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AN UPDATE OF THE
SOCIO-ECONOMIC IMPACT RESEARCH
ON THE TANGAYE (UPPER VOLTA)
SOLAR ENERGY DEMONSTRATION

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PREFACE

The following is a report submitted to the Photovoltaic Development and Support Office of the NASA Lewis Research Center (Cleveland, OH USA) somewhat expanded for greater clarity. Nevertheless, many of the references will be best understood with regard to previous reports. It is hoped, then, that readers will read this update as such, as the "longitudinal" or diachronic study of the Tangaye Solar Energy Demonstration continues.

TABLE OF CONTENTS

Preface	i
Table of Contents	ii
Introduction	1
A. Background	1
B. Setting	2
Mill-Use	3
Upkeep of the Mill	10
Mill Earnings	16
Issues of Health at the Station	18
Water Use	20
The Mill Cooperative	21
The Station-Manager's Replacement	22
Replacement of the AID Project Manager	24
HER Involvement in the Tangaye Demonstration	25
Use of the "Guest House"	27
Exposure/Spread Effect of the Tangaye Demonstration	34
The New/Old Road Issue	37
Notes	39
Works Cited	40
Appendix I Mill Expenses and Deposits	41
Appendix II Trip Report: 15-16 July 1982	42

Introduction

The Tangaye Solar Energy Demonstration was visited from 5-14 July, 1982. Mr. Ouedraogo of the Upper Voltaic Water and Rural Works Department (Hydraulique et Equipement Rural, HER); William Bifano and Richard DeLombard, respectively Manager and an Engineer with the Solar Energy Projects Office of NASA Lewis; Larry Dominessy and Kevin Mullally, outgoing and incoming AID-Ouagadougou project managers; and Dr. Allen Roberts of the University of Michigan arrived at Tangaye on 5 July. All but Dr. Roberts returned to Ouagadougou the following day.

Bifano and DeLombard visited Tangaye (as a stop on a multi-purpose trip to Senegal, Mali and Upper Volta) to check the PV system about a year after it had been modified (see below). Dominessy was making a last and Mullally a first visit to the station. Ouedraogo assisted the team's effort and discussed the HER's continued interest in and commitment to the demonstration. The purposes of Dr. Roberts' visit were (a) to update the socio-economic impact studies of 1979 and 1980; (b) to study the effects of NASA Lewis' having increased the PV array and electricity output, with regard to station use; and (c) to focus particular attention upon the evolution of station management over two years since his last visit to Tangaye.¹

A. Background

For six weeks in the spring of 1981 (20 April till 3 June) James Nichols and James Martz of NASA Lewis replaced all photovoltaic modules with ones of slightly different design, as those originally installed in 1979 "were failing due to thermal stress-induced fatigue cracking of the cell electrical interconnects" (Martz, 1981: 1). Responding to the desire of Tangaye millers and villagers for more milling time made known to NASA Lewis by Larry Dominessy of USAID Ouagadougou, the output of the array was doubled to 3.6 KW peak power.

This modification would nearly triple the hours the mill could be run. A different hammermill (a Jacobson model 120 B) was installed that had been chosen for its reduced maintenance requirements and increased grinding rate (perhaps as much as three times that of the previous mill: 91 versus 30 kg/hr for maize --ibid: 15). The overall efficiency of milling then, might be increased as much as 9 times over what it had¹ been until then.

A few other changes were made at the Tangaye "station." The floor of the battery room (a portion of the mill building) was cemented. A sodium vapor lamp outside and fluorescent lights inside the guest house and a refrigerator were installed. These would be new loads for the PV array. Running water was also brought to the house from the station system.

Mill personnel, Tangaye residents and Daouda Yeye of the HER offered invaluable assistance and were given on-the-job training as these adjustments were made. An automatic data recorder was installed but other information (specifically concerning the PV-powered refrigerator) would be collected by the station manager. Villagers were enthusiastic about the improved system (ibid: 16).

B. Setting

Prior to Dr. Roberts' arrival on 5 July, the rains had begun early, then ceased. Some people in Tangaye planted three or four times, only to have the seeds sprout and then wither. The heavy rain on the night of our arrival sent everyone to their far-flung fields to plant or check on their crops. The Voltaic agricultural extension agent said that one has until the 10th or the 15th of July to plant corn and other last crops if one hopes to have them thrive and ripen before the dry season begins and all growth ceases. The Tangaye markets of 6, 9, and 12 July were about one-third the size of most others seen before, because of the exodus of villagers to their fields where

they often camp overnight while planting and hoeing around seedlings. This set of circumstances meant that for the ten days of Dr. Roberts' visit, fewer people than usual used the station facilities for its direct services (water and milling), or secondary ones (bathing, laundry, etc.). Fewer than usual were available for interviews and observation.

To further complicate matters, a request made in February 1982 that the mill notebook recording names and hamlets of mill users be continued or recommenced was not transmitted to Tangaye. There is no record, therefore, of exactly who has been using the mill during the last two years. To make up this deficit, Dr. Roberts composed a very short questionnaire which was implemented by three research assistants in two of the hamlets selected for special study during the 1980 fieldwork. Because of the brevity of the stay at Tangaye, and due to the nature of a sketchy questionnaire, results of this research must be considered impressionistic and not definitive in any way.

Mill-Use

Bill Bifano and Dick DeLombard from NASA Lewis found that the PV system was working well, although we were told that the lights at the station house turn off automatically around 7:30 or 8:00 PM. This is because the mill is being used so heavily. The system protects itself by shutting off its loads at a particular battery depth of discharge. In effect, then, although the system has been enlarged, the increased use, to be discussed below, means it is still being pushed to its capacity. This is a felicitous finding.

The doubling of the PV array by NASA Lewis a year ago has meant that there is sufficient electricity to run the mill every day of the week for six to eight hours. At first glance, one might assume that the extra mill-use would be by experienced Tangaye villagers taking advantage of increased service,

or by Tangaye residents who had never used the system before. While it appears that this assumption is well-founded, there is another factor at play that was not so expected. The station manager, Fernand, and the chief miller, Sumaili, among others, remarked that people are now coming from "30 or 40 kilometers away" to use the mill at Tangaye. This is especially true for grinding maize and white sorghum, which cannot be ground by other area mills² without an intermediary step of soaking and decorticating, tedious work which people would rather avoid by carrying their grain by bicycle, donkey-cart, or on foot the extra distance to Tangaye. The chief of Tangaye, Kouela Noktanga, said that people come from Tibga and Gounghin (and some other towns/villages he cited), even there where mills already exist, because of this special capacity. This he stated with great pride. Fernand added at the same time that this is why there is always grain waiting overnight to be milled these days since without these visits by outsiders the millers could now easily accommodate all Tangaye villagers' needs.³

As noted above, there has been no continuation of data-taking in the notebook at the mill where, through September of 1980, the identity of particular mill-users was recorded. In order to obtain a better impression of who these individuals might be (or at least to better determine the identity of users resident in Tangaye) a simple questionnaire was devised, and three research assistants sent to implement it. Four questions were asked concerning how many times in the past two months the woman had used the mill; in general, had she used the mill more or less this year than last?; why might this be so?; what would the woman prefer to be doing with spare time freed by mill-use?

Two of the four hamlets targeted in the 1980 study were chosen for scrutiny. Hamlets Five and Nine (see accompany maps) are respectively



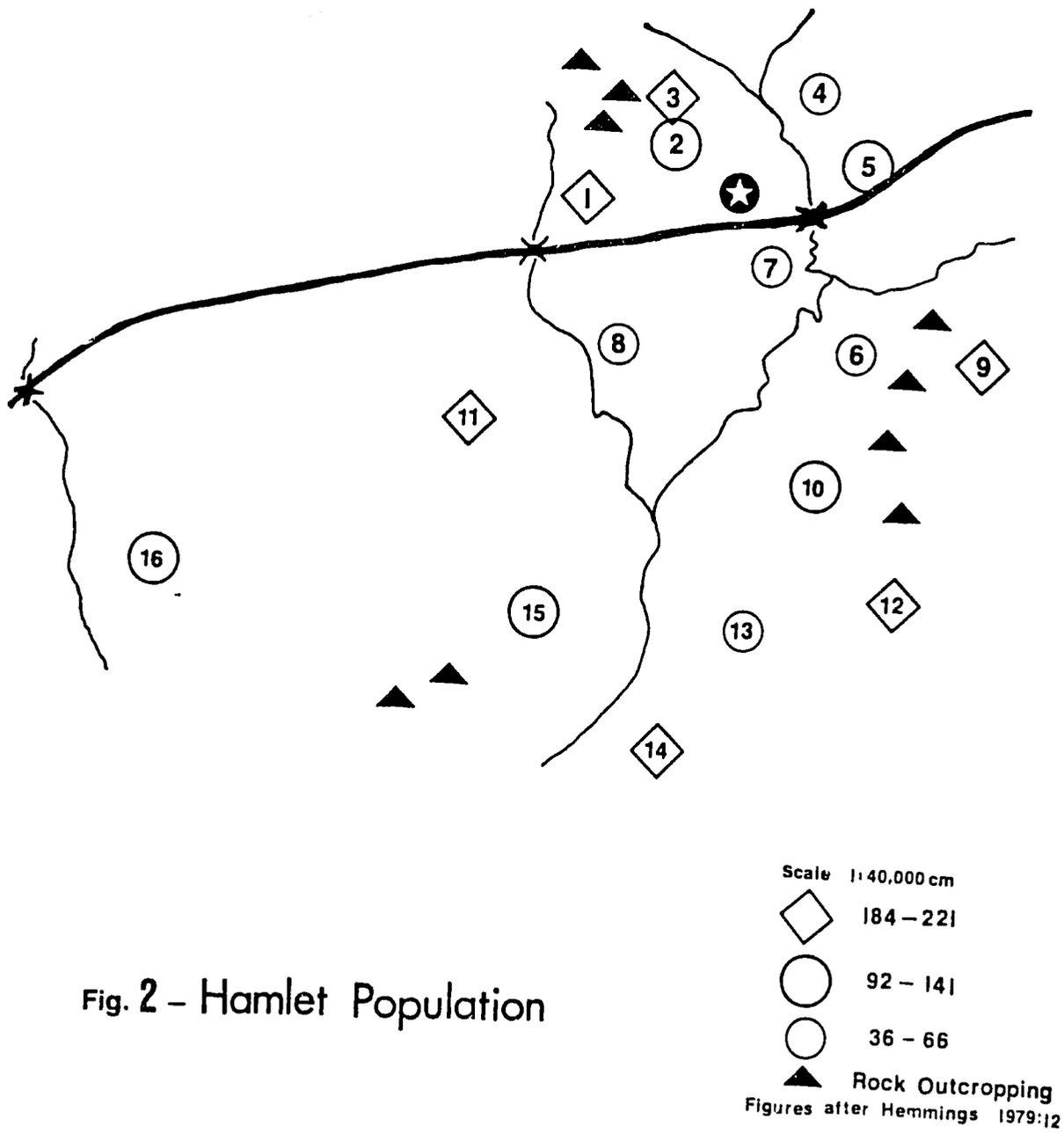


Fig. 2 - Hamlet Population

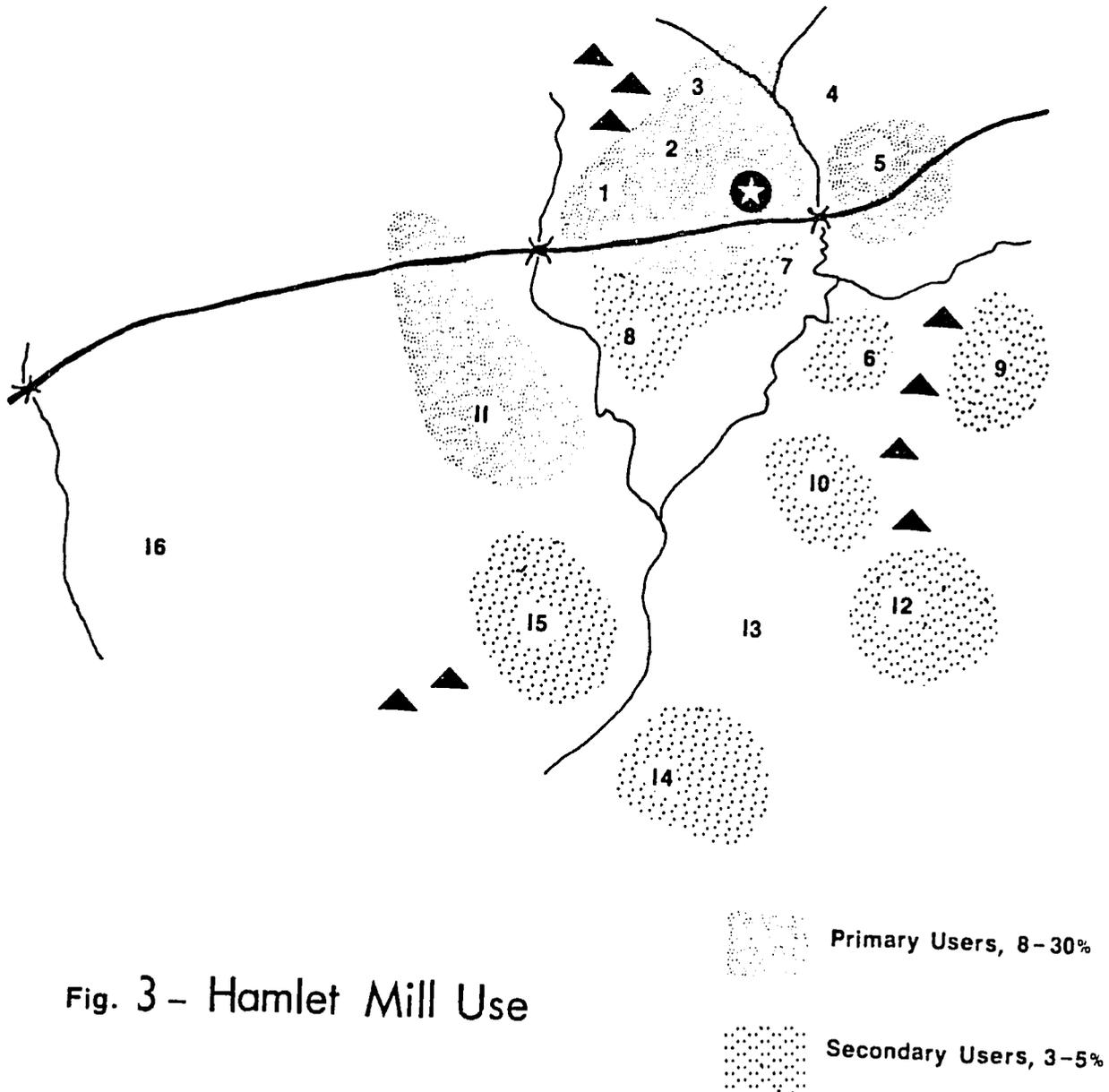


Fig. 3 - Hamlet Mill Use

nearby and at a moderate distance from the station, and are representative of Tangaye's hamlets with regard to population density and characteristics.⁴ Women from Hamlet Five were found to be among "primary users" in the 1980 study, while those from Nine were "secondary users," respectively constituting 8-30% versus 3-5% of total visits to the mill for the given time period (Roberts 1980: 42). Because many people were in their farthest fields cultivating after the latest rain, it was difficult to contact women from these hamlets. While 80-some from these two were, time did not permit us to study any other hamlets than these.

Again, the results so gained are impressionistic, at best. The first question, for instance, concerned mill-use over the past two months. Women cannot be expected to have an exact reckoning of this, and so these are approximative figures. According to the 1980 results, women from Hamlet Five could be expected to use the mill about four times, on the average, for the months of April and May of 1980. Hamlet Nine women used the mill about once for these same months of 1980. In 1982 the approximative figures were six times per woman for Hamlet Five during April and May, and five times for Hamlet Nine. Again, it cannot be said from these figures that Hamlet Five women now use the mill at an increased ratio of 4 to 6 from 1980 to 1982, that is, an increase of about one-third. Nor can it be said that Hamlet Nine women now use the mill five times more than they did in 1980. One can say, however, that on the whole there is some significant increase in mill-use over the two years in question. These averages, however, may be considered more closely through individual responses to the questionnaire.

Of the 82 women questioned, 47, or about 57%, used the mill less than the average of 5.5 times for the two months and the two hamlets combined. Thirty-five women, or 43%, used the mill at least as many as the average of

5.5 times for the two months, or more. A good many of the women who used the mill less than the average number of times did not use it at all. Most who used it the average number of times only used it that often, or perhaps 6 or 7 times in the two months. A very few women used the mill from 12 to 25 times. It is these latter who tilt the average upwards. These same women, if it is true that they use the mill as frequently as they say, must be relying upon its services for almost all of their flour needs. Should there be a possibility for a future follow-up to this study, these particular women should be investigated more thoroughly to determine the nature of their wealth that permits them to use the mill so frequently, and the effect that these services have upon their lives more generally.

Moving to the second question concerning relative mill-use between this year and last, about 22% of the women questioned say they use the mill as often or more this year than they did in 1981. Seventy-eight percent say they use it less. 1981 was a year in which there was no socio-economic study. We could not ask the women to compare this year's usage with 1980, however, since this would be too far removed in time to obtain any but the most conjectural responses. All we can deduce from these answers, then, is that women feel that they are using the mill less now than they once did. This might be interpreted to mean that they wish that they could use it more now than they do, and have in the past.

The predominant reason women give for their using the mill less this year is a lack of money. Perhaps this reflects the worldwide economic recession. A few said that last year they were ill, or pregnant, or had more grain last year and so used the mill more than they do now. Women who say they use the mill as often or more this year, on the other hand, complain that they do so because they are getting older now, that they do

not have time to grind flour themselves for a variety of reasons, or (in a few cases) that they have increased the output from their gardening and thus have more grain to grind. There is also an overall feeling that the harvest last year was more bountiful than it was this year. In this regard they must be referring to the harvest of 1980 versus the harvest of the fall of 1981.

When asked how they do, or would like to, spend their free time, most answered that they would like to engage in more market activities. The form of "penny capitalism" that most of these women would like to increase is the production and sale of soumbala, the fermented locust-bean or soybean cakes used as a seasoning in the regional cuisine. Large numbers of these tiny cakes are prepared in Tangaye and exported to Niamey or other points eastward. Other women said they would like to produce more millet beer, more bean cakes, or would like to sell more kola nuts in the local markets. A few made reference to a desire to increase their cotton-spinning. None referred to a desire to increase her area under cultivation, or to otherwise increase her agricultural tasks.

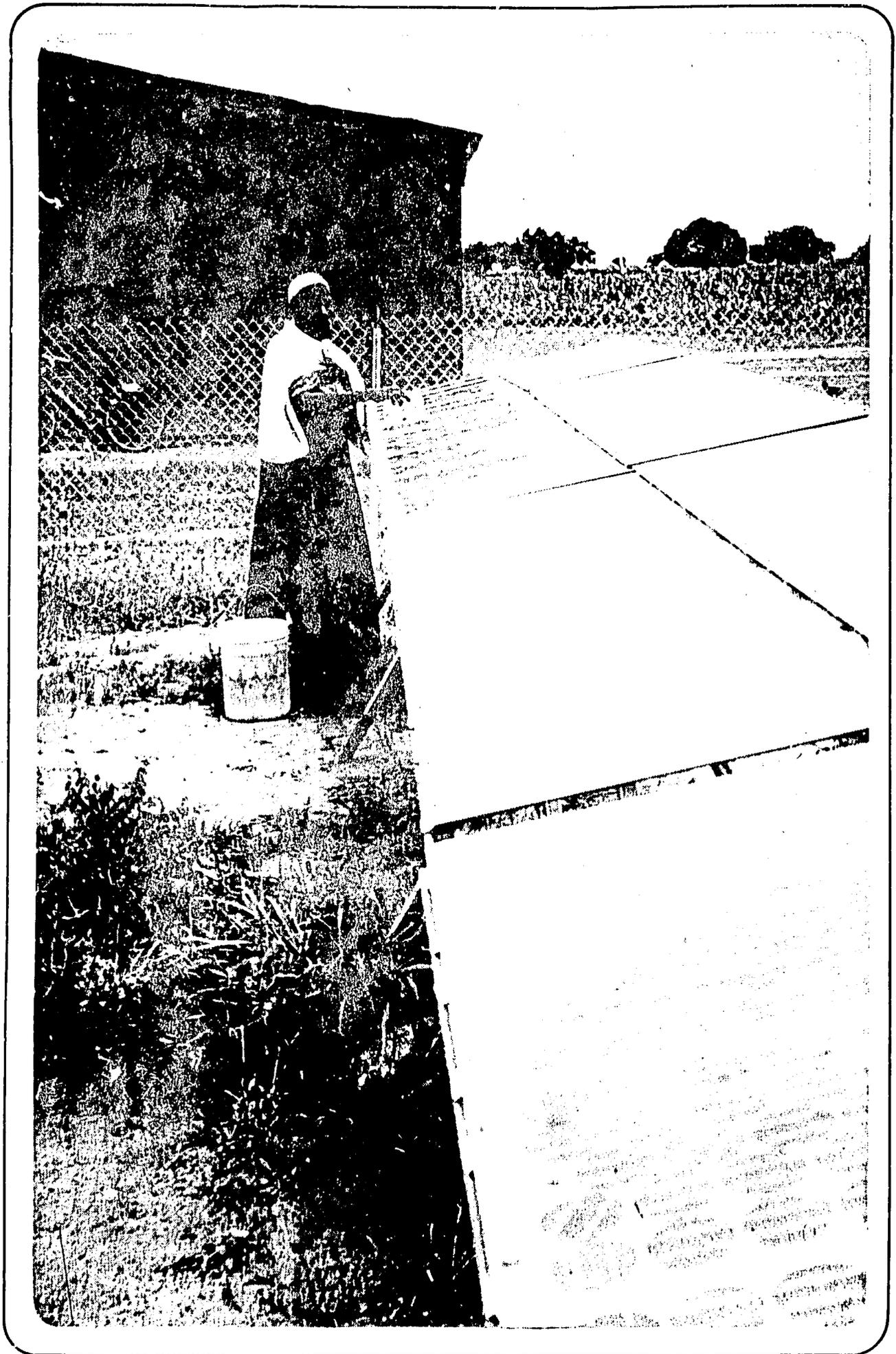
Upkeep of the Mill

When a windstorm lifted the roof from the mill building in late May of this year, one of the beams snapped under the strain and the whole roof and ceiling were tossed behind the building. As Fernand (the station manager) explained, he was just preparing a trip to Ouagadougou to tell "them" about this set of circumstances when Larry Dominessy happened by for a visit. Larry asked if there were funds from mill receipts immediately available and not yet deposited in the Fada N'Gourma account that might be used to buy the necessary 27 roofing sheets and timber. Larry would contribute the nails. There was, and Larry and Fernand took 40,000 FRA francs (about

\$125) and bought the necessary materials at Koupela. The local Tangaye mason worked for free helping to repair the roof.

It was decided--apparently by Larry Dominessy--that the ceiling of the mill building would not be replaced. Larry told me that the ceiling was collecting dirt and was where rats have been nesting. Rats are still to be seen in the mill building and it is not clear whether there are more or fewer now than before. Without an intervening ceiling, however, wind now enters the building under the edge of the roof and blows whatever flour there may be on the floor or in the mill all over the room. When the NASA team arrived on 5 July, we discovered an even and rather thick coat of flour everywhere. Bill Bifano, Larry Dominessy, Ouedraogo of the HER, and mill staff assisted in cleaning the place up during the NASA one-day visit. Bifano noted that flour coating the mill motor could lead to its overheating. The brushes were cleaned as well as the outside of the motor. The matter of this flour will be discussed again below.

Bifano and DeLombard recognized that the station batteries, although still charged at an adequate level, had a depth of discharge such that the station house lights were being shut off automatically in the early evening.⁵ Bifano suggested I ask Sumaili to stop milling for a day or to mill much less for several days, to allow the batteries to recharge from the PV array. Sumaili said that the millers had noticed that the batteries were low by the way the mill was working (a statement for which I unfortunately failed to seek clarification), and they had considered not milling for a while. Sumaili suggested they mill the grain already stored in the building on 6 July from days prior to that, and then stop for two days. In effect, milling was continued on Tuesday, Wednesday, and Thursday, and then the mill



Sumaili the miller washing the array.

was completely shut down on Friday and Saturday. In the afternoon of Sunday, milling was begun again. It had rained much of the early morning on Sunday, and many people were at church. Sumaili and Douala spent the morning cleaning weeds from around the PV array, and then milled through the afternoon.

I told Sumaili that the NASA people had been pleased to find the mill and pump so well kept and in need of so little of their attention. Sumaili said he wanted to keep the mill going for many years, as it is such a help to them and others in villages around Tangaye, who now come there to mill their grain. At one point, Sumaili asked me to photograph him while wiping off the PV array with a sponge and bucket of water "so that they will know we do this every week."

The last set of mill hammers was in use when we arrived at Tangaye. All four corners of the rectangular steel pieces can be used to strike the grain, and so the hammers can be rotated. Larry Dominessy estimated that the present set of hammers would last another two months or more. No attempt has been made to order another set of hammers, which must come from the US. Bifano said he would order some. Clearly, these parts must be stocked or otherwise made available locally, or else a time will come when none is available, and the mill will no longer be operable.

Fernand said Larry told him the mill cooperative should pay for the hammers with mill profits. Again according to Fernand, the Chief of Tangaye had agreed; they would reimburse Larry when the hammers came. On his 5 July visit Larry stressed that the money should be given in advance, and then the order can be placed. The Chief was out of Tangaye and so could not respond to this. Now someone will go to Fada to get the necessary money from the bank account to give to Larry since he is leaving Upper Volta

soon. If Larry were to stay on, Fernand said, they would have left the money in the Fada account and given Larry money from the day-to-day mill earnings not yet deposited.

During the 5 July visit Larry Dominessy fixed the broken springs in one of the faucets from the station water tank. At first, faucets were obtained from local hardware stores; but these proved to have a very short lifetime. NASA Lewis staff provided replacements that would last longer but these were more difficult to obtain. The original idea was that the faucet should be self-closing, that is spring-loaded; perhaps a simpler, longer-lasting and locally available faucet would be more appropriate (James Martz, personal communication).

These cases exemplify the fact that the infrastructure of management of the Tangaye demonstration and especially contacts between the local station manager and those overseeing the project from Ouagadougou require some further attention. An established means of ordering critical replacement parts must be established at the initiative of the station manager in using advanced payment from previous mill receipts. He will not be able to order parts by himself and will need assistance from HER and/or IREN. One of the paradoxes of this sort of development project is that whereas "all" responsibility for the Tangaye demonstration has been given to HER, the mill is of American manufacture and so its parts must come from the U.S. Placing an order for them is difficult from Tangaye or from HER without the assistance of AID staff. It is in this regard that Kevin Mullally's continued scrutiny of the demonstration will prove particularly important. He should assist--but not assume--decision-making in matters such as this if the Tangaye station is to function independently. If IREN staff trained in PV engineering who are experimenting with and will oversee similar arrays

and loads should participate with HER in the ongoing program at Tangaye (see appendix), then their skills may be put to use in this critical domain of recognizing maintenance problems and using their organization and contacts to order and install replacement parts. The complaint one (anonymous) American familiar with the Tangaye demonstration voiced that "it should not be all that difficult" to procure and install parts built if they would get off their duffs and do it" (my emphasis) is a recognition of a problem but certainly not the offering of a solution. Degrees of dependency are difficult to assess since the "success" of a development project may be the product of some expatriot agent or agents taking unusual care, interest and initiative to realize goals defined from the offset or perceived as the project evolves. At what point such mutual effort ceases to be positive cooperation and becomes mendicancy or "neo-colonialism" as it might be seen from opposed viewpoints is a function of political considerations. This sort of issue should be discussed openly between expatriot and Voltaic project counterparts as IREN and the government of Upper Volta seek to establish a national energy program to compliment the particular tasks of agencies like HER.

The above should not be taken to mean that Tangaye villagers are showing no initiative in the upkeep of the station. The retired Voltaic army sergeant major who lives behind the mill and who has been named "mill president" and assistant to Neba, the cooperative president, said (without any suggestion on my part) that the cooperative should get a half sack of cement and fix the porch and one wall of the guest house. These are eroded in the case of the porch by two years' use and in the wall's by damage from the same windstorm of last May which lifted the roof from the mill building. The "mill president" said that they of the station cooperative have two and a half sacks of cement at the station which could be used for such repairs. This

is particularly urgent because rain leaking around repairs made after the windstorm is eating away the corner of the house. Unless repairs are made soon, the entire wall may collapse.

As another case of local initiative, on 16 May 1982, (as recorded in the notebook that Fernand is maintaining) the pump of the station turned itself off. Fernand looked at the fuses and all of them "worked." He opened the switch housing mounted on the pump and took off the "on-and-off" and "the part that is green." He adds that "the green on-and-off is number H3-17A" (a heater to trip the switch on overload). He replaced this latter part and the pump started again. Fernand later showed the part to Larry Dominessy who said that it was not burned out or broken. Importantly, this case illustrates the willingness of Fernand to intervene when there is a malfunction or other problem with the station system.

The new hammer mill installed during the spring of 1981 by NASA Lewis staff has screens that can be fitted into it or removed for replacement. Sumaili said that he and Douala had decided to make a special pierced screen for the grinding of fermented sorghum for beer-brewing. Ordinarily, this mushy substance cannot be ground in local mills. Larry Dominessy said that they had taken a screen that was already well worn and had been replaced by a new one. With a nail as a punch, they had made holes in it about the size of a pen.⁶

Sumaili said that the reason for their taking this decision was "to make money." This was not an outright invention on their part, since it appears that several other mills (although none in the Tangaye catchment area) do have screens which allow the grinding of fermented sorghum. It was, however, a local adaptation made at local initiative. Sumaili said that they had not asked permission from Larry Dominessy to make such a screen (and it should be

noted that he mentioned Dominessy and not HER staff in this context). He did not think that Larry would mind their having done this and I assured him that he would not. I said it seemed a good idea. Of interest is that, whereas in 1980 women engaged in beer-brewing used the mill more than most, this was not to grind grain for the beer-brewing process itself; instead, it was to have finely ground flour at home for quick meals while the women were busy brewing. Now the mill itself plays a part in the production process. Because of the brevity of my visit, a possible increase in beer-brewing due to this new process could not be investigated.

Mill Earnings

Fernand said that since the PV array has been increased, they at the station have been able to satisfy everyone's needs for milling. Those who do not use the mill now do so by choice. No one is dissuaded by the long wait anymore, he added. A few women interviewed still complained of this, however, and flour is left overnight. The comparative lengths of time waiting could not be measured. Fernand also said that whereas receipts for the mill used to be around 18,000 francs for a good month, now they may bring in as much as 55,000 francs. A table of the monthly receipts from the mill is given in an annex to this report.

The two millers are now paid 5,000 francs each per month, as is Fernand. Sumaili explained that this is because as the array was increased, so has their work. Sumaili noted, however, that this still only constituted a "village salary" and is not comparable to what might be earned in one of the cities to which many Voltaic people migrate for job opportunities. There is where "real money" is to be made, he said.

Despite the plans deliberated for such a long time even as described to me in 1980 (Roberts 1980: 102-106), to establish a bank account in Fada

N'Gouïma for mill receipts, none was opened until February, 1982. The difficulties in choosing bankers were cited in 1980 as an illustrative case of how Tangaye villagers were unsure as to what prerogatives were theirs with regard to the station and at the same time, afraid for reasons of both local-level and regional politics to assign particular individuals the task. On the one hand, individuals might use this recognition in one local-level arena of vying for power; on the other, any "mistakes" in money management as identified by regional authorities might cause individuals to be punished. Inertia proved safest till February, 1982.

Until then, money was kept by the treasurer, Issa, at his house. He was ill from December through February of 1982, and so, while he was holding almost 20,000 francs at his house, another three month's receipts (over 100,000 francs) were held at the mill itself. Issa's house burned down in February. The account book was scorched in the fire, but luckily the money was not destroyed. It was then that the cooperative members decided a bank account should be opened after all. Fernand added that Radio Ouagadougou announcers say that people should deposit money in banks to avoid destruction in house fires, and they at Tangaye decided to do this. The cooperative gave Issa 10,000 francs because he could have said the money was destroyed in the fire and kept it himself, but was honest and showed it had not been burned.

The Chief went to the Commandant/Arondissement Chief for advice on banking, and the latter asked if there was a reliable person in Tangaye who could read and write French. The Chief named Fernand (already acting as station manager) and so it is he and he alone who can deposit and withdraw money from the mill account. For the first deposit, two men accompanied Fernand to Fada, and, as he said, the matter of establishing an account was quickly and easily accomplished (contrary to fears in Tangaye as outlined in

my 1980 report). Since the first deposit, Fernand has made three others, so that at present there are about 400,000 francs in the account. Issa is no longer among the salaried workers of the station, his function having been replaced by Fernand's trips to the bank. The actual amounts deposited are shown in annex along with the monthly receipts and expenses for the mill. In brief, it seems as though the matter of banking, over which there has been a great deal of concern and politiking in Tangaye for at least three years, has been resolved.

Issues of Health at the Station

We noticed upon our arrival at Tangaye that the millers (Sumaili and Douala) were white with flour and that the floor and everything else within the mill building was covered with the stuff. Sumaili often stands directly in front of the flour chute to operate the intake of grain into the mill. The dust from the flour falling down the chute into a receptacle on the floor rises directly into his face. His nose was full of flour. We commented on our first day in Tangaye that the millers should wear face masks as were originally provided. I told Sumaili that it is not good for him to have flour in his lungs. On the next day he asked me for some medicine and specifically for Vicks syrup for his chest. He said he sometimes buys small cans of evaporated milk at the local market to drink and "wash the dust from his heart and chest." I again told him he should wear a cloth over his nose and mouth while he is milling and asked him about the original masks which were provided by NASA Lewis. He said that these did not keep the flour from his nose and so he didn't use them.⁷ Bill Bifano also noted that Sumaili might stand on the other side of the mill and still operate its various parts without getting the updraft of flour dust from the chute. Later in the



Sumaili grinding grain in the mill building.

week I observed Sumaili with a cloth around his face and standing on the other side of the mill on top of a box.

In this same regard it may be mentioned that the protective ear guards provided to shield the millers from the constant noise of the mill are not being used and have not been for a long time. Apparently the ear protectors are no longer necessary after the burr was replaced by a hammer mill (Jim Martz, personal communication). The devices were not in use during my 1979 visit, when the burr mill was still in place.

The water level in the station batteries has been well maintained, and only one report has reached NASA Lewis of water having to be added to them during three years of operation (Jim Martz, personal communication). The face shield and rubber apron have not been used recently, then, and are covered with deep dust. When NASA Lewis staff were taking specific gravity readings (and I was assisting them and am therefore no more "innocent" than they!) none of us wore protective devices. With the highly infrequent need for battery upkeep and the change in station managers, it is not clear whether the new personnel know of the protective devices and how/when they should be used.

These sorts of occupational hazards were foreseen during the planning of the project by NASA Lewis. Appropriate devices were provided at the very start. When there is a change in personnel at the station (as in the case from Pascal to Fernand), however, someone should see to the continuity of these practices. Because they are bothersome, it would probably be a good idea for someone to repeat to the millers and other station staff the explanation for such practices with regard to their own health and safety.

Water Use

Many people were in their fields because of the rains and everyone was hurrying to plant their corn, peanuts, and a last sowing of white sorghum. Water use at the station was down for this reason and because earlier rains had already made water available in hand-dug wells closer to home. The great majority of women and children observed using station water were from compounds closest by, as was found in 1980. The increase in PV array size does not seem to affect water supply, since this appeared adequate with the smaller array.

Donkeys were observed using the station spigots. One sauntered up and drank from a person's pail, and another sucked water from a dripping faucet as from a teat.

There have been several new wells dug and cemented during the past two years. A new cemented well and a new hand-dug one are to be found just across the street from the station. The Baptist missionaries told the master sergeant that if he would have a well dug, they would send someone to cement it for him. From the look of the water in his new well compared to that in the old cemented one of another resident 25 or 30 meters away, it does not look as though anyone uses the new one: it is filled with fetid brown algae, whereas the older one is clear and was observed to be used regularly. The Catholic sisters from Diabo also have paid for a cemented well near Hamlet Five on the northern side of the road not far from the Catholic church.

Fernand and I went to see the cattle wells north of the market place along the stream. It appears that no more than two of the eight or ten cattle wells have been kept up over the past dry season. Even those two do not seem to have been used with great frequency. Most are overgrown with weeds, the sides crumbling; they present a very frightening hazard to passers-by.

The Mill Cooperative

During the few days I was in Tangaye, there was no opportunity to observe the functioning of the cooperative, nor was I able to meet at any length with the cooperative president, Neba. His first wife had died two months previous to my visit, and an important part of the funeral ceremony was held in the afternoon of the first day of my visit. Still in mourning, Neba did not come around to chat as was his wont in 1980. Only at the very end of my visit did he come by to greet me. He was very subdued and sad.

The one readily apparent change in the power structure of the mill cooperative is the increased participation in decision-making by the master sergeant. He has become "mill president," to use Fernand's term. In 1980, Neba had requested that the master sergeant become his assistant or "secretary" to oversee the day-to-day functioning of the mill. The compound of the master sergeant is directly behind the station and so he passes by the place many times daily. At that time Pascal had forestalled the move because, I assume, of the tension between the master sergeant and the Chief of Tangaye. Not long after Pascal's departure from Tangaye, the master sergeant became "president of the mill." Now he joins the two millers in making decisions about the functioning of the mill, then they go to Neba, the cooperative president, who in turn consults the Chief of Tangaye. Fernand said that the master sergeant replaces Neba when the latter is sick or absent from Tangaye. Fernand himself seems to play a less direct role in decision-making than did Pascal, his predecessor (see Roberts, 1981:22-24).

This turn of events is not to be construed as negative. It is, however, interesting to note via the preceding socio-economic impact reports that the station continues to be the arena for local-level politics. The prestige

of the master sergeant continues to grow. Although not a Baptist (nor does he attend the Catholic church), the American missionaries have given him his own cemented well. He is active in leading cooperative agricultural activities, which he does with great gusto. It appears that the most overt friction between him and the Chief is at an end or at least has subsided.

The Station-Manager's Replacement

In November of 1980, Pascal Leosso go left the project to assume new responsibilities for an AID project in Bobo Dioulasso. Problems with replacing Pascal were already apparent during my last weeks in Tangaye in 1980. The Chief of Tangaye wanted his own first son to replace Pascal while the son of the cooperative president, who was my chief research assistant, also wanted the job. The Chief's eldest son is a very difficult character. His younger brothers (including Harouna Kouela, Voltaic Ambassador to the Arab States) have far outshone him while he has remained in Tangaye, supposedly to second his elderly father. The Chief has shown much greater favor to his younger sons. Fernand said (with some merriment) that, while the eldest son had to work very hard to gain a first and only wife, the Chief's youngest son already has three wives bestowed upon him by his father. The arrogance of the eldest son is very apparent, nonetheless. Denied the job of station manager (and it is not clear how or by whom this decision was made), the eldest son now collects market taxes as is done throughout Upper Volta but which was only started this year in Tangaye. Women or vendors must pay 5 to 25 francs to sell things in the marketplace and this revenue then goes to the state.

The cooperative president's son was also a problematic choice to replace the station manager. The two millers were especially opposed to his candidacy.

On several occasions the young man apparently strode into the mill building crowded with people, threw open the control cabinet and "acted as though he owned the place." He apparently shut off the mill without consulting the millers. This infuriated Douala, the miller, and he and Sumaili, being older (and wiser) than the cooperative president's son, resented his impertinence. Since working for me in 1980, the young man has had a series of disappointments concerning employment. Not being named station manager has been one of them.

Fernand was Pascal's choice for station manager. Pascal told him that he should record station data and continue Pascal's work even if he were not paid for doing so. There was discussion of the matter of his salary at a meeting with Daouda Yeye of the HER and Larry Dominessy. Daouda said that the station manager should not be paid as he would be a Tangaye resident and the station was meant to help the village. The cooperative president, Daouda continued, is not paid, so the manager should not be, either. In effect, Fernand worked for six months without salary, taking data and overseeing station functioning. When NASA Lewis staff came in the spring of 1981 to increase the PV array, Fernand helped out. A meeting of the station cooperative was held to decide whether the millers should receive an increased salary commensurate with their increased activities after the array was augmented, and it was decided that Fernand should receive the same salary as they.

Fernand is a Kouela, but said he is not sure exactly how he is related to the Chief of Tangaye. He noted that his assuming the station manager's role was not without its difficulties. "A son of the village cannot speak any which way," he said. If Pascal were still station manager, there would be many related social activities associated with the station, as there had

been in the past (e.g., sports, tree-planting, and the like; see Roberts 1980: 108-112). Pascal had started a committee of young people in the village, but his departure, the death of Alain (the popular and effective agricultural teacher) and Issa, the agricultural extension agent leaving the service for a job in Fada, have meant there has been little activity of the sort lately. Furthermore, the replacements for the agricultural (FJA) teacher and the extension agent did not get along with each other, and people in the village hoped that the FJA teacher would leave and be replaced. This has happened, and now the new teacher appears to have better adapted himself to life in Tangaye, although there are problems with him as well. Fernand hopes that with this new group of people, the same activities that Pascal had stimulated may be started once again.

Fernand is a quiet individual and yet shows great enthusiasm for the station and is willing to take responsibility for it. He, like Pascal before him, is active in a number of other areas beside that of the station. For instance, last year when the Catholics brought some "two-and-a-half-tons" of rice in a truck for sale in Tangaye, Fernand, the cooperative president's son, and my ex-cook together in one day sold 100 sacks at 2000 francs each. They were paid a modest wage for this. Fernand has also been active in literacy courses and other uses of the station facilities, as will be described below.

Replacement of the AID Project Manager

After two terms in Upper Volta, Larry Dominessy is leaving for a new post in the Cameroons. His participation in the Tangaye Demonstration has remained active over the last two years. He has stopped in Tangaye from time to time and has shown films and slides there which he has taken at Tangaye

on past occasions. He also brought medical and personal-hygiene films to show at Tangaye. Apparently the ORD film program has not been operative, at least in this area.

Clearly, Larry Dominessy will be sorely missed at Tangaye. Sumaili did not seem to realize that Larry would be leaving Upper Volta within a month. I told him that Kevin Mullally would replace Larry, and that Kevin was a Peace Corps Volunteer in Chad as I had been as well. He would maintain the interest in the Tangaye Demonstration shown by AID staff in the past. Larry Dominessy promised to bring his wife and baby to Tangaye for final adieux before his departure at the end of the month.

HER Involvement in the Tangaye Demonstration

Ouedraogo of the HER came with us to Tangaye on 5 July and returned with the others on the 6th. He is the only one of the original three from HER (including Daouda Yeye, who worked closely with the NASA Lewis team when the array was expanded) responsible for the Tangaye demonstration. Bill Bifano asked if other HER staff would be assigned by next March when someone comes from Lewis for a final visit to Tangaye at the completion of the two-year back-stopping period. It would be good to have these new personnel given a final training and an opportunity to ask the NASA person questions. Ouedraogo said that at present there are discussions within the government of Upper Volta as to whether there should be a separate energy institute at the ministry to accept responsibility for projects such as that at Tangaye. Here he was referring obliquely to the Institute for Research on New Energy (IREN) discussed in my trip report of 15 and 16 July (see Appendix Two). There appears some friction between HER and IREN staff (or at least between Ouedraogo

and some of the people at IREN). At present it is difficult to say whether HER will remain solely responsible for the Tangaye Demonstration, whether the responsibility will be shared between HER and IREN, or whether IREN engineers and technicians will assume sole responsibility. Ouedraogo did say at this time that the demonstration at Tangaye is of such importance that he could assure Bifano that new people will be assigned to its supervision.

Ouedraogo remarked that he thought it had been stated that NASA Lewis might again extend its back-stopping. Bifano and DeLombard were in the other vehicle so I said that I was not in a position to respond, but that whereas I didn't know if NASA could or would do so officially, I knew that the Lewis staff as individuals were sufficiently interested in the project that they would always answer questions via mail or telex and otherwise be of assistance if possible.

During the first day at Tangaye, as the various checks and minor repairs of the system were effected by Dick DeLombard and Larry Dominessy, Ouedraogo was present and acted as interpreter for the Tangaye villagers. For the most part he did not do any of the work himself, or certainly did not take initiative to do the work except as assisting others. Undoubtedly, this in part was out of respect for the visitors from NASA Lewis and AID Ouagadougou and may be due to Ouedraogo's training being in other areas; but it may be symptomatic of difficulties in the future concerning the upkeep and troubleshooting for the demonstration by HER personnel. When the NASA Lewis person goes to Tangaye in March of 1983, great care must be taken to review the various ways that the system can be checked and put in order with whoever accompanies him, be it someone from HER or from IREN (or, hopefully, representatives of both). This has already been done in the past, and manuals are available. My

feeling is that the message that initiative must come from Voltaic staff cannot be (diplomatically!) repeated too frequently if the system is to be maintained over the next years. Given the evolution of organization for IREN within the greater regional CRES research strategy in solar energy for West Africa (see Appendix II), my hope is that such minor problems as may arise at Tangaye will fall within the capacities and interests of IREN technologists and engineers. It remains to be seen how efficiently IREN and HER staff will be able to work together on projects such as that at Tangaye.

Use of the "Guest House"

Prior to my arrival at Tangaye in 1980, a house was built just behind the mill building. I lived there for my three months of field work during that summer, and since then the house has served a number of purposes to the benefit of the community. I will refer to this as the "guest house" (since it has often served that purpose), but it should be understood that the community has assumed responsibility for it ever since my departure, and should determine an appropriate use for the house beneficial to a maximum number of Tangaye residents.

When NASA Lewis staff visited Tangaye in the summer of 1981, they extended wires from the station to the guest house, installed lights in all the rooms and connected a DC refrigerator shipped to Upper Volta with the replacement modules. These are now put to a variety of uses, the first of which concerns adult literacy. The Catholic sisters from Diabo have given a blackboard, and the ORD several benches for adult literacy classes at the house. Fernand and the cooperative president's son were among six young people from Diabo and thirteen from nearby Tibga who participated in a government-sponsored two-week training program in October of 1981. A teacher came from Ouagadougou and classes were held for the prospective instructors at Fada N'Gourma. They were taught how to

use books on writing and arithmetic, which they would take back to their respective villages to teach literacy in More, the language of the Mossi (and the one of which that of the Zoose of Tangaye is a dialect.)

Originally, the students in Tangaye were divided between Fernand and the cooperative president's son. The latter was given those who had not done well in the FJA course (that is, Formation of Young Agriculturists, a three-year course and the only permanent school in Tangaye). Fernand was given those students and adults who had done well in the course or who had a modicum of literary skills. From the start, the cooperative president's son did not exercise his responsibilities. He missed classes, and became angry when students did not come when he did. Two or three times, the sister from Diabo came at the appointed class hour to find no one there. When she checked in the same manner on Fernand's class, she found him diligently teaching his students. The cooperative president's son requested the sisters pay him a salary to move as teacher to a nearby village, but this was not taken seriously. Fernand, on the other hand, has worked at the job well. At first the teaching was done for free, but now the sisters pay 350 francs to Fernand for each class he teaches. The ORD should pay this amount, but they have no money available, and so the sisters provide the salary. At first, the sisters said that each student should pay 100 francs per month, so that the teachers could be paid; but Fernand said that if that were the case he would prefer to work for nothing, since the students would stop coming for lack of money. Now the sisters pay him.

Fernand holds two classes a week during the rainy season. On Sunday just after church, girls and young women are given literacy classes in the Catholic church building. During the evening of the same day, a class for young men is held in what was the bedroom the the guest house, where the blackboard and

benches are also stored. Fernand has eleven consistent students. Because the rainy season is also the agricultural one, it is difficult to maintain a teaching schedule. A hard rainstorm prevented his teaching the class on the Sunday night I was present, and otherwise many people camp near their fields and cannot attend class during this time. Fernand said that his hope during the agricultural season is to review what has been learned during the dry season, as he and his students have already finished the first book and will move on to a second in the fall. Use of PV-powered lights at the house permits these evening classes to be held.

It will be recalled that in 1980 the hope voiced by Tangaye residents was that the house could be converted to a pharmacy or a small healthcare facility with a midwife in attendance. The then director of the EORD promised the people of Tangaye a pharmacy to be opened in the house. Discussions were held as to who from Tangaye might have sufficient education to attend a training course. An attempt was made to contact a pharmaceutical supplier from Ouagadougou, but the fundamental problem of lack of initial capital on the part of Tangaye residents, and the ordinary difficulty of keeping such promises as the director's due to budget deficits led to the collapse of the idea. This is bitterly regretted in Tangaye, as it is pointed out that other areas in their region have been favored while theirs has been neglected.

The Catholic sisters from Diabo keep a baby-weighing scale at the house and come two weeks in a row, then skip three weeks before they return again. Babies are weighed, powdered milk is distributed, malaria-suppressant and some other medicines are given out. In the context of a discussion of the EORD-proposed pharmacy, I said that the sisters' infant-care program and medicine distribution was progress from 1980, when there was nothing of the kind at Tangaye. I was told that this was only done infrequently, and "we could die

in the meantime." The new government in Upper Volta permits the Catholic mission in Diabo to stock and sell medicines, as is done at the government dispensary there. Tangaye people are quick to note, however, that Diabo is more than an hour's walk from Tangaye, and with the sort of local-level politics (Chief of Tangaye versus Canton Chief, Tangaye as chosen for solar energy demonstration, telecommunications relay, or Baptist projects, etc.), having a dispensary in Diabo is just not "good enough." Clearly, a dispensary and/or a pharmacy at Tangaye would improve healthcare, but this is not the only factor at play. Socio-political prestige is important as well.⁸ The dispensary that Peace Corps Volunteers are said to have established at Pouitenga was cited as an example of what Tangaye villagers would like to have. I was asked how they might gain such a dispensary, and told that the new government wants villagers to be independent and to make their own requests to donor agencies. I explained how they might prepare and submit a proposal for such an intervention to some outside donor agency.

This does not diminish the positive effect of the Catholic initiative at the station house. On both Wednesdays I was in Tangaye, a clinic was held at the house, to which over 80 women came each time. On Wednesday, 7 July, at about 6:30 AM, women began to congregate on the cemented porch of the guest house, and by 7:15 someone went to get the key to the storeroom where the medical supplies and scale are kept, from the master sergeant, who keeps it. A table, benches, a scale, and a trunk of medicines were brought out and set up on the porch. Ordinarily, a Catholic sister from Diabo comes to help with the clinic, but she did not on this occasion and was replaced as nurse by a local woman. This lady has no formal training in medicine, but her husband worked as a guardian for a French family, and she was in France for a time. She was chosen for the job because she has been to school and can write, and because

of this general worldliness. She is in her early twenties and generally dresses in a "city," rather than a "village," fashion, but is very friendly and not at all supercilious with those coming to seek her assistance. She was ably assisted by a 14-year-old boy who operated the baby scale. Each woman placed her infant on it and handed the nurse a health care preserved in a plastic envelope. This card shows a vaccination record as well as a growth graph taken from regular weighing of the baby. The wife of my cook was seated at the other end of the table, and distributed a variety of pills and potions, vitamins, aspirin, and malaria-suppressant being prominent. Other medicines were taken from the open trunk beside her.

The women of Tangaye all dressed up to come to the dispensary and wore their prettiest wax-print blouses and wrap skirts. Each group of women is given a square of vinyl of a single color and then these women are treated before those of the next wave who hold a different color token may begin; thus the efficiency of treatment is assured. The women sit in the circle of benches and gossip with each other as they wait to be treated. This is an important social occasion as well as a medical one. When I remember in 1980 giving my cook a can of malaria-suppressant pills for him to distribute, and when I recall the lack of medicine in evidence at Tangaye, except for the few odd patent pills and ointments sold by bicycle traders at the Tangaye market; this dispensary, however, humble, seems very tangible progress. It is an honor to have it in the house behind the mill building and thus associated with the NASA Demonstration.

There is now more medicine available in Tangaye. My cook sells Nivaquine malaria-suppressant at five francs a pill, aspirin and diarrhea suppressant at the same price. These he buys from the Catholic sisters at Diabo. Payment is given for medicines at the clinic as well. 25 francs is paid to

have a baby weighed, and then medicines are 15 francs for an infant, 25 francs for an older one. Once these amounts are paid, repeated doses during the wet season are given for free, since it is then that people are farming and money is scarcest. During the dry season, when people's harvests are in and money is more plentiful, medicines are purchased upon each visit. The baby-weighing, however, is paid for each time, no matter what season; and from this money, then, the nurses are given a small salary of 300 - 500 francs per session.

The medicines distributed at the clinic come from the mission at Diabo. On 14 July, when a sister did come to the clinic, she said that the malaria suppressant is obtained from Fada hospital through a government program. The other medicines sold or distributed are gotten through a variety of channels (but not CARITAS, as I had guessed). The Catholic mission healthcare program is said to be the continuation of an older one interrupted in 1980 by the nationalization of all pharmaceutical distribution. The Catholic mission then was prohibited from maintaining such small-scale programs as that at Tangaye. Now the sisters also have a pharmacy at Diabo which supplies the Tangaye program.

In 1981, there was again a meningitis outbreak, and two children died in Tangaye. Two or three others perished in villages adjacent. The Daibo dispensary was notified and they in turn contacted hospital officials in Fada. A vaccination team was sent from there to Tangaye, and as a result of attention in 1980 and 1981, there were no deaths reported from meningitis during the spring of 1982. Vaccination was continued then as well.

American Baptist missionaries now based in Sanouabo, some five kilometers southwest of Diabo, came to Tangaye every Tuesday during the dry season to offer medical assistance. This was interrupted during the wet season but has been promised to be begun again in October. I was told that "almost the whole village" came every Tuesday to obtain medicines and to have sores dressed.

Again, in this regard, the increased attention by both Catholics and Baptists can only benefit the villagers of Tangaye.

These programs are greatly facilitated by the secure storage area of the station house and its lighting. As a technical aside, it may be noted that the sodium vapor lamp outside of the house on the porch, although throwing a yellow light, still attracts many insects. After a rain, the next evening clouds of flying termites were attracted to the lamp. This sort of lamp, then, may not attract as many bugs as would a fluorescent one, but they come nonetheless.⁹

A further use of the station house is being made by the American Southern Baptist missionaries. Sacks of phosphate fertilizer have been stored in the "bedroom" of the house for sale by the master sergeant for 3000 francs per sack. They started out with about 40 sacks and there remain about half that number. Interestingly, at this price Tangaye villagers are able to buy fertilizer at 250 francs below the government price; as was noted, though, the government extension service has none available at present. A related Baptist intervention in Tangaye was to grant 250,000 F or about \$700, to the FJA program to continue agricultural teaching through the purchase of a pair of oxen, an ox-plough, a donkey and a donkey-plough. It appears that some of this money has been misappropriated. The wry comment made to me in this regard was that, because the Baptists speak only English, communicating with them is difficult in general, and that it would be impossible to explain to them a matter so complex as this.

Another use of the station house that may be mentioned is Fernand's bar. In 1980, when the main road to Fada N'Grouma still passed by Tangaye, a beer truck would come once or twice a week and drop off bottles of beer and soda which Fernand would sell both in Tangaye and at a bar of his in Tibga. With the new paved road now passing well to the north of Tangaye, Fernand has much

more trouble obtaining beer and must take a donkey cart the 8-10 kilometers up to the road to exchange his empties for full bottles. The truck only comes once a month, and so he must make larger exchanges each time, which requires a greater amount of capital exchange. Every three months he must go to Fada to pay 18% of all profits as a tax to the government. He must also pay a 19,000 franc yearly tax for maintaining a bar. It was thought that Fernand could be enticed to become station manager if he were allowed to use some of the station facilities for his bar. He now puts beer and cold drinks in the refrigerator at the guest house and people come to sit on the porch to drink them. The Sous-Prefet from Diabo often stops to drink cold water on his way to Fada. Many others come from around about to get cold drinks. This increases the station's use as a social focus for Tangaye.

One other anecdote may be mentioned in this regard. Last year at one point Fernand was piling his cases of empty bottles beside the road and had 75,000 francs in his pocket, about half of which was his, the other belonging to several entrepreneurs wishing to purchase stocks of beer. This somehow fell out of his pocket and was never found again. Larry Dominessy, Gay Morgan, and Pascal Leossogo gave Fernand 25,000 francs from their own pockets to help him pay back his creditors. He said he would never forget their kindness. Again, this demonstrates the close personal bonds between USAID staff and people at Tangaye associated with the solar energy demonstration.

Exposure/Spread Effect of the Tangaye Demonstration

A number of organizations have begun paying increased attention to Tangaye, and although the solar energy demonstration should not be considered the primary reason for this, it certainly is an indirect cause of these beneficial effects. As has been mentioned in previous sections, both Catholic and American Southern

Baptist missionaries have increased their attention upon Tangaye. Fernand said that only younger people in Tangaye consider this a competition between the two groups of missionaries to gain converts through their gifts. Older people such as he and my cook, who are both important Catholic laymen, helped the Baptists make bricks for the dispensary that they had promised but were never able to offer. This they did because it would have been good for the village, not just the Baptists there. Other Catholics refuse to assist in this process, Fernand added, saying the Baptists alone should do this work, as they would benefit most directly.

The Baptists have also built an earthen dam in Tangaye, in an attempt to block the stream that bisects the village and make a water-retention pond for use during the dry season. This good idea suffered in its execution. A dam some 100 meters long was constructed with a bulldozer. However, the bed of the stream was not leveled off, nor were spillways provided, and with the first rain, all water was channeled directly at one point in the dam, which immediately gave way. No water whatsoever was retained for the dry season.

A telecommunications antenna was installed two kilometers east of the station of Tangaye. It can be seen for many miles, and the feeling at Tangaye is that it, like the solar energy demonstration, has added to the prestige of Tangaye and its residents.

Last year the EORD agricultural extension agent sponsored a reforestation project. A plot on the road towards Fada, past Hamlet Five, was prepared and enclosed with wire fencing provided by the government through EORD. Eucalyptus saplings were planted within this, and for the most part, they are going very well a year later. The present EORD agent, Noaga, has a dozen rolls of fencing in his compound for another plot adjacent to that already established. He has

planted seeds which are now transplanted into small plastic bags which he waters regularly, and these will be planted in the new plot next year.

This reforestation is part of a national project, but its success has a precedent in Arbor Day of 1980 (see Roberts 1980: 108-110). Almost all the trees planted in 1980 died, with the exception of one mango planted just behind the water tank, and the first eucalyptus tree planted by the Chief. Most importantly, the idea and enthusiasm for reforestation were "planted" in 1980 and continued to "grow."

Other recent development in Tangaye includes the construction of a store just off the main road facing the mill building on its same side of the street. The brother of Sumaili the miller has worked for some years in the Voltalex fabric factory in Koudougou, just west of Ouagadougou. He has used savings from that salary to build a rectangular, tin-roofed building about 15 meters from the road. It is not yet completed, but the man plans to establish a store there and sell cloth made by his factory. Fernand sees this as an example of the sort of entrepreneurial activity he would like to undertake as well; he would purchase grain and peanuts to stock and resell during the wet season when prices double on the local market. He wishes to obtain a loan for initial capital, but is not sure how to do this. A Catholic priest from Tibga had promised to loan him 50,000 francs to buy fencing for a vegetable garden, and he hoped to have tomatoes, peppers, cabbage, carrots and lettuce to sell in the market and eat himself, but the priest became ill and was repatriated. It should be noted that the same "motivated" individuals (that is, those who wish to exploit opportunities available through the money economy of Upper Volta) like Fernand appear repeatedly as instrumental actors on the various development programs or related activities initiated at Tangaye by public and private agencies.

A different sort of attention paid to the Tangaye Demonstration came from two Frenchmen, one of whom was Bernard Thiebaut of COMES (The Commissariat of Solar Energy), a French governmental institution. Larry Domminessy said that the man had visited him to inquire about Tangaye. Larry sent him to Ouedraogo at HER, who sent him back to AID for permission to visit and stay in Tangaye. Larry said he was not sure what the man wanted, since a lot of people stop in to see him like that, but he seemed to be seeking some overview of solar energy research in Upper Volta. One of the men spent a week at Tangaye and another two days studying the PV system. From Tangaye they were to go on to Gabon. They were equipped with a Land Rover and visited nearby towns to inspect other mills in the area. Fernand said that Thiebaut was critical of the Tangaye system and said that he didn't think it would work for long. Fernand had disagreed with him. Neither Larry Domminessy nor Ouedraogo were debriefed by the Frenchmen, nor have they received any letter or report from the visit. Thiebaut did send a soccer ball to the people in Tangaye in thanks for their hospitality. Larry, Ouedraogo and I discussed what a pity it is that competition among nations so often precludes constructive discourse and a frank exchange of information from which developing countries might benefit.

The New/Old Road Issue

The paving of the new road between Ouagadougou and Fada N'Gourna has been completed. There are now two small roads leading from the main one to Tangaye. People in Tangaye are discontent with this arrangement. They feel that the new road bypasses Tangaye and other villages, and crosses a large uninhabited expanse. Vehicles using the old road through Tangaye are now obstructed by the many wash-outs where no repair work has been done over the past year or more. Tangaye residents feel that the combination of the solar energy demonstration and the telecommunications antenna at Tangaye should have meant

that the paved road would pass through their village. That it does not, seems both nonsensical and is insulting to them.

The Chief of Tangaye said that farmers, cattle-owners, and merchants in Tangaye and surrounding villages should get together and contribute money to a fund for two or three years. This would then be taken to the government, and even if it did not suffice, the GUV would then come and fix their road for them. This is the only way that the government road-workers will come there to fix the old road. He added that the new administration in Ouagadougou has said that villagers must seek their own solutions to local problems and not await intervention by the central government. I cited to the chief the case of Kenya, where self-help projects have long been an effective rural-development strategy. The Chief agreed that this should be done in Upper Volta as well.

The Arrondissement of Diabo has been upgraded to a Sous-Prefecture. Again, people in Tangaye cite this as a reason for their surprise that Diabo and Tangaye have become so isolated because the new road passes to their north. Three or four vehicles used the road each day I was in Tangaye, but mainly motorcyclists, bicyclists and pedestrians travel on it now. Wash-outs and erosion are becoming so extreme in some places that passage will be impossible by the end of this rainy season. I was asked by Tangaye villagers about the proposed AID rural-roads project, which would improve a road from the southeast, ending at Diabo. In the past, Larry Dominessy had expressed the hope that this road might be extended from Diabo to the new paved road. When I asked about this, Dominessy said it is not clear at present whether the project is feasible, from several points of view. The kinds of services that used to be available to people at Tangaye, including a bread truck that stopped once or twice a week, a film crew that would bring films at least once in a while from Fada, and others of the sort are sorely missed by Tangaye residents.

NOTES

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²Other mills in the area of Tangaye are diesel-run and of the burr mill variety. As James Martz of NASA Lewis has noted (private communication) unless sorghum and corn hulls are removed, excessive wear of burr plates results. The hammers of mills such as that now at Tangaye are not worn down so quickly by such use. Contrary to what some local people may assume, mill type (burr or hammer) rather than power source (fossil or solar) determines the capacity to grind these whole grains.

³Note that shortly after modifying the power system, James Martz found that "the increased array size permitted sufficient mill operation time to grind all grain brought in by the villagers. As a result of the new mill and increased array, milling capacity now exceeds demand" (1981: 14).

⁴Hamlets Five and Nine were among the four chosen for closest scrutiny in the 1980 research. The two not chosen in 1982, that is, One and Fourteen, were closest and farthest from the station. Hamlet One presents unusual characteristics (see Roberts 1980: 73-75) and women from Hamlet Fourteen rarely used the mill in 1980. In the very short time available in 1982, I chose to examine mill-use in Hamlets Five and Nine because of distance from the station (close and moderate) and because two of the research assistants were from those places and would be able to contact women more easily throughout the course of the day.

⁵An alternative suggestion made by Engineer James Martz of NASA Lewis was that the trip setpoint be lowered to 100 volts to prevent automatic shutdown of the system during the voltage dip associated with current surge during starting of the mill.

⁶James Martz has noted that such screens are available from the manufacturer, that their use might increase the grinding rate for fermented sorghum, and he suggests a quarter-inch perforation as appropriate (personal communication).

⁷I have since been told by James Martz that rather than dust masks, the ones in question were to protect those inspecting the batteries from acid splashing.

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Volta) Solar Energy Demonstration. (Center for Afroamerican and
African Studies, The University of Michigan) AID 696-089-90
(September, 1980).

APPENDIX I: Table One

<u>Receipts from mill:</u>		<u>Expenses:</u>	
10/10/80	11,040 F	5,500 F	salaries
4/11/80	23,860 F	5,500 F	salaries
		32,760 F	spent to receive head of USAID in Sept. (i.e., the Administrator from AID-DC)
Nov. 80	24,100 F	3,000 F	salaries
		4,770 F	to celebrate P's leaving
		1,600 F	to purchase oil
Dec.	17,010 F	3,000 F	salaries
6/ 1/81	24,225 F	10,000 F	to Issa for house fire
		4,000 F	salaries
6/ 2/81	14,330 F	4,000 F	salaries
		2,000 F	trip to Ouaga by F
		460 F	drinks for "un etranger"
March 81	21,300 F	4,000 F	salaries
		7,000 F	?
April	15,345 F	4,000 F	salaries
May	27,210 F	4,000 F	salaries
June	48,105 F	5,000 F	salaries
July	50,585 F	11,000 F	salaries
Aug.	52,025 F	11,000 F	salaries
Sept.	47,205 F	19,000 F	salaries and ?
Oct.	51,635 F	11,000 F	salaries
		2,500 F	
Nov.	51,460 F	11,000 F	salaries
		4,275 F	
Jan. 82	52,115 F	15,000 F	salaries
		1,500 F	for photo
Feb.	45,120 F	15,000 F	salaries
		2,500 F	to Fada
Mar.	50,560 F	15,000 F	salaries
		5,560 F	to Fada
Apr.	50,235 F	15,000 F	salaries
		5,000 F	to Fada
		5,000 F	etranger
May	48,005 F	15,000 F	salaries
		4,000 F	roof
June	55,100 F	15,000 F	salaries

APPENDIX I: Table Two, Bank Deposits

5 February	300,000 F	(deposit account)
12 February	50,000 F	(deposit Account)
6 April	30,000 F	(in a separate "current account")
7 May	32,000 F	(deposit account)
14 July	48,000 F	(held at mill)

APPENDIX II: Trip Report--Ouagadougou

To: NASA Lewis PV Development and Support Program

From: Dr. Allen F. Roberts, Center for Afroamerican and African Studies,
The University of Michigan

Trip Report: Ouagadougou, 15th and 16th July, 1982

The vehicle sent by AID to fetch me in Tangaye came at midday on Wednesday, 14 July, and we returned to Ouagadougou by late afternoon that same day. I had a meeting upon arrival with Larry Dominessy and later had dinner with him and his wife. We discussed the transition from his being responsible for the Tangaye Demonstration to the dossier being passed to Kevin Mullally, a new AID staff member. Dominessy is going on the Cameroons and hopes to continue his interest and support for PV demonstrations once he has gotten established there. He hopes to mount a small demonstration of his own, either at his own home in Yaounde or someplace suitable nearby. We talked about the possibilities of his supporting a demonstration of wider scope in Cameroon for which NASA Lewis might give some sort of support or back-stopping. He said that to date he is not sure of what projects will be given to him to manage in Cameroon and so could not be sure what his responsibilities would be. He did express the desire to work further with NASA Lewis in the development of appropriate photovoltaic projects in Africa and specifically in Cameroon, and wants to be kept up to date on the evolution of the Tangaye demonstration for which he has worked so hard.

Dominessy showed me a number of movies he has taken, some of which were shot at Tangaye. I mentioned to him the meetings held and letters written concerning a possible film by USICA with NASA support, which would include a segment on Tangaye; and I suggested that should this film be realized, clips from movies or stills from his own collection on the development of the

Tangaye project might be useful. He was enthusiastic about a filming project and offered his films for use in such a project.

On 15 July I attended the weekly AID staff meeting at 8 A.M. The new AID mission director, Emerson Melaevan, had invited me to make a presentation on my findings and on the Tangaye Demonstration more generally. Mr. Melaevan introduced me and I gave a ten- to fifteen-minute presentation concerning the Tangaye Demonstration.

I first noted that this micro-scale project has had significant impact within the context of Upper Volta and West Africa more generally as well as worldwide, through the coverage it has received in various publications and at a number of conferences. As for the results from my most recent ten-day visit, I noted that everything works at Tangaye, and that the Tangaye villagers are very proud of this fact. This is in part due to Larry Dominessy's continued interest in the project, but also to local initiative. In this regard I mentioned the millers taking the initiative to "invent" screen for the mill which will facilitate the grinding of fermented grain for brewing beer, and also the continued management and decision-making on the part of the cooperative, the millers, and the station manager. The impressionistic results gained during my ten days' stay concerning mill use and station use for infant-care and literacy programs were presented. Finally, mention was made of the seminar that NASA Lewis is preparing in conjunction with other demonstrations, and of the hope that the materials so prepared might be used in Upper Volta in some way.

After the talk, Mr. Melaevan expressed his gratitude and enthusiasm for the project more generally. We scheduled a meeting for the next morning to talk in greater detail about my results as well as the future of the Demonstration.

At 10 AM on the same day, I met with US Ambassador Julius Walker. This too was a very cordial meeting. Ambassador Walker showed interest in the Tangaye Demonstration. While he described it as "one of the funnier things going--a space-aged thing but here in the armpit of Upper Volta!," he is enthusiastic about the demonstration and especially the ways that it is serving the community of Tangaye. We suggested that we should use the Tangaye Demonstration as a means of drawing American and international recognition to US efforts for development in Sahelian Africa.

In this regard, I mentioned NASA LeRC's recent effort to contact the NOVA program at WGBH in Boston and the meeting that Bill Brainard and I had had with USICA staff members in Washington. This greatly interested the ambassador, and he requested that we send him copies of the letters to both NOVA and USICA. He wishes to gain greater American coverage of projects in Upper Volta since, as he said, no one in the United States knows what Upper Volta is, let alone where it is. He requested that we share with him any other ideas we might have, upon which he might act to attract the attention of an American audience to Upper Volta development projects. He asked for suggestions from NASA LeRC as to people he might contact personally to gain a greater American awareness of this and other projects. He wants us to stay in touch concerning the progress of the filming projects and said that his daughter works in American TV and she might have some ideas as well.

Later that morning I spoke with Glen House, a consultant from the Tuskegee Institute working in Ouaga with the SECID Program. He mentioned the names of several individuals in Upper Volta and at REDSO Abidjan who would be interested in knowing more about the Tangaye Demonstration. These include: Toby Pierce, working in Ouaga with CILSST; Dr. Muhussein Nacro, a researcher with the Voltaic National Research Center for Science and Technology

(Dr. Nacro will soon be in the United States at the University of Georgia for a postdoc program); and Julian Engle, who is working with SECID via REDSO Abidjan on environmental seminars. I was not able to contact any of these individuals, but their names might be kept in mind for future reference.

In the afternoon of 15 July I went to the National Research Center for Science and Technology (CNRST). My reasons for going were first, to find out if their journal on social science research was still being published, and second, to obtain more information concerning a demonstration of renewable energy Dominessy had mentioned to me as having been presented at the CNRST. It was quite by chance that I discovered a newly-founded Institute for New Energy Research, IREN, at the CNRST. I went to IREN and proceeded to have a very lively two-and-a-half-hour discussion with several of the research people there. This was continued into the evening as I was invited for drinks and dinner by one of the researchers. I met Mr. Yameogo, an expert on biogas; Mr. Werem Aladi, who has training in photovoltaics and is most interested in measuring insolation; Canon Gnemby, also a person with training in PV technology; and Alain Delmas, a French technical counselor with training in photovoltaics. Delmas was originally on loan from the French government, but now apparently works directly for IREN. I did not meet the remaining two people at IREN, one of whom is Garango Theophile, who has training in thermal drying.

We spoke about the National Colloquium on Energy held in Ouagadougou from the 9th to the 12th of March, 1982. This was financially sponsored by the West Germans, and drew a wide audience from Voltaic government personnel as well as a more general public. Various renewable energy devices and technologies were exhibited and guided tours were given to groups of school children and other interested parties. Meetings were held and a long series of recommendations made to the government for a national energy program platform. These

recommendations concern fuel wood, improved cookstoves, transportation, and the conservation of fossil fuels. Of most direct interest to the NASA LeRC Photovoltaic Development of Support Program are recommendations concerning the creation of IREN and its research program. To quote Recommendation No. 2, "Considering the numerous problems raised relative to the anarchic introduction of equipment using new and renewable sources of energy, and considering the fact that the development of such sources of energy and equipment is still in an experimental stage, the National Colloquium on Energy recommends: (1) that the national center for energy take responsibility for the receipt and testing in controlled circumstances of all new equipment; and (2) that the national center for energy receive the necessary means to maintain and further these experiments" (Nat. Energy 1982:22). These recommendations are made in the hope that a national policy can be implemented for a more rational energy program.

IREN staff have been working closely with several people at HER, including our contact, Mr. Ouedraogo. I was told that the hope at both institutions is that a coordinated research policy can be developed which will bring under the scrutiny of IREN the diverse projects of donor agencies in Upper Volta, this as a means to control the "wild entry" of projects of every sort. I was further told that IREN staff would like to know more about the results from the Tangaye Demonstration. They were "surprised" that these results had not reached them already. I said that I would have the various documents sent on to them upon my return to the United States, and that I thought that these were already in the hands of AID and HER. They said that they hoped to use the results from Tangaye in the development of their own program of experimentation and evaluation. I said that this kind of program seemed to resemble that of the Solar Energy Laboratory (LESO) in Bamako and that I

hoped the interest shown by NASA Lewis staff for that program might be extended to IREN as well. IREN will be the participant from Upper Volta to the Center of Research on Solar Energy (CRES) to be created at Bamako. I was told that they do not have much information about LESO in Bamako, and no one from IREN has visited there. They would hope that as CRES develops, a greater exchange of ideas between such local research centers as LESO and IREN might be facilitated and expanded.

One of the research programs they have planned for the near future is the testing of several French and Belgian photovoltaic refrigerators. They have heard about Lewis' program for placing a medical refrigerator in Upper Volta, and hope to include it in their plan as well. While I was told that there is close cooperation between IREN and HER, people at IREN were not aware that the PV refrigerator will no longer be placed at Haounde, and wanted to know the details and reasons for this switch. I said that I was not familiar with these latter, and that Mr. Ouedraogo would be able to tell them more about why the change had been made.

We discussed the NASA Lewis program of photovoltaic demonstrations and I told them of my particular participation. They showed great interest in the component of social-impact analysis, and requested more documents about the Tangaye Demonstration. In this regard as well, I discussed with them the PV seminar and the two-day PV colloquium that William Bifano and Richard DeLombard of NASA LeRC and I had just given in Bamako. I said that in March of next year, NASA Lewis will be sending at least one person to see to the transition from NASA's back-stopping of the demonstration at Tangaye to total responsibility for the demonstration being given to HER. I said that I would request that whoever comes from NASA Lewis give the same sort of one- or two-day presentation at IREN that we gave in Bamako at LESO. This suggestion was greeted with great enthusiasm. I also said that that PV seminar proceedings would be translated

into French and that Dr. Rosenblum will be giving a seminar presentation in Gabon during the summer of 1983. I said that, once these documents are translated and reproduced, I would see to their being forwarded to IREN. I would also investigate the possibility of Dr. Rosenblum passing through Ouagadougou during that same trip. Whether or not he gave the same seminar presentations at such a time, he might have discussions with IREN and other interested personnel. I stressed the fact that these would be suggestions that I would make to NASA, and were not promises on my part or NASA's at this point. They said that they understood this fully, and hoped that a closer collaboration between NASA Lewis and IREN could be established.

At 9 AM on 16 July, Larry Dominessy and I met with Emerson Melaevan, the new director of the Ouagadougou AID mission. He asked me some general questions about the cost-effectiveness of PV applications. He also wanted to know to what degree Tangaye villagers wanted to maintain the system, and would be willing to assume responsibility for its maintainence in the future. I told him more details from my ten days' visit. Mr. Melaevan said that AID would continue its interest in the demonstration, even though all official American participation will end in March of 1983. In this regard, he suggested that Kevin Mullally visit Tangaye every three or four months to be sure that everything is running well. Dominessy said that Mullally should be sure to take the HER representative with him each time, and I said that a person from IREN should also be invited. This led to a discussion of my meeting at IREN. I said that IREN may take over from HER primary responsibility for troubleshooting at Tangaye. In this way, IREN staff with specific training in photovoltaic engineering and physics will be participating in the continuation of the project. Finally, we discussed a bit more those parts of the trip that had preceded our arrival at Ouagadougou.

I told Mr. Malaevan about our conversations in Bamako with LESO staff, and the problems that they have had in dealing directly with private sector renewable energy firms. Dominessy offered some Voltaic examples of the same sort of difficulty of water pumps that burn out or are not appropriate to tasks, and are not under proper warrantee to protect the project and its investments.

Later in the same morning, Dominessy, Mullally and I went to HER to meet Mr. Nikiema Dieudonne, the general director. We spoke with our contact, Mr. Ouedraogo, for a half-hour prior to meeting the director, and he told us about the relations HER has established with IREN. He said that HER's primary interest is in "getting water to the people," and he appeared skeptical of the goals IREN has set for itself. He said that everyone wants to have his own program of research, and that there seems to be no coordination or cooperation among research programs already established. There is "no scientific spirit" among all these various people. Ouedraogo said that the French are financing IREN so far, and that the West Germans had also proposed further aid for solar-energy research, which was interrupted by the change in the government of Upper Volta.

Ouedraogo mentioned the case of 13 solar thermal pumps that were to have been installed in various towns including Koupela, 40 km. west of Tangaye. Ouedraogo complained of a lack of proper management and that the pumps did not fit within the housings sent with them. Only 7 were ever deployed; only one now works. Management was so poor that the guardians were not paid and there was no upkeep or regular back-stopping by anyone outside of the village. With this kind of example at hand, it is no wonder that the rhetoric at the energy colloquium, as represented in its various recommendations, is fairly strident.

In our meeting with Mr. Nikiema, the director of HER, he asked if there were any problems with village management at Tangaye. I said there were not,

and mentioned some of my most recent findings. Larry Dominessy said that AID would remain interested in the Tangaye Demonstration. Mr. Nikiema stressed the special importance they attach to the Tangaye project as an example of how solar energy can be exploited in Upper Volta. He and Larry then discussed other projects that AID has with HER.

During the afternoon of the same Friday, I visited USICA to obtain the recent issue of Topic magazine containing an article on renewable energy, including photographs of the Tangaye Demonstration. Unfortunately, no copies were left at the cultural center. I left for Abidjan the next day, Saturday, 17 August, en route for Libreville where discussions on a different set of NASA LeRC PV demonstrations were planned.