PD-AAY-155

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE ("X" appropriate box)
[x] Original [ ] Change [ ] Add [ ] Delete

PP

DOCUMENT CODE 3

2. COUNTRY/ENTITY
PAKISTAN - ASIA

3. DOCUMENT REVISION NUMBER

4. PROJECT NUMBER
391-1170

5. BUREAU
a. Symbol: ASIA
b. Code: 4

6. ESTIMATED FY OF PROJECT COMPLETION
FY 80

7. PROJECT TITLE - SHORT (stay within brackets)
[Village Level Food Processing]

8. ESTIMATED FY OF AUTHORIZATION/OBLIGATION
a. INITIAL mo. 6 yr. 76 b. FINAL FY 78

9. ESTIMATED TOTAL COST ($000 or equivalent, $1)

a. FUNDING SOURCE	FIRST YEAR FY ____ b. FX	c. L/C	d. Total	ALL YEARS e. FX	f. L/C	g. Total
AID APPROPRIATED TOTAL	80	95	175	242	323	565
(Grant)	(80)	(95)	(175)	(242)	(323)	(565)
(Loan)	(-)	(-)	(-)	(-)	(-)	(-)
Other U.S. 1.	-	-	-	-	-	-
Other U.S. 2.	-	-	-	-	-	-
HOST GOVERNMENT	-	46	46	-	235	235
OTHER DONOR(S)	-	-	-	-	-	-
TOTALS	80	141	221	242	558	800

10. ESTIMATED COSTS/AID APPROPRIATED FUNDS ($000)

a. Appropriation (Alpha Code)	b. Primary Purpose Code	c. Primary Tech. Code	FY 76 d. Grant	e. Loan	FY 77 f. Grant	g. Loan	FY 78 h. Grant	i. Loan	ALL YEARS j. Grant	k. Loan
FN	162	112	175	-	300	-	90	-	565	
		TOTALS								
11. ESTIMATED EXPENDITURES					145		250			

12. PROJECT PURPOSE(S) (stay within brackets) [ ] Check if different from PID/PRP

[Feasibility methods of improving small scale sugarcane, oilseed and rice bran processing identified, developed, tested and the potential for commercialization of improved technology demonstrated.]

13. WERE CHANGES MADE IN BLOCKS 12, 13, 14, or 15 OF THE PID FACESHEET? IF YES, ATTACH CHANGED PID FACESHEET

[x] Yes [ ] No

14. ORIGINATING OFFICE CLEARANCE

Signature: Richard R Newberg

Title: Assistant Director/Agricultural Policy

Date Signed: mo. May day 6, yr. 1976

15. Date Received in AID/W, or For AID/W Documents, Date of Distribution
mo. day yr.

AID 1330-4 (7-75)

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I. Summary and Recommendations

A. Recommendations

1. The total cost of the project is $800,000 equivalent. It is recommended that AID contribute $565,000 of these costs through dollar grants to the Government of Pakistan, Appropriate Technology Development Organization. A Project Agreement will be signed in fiscal year 1976 obligating $175,000. Additional obligations will be made in the transitional quarter and fiscal years 1977 and 1978. These obligations are scheduled for $150,000, $150,000 and $90,000 respectively.

2. This project is designed so that U.S. dollars will finance contract costs, including foreign exchange and local costs. A Special Letter of Credit is the mechanism that will be used to disburse funds for local costs.

3. In line with the local cost financing approach, a waiver of U. S. source restrictions on the procurement of services is requested so that the costs of locally procured services may be financed by this grant. For complete justification, see Section IV-C-4.

4. One major phase of the project is a world-wide search for appropriate technology. If the most appropriate equipment is available only outside of the U.S., then a waiver of U.S. source restrictions on the procurement of commodities will be required. Total procurement of commodities is not expected to exceed $35,000 and procurement from anyone source will be less than $25,000. Therefore the Mission Director will exercise his discretionary powers to waive the U.S. source restrictions on procurement of commodities.

B. Description of Project

1. Project Activities

This project seeks to identify, develop, produce and ultimately disseminate (on a pilot project basis) appropriate technology of a suitable

scale and sophistication for use in farm and villages level processing of sugar cane, oilseeds and rice bran. The project is based on the premise that elements of appropriate technology exist elsewhere in the world, can be identified and brought to Pakistan where modifications and adaptations can be undertaken as required to permit local fabrication and commercially viable operation in the village environment.

The project will be carried out in four carefully structured overlapping phases. Because the project intends to test and demonstrate the feasibility of developing improved appropriate technology, a set of special evaluations is planned which will permit timely assessments of the feasibility of achieving the project objectives. These evaluations are scheduled to coincide with the completion of each study and/or a discrete set of functional activities. Thus the information will be in hand required for decisions on: (a) whether to proceed with the project implementation; and (b) specifics of revisions to make project plans as new information is developed.

During Phase I, analysis of secondary and field survey data will be carried out to establish economic and engineering parameters of equipment to be developed in the course of the project. This research will also provide preliminary guidance regarding the technical and economic feasibility of developing improved appropriate food processing technology and will indicate specifications and standards required, and economic criteria which must be met. The first part of Phase II, search of the technical literature will commence simultaneously with Phase I research. An evaluation will be held in March 1977 to identify the most promising candidate technology applying Phase I economic and engineering criteria. In Phase II, project personnel will then visit countries where the candidate technology is located. Based upon on-site inspection the most promising technology will be procured; equipment, drawings, operating manuals and other technical literature will be shipped to Pakistan.

Phase III activities will commence with testing the imported equipment and food processing techniques acquired in Phase II. Based upon the results of these tests, an evaluation will be held (August, 1977) and final selection of prototype equipment and processing techniques will be made. Modifications in design, materials and processing techniques will be made, as necessary, to permit the adopted technology

to be fabricated locally and operated efficiently in the village environment for which it is intended. Phase III prototype development will terminate when project performance criteria established in Phase I are met. Four models of each prototype will be fabricated for Phase IV demonstration purposes. At the end of Phase III an evaluation will be held (May, 1978) to finalize details of the industrial extension strategy. Industrial extension entity (s) will be identified and responsibilities defined.

Industrial extension activities will be carried out during Phase IV (pilot project production and marketing of improved technology). Workshops and manufacturers exhibiting interest in, and potential for undertaking, construction of the improved food processing equipment will be selected. They will be provided with assistance in first fabricating and then marketing the improved equipment, The industrial extension agent will also work with food processors, instructing them in the proper use and maintenance of the equipment. Credit will be made available as necessary to facilitate food processors' access to the new technology. Phase IV will conclude with a market study designed to assess the acceptability of the new technology to the target population. Drawing upon the results of Phase I and IV research, a choice of technology study will be developed which will provide the Government with policy guidance on appropriateness of small, intermediate, and large scale food processing technology, given Pakistan's resource endowment. An end of project evaluation in December 1979 will identify constraints inhibiting widespread adoption of the improved food processing technology and make recommendations for post project actions required to relax these constraints.

2. Project Implementation Responsibilities

Project Implementation will be carried out by a contractor; sub-contractors will be employed as necessary. A combination of Pakistani and American firms is likely to be necessary to successfully carry out the diverse and sophisticated activities envisioned. A prime contractor will assume full responsibility for all phases of project implementation. The Appropriate Technology Development Organization will guide and monitor project implementation. Quarterly reports prepared by ATDC evaluating the performance of the contractor (s) will be submitted to USAID to facilitate Mission monitoring of Project Implementation. A Joint Government of Pakistan - A.I.D. Project Implementation and Evaluation Committee will be established to

conduct the special evaluations described above. Annual evaluations will also be held to assess the overall performance of the contractor (s) and identify problems in monitoring project implementation.

3. Project Linkages

A.I.D. will provide dollar financing for all contract services (local and American) and commodities procured for this project. The Government of Pakistan will finance all project management costs incurred by the Appropriate Technology Development Organization and Phase IV industrial extension costs. It will also provide credit to innovating food processors.

These inputs will produce the following outputs: Phase I studies and reports; Phase II world search reports and selected equipment and technical literature; Phase III improved models and report; and in Phase IV equipment fabricators will have developed the capability to produce and market improved food processing equipment, innovating food processors will have procured and tried improved equipment and the Government will have important policy guidance regarding the kind of technology to promote and a strategy for promoting wide scale use of appropriate food processing technology.

Achievement of the project purpose will flow from these outputs. Feasible methods for improving small scale sugar cane, oilseed and rice bran processing will have been identified, developed, and tested and the potential for commercialization of improved technology will have been demonstrated.

Ultimately the project purpose will contribute to the goal of the project if important assumptions hold true. The project goal is to "increase employment, raise incomes of small farmers and village food processors and increase the supply of village produced sugar and edible oil". Assumptions critical to the realization of this goal are that incentives will be sufficient to induce food processors to invest in the new technology, that the improved technology will not be labor displacing and that the food processing population will have access to sufficient resources to procure the new technology.

4. End of Project Status

The successful execution of this project will result in between 50 and 200 units of improved cane processing equipment, between 50 and 100 oilseed processing units and 8 rice bran processing units having been tried by the target population and proved acceptable. A strategy for widespread production and dissemination of the improved food processing technology will exist.

C. Summary Findings

1. Technical Feasibility Summary

A review of the available literature suggests that considerable research has been done or is in progress on small scale sugar cane processing. Several promising technical alternatives exist for improving juice extraction rates. There is also considerable potential for reducing losses and/or producing a purer sugar product by employing improved sugar refining techniques. Increases in sugar recovery rates of between 20 and 30 percent appear to be feasible.

Relatively little relevant research was identified on modern small scale oilseed processing technology. The feasibility of developing an improved kohlu or a substitute, an improved expeller and/or small scale solvent extraction units will be carefully assessed in Phases I and II.

The technology for recovering edible oil from rice bran has been developed for fairly large scale processing units. The feasibility of developing small scale rice bran stabilization units or small scale, economical rice bran oil extraction units will be explored in the course of project implementation.

2. Financial Analysis Summary

Budget estimates for this project are based on the assumption that Pakistani institutions can and must play a significant role in project implementation. Work executed in Pakistan by Pakistanis will cost a fraction of what it would cost to have the same assignments carried out

by foreigners. Due to the nature of the project (demonstrating the feasibility of developing improved appropriate food processing technology) precise estimates of the amount of time and the precise mix of services required to execute each phase of project implementation cannot be estimated with great certainty. This consideration is reflected in the decision to execute this project on a cost plus fixed fee contract basis. Detailed estimates of the cost of all inputs have been made and are reflected in the tables included in Section III-B, "Financial Analysis and Plan". The actual cost of project implementation will be determined by :

1. The terms of the contract negotiated with the prime contractor selected through a request for proposal procedure.

2. Decisions made during the course of project implementation. A series of evaluations are scheduled throughout the course of project implementation to decide on details of subsequent steps.

It is not envisioned that this project will impose any recurrent budget requirements on the Government of Pakistan.

3. Economic Analysis Summary

Due to the feasibility nature of this project, a rigorous economic analysis is not possible at this time. Project implementation plans call for field survey research and secondary data analysis which will provide the project with sound economic guidance.

It is possible to estimate the magnitude of the benefits that the project might ultimately generate. A 20 to 30 percent increase in sugar recovery rates from village level units would produce 300,000 to 450,000 tons of crude sugar worth between Rs. 400 and 1,000 million at today's prices. To the extent that sugar prices do not decline, small farmer-producers in Punjab and NWFP are likely to be the primary benefactors. (Ten rupees = one dollar)

It may be possible to recover an estimated 10,500 to 18,000 tons of edible oil from oilseeds with improved appropriate technology. This gain would be worth $4,200,000 to $7,200,000 dollars in foreign exchange savings due to reduced edible oil imports.

If appropriate technology can be developed to recover edible oil from rice bran, upto 30,000 tons of rice bran oil could be produced worth $12,000,000 in foreign exchange savings.

The speed with which these benefits are obtained will depend on the relative costs and efficiencies of old and new machines. If highly favorable as we expect these would come quickly. Otherwise largely as present machines are worn out.

D. Project Issues (raised in AID/W PRP Review)

Concern was experessed over the technical feasibility of this project during the AID/W review of the project paper. Due to this concern an extensive review of the literature was made and a detailed summary of the technical feasibility of this project appears in Section III-A, "Technical Feasibility".

Concern for the economic feasibility of the project was also assessed. Definitive economic analysis is not possible at this stage due to the feasibility nature of the project. However the economic analysis in Section III-D does demonstrate that this project is economically attractive given the magnitude of potential benefits and their likely distribution.

Some of the important assumptions relating project purpose to goal were questioned. The concern about credit is being dealt with under the project inputs. The industrial extension strategy described in Section IV-A, should allay concern about manufacturers responding to the demand for improved processing units; the project explicity recognizes the possibility of developing both small and intermediate scale technology if the latter proves more feasible. The industrial extension activities in Phase IV will have to be molded accordingly.

We share AID/W's concern for the importance of selecting an institutional home for the project that is capable of discharging the important responsibilities of project management. The Appropriate Technology Development Organization (ATDO) has been selected by the Government of Pakistan to assume responsibility for this project. In consultation with ATDO it has been decided to establish as conditions precedent to disbursal of project funds the following requirements :

A. Adequate professional staff be recruited and assigned solely to this project.

B. Procedures for the disbursement of funds to the implementing entity (contractor) be established which will facilitate the timely disbursement of project funds. We believe that when these conditions are met ATDO will be fully capable of effectively discharging its project management responsibilities.

The final issue relates to the adequacy of incentives for food processors to invest in improved appropriate food processing technology. This year the Government took the unusual step of prohibiting large sugar mills from procuring and reprocessing gur into white crystalline sugar. As mills have regularly engaged in this practice in the past, this regulation has had the effect of significantly reducing the demand for gur in many markets and thereby depressing the farm gate price of gur accordingly. In view of the important policy issue at stake, (i.e. what is the appropriate scale of technology for Pakistan, judged by economic criteria?), explicit provision has been made for economic studies that will provide the Government with better information on the economic implications of supporting small, intermediate or large scale food processing technology. This project seeks to provide the Government with a true choice among distinctly different technologies by developing improved small and perhaps intermediate technology.

II. Description of the Project

A. Background

Traditional technology is widely employed in Pakistan in small scale processing of sugar cane and oilseeds. Approximately 70 percent of the sugar cane and 20 percent of the rape and mustard seed produced in Pakistan are processed at farm and village level. The small scale equipment used generally has very low pressure capability, and is old and poorly operated. As a result sucrose and oil extraction rates achieved by these small processors are much lower than those possible with large scale, modern plants. The small mills employ more labor per unit of output and per unit of capital than large modern plants. The final products, though less refined, are widely accepted and, because of the low price, widely consumed by the lowest income families in the villages where they are produced. While centralizing processing in large modern plants might theoretically increase sugar and oil availability, it would involve almost insurmountable practical problems and major expenditures for assembly and transportation of the raw materials and redistribution of finished products, as well as a large investment in new plants. Further, it would substantially reduce employment in the villages and remove from village consumers a supply of low cost food. Both social and economic goals clearly indicate the desirability of efforts planned under the project to improve farm and village processing rather than invest heavily in large modern plants.

Approximately 1.5 million acres of sugar cane are grown in Pakistan but less than 25% of it is processed in large scale modern mills. A small amount of the cane is used unprocessed for food and feed. However, about 70% of the total crop, (15-16 million tons per year) is processed in very small farm and village presses. Animal powered presses, usually having three rollers, are used in farm and village operations to extract the juice from cane. A single-pan evaporator, fired with dried cane stalk waste (bagasse), is employed to produce an unrefined or partially refined sugar product (gur or shakker). Village cane crushers visited in a 1975 survey had extraction rates between 57 and 74 percent of the total sucrose content of the cane, as compared with modern sugar mills operating in Pakistan which range from 88 to 95% sucrose extraction rates. It is estimated that large mills generally extract 30-40% more sucrose from the cane than is obtained by the average farm and village operation.

Most of the bagasse, along with the residual sucrose it contains, is burned to evaporate the cane juice. Only a very small amount is fed to animals. The amount of sucrose lost due to inefficiency in small scale farm and village level extraction is estimated to be at least 300,000 tons and more likely 450,000 tons MT per year, with a current market value of Rs. 400 and Rs. 1,000 million (wholesale market prices are currently averaging Rs. 50 to Rs. 85 per maund) (1 maund = 82.28 lbs.).

Most of the sugar cane in Pakistan is grown on small and medium size farms. Eighty percent of all sugar cane is produced on farms of less than 25 acres and 50% is grown on farms of less than 12.5 acres. Farm and village level cane processing operations generally also are very small. Typically, cane processors own and operate their own equipment. They produce enough sugar for the family's requirement and market any surplus,thus supplementing the family's cash income. There are some larger village level operations where cane is bought and the output sold. In some cases, custom processing of cane is done for small farmers. Data from very limited field observations suggest that farmers producing for farm and village level processing have smaller acreage than those producing for delivery to large mills.

Rape and mustard seed appear to be the most important oilseeds processed at the village level. Production and processing patterns for the brassicas are somewhat different than those for cane. About one third of the 1.3 million acres of these oilseed crops planted each year are on farms below 12.5 acres, one third on farms of 12.5 to 25 acres and most of the remainder on farms of 25-50 acres. However, traditional processing is done at a village, rather than farm level. Typically the village oil pressman (teli) operates over the course of the year, processing oilseeds as villagers come to have oil pressed for home consumption. A crude wooden press (kohlu) or a somewhat improved steel model is used to extract the oil.

The exact percentage of the rape and mustard seed processed in the village is unknown. A recent study estimated that approximately 50,000 tons out of a total of 250-300,000 tons of rape and mustard seed produced each year is processed in crude, village level presses. The balance of the crop is processed in low pressure (Lahore) expellers.

The Lahore expellers operate in both market towns and larger cities. These expellers comprise a more modern sector of the brassica oil extraction industry, and are capable of extracting to a 6 or 7 percent residual oil on cake. The traditional kohlu generally is estimated to extract to 9 to 16% residual oil in rape and mustard seed cake.

Data on the disposition of cake from village kohlus and low pressure expellers are not available. However, we do know that part of the cake is used for livestock feed and part of it goes to solvent plants where the residual oil is extracted and used for industrial purposes. By the time the cake reaches the large mills for reprocessing, the free-fatty-acid content has increased to the level where the oil no longer is suitable for edible products. Animal nutritionists in Pakistan consider the extra oil in the cake as it comes from the kohlu to be of zero or even a negative value when fed to most livestock. Because reliable figures are not available on the amount of oilseed processed by village level presses or the extraction rates of the equipment used, it is not possible to estimate accurately the savings of edible oil that might be possible from improved technology.

These unrefined oil and sugar products produced in village mills are readily accepted in rural areas and are considered nutritionally equal to the refined products. The crude sugar contains the molasses and hence has a higher invert sugar content than refined sugar. It also has some minerals and protein which would be lost if it were processed into crystal sugar.

Small scale farm and village sugar and oilseed mills enjoy some advantages which permit them to compete with large mills, despite low extraction rates and generally lower product prices. Their assembly, transportation, handling and distribution costs are very low. The raw materials are grown and most of the finished products consumed within a very short distance of the mill. Labor costs are low because the family and hired labor used generally would otherwise be underemployed. Another advantage the small sugar mills enjoy is the relatively short time between cutting of the cane and processing. The large mills often receive cane which has been cut several days to two weeks earlier, with resulting heavy sucrose inversion. In contrast, small farm and

village mills usually process the cane the same day it is cut, well before inversion becomes a problem. Further, to the extent that the farmer processes his own cane or has it custom processed, he has a direct incentive to produce cane with a higher sucrose content -- an incentive lacking in large plant processing where, by law, the grower is paid solely on the basis of the weight of the cane.

Supplies of crude sugar and unrefined vegetable oil are inadequate to meet demand. These products often are not available or are available only at highly inflated prices and the poorest segments of society suffer.

About 3.7 million acres of rice are grown in Pakistan producing some 4.0 million tons of paddy. Assuming that the paddy yields 7 percent bran, 280,000 tons of bran are produced containing 6 to 12 percent oil. The crop is processed in some 2,000 rice mills located throughout Punjab and Sind. In converting paddy to polished rice, the bran is removed. Presently this bran is largely wasted although it contains substantial quantities of edible oil. Rice bran oil is not recovered because mills do not have facilities for treating the bran immediately after it is removed from the rice. It is essential to either extract the oil or stabilize the bran within 24 hours of the time of milling due to the rapid action of an active enzyne in the bran which converts oil to free-fatty-acids and renders the product unfit for human consumption.

The installed rice husking capacity in 1973-74 was 1084 tons per hour, two hundred and one sheller mills have a combined capacity of 190.7 tons per hour and 1788 huller mills have a combined capacity of 844 tons per hour. The sheller mills generally have a much larger capacity and produce a higher quality bran. Relative to the sheller mills, the husker mills are smaller, produce a bran product which includes considerable amounts of other parts of the seed, is coarser in texture and the oil and protein content are lower. Given these characteristics of the rice processing industry -- many small mills, widely scattered and most of which produce low quality bran -- the project will seek to determine the feasibility of processing rice bran and producing an edible oil product and develop suitable small scale equipment for that purpose.

B. Detailed Project Description

Preliminary analysis indicates that a substantial increase in the average extraction rates might be achieved in small scale sugar and oilseed mills by application of the most modern technology available to improve equipment design and operations. Research in progress on developing small scale rice bran stabilization technology suggests that it may be feasible to develop an important new source of edible oil.

Because of the large sugar losses that result from the widespread use of the physically inefficient traditional cane crushers, the Government is pursuing a policy supportive of large scale industrial processing of cane. This project seeks to present the Government with a more attractive alternative -- the development of small-scale equipment and processing techniques capable of producing a quantum increase in the quantity and quality of sugar produced. The target is an average extraction rate of 80% to 90% of the available sucrose from village mills employing the new technology -- an increase of 20 to 30% in the amount of crude sugar produced per ton of cane.

Through improved small scale technology, the project similarly seeks to increase the extraction rates on rape and mustard seed from the present 9 to 16% residual oil in the cake, without changing the locale of processing. Given the low current extraction rates associated with village presses (kohlus), an increase of 20% in amount of oil extracted appears feasible with improved equipment and operation.

The project also seeks to demonstrate the feasibility of recovering significant quantities of rice bran oil from bran that presently goes totally unprocessed. The bran itself is largely discarded as waste, although some is used as feed. Appropriate technology that is capable of stabilizing the rice bran or extracting the oil immediately after husking could produce 30,000 tons of edible oil annually.

The stated goal of this project is to increase employment, raise incomes of small farmers and village food processors and increase the supply of village produced sugar and edible oil.

The project will involve four phases with specific points at which formal evaluations will be made and decisions taken affecting subsequent activities. These phases are :

I. Evaluation of the potential for improvement in extraction rates and conditions which the improved technology must meet.

II. World-wide search for improved technology .

III. Redesign, testing and refinement of candidate technology for the different situations encountered in Pakistan.

IV. A fairly large industrial extension effort to develop the capability of fabricators to produce and market the improved technology, and preparation of a strategy for widespread dissemination of this technology beyond the life of this project.

AID will assist Pakistan in this effort through a dollar grant of $565,000 to help finance costs of carrying out the various activities. An initial grant obligation of $175,000 will be made in FY 1976. Additional grant obligations of $150,000 in the transitional quarter, $150,000 in FY77 and $90,000 in FY1978 will be made. The AID funds will be used to finance costs of a prime contractor, who will be responsible for the execution of the project. The prime contractor may sub-contract as necessary some elements of the project to other firms. The funds may also be used to finance these sub-contractor costs.

A carefully phased series of activities, with critical evaluations and decision points have been established to maximize the likelihood of discovering, testing and obtaining acceptance of significantly improved technology. This will set the stage for achievement of the primary goal. The principal steps of project implementation in each phase are outlined in the Project Implementation Plan (Section IV-C.). For full details of project scheduling see Annex C.

Field survey research and secondary data analysis will be carried out during Phase I to determine the technical and economic feasibility of developing improved food processing technology appropriate for Pakistan's resource endowment. Studies undertaken will include :

1. Micro analysis of the economics of village level sugar processing and edible oil extraction by kohlus and low pressure expellers.

2. General socio-economic analysis to identify potential constraints to adoption of new food processing technology.

3. Engineering study of evaluating the performance of present day village processing equipment.

4. Evaluation of capabilities of present day food processing equipment manufacturers.

The products of Phase I research will include :

1. Report based on the above analysis assessing the feasibility of identifying and developing improved food processing technology of a suitable scale and sophistication for village-level operation. An evaluation will be conducted at the end of Phase I to determine the advisability of proceeding on with project implementation.

2. A set of engineering and economic parameters will be established which will serve as criteria to guide Phase II identification of appropriate technology.

3. A set of base line data will be in hand which will identify the project's target population and permit follow-on research required to evaluate the impact of the project.

4. An assessment of manufacturing capabilities that shall facilitate definition of Phase IV implementation strategy including :

   A. Identification of candidate firms for fabricating prototype equipment.

   B. Determination of entity (s) best suited to undertake Phase IV industrial extension responsibilities.

The Project is based on the premise that appropriate technology can be identified somewhere in the world. Phase II activities are planned to carry out this search. A systematic search of the literature will commence simultaneously with the start of Phase I research. The search will include a review of patent literature, contacting organizations promoting appropriate technology, and the utilization of technical information retrieval services. Applying the criteria developed in Phase I research, the technical literature will be screened and candidate technology identified. Then selected countries will be visited and the candidate technology will be inspected, evaluated, and, where appropriate, procured and shipped to Pakistan. Complementary technical literature, designs and related materials will also be procured and sent to Pakistan.

The products of Phase II activities will include :

1. Prototype equipment selected, procured and shipped to Pakistan.

2. Blue prints, operators' manuals, manufacturers' specification and other technical literature procured and brought to Pakistan.

Phase III activities are designed to test and modify imported prototype equipment and alternative food processing technologies such that all equipment and materials can be produced in Pakistan and the improved, adopted technology can be utilized in the village environment. Phase III will be initiated as soon as prototype equipment and necessary technical literature arrives in Pakistan. With guidance provided by the technical literature, equipment and processing techniques

shall be carefully tested to determine performance standards. Then, applying Phase I criteria to guide research, the imported technology shall be adapted as required to meet the project's performance and population targets. A reiterative process of testing, adaptation, adoption, etc., shall be carried on until improved, appropriate technology has been developed.

Based on Phase I evaluation of the capabilities of food processing equipment manufacturers and the type of equipment and processing technology developed in Phase III, a report will be prepared recommending the industrial extension strategy to be pursued in Phase IV. Responsibilities of implementing entities will also be identified.

The products of Phase III activities include :

1. Improved prototype equipment designed, developed and tested.

2. Improved food processing techniques developed and tested.

3. Equipment drawings, operators' manuals for prototype equipment, and food processing instructions and description of improved processing procedures printed.

4. Phase III report submitted specifying performance standards of prototype equipment and estimating the production costs of custom and commercially produced equipment.

5. A Phase IV industrial extension strategy defined.

Industrial extension activities will be carried out during Phase IV (pilot project production marketing of improved technology). Manufacturers exhibiting interest in and potential for undertaking construction of the improved food processing equipment will be selected. They will be provided with assistance in first fabricating, testing, making minor refinements and then marketing the improved equipment. The

industrial extension agent will also work with food processors training them in the proper use and maintenance of the equipment. Credit will be made available as necessary to facilitate food processors' access to the new technology. Phase IV will conclude with a market study designed to assess the acceptability of the new technology to the target population. Drawing upon the results of Phase I and IV research, a choice of technology study will be developed which will provide the Government with policy guidance on appropriateness of small, intermediate, and large scale food processing technology given Pakistan's resource endowment. An end of project evaluation in December, 1979 will identify constraints inhibiting widespread adoption of the improved food processing technology and make recommendations for post project actions required to relax these constraints.

The products of Phase IV activities will include :

1. Demonstrated capabilities of selected manufacturers to fabricated improved equipment.

2. A target of 50 to 200 sugar cane processors, 50 to 100 oilseed processors and 8 rice mills have purchased and tried improved equipment.

3. End of project report which includes :

   A. Evaluation of suitability of improved equipment to operate in food processors' environment.

   B. Project appraisal and choice of technology study.

   C. A strategy for achieving commercial production and wide scale adoption of improved technology by food processors.

The major inputs required to produce the outputs listed above (in the logical framework) include :

1. Dollar financing for all contract services and commodities to be procured for this project. This is expected to include

an estimated 29 man months of foreign expertise and $35,000 dollars worth of foreign prototype equipment.

2. Local financing provided by the Government of Pakistan for ATDO to carry out project management; items to be procured include salaries and allowances of professional and support staff, vehicles, POL and other transportation items, office rent and office facilities including utilities, furniture, office equipment.

3. Credit for innovating food processors.

4. Government of Pakistan financing for Phase IV industrial extension activities including salary and allowances of staff, travelling allowances and office facilities.

A set of important assumptions have been made about the linkages between project inputs, outputs, purpose and goal.

Input to Output Assumptions:

It is assumed that a capable contracting entity willing to accept responsibility for all phases of project implementation can be identified. Some combination of Pakistani and American expertise is likely to be necessary to successfully execute the entire project.

Output to Purpose Assumptions:

A crucial assumption is that it is feasible to develop improved sugar cane, oilseed and rice bran processing technology appropriate to Pakistan's resource endowment. This will depend partially upon Phase I research -- it is assumed that no prohibitive socio-economic constraints will be identified. It is also assumed that suitable elements of appropriate technology exist somewhere in the world, can be identified, combined and adapted to operate efficiently in the Pakistani village environment.

Purpose to Goal Assumptions :

The most crucial assumption is that sufficient incentives will exist for food processors to adopt the new technology. Price policy is especially critical. For the project goal to be achieved, it is assumed that public price policy will not actively seek to depress gur prices. Price policy for edible oil, including rice bran oil is, of course, also crucial. (Project outputs will include data to help the Government make these policy choices on a more informed basis.) Other assumptions that have been made are that the improved technology will not be labor displacing and that it can be priced within the range of the target population.

III. Project Analyses

A. Technical Feasibility (A more detailed discussion of technical feasibility can be found at Annex. B).

1. Sugarcane Processing Technology

The most prevalent village sugarcane extraction technology is the three-roller crusher (or mill). Typically bullock powered, it has a crushing capacity variously estimated at 150-500 pounds of cane per hour and it is capable of extracting up to 70% of the total sucrose from cane. Once the juice is extracted it is placed in an evaporator where most of the water is driven off and then various refining procedures are carried out depending on the final product desired: gur - a dark brown largely unrefined sugar product; shakker - a light brown powdery product; and desi (local) sugar - a semi-white crystalline product. Technical alternatives for improving these processes include :

a. improvement of the traditional 3 roller crusher
b. expeller extraction
c. pre-shredding
d. pithing
e. diffusion extraction
f. imbibition
g. improved refining

2. Oilseed Processing

The traditional village kohlu consists of a wooden mortar in which a long wooden pestle and driven around the station in mortar. The traditional kohlu has been improved by shrodding the critical parts with steel; by constructing the entire kohlu from steel; and by making the mortar rotary. Low pressure ("Lahore") expellers represent an intermediate oilseed processing technology that is widely applied in Pakistan. Opportunities for improved extraction technology include :

a. the condition and characteristics of the oil bearing material (treating the oilseeds in advance of the oil extraction process).
b. pressure (in the expeller process).

c. time
d. solubility of oil and permeability of oil bearing material (in the solvent extraction process).

3. Rice Bran Processing

Rice bran is not currently processed for oil in Pakistan. Technical alternatives for processing include :

a. equipment to process the bran immediately after milling.
b. stabilizing the rice bran by the de-activating the enzyme which converts the oil to free fatty acids, thus allowing the rice bran to be transported to centrally located plants for processing.

4. Appropriateness of Technology

The intent of this project is to identify, develop, produce and ultimately disseminate technology appropriate to Pakistan's resource endowment. Phase IV analysis will address the question of choice of technology among the alternatives of :

a. Village-level or small scale processing technology.
b. Intermediate processing technology.
c. Large scale, industrial processing technology.

5. Suitability of Technology for Local Manufacturing

It is the explicit intention of this project to develop improved food processing equipment that can be fabricated and assembled in Pakistan. Project selection criteria will guide the identification, selection and development of improved food processing equipment to conform to these objectives. Given the diversity of skills and capabilities of metal fabricating workshops and large scale manufacturers, it is anticipated that project objectives of local fabrication can be fully satisfied. Most if not all materials that will be required to fabricate the improved equipment developed during this project are almost certainly readily available in Pakistan. Explicit provision for exceptions to rule will have to be carefully considered and resolved in the course of project implementation.

6 Environmental Assessment

Under this project the Government of Pakistan will identify, develop, produce and ultimately disseminate on a pilot basis appropriate technologies for processing sugarcane, oilseeds and rice bran, of a suitable scale and sophistication for operation in villages. At the end of the project, only a relatively few prototype units of each type will have been built and tested. Thus the environmental effects of the project itself will be limited.

The present environmental situation in these industries in Pakistan is that primitive processing practices and consumption of the products at the local level produce few adverse environmental effects and have some environmental advantages over processing in large commercial units.

The 25 large mills, which process about 5,000,000 tons of cane per year, obtain their cane from a radius of 15 to 20 miles and more, largely by truck. The final product also must be transported relatively longer distances to consumers. This trucking activity produces a certain amount of air and noise pollution. In contrast the 15 million tons of cane per year that are now processed at the farm and village level are mostly transported by head loads or animals for short distances to the processing sites. Similarly, decentralized processing of oilseeds involves much less transportation both in raw material collection and in distribution of the oil and cake.

The waste problems are much less severe when the sugarcane, oilseeds and bran are processed at the village or farm level. Bagasse obtained as a by-product of cane processing at the farm or village is used in the immediate area. Most of it is burned as fuel to evaporate the cane juice; the rest is used for animal feed or is spread on land to improve the condition of the soil. Some of the large mills are powered by bagasse but others depend on gas or oil. In most cases large mills have an excess of bagasse which accumulates in large quantities in slowly-decomposing piles. Similarly some rice bran from the mills is currently processed or fed to animals, but most of it also accumulates at the mills and creates waste disposal problems.

By undertaking this study, the Government has made a decision, in principle at least, to promote the widespread use of the small scale new technologies that this project will develop. Since the most appropriate technologies have not yet been selected, it not possible to predict at this time what their environmental effects will be; but these effects will definitely be among the factors to be considered in the evaluation of the several possible systems before a final selection is made. It is expected, however, that technologies will be available that will have few or no adverse environmental effects. Any minor environmental problems that develop will be dispersed among thousands of small units and will have no significant cumulative effects.

Because of the relatively lower extraction rates where processing of sugar and oilseed is carried out at the farm or village level, the Government has been actively pursuing a policy of centralization of processing in large-scale, capital-intensive units. Development of substantially more efficient small-scale processing equipment will make it technically and economically feasible and politically acceptable to reverse this trend. On the other hand, the alternative of not developing appropriate small-scale technologies will accelerate the tendency to concentrate the processing in large-scale capital-intensive units, thus aggravating the air, noise and waste disposal problems mentioned above.

B. Social Analysis

1. General Social Analysis

Due to the target population and the nature of the food processing activities upon which this project focuses, social feasibility issues may be of special import in this project. Consequently Phase I research plans include explicit provision for socio-economic analysis intended to :

a) Describe and analyze the social milieu in which village food processing activities occur.

b) Identify constraints, including social factors, that may limit the target populations' access to or acceptance of innovations that may be developed in the course of project implementation.

In this regard the following variables will bear special attention :

1. The social status of village food processors, especially in the case of the institutionalized role of the village oil pressman, "teli".

2. The land tenure status of farmers who are processors (as is predominantly the case with sugar cane processors).

3. Labor force participation rates by casual and permanent labor, differentiated by age and sex.

4. Family labor force participation rates differentiated by age and sex.

5. Remuneration arrangements between food processors and clients, with special attention to the existance and implications of traditional exchange ("seyp") relationships.

6. Subsistence characteristics of home or village food processing activities that may insulate food processors from market incentives.

7. Ownership of food processing equipment and decision making powers regarding investment, operation, maintenance, and fees charged for food processing services.

2. Population Impact

The demographic impact of the Village Level Food Processing project per se will be negligible because it is conceived as a research and demonstration activity. Very few individuals will be directly affected by the project itself. Hence, the normal demographic outcomes of such aspects of development as increased incomes, better nutrition, lower mortality, and improved status of women will not arise directly within the life time of this project.

However, in the longer run, and to the extent that this project leads to the ultimate goals which are articulated -- increased farm and processor incomes and improved nutrition in the rural areas of Pakistan -- it is possible to conclude that the project is consistent with the goal of reducing the population growth rate of the country.

Increased farm and processor incomes may, over a number of years, lead to some decline in rural fertility. The relationship between income and fertility is not very well understood in any society, and is practically unresearched in Pakistan. However, from research carried out elsewhere, it appears that fertility tends to respond in a curvilinear manner to changes in income. At the lowest levels of income, fertility tends to rise somewhat as income rises. However, beyond the base subsistence level, additional increases in income tend to be associated with declining fertility. Therefore, to the extent that the search for improved technologies anticipated by this project leads to the widespread adoption of technological innovation in village level food processing in Pakistan, and to the extent that the successful adoption of such technologies leads to the anticipated increase in the

incomes of processors and farmers, fertility should experience some decline.[1]

Similarly, to the extent this project leads to increased availability of crude sugar and edible oil in the rural areas, and to the extent that this increased availability leads to improvements in the nutritional and health status of the rural population, the long run effect of the project should be declining fertility. However, short-run declines in mortality that would result from increased availability of these foods will result in a slightly elevated rate of population growth during the first few years after such availability became manifest, followed by a longer run decline in fertility caused by the declines in mortality.[2]

As a general conclusion it can be said that this project will not have any significant pronatalist effects and may have significant second-order antinatalist effects.

1/ The most recent and most comprehensive examination of the relationship between income and fertility in Pakistan is M. Ali Khan and Ismail Sirageldin, "Education, Income and Fertility in Pakistan," unpublished paper, the Johns Hopkins University (Department of Population Studies), Baltimore: 1975 (mimeo). Their findings tend to confirm the generalizations posited here. For a broader review of the general literature on income and fertility, see William P. McGreevey and Nancy Birdsall, "The Policy Relevance of Recent Social Research on Fertility," Occasional Monograph Series, No. 2, Interdisciplinary Communications Program, The Smithsonian Institution (Washington, D.C., 1974).

2/ The relationship between mortality, especially infant and child mortality, and fertility has not been firmly established as being casual. However, there is considerable evidence which suggests a strong association between these variables -- perhaps a casual relationship. The most recent evidence on this point in Pakistan, which supports the contention articulated here, is the doctoral dissertation of Dr. Abdul Razzaque Rukanuddin on infant mortality and fertility, Johns Hopkins University, Department of Population Studies (Baltimore, Md.), 1975 (Unpublished).

3. Role of Women

This project is aimed at improving incomes and employment opportunities for low income rural people as a group and at expanding supplies of low cost sugar and edible oil products which are particularly important in the diets of low income rural people. Although it is expected that female roles will be greater with the small scale than the large scale processing alternatives, the project does not lend itself to design to especially enhance the roles of women as decision makers and laborers. The project will deal mainly with processing and indirectly affects harvesting and production. Women tend to participate somewhat more in harvesting than in production of crops such as sugarcane and oilseeds. They participate to some extent in processing of sugarcane where it is done at farm or village level but very little where it is done on a large scale. As managers of the household and tenders of liverstock they participate in decisions on amounts and timing of farm and village level sugarcane processing. Also there should be some incidental 'anting of nutrition benefits toward females. Evidence indicates that in neral in low income rural families where caloric intake is substand , females suffer more than males. In that the project is expected to increase caloric intake of low income families, it can be expected to benefit females marginally more than males. More information on roles of different groups will be generated during the first phase of this project. This will help to determine possibilities for enhancement of women roles during implementation of subsequent phases.

C. Economic Analysis

It is the purpose of Phase I of this project to establish a data base from which the economic feasibility of potential innovations in village level food processing technology can be assessed (See Annex D, for description of project implementation). Field research and secondary data analysis will be carried out that allows a market study of food products and their by-products as well as a cost analysis of the existing methods of production. The latter analysis will place particular emphasis on labor utilization patterns and socio-economic characteristics of food processors at the village level. Value added,

benefit-cost ratios and internal rates of return will be calculated for the existing situation. This analysis will then form a base against which to judge potential innovations resulting from a world wide search for appropriate technology. It will also provide the base line data and analyses against which the end of project evaluation will be made.

Assessment of this sector to date indicates that the direction of income gains and potential increases in output are more than adequate for this project to qualify for USAID financing.

1. Economics of Sugar Production

Data from an informal survey of 10 crude sugar processing units conducted by USAID in 1975 indicated that most of the farm and village level mills are very small in terms of output and very labor intensive relative to the modern mills. Although not substantiated by adequate data there appears to be an inverse correlation between the scale of processing units and the size of holdings of growers, i.e. more small cane growers process their crop on their farm or in their village than do large cane growers. Therefore, innovations in this sector which allow village producers to compete more effectively with the modern sector should tend to favor a more equitable distribution of income and increase rural employment.

Micro-economic data also indicates the primary beneficiaries of these innovations will be small farmers since , as indicated above, small farmers process a higher percentage of their cane at home than do large farmers. The table below shows that most of the sugarcane crop is produced on small and medium farms.

Percentage of National Sugar Cane Crop
Grown by Different Size Farm Operators

Size of Farm (Acres)	% of Pakistan's Total Cane Crop Acreage
0-5	15%
5-12.5	33%
12.5-25	31%
25 and over	21%

Source: 1960 Census of Agriculture

An indication of the importance of project benefits to smaller farmers can be seen from the following table. It shows that the smallest sugar cane growers devote the highest percentage of their crop acreage to sugarcane. The percentage of cropped acreage committed to sugarcane production by cane growers is an inverse function of the size of holding.

Relative Importance of Sugar Cane Production
to Different Size Farmers

Size of Farm	% of Cane Growers' Cropped Acreage Devoted to Sugar Cane
0-1	52%
1-2.5	28%
2.5-5	16%
5-7.5	12%

7.5-12.5	9%
12.5-25	7%
25-50	6%
50-150	5%
150 and over	3%

Source: 1960 Census of Agriculture

Rough comparisons of the capital and labor requirements between modern mills and village level crude sugar technology currently employed in Pakistan are given in the Techno-Economic Feasibility Report on Mini-Plants in Pakistan produced by Intermediate Technology Services Ltd., for the Government of Pakistan. The study estimates that village level gur plants are relatively labor intensive requiring 100 times the labor input per unit output compared to the requirements of a modern mill. At the same time gur plants use 1/10 to 1/15 the capital per unit of output required by a modern mill. As a result, the study concluded that gur plants appear competitive at present relative price ratios in Pakistan. The cost of producing gur ranges from Rs. 1553 to Rs. 1924 per metric ton in 1974 prices. This range depends on extraction rates and the number of days per year the plant operates. In comparison, the study estimates the cost of producing refined sugar per ton at modern mills ranges from Rs. 1996 to 2440 per metric ton in 1974 prices.

In both cases the dominant cost is the sugar cane itself which is responsible for 80% of total costs of production. Costs per unit output are relatively insensitive to capital costs and very sensitive to efficiency of extraction. As a result, it is economically feasible to introduce more expensive but improved extraction equipment into village level gur plants and reduce costs per unit output without requiring labor displacing innovations or economics of scale.

At the retail level, the free market price of gur currently ranges between Rs. 1.50 and 3.00 per seer (7.5 to 15 cents per pound). The ration shop price of refined sugar is Rs. 4 per seer and the free market price ranges between Rs. 7 and 9 per seer. Therefore retail prices of refined sugar are three times that of gur whereas the costs of production are only estimated to be roughly 25% higher. However, the marketing structure for refined sugar is sufficiently complex that conclusions as to relative profitability between the two processes cannot be drawn until the completion of Phase I studies.

It should be kept in mind that the products for which different technologies are being compared, although close substitutes, take different physical forms and therefore meet different consumer preferences. However, if the above cost data are correct, the implications of increased efficiency are clear. Current costs of producing crude sugar are competitive with the production costs of large mills which produce refined crystalline sugar. Increasing the efficiency of the village level cane processing technology will prolong the survival of the labor-intensive traditional sector and at the same time advance economic and social development objectives. That is, higher wage rates will be required to induce a shift to the capital-intensive but labor-saving modern milling processes than are required at present. This will ensure a higher level of employment and a more equitable income distribution in Pakistan's sugar producing sector throughout the development process.

The magnitude of potential increases in output is very high. Approximately 15 million tons of Pakistan's 23 million ton sugar cane crop is processed in the village. Given the sugar recovery rates as set out in the technical section of this paper, the potential 20 to 30 percent improvement possible from more efficient technology could produce an additional 300,000 to 450,000 tons of crude sugar. In April 1976 the wholesale market price range for crude sugar in Pakistan was Rs. 50 to 85 per maund (1 maund= 82.28 lbs). This translates into a current domestic wholesale market value between Rs. 400 million and Rs. 600 million at the lower price, and Rs. 680 million and Rs. 1000 million at the higher price. This is equivalent to approximately $ 40 to $ 60 million at the lower price and $ 68 to $ 100 million at the higher price.

Increased output of the magnitude described above is unlikely to effect the sector adversely. The diffusion of innovations will be spread over several years so that demand generated by population and income gains will easily absorb the increased output envisioned. Assuming population increases of 3 percent per year and increases in real income of 6 percent per year, it is clear that a 13 to 19 percent increase in sugar production which could result from the above innovations will be easily absorbed over the period of adoption. At present, sugar imports are banned and refined sugar is strictly rationed so that at current prices demand exceeds supply. This ensures a high demand elasticity for alternative sugar products such as gur and shakker as well as a capacity to absorb production from new acreage induced by increased efficiency.

2. Economics of Oil Processing

Little reliable information exists concerning production processes, extraction rates, and costs of village level processing for rapeseed, mustard seed and other minor oilseeds.

Rape and mustard seed are the principal oilseeds processed in village kohlus which is basically a pestle and mortar extraction process. It is estimated that 50,000 tons out of an average 280,000 ton crop is processed at the village level. Minor oilseed crops amount to another 50,000 to 60,000 tons of oilseeds. If it is assumed that increases in extraction rates of 20 to 30% are feasible, 2,000 to 4,000 tons of rape and mustard seed oil could be produced. Similar gains in oil production might be realized by processing the minor oilseed crops with improved equipment.

It may also be feasible to develop technology that can improve extraction rates for low pressure expellers. Low pressure expellers process the balance of the rape and mustard seed crop of 230,000 tons per year. Typically they are operated to extract oil to a level of about 8 or 9% residual oil on cake. Improved technology might increase oil recovery by 10% to 15%. Improvement of this magnitude would produce 6,500 to 10,000 tons of additional oil.

If feasible technology can be developed to permit the extraction or rice bran oil up to 30,000 tons of edible oil might be produced as indicated in the technical feasibility discussion in Annex B.

These potential gains are summarized in the table below :

Increased Oil Production from:	Low Estimate	High Estimate
	(Metric Tons)	
Rape and Mustard(presently kohlu pressed).	2,000	4,000
Rape and Mustard(presently pressed by low pressure expellers).	6,500	10,000
Other Minor Oilseed Crops (presently kohlu pressed).	2,000	4,000
Rice Bran Oil Extraction.	30,000	30,000
Total:	40,500	48,000

During FY 1975 Pakistan imported 184,000 metric tons of edible oils at a foreign exchange cost of $137.4 million. The current FCB import oil price is approximately $400 per metric ton. If technology can be developed to raise extraction rates for the various production processes outlined above, then the foreign exchange savings at current prices for each sub-section are as approximated in the table below :

Foreign Exchange Savings from:	Low Estimate $	High Estimate $
Rape and Mustard (kohlu pressed).	800,000	1,600,000
Rape and Mustard (Low Pressure Expellers pressed)	2,600,000	4,000,000

Other Minor Oilseeds (kohlu pressed).	800,000	1,600,000
Rice Bran Oil Extraction	12,000,000	12,000,000
Total:	$ 16,200,000	$ 19,200,000

Domestic wholesale prices for the type of edible oils discussed here are generally higher than the soybean oil price used above for computing foreign exchange savings. Therefore, the potential wholesale market value should be equal to or slightly higher in magnitude than foreign exchange savings.

The incidence of benefits generated by the application of improved appropriate oil extraction technology is problematic. It is not clear how the returns to improvements in extraction rates will be divided among the large numbers of small farmers, processors and consumers. This will depend in part on the type of technology developed and will be subject to analysis in the course of project implementation. To the extent that oilseed growers participate in the benefits generated by this project we can expect the small and medium farmers in irrigated areas to be the primary benefactors. The 1960 Census of Agriculture shows that approximately one-third of the brassica oilseed production occurs on small holdings, one-third on medium size holdings, and one-third on large holdings. Other sources indicate that roughly three-fourths of the crop is produced under irrigation.

D. Financial Analysis and Plan

Summary Cost Estimates

Table I shows the total estimated costs for the project including contingencies and inflation. The $323,000 total cost for contract services includes $203,000 foreign exchange for technical assistance, international travel cost and per diem for world search and $120,000 equivalent local currency costs for Phase I-IV research studies, library research and designing, testing, fabricating prototype equipment and for developing model prototypes. AID is also financing $35,000 in foreign exchange costs for importing equipment from suitable sources identified in Phase II.

The GOP is financing the remaining local currency costs for industrial extension services, credit and management costs. These costs amount to 29% of the total project costs thus meeting the requirement of FAA Section 110(a). Additional host country contributions will also include between Rs. 713,000 and Rs. 3,653,000 arising from equipment procurement by innovating food processors.

The breakdown of the above costs is shown in Annex. F. AID financed costs listed in Table I were based on USAID's best estimates of current prices plus an inflation factor of 10% for costs incurred in year one, 15% for year two and 20% for year three. A contingency of $69,000 (12%) was added to the total to allow for unforeseen expenditures, with most of the contingency attributed to local currency costs which reflects their greater uncertainty.

Host country contributions shown in Table I are based on GOP budgetary data for operational costs given in Annex F. These data include projected increases in the budget over the life of the project. In addition, an inflation factor of 10% was added to the total for possible salary increases for Government employees. The contingency factor in the budget has been broken out and is shown in Table I.

Financial Plan

The disbursement over the life of the project is shown in Table II. A detailed description of each of these output figures is contained in the Detailed Description (Section II-B) and Annex. F.

Financial Arrangements: Foreign Exchange Costs

The project will utilize standard letter of commitment/letter of credit procedures for foreign exchange costs for technical services and commodities.

*Local Currency Costs (fixed amount reimbursement with advance)

For the $323, 000 local currency costs (including contingency) financed by AID, an advance special letter of credit will be opened for 50% of the estimated total costs (about $150, 000) upon assurance that the GOP has made provision for release of adequate rupee funds for these costs to the implementing agency. The remaining 50% of the local currency costs will be reimbursed to the GOP by amending the SLC when evidence has been presented that these total costs have been incurred by the implementing agency. Any costs incurred in excess of original estimates plus inflation and contingency allowance will be met by the GOP.

Redisbursement of Grant Funds.

A procedure for redisbursement of grant funds from the Implementing Agency (ATDC) to the grant beneficiaries has not yet been finalized. Such a procedural plan will be submitted for AID approval as a condition precedent to initial disbursement of grant funds.

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* A waiver of U. S. source restrictions will be sought for these costs per section IV-C-6.

Financial Rate of Return/Viability

An estimate of project benefits is contained in the Economic Analysis, Section III-C.

Internal Rates of Return will be calculated for each of the various techniques for developing improved food processing technology. Only those techniques assessed as financially viable will be considered for further evaluation. Details of the analysis will be worked out between ATDC and the contractor during contract negotiation.

Table. I

SUMMARY COST ESTIMATE & FINANCIAL PLAN
(US $000)

Source	AID F.X.	AID L.C.	Host Country F.X.	Host Country L.C.	Others F.X.	Others L.C.	Total F.X.	Total L.C.
Contract Services 1/	203	120	-	-	-	-	203	120
Local costs for procurement of prototypes equipment from custom fabricators.	-	138	-	-	-	-	-	138
Commodities 2/ (Imported equipment for designing, testing and fabricating prototype)	35	-	-	-	-	-	35	-
Industrial Ext. Services	-	-	-	30	-	-	-	30
Credit for Innovating Food Processes	-	-	-	40	-	-	-	40
Management costs			-	137.5	-	-		137.5
Sub-total:	238	258	-	207.5	-	-	238	465.5
Inflation 3/	-	-		21.00	-	-	-	21.0
Contingencies	4	65.0	-	6.5	-	-	4	71.5
Total:	242	323 = 565		235.0	-	-	242	558.0 = 800 Grand total

1/ FX- includes 29 MM of technical assistance and international travel costs for world search.
LC - includes studies in Phase I, library search in Phase II, local costs for: a) designing and testing prototype equipment; b) materials for prototype equipment and developing model prototype (20 units), in Phase III (780,000).

2/ $ 35,000 includes procurement of 4 models of sugarcane processing units, 4 models of oilseed processing units and 2 Rice Bran processing units including freight and insurance charges.

3/ See text for calculation of inflation factor in AID-financed costs.

Table II

COSTING OF PROJECT OUTPUTS/INPUTS
(In $000 or equivalent)

Project Paper - Village Level Food Processing
Project #: 391-4170

Project Inputs	Project Outputs #1 Oct. 76-April'77	#2 Oct. 76-July'77	#3 Aug. 77-May'78	#4 June'78-Dec. '79	Total
AID Appropriated					
1. Phase I research studies	34(LC)				34.0
2. Phase II- Commodities		35.0(FX)			85.0
Phase II- Procurement library research		7.0(LC)			
Phase II- International travel cost for world search.		15.0(FX)			
Phase II - Technical assistance		28.0(FX)			
3. Phase III- Local costs for developing, designing and fabricating equipment.			64(LC)		186.0
Phase III- Technical Assistance			122.0(FX)		
4. Phase IV - Procurement of fabricated equipment				134.0(LC)	191.0
Phase IV - Technical Assistane				37.0(FX)	
Phase IV- Studies and reports				20.0(LC)	
Sub-total:					496.0
Contingencies	8.0	12.0	24.0	25.0	69.0
					565.0
Other U.S.	-	-	-	-	-

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Contd.... Table. II

Host Country §	#1	#2	#3	#4	Total
1. Phase I - Management Costs	45.6(L. C.)				45.6
2. Phase II- Management costs		35.5(L. C.)			35.5
3. Phase III- Management costs			35.7		35.7
4. Phase IV- Industrial ext. services				30.0(LC)	91.3
Phase IV - Management costs				21.3(LC)	
Phase IV- Credit costs				40.0(LC)	
Sub-total:					208.0
Inflation 10%					21.0
Contingencies					6.5
Total:					235.0

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IV. Implementation Arrangements

A. Analysis of ATDO's Administrative Arrangements

1. Selection of Host Institution

The Government of Pakistan, in consultation with USAID, has selected the Appropriate Technology Development Organization (ATDO) to assume overall responsibility for planning and implementing this project. The decision was based on the ATDO's special mandate; it was set up in 1974 as a new unit within the Planning Commission and charged with the responsibility of identifying, developing and promoting applications of appropriate technology. In discharging this mandate the ATDO has established working relationships with a host of institutions associated with one or several of the various stages of developing and commercializing appropriate technology. These affiliations include the Pakistan Council for Scientific and Industrial Research; Pakistan Industrial and Technical Advisor Centre; various Provincial Departments of Planning and Development, Agriculture, Forestry, and Industry; Small Industries and Handicraft Corporation; University Engineering Departments; Nationalized Banks; Chambers of Commerce and Agriculture as well as private entrepreneurs. Thus by virtue of its mandate and experience the ATDO is uniquely positioned to bring together all of the elements required for the successful execution of this project. ATDO will guide, monitor and evaluate project implementation.

2. Implementation Responsibilities

The Appropriate Technology Development Organization (ATDO) shall guide, monitor and evaluate all project implementation activities. A prime contractor, selected through a request for proposal procedure, shall assume responsibility for all project implementation activities. ATDO shall authorize the disbursement of project funds in instalments specified in the Project Agreement to the implementing authority, upon verifying that the prime contractor has satisfactorily fulfilled the terms of the agreement in terms of quality, quantity and timeliness of goods produced and services rendered. ATDO shall coordinate its project monitoring and evaluation activities with USAID and shall

authorize the disbursement of project funds upon consultation with USAID and with USAID approval according to procedures set forth in the Project Agreement. To facilitate the execution of these responsibilities ATDO will appoint a project manager whose full time responsibilities will be backstopping this project. He will be assisted by two professionals and necessary clerical staff and have ready access to logistic support as required to perform his duties. Authorization and disbursement procedures shall be clearly stipulated in the project agreement. ATDC's present procedures must be simplified and streamlined to facilitate project implementation. The most serious problem ATDC has experienced to date has been the approval for and disbursement of project development funds. Because the requirements of adequate staffing and responsible financial management are essential to successful project implementation, these issues must be satisfactorily resolved prior to the disbursement of project funds as stipulated in the conditions precedent.

The prime contractor shall be directly or indirectly responsible for all phases of project implementation. It shall be directly responsible for all activities it undertakes to execute itself and shall be indirectly responsible for any project activities carried out under sub-contracting procedures.

B. Analyses of AID's Administrative Arrangements

The project manager shall be responsible for monitoring all project implementation activities. The officer will work closely with the professional project staff in ATDC assigned to this project. Quarterly progress reports prepared by ATDC as part of its project management responsibilities will provide the USAID project manager with the primary project monitoring tool. Contents of the report are described in Section IV. C-2 below. The agricultural engineer in the USAID's Office of Agricultural Policy shall consult with the project manager on technical issues as required. It is anticipated that the project manager will spend 40 percent of his time engaged in monitoring and other project management functions during the first year of the project and perhaps 20 percent of his time thereafter.

C. Implementation Plan

The project will be implemented by the Appropriate Technology Development Organization (ATDO) a special unit recently established with the Planning Commission with an assignment specifically of identifying problems and needs which might be addressed by Intermediate Technology and developing and promoting application of appropriate technology. Using funds provided by the GOP and AID, ATDO will request proposals, select the prime contractor and contract for services required to carry out this project. It will monitor performance, arrange for periodic evaluation and participate along with other members of the joint committee in evaluation and preparation of recommendation, as appropriate, on redirection of the project in subsequent phases.

Following are the major steps :

1. Scheduling

May 3, 1976	Begin contracting procedures.
June 28, 1976	Sign Project Agreement.
Sept. 30, 1976	Execute contract between contractor and the Government of Pakistan.
October 4, 1976	Begin Phase I and Phase II activities.
January 3, 1977	First periodic project evaluation/decisions.
March 14, 1977	Mid-Phase I and Mid-Phase II evaluation/decisions.
May 23, 1977	End Phase I activities.
May 30, 1977	Begin Phase III activities.
August 1, 1977	End Phase II activities.

August 22, 1977	Mid-Phase III evaluation/decisions.
January 2, 1978	Second periodic project evaluation/ decisions.
May 19, 1978	End Phase III activities.
June 19, 1978	Begin Phase IV activities.
January 2, 1979	Third periodic project evaluation/ decisions.
Dec. 31, 1979	End of Project Evaluation/final report.

For full details, see Annex. C, "Project Performance Tracking Network Chart" and Annex. D, "Implementation Plan".

For full details of the relationships and time phasing of all significant project activities, see Annex C "Project Performance Tracking Network Chart". A life of project network and sub-networks provide full details. Annexure D, "Implementation Strategy" summarizes project activities systematically from Phase I through Phase IV. Evaluations are planned for all of the important project milestones; see Section IV-D and Sub-network "F", Annex.C for full details.

2. Arrangements for Monitoring Project Implementation

A project manager and two professional advisors, one engineer and one economist will be appointed by ATDO. Their full time duties will be to guide and monitor project implementation activities by the implementing entity (s) (contractor and sub-contractors). They will be supported by necessary clerical staff, office facilities and logistics funding. All major implementation activities identified in the "Implementation Strategy", Annex. D, will be closely monitored by ATDO. Quarterly progress reports will be prepared and submitted to USAID. The reports will cite activities carried out during the quarter under review, compare these to the schedule of activities set forth in the Performance Tracking Network, assess the overall performance of the contractor and sub-contractors, and make recommendations to USAID if any remedial action is required.

3. Logistic Support

The prime contractor will provide all logistic support including housing, transportation and office facilities required to implement this project. In the event of an American prime contractor, full responsibility for providing all necessary logistic support shall nevertheless remain with the prime contractor. However, this might be arranged through a Pakistani sub-contractor. Explicit provision in the request for proposal procedures will be made to assess contractors' capability to determine and provide logistic support essential to efficient project implementation.

4. Contracting Details

All project implementation activities with the exception of some Phase IV industrial extension services and the provision of credit facilities will be executed on contract. A prime contractor will be selected through a request for proposal procedure. Important selection criteria which the contractor must meet includes: (a) demonstrated technical competency in areas central to the nature of the project, e.g. engineering capabilities; (b) administrative capabilities to coordinate and integrate diverse project activities; and (c) the ability to provide all services called for in the course of project implementation either directly or through sub-contracting or joint venture arrangements. Because of the diversity of activities and skills required, it is anticipated that some combination of Pakistani and American institutions will likely be required to execute all phases of project implementation. Firms submitting bids will be requested to describe how they will carry out each major activity and which partners or collaborating entities, if any, that they expect to work within the course of project implementation.

It is anticipated that a cost plus fixed fee contract will be used which will specify the maximum amount in both dollars and local currency that can be disbursed under this project. No exception to this ceiling will be permitted and the contractor must pledge himself to deliver all goods and services specified in the contract, irrespective of this ceiling.

5. Disbursement of Funds

Upon receiving evidence that all of the Conditions Precedent to disbursement have been satisfactorily met, funds will be disbursed through the mechanisms of a Special Letter of Credit (SLC) for local costs and a Letter of Commitment (L/Comm) for foreign exchange costs.

6. Waiver of U.S. Source Restrictions (Commodities).

Phase II of the project consists of a world wide search for appropriate technology. Prototypes of the most promising candidates for adaptation to Pakistan's needs and environment will be purchased and imported into Pakistan for trial and adaptation as necessary.

Obviously it is not possible to determine now in what country (ies) such commodities will be found, but if the source of prototypes is not the United States, then a waiver of U.S. source restrictions on the purchase of commodities will be required. Since commodities would be purchased from sources other than AID Geographic Code 000 only if that is the best available technology, then a waiver per AID Handbook 15, Chapter 2A 7a(2) seems completely justified. Since there is no anticipation that any transaction for the procurement of commodities will exceed $25,000, the Mission director is prepared to exercise his waiver authority (per AID Handbook 15, Chapter 2A 8d(2) as appropriate. In the unlikely event that a procurement transaction does exceed $25,000, a request for waiver will be made to AID/W at the appropriate time.

D. Evaluation Arrangements

A set of special and routine evaluations will be carried out in the course of project implementation. The timing of these evaluations and their relationship to other project activities are shown in Annex. C, "Project Performance Tracking Network Chart".

The proper execution of these evaluations are crucial to responsible project management, due to the nature of the project. The project intends to determine the feasibility of identifying, developing, producing and disseminating (on a pilot project basis) improved appropriate food processing technology. Thus Phase I research activities will be undertaken to permit an analysis of the technical and economic feasibility of identifying and developing improved appropriate technology. It will define the parameters of present equipment and its efficiency and the technical requirements for alternative degrees of economic advance and for an acceptable benefit/cost ratios. Simultaneously a search of the literature will be initiated. An interim Phase I report will be prepared and it will consider results obtained in the Phase II search of the literature. Based on this interim report a decision will be made whether or not to proceed with the worldwide search and other implementation steps. If the project purpose is deemed technically and economically

feasible, candidate technology will be selected based on the recommendations of the mid-Phase II search of the literature report. These two special evaluations (mid-Phase I and mid-Phase II) are scheduled to be held concurrently in mid-March, 1977. Phase II worldwide search for appropriate technology through on-site inspection will commence only if these evaluations determine that continuation of the project is warranted.

The third evaluation will be a final assessment of the technical and economic feasibility of developing improved food processing technology and will be based on the rigorous analysis contained in the end of Phase I report. At this time an evaluation of the capabilities of currently used sugar cane and oilseed equipment manufacturers will be made. Specifications and standards for improvement will be established. This evaluation will guide the definition of industrial extension strategy and identify firms with potential for producing improved equipment during Phase IV.

Two special evaluations will be carried out in Phase III. The mid-phase evaluation (August, 1977) will select the prototype equipment and food processing techniques which will receive priority attention. Candidate technology will be adapted and improved as necessary for use and manufacture in Pakistan. The end of Phase III evaluation will be held in June 1978 to determine the precise industrial extension strategy to be pursued in Phase IV, select the industrial extension entity (s) and define their extension responsibilities.

The final special evaluation will be held at the end of the project (December, 1979). The evaluation will assess the suitability of the improved technology that has been developed in the course of project implementation applying efficiency and equity criteria. The need for further special public support to achieve these objectives of wide-spread adaptation of appropriate improved food processing technology will also be assessed.

The purpose of each of the special evaluations is to :

1. determine whether project implementation should proceed based on information and analyses to be generated in the course of project implementation; and

2. guide follow-on project or post project activities.

Three regular evaluations will also be carried out in the course of project implementation. These evaluations will be held in January, 1977, January, 1978 and January, 1979. During these evaluations the performance of the contractor and sub-contractor (s) will be reviewed with respect to the quality and timeliness of services rendered. Actual project implementation progress will be compared with the planned performance tracking network. The performance of USAID and the Appropriate Technology Development Organization (ATDC) in monitoring project implementation will also be reviewed. Finally, ATDC's management performance will be reviewed particularly with respect to timely and proper disbursement of funds.

All of the evaluations described above shall be carried out by the joint Government of Pakistan - USAID Village Level Food Processing Project Committee. Reports and other special documents required to conduct the evaluations shall be circulated by the Chairman of joint committee one week in advance of the scheduled evaluation. The evaluations will be held on the dates appearing in the planned Performance Tracking Network unless rescheduled by mutual agreement of the Head of ATDC and the Project Chairman, USAID. Findings and recommendations will appear in the official minutes of these meetings. The Chairman of the joint committee, as the senior Government of Pakistan official responsible for this project, will be responsible for insuring that all recommendations are carried out to the fullest extent possible.

E. Conditions, Covenants, and Negotiating Status

The following project specific conditions precedent and covenants will apply to this grant unless AID otherwise agrees in writing :

1. Conditions Precedent to the Initial Disbursement of Funds:

a) The Grantee shall establish a position for and recruit a qualified project manager who will be assigned full time to this project. In addition adequate clerical support and office facilities will be available and a schedule for bringing the two other professional people on board will be established in accordance with project needs.

b) The Grantee shall provide a procedure, satisfactory to AID, covering the disbursement by ATDO of the funds provided in the grant.

c) The Grantee shall enter into a contract with a suitable organization to provide basic implementing services to the project, as mutually agreed to by the Borrower and AID.

2. Special Covenants :

a) The Grantee shall establish a joint GOP and AID Project Implementation and Evaluation Committee to evaluate project progress and problems. The Committee will hold special evaluations as described in the Section IV-D, "Evaluation Arrangements" of the Project Paper. In addition the Committee will hold regular annual evaluations beginning on the First Monday in 1977 and continuing through the life of the project.

b) The Grantee insures that adequate Rupee funds required for the project's timely and effective execution will be made available promptly as needed.

USAID and ATDC have identified the need for the above special conditions precedent and covenants and ATDO has agreed to pursue these matters with the Government so as to insure that timely consideration is given to each point. As of this time, USAID foresees no significant problems in negotiating a project agreement which includes the above points.

ANNEXES

PROJECT PAPER

VILLAGE LEVEL FOOD PROCESSING

USAID/ISLAMABAD
MAY, 1976

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ANNEX. A

AID/WASHINGTON CABLE APPROVING PRP

CABLE NUMBER: STATE 008519/1/2

SUBJECT: Village Level Food Processing Technology-FY 77-PRP

1. SUMMARY: The Asia Bureau Project Advisory Committee approved the subject PRP on December 5, 1975. In preparing the PP, the Mission should address the points raised below :

2. Casual relationship between purpose and project goal: The project goal addresses both employment and income, as well increased yields of sugar and oil. Experience in Pakistan as well as elsewhere indicates potential for increasing extraction rates. Experience also indicates that increased yield is in the first instance primarily a function of increased pressure, which in turn, is a function of increased power and strength of equipment. This implies a quantum increase in the scale of investment and operations, and points toward less on-farm and small-scale processing activity. For example, in India moving up from a two-to-three roller-cane crushing operation generally implies moving up from bullock power to electric or diesel power, and increasing the scale of operations from the small-farm level to handling crushing needs for two or three villages. The PP should explicity examine this experience in terms of the Pakistani situation, projecting and quantifying relationships and likely changes in cropping patterns, raw and finished product prices, on-farm and village employment and income, in terms of increments of expanded scale and investment. The PP must demonstrate that the intended rural population can and will most likely benefit from improved technology, and to set more precise criteria for the exploration/development of technology. A separate memo follows that more explicity lays out the basis of our concerns in this area.

3. Important assumptions relating project purpose to goal achievement that need to be addressed in PP preparation :

(A) Price relationship are such that improved technological co-efficients vis processing oilseeds and sugar cane are sufficiently attractive that small farmers will want to acquire the new technology.

(B) Small farmers will have access to capital (institutional or private) that will enable them to invest in improved technology.

(C) Manufacturers will respond to the demand for improved processing units.

(D) On-farm processing technological improvements will be neutral to scale of operating enterprise.

4. Institutional home for the project: We are concerned with the tentative choice of the Appropriate Technology Development Cell, particularly in light of PARC experience. Therefore, we suggest that other alternatives be considered as well in preparation of the PP. The intimate relationship with agriculture at the local level suggests the possible desirability of implementing the project through Lyallpur University and/or other institutions within the agricultural research framework that might not have to go through the start-up pangs a new office would have.

5. Contract Management :

(A) Handbook 14 (AIDPR) provides that contracting and sub-contracting shall be with U.S. firms and universities, except that necessary procurement from other than U. S. sources may be accomplished with source/origin waiver per sub-part 7-6-51 AIDPR based on strong Mission written justification.

(B) Nature of sub-contracting appears to be essentially unknown at this time. Any scope not anticipated before institution of prime contract and added later, whether for performance by prime or sub, is new procurement and must meet same conditions and be subject to same procedure as original procurement. Therefore, we suggest as many details for contracting be estimated as possible so that they can be included in initial prime contract.

6. General comments/suggestions on project implementation for your consideration. (Page 17)

(A) We suggest phase 1 and 11 might well be done at the same time.

(B) Cost estimates likely high on Phase 1 and 11, but low on Phase 111.

(C) Relationship between Phase IV (establishing manufacturing capability) and project purpose. Does the envisioned phase IV go beyond the explicit project purpose?

(D) Achievement of Phase 1V would seem to call for considerable more resources than budgeted. Are budget resources sufficient?

7. PP must also treat :

(A) The role of women as they impact on the project design and management directly and as the project is likely to affect them.

(B) Environmental effects of project.

(C) Social implication beyond employment/income considerations.

8. Project Development :

(A) We have asked USDA to begin a search for relevant information regarding small-scale processing technology.

(B) Page 23-PRP: Available direct-hire staff has not been identified for requested TDY assistance. Please submit PIC/T for project development assistance. We plan obtain technical services and PP preparation assistance IQC contractors and/or USDA.

ANNEX. B

TECHNICAL FEASIBILITY

Sugar Processing Technology*

1. Description of Existing Village Cane Processing Technology

The most prevalent village sugar cane extraction technology is the three-roller crusher (or mill). The equipment is typically bullock powered, has a crushing capacity variously estimated at 150 to 500 pounds of cane per hour and is capable of extracting up to 70 percent of the total available sucrose from the cane. Table-I summarizes some estimates of the performance parameters of the three-roller crusher. The wide range of estimates is explained by the fact that: (1) different models of equipment are being compared; and (2) that field survey estimates of performance standards characterizing on farm use are compared with research station performance test results. These estimates of extraction rates and crushing capacity should be regarded as illustrative of the range of performance of the traditional three roller crusher in operation today; actual design and on-farm performance parameters must be estimated much more precisely during Phase 1 research.

Once the juice is extracted, it is placed in an evaporator where most of the water is driven off while various refining procedures are carried out depending on the final product desired. Gur, a dark brown largely unrefined sugar product, is composed of crystalline sugar, mother of liquor, molasses and relatively high percentages of inverted sugars, moisture and impurities. Shakker, a light brown powdery product, is produced by various purification operations which may include filtration, neutralization and the addition of chemical or vegetable clarificants to the juice while it is being boiled down in the evaporator. The operations generally improve the quality of the final product by removing impurities but result in lower sugar recovery rates. (One study estimates that the difference in the weights of the final products is approximately 10%(1).) Desi (local) sugar, a semi-white crystalline product is produced to a lesser extent. Cane juice is boiled down to a thick syrup (rab) in the ovaporator and then placed in a large drum for approximately 10 days to permit crystallization to occur. Then the "rab" is placed in a small centrifuge, usually hand powered, which separates the crystalline sugar from a molasses concentrate. The desi sugar that is produced weights only about half as much as the gur that could have been produced (1).

* Footnotes in this section are keyed to a numbered bibliography appearing at the end of this section.

TABLE 1

Estimates of Performance Standards of Village Cane Crushers

Source	Juice extraction expressed as % of cane weight	% or total available sucrose extracted	Crushing capacity
	%	%	Lbs cane per hour
Board of Economic Enquiry Study	55-65		
Informal Mission Spot Check	56-63 (Ave. =60	57-74 (Ave. =70)	
Sir Wm. Robert's Estimates for 5 different models			
Nahan Sultan	56-65		200-330
Batala	53-60		200-300
Elephant	51-56		150-165
Chattanooga #122	59-65		250-500
Chattanooga #112	53-60		250-305
M. K. Garg Study (Indian data)	55-60	67-68	
ITDG Report to Planning Commission	55-70	55-70	150-400

2. Choice of Technology

It is obvious from the description above that a variety of sugar products can be produced; product definition is a function of the extent to which the juice is refined or processed. Figure-1 shows schematically the operations associated with producing a range of sugar products from liquid sugar to refined white crystalline sugar. A range of technical alternatives is available for most of these refining operations. Sugar losses occur at every stage of refinement; the extent of the losses depends on the nature of the technology employed. Thus the choice of refining technology employed dictates not only the sugar recovery rate but the type of sugar product obtained.

Sugar production involves four distinct operations: (1) crop production (cane or beet); (2) preparation of the crop for processing; (3) extraction of the sugar bearing juice; and (4) refining the juice. (As we have seen, the techniques selected determines the final sugar product and by-products produced.) Figure-II deserves careful attention. It shows that various technical alternatives are associated with each of these operations and that the efficiency of each of the alternatives is a function of physical variables. The technical alternatives selected will depend on their social, economic and technical suitability for village operation and as well as the final product desired.

3. Technical Feasibility of Improving Tradion Sugar Cane Processing Technology

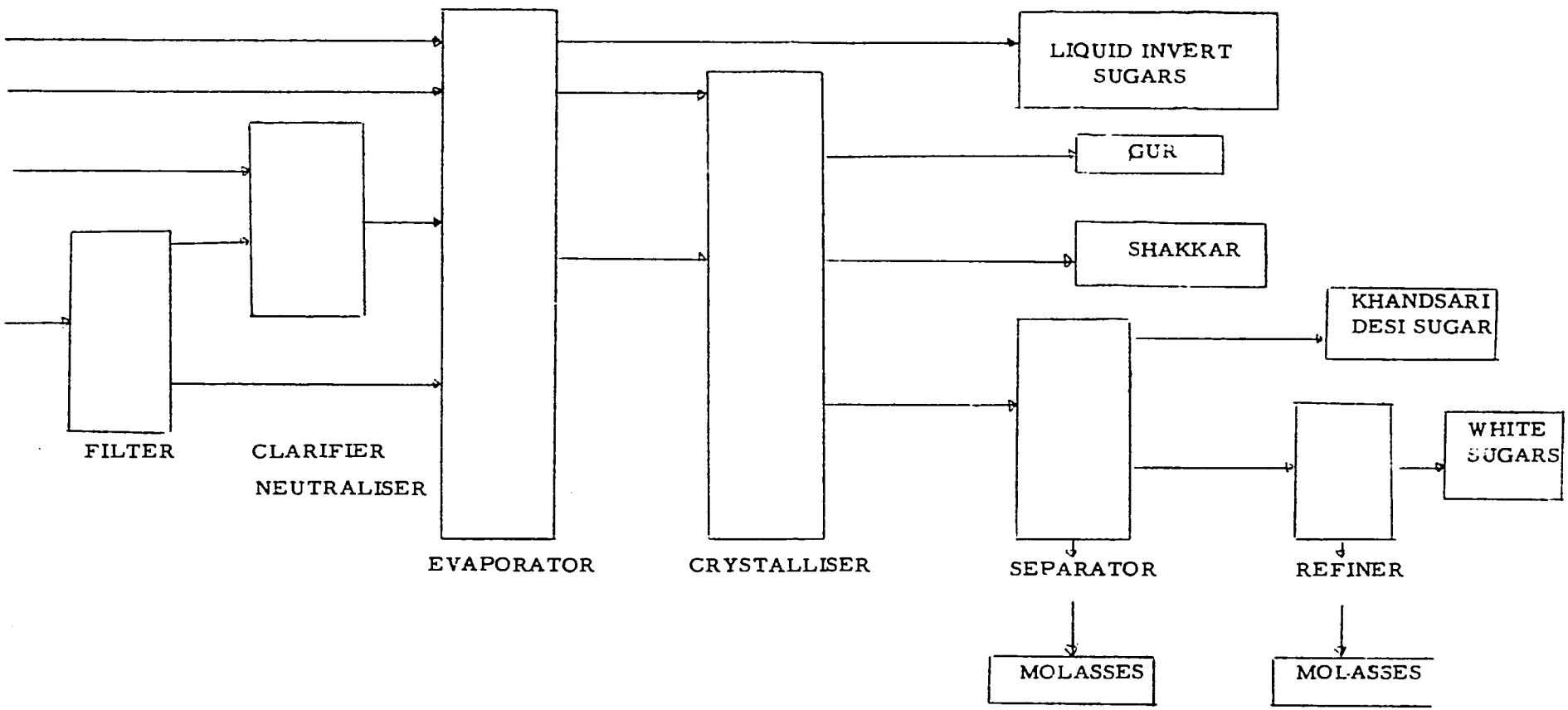
The scale of technology associated with producing gur, shakker and desi sugar is very small; most processors are individual small farmers who process part or all of their cane crop into one or several of these products. Outlined below is a range of technologies that must be evaluated to determine the technology best suited to improving village sugar production technology. Improvements are defined as (1) increased recovery rates of sugar products and by-products; (2) increased processing capacity; (3) increased purity of final sugar product; and (4) production or increases in production of by-products.

a. Operation: Crop Production

It is beyond the scope of this project to address the goal of increased sugar production through increased crop production. Considerable research has already been carried out in this area. Recent reports by Irvine(2) and the FAO(3) contain policy recommendations for increasing sugar production through increased crop yields. Although this project focuses on developing improved processing technology, this does not imply that the net benefits of a "processing strategy" are higher than a "crop production strategy". This question is beyond the purview of the project. It should be noted however, that crop production strategy aimed at increasing sucrose availability per ton of cane depends on incentives which may depend on policy and processing strategy.

FIGURE I

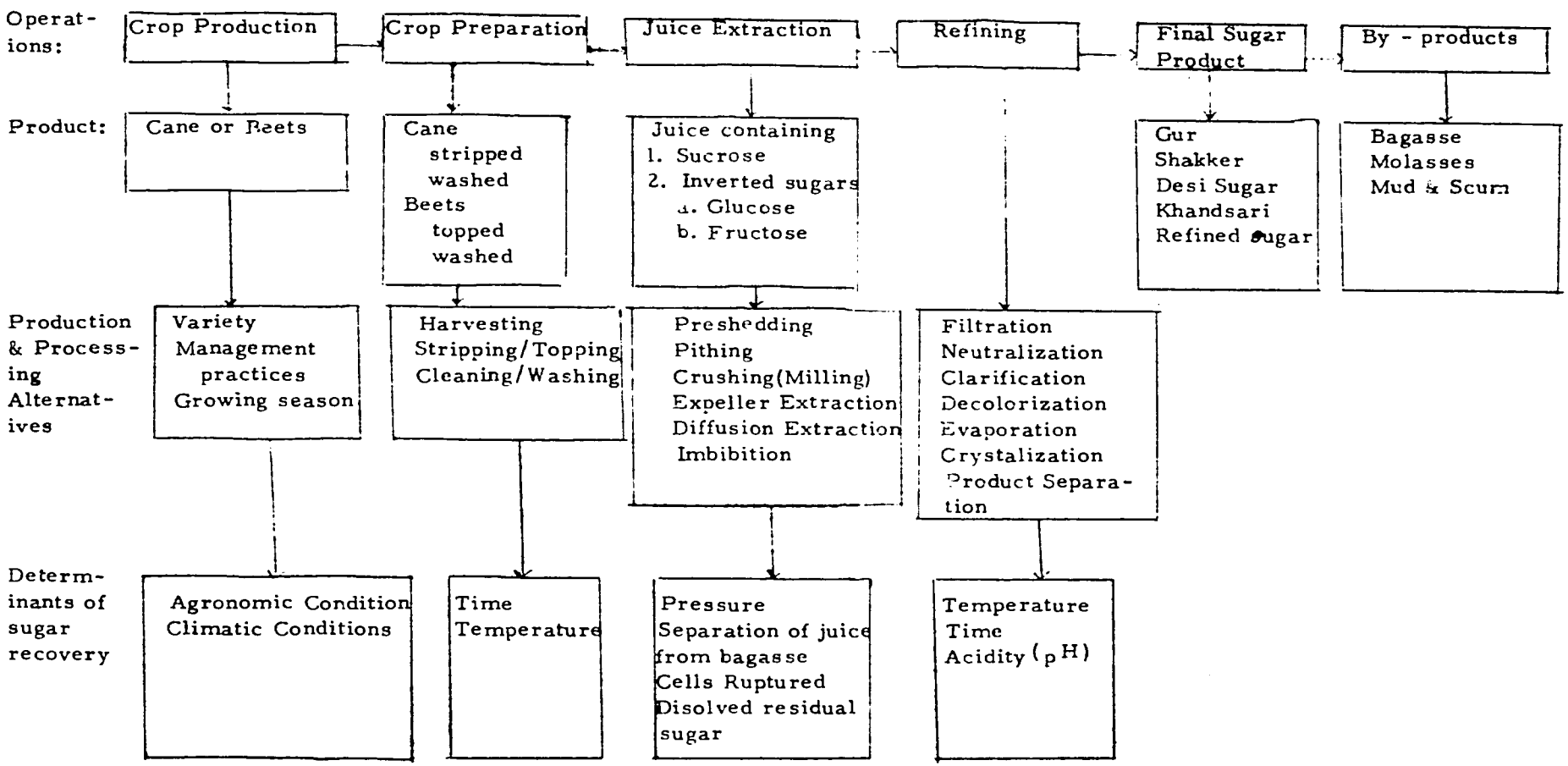
REFINING OPERATIONS AND PRODUCT SCECTRUM



Source: Adapted from Techno-Economic Feasibility Report on Mini-Plants in Pakistan, Fig. 53, Page 88.

Figure - II

Determinants of Sugar Production, Recovery and Product Definition



b. Operation: Crop Preparation

Sugarcane is cut, topped and stripped before being processed regardless of the scale of processing technology employed. Sugar beets are topped and washed. Large scale mill processing sometimes adds an additional step of washing the cane; it is estimated that washing res lts in a loss of approximately 1.1/2% of the available sucrose(4). Although this loss (which is associated with large scale milling) is not significant, small scale processors do enjoy two other important advantages: (1) greater latitude in determining when to process their crop; (2) on-farn or in-village processing resulting in minimal transportation and usually same day processing of cut cane. There is an optimal season in which to process cane. Early in the season the cane's sucrose content is still increasing, beyond the optimal harvesting period the recoverable sugar content drops due to the inversion of sucrose. The rate of inversion is a function of time and temperature; the hot weather of late season harvesting and processing lowers the recoverable sugar content of the cane. The process of inversion is greatly accelerated once the cane is cut. Long periods (days) between harvesting and processing and high temperatures produce significant inversion losses. In Pakistan, where mill processing often occurs several days after harvest, these losses are believed to be high. Given the transportation network in Pakistan and the present pattern of delayed milling together with the sub-optimal early and late season processing pattern of large mills, it appears that small scale village processing will continue to enjoy the advantage of operating on cane with appreciably higher recoverable sucrose content than th large industrial mills.

c. Operation: Juice/Sugar Extraction

The extraction rate of juice from cane and beets is a function of:

A. Pressure applied

B. Length of time which pressure is applied

C. The percentage of sugar storage cells ruptured before or during extraction, the latter is largely a function of A and B.

D. Physical separation of juice from bagasse (or pulp) after crushing.

E. The extent to which residual sugars are disolved and extracted after initial separation of juice and bagasse.

Various technical alternatives exist for applying some or all of these principles with increased effectiveness.

(1) Milling

The traditional village cane crusher described above is a simple three-roller mill. Opportunities for increasing its extraction efficiency exist from improved equipment design, maintenance and operation. The Intermediate Technology Development Group (ITDG) Report to the Government (4, p.108) suggests that attention should be given to the loose and poorly fitting axle bearings, the rough castings, the flimsy and loose fixing plates and the poor or rudimentary bearing designs. Other improvements may be considered including increasing the power input. Numerous motor powered village mills exists; most designs significantly increase the crushing capacity but only marginally improve the extraction rate. With a given power supply a trade off clearly exists between increasing the capacity and increasing the extraction rate. Factors "A" "B", and to a lesser extent "D" are related to the power input. The relationship of power input to juice output (power-extraction rate relationship) is nonlinear; power requirements rise rapidly as the extraction rate increases. Moving from bullock to motor power crushers has technical and economic implications that must be carefully assessed in view of the project objective of developing improved village processing technology with wide range applications (geographic and income).

(2) Expeller Extraction

The screw press or expeller has found commercial application in large scale mills producing refined sugar. Extraction rates of 97-98% of the available sugar are reported by equipment manufacturers. Work by Garg and others in India has produced intermediate technology (for Khandsari production units) which achieves extraction rates of 85 to 90% of the available sugar (4, pp 93&111, & 5) with a crushing capacity of 1.25 to 2.5 tons per hour. Power requirements are 60 to 80 HP for the larger unit. It is reported that only minor modifications on existing oilseed expellers are necessary to apply this technology to sugar cane juice extraction. Research and development work supported by the Appropriate Technology Development Organization, GOP, and USAID suggests that the expeller principle shows some promise for small scale applications as well. Extraction rates of up to 85% were achieved with a one HP unit. However significant work remains to be done to bring this technology up to project standards. Nevertheless it merits careful consideration.

(3) Preshredding

Large sugar mills use equipment to preshred the cane before it is milled. Based on the technical and economic feasibility of developing a bullock powered shredder, the ITDG identified this technology as very promising (4, p.109) for improving village-level technology extraction rates. Considering the severe constraints associated with introducing motor powered equipment, developing improved cane crushers for operation in tandem with a bullock powered cane shredders deserves high priority attention.

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(4) Pithing

Some work has been done on developing technology for removing the hard, fiberous outer shell of the cane, thus separating it from the solf, sugar bearing pith. Research supported by the Canadian International Development Agency in the Carribean and elsewhere and work in Mauritius deserves investigations. If the power requirements of shredding cane exceed feasible design capabilities of bullock powered equipment, pithing the cane might serve as a less power demanding operation for achieving the same objective of delivering cane to a bullock powered crusher in a form which modest power inputs could extract an appreciably higher percentage of the available sugar.

(5) Diffusion Extraction

Large mills processing beets and to an increasing extent cane, employ diffusion extraction technology. The beets or cane are preshredded, then placed in a bath of preheated water which dissolves and removes up to 97% of the available sugar. The pulp or bagasse is then pressed to extract the diluted sugar juice solution. The ITDG Mission recommended small scale applications of this technology suitable for village-level operation be investigated for both cane and beet processing (4, pp.109, 110 & 138, 139). The low power extraction requirements is the most important of the several advantages cited.

(6) Imbibition

A standard processing procedure in large sugar mills is flushing out residual sugar remaining on the ruptured cell walls following the second, third.....n^{th} milling of the cane. This principle might be applied to village processing if extraction equipment capable of significantly lowering residual juice content of cane is introduced. Improved cane crushers, multi-pass crushing or the introduction of expellers are some of the innovation that might reduce the residual juice content of bagasse to levels where small scale imbibition technology might prove technically feasible and economically attractive. However, for the small mills additional evaporation required may introduce an unacceptable increase in fuel or labor cost.

d. Operation: Refining

Refining operations transform the extracted juice into a final sugar product. A range of products and by-products is possible depending on the technology employed. See Figure-1 for a review of refining procedures associated with producing liquid, brown off-white and refined white crystalline sugars. The purpose of refining is to remove impurities and thus improve the "quality" of the final product. Quality is used here in the limited sense of consumer preference. Refined sugars are generally preferred over unrefined or semi-refined sugars. However, in villages and among the urban poor, gur, shakker, and desi sugar are

traditional products which are widely accepted and used, if not preferred. From a nutritional point of view, gur is comparable or superior in quality to refined sugars. Although it contains a relatively high percentage of inverted sugar in the form of glucose and fructose, these are nutritious sweetening agents.

Refining operations generally improve the purity of the final sugar product but tend to increase costs and lower the sugar recovery rate. Thus a trade-off exists between operating costs, sugar quality and quantity. More sophisticated refining techniques minimize these losses but generally are associated with large scale sugar mills. Thus the refining techniques associated with gur production compare very favorable with refining operations in large scale mills in terms of minimizing sugar losses. (Inverted sugars produced during gur production are regarded here as sugar). The advantage of large scale mills in terms of sugar recovery are associated with higher extraction rate; but it will be recalled that these gains are offset in part by sugar losses arising from processing cane during the sub-optimal periods of the early and late processing season and from losses occuring between cutting and delayed processing. These latter factors result in inverting sucrose; the inverted sugars will not crystallize out during refining. Thus they are "lost" in so far as the refined product is concerned and end up in the molasses rather than appearing as white crystalline sugar. Estimates for Pakistan of the final product recovery rates suggest that 100 pounds of cane will produce about 10 pounds of gur but only 8.1 to 8.5 pounds of white refined sugar. (1, 4, p 93)

This project will evaluate the feasibility of improving the final sugar product by broadening its market acceptance and shelf life as well as increasing recovery rates. A total of seven possible steps may be carried out: filtration; neutralization; clarification; decolorization; evaporation; and crystalization and product separation. A range of technical alternatives involving different scales of operation exists for most of these steps. The purity of the final product and the quantity refined from the juice are functions of temperature, time and acidity. All refining procedures involve evaporating of most of the water from the juice. But heat inverts sucrose to glucose and fructose. The quantity inverted is specified by:

$i = cs_o t$ Where i = invert sugar
s_o = initial sucrose concentration
t = time
c = inversion constant

But the inversion constant increases rapidly with temperature. For example:

c = .115 at 50 °C
c = 3.333 at 90 °C
c = 8.922 at 100 °C

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Inversion of sucrose in large scale operation is minimized by evaporating the juice at low temperatures using vacuum apparatus. Open pan evaporators used in gur production bring the temperature of the juice up to 115 °C and consequently 10% or more of the sucrose is inverted in the process. (4, p. 83, 84&94). Given the scale of technology associated with vacuum pan evaporation and crystalization, there appears to be little hope of applying this technique to small or intermediate scale processing operations.

Neutralizing the juice during evaporation operations may cut inversion of sucrose by as much as 50% thus improving the quality of the final product considerably. A variety of chemical and vegetable extract clarificants can be used. Gains in product quality may be offset by lower final product recovery rates. Recovery rates for shakker, a semi-refined brown sugar, average as much as 10% less than for gur according to a recent survey carried out in the Punjab (1, p. 216)

In the course of project implementation the full range of technical alternatives associated with each of the seven refining steps will be evaluated and the alternatives most suited to village-level processing in Pakistan will be adapted as required for village use. In addition to improving sugar production technology there is the potential for producing by-products. Improved furnace and evaporator designs offer the prospects of improving the efficiency of fuel consumption (saving bagasse may produce surplus fuel for home consumption or sale). Molasses, mud and scum are by-products of Khandsari plant operation (an intermediate technology between farm level gur, shakker and desi sugar production on the one hand and large scale sugar mills). Cottage and small scale industry based on these by-products is plausible (although outside the purview of this project) but probable only if Pakistan elects to pursue a strategy of promoting intermediate sugarcane processing technology, i.e., khandsari units. For a fuller discussion of the technical and economic feasibility of Khandsari units, see Garg(5) and Baron(6); the ITDG Report(4) summarizes these reports and applies these conclusions to Pakistan.

The ITDG Mission Report, Techno-Economic Feasibility Report on Mini-Plants in Pakistan, Chapter II, "Sugar Processing" has been extensively referenced in this section. For a more detailed discussion of the technical feasibility issues associated with (1) improving village-level sugar processing technology; (2) Khandsari sugar mills; and (3) production and utilization of by-products, refer to this report in full. An abridged copy containing sections cited in this report has been sent to AID/W, AID/Technical Resources Rural Development.

Brassica Oilseed Processing Technology

1. Description of Existing Technology

Kohlus or ghanis are the traditional technology employed in village-level processing of edible oils. The traditional kohlu consists of a wooden mortar in which a long wooden pestle rotates, powered by a bullock which is yoked to an extension attached to the pestle and driven around the

stationary mortar. The traditional kohlu has been improved by shodding the critical parts with steel; other improved models are constructed completely of steel. These improved models are often powered by motors. Another improvement has been to make the mortar rotary, moving counter to the direction of the pestle's movement and powered by a motor.

No research on the characteristic and performance of the village edible oil processing sector has ever been carried out in Pakistan although "informed" guesses have often been made in the course of edible oil studies (7, 8, 9). Traditional kohlus are made in the villages and consequently the capacity and extraction rates vary considerably. Estimates of the residual oil range from 9% to 16%, i.e. 9% to 16% of the weight of the pressed cake is residual oil. Kohlus also differ in size, but typically processing capacity is estimated at 80 to 120 pounds of seed per day. The improved kohlus are believed to operate in the upper end of this spectrum of estimates leaving only 9% to 11% oil in cake and having a processing capacity of around 120 lbs of seed per day. The above guestimates apply exclusively to rape and mustard seed processing; there is no information on kohlu processing of cottonseed (the major source of domestically produced edible oil) or minor oilseed crops.

Low pressure ("Lahore") expellers represent an intermediate oilseed processing technology that is widely employed in Pakistan (intermediate in scale between kohlus and large high pressure or industrial solvent plants). The installed capacity of low pressure expellers is estimated, (9) to be more than sufficient to process the total edible oilseed production. The solvent extraction plants grossly under utilize their installed capacity of 519,000 tons per year, due to the present incentive structure. In 1974-75, only 6 plants operated processing 56,000 tons of cottonseed as well as some cottonseed and rape and mustard seek cake. Thus, in terms of processing capacity, both designed and utilized, Lahore expellers are by far the most important edible oil processing technology.

Installed capacity of Lahore expellers is widely dispersed although there is a significant concentration of plants in the large cities of Karachi, Lahore, Hyderabad, and Rawalpindi. The balance of the capacity is scattered widely throughout provincial towns, but due to the power requirements very few units are located in small villages.

The capacity and extraction rates of Lahore expellers vary with size, make, maintenance, and skills of the operator. All are manufactured in Pakistan. Designed capacity of Lahore expellers ranges from 1 1/2 tons to about 15 tons per day but the most prevalent size is a unit with rated processing capacity of 7 1/2 tons of cottonseed per day. Operators claim these machines will actually handle 5 to 6 tons of cottonseed or 2 1/2 to 3 tons of rape or mustard seed per day(8, p.5). The difference in extraction rates between cotton and brassicas is due to their intrinsic qualities; cottonseed extracts about twice as fast as brassicas to the same residual oil content. Residual oil ranges between 6 and 10% of the cake weight with double or triple pressing, depending on the condition of the expeller, (8, p.4). Brian points out that the expeller (like the

66

solvent extractor) is a constant volume device, its capacity relates proportionally to the extraction rate of the seed processed(8, p.14). Thus there is a direct trade off between throughput and the extraction rate. The actual level of throughput and extraction rate is a matter of economics. Brian summarizes the problem very well(8, p.7):

> An extraction device, whether kohlu, expeller, or solvent extractor removes oil according to the capacity it is operated at. It is common practice for any operator of such a device to operate it at higher capacity when seed prices are low. The added throughput of a cheaper seed material will offset the loss of revenue from the higher oil content of the meal..... In oilseed processing the flexibility of the processing plants capability for added throughput at an "expense" of higher oil residual is normally used to its fullest economic return extent.

2. Opportunities for Developing Improved Extraction Technology

Extraction rates are a function of:

1. The condition and characteristics of the oil bearing material.
2. Pressure (in the expeller process)
3. Time
4. Soluability of oil and permeability of oil bearing material. (in the solvent extraction processes.)

The first variable suggests that extraction rates may be increased by treating the oilseeds in advance of the oil extraction process. Seeds may be conditioned with heat and/or moisture; the process coagulates the proteins and causes the oil present to coalesce, making it more readily available for removal(8, p.3). Mechanical conditioning may also increase extraction rates where the oil bearing portion of the seed is protected by a hard shell as in the case with the cotton seed hull. The relationship of e extraction rates to power requirements is exponential; as the level of residual oil in the cake drops the power requirements for extraction rise dramatically(8, p.9-13).

Opportunities for improving the kohlu need to be carefully assessed during Phase I feasibility studies. Improvements in the material used (steel), power source, (motor power) and mode of operation (rotary base) have been introduced in the past. Informed guesses suggest that extraction rates have improved little although the capacity has increased 50%. Given the discussion above we recognize that the extraction rates could have been improved if the throughput of material were held constant but the present economics dictate high volume processing. An improved bullock powered kohlu (Wardha kohlu) with standardized parts was developed in India. A report on this innovation claims that the extraction rate was improved from 15% or 16% residual oil on mustard cake

to 11.2% (10, p.9). If it does not appear to be technicall and economically feasible to substantially improve the performance of the kohlu, other alternatives should be assessed.

One alternative would be to focus on intermediate technology as opposed to village-level processing. Under this strategy an improvement and/or replacement for the low pressure expeller would be the goal. Improvements in the design and/or materials used could conceivably improve the performance standards of the Lahore expeller. Alternatively operators might be trained to operate and maintain their equipment more efficiently; however, as the Lahore expeller industry is large, market oriented and competitive it is difficult to imagine potential for significant improvements here without significant technical breakthroughs. Alternatively, a better expeller could be developed. A more radical solution could be the development of intermediate scale solvent extraction units. While technically feasible, the economics of such a development and the technical problems associated with maintenance and operation suggest that operating such equipment outside the large towns might be difficult. The ITDG Mission weighed this alternative but was not optimistic about small scale applications of this technology (4, p.175).

Rice Bran Processing

Another important potential source of edible oil is rice bran. The oil content of rice bran produced in Pakistan is estimated at 6 to 12%. About 4.0 million tons of paddy are produced annually which yield about 280,000 tons of rice bran per year (assuming a 7% yield of bran on paddy). Presently this bran is discarded as waste or used as feed. The problem in recovering this oil is associated with a very active enzyme lipase, which coverts oil to free fatty acids within a very short time after the paddy is processed. The rate at which this chemical reaction takes place is a function of the moisture content of the bran, temperature, and time. Within 24 hours the free fatty acid content rises to levels that make it uneconomical to reclaim the remaining edible oil. Two potential solutions exist. One is to develop intermediate technology that can operate economically at levels of very low volume processing. Rice bran oil could then be extracted at rice mills immediately upon processing of the paddy. Because of the low volume of rice bran produced daily at individual rice mills, this alternative requires the development of very small scale oil extraction equipment that can be operated economically. Alternative, the rice bran could be stabilized by deactivating the enzyme which converts the oil to free fatty acids. A simple, two step process is required:

1. The rice bran is heated very quickly to 100 °C and held at this temperature for 2 to 3 minutes meanwhile being constantly agitated.

2. The bran is allowed to cool and then gentle heat is applied to reduce the moisture content to around 5 percent.

Bran treated this way is stable, although not indefinitely. Once stablized, the rice bran can be transported to centrally located plants for processing. Existing solvent extraction plants could be used although expression technologies are also applicable. Aside from the technical feasibility issues which must be resolved, two other issues must be addressed:

1. The price of the final product would have to be at levels that made extraction profitable (unless the Government is prepared to subsidize production).

2. It must be determined whether rice bran oil is acceptable to the Pakistani consumer in its unrefined form (unless exports are envisioned or refinement is undertaken to deoderize the oil and neutralize its taste and/or blend it into ghee or other edible oil commodities).

Appropriateness of Technology

The intent of this project is to identify, develop, produce and ultimately disseminate technology appropriate to Pakistan's resource endowment. Phase IV analysis will address the question of choice of technology among the alternatives of:

A. Village-level or small scale processing technology.

B. Intermediate processing technology.

C. Large scale, industrial processing technology.

Although the evidence presently available is not definitive, it clearly suggests the advantage of pursuing a smal scale sugar processing strategy. Less evidence is available for making the choice among the range of technologies available for edible oil processing. The project is designed to generate data and carry out research during the initial phase of project implementation which will guide the selection and adaptation criteria to be applied in developing improved processing technology.

The acceptability of the new technology to the target population of small scale processors will be a function of:

1. The profitability of the innovations: Profits must be commensurate with the risks associated with adopting new technology. The profitability of the new technology will be extremely sensitive to the Government's price policy. We assume here that historical price relationships will not deteriorate.

2. The cost of the new technology relative to the target populations resource base and access to credit. Even if the new technology promises to be significantly more profitable than existing technology limited resources may make credit on important constraint to adoption.

3. The similarity of the improved technology to existing technology will affect the rate of adoption. Significant departures from traditional practices will inhibit processors' acceptance of the new technology.

4. The more compatible the new technology is with processors' total operations the more acceptable it will be to them. Innovations that eliminate useful by-products, impose extraordinary labor or draft power requirements, or necessitate new social organizations to undertake traditional food processing tasks will be more difficult to sell.

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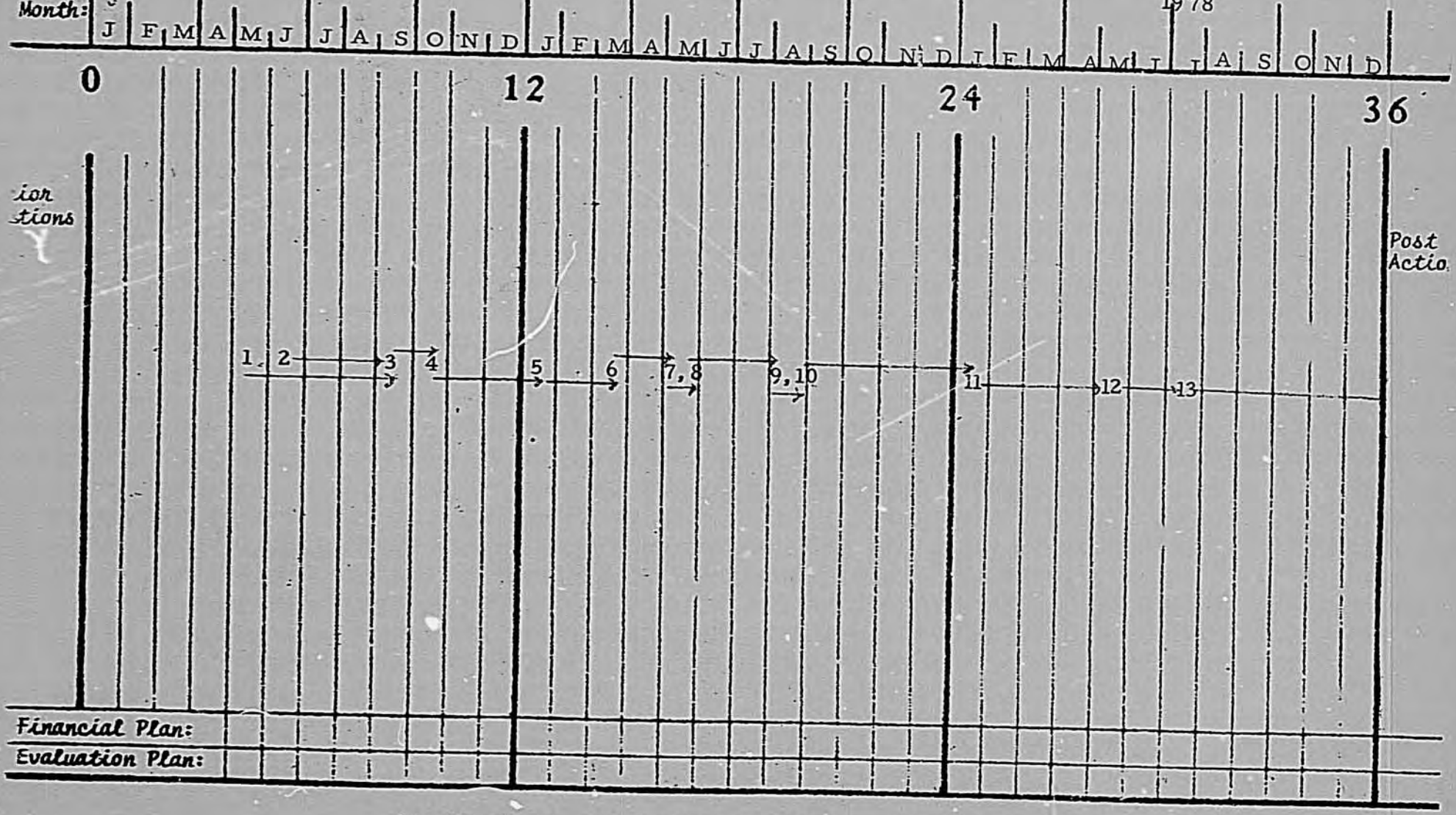
*Numbers are keyed to footnotes appearing in the preceding Technical Feasibility Section.

PPT M
(May be Expanded as Approp iate).

Annex. C

Country:	Project No:	Project Title:	Date:	/ / Original / / Revision #	PPT appr
Pakistan	391-4170	Village Level Food Processing			



PROJECT PERFORMANCE NETWORK

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PPT M
(May be Expanded as Approp iate)

Country:	Project No:	Project Title:	Date:	/ / Original / / ~~Revision #~~	PPT appr
Pakistan	391-4170	Village Level Food Processing			

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Financial Plan:

Evaluation Plan:

PROJECT PERFORMANCE NETWORK

Country:	Project No:	Project Title:	Date:	/ / Original / / Revision #	Apprvd:
Pakistan	391-4170	Village Level Food Processing			

CPI DESCRIPTION

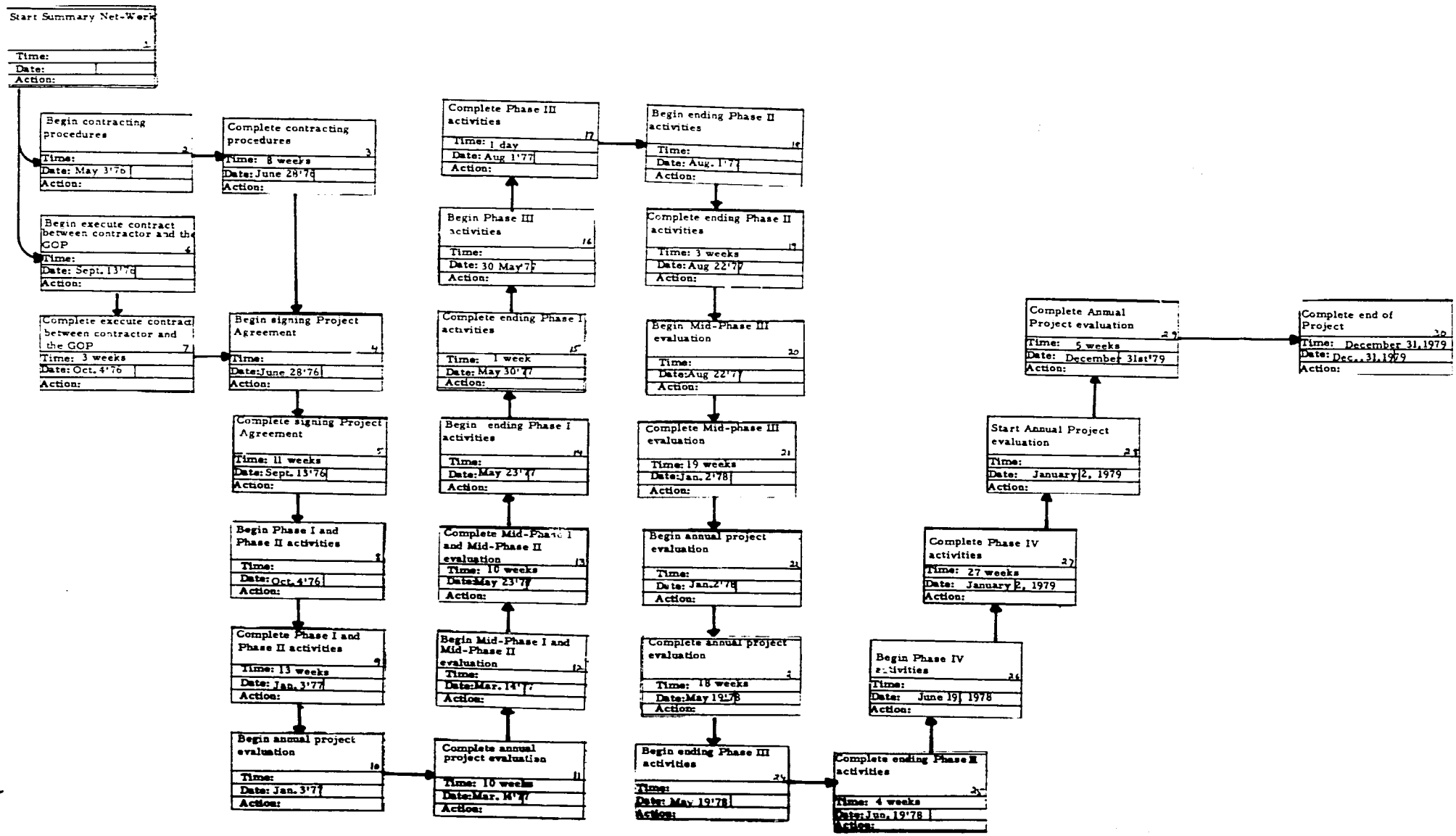
Event	Date	
1.	May 3, 1976	Begin contracting procedures.
2.	June 28, 1976	Sign Project Agreement.
3.	Sept., 13, 1976	Execute contract between contractor and the Government of Pakistan.
4.	Oct. 4, 1976	Begin Phase I and Phase II activities.
5.	Jan. 3, 1977	Annual project evaluation.
6.	Mar. 14, 1977	Mid-phase I and Mid-phase II evaluation.
7.	May 23, 1977	End Phase I activities.
8.	May 30, 1977	Begin Phase III activities.
9.	August 1, 1977	End Phase II activities.
10.	August 22, 1977	Mid-phase III evaluation.
11.	Jan. 2, 1978	Annual project evaluation.
12.	May 19, 1978	End Phase III activities.
13.	June 19, 1978	Begin Phase IV activities.

Country:	Project No:	Project Title:	Date:	/ / Original	Apprvd:
Pakistan	391-4170	Village Level Food Processing		/ / ~~Revision~~	

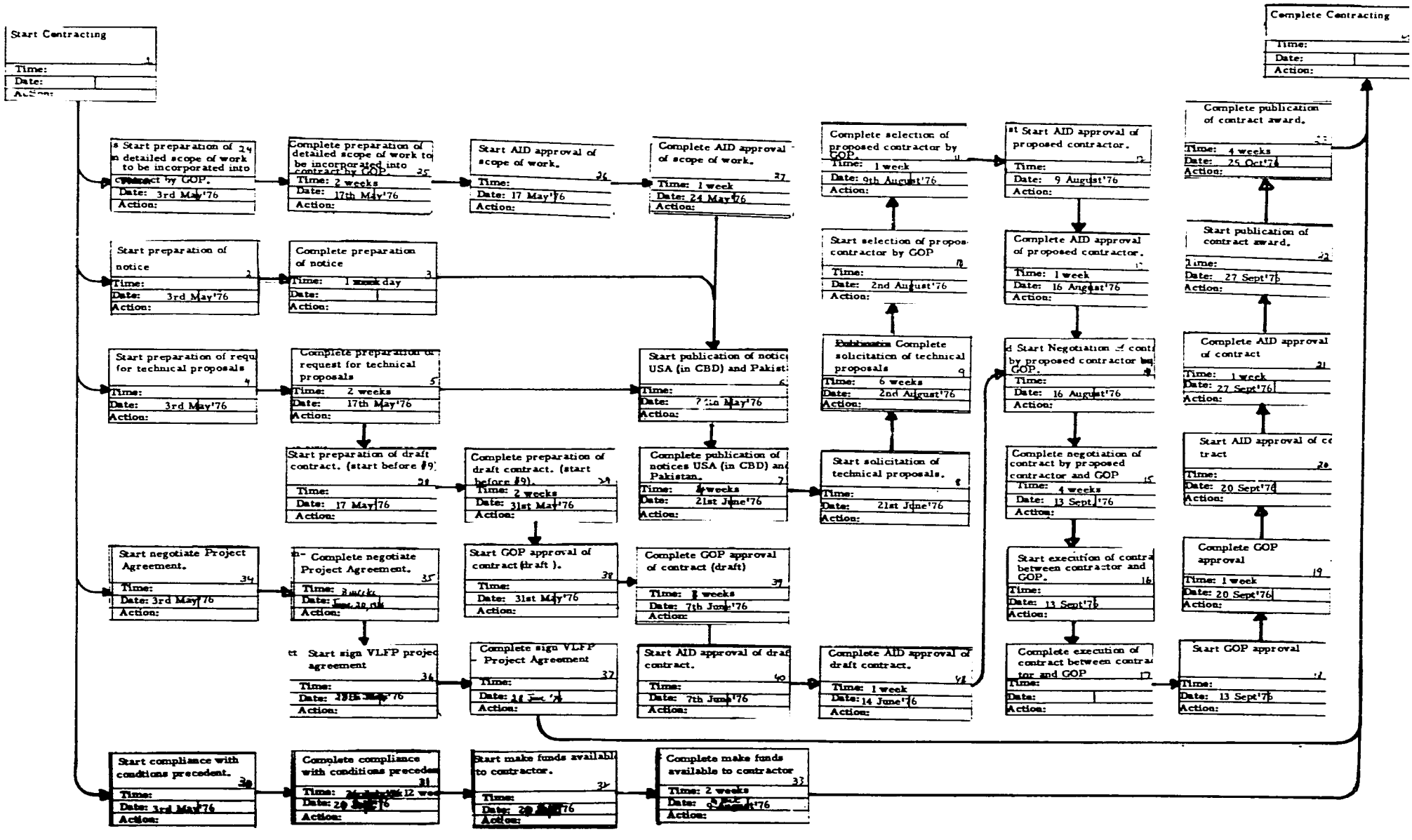
CPI DESCRIPTION

Event	Date	
14.	Jan. 2, 1979	Annual project evaluation.
15.	Dec.31, 1979	End of project.

Village Level Food Processing
Summary Network
Life of Project



Contracting Sub-Network - A



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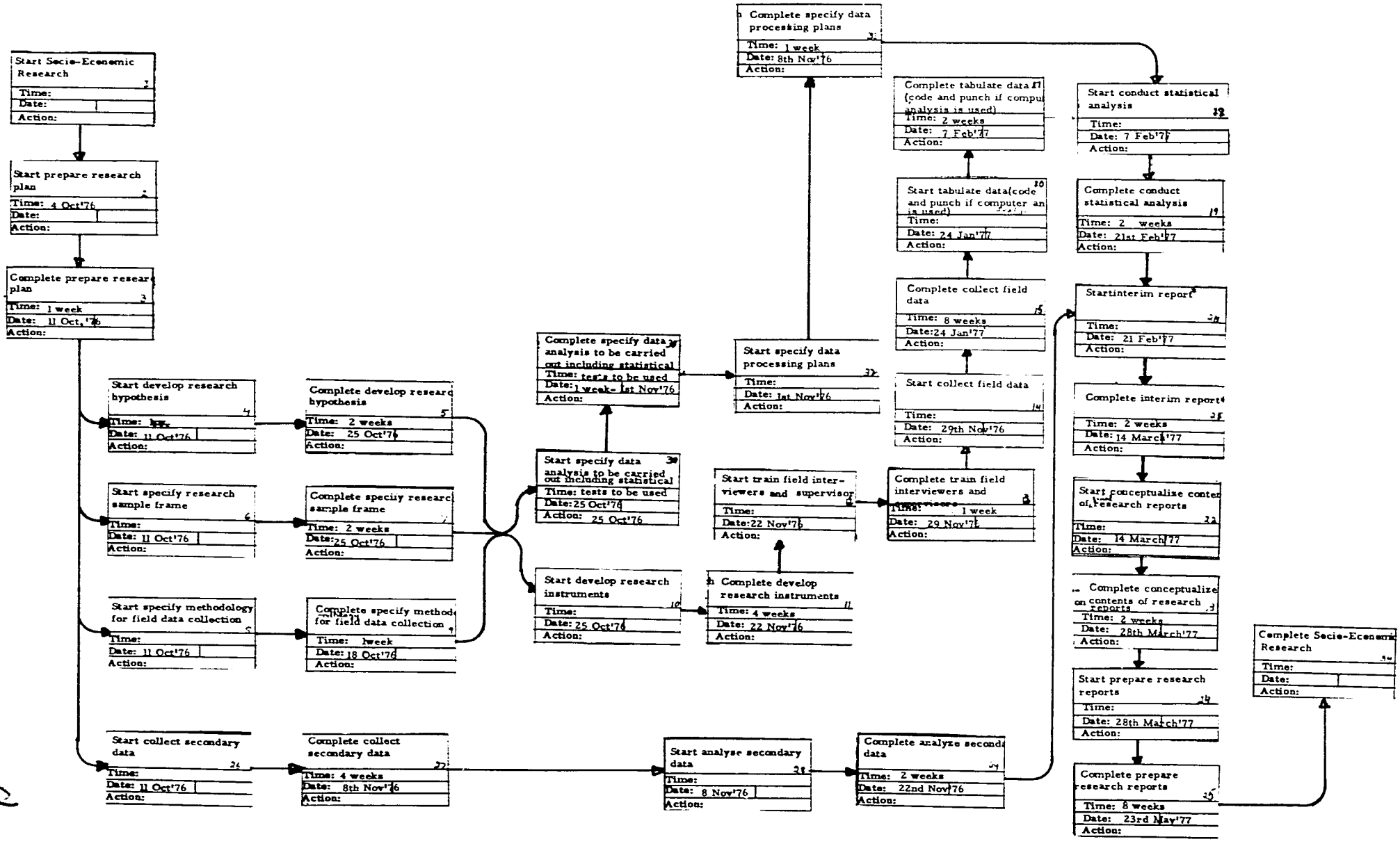
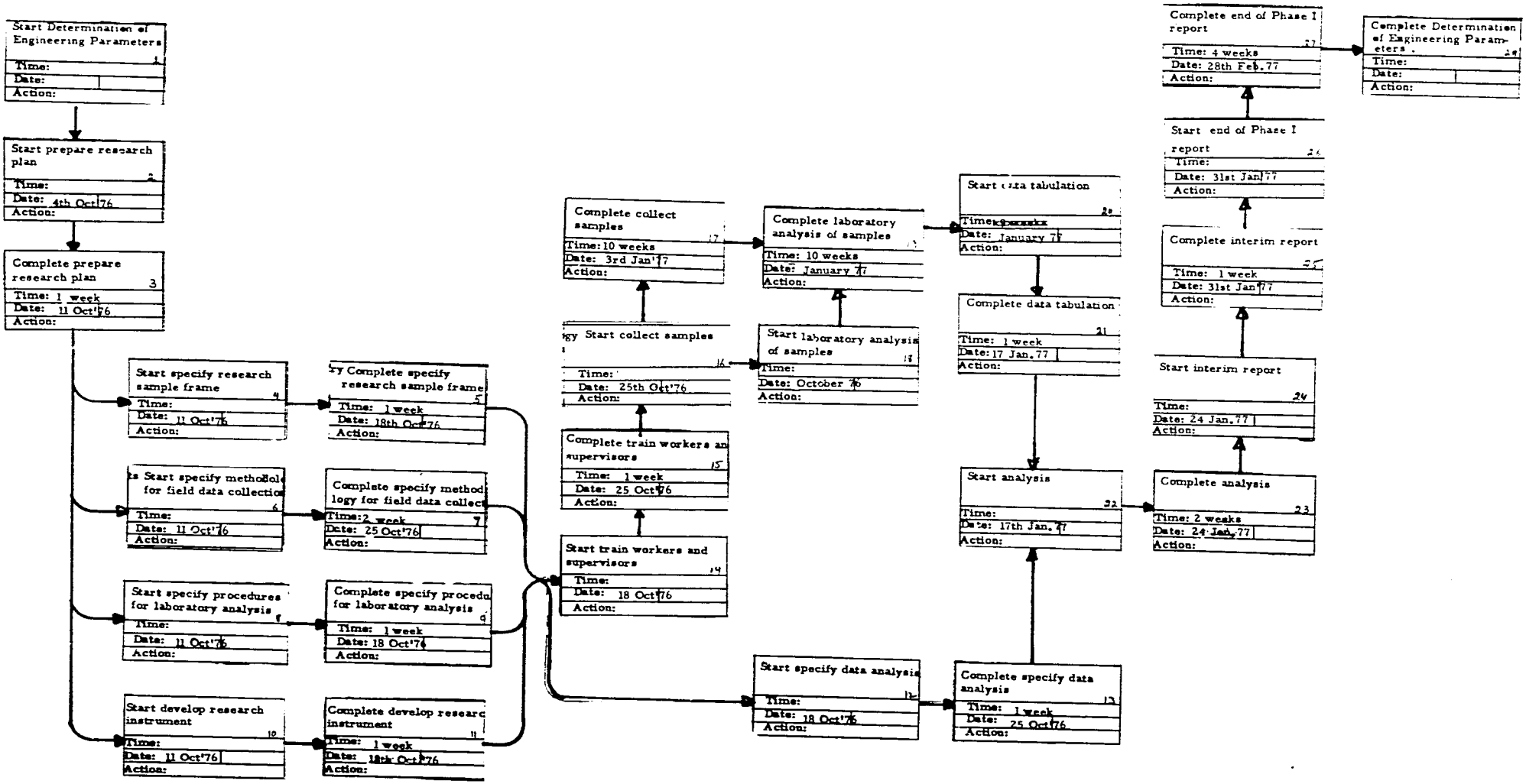
Sub-Network "B-I

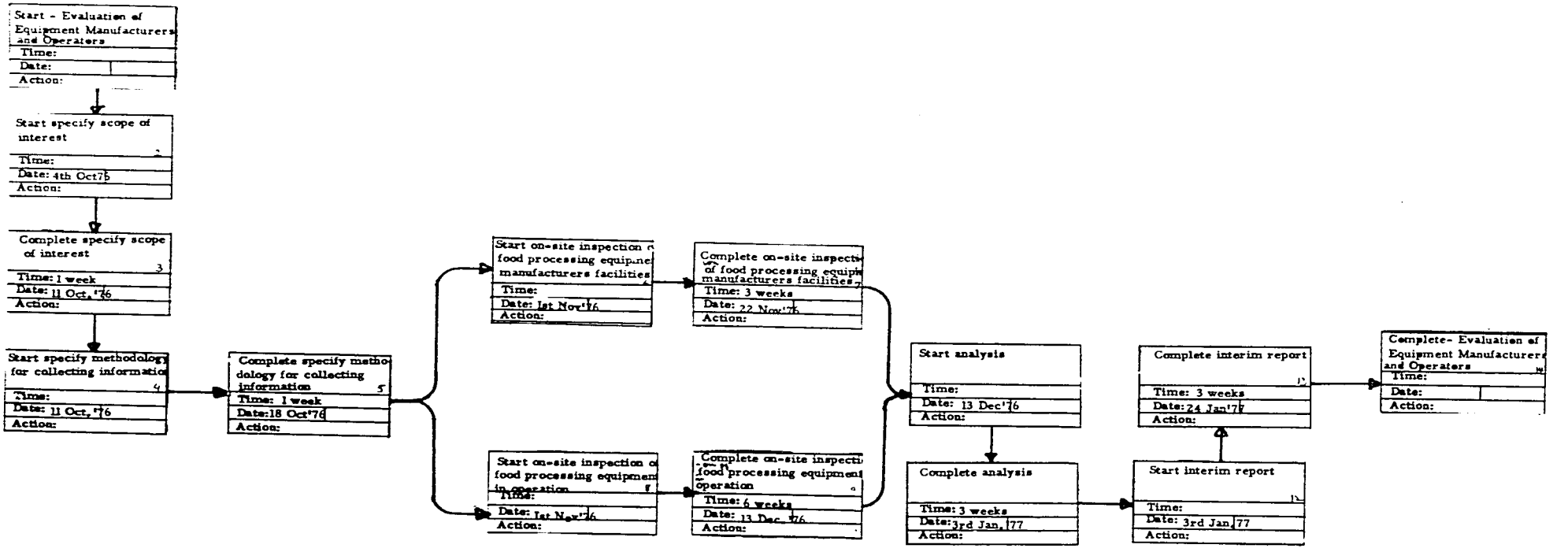


Phase I - Determination of Engineering Parameters Sub. Network B-II

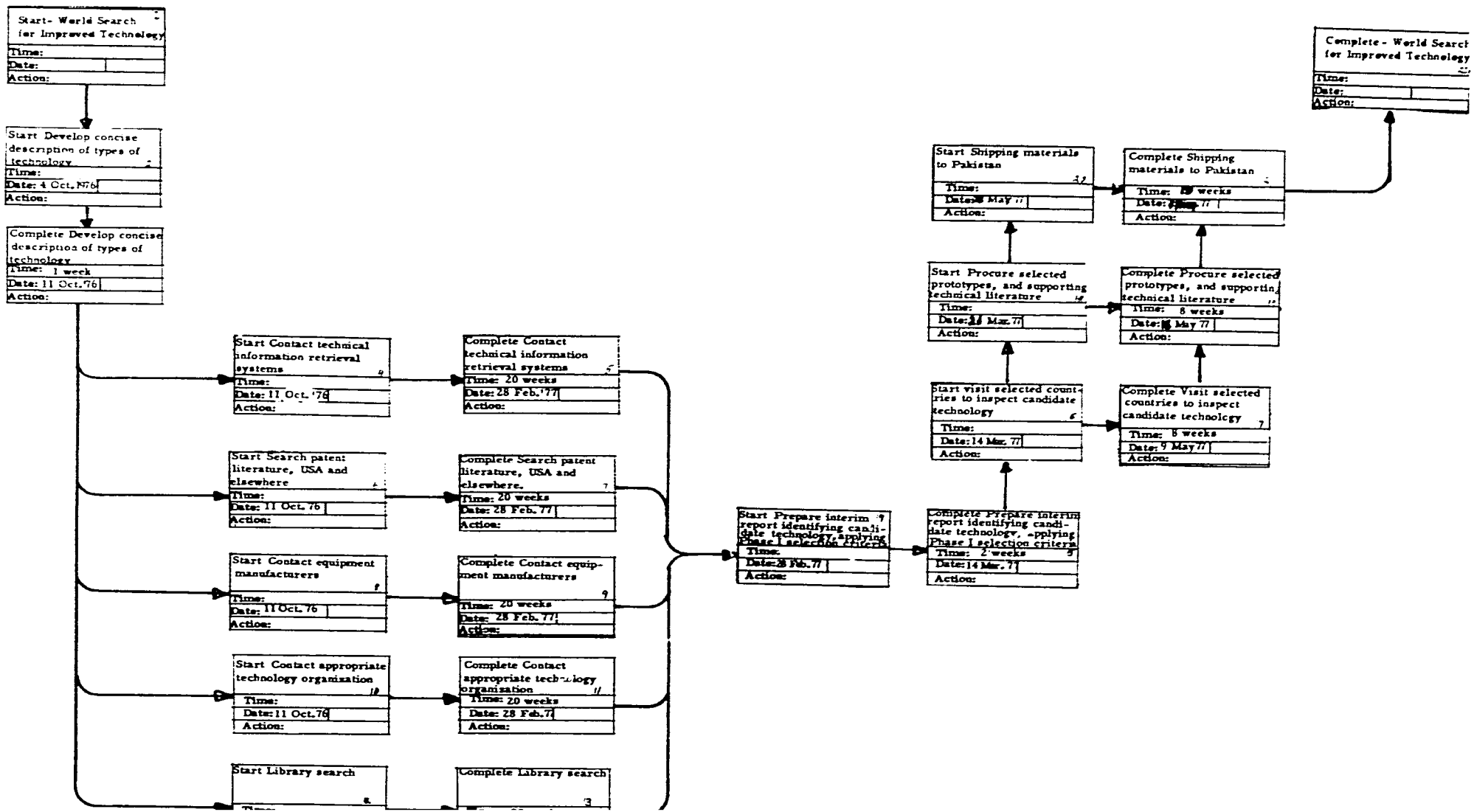


79.

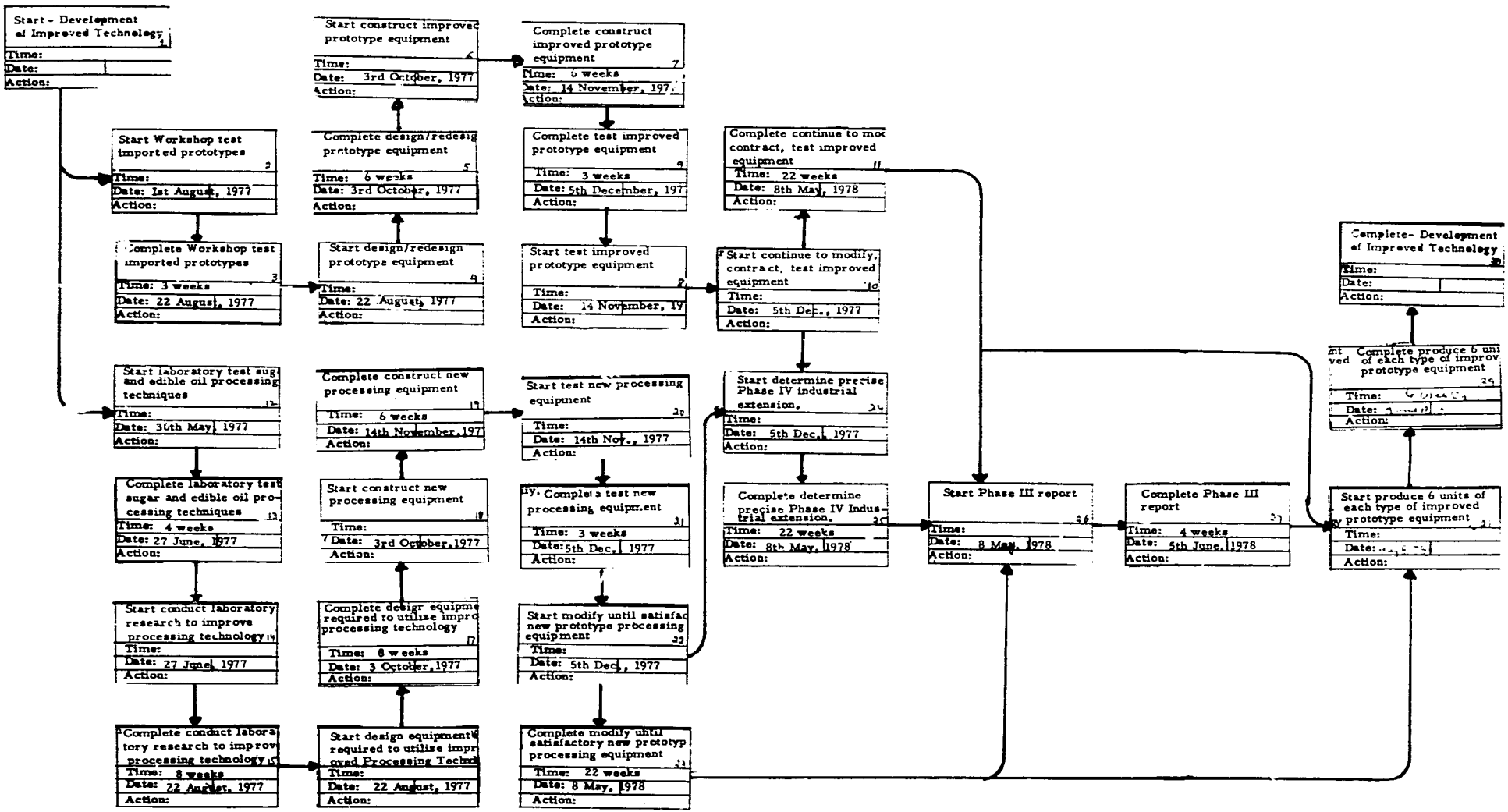
Phase I Evaluation of Equipment Manufacturers & Operators
Sub. Network B-III



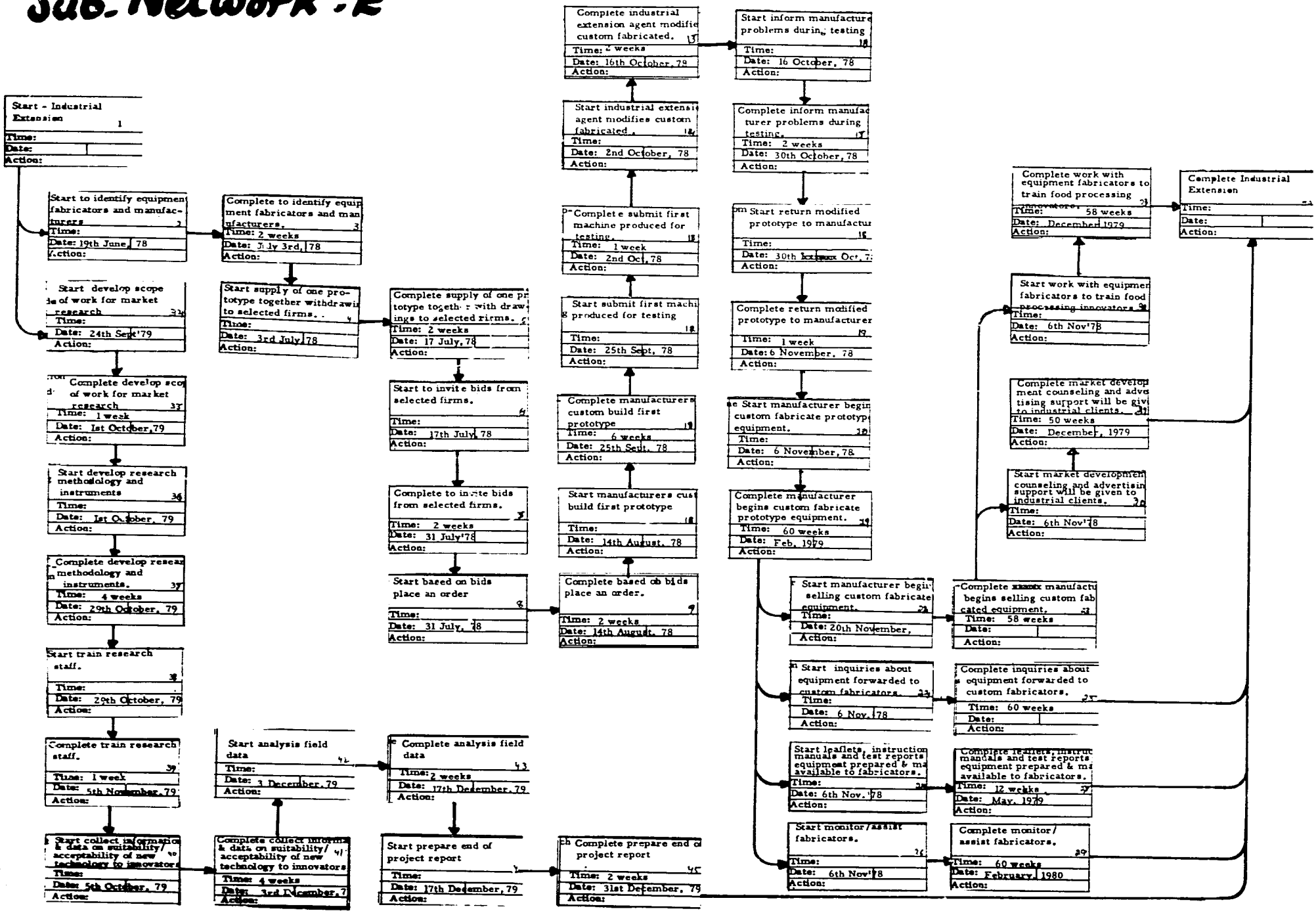
Phase II - World Search for Improved Technology Sub. Network C



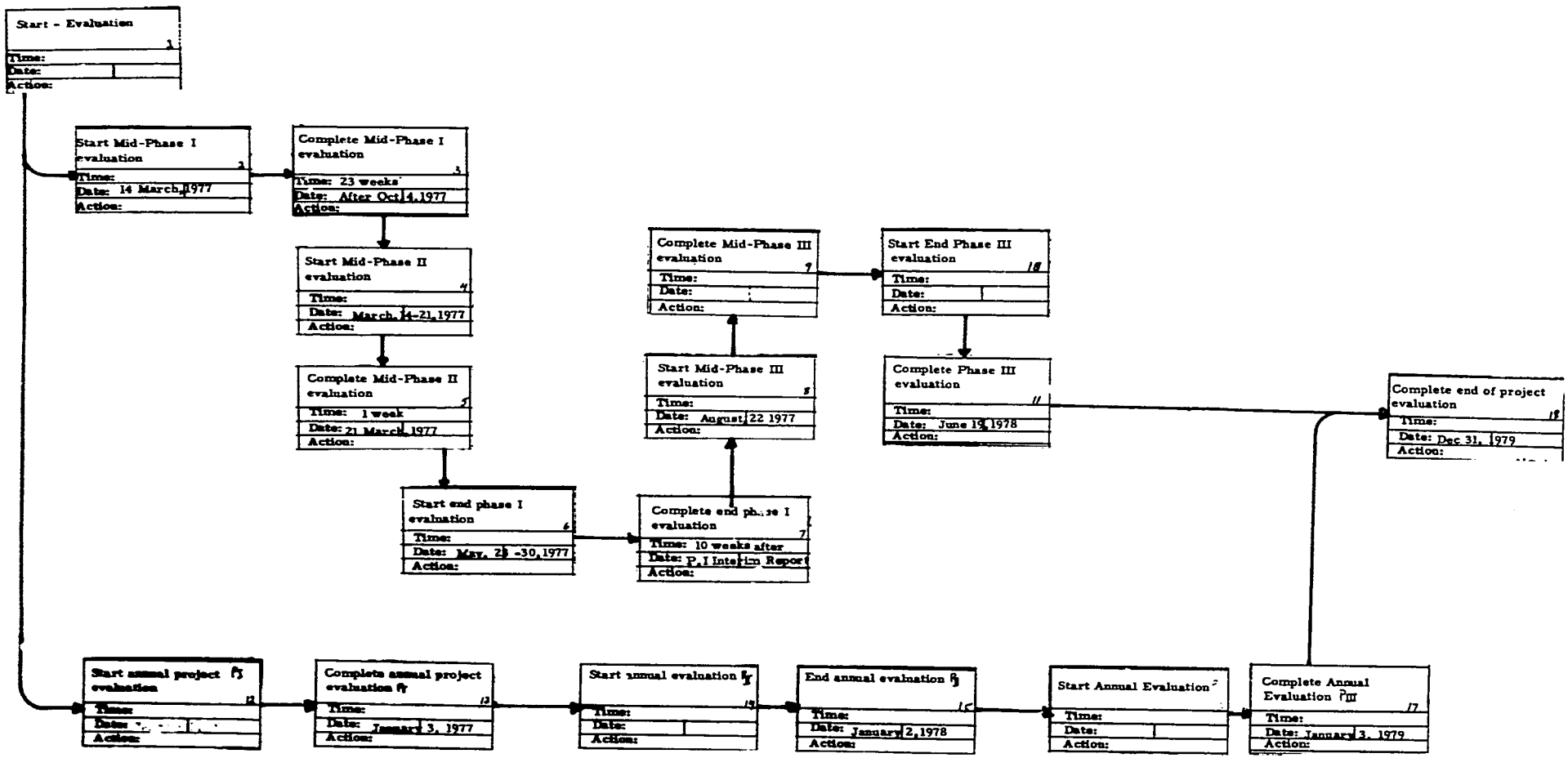
Phase III - Development of Improved Technology Sub-Network D



Phase IV Industrial Extension
Sub-Network - E



Phase I-IV Evaluation
Sub-Network F



ANNEX D

IMPLEMENTATION STRATEGY

Project implementation involves the execution of four distinct but partially over lapping phases. The following activities shall be carried out in the course of implementing Phases I through IV:

Phase I: Evaluation of the Potential for Developing Improved Food Processing Technology

Research, based on primary and secondary data sources, shall be undertaken to determine the technical and economic feasibility of developing improved food processing technology appropriate for Pakistan's resource endowment. The following kinds of studies shall be undertaken:

1. Micro analysis of the economics of village-level sugar processing, and edible oil extraction by kohlu and low pressure expeller operators. The analysis shall include:

   A. Identification of the target population of food processors: numbers, location and annual production. Also essential benchmark data, i.e., annual income (magnitude, source) social status, assets (processing equipment; size of farm and tenurial status for farmer-food processor).

   B. Analysis of income arising from food processing activities including:

      1. Gross revenue

      2. Expenses: Investment, operating, maintenance

      3. Net income

      4. Sensitivity analysis to changes in input and output prices.

   C. Labor utilization patterns:

      1. Composition of food processing labor force:

         a. Family members by age and sex

         b. Hired labor, casual and permanent by age and sex.

      2. Seasonality

D. Disposal of products and by-products:

1. Kinds of by-products produced, (e.g., cane tops, oilseed cake) method of disposal, value.

2. Home consumption of products and by-products; quantity, values.

3. Marketing channels used to dispose of products.

2. General socio-economic analysis:

A. Identify constraints that might inhibit food processors from adapting improved technology.

B. Identify and attempt to quantify incentives that will be required for food processors to adopt improved technology.

C. Identify and explain subsistence characteristics of food processing and marketing activities that may inhibit adoption of improved technology.

3. Description and evaluation of existing technology:

A. Extraction rates: design and actual under field conditions

B. Processing capacity: design and actual under field conditions

C. Characteristics of equipment in operation:

1. Age

2. Condition

3. Power source

D. Problems of existing equipment:

1. Maintenance

2. Repairs

3. Construction materials

4. Design features

E. Description and evaluation of capabilities of present day food processing equipment manufacturers:

1. Facilities

2. Quality and diversity of staff skills

3. Quality of materials used.

Products of Phase I research will include:

1. Interim and final reports based on the above analysis assessing the feasibility of identifying and developing improved food processing technology of a suitable scale and sophistication for village-level operation will be prepared.

2. A set of engineering and economic parameters will be established which will serve as criteria to guide Phase II selection of appropriate technology.

3. A set of base line data will be in hand which will identify the project's target population and permit follow-on research required to evaluate the impact of the project. The analysis will calculate benefit:cost ratios, internal rates of return and value added for each major food processing technology under consideration.

4. An assessment of manufacturing capabilities that shall facilitate definition of Phase IV implementation strategy including:

   A. Identification of candidate firms for fabricating prototype equipment.

   B. Identification of entity(s) best suited to undertake Phase IV industrial extension responsibilities.

Phase II: World search for improved technology

Research will be undertaken to identify candidate technology that may be adopted and, if necessary, adapted for use in Pakistan. This search shall include:

A. A review of the literature

B. Contacting organizations which provide information on intermediate technology, e.g., Volunteers for International Technical Assistance, Intermediate Technology Development Group, London, etc.

C. A search of patent literature as deemed appropriate.

D. Utilizing technical information retrieval services.

E. Correspondence with private firms and public bodies identified by the above initiatives as likely sources of appropriate technology.

Applying criteria developed in Phase I research, the various alternative technologies will be screened and the most promising candidates selected. These specimens will be brought to Pakistan for trial and adaptation as necessary. This shall be undertaken by:

A. Ordering and importing equipment, blue prints, operators' manuals and other relevant technical literature, where possible.

B. Sending qualified personnel to make on-site inspections of the equipment in operation to assess its performance, appropriateness for village operation in Pakistan, and suitability for fabrication in Pakistan. Prototype equipment will be procured and shipped to Pakistan.

Products of Phase II activities will include:

1. Interim report identifying candidate technology to be screened and selected through on-site inspection throughout the work.

2. Prototype equipment selected, procured and shipped to Pakistan.

3. Blue prints, operators' manuals, manufacturers' specification and other technical literature procured and brought to Pakistan.

Phase III: Development of appropriate prototype technology

With guidance provided by the technical literature, imported prototype equipment and processing techniques shall be carefully tested to determine performance standards. Then, applying Phase I criteria to guide research, the imported technology shall be adapted as required to meet the project's performance and population targets, A reiterative process of testing, adaptation, testing, adoption, etc., shall be carried on until improved, appropriate technology has been developed.

Products of Phase III activities:

1. Improved prototype equipment designed, tested and developed to project performance standards.

2. Improved food processing techniques developed and tested.

3. Interim report containing test results and recommendations.

4. Equipment drawings, operators' manuals for prototype equipment, and food processing instructions and description of improved processing procedures printed.

5. Phase III report submitted specifying performance standards of prototype equipment; procedures and standards associated with improved processing techniques; and estimates of the production costs of custom and commercially produced equipment. The report shall also provide guidance on the precise nature of the industrial extension strategy to be pursued in Phase IV and recommend entities and their responsibilities for industrial extension activities based on an evaluation of Phase I, II and II results.

Phase IV: Industrial extension

Phase IV activities will seek to:

A. Develop the capabilities of machinery fabricators to produce improved prototype equipment;

B. Encourage fabricators to engage in market promotion activities;

C. Promote food processors' adoption of improved technology through on-site training of innovators and selected advertising.

D. Assess suitability and performance of improved equipment through market analysis and selected field research designed to:

1. Determine the performance of the equipment under commercial operation.

2. Determine food processors' opinion of new equipment.

E. Evaluate the entire project and provide policy guidance on the need for any follow-on action required to achieve the project purpose.

The International Rice Research Institute's (IRRI) experience with the Agricultural Machinery Development Program seems highly applicable to this project.

In patterning Phase IV after the IRRI model, a suitable public sector entity will be identified to undertake industrial extension activities. Selection will be made at the end of Phase III by ATDO in consultation with USAID. The selected public sector entity shall under the following industrial extension activities:

1. Identify equipment fabricators and manufacturers which exhibit potential for and interest in producing improved equipment.

2. Supply one prototype together with appropriate drawings and design performance specifications to selected firms.

3. Invite bids for a few prototype units from selected firms.

4. Based on evaluation of bids place an order for a few units. Firms should be permitted to modify equipment to improve the design but with the understanding that replicated units must meet original performance specifications.

5. The first machine produced must be submitted to the industrial extension agent for testing to ensure it meets performance specifications.

6. Manufacturer will be informed of problems identified during testing and suggestions for improvements will be made. The test piece of equipment will be modified by the industrial extension agent as required to bring it up to project standards.

7. The tested and modified prototype will be returned to the manufacturers to serve as a model for future production.

8. The manufacturer will be permitted to produce the balance of units contracted for.

9. During this custom fabrication stage, the manufacturer will be encouraged to sell improved equipment whenever possible. The industrial extension agent will take possession of units it contracted for on an availability basis, preference being given b by the manufacturer to commercial orders.

10. During the custom fabrication stage the industrial extension agent will also engage in the following promotion activities:

    A. Inquiries about equipment will be forwarded to custom fabricators.

    B. Leaflets, instruction manuals and test reports on the improved equipment will be made available to fabricators to facilitate marketing.

C. Market development couseling and advertising support will be given to industrial clients.

11. Sufficient field data will be collected to permit the following analysis:

A. Project Appraisal: Benefit/Cost analysis, value added and internal rates of return associated with improved technology compared to the analysis carried out on traditional food processing technology in Phase I.

B. Choice of technology study to provide policy guidance required to determine implications of promoting various scales and types of technology available at the end of the project. The analysis shall include but not be limited to:

1. Sugar Cane Processing:

a. Village-level processing

b. Khandsari production

c. Large-scale mill production

2. Oilseed Processing:

a. Village kohlus

b. Low pressure expeller units

c. High pressure expeller units

d. Solvent extraction plants

3. Rice Bran Processing:

a. Stabilization units

b. Small-scale oil extraction units

Products of Phase IV activities include:

1. Demonstrated capabilities of selected manufacturers to fabricated improved equipment.

2. A target of 50 to 200 sugar cane processors; 50 to 100 oilseed processors and 8 rice mills have purchased and tried improved equipment.

3. End of project report which includes:

   A. Evaluation of suitability of improved equipment to operate in food processors' environment.

   B. Project appraisal including benefit-cost analysis, value added and internal rates of return and other analytical tests appropriate for a choice of technology study.

   C. A strategy for achieving commercial production and wide scale adoption of improved technology by food processors. The assessment will include but not be limited to an evaluation of the need for public intervention in the form of:

      1) Credit for machinery manufacturers and food processors.

      2) Industrial extension to assist manufacturers to retool production facilities.

      3) Industrial extension to upgrade marketing and service capabilities of equipment manufacturers.

      4) Extension activities to familiarize food producers with improved equipment: availability, performance, training in how to use new equipment.

ANNEX. E

The Grantee's Application for assistance was not yet available when this PP was printed and is to be forwarded to AID/W upon receipt.

ANNEX. F

Table I showing breakdown of costs for Phases I-IV

Phase I

I. Socio-economic study

1.	Interviewers salaries and allowances, 40 interviewers for 3 months.	Rs. 100,000
2.	Training of Interviewers.	15,000
3.	Translation of interview schedules.	5,000
4.	Processing of data.	20,000
5.	Analysis of data.	10,000
6.	Printing and office costs.	30,000
7.	Computer tape.	5,000
8.	Transportation of interviewers.	15,000
	Sub-total:	200,000
	Contractors' overhead and profit, 10%	20,000
	Contingencies	40,000
		Rs. 260,000

II. Equipment Performance Standards

1.	Salaries of 2 Engineers and one Research Officer and supporting staff for 3 MM; Engineers @3,500 P/MM and Research Officer @ 2,000.	Rs.48,000
2.	Travel costs including POL.	16,000
3.	Report writing and analysis.	8,000
4.	Final report.	15,000
	Sub-total:	87,000
	Contractors' overwrite.	8,700
	Contingencies @ 15%.	14,355
		Rs110,055

III. On-Site Investigators

1.	Field surveys for sugarcane, rape and mustard and rice bran.	
2.	Staff salaries for 2 Engineers and supporting staff for 3 MM.	18,000
3.	Travel costs.	10,000
4.	Report writing.	2,000
5.	Final report (50 copies @ Rs. 30/- per copy)	1,500
	Sub-total:	31,500
	Contractors' overhead and profit.	3,150
	Contingencies @ 15%.	5,197
		39,847
		Say:Rs. 40,000

Phase II

I. Library Research

1.	Staff salaries of Research Officers, Engineer and suppoting staff.	Rs. 30,000
2.	Procurement of literature.	10,000
3.	Postage and stamps.	5,000
4.	Travel costs.	9,000
5.	Office expenses	10,000
	Sub-total:	64,000
	Contractors' overhead and profit.	6,400
	Contingencies @ 15%.	10,000
		Rs. 80,400

II. Equipment Procurement

1.	4 sugarcane processing models from 4 different countries @ $1,500 per model.	$ 6,000
2.	4 oilseed processing models from 4 different countries @ $1,500 per model.	$ 6,000
3.	2 rice bran processing models @ $2,500 per model.	$ 5,000
	Sub-total:	$17,000

Inflation factor 15%.	$ 2,500
Insurance and freight charges.	$15,500
	$35,000

Assumptions :

Phase III calculations :

A. Design and testing prototype equipment

4 expert craftsmen	Rs. 30/day	Rs. 120
3 assistants	Rs. 20/day	Rs. 60
1 supervisor	Rs. 35/day	Rs. 35
Costs per day		Rs. 215
Rs. 215/day x 150 workdays/ prototype x 6 prototypes .		
Sub-total "A".		Rs.193,500

B. Materials for modeling

5 prototypes @ Rs. 9,000	Rs. 45,000
1 prototype @ Rs. 40,000	Rs. 40,000
Sub-total: "B"	Rs. 85,000

C. Model Prototypes, 20 units

Sugarcane tech.	4 fabricators x 2 prototypes = 8 units, 8 unitsxRs. 7,000/unit	Rs. 56,000
Oilseed tech.	8 units x Rs. 16,000/unit	Rs.128,000
Rice bran tech.	2 fabricators x 2 units = 4 units 4 units x Rs. 46,000/unit	Rs.184,000
Sub-total "C".		Rs.368,000
Total:		Rs.646,500
Contingencies		Rs.134,000
		Rs.780,500

Phase II-IV - technical assistance 29 MM @ $ 6,500 per MM	$1,88,500
International Travel and per diem.	$ 15,000
Sub-Total:	$2,03,500
Contingencies	$ 3,500
Phase IV	$2,07,000

1. Procurement of Prototype equipment from custom fabricators.

A. Sugarcane units @ Rs. 7,000	Rs. 224,000
B. Oilseed units @ Rs. 25,000	Rs. 800,000

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C. Rice bran units @ 50,000	Rs.200,000
Sub-total:	Rs. 1224,000
Inflation factor.	122,400
Contingencies	153,600
Total:	Rs. 1500,000

Table. 2

Breakdown of Foreign Exchange and Local Currency Costs - AID and Host Country

	F. X. (in $ 000)	L. C. (in Rs.000)	Total
I. Contract Services			
Phase I studies	-	340	
Phase II :			
1. Library research	-	70	
2. Technical assistance	28	-	
3. International travel and per diem for world search	15	-	
Phase III :			
1. Technical assistance	122.5	-	
2. Local costs for developing, designing and fabricating equipment.		640	
Phase IV :			
1. Technical assistance	37.5	-	
2. Studies and reports		200	

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Table 2 continued....

II. Commodities			
Imported equipment for designing, testing and fabricating prototype models.			
4 different sugarcane processing models from four countries.			
4 different models for oilseed processing from 4 countries.			
2 models from 2 different countries for rice bran equipment.			
Insurance and freight charges included	35,000	-	
III. Local costs for procurement of prototype equipment from custom fabricators.		Rs. 1340	
Contingencies	$ 4.0	Rs. 650	
Host Country			
Industrial Extension Services	-	Rs. 300	300
Credit for Innovating Food Processors	-	Rs. 400	400
ATDO's budget management costs		Rs. 1375	1375
Sub-total:			2075
Contingencies			65
Total:		Rs.	2140

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Table 3. Breakdown of GOP contribution

SUMMARY BUDGET	Ist Year	2nd Year	3rd Year	4th Year	Total
I. Pay of Officers	70800	73920	77040	40080	261, 840
II. Pay of Establishment	21540	22896	24252	12804	81, 492
III. Other Allowances and Honoraria	63545	71360	73974	54964	263, 843
IV. Travelling Allowances and Expenses	25750	40750	40750	22000	129, 250
V. Misc. Expenses	275000	146000	141000	83000	645, 000
VI. Contingencies	10000	20000	20000	15000	65, 000
Total:	466635	374926	377016	227848	1, 446, 425

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	Ist Year	2nd Year	3rd Year	4th Year	Total
I. PAY OF OFFICERS					
1. One Project Manager in Grade 20 (2300-100-)	27600	28800	30000	15600	72000
2. One Mechanical Engineer in Grade 19 (1800-80-2200)	21600	22560	23520	12240	58920
3. One Economist in Grade 19 (1800-80-2200)	21600	22560	23520	12240	58920
II. PAY OF ESTABLISHMENT					
1. One Office Super. in Grade 16 (400-35-730)	4800	5220	5640	3030	18690
2. One Assistant in Grade No. 11 (275-20-475/25-600)	3300	3540	3780	2010	9630
3. Two Stenographers in Grade 11 (275-20-475/25/600)	6600	7080	7560	4020	25260
4. One Typist in Grade 5 (150-6-180-/8-220/10-280)	1800	1872	1944	1008	6624
5. Two Drivers in Grade 3 (120-3-150/5-180)	1440	1512	1584	828	5364
6. Three Peons in Grade 1 (100-2-116/3-140)	3600	3672	3744	1908	12924

III. OTHER ALLOWANCES & CRITERIA	Ist Year	2nd Year	3rd Year	4th Year	Total
1. Rest and recreation	-	7,815	7,815	3,907	19,537
2. House Rent Allowance	18,096	18,096	18,096	18,096	54,288
3. Conveyance allowance	3,240	3,240	3,240	3,240	9,720
4. Dearness allowance	19,500	19,500	19,500	19,500	78,060
5. Compensatory allowance	22,709	22,709	25,323	13,221	83,962
IV. TRAVELLING ALLOWANCE	15,750	15,750	15,750	10,000	57,250
Travel expenses	10,000	25,000	20,000	12,000	72,000
V. MISC. EXPENSES					
Office Rent	36,000	36,000	36,000	18,000	126,000
Postage & telephone	45,000	45,000	45,000	20,000	155,000
Furniture	30,000	10,000	5,000	5,000	50,000
Typewriters & Calculators	25,000	-	-	-	25,000
Vehicles	70,000	-	-	-	70,000
POL	25,000	25,000	25,000	10,000	85,000
Mimeograph machine & equipment	20,000	-	-	-	20,000
Repair & maintenance of office equipment	5,000	5,000	5,000	5,000	20,000
Periodicals, Newspapers, etc.	5,000	5,000	5,000	5,000	20,000
Electricity	15,000	20,000	20,000	20,000	75,000
VI. UNFORESEEN EXPENDITURE	10,000	20,000	20,000	15,000	65,000

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ANNEX. G

LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date December 31, 1979

Date of this Summary May, 1976

Project Title: Village Level Food Processing - 391-4170

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
DEVELOPMENT HYPOTHESES — If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes: Increase employment, raise incomes of small farmers and village food processors and increase the supply of village produced sugar and edible oil.	Measures of Goal Achievement: 30% increase in sucrose and 20% increase in edible oil extracted at village level per unit of cane and oil seeds processed with the improved technology; rice bran oil produced commercially.	Baseline and follow-on surveys of small scale processors to obtain data on : a) processing equipment used. b) extraction rates. c) employment and labor utilization patterns. d) home consumption and sales of products and by-products.	Concerning long term value of program/project:
If Purpose, Then Goal — If Outputs, Then Purpose	Project Purpose: Feasible methods of improving small scale sugar cane, oilseed and rice bran processing identified, developed, tested and the potential for commercialization of improved technology demonstrated.	Conditions that will indicate purpose has been achieved: End of project status. a) 200 improved cane processing units, 100 oilseed processing units, and 8 rice bran processing units proven effective and acceptable to target population*. b) A strategy for producing and disseminating the improved technology exists. *. Targets are provisional subject to the number of types of equipment developed and the industrial extension strategy pursued in Phase IV.	Final project report.	Affecting purpose-to-goal link: 1. GOP price policies and statutes will provide sufficient incentives. 2. Market demand for village produced sugar (gur) and edible oils will be sufficiently large to absorb the increased supply of gur and edible oils at prices that provide village processors with adequate incentives. Contd...
If Outputs, Then Purpose — If Inputs, Then Outputs	Outputs: 1. Phase I research completed and reports submitted on: a. Socio-economic analysis b. Micro-firm analysis c. Mechanical characteristics and physical efficiency of small scale sugarcane and oilseed processing technology. d. Capabilities of food processing equipment manufacturers. Contd..	Magnitude of Outputs necessary and sufficient to achieve purpose. 1. Studies completed. 2. Interim report submitted. 3. 4 models of improved sugarcane processing equipment fabricated. 4 models of improved oilseed processing equipment fabricated. 2 models of improved rice bran processing equipment fabricated. Contd.....	1. Interim and end of Phase I reports. 2. Interim Phase II report. 3. Fabricators records. On-site inspection. End of Phase III report. 4 & 5 Manufacturers' sales records.	Affecting output-to-purpose link: 1. Socio-economic constraints are not prohibitive. 2. Appropriate technology exists elsewhere in the world, can be identified and adapted to the Pakistani village environment. 3. Significantly improved appropriate food processing technology can be developed.
If Inputs, Then Outputs (MANAGEABLE INTEREST)	Inputs: Activities and Types of Resources 1. Funding for Phase I research and reports on : a. Socio-economic study of village level food processing environment. b. Micro-firm analysis of village food processors. c) Performance parameters of existing food processing technology. d. Capabilities of food processing equipment manufacturers.	Level of Effort/Expenditure for each activity. 1. USAID $40,000 for local costs Host Country $46,663 in local currency management costs. 2. A. USAID 1. $35,000 equipment 2. $17,000 international travel and per diem. 3. $26,000 technical assistance.	(Contingencies and inflation included).	Affecting input-to-output link: 1. ATDO will institutionalize the capability of this project effectively. A contracting entity (contractor and sub-contractors(as necessary) capable of executing all phases of project implementation can be identified.

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LOGICAL FRAMEWORK
FOR
SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____
Date of this Summary _____

Project Title: Village Level Food Processing 391-4170

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes:	Measures of Goal Achievement:		Concerning long term value of program/project:
If Outputs, Then Purpose	Project Purpose:	Conditions that will indicate purpose has been achieved: End of project status.		Affecting purpose-to-goal link: 3. Presently employed permanent or casual labor will not be displaced. 4. Improved cane crushers and oil extractors and rice bran processing units can be priced within the range of the target population 5. Rice bran oil will find a market.
If Inputs, Then Outputs	Outputs: 2. Interim and report summarizing the results of a worldwide search for appropriate technology suitable for testing and adaptation for use in villages in Pakistan equipment and technical literature shipped to Pakistan. 3. Prototype sugarcane, oilseed and rice bran processing equipment and related processing technology Contd...	Magnitude of Outputs necessary and sufficient to achieve purpose. *4. 200 units improved sugarcane processing & equipment fabricated. 100 units of 5. improved oilseed processing equipment fabricated. 8 units of improved rice bran processing equipment fabricated. *. Target are provisional subject to the number of types of equipment developed and the industrial extension strategy pursued in Phase IV. Contd.....		Affecting output-to-purpose link:
	Inputs: Activities and Types of Rescurces 2. Funding for Phase II world search for appropriate technology, interim report and importation of selected equipment and technical literature. 3. Funding for Phase III prototype design, testing, adaptation and production of model equipment and end of Phase III report. 4. Funding for procurement of custom fabricated equipment from manufacturers.	Level of Effort/Expenditure for each activity. 4. $8,000 in local currency costs for literature search. B. Host country $37,493 in local currency management costs. 3. A. USAID 1. $123,000 technical assistance. 2. $78,000 for local costs. B. Host Country $37,701 in local currency management costs.		Affecting input-to-output link:

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: Village Level Food Processing 391-4170

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes:	Measures of Goal Achievement:		Concerning long term value of program/project:
If Outputs, Then Purpose	Project Purpose:	Conditions that will indicate purpose has been achieved: End of project status.		Affecting purpose-to-goal link:
If Inputs, Then Outputs	Outputs: developed/tested. Models of prototype equipment fabricated. End of Phase III report. 4. Equipment manufacturers & producing and marketing custom 5. fabricated equipment. 6. innovating food processors using improved technology, equipment partially financed with project credit. Contd...	Magnitude of Outputs necessary and sufficient to achieve purpose. 6. Results of Phase IV market evaluation studies. Loan disbursements for project equipment. 7. Phase IV studies completed.		Affecting output-to-purpose link:
	Inputs: Activities and Types of Resources 5. Funding for industrial extension. 6. Funding for credit for accepting food processing innovators. 7. Funding for Phase IV studies and reports.	Level of Effort/Expenditure for each activity. 4. USAID $126,000 in local currency for procurement of equipment. 5. A. USAID $39,000 technical assistance. $150,000 in local currency for procurement of fabricated equipment. B. Host Country a) $30,000 in local currency for industrial extension. b) $22,784 in local currency for Phase-IV management costs.		Affecting input-to-output link:

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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LOGICAL FRAMEWORK FOR SUMMARIZING PROJECT DESIGN

Est. Project Completion Date _____

Date of this Summary _____

Project Title: Village Level Food Processing - 391-4170

	NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
If Purpose, Then Goal	Program Goal: The broader objective to which this project contributes:	Measures of Goal Achievement:		Concerning long term value of program/project:
If Outputs, Then Purpose	Project Purpose:	Conditions that will indicate purpose has been achieved: End of project status.		Affecting purpose-to-goal link:
If Inputs, Then Outputs	Outputs: 7. Phase IV studies on acceptability of new technology innovating population and choice of technology.	Magnitude of Outputs necessary and sufficient to achieve purpose.		Affecting output-to-purpose link:
	Inputs: Activities and Types of Resources	Level of Effort/Expenditure for each activity. 6. Host Country $40,000 in local currency for credit 7. USAID $20,000 in local currency for studies and reports.		Affecting input-to-output link:

DEVELOPMENT HYPOTHESES

MANAGEABLE INTEREST

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CHECKLIST OF STATUTORY CRITERIA

BASIC AUTHORITY

1. FAA ¢ 103; ¢ 104; ¢ 105; ¢ 106. Is grant being made

a.	for agriculture, rural development or nutrition;	Yes,
b.	for population planning or health;	No.
c.	for education, public administration, or human resources development;	No.
d.	for the following activities:	No.
	1. programs of technical cooperation and development;	
	2. programs to help the recipient country alleviate energy problems;	
	3. programs of research into, and evaluation of the progress of economic development or into the factors of development activities and development assistance;	
	4. programs of reconstruction following natural or manmade disasters;	

The following abbreviations are used·

FAA - Foreign Assistance Act of 1961, as amended.
FAA, 1973 - Foreign Assistance Act of 1973.
App. - Foreign Assistance and Related Programs Appropriation Act, 1975.
MMA - Merchant Marine Act of 1936, as amended.

5. programs designed to help solve special development problems;

6. programs of urban development.

COUNTRY PERFORMANCE

Progress Towards Country Goals

2. FAA ¢ 201 (b) (5), (7) & (8); ¢ 208

A. Describe extent to which country is:

(1) Making appropriate efforts to increase food production and improve means for food storage and distribution.

Food production is a major focus of Pakistan's development effort. Current food production targets will make the country self-sufficient in wheat by 1979. The Government has supported these targets by adopting a price support policy for wheat, allocating large amounts of domestic credit for farmers and implementing rural credit campaigns. It has removed restrictions on the domestic sales and distribution of fertilizer, continues to invest major amounts in farm mechanization, improved irrigation, domestic fertilizer production and fertilizer imports. Since 1972, domestic fertilizer sales have increased from 381,000 nutrient tons to an estimated 584 thousand tons in 197[illegible] (up 53%). It is making significant efforts to adapt foreign technology (supported by a major [illegible]pril 30, 1974 A.I.D. loan agreement), build new fertilizer plants, better distribute high-yielding seed varieties and extend irrigated acreage.

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(2) Creating a favorable climate for foreign and domestic private enterprise and investment.	Nationalization of domestically owned banks and a number of major industries in fulfillment of election pledges by the current government created uncertainties for investors that have retarded private investment in large-scale industries. A formula for the payment to investors has been publicly adopted, and clearer demarcation of the industrial role of private and public investors have improved the climate somewhat. The Government's leaders have publicly affirmed that a substantial degree of domestic and foreign private investment is essential to the country's economic development. Inducements to new private investment are offered, and there is active growing investment in medium and small scale industry. Lately, U.S. investors have evidenced perceptible interest in establishing or expanding prospects and the Government has already approved many of these: e.g. Rafhan Maize (ICP), Premier Tobacco, Fauji Agrico fertilizer plant.
(3) Increasing the public's role in the developmental process.	The present government describes itself as a "People's Government". During the summer of 1973 a new constitution establishing a parliamentary form of government was put into effect in Pakistan. At the lower level, the fledgling Peoples Works and Integrated Rural Development Programs contemplate more active participation in development at the village level.
(4) (a) Allocating available budgetary resources to development.	Development investment expenditures account for about 38% of the consolidated Government budget in FY 1976. They have increased from Rs. 10,838 million (35%) in FY 1975 to Rs. 13,500 million in FY 1976.

(b) Diverting such resources for unnecessary military expenditure (See also Item No. 21) and intervention in affairs of other free and independent nations.) (See also Item No. 11).	The budget for defense expenditures increased by only 12% in FY 1976, significantly less than the 25% increase in development expenditures. In FY 1975 Rs. 6,832 million was spent on defense expenditures, and revised estimates this year are Rs. 8,200 million. There has as yet been no significant increase following (a) India's detonation of a nuclear device, (b) the continuing strain in Afghan-Pakistan relations, or (c) the lifting of the U.S. embargo on sales of lethal defense items to Pakistan.
(5) Making economic, social, and political reforms such as tax collection improvements and changes in land tenure arrangements, and making progress toward respect for the rule of law, freedom of expression and of the press, and recognizing the importance of individual freedom, initiative, and private enterprise.	The current government promulgated a quick succession of different land, labor, banking, education, health, and law reforms, which are making significant contributions to social, economic and political development as they are being implemented. The rule of law is publicly endorsed, though the laws have recently been amended making it easier for the government to move against certain elements of political opposition. The government has announced a new plan to strengthen democratic local government.
(6) Willing to contribute funds to the project or program.	Approximately 30% of the project costs will be financed by the Government.

(7) Otherwise responding to the vital economic, political, and social concerns of its people, and demonstrating a clear determination to take effective self-help measures.	As the responses above suggest, the recipient government has committed itself to meeting the vital economic, political and social concerns of its people. Since coming to power, the self-help measures the government has taken include the rupee devaluation of May 1972 and import liberalization program, increases in tax revenues and other stabilization measures, steps to increase subsidies on farm inputs, and substantial flood relief recovery and rehabilitation efforts. It has lifted or relaxed internal restrictions on the transport and sale of wheat, and increased the government procurement price substantially, measures that will give significant increased incentive to agricultural production.
B. Are above factors taken into account in the furnishing of the subject assistance?	Yes.

3. FAA ¢ 116

(a) Has the Secretary of State made a determination that the recipient country does not engage in a consistent pattern of gross violations of internationally recognized human rights?	
(b) If not, does this project directly benefit the needy people of the recipient country?	Yes.

Treatment of U.S. Citizens and Firms

4.	FAA ¢ 620 (c). If assistance is to government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested by such government.	No.
5.	FAA ¢ 620 (e) (1). If assistance is to a government, has it (including government agencies or sub-divisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	The March 1972 Life Insurance Nationalization affected an American Company, which negotiated a satisfactory settlement, and received compensation in 1973. In addition, the nationalization of schools potentially affects one American church organization which owns substantial property in Pakistan. The church organization is holding discussions with the government on the matter.
6.	FAA ¢ 620 (o); Fishermen's Protective Act. ¢ 5. If country has seized, or imposed any penalty or sanction against any U.S. fishing vessel on account of its fishing activities in international water,	Not Applicable.
	a. has any deduction required by Fishermen's Protective Act been made?	Not Applicable.
	b. has complete denial of assistance been considered by A.I.D. Administrator?	Not Applicable.

Relations with U.S. Government and Other Nations

7.	FAA ¢ 620 (a). Does recipient country furnish assistance to Cuba or fail to take appropriate steps to prevent ships or aircraft under its flag from carrying cargoes to or from Cuba?	Pakistan does not furnish assistance to Cuba. However, during October 1973, 4,000 tons of barley were shipped to Cuba by a private exporter. There had never been any previous barley exports from Pakistan to Cuba. The GOP was unaware of the transaction because there was no procedure for licensing or controlling shipments of barley. Controls have now been instituted and the GOP has assured the U.S. that no further exports will be made.
8.	FAA ¢ 620 (b). If assistance is to a government, has the Secretary of State determined that it is not controlled by the International Communist Movement?	The Secretary of State has determined that Pakistan is not controlled by the International Communist Movement.
9.	FAA ¢ 620 (d). If assistance is for any productive enterprise which will compete in the United States with United States enterprise, is there an agreement by the recipient country to prevent export to the United States of more than 20% of the enterprise's annual production during the life of the loan.	Not Applicable.
10.	FAA ¢ 620 (f). Is recipient country a Communit country?	No.
11.	FAA ¢ 620 (i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression?	No.
12.	FAA ¢ 620 (j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property?	No.

13.	FAA ¢ 620 (l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, in convertibility or confiscation, has the A. I. D. administration within the past year considered denying assistance to such government for this reason?	Pakistan has instituted the investment guaranty program for the specific risks of expropriation, inconvertibility and war risk.
14.	FAA ¢ 620 (n). Does recipient country furnish goods to North Viet-Nam or permit ships or aircraft under its flag to carry cargoes to or from North Niet-Nam?	Not Applicable.
15.	FAA ¢ 620 (q). Is the government of the recipient country in default on interest or principal of any A. I. D. loan to the country?	No.
16.	FAA ¢ 620 (t). Has the country severed diplomatic relations with the United States. If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?	Diplomatic relations with the United States have never been severed.
17.	FAA¢ 620 (u). What is the payment status of the country's U. N. obligations? If the country is in arrears, were such arrearages taken into account by the A. I. D. Administrator in determining the current A. I. D. Operational Year Budget?	Pakistan is not delinquent in any obligations to the United Nations.
18.	FAA ¢ 481. Has the government of recipient country failed to take adequate steps to prevent narcotics drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the U.S. unlawfully?	No.

19.	FAA ¢ 659. If (a) military base is located in recipient country, and was constructed or is being maintained or operated with funds furnished by U.S., and (b) U.S. personnel carry out military operations from such base, has the President determined that the government of recipient country has authorized regular access to U.S. correspondents to such base?	Not Applicable.
20.	FAA ¢ 666. Does the government of recipient country object to the presence of any officer or employee of the U.S. who is present in this country for the purpose of carrying out economic development assistance on the basis of the race, religion, national origin, or sex of such officer or employee?	No.

Military Expenditures

21.	FAA ¢ 620 (s). What percentage of country budget is for military expenditures? How much of foreign exchange resources spent on military equipment? How much spent for the purchase of sophisticated weapons systems? (Consideration of these points is to be coordinated with the Bureau for Program and Policy Coordination, Regional Coordinators and Military Assistance Staff (PPC/RC).	During fiscal year 1976, Pakistan's known defense expenditures are projected to be about Rs. 8,200 million, 23% of the consolidated government budget. Last year defense expenditures were Rs. 6,832 million, about the same percentage of the total budget. We have no precise estimate of foreign exchange resources utilized to acquire military hardware and other defense equipment, but believe these to be about $200 million annually largely to replace and maintain obsolescent equipment, much of it supplied by the U.S. as military aid during the 1950's and early 1960's. Pakistan has purchased sophisticated weapon systems from abroad, including Mirage jet fighters from France, armored personnel carriers from the U.S. and tanks and jet fighters (many on concessional terms) from the Peoples Republic of China.

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Conditions of The Loan

General Soundness

22. FAA § 201 (d). Information and conclusion on reasonableness and legality (under laws of country and the United States) of lending and relending terms of the loan.

Not applicable.

23. FAA § 201 (b) (2); § 201 (e). Information and conclusion on activity's economic and technical soundness. If loan is not made pursuant to a multilateral plan, and the amount of the loan exceeds $100,000, has country submitted to A.I.D. an application for such funds together with assurances to indicate that funds will be used in an economically and technically sound manner?

Although this is a grant project, a thorough analysis of the economic and technical soundness of the project is included in the PP. The program as proposed is considered technically and economically sound.
A joint USAID/GOP committee has developed the project paper. An application was received. (See Annex H.)

The project agreement will include requirements for judicious use of the funds.

24. FAA § 201 (b) (2). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects.

Not applicable

25. FAA ¢ 201 (b) (1). Information and conclusion on availability of financing from other free-world sources, including private sources within the United States.

Although Pakistan has received and expects to continue to receive substantial assistance from other countries, this financing is largely committed to other high priority uses. Many of the projects financed by this other assistance are complementary to the project to be assisted here, and this combination results in a synergism that will substantially increase their total contribution to Pakistan's productivity, economic and social development, and repayment capability. A.I.D. is not now aware of any U.S. private sector interest in investing or otherwise contributing to this project activity.

26. FAA ¢ 611 (a) (1). Prior to signing of loan will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the United States of the assistance?

Not applicable.

27. FAA ¢ 611 (a) (2). If further legislative action is required within recipient country, what is the basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of loan?

No such legislative action is required.

28. FAA ¢ 611 (e). If the loan is for Capital Assistance, and all U.S. assistance to project now exceeds $1 million, has Mission Director certified the country's capability effectively to maintain and utilize the project?

Not applicable

Loan's Relationship to Achievement of Country and Regional Goals

29.	FAA ¢ 207; ¢ 113. Extent to which assistance reflects appropriate emphasis on: (a) encouraging development of democratic, economic, political, and social institutions; (b) self-help in meeting the country's food needs; (c) improving availability of trained manpower in the country; (d) programs designed to meet the country's health needs; (e) other important areas of economic, political and social development, including industry, free labor unions, cooperatives, and Voluntary Agencies; transportation and communication; planning and public administration; urban development, and modernization of existing laws; or (f) integrating women into the recipient country's national economy.	This project will improve small scale decentralized food processing and thus permit a continuing direct participation by rural people in the economic decision-making process. It is directly concerned with helping meet the country's food needs through self-help. (Note: (e) and (f) are not applicable
30.	FAA ¢ 209. Is project susceptible of execution as part of regional project? If so why is project not so executed?	No.
31.	FAA ¢ 201 (b) (4). Information and conclusion on activity's relationship to, and consistency with, other development activities, and its contribution to realizable long-range objectives.	This project is directly in line with Pakistan's major development plans. It will contribute to the achievement of food self-sufficiency, and improve the distribution of income.
32.	FAA ¢ 201 (b) (9). Information and conclusion on whether or not the activity to be financed will contribute to the achievement of self-sustaining growth.	Please see Item 31 above.

33.	FAA ¢ 209. Information and conclusion whether assistance will encourage regional development programs.	Not Applicable.
34.	FAA ¢ 111. Discuss the extent to which the grant will strengthen the participation of urban and rural poor in their country's development, and will assist in the development of cooperatives which will enable and encourage greater numbers of poor people to help themselves toward a better life.	This project will result in an increased return to small farm and and village-level food processors, which will have a direct impact on the qualitative improvement of the lives of rural people, and their chances for participation in development. Development of cooperatives cannot be predicted to any satisfactory degree at this stage.
35.	FAA ¢ 201 (f). If this is a project loan, describe how such project will promote the country's economic development taking into account the country's human and material resources requirements and relationship between ultimate objectives of the project and overall economic development.	Not applicable, grant funded
36.	FAA ¢ 281 (a). Describe extent to which the grant will contribute to the objective of assuring maximum participation in the task of economic development on the part of the people of the country, through the encouragement of democratic, private and local governmental institutions.	The project will encourage small-scale, private food processing in the rural section.
37.	FAA ¢ 281 (b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development; and supports civic education and training in skills required for effective participation in governmental and political processes essential to self-government.	The project recognizes the needs of the rural population and the desire for continuing participation in food processing activities and their desire and capacity to achieve income goals. There is no direct effect on the use of the country's intellectual resources or on civic education and training in skills needed for increased civic participation.

38.	FAA ¢ 201 (b) (3). In what ways does the activity give reasonable promise of contributing to the development of economic resources, or to the increase of productive capacities?	The adoption of improved food processing technology shall result in a more efficient utilization of economic resources and commensurate increase in incomes.
39.	FAA ¢ 601 (a). Information and conclusions whether grant will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; (c) encourage development and use of cooperatives, credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	a) The project will have no direct effect on international trade. b) The project will increase the opportunities for small-scale food processing and encourage efficiency among competitors. c) The project is not likely to affect cooperative activity. d) The project, by increasing the efficiency of small-scale food processing will increase competition in Pakistan's agro-business sector. e) The project will increase the technical efficiency of food processors. f) There will be no impact upon labor unions.
40.	FAA ¢ 619. If assistance is for newly independent country, is it furnished through multilateral organizations or plans to the maximum extent appropriate?	Not Applicable.

Project's Effect on U.S. and A.I.D. Program

41	FAA ¢ 201 (b) (6). Information and conclusion on possible effect of loan on U.S. economy, with special reference to areas of substantial labor surplus, extent to which U.S. commodities and assistance are furnished in a manner consistent with improving the U.S. balance of payment position.	Not applicable, grant funded.

42.	FAA ¢ 202 (a). Total amount of money under loan which is going directly to private enterprise, is going to intermediate credit institutions or other borrowers for use by private enterprise, is being used to finance imports from private sources, or is otherwise being used to finance procurements from private sources.	More than 65% of the AID grant will be used for technical assistance and contractor support costs in the private sector. Remaining AID financial costs are for commodities which will be procured in the private sector
43.	FAA ¢ 601 (b). Information and conclusion on how the grant will encourage U.S. private trade and investment abroad and how it will encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	This project is not expected to directly foster U.S. private trade and investment abroad.
44.	FAA ¢ 601 (d). If a capital project, are engineering and professional services of U.S. firms and their affiliates used to the maximum extent consistent with the national interest?	Not applicable
45.	FAA ¢ 602. Information and conclusion whether U.S. small business will participate equitably in the furnishing of goods and services financed by the loan.	Small Business notification procedures will be utilized.
46.	FAA ¢ 620 (h). Will the grant promote or assist the foreign aid projects or activities of the Communist-Bloc countries?	No.
47.	FAA ¢ 621. If Technical Assistance is financed by the grant, information and conclusion whether such assistance will be furnished to the fullest extent practicable as goods and professional and other services from private enterprise on a contract basis. If the facilities of other Federal Agencies will be utilized, information and conclusion on whether they are particularly suitable, are not competitive with private enterprise, and can be made available without undue interference with domestic programs.	Standard competitive procedures will be used to obtain services from private consulting firms on a contract basis.

Loan's Compliance with Specific Requirements

48.	FAA ¢ 110 (a); ¢ 208 (e). In what manner has or will the recipient country provide assurances that it will provide at least 25% of the cost of the program, project, or activity with respect to which the grant is to be made? or has a determination been made that the recipient country is relatively least developed and the requirement has been waived?	The project agreement will specify that the host country will provide at least 25% of the cost of the entire activity.
49.	FAA ¢ 660. Will grant be used to finance police training or related program in recipient country?	No.
50.	FAA ¢ 114. Will grant be used to pay for performance of abortions or to motivate or coerce persons to practice abortions?	No.
51.	FAA ¢ 201 (b). Is the country among the 20 countries in which development loan funds may be used to make loans in this fiscal year?	Not applicable, grant funded.
52.	FAA ¢ 201 (d). Is interest rate of loan at least 2% per annum during grace period and at least 3% per annum thereafter?	Not applicable, grant funded.
53.	FAA ¢ 201 (f). If this is a project loan, what provisions have been made for appropriate participation by the recipient country's private enterprise?	Not applicable, grant funded.

54.	FAA ¢ 604 (a). Will all commodity procurement financed under the loan be from the United States except as otherwise determined by the President?	Yes.
55.	FAA ¢ 604 (b). What provision is made to prevent financing commodity procurement bulk at prices higher than adjusted U.S. market price?	Not Applicable.
56.	FAA ¢ 604 (d). If the cooperating country discriminates against U.S. marine insurance companies, will project agreement require that marine insurance be placed in the United States on commodities financed by the loan?	Not Applicable.
57.	FAA ¢ 604 (e). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity?	Not Applicable.
58.	FAA ¢ 604 (f). If grant finances a commodity import program, will arrangements be made for supplier certification to A.I.D. and A.I.D. approval of commodity as eligible and suitable?	This is a project grant.
59.	FAA ¢ 608 (a). Information on measures to be taken to utilize U.S. Government excess personal property in lieu of the procurement of new items.	Not Applicable.
60.	FAA ¢ 611 (b); app ¢ 101. If grant finances water or water-related land resource construction project or program, is there a benefit-cost computation made, insofar as practicable, in accordance with the procedures set forth in the Memorandum of the President dated May 15, 1962?	Not applicable

61.	FAA ¢ 611 (c). If contracts for construction are to be financed what provision will be made that they be let on a competitive basis to maximum extent practicable?	Not applicable.
62.	FAA ¢ 612 (b); ¢ 636 (h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the United States are utilized to meet the cost of contractual and other services.	The host country will provide agreed amounts of local currency expenses of the project.
63.	Section 30 and 31 of PL 93-189 (FAA of 1973). Will any part of the grant be used to finance directly or indirectly military or paramilitary operations by the U.S. or by foreign forces in or over Laos, Cambodia, North Vietnam, South Vietnam, or Thailand?	No.
64.	Section 37 of PL 93-189 (FAA of 1973); App. ¢ 111. Will any part of this grant be used to aid or assist generally or in the reconstruction of North Vietnam?	No.
65.	FAA ¢ 612 (d). Does the United States own excess foreign currency and, if so, what arrangements have been made for its release?	The U.S. owns excess Pakistani rupees that are programmed for use in a number of projects.
66.	FAA ¢ 620 (g). What provision is there against use of subject assistance to compensate owners for expropriated or nationalized property?	Proceeds disbursement procedures to be included in the project agreement will prevent use of the funds for purposes other than intended.

67.	FAA ¢ 620 (k). If grant is for construction of productive enterprise, will aggregate value of assistance to be furnished by the United States exceed $100 million ?	Not Applicable.
68.	FAA ¢ 636 (i). Will any grant funds be used to finance purchase, long-term lease, or exchange of motor vehicle manufactured outside the United States or any guaranty of such transaction?	No.
69.	App. ¢ 103. Will any grant funds be used to pay pensions, annuities, retirement pay, etc., for military personnel?	No.
70.	App. ¢ 105. If grant is for capital project, is there provision for A. I. D. approval of all contractors and contract terms?	Although this is not a capital project, there will be a provision for AID approval of contractors and contract terms.
71.	App. ¢ 107. Will any grant funds be used to pay UN assessments?	No.
72.	App. ¢ 108. Compliance with regulations on employment of U. S. and local personnel. (A. I. D. Regulation No. 7)	Not Applicable.
73.	App. ¢ 110. Will any of grant funds be used to carry out provisions of FAA ¢ 209 (d) or FAA ¢ 251 (h)?	No.
74.	App. ¢ 112. Will any of the funds appropriated or local currencies generated as a result of AID assistance be used for support of police or prison construction and administration in South Vietnam or for support of police training of South Vietnam?	No.