" to men. U.S. development programs now have a Women-in-Development component, and rightly so; yet a possibility exists that a nation which refuses to accept the ERA Amendment may assert a more radical sexual egalitarianism in planning development projects abroad, than is assumed proper at home. The benefits of the Tangaye project were directed

at women, and so it was assumed that women would manage the project. Yet Zaose women like those at Tangaye do not deal with machinery; culturally, this is a male province, just as cooking is a female one. Men and women should not work together in the close confines of a building like that for the mill (where female accountants might still assist male millers), to avoid sexual misadventure (or suspicions thereof). It is recommended that both an under-emphasis and an over-emphasis of feminist or other culturally-derived ideological positions be avoided by a measured scrutiny of local beliefs and practices, on a case-to-case basis in collaboration with host-country counterparts.

V.D. RESEARCH AND EVALUATION METHODOLOGY

V.D.1. THE BASELINE STUDY

The Tangaye project was a part of the umbrella study, "Energy Needs in the Food System"; five months were dedicated to establishing a data baseline, a period longer than will be possible for most future projects. For ones that are of this length and for which research is the primary objective, it is recommended that the anthropologist be resident in the community under study, and that s/he suspend all other research obligations. A baseline study should be a self-contained document, with adequate explanation of method, perspective, and all findings (especially quantitative ones). The anthropologist who undertook the baseline study for the Tangaye project did not perform mid-term or final evaluations; because many assumptions were taken for granted in the baseline, the later investigator ignorant of these was handicapped.

Because it cannot be known in advance what factors will prove most significant in evaluating social impact, which persons or activities will facilitate or impinge upon the project's success, and the like; a baseline must establish a wide sweep of data, under the assumption that this will lead to long-term assessment. Tried and tested methods exist to assist in this task: maps may be made of areas under cultivation (to determine whether more acreage is cultivated because of water or milling); maps of distances to fields, pasturage and firewood sources, and of compounds indicating numbers of and quantities contained within granaries could also prove useful. Because of the ardousness of this task, several hamlets at Tangaye might have been targeted. An established census form (e.g., The Rhodes-Livingstone Institute Census Card - Epstein 1967: 247) could be administered to determine social characteristics of the community. A veterinary's assessment of the health and care for cattle might be sought. Market measures of beer-brewing, handicraft production and the like could be established. Observation and interviews of particular women engaged in such activities could be followed up in later stages of the research. As a proverb cited at Tangaye has it, "the heel may hurry, but it will never get there before the toe"; trying to reconstruct data hindside-to is doomed from the start. A anthropologist resident in the community and aided by salaried assistants should be able to complete such work (as well as the more particualr tasks of the project, like determining the nature of village activity cycles, water resources and their exploitation, food preparation and schedules, and the like) in five months. An additional benefit from such a holistic approach (and an added incentive for the career-minded anthropologist) would be that such a study would be a veritable ethnographic monograph, which might be published through an interested host-country university

journal or series, and thus become available to a wide spectrum of readers. Information gleaned at taxpayers' expense would not "die" with a particular project or within a particular set of offices.

V.D.2. MID-TERM RESEARCH

The strategy for the entire research project was devised by Hemmings, with minor modifications made during a brief mid-term visit by the present author. Questionnaires were prepared that could be administered by assistants in the absence of an anthropologist's direct supervision. It is recommended that questionnaires, if used in a study of this length and depth, be a secondary tool, complementing interviewing and participant observation by a resident scientist as primary methods. Assistants should remain that; the weight of the study should rest upon a trained anthropologist's own insight. It is further recommended that when a village the size of Tangaye (with its widespread hamlets) is to be studied, that parts (hamlets or neighborhoods) be targeted according to explicit criteria, rather than spreading a sample across the entire community; this will allow sufficiently-close scrutiny within the limited time available. The identity of households or individuals in the sample, if deleted from circulated reports, should be kept available for follow-up studies.

A related recommendation concerns the deployment of time; in future studies in which assistants will administer questionnaires for six months or longer as was the case at Tangaye, the principal investigator's salaried time should be divided in such a way that s/he can review completed data sheets at some midpoint. Oversights or errors may be discerned in such a manner, and rectification made. If, for instance, the anthropologist is to spend three months in the field for a final evaluation, two weeks of that paid time might most profitably be spent three or four months prior to leaving for the field, studying data collected till then, at his/her own home institution.

V.E. OTHER POINTS

Following the baseline-study period, consultants Burrill and Popper noted that "the Solar Energy Demonstration in Tangaye is an inter-agency project. It presently lacks design clarity, and communication among the parties to the project is less than optimal" (1978: I-3). This confusion preceded their intervention, and did not abate as the project evolved. Different participants saw different goals for the demonstration, and the fact that social research was the primary focus of the whole plan was sometimes overlooked. Burrill and Popper noted at one point that "AID should review Ms. Hemmings' data collection plans to ensure coverage of such items as . . . ." (ibid III-7); in my experience the predominant feeling at the Ouagadougou mission was that this project was so small compared to the mountain of responsibilities with which each harried staffer had to contend daily, that if social research was to be done (and one questioned its need, indicating a lack of knowledge of the basic project goals), the scientist hired to undertake it should assume all responsibility for design and completion. This is not to say that mission personnel were not helpful, nor that they did not provide extraordinary assistance while investigators were in Upper Volta and in their absence.

It is noteworthy, however, that NASA personnel who visited with Hemmings while she was conducting the baseline study felt that "she had not been given

adequate direction to structure the socio-economic study to develop the data during the period of the experiment necessary to conclude her study" (Ratajczak 1978:9). The baseline report lacked direction and purpose, reflecting to some degree that AID staff did/could not offer sufficient guidance.

Such difficulties are both a function of the particular personalities of AID mission staff and consultants, and how well they can work together; and of tendencies experienced in this project and apparently more generalized, judging from comments at a recent conference on social-impact analysis held at Michigan State University. In part this reflects a lack of oversight (e.g., of basic assumptions being explained to and understood by parties over the course of personnel changes within the project period) and a lack of information-sharing. "Energy Needs in the Food System" was not required reading, made available to the anthropologist assuming responsibility for mid-term and final assessments, with the dictum that it be consulted before proceeding further. Financial constraints meant that all of the brief period allotted the mid-term study was dedicated to achieving "tangible" goals, as outlined in the scope of work. From the outside, it seems as though AID has too many projects going on simultaneously, with too few people to staff them properly, and too little money to allow consultants to properly research their field studies. Such dire constraints mean that a desire for continuity among parts of the same project, among different projects of the same or related sorts, among similar projects by different agencies over the years (including colonial periods) becomes somewhat whimsical. While an anthropologist's desire for profundity of research may be unrealistic for most projects, it is heartening to learn that AID is making great strides to include the assessment of social factors as an early input to project design. AID has recognized that "there is still too much of an adversary relationship between AID generalists and anthropologists" (Shakow 1981: 10); the compromises that will be drawn between academically-oriented social scientists, and AID generalists (with their "more conventional emphasis on engineering feasibility"- ibid., 8) will profit those that should be the focus of both parties: the poorest of the world's poor.

WORKS CITED:

Bifano, W.
1981 Review of Stand-Alone Photovoltaic Application Projects Sponsored by U.S. DOE and U.S. AID. NASA LeRC.

Bosken, J.
1976 Studies of Energy Needs in Food System. TAB 931-11-995-234.

Burrill, G. and R. Popper
1978 Evaluation Planning for the Tangaye Solar Energy Demonstration. Pratical Concepts, Inc., for USAID/UV contract AID/ta-c-1469.

Epstein, A.
1967 The Craft of Social Anthropology. London, Tavistock.

Hemmings, G.
1978 Base-Line Study for Socioeconomic Evaluation of Tangaye Solar Installation. USAID/UV (report number unavailable).

Meyer, R. et alia
1978 Solar Energy Demonstration - AIP. PID no. 686-0234, USAID-Ouagadougou.

NASA LeRC
1977 Project Development Plan for Solar Photovoltaic Energy Demonstration in Upper Volta. Photovoltaic Development and Support Office, NASA Lewis Research Center.

Ratajczak, A.
1978 Memo from 4222/Head, Application Engineering Section, 21 March: Trip Report. NASA LeRC.

Roberts, A.
1979 Mid-Term Evaluation: Social Impact, Tangaye Solar Energy Demonstration. USAID contract AID/afr-c-1602.

1980 A Final Evaluation on the Social Impact of the Tangaye (Upper Volta) Solar Energy Demonstration. USAID/UV contract AID-686-089-80.

Shakow, A.
1981 The Policy Perspective: Anthropology in the Agency for International Development. Paper delivered at 79th Annual Meeting of the American Anthropological Association.