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PROJECT PAPER
FY80

AGENCY FOR INTERNATIONAL DEVELOPMENT

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A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL						
(GRANT)	(81)	(219)	(300)	(81)	(219)	(300)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		80			80	80
OTHER DONOR(S)						
TOTALS						

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY F. GRANT	E. 1ST FY G. LOAN	H. 2ND FY I. GRANT	H. 2ND FY J. LOAN	K. 3RD FY L. GRANT	K. 3RD FY M. LOAN
(1) SH	740	878		300					
(2)									
(3)									
(4)									
TOTALS									

A. APPROPRIATION	N. 4TH FY O. GRANT	N. 4TH FY P. LOAN	Q. 5TH FY R. GRANT	Q. 5TH FY S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) SH					300	
(2)						
(3)						
(4)						
TOTALS					300	

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PREFACE

This AIP was prepared by George Burrill, President, Rural Development Inc., Suite 203, 109 South Winooski Ave., Burlington, Vermont, and Charles Steedman, Center for Research on Economic Development, University of Michigan, Ann Arbor, Michigan. Field visits and project preparation took place in Senegal between September 24, 1979 and October 11, 1979.

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I. PROJECT BACKGROUND

Three components of a renewable energy project identified by the Overseas Development Council in March 1978 have been retained for funding under this AIP. A design effort led by the Center for Research on Economic Development of the University of Michigan in late 1978 included the three elements in the project proposed but not approved at that time.

The three components are:

1. Promoting wider use of an improved method of charcoal production.
2. The development and testing of woodburning and charcoal cookstoves made of local materials.
3. The introduction of simple solar fish dryers and storage tents.

All three advocate simple and inexpensive improvements that will use Senegal's renewable energy resources more efficiently. Except for the cookstoves, the new technologies require very little change in customary ways of doing things and entail little or no risk for Senegalese users. This may be the case for the woodstoves as well, but since an efficient, culturally acceptable set of models must still be developed, such a claim cannot yet be made.

The three project components offer solutions (though not complete ones by any means) to a problem that affects Senegal and its Sahelian neighbors. The problem has been clearly described recently in such documents as the CILSS/Club du Sahel report of October 1978 on Energy in the Development Strategy of the Sahel and the Senegal Fuelwood Production Project Paper of February 1979. It is simply that Senegal is consuming fuelwood, both as wood and as charcoal, faster than it is being produced, either through natural regeneration or through reforestation projects. The reasons are numerous. They include urban growth at a rate of some seven percent annually in the Dakar-Thies area on the Cap Vert peninsula, far from the major sources of fuelwood; extremely poor natural regeneration of forests in the aftermath of the drought; a general rate of population growth of at least 2.6 percent annually; and the implementation of ambitious irrigation schemes along the Senegal and Gambia Rivers which will result in the loss of forest cover. The loss of these and other forest resources through deliberate cutting, inundation and fires has numerous harmful effects on the environment. Erik Eckholm in Losing Ground has eloquently described the losses of topsoil, degradation of soil structure, flooding and damage that occur in such situations.

There seems little question that Senegal faces a serious fuelwood crisis. The prospect that the gap between demand and supply for wood and charcoal will widen at an increasing rate is not fantasy. In a report to CIDA in January 1975, forestry expert D.E. Earl projected that Senegal's consumption of fuelwood, including charcoal, would increase from an estimated 1.5 million cubic meters in 1974 to almost 3.3 million in 1990. In the same projection, Earl estimated much lower levels of consumption in 1990 for Mali, Upper Volta and

Niger. The highest would be 1.8 million cubic meters in Upper Volta.

Senegal's vulnerability is accentuated by its high level of urbanization compared to the other Sahelian countries. This creates greater reliance on charcoal as a cooking fuel. Urban dwellers in Senegal seem to prefer charcoal, which uses more of the fuelwood resource than firewood. In close urban quarters charcoal can be stored more easily than wood and its smokelessness is a clear advantage. Alternative fuels such as butane, kerosene and electricity are too costly to use or require too much investment for the vast majority of city dwellers in Senegal. A survey in 1974 found that 93 percent of a sample of over 2,000 households in Dakar used charcoal as the primary cooking fuel. In the period since then the Senegalese Government has tried through heavy subsidies to encourage the use of butane instead of charcoal. The campaign has fallen far short of its goals. Use of butane did increase but so has that of charcoal, contrary to what was hoped. In fact, figures for the shipment of charcoal into Dakar recorded by the Water and Forests Department, while not complete, show that the level increased by 31 percent between 1975 and 1978, from 71,000 tons to 93,000 tons. Meanwhile, rounds of oil price increases have made butane, kerosene and electricity even more expensive. Senegal, which is completely dependent on imported crude for these forms of energy, saw suppliers raise their prices by 24 to 31 percent between December 1978 and April 1979.

What is clearly needed to avoid a catastrophic situation within the next few years is action on a number of fronts. As the first donor to act decisively on the supply side, AID approved the Senegal Fuelwood Project in April 1979. Four years of planting and nurturing eucalyptus and other species in the Bandia Forest should provide 3,000 hectares of high-yielding plantation located very near to the major charcoal consumption centers of Dakar and Thies. After ten years the project could be producing wood that with traditional methods would yield 8,000 metric tons of charcoal. The possibility of doubling the area to 6,000 hectares is envisaged, and if the cultivation methods to be used in the project are successful, they may be applied elsewhere in Senegal.

This AIP intends to intervene on the supply side in a way that will complement the Bandia Project and in fact make it, as well as other fuelwood production efforts, even more productive. As will be explained in more detail in the technical analysis section, current charcoal making methods in Senegal attain yields of charcoal-to-wood source (oven-dry basis) of 21 percent at the most. This project proposes to introduce among charcoal producers a slightly modified version of the traditional kiln which can produce yields as high as 30 percent. The modifications are inexpensive yet effective. If widely adopted among the 400-odd exploitants (producers) who field charcoal production teams around the country, the improved method could theoretically increase the availability of charcoal from the same wood resource 30 to 50 percent.

Calorific value?

i.e. 21 - 30??

Wt. or Volume

This AIP would also act on the demand side of the fuelwood equation. The cookstove component should be seen in the context of the CILSS effort now underway to promote extensive use of woodburning cookstoves in order to reduce fuelwood consumption. The most widespread method of cooking in the Sahel is the use of an open fire surrounded by three stones that support the cooking pot. In rural areas of Senegal the stones are sometimes replaced by a three-legged metal stand. In either case the thermal losses to the atmosphere are large; one estimate is that only about five percent of the heat available in the fuelwood is actually absorbed by the cooking pot. As a result Sahelians are thought to consume three to five times as much energy for cooking purposes as people in developing countries.

A recent report to CILSS° puts the introduction of stoves into a Sahelian context and provides information on the results of early experiments with stoves in Upper Volta. The report then suggests that each Sahelian country undertake a two-year program divided into two phases. A six-month initial phase would inventory traditional cookstoves found in the country and identify improvements that could be introduced. The second phase of 18 months would concentrate on designing and building prototypes of improved stoves and then testing and modifying them in the light of user reaction.

CILSS proposes to support individual country programs by providing a base for a technical coordinator. Regional seminars would provide a further element of coordination among national efforts. Donors must be found for each national program. CILSS is planning to send design teams to most of the Sahelian countries in the next three months to prepare project identification documents for submission to Club du Sahel donor countries.

In all likelihood, approval of this AIP would make the U.S. the donor for Senegal and obviate the need for a CILSS design effort here. For Upper Volta, the Outline and many details of a project have already been established. VITA (Volunteers in Technical Assistance) will implement it with funding from IBM-Europe and another donor yet to be identified. This AIP for Senegal would benefit in its initial stages from close liaison with the VITA effort.

The third component of this AIP is not concerned directly with the fuelwood crisis but does attempt to use another of Senegal's renewable energy resources in a more efficient way in order to benefit the rural population. Solar energy is in fact traditionally used to dry the portion of the fish catch that cannot be iced and transported to the main consumption centers, particularly Dakar, St-Louis and Thiès. Open-air drying of fish in the sun, however, does

°: Jacqueline Ki-Zerbo et Guido de Lepeleire: L'Amélioration des Foyers pour l'Utilisation Domestique du Bois de Feu: Ses Possibilités et son Impact au Sahel. Mai 1979.

not prevent flies from laying eggs in the moist flesh. Worms and later insects (dermestes) cause continuous losses in available protein right up to the time of consumption. The time period during which dried fish is stored and transported varies between two weeks and four or five months. Recent tests of dried fish at MBour have revealed an average loss of 25 percent of dried weight after one month; after two or three months losses can be considerably higher.

Those who end up being deprived of available protein by these losses are the vast number of Senegalese outside of the main cities for whom dried fish is an important element in the diet. Fermented and dried fish known as guedj is found in the sauce of almost every traditional Senegalese dish. The volume of fish consumption in Senegal, both fresh and dried, is shown by the fact that in 1977 the traditional catch from motorized and sail-powered pirogues amounted to 211,600 metric tons, almost none of which was exported. The traditional catch provided 40 kilos of fresh fish for each man, woman and child in Senegal, before exports and prior to weight and other losses incurred in drying and subsequent handling.

Concern with these losses has prompted research on fish dryers at one of Senegal's two solar energy research institutes (I.P.M.). The solution under study there relies on flat-plate collectors and entails a costly installation. Independently, Senegalese technicians at the national nutrition research center (I.T.A.) have experimented with small, simple, and inexpensive solar tent dryers and storage units. As will be explained in the technical analysis section, initial tests with the tents revealed defects but also showed that they raise the temperature high enough to kill larvae, worms and insects -- which is precisely what open-air solar drying cannot do. The tents have other advantages as well. They keep out dust, protect fish from rain, and allow them to be left out overnight. This AIP therefore intends to provide a modest amount of support to this Senegalese renewable energy initiative, enabling it to go further and faster than if it continues to depend on the resources of I.T.A. alone.

In drafting this document, we have drawn on several sources that are identified in the text. Portions of the technical and social soundness analyses have been taken verbatim from the contributions of Clarence F. Kooi, J. Clark Spooner, and Sheila S. Walker to the 1978 design effort, distributed by CRED under the title of "Working Papers for a Renewable Energy Project in Senegal", March 1979.

II. PROJECT DESCRIPTION

A. Improved Charcoal Production

As stated in the background section of this AIP, the charcoal component will address the problem of declining forest resources with concomitant environ-

mental degradation and agricultural production losses by training charcoal makers in a method of charcoal production which increases the output of charcoal by 30 to 50 percent over the traditional method. The only financial investment required is the purchase and fabrication of a chimney costing approximately $73 or 15,000 CFA °, a cost usually recovered the first time it is used. The method itself is explained in more detail in the technical section. This improved method has been developed over the last two and a half years by Ed Karch, a forester and Peace Corps Volunteer with the UNDP-FAO forestry project in Ziguinchor, Senegal. This component will build on the work of Mr. Karch and on the experience and resources contained in the FAO project.

The purpose of this component is to get approximately 270 heads of charcoal making teams to adopt the new "Casamance kiln" method. This will be accomplished by carrying out a series of training programs in various parts of Senegal over the two years of project duration. The project will be under the direction of Pape Djiby Koné of the State Secretariat for Water and Forests in Dakar and will utilize personnel trained at the FAO project by Mr. Karch.

The table below shows the number of persons (exploitants) licensed by Water and Forests to cut trees and to then make charcoal. It also shows the number of cooperatives, companies and workers involved in Senegal's charcoal production.

Each head directs a team of charcoal makers, and each head works for a cooperative or individual who may have thirty or more teams in various parts of Senegal. If the AIP project is successful in getting these heads who go through the training to use the new method with their workers, approximately 1000 workers of the 8-9 thousand charcoal workers in Senegal could be using the new method by the end of year two.

Results of data to be gathered on yields, training procedures, rate of adoption and possible barriers to adoption of the technique can be used at the end of the project to determine potential strategies for getting the rest of Senegal's charcoal production makers to adopt the method. Of course, adoption by others will also be affected by policies of Water and Forests as relates to independent charcoal makers.

proportion of total?

°: An exchange rate of $1 = 205 CFA will be used throughout this paper.

NUMBER OF ENTREPRENEURS IN FIREWOOD AND CHARCOAL SECTORS

REGIONS	NUMBER OF ENTREPRENEURS				CHARCOAL QUOTAS (100 Kg.)
	INDIVIDUALS	COOPERATIVES	COMPANIES	WORKERS	
CAP VERT	28	1	-	560	-
CASAMANCE	55	4	-	1100	250.000
DIOURBEL	34	1	-	680	-
SENEGAL ORIENTAL	34	3	-	680	150.000
FLEUVE	99	3	1	1980	270.000
THIES	47	2	-	940	20.000
LOUCA	9	1	-	180	50.000
SINE SALOUM	80	7	2	1600	150.000
TOTAL	386	22	3	7720	

The project will be carried out as follows:

Formation and Selection of the Traveling Training Team.

The FAO project already has a trained team of six charcoal makers who have been working with Mr. Karch for at least one year. The FAO project plans to expand this number to at least 30 and perhaps as many as 100, over the period November 1979 to May 1980, at which point the rains will be too heavy in the Casamance to make charcoal. In addition, Mr. Karch's Volunteer Service will be completed in June and he will be returning to the U.S. During November 1979, six heads will be selected by Water and Forests from several cooperatives and sent to become part of the charcoal teams under training at the FAO project. Water and Forests will, at the same time, identify a recent graduate of the Ecole Nationale des Agents Techniques des Eaux et Forêts at Djibelor, who will be assigned to his charcoal training group at the FAO project. This forestry agent will later become the director and main field person for running the training sessions under this project.

In late March 1980, six of the charcoal makers will be chosen from the FAO project to be the instructors on the traveling team under the direction of the forestry agent. These instructors will be chosen for knowledge of the new improved charcoal-making method and for their ability to pass that method on, or, in other words, to be teachers of people who have been charcoal makers for many years. In order to be believed by veteran charcoal makers these instructors will have to have made charcoal themselves for some years and to have command of the new process that can only come with having worked with it for a number of months.

The Training Cycle.

The first training cycle will take place in the Casamance in April and May 1980, over a six week period at a site to be determined by Water and Forests. All other training cycles will follow the same six-week pattern; hence the training that is described below holds for all 9 cycles which are programmed under this AIP. Thirty heads from cooperatives in the Casamance region will be selected through and by Water and Forests for ability and likelihood of being successful trainees. They will carry out construction and burning of two successive Casamance kilns, working in teams of three.

Each kiln takes approximately three weeks to build, burn, cool and be sacked, with a few days in between to rest (the burning period requires 24 hour work days) before starting the second one. The project will supply the necessary travel funds, tools, wood, and a living subsidy for each trainee. The living subsidy on the second kiln will be less than for the first in order to encourage interest in the outcome, as the trainees will share in the proceeds from sale of the charcoal. Each trainee will be given a chimney to take with him upon leaving the training so that he can immediately go back to his

cooperative team and begin using the new method. This will be an extremely strong and needed incentive to allow for a high level of success and to discourage any lag between the training and the start-up of using the new method.

Another important aspect of this project is the training of a local blacksmith in how to make the chimney (a torch is needed but they are quite common in Senegal). The training director (forestry agent) will take a sample chimney to a local blacksmith, explain what is needed, and then commission the blacksmith (or several if they are available) to make 30 chimneys for the trainees. The chimneys are relatively simple to construct, consisting of three 55-gallon drums soldered, welded or even wired together. Following the training program this means that there will be one or more artisan(s) who can make chimneys for whomever in the area wishes to begin using the new method.

Selection of Training Sites and Follow-up.

It will be important to give the training team the experience of running one program no later than April-May 1980, just prior to Senegal's rainy season, when charcoal-making halts. Waiting past April to begin would not allow enough time for a satisfactory program. The training director would use the period from June through September 1980 to make arrangements for the four training cycles that will occur from October 1980 through May 1981. Experience in the first program will permit him to make more realistic arrangements. Likely sites for the subsequent programs are in the Senegal Oriental, Sine Saloum, and Thies regions. The latter has been suggested since the AID Fuelwood Production Project in the Bandia Forest 20 km south of the city of Thies will be getting underway and there are plans to clear 750 hectares of existing trees to make way for the first year's plantings. Existing coverage is sparse but is largely Acacia Seyal, a good charcoal-producing tree.

Precise locations for the training programs will be chosen by Water and Forests in Dakar. The process for choosing trainees will also be directed by the Dakar office, though actual selection will probably be delegated to Regional Inspectors. From June 1981 through January 1982, when the program would end, an additional three or possibly four training cycles will be conducted. A fourth cycle could be squeezed in only if there are no substantial delays in any program and if it is decided to conduct one program in the drier Fleuve Region at the begnning or end of the 1981 rainy season. For the moment, however, the policy of Water and Forests is not to include the Fleuve Region since it wants to reduce the amount of charcoal produced there once the trees dead from the drought and cut in the path of irrigation projects have been turned into charcoal.

Follow-up, or essentially a field visit, is important for two reasons. First, to give some advice and support to the trainees after they have been working with the method for a while. They will leave training feeling that

at some point later questions will have a chance to be answered. Two, if the training program is to be expanded or continued it will be necessary to gather data on the level of adoption of the method by the trainees, the yields they are getting, reasons for not using the technique if they are not, etc. These follow up visits will be made by the training director, one or more of the trainers, local forestry personnel having knowledge of the method, and to some extent by Mr. Karch. During the first training cycle Mr. Karch will design a simple series of questions and information to be taken during the visit by whomever does it in each instance. These data sheets will be based on the questions laid out in the evaluation section of the AIP. They will also be aimed at aiding the former trainee improve his practices. A follow up schedule will be set up by the training director with Water and Forests in Dakar, and any regional Water and Forest personnel to be involved. Ideally the first follow up should occur within three months after training and another during the following charcoal-making season.

B. Woodburning Cookstoves.

Simply put, the objectives of this component of the project will be to settle upon a set of stove designs that are distinctly more efficient than open fires while at the same time being affordable by rural Senegalese, compatible with local customs, and capable of being operated and maintained by the user. In designing the stoves there will necessarily be conflict between efficiency on the one hand and low cost and simplicity of operation on the other. Continuous experimentation will be required to obtain models that do not require too much sacrifice of one particular criterion.

In keeping with the Sahel cookstove project framework suggested by the Ki-Zerbo report, this AIP proposes to begin with a period of prototype design, construction and testing, to be followed by experimentation with the most promising models in rural settings.

The locus of the initial six-month effort on prototypes will be the Institut de Physique Météorologique (I.P.M.) of the University of Dakar. While I.P.M. has in the past concentrated its research efforts on a range of solar energy devices, it is soon to be transformed by government decree into a national Center for Renewable Energy Research (CERER). In this context, the State Secretary (Minister) for Scientific and Technical Research determined last December that research on improved usage of fuelwood and charcoal resources would be the responsibility of CERER. In preparing for such an eventuality, I.P.M. has in recent months proposed to work on improving the efficiency of the charcoal brazier known as the fourneau malgache, which is ubiquitous in urban areas of Senegal.

To work on the charcoal stove, I.P.M. has been assigned an engineer recently graduated from the Thies Polytechnical School. A professor from Brace Research Institute in Canada has also promised to get a CUSO volunteer technician sent to I.P.M. to assist with the effort. They would be supervised

by Professor Djibril Fall, director of the Institute, and probably by Gérard Madon, a French engineer assigned to I.P.M.

The woodburning stove is intended for rural areas of Senegal where fuelwood is by far the primary fuel. Simple clay stoves are said to have been used in parts of Senegal in the past and may still be found among the Diola population in the Casamance region. I.P.M. has agreed to conduct an inquiry on its own in the near future to find if models are still in use. Whatever the results of such a study, the most promising basis for design and testing of stove models at I.P.M. will be the Lorena stove of clay and sand that has been introduced in Guatemala. Ianto Evans ° of the Aprovecho Institute in Eugene, Oregon, has tentatively agreed to provide technical guidance to I.P.M. in the initial stages of its work on prototype development. Evans will be working as well with the VITA woodstove project in Upper Volta.

Two other local sources of expertise have indicated they would help. Martial Boujasson, a French architect with the UN Environmental Training Program (ENDA) in Dakar, has had several years of experience building structures with pressed-earth block. He is well qualified to advise on clay/sand mixtures for stoves. Ed Karch, mentioned above as an advisor on the charcoal production component, could probably be borrowed for a few days from his work in Ziguinchor to participate with Evans and Boujasson in the design and testing of some prototypes at I.P.M.

The initial development stage would last five or six months, at the end of which time I.P.M. would be expected to have one or more prototypes that have been found ready for limited field testing. One grass-roots rural development organization that has expressed enthusiasm about participating in this second stage of the project is the Maison Familiale Rurale (MFR) with headquarters in Thies. To enable MFR representatives and possibly those of other organizations to learn how to build and operate the prototype, a short six-day training program would be arranged at Dakar in the sixth month of the project. The participants from each group would include at least one woman. Their task would be to cook several meals on prototype stoves previously built at I.P.M., learning how to build and regulate fires in the stoves. Male participants would work on the construction of prototypes, some of which

°: If Evans, or one of his knowledgeable associates, is not available, then the Mission could contact Mr. Al Ulmer, Rural Development Inc., 109 S. Winooski Ave., Burlington, Vt. (802-658-3890). He is a stove designer, mason, and former PCV in West Africa.

how will scientific measurements of efficiency & fuelwood savings be done?

would have been partially built beforehand so as to telescope the training activity. Trainees would thus avoid waiting through the drying process.

After completing the training program, the participants would return to their Regions. In the case of the MFR participants, they would build two or three working stoves at MFR headquarters at Thies and partially build others in preparation for the training of village-level extension agents. About one month later, six MFR centers would send moniteurs, monitrices and a village mason to Thies to undergo a training program similar to the one at I.P.M., though this time under the direction of MFR staff.

At the completion of this program, the stage would be set for actual village level trials, under controlled and closely supervised conditions. The MFR method for introducing new techniques into their villages is to use them first at the MFR center in the expectation of arousing curiosity and interest on the part of the villagers. If sufficient interest is shown, MFR agents help villagers learn the techniques. The Maison Familiale wants to handle stoves in the same fashion. Stoves would be built at each of six MFR centers until one was made that operated satisfactorily. As explained in the technical analysis section, it is prudent to expect that different combinations of local clays and sand must be tried before a proper mixture is found; this may require building, testing, and then destroying several stoves.

In most MFR villages, according to Maison Familiale headquarters, both moniteurs and monitrices take meals together, often cooked by a village woman hired for the purpose. For a period of five to six months or even longer if necessary, the stoves would be used daily at the MFR centers and records kept of their performance. It will be important to keep track of amounts of fuelwood consumed per type and size of meal; time of preparation, problems encountered and defects in design that become apparent in the course of daily use.

Coordinating the gathering of such information from the MFR village sites as well as from the Thies headquarters will be two Peace Corps Volunteers, one female and one male, based in Thies. The lead time required to recruit and train PCVs may prevent the Volunteers from being assigned to the project prior to the end of September 1980. This would be just about the time that the I.P.M. training program could be expected to occur. Attendance by the Volunteers would be essential and appears possible since they would probably be part of a group training for assignments with Promotion Humaine, starting in July 1980. This AIP proposes that the Volunteers selected for these positions spend three or four days with Ianto Evans at the Aprovecho Institute in Oregon prior to coming to Senegal. By that time Evans will have done his initial consulting with I.P.M. and will have first-hand familiarity with woodstove potential in Senegal. The purpose of sending the Volunteers to Oregon is not only to give them some exposure to woodstove construction and operation before coming to Senegal but also to provide a direct link with Evans and other technical sources in the English-speaking world.

The Volunteers would be assigned to Promotion Humaine, a service with which Peace Corps has had a long working relationship. The Maison Familiale Rurale also comes under the jurisdiction of Promotion Humaine. To enable the Volunteers to cover the village test sites and to visit I.P.M. periodically from their Thies base, as well as to be able to carry tools and equipment, they would be assigned a vehicle. It would probably be small (3/4 ton) Chevrolet pickup truck, spares for which now seem to be adequately supplied in Dakar.

As villages for the initial stove tests, MFR has suggested three with differing ethnic make-up in the Thies region and three others in other Regions °. The Thies villages are Fandène (entirely Sérère), Chérif Lo (Wolof and some Bambara) and Noto (a mixture -- 40% Sérère, 30% Wolof and 30% other ethnic groups). Other differences add to their interest as test sites. Fuelwood is used exclusively at Fandène; at Chérif Lo villagers have little opportunity to get charcoal and use it sparingly; and at Noto charcoal is relatively plentiful. Whether the preference for and availability of charcoal has an effect on the acceptability of woodstoves will be examined. It should be noted that in general the MFR agents know their villages very well and work extremely closely with the villagers. They are as well placed as any outside change-agents to discern the villagers' true reactions to and difficulties with woodburning stoves. It will be the job of the Volunteers to bring this information to the attention of the engineers and technicians at I.P.M. so that modifications can continuously be suggested and tried.

I.P.M. will spend approximately one year building modifying and adapting prototypes. The second six months will be devoted to efforts to improve models in the light of village experience. If all goes well, at the end of the first year one or more models will be ready for wider testing. If they are not ready, this phase would have to be postponed by up to six months. An ad-hoc committee under the chairmanship of the State Secretariat for Scientific and Technical Research (SERST) should be asked to make such a determination. Members could include I.P.M., Maison Familiale, the State Secretariat for Women's Programs (Condition Féminine), Promotion Humaine, Water and Forests and AID/Senegal. Such a working group was suggested while this AIP was being prepared, but no meeting could be arranged in the time available. *

One possible role of the committee would be to decide how the phase of wider testing and dissemination might be conducted with the funding available both from this AIP and from Senegalese government resources. The

°: Ndioffene in Diourbel Region, Diaoulé and Latmingué in Sine Saloum.

* formation should be specified in grant agreement

committee could be helped in this effort by the evaluation team that is proposed for the 15th month of the AIP (see evaluation section). If there has been good success in the early stages of the stoves component, it is at this point that a much more intensive dissemination project could be proposed for AID funding.

A method for the second phase of dissemination and testing has been suggested by the director of the Professional Training division of Promotion Humaine. Supervision of the MFR is now entrusted to this division under a proposed reorganization of Promotion Humaine. The Professional Training division has since 1963 run a number of artisans' training centers in different parts of the country. Masons and other artisans who have exercised their profession for at least three years are chosen by their Rural Communities for nine months of training at one of the artisans' training centers. These are located at:

Kaëlo (Diourbel Region)
Missira (Senegal Oriental)
Nianga (Fleuve)
Ogo (Fleuve)
Sedhiou (Casamance)
Tivaouane (Thies)

A higher level center for training trainers is located at Kaffrine center. They could then be introduced at the artisans training centers. Village masons who graduate from the centers could test stoves in their villages under the supervision of training center staff. Agricultural tools developed by SISCOMA have been tested in this fashion in the past. Details of how this effort might be supported with project funds would have to be worked out, preferably by the ad hoc committee with suggestions from the project evaluation team.

Another way of moving to somewhat wider dissemination and testing has been suggested by Peace Corps/Senegal. In late October 1979, twenty-five rural animation Volunteers will be trained to conduct a one-year energy survey in their villages. When stove models are ready for village testing, they could be introduced by the Volunteers in many of their villages. Data on fuel consumption would already have been gathered from sample households where the stove might be introduced; as the survey continued it would provide very useful information on resulting changes in consumption patterns. Arrangements would have to be made for trained masons to make the initial stoves in the Volunteers' villages.

What is required before the wider dissemination and testing stage is reached, however, is the development of an adequate set of models that meet the criteria listed at the start of this section. The efficiency, cost difficulty of construction and operation, and degree of adaptation to local customs will all have an effect on the way in which the stoves can be disseminated to rural users. These issues will be the primary and essential focus of this AIP.

C. Solar Fish Dryer.

The Solar Fish Dryer component of this AIP will develop and field test several models of a "solar tent" drying and storage system already under development by the Institut de Technologie Alimentaire (ITA). The technical analysis section of this AIP contains a description of this inexpensive renewable energy technology (the present models of the tents cost 10,000 - 12,000 CFA apiece). The intent of this component of the AIP is to develop the ITA Fish Dryer model within a village setting so that the design will reflect user needs, and so that appropriate procedures for spreading its use can be determined.

$50-60

The AIP component purpose is to find out (1) if the 'solar tent' technology can be developed to perform adequately from a technical standpoint, (2) in an acceptable manner for the villagers that use it, and (3) how it might be more widely spread. In order to address this purpose a series of basic technical, economic and social questions must be answered.

Technical

- Will the tent dryer and storage system operate consistently at high enough temperatures to effectively reduce damage and loss due to infestation ?

- What repairs, maintenance, and skills are required ?

- What is the projected lifetime for each model system developed in the program ?

Economic

- What are the projected costs of an installed system ? Are there variations or options that can reduce this cost ? What are the maintenance costs ?

- Will the users invest the required capital on an individual basis ? Cooperative basis ?

- Can users (investors) increase income through use of the dryer and storage system ?

Social

- What is the most appropriate approach (e.g. individual or organization) for:
  - a - acquiring and managing the tents, and
  - b - spreading use of the technology in the village; and how does this vary from region to region along the coast ?

- What social impact will widespread use of the technology likely bring about ?

On users and on the fish marketing and distribution system ?

In order to answer these questions data gathering and analysis must be carried out according to the evaluation section of the AIP.

PHASE I

The first phase (9 months) of the project will be mainly technology R & D. Several models will be built and tested by ITA at their Dakar facilities. Then 5 - 10 model systems will be placed in Joal and possibly MBour for four or five months of continued refining, development and testing.

Phase two will consist of placing 10 - 15 of the best improved system in several villages (e.g. Joal, MBour, Guédé, Fass Boye, St-Louis, Kayar). These installations will be monitored and improved. Data will be gathered on performance and acceptance by users, according to the AIP evaluation plan. ITA will have responsibility for developing, installing, monitoring and reporting on the solar dryer tent system.

Messrs. Niokhor Diouf and Mamadou Sarr of ITA, along with their support personnel, will construct the models under phase one. As outlined in the technical section of this AIP, model construction and testing in Dakar will take three months, and will include construction of both the smaller scale or individual-sized tents and larger or cooperative-sized models, and experimentation with materials. That is, with heavier polyethylene, plexiglass, framing, and drying rack materials.

Also during these three months period several trips will be made to the field sites at Joal and Mbour to make necessary arrangements in preparation for installations under Phase I. This will entail the hiring of a local person, on a part time basis, to monitor the systems and record data.

The ITA team will then (month four) install the 5 - 10 test models, with the help of the users and artisans. Polyethylene tents will be brought from Dakar where they are now sold, but all other construction materials will be obtained locally. A stay of several days will be required at each site by the ITA team.

The team will then visit the field sites every three weeks to monitor the project as called for in the evaluation plan, and to develop improvement strategies for the systems.

Also during this latter four months of Phase I the ITA team will visit the sites selected for Phase II operations. Arrangements will be worked out with the regional Service des Pêches Maritimes, users and local monitors and system installers will be identified. Appropriate strategies for partial payment by users for the tents may be developed. For example, users might pay 20%

of materials and construction costs, to be paid over time to the local Service des Pêches Maritimes and remitted to ITA for defrayment of project expenses not covered by this AIP budget.

At the end of Phase I there will be a meeting between AID, ITA and Recherche Scientifique to determine if the 'solar tents' have developed technologically, economically, and socially to a point whereby Phase II (more widespread trials) should take place. If the determination is negative, for example that the tent materials are either too fragile or too expensive, then a determination will be made as to further development plans or for project termination.

PHASE II

~~Phase II, beginning in month ten~~, will require the ITA team to spend several days at each site installing two systems and instructing people in their construction and use. Up to 15 systems will be installed in each of the four village sites. The number will depend upon how many are individual systems and how many are larger, or cooperative systems.

A local artisan will be hired to put them up and paid by ITA on a piece basis for each system installed. Users (individuals or cooperative) will have been selected and the overseeing of day-to-day installation can be carried out by a local organization under the direction of the ITA team. Actual work will be done by the paid artisan. Monitoring of system performance will be, as in Phase I, by a monitor hired by ITA. The ITA team will visit each village every three weeks to monitor progress according to the evaluation plan, to aid with system installation problems, etc.

The process outlined above for system installation and the organization required to accomplish getting the system in place, may well not turn out to be the best approach. It is put forth as a starting point. Any changes should be documented, but certainly done if advantageous to the project. What should be kept in mind by the AIP project manager and the ITA team is that the question posed by the project purpose statement must be addressed both by the management tasks and by any changes in implementation design.

The ITA team will continue with site visits every three weeks through the end of month 15, or the period of the mid-project evaluation assessment. One outcome of this assessment will be to help determine project direction, but continued monthly visits from months 15-24 aré envisioned at this time. ITA will prepare and produce a written report on the project at the end of the two years.

There are several scenarios regarding the development of these 'solar tents' which may develop over the two year AIP time frame.

One: The project fails, through either social or economic constraints. Should this occur, risks of great importance do not seem to be present. Large amounts of funding will not have been expended and the users or villagers will not have been asked to drastically change their traditional ways or undertake large personal risks.

Therefore no great harm should be done either to later attempts at developing renewable energy technology or to the villagers.

Two: The individual low cost tents work well and are being acquired by people in the villages. This scenario means that the tent system could be completely self sustaining in the private sector and no further external efforts would be needed.

Three: The larger or more expensive tents work and are desired by the villagers. The best strategy would have to be assessed at the time, and would probably require another project or some Senegalese Government program support. This would depend on the requirements for forming of cooperatives in the case of large tents, or for financing.

III. TECHNICAL DESCRIPTION

A. Improved Charcoal Production

The CILSS report on energy cited in Section I has convincingly argued that cooking with wood rather than charcoal would reduce the weight of forest wood that need be cut. This primarily a result of the low wood-to-charcoal conversion efficiency (yield) which is obtained from traditional production methods. It is variously estimated at 8 to 21 percent (charcoal weight/dry wood weight). The CILSS report calculates that the weight of forest wood that must be cut in order to boil 1,000 liters of water is 330 kg for wood burning and 830 Kg for charcoal burning. With improved stoves it is estimated to be 65 kg for wood burning and 160 kg for charcoal burning. This illustrates that it is considerably less wasteful of forest resources to burn wood and use improved stoves.

Nonetheless, it is expected that charcoal will continue to be used extensively in Senegal, particularly in Dakar and Thies[°]. Relatively smokeless fires and a clear preference for charcoal help explain the high level of consumption. It would therefore be wise to develop more efficient

[°]: Etude: Budget Consommation, Vol. I. Université de Dakar, Institut Universitaire de Technologie, 1975. This survey of 2312 households in Dakar found that 93% used charcoal as the principal source of energy for cooking.

methods for making charcoal. Improving charcoal yields in order to lower the pressure on Senegalese forests was recommended by E. Uhart, charcoal production advisor to the Economic Commission for Africa in 1976.°

Traditional charcoal production in Senegal is described briefly in the Senegal Fuelwood Production Project Paper (appendix C.). A kiln is built by stacking wood, the larger ends toward the middle, in a large mound around a central vertical post. °° It is covered with grass or bush and then with loose earth to prevent air from entering. The post is withdrawn and a fire started in the center hole. When it is burning well the center hole is sealed and air holes are opened in the sides at the proper times. As the wood burns, the entire stock settles. When the smoke stops, after 10-14 days, the holes are sealed and the pile is allowed to cool. The major drawback, apart from yield is the long period of time required for carbonization. Quality is also difficult to control.

A FAO-UNDP-sponsored forestry project in Ziguinchor has experimented with charcoal-making methods, as one facet of its activity. After determining that traditional yields were higher than most observers believed, °°° the project developed a new method that gives yields of 30 percent if done correctly and the wood is dry. It is a modification of the traditional process. Instead of building the stack directly on the ground, an air space is built underneath by means of a network of logs. A circumferential air chamber is also created by laying an apron of brush on the outside and a chimney is placed beside the stack. The air spaces and chimney replace the traditional results in better combustion of the volatile gases and/or less heat loss from the stack.

Other advantages of the new method, now called the "Casamance kiln", include an ability to mix size, density and moisture content in the wood being used without adverse effect. The Casamance kiln has demonstrated that smaller or less dense logs will stop burning when carbonization is complete (i.e. they will not turn to ash) even though logs next to them are still burning. Tests of the kiln in comparison with traditional kilns reveal that the former takes 0.5 to 0.7 hours to carbonize one stere (stacked cubic meter) of wood whereas the latter takes 3.6 to 7 hours. This is a significant saving for the charcoal makers, who are paid by the number of sacks of charcoal produced, not for their time.

°: Edmond Uhart: Projet de Rapport sur les Problèmes du Charbon de bois au Sénégal. Addis Ababa, ECA, March 1976. Page 11.

°°: The following discussion draws heavily on G.E.Karch's paper "Carbonization Research", December 1978, and on conversations with Karch.

°°°: Uhart, op. cit., for example, states that the traditional kilns yield only 8-12 percent. The UNDP/FAO project found it to be 21 percent.

Kiln construction and

The UNDP/FAO forestry project, under Karch's direction, tried other methods of charcoal production before settling on the Casamance Kiln as the one best suited for wider use. Uganda Mark V metal kilns were built and installed at the project sawmill in Ziguinchor. They proved to be expensive ($2,000 per unit at the time), gave little additional yield over the traditional kiln, were difficult to operate and were subject to considerable warping from the heat. In fact, the Senegalese government seriously considered requiring licensed charcoal makers to use such kilns a few years ago but abandoned the idea because of the heavy investment that would be required.

Work is continuing on a modified version of the Jamaica Report, whose original design was found to be deficient. The retort consistently produces yields of 40 percent in high-grade charcoal. It is now realized however, that imported stainless steel must be used in construction. The retort is fired externally by sawdust, and carbonizes mill waste. This means that it would be suitable in conjunction with sawmill operation.

A final design developed at Ziguinchor is the "Petit Four", which uses two oil drums, one on top of the other. It could be used artisanally at the village level but its introduction would probably be difficult and its potential for savings of Senegal's wood resource is slight compared to the Casamance kiln.

The organization of charcoal making with the traditional or Casamance kiln is based on three-man teams. Wood is cut with locally made axes or occasionally with a two-man crosscut saw, which is not much good with logs over 30 cm in diameter. Charcoal makers usually leave in the forest anything over 50 cm. In fact, the director of the UNDP/FAO project estimates that 25 to 40 percent of the wood is left in the forest. Without chain saws, not much can be done about this, but it is clearly a terrible waste of the resource. Chain saws used in the UNDP/FAO project have had long down-times because of improper sharpening and maintenance. The traditional way of forwarding wood from stump to kiln is by head load.

It will take a three-man crew 21-23 days to complete carbonization of a 100-stere kiln. A 103-stere kiln produced by the UNDP/FAO project, for example, took 24 days:

8 days to build
7 days to light off, burn and let cool
9 days to unpack and bag

The actual carbonization (Burn) with the Casamance kiln will take from one to four days, depending on the size. Kilns varying from 30 to 150 steres can be used.

Losses of charcoal occur after bagging, in the handling and transport required to get the product to the centers of consumption. These too are disturbing. With limited resources, however, this AIP is tightly focused on the one phase of the entire operation where a reasonably proven improvement of method can increase the amount of charcoal produced from the same amount of wood piled on a kiln by a conservative estimate of 30 percent.

B. Woodburning Cookstoves.

The essential qualities to be sought in stoves which would be proposed for widespread acceptance in rural areas of Senegal are:

1. efficient performance that reduces fuelwood consumption signifanctly;
2. construction almost entirely with local materials;
3. affordability by rural people with very low incomes;
4. compatibility with local cooking customs and hence social acceptability.

Stoves that have most if not all of these qualities have been successfully designed and introduced in other countries. The oft-cited Singer designs for Indonesia ° have been published by the FAO and tried in several places. More recently, the success of the Lorena stove in Guatemala has attracted considerable attention. Made of clay and sand, the stove holds promise for the Sahel as a whole but will require obvious modification in order to become compatible with local customs. A useful starting place for work on the Lorena stove is an 80-page booklet published in January 1979 by Volunteers in Asia;°° copies are being provided to interested parties in Senegal.

Other designs are available as well. VITA has informally compiled a set of articles on woodburning stoves from American, Indian, Japanese and other sources; a copy has been given to I.P.M. along with a bibliography on stove designs prepared by the Intermediate Technology Development Group (ITDG) of London, which will be testing stove construction materials in Upper Volta under the VITA project. With the subject drawing increasing interest from development groups, several are beginning to do research on it. One such is the Fund for Research and Investment for the Development of Africa Ltd (FRIDA) with headquarters in London and a field office in Bamako.

°: H. Singer. Report to the Government of Indonesia on Improvement of Fuelwood Cooking Stoves and Economy in Fuelwood Consumption, Rome, FAO, 1961.

°°: Ianto Evans. Lorena Owner-Built Stoves. Stanford, Volunteers in Asia, 1979.

I.P.M. will need to draw on these and other resources as it works on prototypes. The appointment of a CILSS coordinator, as mentioned in the background section, should improve access to information not only about work being pursued in Sahelian neighbors but also about the results of research in other countries. One of the roles of the Peace Corps Volunteers in this project will be to gather information from English language sources.

Testing of various designs, as best as we could tell, has not taken place in Senegal but has occurred recently in Upper Volta. A couple of hundred have been built there and an undetermined number are still in use. One model is called the "Nouna" stove after the town where it was introduced by a German Volunteer. Some 150 have been installed. Other prototypes have been built in a hospital and social center in Ouagadougou, according to the Ki-Zerbo report. Peace Corps Volunteers in Upper Volta are also active, ones stationed in Kaya, Koundougou and Leo having built different models. Unlike the Nouna stove, which is made of cement and reinforcing rod, the Leo stove is built of clay brick.

Whitney Garberson, now of VITA, conducted some simple tests in Ouagadougou with four models: the high version of the FAO (Singer) stove, the low version of the same stove, the Nouna stove, and an Indian chula that is very similar to the Lorena stove. The Lorena-type gave the best results and the Nouna model the worst.

Whatever models are tried by I.P.M. in Senegal, the one (s) that will prove to be most suited to conditions in the country will almost certainly be "none of the above". Mme Ki-Zerbo is reported to believe that there have been too many attempts to bring stove models in from the outside, the proposer usually suggesting that everyone wait a minute because he or she has the perfect stove for local conditions. It is worth emphasizing again and again that the women who would be asked to cook their meals on the Senegalese stoves and the masons who would be asked to build them should from the very beginning have a great deal of influence on what is being produced. The project description suggests how this might be accomplished.

Before reviewing some of the technical problems that must be faced and overcome in building stoves, it is worth looking at some of the technical barriers that will make it essential to have advice from those who cook on the stoves. The Ki-Zerbo report cites a number of them, including:

1. The switch from an open fire seen by the user and regulated by eye to one that is almost completely hidden. Adjusting intensity of heat by pushing logs onto the fire will give way to regulating by alterning the flow of air through the firebox.

2. The need to find an appropriate height for the stove which will permit easy accomplishment of varied cooking tasks.

3. The need to cut wood to a size considerably smaller than the 1 to 1-1/2 meter lengths that are used with open fires.

4. The need to clean the chimney regularly (Singer advocates six-month intervals) so that deposits do not build up and cause a fire hazard.

5. The need to keep stove orifices covered with lids when not in use and to be able to open them easily when required.

6. The need to find a stove base that will not get too hot to stand on, even in bare feet.

What are some of the technical characteristics of a stove that might overcome these barriers ? One must look at both the wood combustion process and the cooking process. When wood is heated it undergoes complex chemical changes resulting in gases being ejected from its surface. When the gases reach a temperature of about 600°C they begin burning if the right amount of oxygen is available. The solid part that remains begins burning later. In fast burning wood fires about 2/3 of the wood is burned as a gas while in slow burning fires about 1/3 is burned as gas.

In order for the gas to burn completely it must find itself in a region having a sufficiently high temperature (about 600°C) and the proper amount of air. A lack of air results in incomplete combustion while an excess of air carries off heat that should be used in the cooking. If great enough, the excess air can cool the gas below its ignition temperature so that, again, the combustion would be incomplete. Thus one must control the air inflow rate and the combustion rate.

Firebox walls made of iron can lower the temperature of the gases flowing near the walls and thus produce incomplete combustion. Such walls are also good transmitters of heat to the space around the stove. This is desirable in colder climates but not in the Sahel, where space heating is seldom needed. One wants, as far as possible, to concentrate the heat on the cooking utensil. Firebrick, ceramic, or clay walls, which are better heat insulators, are an obvious choice for cook-stove construction in the Sahel. A further advantage of such construction materials is their local availability and lower cost. The firebox must be constructed so that the inflow of air can be controlled and the heat directed mostly to the cooking utensil. It must have an appropriate chimney to effect the proper gas and air flows.

In sum, a stove should satisfy the following criteria:

a. Construction with local materials; the metal (or even fired clay) firedoor can be made in Senegal;

b. Controlled combustion by control of air intake;

c. Use of insulating walls to minimize heat loss to the surrounding space and to maintain high temperatures on internal surfaces in order to

increase combustion efficiency;

d. Placement of the major heat exit in the cooking apertures, which are completely covered by utensils or, when not in use, by insulating lids. The heat exit apertures will be as air-tight as possible to allow combustion control by means of the adjustable air inlet at the firebox entrance.

Some major technical problems remaining to be solved are:

1. Finding and preparing the proper clays. Tests for proper clay, proper clay treatment and building techniques have been developed.

2. Making a standard tight-fitting door for the firebox opening.

3. Accomodating heating hole sizes to cooking utensil types and dimensions. The utensils should sink down into the holes to receive maximum heat. Iron grills may have to be installed in some holes.

4. Optimizing the dimensions of the stove, particularly the firebox and gas passage dimensions.

5. Developing standard designs and construction aids that can be widely diffused.

6. Adapting designs, as necessary, to fuels other than wood (i.e. charcoal).

Useful discussions of these issues may be found in Lorena Owner-Built Stoves and the Singer report cited above. Copies of both have been given to I.P.M.

We made no survey of cooking methods in Senegal but rather sought some information on questions pertinent to the design of stoves. Mme Joséphine N'Diaye, head of the Formation Technique Féminine section of MFR was our main source. She had conducted comparative tests of four cooking methods: the traditional wood fire, butane gas stove, a stove using peanut shells and one using millet residues. The advantages of the wood fire were found to be rapid cooking time, a hot fire, and lower cost than a charcoal fire. The disadvantages were the difficulty of getting wood, high cost of wood and excessive smoke.

Among the most common dishes in rural Senegal are cous-cous, lakh (a millet preparation) and dakhine (rice and peanut meal). Cous-cous preparation can take two hours since the grains must be steamed twice in succession. Normally enough grain for three or four meals is cooked at one time, and for the subsequent meals only the sauce need be prepared. (In a hurry, rural women often use two fires to cook grain and sauce simultaneously). Lakh normally takes one hour to cook, dakhine one hour and a half, and other dishes as little as 15 minutes. City dwellers take more time preparing

meals than rural women.

In rural areas the mid-day meal is usually begun at noon and completed before 2 p.m. Lakh, dakhine and occasionally chebugen (fresh fish and vegetables simmered in rice) are taken at mid-day. Cous-cous is prepared in the evening, beginning at 5 p.m. There are few seasonal alterations in this pattern. In the Casamance Region, where women spend all day in the fields, they cook before dawn and take a cold meal to eat in the fields at mid-day. Tow, a millet paste eaten with sauce, is found only among the Malinké in Sénégal Oriental.

Wood fires are made with pieces of wood no more than 1.5 meters in length. One-meter lengths are preferred. Wood is trimmed with machetes (coupe-coupe) which almost every family possesses or with hatchets that are owned by perhaps one family in five. The strength of the fire is regulated by pushing wood onto the fire from three sides or by withdrawing it. The latter occurs when rice has been brought to a boil so as not to burn it. Small wind-breaks are set up on the sides when the wind is strong.

A final technical note is that ways of testing both the performance of stoves and cooking methods for them are described in the Singer report, pages 12-18.

C. Solar Fish Drying and Storage System

Almost all fish drying in Senegal is done by traditional direct solar drying. Fish are placed on racks raised above the ground for good air circulation and exposure to sunlight.

The fish are usually turned twice a day, are brought in at night, and the process takes three to four days. Before drying, some fish are fermented in a salt brine to make guedj. Selection depends upon the species of fish. Most of the fish caught and processed for the Senegal dry fish market are, in fact, made into guedj. Smoked fish is primarily for the export market and is a much smaller part of processed production. Whether fish are dried directly after being caught, or are fermented into guedj and then dried, infestation by micro organisms, flies and insects begins immediately. However, the greatest part of the losses under the traditional system occurs during the storage, after the drying process is complete. The infestation process which has started during the drying continues until consumption occurs, on until the fish has completely deteriorated (about six months).

Any attempt to prevent major losses of fish on the dried fish Senegalese market must address both drying and storage problems (and eventually time lags between storage and consumption), as well as take into account taste preferences of the Senegalese. Drying fish to a moisture content of less than 20 percent eliminates most losses from microbe activity and greatly

inhibits insect infestation, but this product is good only for the export market as taste preferences of the Senegalese require between 25 and 35 percent moisture content.

Between 30 and 35 percent of all fish (fresh and otherwise) consumed in Senegal are dried using the traditional methods (figures from 1976 and 1977.) The technology proposed for research and development in the AIP can reduce losses and spoilage of this catch through improved use of solar radiation. A recent report by Niokhor S. Diouf of ITA entitled, Rapport Préliminaire résumant notre Recherche sur l'Utilisation de l'Energie Solaire pour le Séchage des Aliments, details the initial and favorable results of the solar tent drying system to be used in this AIP. ITA's work is based on research and field work described in a chapter entitled "A Polyethylene Tent Drier for Improved Sun Drying of Fish" in Food and Technology in Australia by P.E. Doe et al.

The tent has a wooden frame made from scrap wood or straight branches three or four inches in diameter. One to three horizontal drying racks are built using wood or netting. The tent is then covered with a shaped piece of polyethylene. Total cost including labor is 10,000 to 12,000 CFA. General dimensions are 2.6 meters long by 1.7 meters high by 1.7 meters wide, giving two square meters of solar collecting surface. The drying tent uses a clear polyethylene and the storage tent a black polyethylene. Each drying cycle can dry approximately 100 kilos of fresh fish. The storage tent of the same dimensions can store up to 250 kilos of dried fish.

The drying tent works simply by allowing air to enter at the bottom to be heated as it moves upwards and to exit through an aperture at the top, removing humidity in the process. Tests in Joal and MBour by ITA have produced an acceptable product for the people. The temperature in the tents -- and in the initial tents that were built at the ITA facilities in Dakar before any field tests were done -- were normally between 56°C and 58°C, and did not drop below 40°C at any time during the night. This means that the tent increased the temperature by between 15 and 25 degrees centigrade at all times. As a temperature of 50°C prevents microbic activity and kills all insects, the tents were successful in preventing losses due to pest infestation and greatly reduced microbic activity.

The storage tent reaches temperatures in excess of 50°C and thus prevents the infestation and losses which normally occur during storage. By closing the tent and not allowing air to circulate, the humidity level is kept constant and the fish do not dry to a lower humidity, thus keeping the fish in a condition that is culturally acceptable.

The first table below shows the result of one of the drying cycles of guedj conducted in Mbour by ITA this past August. Results of traditional drying done alongside the tent are shown below in the same table. Since

MBOUR SECHAGE SOLAIRE SILURE GRAND

GUEDJ DE SILURE

Pluie dans la nuit du 9/8 au 10/8 jusqu'à 10H00

	9/8		10/8		11/8		12/8
TENTE SOLAIRE	10H	16H	10H45	18H25	16H	18H30	18H
Eau	80%	72,4%	68,2%	32,3%	30,7%	24%	
ABVT mg/100g	14,58mg/100g	17,45 mg/	21,73 mg/100g	34,36mg/	56,25mg/100g	62,85mg	
SECHAGE NATUREL							
Eau	77,1%	75,2%	70,4%	65,4%	45,5%	36,4%	30,97%
ABVT	20,85 mg/100g	31,87mg/100g	80,09mg/100g	70,80mg/100g	118mg/100g	145mg/100g	198,95 mg

Pour le séchage à l'état naturel sur les claies, présence de larves qui causent des pertes pendant le séchage Mais si on introduit les poissons infestés dans les tentes à séchage, les larves sont éliminées en quelques heures (2 à 3 heures). En outre, ce tableau montre que les microorganismes responsables de la dégradation du poisson en cours de séchage sont gênés lorsque la température est maintenue entre 40 et 55°C, alors qu'entre 30 et 40°C les micro-organismes provoquent la dégradation du poisson en cours de séchage ainsi l'ABVT des poissons transformés est supérieur à 100mg/100g seuil admis par la FAO

MBOUR STOCKAGE DE PRODUITS TRANSFORMES. ETUDE ET EVOLUTION.

HISTAMINE ET EAU

MAQUEREAUX A LA TENTE SOLAIRE

TENTE DE STOCKAGE

	12/8	13/8	14/8	15/8	16/8	17/8	18/8	19/8	20/8
Eau	19%	20,18%	22,2%	20,4%	29,4%	18,5%	20,08%	20,07%	20,56%
ABVT 1/	83,6mg		85 mg/100g			85,15mg			88,67mg
Histamine	78mg		70mg			45mg		36mg	30mg/100g

1/ Acide basique volatif total: indice de qualité des poissions tranformés et frais.

Histamine: qui se forme par decarboxylation bactérienne de l'hotidine acide aminé du poisson. En quantités importantes, il peut provoquer des intoxications alimentaires.

Indole qui se forme par décarboxylation bactérienne du tryptophane acidé aminé du poisson. C'est un indic de qualité des poissons transformés et frais.

STOCKAGE NATUREL AVEC PERTE DE POIDS PAR ATTAQUE DE DERMESTES

(20 à 25% par mois)

MAQUEREAUX SECHES A L'AIR LIBRE

	12/8	13/8	14/8	15/8	16/8	17/8	18/8	19/8	20/8
Eau	24,12%	23,80%	25%	22%	22,8%	21,9%	22,9%	23,8%	22,01%
ABVT mg/100g	143 mg		144 mg			147,7mg			250mg
Histamine mg/100g	260		195			162mg		110mg	72mg

Le prélèvement des échantillons se fait à 18H30 de chaque jour dans des sachets plastiques sous vide, les analyses ont eu lieu à l'ITA.

Pour le stockage naturel, on a observé des larves et des dermestes causant des pertes de poids, l'humidité remontant chaque matin. Pour le stockage à la tente, pas de dermestes. En outre il y a chute des taux d'histamine en 8 jours réduisant considérablement les risques d'intoxication.

the Senegalese prefer fish at approximately 25 to 35 percent moisture content when bought on the market, the fish were dried to that level. In this particular test, the drying cycle took longer than it might have otherwise because it rained during one day of the test period. It is important to note that no labor is required with the tent system when it rains as the tent is simply shut. With the traditional method all the fish must be brought inside under cover, thus increasing the labor required for the drying cycle. In addition to protection against rain, both the drying and storage tents protect against dust and animals.

The second table is a comparison of traditional storage with the tent storage system, over a one week time period. Most important, no insect infestation occurred in the storage tent as opposed to immediate attack in the traditional system. According to a series of ITA tests, the resulting losses average 25 percent by the end of the first month, increasing up to 50 or 60 percent by the end of four months.

When comparing the tent dryer with the more sophisticated model of solar dryer developed by I.P.M., it appeared to us that while the capacity of the I.P.M. model was greater (250 kg/day for 20 m2 of collecting surface), the extremely high cost of the device and the complexity of its construction were handicaps too serious to overcome.

Several problems with the design and materials in the nets were uncovered by ITA during their field tests, as well as several interesting possibilities for increasing the usefulness of the tents. The basic indications are that the tents can be very successful, but in order to be fully adopted by the villagers these issues need to be addressed.

First, the tents were intentionally put in place during a windy period of the year to see how they would perform. The clear polyethylele of 100 microns tore in the wind, although the heavier black of 300 microns stood up quite well. ITA wants to experiment with heavier clear polyethylene. Also, wind came up under the tents, and ITA has concepts for correcting this that they wish to test. If the concepts work, this will also improve tent and material durability. The wind problem is not as great in the Fleuve region as it is along the coast and hence the tents will probably not need as much durability for use there). Presently, the ITA goal is to have a tent cover that will last one year before being replaced at a cost of about 6,000 CFA. Another concept ITA wants to pursue is to substitute plexiglass for polyethylene. This may reduce costs over the lifetime of the system and should eliminate the need to change the tent cover each year. In any case, this plexiglass concept must be experimented with in much greater detail.

Second, the angle of the tent slope on the sides must be adopted to the conditions in Senegal so as to take better advantage of the solar radiation which is available. This change should also improve the performance of the system.

Third, ITA wants to experiment with larger tents for both drying and storage. Larger drying tents would be more efficient for those people who have very large operations or might be used to encourage the formation of cooperatives, something that the government would like to see more of among the villagers on the coast. Moreover, it is likely that larger storage tents may be much more efficient from both cost and convenience standpoints.

At a minimum, all of these problems and possibilities would be fully explored at ITA's Dakar facilities before being tested again in the field. As stated in the project description section, a meeting should be held between ITA, SERST, and AID at the end of Phase I to determine the state of the technology and to decide whether or not to move into wider field testing as called for in Phase II.

IV. ECONOMIC FEASIBILITY

In two of its three components, this AIP would spend AID funding on R &D work devoted to simple, inexpensive technologies that would provide tangible benefits to their users and at the same time limit degradation of national resources, proving potential benefits to the entire population.

Woodburning cookstoves would not provide a different source of energy for rural people. The alternatives to wood seem to be ruled out at this time. On the one hand, solar cookers would seem to be an ideal solution in most parts of Senegal, but the almost universally-held opinion today is that solar cookers -- at least the ones that have been tried here and elsewhere -- would cause so much alteration of cooking habits as to be impractical. On the other hand, petroleum-based fuels are already far too expensive to be seriously considered for rural areas; and greater use of dried animal dung would only add to the already serious problem of declining soil fertility.

What the woodstoves would do, if properly contsructed and used, would be to reduce the consumption of wood in a household by about 50 percent, perhaps somewhat less, perhaps somewhat more. The Lorena stove in Guatemala saves 50 percent. From the viewpoint of the user, would the investment in such a stove be worthwhile ? Limited experience in Upper Volta seems to indicate that the answer is solidly affirmative. The Ki-Zerbo report estimates that Sahelian stoves will cost from 3,000 to 9,000 CFA ($14.60 to $43.90). Nouna stoves cost no more than 3,000 CFA and firebrick stoves even less. Can this amount be afforded ? Family budgets for fuelwood in Senegal are not yet known, or at least not available in sources known to us. The Peace Corps village energy survey, mentioned in the technical description section, should begin to suggest answers in the near future.

For lack of a better figure, let us assume that budgets are in the range of 1,500 to 3,000 CFA per month, a number used by Ki-Zerbo. This would indicate that a stove which reduces wood consumption by one-half would pay for itself in four to twelve months on a 1,500 CFA budget or two to six months on a 3,000 CFA budget. Since a more expensive stove would imply a larger fuelwood budget for the household purchasing it, one may conclude

that the stoves, which will be designed to last far more than one year, will have a pay-back period of well within a year. Given the short time period involved, a rate of interest as high as 50 percent would not alter this result.

A recent report that mentions the introduction of stoves in Upper Volta °, states that stoves in Nouna and Ouagadougou are thought to save their users about 2,500 CFA per month, a higher estimate than Ki-Zerbo's. A cartload of wood costing about 4,000 CFA will last two to three months when a stove is used but only three to four weeks when cooking is done over an open fire.

The social costs of high levels of fuelwood consumption are heavy. Villagers are legally permitted only to gather dead wood for fuel, and after the Sahelian drought dead wood was more plentiful than before. Now, however, it is again scarce.

If one assumes that the value to the country of the fuelwood consumed is represented by the replacement cost of setting up fuelwood plantations producing an equivalent amount of wood, the forest losses avoided by improved cooking efficiency can be estimated as follows. One can only guess at the figures for per capita consumption of fuelwood, no survey having been done. The generally accepted range for Senegal is 1.0 to 1.5 steres of wood per capita per year. Using a conversion factor of 0.6 cubic meters of solid wood to one stere, an average Senegalese would consume 0.6 to 0.9 m3 of wood per year.

Winterbottom suggests for Upper Volta that per m3 the total cost of fuelwood produced by a plantation is 5,000 to 10,000 CFA. Using the lower figure and assuming a household of eight persons, we find that the value of the wood consumed per household would be 24,000 to 36,000 CFA per year. A fifty percent reduction in consumption would represent an avoidance of loss to the national forest worth 12,000 to 18,000 CFA per household per year by means of a stove costing a fraction of that amount.

Solar tent dryers, like stoves, are in the R & D stage and would provide tangible benefits to their users and to the country as a whole. Economic feasibility is more easily calculated in the case of the dryers.

°: Robert Winterbottom: Koudougou Agricultural Development Project Appraisal Report. Ouagadougou, CILSS, August 1979.

The question of whether people in the fish-drying trade can afford an investment of 24,000 ($117) in a tent dryer and in a storage tent can be addressed as follows. The women's cooperative at Joal, where tents have already been tested, does a large volume of business per individual compared to others in the trade elsewhere, but statistics on their activity are available. In 1978 the cooperative of 390 members transformed 19,027 metric tons of fresh fish into 6,009 tons of dried and smoked fish. (Ninety-two percent of the total was dried). An idea of the volume of activity of the cooperative is given by the fact that the dried weight represented 50 percent of the production of the fish drying "industry" in the Thies region, which includes important centers at MBour and Kayar. If we use 100CFA/kg as the selling price of dried fish, the average member had a gross income of 1,540,000 CFA ($7,500) in 1978.

In the technical description of the dryers, we have assumed that the tent dryer would hold 100 kg of fresh fish and would dry the average batch in about two days. This would produce 35 kg of dried fish. The fact that the fish in the dryer would be protected against rain in the rainy season and would not have to be brought inside at night should result in a labor savings that would permit the individual to handle a somewhat higher volume than would otherwise be the case. It is difficult to estimate what this might be, so we will ignore it for the purposes of this analysis.

The storage tent is assumed to have a capacity of 250 kg of dried fish or slightly more than 14 days' worth of production by the tent dryer. Assuming further that the average storage time for each batch is two weeks and that the losses from infestation and extra handling that would otherwise occur during that time can be calculated at ten percent °, we reach the following conclusion. Twenty-five kg of extra fish preserved in the fish dryer in each two-week period would be worth approximately 2,500 CFA °°. If this amount were fully recouped, the individual would be able to pay back the initial investment within seven months at an interest rate of 40 percent. (At the end of one year the amount to be repaid would be 33,600 CFA; with 2,500 in additional income every two weeks, it would take 27 weeks to repay this amount).

Under these conditions, the tent dryers and storage tents could cost

°: Losses at the end of one month from infestation alone have been found to be 25 percent.

°°: Again we use 100 CFA/kg as the average price of dried fish after transformation. ITA has found that the minimum for some varieties is 100 CFA/kg. with the minimum for guedj being 200 CFA/kg.

as much as 23,000 CFA each, almost double the present price, and the individual would be able to pay back the initial investment at 40 percent (65,000 CFA) within one year. In fact, we are assuming that after one year the polyethylene cover will have to be replaced, at a cost of about 5,000 CFA and that the tent structure would last a minimum of two years before replacement was needed. If this were the case, the individual would have considerable additional benefits in the second year, even if the tents cost 23,000 CFA each.

The social benefits from using the tents cannot be calculated with the data available, but it should be sufficient to note that the additional amount of fish preserved by the tents would provide social benefits. What is more, the fish would be sold into the distribution network virtually free of infestation, and the losses that now occur right up to the time of consumption would largely be avoided.

Program expenditures for improved charcoal production, unlike those for the other two components, do not represent R & D. The social value of charcoal cannot be said to be represented by the price currently established. The offical price in Dakar and Thies is 20 CFA per kilo, but black-market prices of 35 to 40 CFA are estimated by some officials. In fact, steps have recently been taken to increase the price at Kaolack, and it is expected that the official price in Dakar/Thies will have to be raised as well.

The Casamance kiln has demonstrated increased yields of at least 30 percent over the traditional kiln. To take an example of a batch of charcoal produced by the Casamance kiln in Ziguinchor, it turned 103 steres of wood into 13,852 kg of charcoal, a yield of 32.4 percent oven-dry basis (Karch, op. cit., p. 9). This is some 50 percent more than the traditional yield of 21 percent. In other words, the Casamance kiln produces 4,600 more kilos of charcoal than the traditional kiln would theoretically have yielded from the same input of wood. Assigning a shadow price 30 CFA/kg to the additional yield, we find that it represents a benefit of 138,000 CFA ($675).

The project aims to train 250-270 chefs d'équipe of charcoal production teams in a two-year period. It is not too far-fetched to say that if 250 heads each use the Casamance kiln with 100 steres of wood only once and obtain an additional 3,500 kg of charcoal from it, the social benefits would virtually equal the entire investment in the project ($130,000). By assigning a shadow price of 30 CFA/kg to 3,500 kg, this equals 105,000 CFA per team. 105,000 CFA X 250 = 26,250,000 CFA = $128,000.

An alternative investment for the project funds to be put into improved charcoal production would be a fuelwood plantation of the type being installed in the Bandia Forest under the Senegal Fuelwood Production Project. That project paper states that if it is successful, the cost of planting one hectare of plantation could be reduced to about $700. Some 185 ha could be planted with charcoal production funds. Based on Bandia project projections, after four or five years each hectare would yield about 10 m3 per year of eucalyptus

timber. This too would have considerable social value. Without attempting the calculations that a comparison would entail, it can surely be said that the value of the charcoal production project is (a) that it should start producing immediate benefits -- and time is an important variable in combatting deforestation in Sahelian countries -- and (b) that it so neatly complements the Bandia project since the Casamance kiln would increase the benefits from it. The Fuelwood Production Project Paper in fact stresses this point. It speaks of the "clear need to improve the efficiency of conversion of fuelwood to heat energy" and mentions the Casamance kiln as a promising method of doing so. (Annex C, P. 13).

V. SOCIAL SOUNDNESS ANALYSIS

This Renewable Energy AIP can play two important functions in the effort to provide improved energy supplies for Senegal. First, the AIP responds to basic needs of the poor by providing improved energy supply for fundamental tasks. Second, this AIP is directed at providing new technologies (concepts or methods as well as hardware) for villagers and individuals to own, manage, and maintain themselves. Therefore, this project is aimed at creating a situation in which villagers themselves have control over the new technology and are not heavily reliant on subsidies or on outside support systems once the project is over.

In reference to energy supply for basic tasks, the project will help diminish the time and energy spent in gathering firewood for meal preparation. Particularly in the densely populated rural areas, which are coincidentally also the most deforested, gathering wood for cooking daily meals may take several hours. Charcoal is used in the cities and the Government is encouraging the use of butane gas, but both are too expensive for most village budgets or are unavailable. From all indications, women would be pleased to have stoves that would burn more efficiently and thus require less fuel.

Both the improved charcoal method and the fish dryer system increase the productivity level, or value of product output per hour of labor input by the technology users. Not only is productivity higher, time involved is reduced, and thereby the work load, by 25 to 30 percent in the instance of charcoal, and by at least 50 percent in the instance of fish dryers.

In reference to the second project function, a basic concept in this project is the importance of optimizing local control of technology whenever feasible. Much technology introduced into rural areas has not been used once the external support system that brought it has left. In many instances problems developed which people were not trained to solve, or for which they did not have adequate material or funds. Often, people have felt that new technology was not really theirs and hence that they were not really responsible for it. In other words, they had not integrated it into their lives. If new technologies are to be put into service to improve peoples' lives, this integration is necessary. Technologies must respond to needs felt and

expressed by the villagers, which they are willing to try new techniques to alleviate. Villagers must also be provided with training or adequate experience so that the technology can continue in use without excessive external support. This AIP is designed around this concept and is directed to address both issues put forth at the beginning of this section.

Villagers have already experimented with the solar fish dryer and have found it convenient, useful, and not very different from habitual manner of drying fish. They have expressed real interest in working more with ITA on improving the technology. This apparent openess to change may be due to the fact that developments have been occuring along the coast in fish drying methods and in the social make-up of the workforce. For example, the change from drying fish on the ground to drying fish on racks (claies) took place only about 20 years ago. There also seems to be little barrier to entry into the trade. Prior to World War II, most if not all of those involved in the "transformation" of fish were wives of fishermen, and no commercial transaction was generally involved before drying took place. Today, fish to be dried are sold on the beach by sellers from the fishing boat crews to the transformeurs, who may be women, men, old or relatively young. There would seem to be a lack of social barriers or taboos in the trade.

Charcoal makers, on the other hand, are more bound to traditional methods and come from a much narrower range of the population. The trade is limited to men, many of whom are Peul from the Fouta Djallon in Guinea who learned it there. They tend to be the most skilled but also the most wedded to their way of making charcoal. Karch has found them more difficult to teach than charbonniers from other tribal groups. The Malinké (Maninka) change their charcoal-making habits more easily, and the Balante in the Casamance adapt to new technology extremely well.

The Casamance kiln requires relatively few changes in the traditional method. This is one of its appealing characteristics. With the exception of one Peul who would not accept the changes, Karch has found that those to whom he has taught the new method are comfortable with it. A year ago, he recommended training men who had never made charcoal before. In fact, the UNDP/FAO project is doing this by taking farmers from around the Tobor Forest project area. Given the licensing structure established by Water and Forests, however, the only feasible choice at the outset of this AIP is to re-train men who are already in the trade. The evaluation section outlines a procedure whereby a change in the target group or training procedures could be made if necessary.

Of the three components of this project, the one for stoves will require the greatest changes in traditional patterns of doing things and is the most developmental in nature. However, in conversations with women

(for example, with Mme NDiaye of MFR) the AIP design team found real interest and an expressed desire to utilize wood stoves to alleviate the teask of acquiring wood and to economize on consumption of it. A major design criterion for the stove will be that the model (s) developed require as few changes as possible in important traditional ways of cooking, and that (1) the changes required are ones which women themselves have discussed with the stove builders, and (2) that women feel are acceptable changes. Therefore, from the very beginning women will be heavily involved in the stove prototype development process.

As is well known, socio-cultural values are highly important in any consideration of changing methods of food storage or preparation. This AIP is designed to take into account through the model development and trial stages, the effect of these values on possible stove designs for Senegal. (See, for example, Proposal for the Establishment of a Programme to advise and assist Developing Country Low Cost Wood and Waste Fuelled Cooking Stove Project, by Stephen Joseph of ITDC in London; and the Ki-Zerbo report). Both present day practice and historical knowledge must be used in considering the impact of Senegalese socio-cultural values in relation to food preparation.

Thus the technologies to be introduced under this AIP will respond to real, felt needs, and would be integrated from the beginning into the lives of users through local organizations and local individual user involvement. The technologies will serve to lighten the time spent on repetitive tasks by both males and females, and will allow them to spend it more profitably on activities directed at either more economic gain or in other social ways of which they are already aware and would like. As stated above, many villagers are already sensitized to the advantages these technologies would have in their lives, and are anxious to have them improve the quality of their lives.

Beneficiaries and Spread Effect

Women would be the major beneficiaries of both the improved stove and solar fish dryer components, with men being the major beneficiaries of the charcoal component. In general, beneficiaries under this AIP can be divided into three broad categories: immediate, long term, and consumers.

The improved wood stove component will be of immediate benefit to the people in villages who acquire stoves during the field testing phase of the project (perhaps 50 to 100 people), and of course to the Centers in rural areas that acquire stoves and use them for day to day operations and demonstrations. The main beneficiaries will be the women who normally spend hours getting wood and cooking food each day. However, the greatest importance of the project lies with the long term effects of developing a wood-burning stove that will be widely adopted. In this case the project could benefit the entire rural population of Senegal very directly by reducing up to 50 percent indi-

vidual's expenditure of time and money on wood acquisition. In an even larger sense, this component will benefit everyone in Senegal by reducing the demand for wood and thereby the pressure on forests, and the degradation of the environment. In other words, overall energy consumption will be reduced for cooking and thereby conserving energy in one of the largest areas of energy use in Senegal -- an effect than can only benefit everyone.

The solar fish dryer component will be of immediate benefit to the approximately 80 to 100 men and women involved in fish drying activities, who receive the tents, and who will thereby have labor requirements reduced, will experience increased production through reduced losses of fish, and have more time and money as a result. Long term beneficiaries should be the 15,000 to 20,000 people who engage in fish drying on the coast of Senegal and along the Senegal River. Others would be those people who eventually dry fish resulting from the Lowland Fish Culture Project. Everyone involved in the marketing of dried fish in Senegal should benefit as they will experience less loss of fish during the time it is being marketed, along with increased product quality. In this sense consumers will also be long term beneficiaries as they should be buying better quality dried fish and greater protein availability.

Immediate beneficiaries of the charcoal component will be the 250-270 heads who go through the training program, as they will be able to increase their charcoal production (and thereby income) without further subsidy. Charcoal makers who work for these heads should also benefit from increased income and the reduced work time required for processing each kiln. Cooperatives will also benefit from increased earnings. However, the manner in which benefits will be spread among the cooperatives, heads and individual workers will be in large part affected by tradition and by government policy. A profile of this spread will be made in the mid-project evaluation report.

Potential long term beneficiaries will be the entire group of people who make up the charcoal production work force (10,000), and these benefits should follow the same pattern as described above for immediate beneficiaries. Also, the whole country will benefit from reduced pressure on forests and land. Consumers will probably not benefit very quickly as the price of charcoal is likely to rise anyway. However, over the long term substantial benefits should accrue to consumers as the price of charcoal should not rise as fast, if the new charcoal making method is widely practiced, as it would with continued use of the traditional method.

VI. ENVIRONMENTAL IMPACT

An initial environmental examination (IEE) was carried out in July 1978, and the AID/Senegal Mission Director made a negative determination. This was accepted by AID/Washington and the Mission informed in the PID approval cable, State 229553.

VII. SUMMARY COST ESTIMATE AND FINANCIAL PLAN
(in Dollars)

A. Charcoal Production

1. U.S. Technical Assistance		$$
Charcoal production specialist (2 trips of one month each)		16,000
2. Vehicle (assigned to Water and Forests project training director)		
3/4 ton pick-up truck, acquisition cost		10,000
Operating expenses at 5,000/year		10,000
3. Training Program		
(a) Fixed costs spread over 9 cycles		
6 charcoal production instructors, (salary for 22 months at 30,000 CFA/mo)		19,800
Hand tools (shovels, rakes, etc.)		750
Sack frames		200
10 tarpaulins at 250$		2,500
4,000 sacks at 1.25$		5,000
Instructor travel to and from training sites		1,000
(b) Recurrent costs each training cycle° (30 trainees/cycle)		
Wood: 20 kilns X 70 steres	2,800	
Trainee maintenance allowance ($.50/day x 45 days x 30)	2,025	
Chimneys: $75 x 30	2,250	
Cord and needles for sacks	100	
Trainee travel to and from site (500 CFA/trainee)	75	
Total cost per cycle	$ 7,250	
Times 9 cycles		65,250
TOTAL		$ 130,500

how much approximately?

°: Proceeds from the sale of charcoal that are not used on support of trainees or material replacement would go into a revolving fund to support additional training by Water and Forests, provided the GOS agrees.

Charcoal makers are traditionally paid per sack of charcoal produced. Given the low official price of charcoal now in effect, the charcoal makers often receive less than the minimum wage of 750 CFA ($3.65) per day of work. In order to make sure that they do get at least the minimum wage while in training, while avoiding (at Water and Forests request) the use of a daily wage, funds will be set aside to provide for a portion of their living costs. These funds will be supplemented by the proceeds from the two kilns of charcoal that each team of 3 trainees will produce over the six-week period. This procedure will maintain incentive for the trainees to work diligently during the training program.

B. Woodburning Stoves	$$
1. U.S. Technical Assistance	
Stove design specialist (1 2-3 week trip + 1 week salary and per diem in conjunction with an Upper Volta trip)	10,000
2. Travel Ziguinchor/Dakar and per diem for Ed Karch, 5 days	300
3. Vehicle (assigned to PCV)	
3/4 ton truck, acquisition cost	10,000
Operating expenses at 5,000/yr	10,000
4. Prototype development at I.P.M.	
Tools, measuring equipment materials, and transport of materials and helpers	11,000
2 masons for 24 person/months	7,000
5. 5-day training at I.P.M.	500
6. PCV travel in U.S. to Eugene, Ore. + per diem (5 days)	600
7. Travel and materials for cooperating agencies (e.g. Maison Familiale) in trial demonstrations	5,000
8. Travel and materials for cooperating agencies (e.g. Promotion Humaine) in Phase II field demonstrations	13,000
TOTAL	$ 67,500

C. Fish Drying		$$
1. Vehicle (assigned to ITA solar tent drying project)		
3/4 ton pick-up truck, acquisition		10,000
Operating expenses at 5,000/yr		10,000
2. Prototype development at ITA, materials		3,300
3. Phase I prototype field tests		
Materials		2,300
2 local enumerators		400
Test equipment		3,000
4. Phase II field tests		
Materials		9,000
4 local enumerators		1,000
	TOTAL	$ 39,000
D. Evaluation		
1. Semi-rural economist 30 days at $125 + $1000 travel and materials		6,000
2. Semi-rural sociologist 30 days at $100/day + $1000 travel and materials		4,000
3. Two evaluation consultants, 3 weeks each at 5,000		16,000
4. Project evaluation consultant, 4 weeks including one-country travel and per diem		10,000
	TOTAL	$ 36,000
E. Site Project Manager		9,000
Project Costs		
A. Thermal Production	130,500	
B. Renewable Stoves	67,500	
C. Solar Fish Drying	39,000	
D. Evaluation	36,000	
E. Site Project Coordinator	9,000	
	282,000	
Contingency	18,000	
GRAND TOTAL	$ 300,000	

GOVERNMENT OF SENEGAL CONTRIBUTION

	Dollars ('000)
Charcoal Component	
1. Personnel	
a. project director (part time)	3.5
b. salary of one agent technique for two years	5.5
c. salary for one driver for two years	4.5
2. Travel Expenses (maintenance in field)	5.0
3. Office Space and Overhead	6.0
Stove Component	
1. Personnel	
a. project director (part time)	2.0
b. technician, one half time for one year	3.0
c. support personnel at IPM (part time)	3.0
2. Office Space, Laboratory Space, Overhead	5.0
Solar Fish Dryers	
1. Personnel	
a. project director (part time)	4.0
b. one technician full time for two years	14.0
c. three technicians half time for two years	7.0
d. one driver for two years	4.5
2. Travel Expenses (maintenance in field)	7.0
3. Office Space, Laboratory Space, Overhead	6.0
TOTAL	80.0

VIII. ADMINISTRATIVE FEASIBILITY

Since two of the three components (Wood stoves and fish dryers) consist of research and field testing of renewable energy devices, project responsibility on the Senegalese side falls on the State Secretariat for Scientific and Technical Research (SERST). The Minister himself takes considerable interest in renewable energy initiatives. The actual task of overseeing and coordinating the GOS activity will be delegated to the Direction de l'Innovation et du Progrès Technologique (DIPT). A new director was named in October 1979. The office has appeared to be understaffed, given the increasing number of renewable energy activities in Senegal.

The third component (charcoal production) of this AIP is an educational outreach activity in the domain of public forests. As such it falls under the responsibilities of the State Secretariat for Water and Forests. The task of overseeing and coordinating the GOS activity will be given to the Division de la Production Forestière et des Aménagements.

An effective way to manage the program on the AID side would be to hire as project manager a Peace Corps Volunteer completing service in November or December 1979. A six-month PSC would be enough. The time when attention must be given to requisitions, contracts and implementation is in the initial four or five months of the program. If it gets off to a good start, a small amount of initiative on the AID side would suffice to preserve momentum.

Operating Arrangements for Individual Components

A. Charcoal Production. The two principal operating agencies in this component are:

1. State Secretariat for Water and Forests.

2. The UNDP/FAO forestry project in Casamance, whose official title is Mise en Valeur des Forêts de la Basse et Moyenne Casamance et Assistance au Service Forestier. In Ziguinchor, it is simply known as the "Projet Forestier". Concentrating on the Tobor Forest between Ziguinchor and Bignona, the project is attempting to improve the quality and yield of forests by means of fire breaks, enrichment, clearing out of poor species and replanting. Improved charcoal production is only one aspect of this project.

The activities of this AIP, outlined in the project description section, have been agreed upon in meetings between Pape Djibril Koné, Chef de la Division de la Production Forestière et des Aménagements, Water and Forests; J.P. Huygen, Director of the UNDP/FAO project and his staff; and the design team.

B. Woodburning Stoves. The principal operating agencies in this component are:

1. Institut de Physique Météorologique (I.P.M.) of the Faculty of Sciences, University of Dakar. A government decree is expected to turn I.P.M. into the

national center for renewable energy research (CERER). I.P.M. has until now worked exclusively on solar energy, particularly thermo-dynamic, applications. SERST has mandated, however, that it do research on improved utilization of wood and charcoal as fuel. A recent graduate of the Thies Polytechnical School has just been hired and would be available for work on woodburning stoves. Two masons and their helpers will be hired and paid for by project funds. The senior staff of I.P.M. gives woodstove development high priority. They emphasize that the visit of Ianto Evans or a suitable substitute is crucial to getting the project underway. In the early stages, the AID project manager should monitor I.P.M. activity to be sure that momentum is maintained.

2. State Secretariat for Promotion Humaine. This agency is responsible for the training and motivation of rural populations in the development process. Its "rural animation" program is well known.

a. Maison Familiale Rurale (MFR) , a rural community development organization operating in Senegal since 1964, comes under the jurisdiction of Promotion Humaine. The basic purpose is to train rural youth without cutting them off from their village environment. There were 23 villages where paired male and female MFR centers were operating in 1978, twelve in the Thies region. The Chef du Service Technique and the woman in charge of Formation Technique Feminine are the two MFR officials who have discussed the stoves project and have agreed to MFR participation as outlined in the project description.

b. Promotion Humaine also has rural vocational training centers for elementary school leavers. The design team discussed the stove project with Enseigne-Moyen Pratique, but the division most likely to be involved in the field testing phase of the project is Formation Professionnelle. The director of the division suggested the use of artisan training centers as outlined in the project description.

3. Other GOS agencies which become involves in woodstoves are: Centres d'Expansion Rurale (CER). There are now 93 of these centers scattered around the country. They house the extension agents from various ministries and services that work at the village level. The Executive Secretary of the CER has been interested in woodburning stoves and in fact had hoped to experiment with a Tanzanian model suggested by a consultant from the Economic Commission for Africa. He expressed a ready willingness to put the CERs at the disposition of the project when it reaches the stage of wider dissemination of the stoves.

4. State Secretariat for Women's Programs (Condition Féminine). This ministry is interested in any development that will lighten the burden of women's work. It could participate in a project committee if one were formed.

We have suggested to the Minister for Scientific Research that he set up under SERST chairmanship an ad hoc woodstoves committee including the agencies named above. The committee could decide how to organize expanded field trials and demonstrations in the light of experience gained in the first year. The committee would also provide a means of getting outside constributions to the design and development of stove prototypes.

C. Solar Fish Dryers. The principle agency involved will be the Institut de Technologie Alimentaire (I.T.A.) which is directly responsible to SERST. ITA has been given responsibility by the GOS for improving the procedures by which the fish catch of Senegal is processed and marketed. They work very closely with the Service des Pêches Maritimes on other projects, and hence will have a good working relationship with them for this project. The Service des Pêches will, on a regional basis, provide entry contacts and information for the ITA teams when they begin working in the villages, and will be fully aware of the work ITA will be doing. This was, in fact, the procedure already followed by ITA in their previous field work in Joal and Mbour. Three competent and energetic technicians will be the key personnel on the project and will have day-to-day responsibility.

The activities of this AIP, outlined in the project description paper, have been agreed upon in meetings between the design team and Mme Basse, director of ITA.

IX. IMPLEMENTATION PLAN

Senegalese government counterpart agencies have agreed to take a certain number of steps on project implementation even before the project agreement is signed. These are:

1. The director of I.P.M. has stated that they would begin an inquiry into the existing use of woodburning stoves in rural Senegal.

2. The State Secretariat for Water and Forests will select an agent technique for assignment to the UNDP/FAO project in the Casamance. The agent would come either from among recent graduates of the training school at Djibélor, outside Ziguinchor, or from more experienced agents in the service. The State Secretariat will also select six chefs d'équipe from among the cooperatives licensed to produce charcoal for assignment to the UNDP/FAO project. Both the agent technique and the chefs d'équipe would be trained in use of the Casamance kiln method of charcoal production. In April 1980, the agent technique and six trained charcoal makers some or all of whom would be from the six mentioned above, would be constituted into the mobile charcoal production training team.

3. The personnel at ITA who have been working on the solar tent dryers and storage units will continue to develop their prototypes in Dakar with ITA funds.

The implementation schedule that will follow the signing of the project agreement is shown below.

IMPLEMENTATION SCHEDULE

Code °	Event No.	Item	Date
	1	Project Agreement signed	December 1979
B	2	Peace Corps Volunteers requested	December 1979
	3	3 vehicles ordered	December 1979
C	4	Fish Dryer test equipment ordered	December 1979
	5	Senegalese economist and sociologist recruited	January 1980
B	6	I.P.M. hires masons	January 1980
C	7	Material for dryers purchased; ITA begins 3-month test period	January 1980
B	8	Material for stove prorotypes assembled at I.P.M.	January 1980
B	9	Stove specialist arrives	February 1980
B	10	Karch advises stove program at I.P.M.	February 1980
A	11	Water and Forests Regional Inspector (Casamance) selects charcoal trainees and site for first training program	March 1980

° Code: A - Charcoal Production Component

B - Woodburning Stoves Component

C - Solar Fish Dryer Component

A	12	Charcoal instructors selected and arrangements for training program completed	March 1980
A	13	1st charcoal training program begins	April 1980
C	14	ITA begins Phase I field tests	May 1980
B	15	Arrangements made for stove training program at I.P.M.	June 1980
A	16	Charcoal Program director travels to arrange new cycles	June 1980
B	17	PCVs start PC training	July 1980
B	18	I.P.M. holds stove training program	July 1980
A	19	Senegalese economist submits charcoal report	July 1980
B	20	Stove specialist visits I.P.M. en route to or from Upper Volta	September 1980
A	21	2nd charcoal training program begins; others follow at 2-month intervals	October 1980
B	22	Maison Familiale Rurale training program for center staff conducted	October 1980
C	23	Senegalese sociologist and economist submit fish dryer report	October 1980
C	24	ITA completes Phase I review and begins Phase II	November 1980
A	25	Charcoal specialist arrives for one-month visit.	December 1980
	26	U.S. consultants for evaluation team selected	January 1981
B	27	Senegalese sociologist and economist submit report on stoves	January 1981
B	28	Phase I stove review conducted	March 1981
	29	3-week evaluation conducted	April 1981

B	30	Phase II of stove program begins	April 1981
A	31	Charcoal specialist returns & review conducted	June 1981
	32	U.S. consultant for final evaluation selected	September 1981
C	33	ITA drafts final report	December 1981
	34	Final evaluation conducted	December 1981
	35	Project ends	January 1982

X. EVALUATION PLAN

BACKGROUND

Most renewable energy projects are pilot projects, even when the technology is well proven. This is a result of a lack of experience with widespread application. This AIP renewable energy project is certainly very much in this category. The wood stove and solar tent dryer are in various stages of research and development, although the basic design principles and the fact that they can operate favorably in Senegal are not in question. The improved charcoal making method is set as far as technology design is concerned, but the question of how to spread it and introduce it on a wide basis has yet to be field tested.

There are a set of broad general questions that renewable energy projects are seeking to answer, and they can be found throughout the design of this project. These questions and concerns are directly addressed at crucial points in the management activities designed into the project. This evaluation plan seeks to make specific, to each of the three project components, these general questions and to provide a concise plan whereby they can be clearly answered. These general questions are:°

° How well does a given technology or strategy perform technically within the physical setting ?

° How does its cost compare with alternative energy technologies ?

°: From a recent paper by James Howe of the Overseas Development Council entitled; New Village Uses of Renewable Energy Sources.

° How does it fit in with the local culture ?

° How does it match existing or prospective village institutions that could own, operate and maintain it ?

° What can be learned about the best techniques for introducing the technology into villages ?

Within the framework of these general questions and the developmental nature of the AIP, a learning laboratory approach to operating, or managing, monitoring and evaluating the project is proposed. One overall goal of this AIP is to learn how to improve the technology designs and applications as well as how to develop sound innovation strategies. Evaluation in this project therefore has as its principle aim:

° What have we learned from this project about how to make these technologies serve people and work better ?

This means that although impact measurement is included in evaluation concerns, the main focus of this monitoring and evaluation plan is the posing of questions, and the gathering and analysing of data all aimed at concept and technology development.

The analytical and practical process in this learning lab approach takes the following steps:

1) What are the specific economic, social/organizational, and physical/technological issues or questions that we intend to find out about with the project ? These questions on a component-by-component basis are found below.

2) The project has been designed to address and answer these questions. If monitoring is carried out as planned (see below), then the necessary data will be gathered and everyone involved in the project should be able to make sound decisions at the crucial key points in the project (for example, whether to do widespread field testing of the solar fish dryer at the end of Phase I or whether more R & D is required in Dakar, etc.).

3) At the end of the project, evaluation should focus on what was learned, what occured in the way of technology development, and very important, as to how it occurred. AID Senegal and AID Washington will then hopefully have some empirically based information about several renewable energy technologies.

Component questions and data requirements

Improved charcoal making method: The charcoal component is by far the most developed AIP technology, and in some ways the simplest component in terms of monitoring and evaluation. The most crucial part of evaluation in this component is that the data must be properly collected on the follow-up visits.

Technical questions and data --

1) Following training, are the former trainees using the new method ?
2) Are they using the method correctly ? Changes ?
3) What yields are they getting ?
4) How long are the chimneys lasting ?

Data will consist of measurements and observations taken on the follow-up visits, along with answers to questions asked by the follow-up personnel. A data sheet to be used on all follow-up visits will be drawn up by Ed Karch during the first training cycle.

Social/organizational questions and data --

1) What is the socio-cultural profile of the trainees ?
2) What is the socio-cultural profile of those trainees who do not adopt the method ?
3) What is the organizational structure of the cooperatives ? Number of members and geographical distribution ?

Initial data will be gathered by the training director when trainees arrive for training on age, ethnic group, number of years making charcoal, number of years in Senegal, time with cooperative. Brief written comments will be made by the director on each trainee's sheet as to perceptions on capability of trainee to carry out new method (teachers can be relied upon for this information). Cooperativ information from Water and Forests to be supplied to evaluation team.

Economic questions and data --

1) How much are new chimneys costing ?
2) Local market prices of charcoal ?
3) Price being received for the charcoal by the exploitant or cooperativ
4) Method used to calculate payment of workers ? Weight of bags and price per bag to workers ?
5) Level of increased earning per kiln per worker ?
6) Do the workers and the cooperatives (investors) perceive that there is an economic gain ? How much ?

Data will be taken from follow-up sheets. Also, from the study to be done by the Senegalese economist.

As indicated above data will be gathered by three basic means: a data profile sheet during training, a data sheet on technical, economic, and perception information during the follow-up visit, and the economic study by a Senegalese economist. Once the technical information part of the follow-up sheet has been designed by Mr. Karch, the economist should add the economic questions. After review, the sheet can be copied and administered by Water and Forests from Dakar. It should be short and not take more than a few minutes to write up, although answering the questions may require measurements of yield, etc. which take time. The economic study should be very specific to those few charcoal issues raised here so that later decisions and evaluation work will have some basic information. It should be done by the economist early in the project.

Improved woodburning stoves: The crucial elements in this component's evaluation effort will be gathering adequate data to determine the technical success of field tested models, and the attitudes towards the stoves of the women who are using them.

Technical questions and data --

1) What are the thermal efficiencies of each model developed in the project ?
2) What are the material components and durability profiles ?
3) What repairs are required ?
4) What are the projected lifetimes of the various models ? What has been the maintenance and durability experience with each model tested in the field ?
5) What skills are required for construction ? Maintenance ?
6) How many hours of labor are required for construction ? Maintenance ?
7) What important technical innovations or changes were made on field tested models ? Why ?

Data to answer these questions will be taken from the data forms to be filled in by the local directors of field trials and the PCVs. I.P.M. will be responsible for recording all test data, and to keep a record of model development rationale. The field trial data form for technical data on the above questions will be developed by Janto Evans in cooperation with I.P.M. staff, during his first visit to the project. The PCVs will have responsibility for gathering data on these forms during their field visits and for collecting the data gathered by the local directors (or responsible person) at a field test site.

Social/organizational questions and data --

1) What specific design features do women like about each stove model ?Not like

2) What changes in stove design have been made over the course of the project due to cultural issues ? Why on each one ?

3) Are there important cultural variations regionally that affect stove design

4) Did any region of the country seem to be more receptive to trying the stove Why ?

5) Of the organizations which worked with field trials, did some have more success in getting people to try the stoves than other organizations ? Why ?

6) Are there any important foods which for cultural reasons (taste, religious, etc.) can't be prepared on a stove ?

7) Average family size , wood gathering practices, and daily/seasonal cooking patterns ?

8) Amount of time required to get accustomed to cooking on the models ?

9) Amount of time required to train someone to use the stove ?

Data will be developed in three ways: meeting and observation notes taken by local directors of field development efforts (for example, the local director of a Maison Familiale Center), meeting and visitation notes taken by the PCVs, and from written observations of the Senegalese sociologist who will support the stove development effort and carry out several field visits.

Economic questions and data --

1) Costs of all raw materials ?

2) Labor construction time and costs ?

3) Time and costs of training someone to construct or operate the stove ?

4) Local costs of firewood ?

5) Amount of actual savings in CFA on fuelwood over a week or a month ?

6) Amount of projected savings over a year on wood costs ?

7) Do users perceive that it saves wood or time ?

Data will be developed by the same means as under social questions above, plus a brief survey of typical costs on the items listed above, in various regions of Senegal, to be done by the Senegalese economist.

Solar fish dryer system: Crucial evaluation areas in this component are the technology performance of the tents, and the cooperative organizational and investment

inclinations of the 'transformeurs' (mainly the women who do the drying) in relationship to the large-sized tents. The questions below build on those put forth in the project description.

Technical questions and data --

1) What are the temperature and humidity profiles over both drying and storage cycles for the tents ?

2) What level, if any, of infestation occurs in both tents ? Changes in moisture content ?

3) What quantities of fish can be dried and stored in the tents ? What are the time periods ? Variations ?

4) What were the specific design changes made over the life of the project ? Why on each one ?

5) What repairs are required over the life of a tent system ? for each tent installed, how long did it last ?

6) How many person hours does it take to install a system ? Special skills ?

7) How much of the material for contruction is locally available and how much must come from outside Senegal or Dakar ?

8) What further design changes might be introduced ?

Sources for this data will be ITA's monitoring reports of the tents that they construct in Dakar, in the field, and the final report by ITA. ITA will design a data-gathering schedule that will record all quantitative data required for these questions. Part will be gathered by the enumerator in each village and the rest by the ITA team on their periodic visits.

Social/organizational questions and data --

1) What effects, if any, does drying and storing fish in the solar tent system have on consumer acceptance of the fish ?

2) What role can the Service des Pêches play in introducting the systems ?

3) What relationships and prevailing attitudes are there between the 'transformers' and the Service des Pêches ?

4) What local entrepreneurs might be able to supply the materials required for tent construction ?

5) What are the activities and organization of various fishing cooperatives in the fishing villages ?

6) Could members of the cooperatives work together sharing tents for drying and storing ?

7) How would cooperative sharing fit with present social relationships among the people drying fish ?

8) What attitudes exist towards cooperative financing ?

9) What do users have to say about the tent ? Do they think it saves time or is more convenient ?

Data sources for this will be the local women, the Service des Pêches and observations of the ITA project team. It is suggested that the Senegalese sociologist confer periodically with the ITA team and that several field visits to Mbour and Joal be made by the sociologist during the first field trials, which should all serve as a basis for a short report addressing the above questions. This report should be done before the review meeting at the end of Phase I so that it can be used to refine tent introduction strategies for Phase II.

Economic questions and data --

1) What are the costs of all components for all the various designs experimented with in the project ? Other normal uses for these materials and market prices ?

2) What are the costs of all alternative materials for the same purposes?

3) Labor costs of installations ?

4) Labor costs of repairs ?

5) Labor costs in a drying cycle ? Storage cycle ?

6) What are the total lifetime costs of each type tent ?

7) What is the profile of market prices for dried fish on the coastal domestic market and export market ? Seasonal variations ? Regional variations ?

8) What are the characteristic local investments by people involved in fish drying ?

9) What are the characteristic local borrowing patterns of these people ? What are the local interest rates ?

10) Are people getting more money for fish dried in the tents as opposed to fish dried in the traditional way ? How much ? How calculated ?

This data will be taken from the project records of the ITA team and a descriptive report by the Senegalese economist. All field data will be generated by the ITA team, with much of it based on data in their technical data records. However, the ITA team should develop a separate economic data form to be completed on each village where tests are done. The economist can then use the resulting data as a basis for a short descriptive report, probably best done just before the end of Phase I, and updated towards the end of the project.

Process Data Issues

Much of the success of this project will depend on adequate feedback and information flow between the people developing and introducing the technology and the users themselves. As the project involves three separate technologies on somewhat different time frames, this adds to the information complexity for the AID project manager. To help in clarifying what is going on and to make sure that there is adequate local involvement in the decisions about design changes and innovation strategies, it is suggested that periodic meetings be held in each component of this AIP between the project component staff and the various local groups and people that they work with. The degree to which such meetings are formalized will naturally depend upon the people and the circumstances. However, it is suggested that the AID project manager talk with the key staff in each component to make sure that they plan such periodic meetings and that they understand the importance of holding them. Written notes should be kept on these meetings as both a management aid to the project staff and as data for the project evaluation team. One point to be made clear to each component team is to try to record all key decisions in their notes, who was involved, and the reasons for the decision. Major project or technology problems should be given special attention in these ongoing notes.

On the fish dryer and stove components special attention should also be given to periodic discussions between users. That is, the project staff should plan sessions where a number of people who are using the technology have a chance to interact and discuss what is going on with the project. The staff

stand to really gain from this, as information shared between the users will often bring to light and elicit information that never comes out when project staff simply talk to one user at a time. The AID project manager should talk to project staff about trying to do this and, of course, keeping notes on what people have to say.

Summary of written data records

All the written records listed below are covered in the component questions and data requirements section above. They are listed here to provide an easy check list for review.

Charcoal component:

1) The technical and economic data sheet for the follow-up visits -- to be designed by Ed Karch.

2) Personal profile information on each trainee to be done at the beginning of training sessions by the training director.

3) The study by the Senegalese economist early in the project.

4) A written report by the training director at the end of the first full season of training cycles.

Stove component:

1) Technical data sheet to be developed by Ianto Evans.

2) Social/organizational data sheet to be developed by Evans in cooperation with the sociologist.

3) Sociologist's report to be done about month 12.

4) Economist's survey at about month 12.

5) Meeting and visitation notes taken by PCVs and local field trial directors.

Solar fish dryer component:

1) ITA's field enumerator's technical data forms.

2) ITA's staff technical data form.

3) ITA's economic data forms (done with support of economist)

4) ITA's staff field notes and meeting notes.

5) Sociologist's report at the end of Phase I.

6) Economist's report at the end of Phase I.

Data analysis

Given that the project is developing technology, and within the context of our learning laboratory approach, the project is by its very nature carrying on a constant evaluative process. Major data analysis, however, will occur in two different formats at a variety of points in the project. One series of analyses will be carried out by the project staff itself, using the data gathered up to that time as part of the monitoring and evaluation plan. These internal analyses are essentially project review and key decisions points about the direction the project will take at that time. They are:

1) Charcoal component: towards the end of the second training cycle, or what is scheduled now as the first cycle in the training period starting in October 1980, a review meeting with AID, Water and Forests, the Training Director, and Mr. Karch should take place. It should review the apparent successes and problems of the training to date, to determine if any changes are required.

2) Stove component: around month fifteen a meeting of AID, IPM, SERST, PC, and appropriate field people should discuss and review the data and progress of the stove component. If possible it should be coordinated with one of Evans' trips. Phase II then begins.

3) Fish dryer component: at the end of Phase I SERST, ITA, AID, should review prototype development to determine the direction of work and whether or not to begin Phase II.

The second series of analyses will be done by outside technicians at two points in the project: around month fifteen and at the end of the project. The first analysis will essentially be a mid-project evaluation with two main purposes. First, to evaluate the progress of the project towards its programmatic objectives and its progress towards developing sound technology and innovative strategies. The evaluators should analyse the previously collected data, augment it with their own data collection, and provide a report which answers the questions posed in this evaluation design. Second, the mid-project evaluation should provide AID and project staff with suggestions for the next steps that the evaluators feel should be taken with the project, along with what similar work AID should consider supporting.

The mid-project evaluation should consist of a four member team (two from the U.S.) and should spend a minimum of three weeks in Senegal.

1) A U.S. evaluation technician, with experience in renewable energy, appropriate technology or economics.

2) A U.S. sociologist, with experience in AT or renewable energy technologies.

3) The Senegalese sociologist.

4) The Senegalese economist.

Technological feasibility analysis should be done on each technology, along with financial and cost-benefit from both the view of the private investor and the GOS, and a sociological analysis of social and cultural acceptability of technology design and introduction to date.

The second analysis or final evaluation, should be carried out by a single U.S. consultant with evaluation experience, and experience with renewable energy technologies. This person should review the project monitoring data collected after the mid-project evaluation and determine if any changes have occurred which alter the mid-project conclusions. However, the main purpose of this evaluation should be to determine what has been learned in this AT and what the implications are then for renewable energy technology projects, and AID support of similar efforts. This work could be carried out in three to four weeks.

Senegalese Technicians

A Senegalese sociologist and economist should be contracted directly by AID to provide services throughout the duration of the project. The economics department of the University of Dakar could provide an economist. The Institut Fondamental d'Afrique Noire (IFAN) has an important sociological component and has expressed interest in working on energy evaluation issues with AID. [illegible] could well provide the sociological support necessary. Graduate students might also be used as support people for the economist and sociologist in both these areas.

The [illegible] local technicians will serve two important functions for the project. First, as ongoing consultants to the project. For example, the report they are called upon to write as indicated in the evaluation plan, the [illegible] in preparation of data sheets, and for technology specific professional advice during the course of the project. For example, the sociologist should be involved from the beginning in discussions about women's expectations [illegible] cooking stoves, ways of promoting stove use with women, size of pots, [illegible] habits, etc. Second, as fully integrated members of the mid-project evaluation team they should take part in all analysis and help draft the report. Their total time might be broken up as follows: previous to mid-project evaluation, on general project support and report preparation - 40 percent [illegible] contract time; 50 percent of contract time during the mid-project [illegible]; and 10 percent in general consultative support over the remaining [illegible].

[illegible] needs to be assured of (1) adequate sociological and economic [illegible] capability during the life of the project to help develop the technology [illegible] and to help devise strategies to introduce them and, (2) sociological [illegible] economic expertise in data collection for evaluation purposes. If the project manager is assured of these services, as called for in the evaluation plan, then a review of the need for these technicians may be undertaken.

APPENDIX A

Responses to PID Approval Cable

A. Funding level: $300,000 is programmed.

B. Project components included in the AIP are limited to those covered by the PID approval cable.

C. All three components include training and involvement of local artisans. The sophisticated and expensive solar fish dryer is excluded from the AIP. The economic feasibility of all the components is covered in the economic analysis section and to some extent in the technical analysis section. Local conditions have been taken into account in project design and will continue to be included on an ongoing basis via mechanisms designed into the project.

D. The impracticability of banning charcoal production in Senegal is made clear in the project background section. The status of charcoal research is described in the charcoal technical analysis section. The thrust of the charcoal component is to introduce higher yielding techniques into current charcoal producing forests.

E. Beneficiaries are discussed in both the social soundness and economic feasibility sections. Ianto Evans, who designed and developed the Lorena stove, has been programmed into the project to provide technical assistance on the stove component. As mentioned, the expensive solar fish dryer has been excluded from the project and a low cost and more appropriate model has been included.

F. See evaluation plan.

APPENDIX B

Officials contacted in Project Preparation

SECRETARIAT D'ETAT A LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE

Jacques Diouf, Secrétaire d'Etat
Ibrahima Cissé, Direction de l'Innovation et du Progrès Technologique

INSTITUT TECHNOLOGIQUE ALIMENTAIRE (ITA)

Marie Thérèse Basse, Directrice de l'Institut
Ibrahima Camara, Secrétaire Général
Niokhor Diouf
Mamadou Sarr
Youssouf Sy
Jean Roussel, Centre National de Recherche Forestière

SECRETARIAT D'ETAT AUX EAUX ET FORETS

El Hadj Sène, Directeur
Pape Djiby Koné, Chef de la Division de la Production Forestière et des Aménagements

SECRETARIAT D'ETAT A LA CONDITION FEMININE

Aïssatou Sow Barry, Conseiller Technique
Idrissa Diop, Directeur de l'Information et des Etudes

SECRETARIAT A LA PROMOTION HUMAINE

Alioune Watt, Directeur de la Formation Professionnelle
Yaya Konaté, Directeur de l'Enseignement Moyen Pratique
Momar Djim Cissé, Enseignement Moyen Pratique
Clément Faye, Maison Familiale Rurale, Thies
Joséphine N'Dione N'Diaye, Maison Familiale Rurale, Thies

INSTITUT DE PHYSIQUE METEOROLOGIQUE

Pr. Djibril Fall, Directeur
Gérard Madon

SERVICE DES PECHES MARITIMES

Niokhor Diouf, Chef du Service Régional, Joal

PROJET FORESTIER PNUD/FAO, ZIGUINCHOR

J.P. Huygen, Directeur
M. Guèye
M. N'Diaye
G.E. Karch

DIVERS

Marc Frager, SINAES
Aliou Ba, SINAES
Liberty Mhlanga, ENDA
Martial Boujasson, ENDA
Dean Christ, Peace Corps
F. Léger, Mission d'Aide et de Coopération
Frère Picard, CARITAS Sénégal