

PN-ABL-723

7/8291

CONSULTANCY REPORT  
ON  
FARM EQUIPMENT MANUFACTURING TECHNOLOGY CENTERS

MAY 04 - 30 1992

Fred E. Nichols  
3580 Rainbow Blvd.  
Apt. 828  
Kansas City, Kansas 66103

Submitted to  
Winrock International  
USAID Agricultural Research Project  
7, Poorvi Marg, Vasant Vihar  
New Delhi - 110 057  
India

May 30, 1992

## TABLE OF CONTENTS

	PAGE
I. SUMMARY	1
II. INTRODUCTION	2
III. OBSERVATIONS AND FINDINGS	
a. Facilities and Equipment	3
b. Building Layout and Machine Tool Placement	3
c. Machine Tools and Equipment	6
d. Training and Personnel	7
e. Product Development	10
f. Manufacturers and Industrial Climate	11
g. Agro Industrial Extension	14
IV. RECOMMENDATIONS	17
V. SUMMARY	19
APPENDIX	21

## SUMMARY

During the period 4-30 May 1992, the consultant interacted with the Director, Central Institute of Agricultural Engineering and his staff to evaluate machine design projects, review the Farm Equipment Manufacturing Technology Center building plans and equipment lists, consider jigs and fixture requirements and visited manufacturers in Bhopal, Indore and Coimbatore to assess product developments and training needs.

Suggestions and plans were prepared to further improve the FEMTC building and equipment layout and for staff assignment and training needs. At present the Agro Industrial Extension Division is understaffed and lacking in experienced manufacturing or production engineering personnel.

Research and development projects were reviewed to determine whether research and development engineers were giving sufficient attention to market acceptability and manufacturing factors in the development process. This is clearly a weakness in the system and suggestions were made regarding staff evaluations and project approval procedures to encourage greater attention to these aspects in the development process.

Though technical training for small scale manufacturers is to be the primary focus of the FEMTC training, the consultant recommended this be initiated after business management training programs were developed and given to the manufacturers. Most small businesses fail due to business management deficiencies and not technical or product deficiencies.

Agro Industrial Extension is reviewed with its' importance in delivering applied research to farmers and industry. Staffing, training and operational flexibility are discussed with suggestions for increasing the effectiveness of the division. The sub-centers in Coimbatore and Ludhiana were considered with suggestions for their staffing and equipping for more effective communication, liasion and demonstation activities.

## I. INTRODUCTION

### a. Background and Objectives.

All who may read this report will have general if not detailed knowledge of India agriculture, advances and developments therein and some of the needs of the farmers of this nation. Thus, I will not attempt to repeat the various statistics concerning this all important sector. However, the benefits of agricultural advances have not been uniformly distributed throughout the agricultural community. Thus, the range of needs that the agricultural machinery manufacturers must attempt to fulfill ranges from the simplest hand tools to complex units such as self-propelled combine harvesters. Skills and capabilities of the manufacturers have a similar broad range. To assist the farmers and the manufacturers, the Central Institute of Agricultural Engineering (CIAE) Bhopal has an equally complex and difficult task to fulfill. The success of CIAE is judged both by the applied research conducted and the number of useful machines developed and in production by local manufacturers.

In spite of growth in the industry, there is still a great need for further development and growth of the manufacturers, improvement in the quality of goods they produce, their overall business management capability and in the marketing of their products. Too often, farmers buy and use substandard equipment and lose money due to this equipment's failure. The lack of information regarding quality equipment produced elsewhere in the country or of equipment designs that may be more suited to their needs is a continuing problem even in today's world of near instant communication. Prior projects have addressed these problems and have achieved some degree of success. To build on this success, a project on Farm Equipment Manufacturing Technology Centers (FEMTC) was proposed in 1987 but failed to obtain outside financial assistance. However, the project was continued by the Indian Council of Agricultural Research (ICAR)

as an internally funded project.

The project objectives as stated in the sanctioning letter are as follows:

"The fundamental objective of the project is to establish a farm equipment manufacturing and promotion center to undertake activities which will achieve the following specific supporting sub-objectives--

1. To strengthen the manufacturing capabilities of CIAE, Bhopal to undertake batch production of improved proven agricultural machinery for piloting the technology.
2. Improve the quality and technology of manufacturing of agricultural implements and adoption of appropriate standards.
3. Transfer improved manufacturing technology to manufacturers through better manufacturing processes and practices.
4. Improve the ability of manufacturers to select and obtain appropriate high quality materials and component parts.
5. To study and develop a stronger linkage between research, manufacturing and crop production activities to reflect the farmers needs in the machines manufactured."

The assignment of this consultant as contained the terms of reference (see appendix) was to assist the CIAE in further refining the above project via evaluation and modification, if required, of the building plans, machine tools and equipment planned for the Center, assistance with jigs and fixture development for tested designs for future manufacture and assistance in the further development of designs for manufacture. The assignment was completed by interaction with staff and technicians of CIAE, Bhopal. visits to and extended discussions with manufacturers in Bhopal, Indore and Coimbatore and discussions with the Assistant Director General (Engineering) and others in ICAR.

## II. OBSERVATIONS AND FINDINGS

### a. Facilities and Equipment

The continuing development of CIAE, Bhopal has added considerable space for offices, research and development activities and workshop area. With current planned and budgeted training facilities and the FEMTC, CIAE, Bhopal will have suitable facilities to fulfill its current role within ICAR. At present, there is inadequate workshop space for the machine tools and equipment in the inventory. Thus, some machines are only temporarily installed, work area around the machines is limited and worker safety is compromised. Therefore, there is some urgency to the need to construct the FEMTC, relocate and redistribute the equipment between the FEMTC and a smaller research and development workshop.

A FEMTC building floor plan had already been prepared by CIAE. This was reviewed and suggestions for minor revisions in draft form were submitted and discussed with the CIAE staff.

### b. Building Layout and Machine Tool Placement.

I have no major changes to suggest regarding the present building floor plan. A rectangular building will provide more useable working space than nearly any other plan. It would be desirable to place the workers changing room and toilet as a small extension to the south side of the building. This would permit expansion in the future into the open court yard with a structure similar to the materials storage unit.

I question building shelves into the entire length of the building on the one side and between doors as shown on the other. I would guess that they would serve more as "junk collectors" than as useful storage or working areas. They may take up more useable floor space than storage space provided. I believe it more efficient to plan the functions within the building, machine tool placement and then determine where the shelves may or may not be placed.

Assuming that the structure would be built as shown in the one drawing, I prepared a rough sketch of how machine tools and equipment might be placed in the building (Figure 1). This is only a generalized plan and the best way to determine specific location and spacing of the equipment is to make a template for each machine to the same scale as the building floor plan. These templates should show the actual machine base area as well as required work area around the machines for SAFE operation and material handling. This suggested plan permits material flow from the material storage unit directly into the shearing, sawing or other size reduction machines with direct access from along a "visualized" alley in from the first door, down the building and out the second door. This alley provides handling area and work space for larger pieces. The placement of the two doors onto the open courtyard can be adjusted to permit best use of space between the doors for the equipment planned. Using the templates suggested will permit quick trial of different layouts and placement of doors accordingly.

When machine locations have been fixed, a suitable electrical distribution plan can be drawn up and emphasized to the civil planners to ensure that electrical power lines and service outlets are located as needed. Total power available to CIAE is assumed to be sufficient for this facility and all others but this should be rechecked to ensure that adequate electrical lines are installed to the FEMTC.

I suggest placing the air compressor as indicated in figure 1 with an air line running the length of the wall and along the south wall to the painting booth with air jacks every 3-4 meters. This permits air cleaning of machine tools as well as operation of pneumatic hand tools and other equipment without the need of long air hoses that all too frequently and easily are damaged.

I suggest including a tool room and tool crib as shown near the office area. The tool grinder, small pedestal grinder and other tool maintenance equipment would be placed adjacent to the

ool room. A precision flat table, material testing equipment, and other special operations (low noise) would be adjacent to the office area.

There is a stairs indicated on the drawing and I am assuming that the office area is a two storied unit. Since this facility will be used for training as well as fabrication of prototypes, and there is no training room, you may wish to extend the second floor area out sufficiently to have a classroom above the shop office area.

I have placed the welding area in the far corner of the building with an indication that it is partially enclosed. The enclosure should be moveable panels but should shield the other workers in the shop from welding flash. It is rare in India to see such protection from welding flash but it is required in all industrialized countries as arc welding flash can and will lead to blindness. Safety must be a concern of CIAE not only in the design of agricultural equipment but in its production. Similar measures should be taken in the existing workshops and safety should be especially emphasized in the training programs of the village artisans and other skilled laborers.

Shifting the workers changing room and toilet permit placing the painting section as shown in the other corner with direct exhaust to the south of the building.

The area between the painting booth and the welding enclosure and the alley in from the door becomes the machine assembly area. Thus, there is a flow of raw material in the one door, material cutting, fabrication, finishing and assembly through the building and out the second door with a finished product. This should be a more productive layout as well as providing greater safety to all employees.

At present there is no storage for jigs and fixtures. I would suggest fabrication of moveable shelving units for use within this planned building but that could be easily moved to an extension of the building in the future.

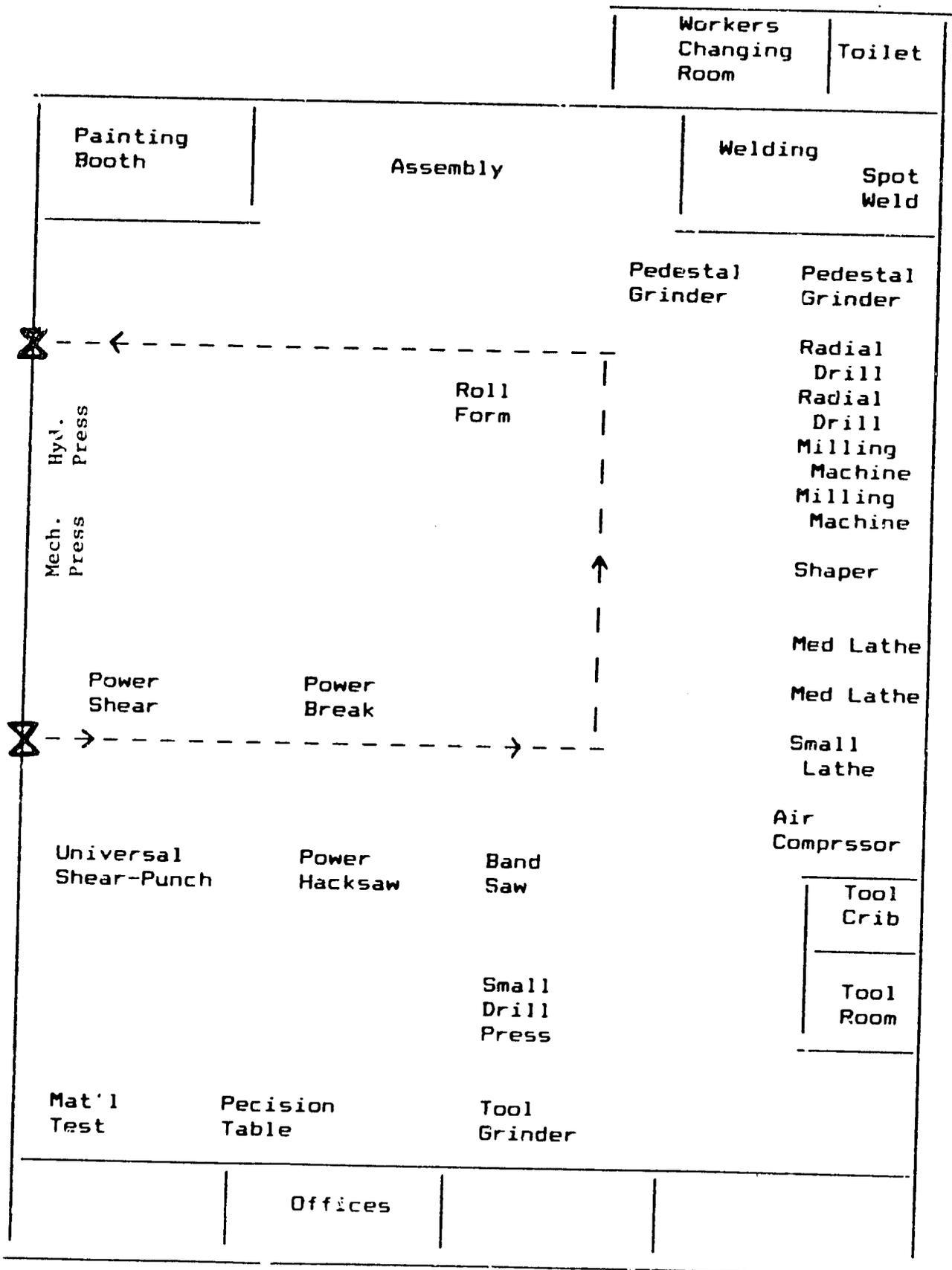


FIGURE 1. FEMTC BUILDING AND EQUIPMENT PLAN

c. Machine Tools and Equipment.

As stated earlier, workshop area limits the use of some machines and creates some safety hazards. However, CIAE's existing inventory of machine tools and equipment exceeds that found in all small manufacturers and even some medium scale manufacturers. Thus, the construction of the FEMTC and purchase of additional machine tools requires a careful review of plans and inventory to ensure that extensive duplication and unnecessary expenditure does not occur. The FEMTC and the research and development workshop should specifically support the defined objectives of CIAE.

I suggest the deletion of the woodworking equipment as a small woodworking shop exists and there is considerable skill and capability in the private sector now to provide the limited wood components required for machines. It is doubtful that CIAE can provide a higher level woodworking skill than already found throughout the nation nor are there many machines or components made from wood that require a capability beyond existing machines or tools that could be purchased from research project funds. Additionally, the woodworking shop should be separated from the metal working areas.

Though the materials testing equipment specified in the sanctioning letter is limited, I believe it desirable to further reduce the list. I recommend that the metallurgical microscope with camera, etc. and the chemical analysis equipment be deleted. There is within Bhopal, in another government agency, the facilities to perform the metallurgical tests, etc. that may be required and their services should be obtained on a case by case and as needed basis.

Mechanical and hydraulic presses are in inventory and a careful evaluation of addition need should be completed before purchasing additional units. I believe it more desirable for CIAE to fabricate the small 15-20 ton press planned, as a model for the small manufacturers to follow, should their production plans require a press. It is not difficult to design and

fabricate a 15-20 hydraulic press from readily available materials and components. The FEMTC should not only serve to show and train personnel on new and proper production tools but to demonstrate methods of achieving similar objectives at a lower cost.

It is unclear to me exactly what machine a "programmable die sinking m/c" is but I seriously question whether it is needed or desirable to include it at this time. From this description, I can guess that it is a higher order machine that will not be seen in small and medium scale factories for many years. I believe it is wiser to keep the machine tools and equipment within the range of dreams and hopes of the small and medium scale manufacturers for the balance of this decade and update equipment at that time when many things will have changed and needs of industry will be further defined. The relevance of highly sophisticated equipment to the needs of the small and medium scale manufacturers at this time and the near future is not apparent to me and I doubt to them either.

#### d. Training and Personnel

The Agro Industrial Extension division has inadequate experienced staff to perform the current tasks. This problem will be further exacerbated with the construction and equipping of the FEMTC. To conduct the field testing, design modification, fabrication of prototypes, training of technicians, engineers, manufacturers, and skilled laborers, field demonstrations and other tasks will require knowledge, skill levels, and personnel not presently assigned to the division. The technicians and skilled laborers in the workshops are well trained and experienced workers and can operate the equipment well. However, there should be some program to keep them current with industry progress and methods as they will, directly or indirectly, conduct some of the training.

No engineer in the division has manufacturing plant experience and two of the manufacturers visited expressed doubt

regarding the capability of CIAE to provide useful training to manufacturers. Thus, I believe this division must be strengthened by the transfer of qualified personnel into the division. When planning training, and appropriately qualified personnel are not available within CIAE, a program to use such personnel from industry and other institutions should be available to ensure that CIAE effectively leads in training. If the trainee, regardless of level, perceives that he has greater knowledge than the trainer, the training effort is lost.

Though the focus has been on technical training for small manufacturers, I firmly believe their success or failure has little to do with their capability to manufacture a product. Prior experience in India and other countries along with the many discussions with manufacturers during this visit clearly indicate that business management skills are a major constraint for many of them. Marketing, after sales services, dealer networks, finance and cash flow, loans for working capital and equipment, purchasing, budgeting and accounting practices, planning and the myriad of other details that must be attended to for a business to achieve success are as important as producing a quality product at a low cost.

Thus, it seems desirable for CIAE to work with other institutions and the business sector to develop a small business enterprise management training program that would address the issues listed above. This training should probably precede technical training programs to provide a stable and growing business environment where technical training can be effectively used.

Contract labor is the primary labor force in small to medium scale businesses. Thus, when it is proposed to train manufacturers in the technical aspects of production, the system only trains a few managers or overseers as they are the only "regular" employees of the manufacturers. They leave nearly all production procedures and problems to the labor contractor. Within this system, there is little or no incentive for the

manufacturer or labor contractor to use improved production methods which give a higher labor productivity, reduce material waste and provide a higher quality end product. Further, there is no incentive for the labor contractor or the laborer to undergo training as they lose their earning capability while in training and government systems and procedures prevent paying a stipend equal to their daily wages. These problems must be addressed if the FEMTC is to have a useful role in training the personnel involved in the production of agricultural products and improvement in product quality.

The question was raised regarding how to create greater interest in manufacturing design and production aspects within the research and development engineers. The simplest answer is that a person either has or does not have such an interest. However, interest can be developed through incentives or possible career retarding penalties. In the present personnel evaluation system for research personnel, there is no question regarding whether any of the individuals designs from research projects achieved commercial manufacturing success. Success should be judged on how many are in actual use by real farmers and not on whether a few have been produced for trial and use on other government farms.

There are also very limited reference materials on production and manufacturing engineering and business in general available in the CIAE library. I suggest that the CIAE subscribe to such monthly publications from India, especially a weekly or monthly Indian business magazine. If manufacturing and production engineering magazines are not published in India, then the British Library and the USIS library should be checked to determine what publications are available, which might best fulfill the need of the institute and then subscribe to one or more of the magazines. These publications should provide ideas to the engineers and provide a greater understanding of the manufacturing sector.

#### e. Product Development

Discussions with research and development personnel regarding their development projects and problems therein suggest areas needing attention that could bring products to the market sooner. Apparently few make working sketches of the machines they are developing, let alone actual drawings of the unit and its components as they begin a project. Dated sketches and drawings provide a record of where you started and all modifications completed in developing a finished product. This eliminates making the same revision twice, provides others with a written record of all ideas tried which will reduce the expenditure of funds in a "re-inventing the wheel" process. Also, this approach permits one to look at the design on paper and consider fabrication procedures. This should lead the research and development person to think of manufacturing processes and requirements as the design goes through the research and development phase and perhaps simplify the design in the process. Complaints on the quality of agricultural products are frequently caused by not considering product quality as a design and manufacturing objective.

It was frequently stated that standardization would lead to improved quality and that drawings were needed for standardization. I agree that drawings are definitely needed and standards assist in improving quality. But, I wonder if I have a different understanding of the meaning of standardization. I would like to emphasize that drawings do not produce standardization but do permit repeatability in the manufacturing process, consequent interchangeability of components when required and a higher quality of product. Standards are used to provide operator safety and comfort as well as for the manufacture of components that are used across industries such as bearings, belts, pulleys, gears, sprockets, drive chains, etc.

The CIAE is an applied research institution. However, it seems that many of the personnel view themselves as basic research personnel and approach machinery development with more

of a theoretical than an applied orientation. I believe this extends the development process, delays the entry of machines into the commercial market and often times produces a machine that is of theoretical interest but has no market acceptance.

The number of commercial designs from CIAE and the flow of such designs from the All India Coordinated Research Schemes is not as great as the manpower and budgetary input might suggest. As a consequence, industry frequently develops products in response to market needs in advance of the research and development community. Then projects are taken up by the research community to develop a similar machine or further develop or improve on these products that frequently repeat the same mistakes that the manufacturer made in the original development of the products. One possible way to short circuit this process would be for CIAE to go to the labor contractor of a manufacturer with a new product, have them come to the institute and fabricate the product jointly with the CIAE technicians. There would be a mutual exchange of knowledge and training between the technicians and skilled labor, a new product would be quickly available for test and evaluation, and the development engineers could use their skills in improving a product for greater benefit to the farmers. Benefits flow to the manufacturer, to the labor contractor and to CIAE and should reduce the overall cost of product development and improvement. Few small or medium scale manufacturers have engineering staff. Thus, the challenge to the CIAE engineers is to demonstrate that their skill as development engineers exceeds the intuitive approach and experience of the small manufacturers.

A verbal design analysis of three projects was conducted with the project engineers. Ideas for modifications that would greatly simplify the manufacturing process and components required were discussed. Further testing procedures were suggested along with ideas for determining potential marketability and total market for the products.

#### f. Manufacturers and Industrial Climate

It was a pleasure to encounter the enthusiasm and optimism of the manufacturers at this time compared to attitudes during prior visits. Development within the agro-industrial sector still has much room for advancement. But, the production of over 120,000 tractors per annum strongly suggests that mechanization and the need for improved tractor powered implements of all types will increase at a rapid rate.

Currently, there is limited pressure on manufacturers to improve their quality. However, some did indicate that the farmers had a much greater awareness of machine quality and were beginning to make their purchases accordingly. There is considerable difference in product quality between manufacturers at this time but market forces will sooner than later force each to improve quality or go out of business. This will ultimately be of real benefit to the farmers as the industry consolidates, providing not only a higher quality product but improved service support for their products.

However, there is clearly a belief among the farmers and many manufacturers that improved quality means more iron in the product. Thus, many machines are becoming quite heavy and this approach may in some cases be self defeating. More iron, more rigidity, more weight and the stresses imposed during operation may lead to more rapid failure than if flexibility and balance in design were considered. It is also wasteful of materials. This provides an opportunity for CIAE to assist in evaluating machine failures, and use good engineering design and test procedures to improve the products. But, it seems that there is such limited contact and information flow between industry and the research and development community that the opportunity and challenge therein go unmet.

There have been product improvements by manufacturers in response to farmers complaints and the requirements of standards established by the Indian Standards Institute. This is encouraging and should continue to improve the products that the

farmers use.

Some manufacturers visited could cite no benefit obtained from belonging to the State's Farm Machinery Manufacturers Association. I received the impression that they considered it an obligation to belong to the association but that they expected nothing from it. Plus, as independent businessmen, they did not want anyone or association interfering with the operation of their business. With this attitude, it would be difficult to have the Association take on any responsibility for activities that would be perceived as assisting their competitors. Most desire to remain "independent" businessmen with their own product and product identification. But, marketing and marketing management skills are a major deficiency of nearly all the small manufacturers.

A marketing cooperative/association might be possible for small manufacturers if there was some working capital for the cooperative/association to buy inventory stocks of equipment from the manufacturers. At present, most smaller manufacturers can only produce one to five units for inventory from working capital. When the season arrives for use of that equipment, the demand far exceeds the supply but manufacturing time does not permit production of units in time to meet the demand. The farmers needs are unmet and the manufacturer misses the opportunity to produce, profit and grow.

All manufacturers visited used contract labor. The few employees maintained by the manufacturers are primarily in management of operations and quite senior people. These people will be the ones available for training and are the more difficult to train as nearly all have obtained their positions based on work experience and would be skeptical of training by young inexperienced personnel from government agencies. Contract labor skills obviously vary greatly and the pressure from the manufacturer to produce a quality product varies greatly too. Though a few jigs and fixtures had been previously provided to some manufacturers by CIAE for production of implements, they

were not to be seen and were clearly no longer in use. The manufacturers do not see the need for jigs and fixtures to improve quality or productivity as labor contracts apparently provide little incentive to the contractor for improved quality and productivity. The market at present consumes enough product to satisfy the aspirations of most of the manufacturers. This too limits the capability to pressure the manufacturer to improve the products he produces. Thus, further study is required of the contract labor-manufacturer relationship to develop appropriate incentive programs for training of individuals and product quality improvement.

There is limited component manufacturing or specialization among agricultural manufacturers at present. Though I believe there is considerable room for development in this area, there was limited interest expressed to move in this direction. Most expressed a desire to continue to produce the entire product themselves without too much consideration of the economics of this approach versus that of component manufacture and specialization.

However, with the continued growth of tractor production in India and the great number of tractor units now in use, I firmly believe that power take off (PTO) driven implements will become far more common in the future. But, there is no manufacturer of PTO shafts in the country. Thus, this appears as a real opportunity for some manufacturer to acquire technology from Europe or America for the production of telescoping PTO shafts for the tractor horsepower sizes produced here. This would also influence future field equipment designs and the research and development projects that might be considered by CIAE staff. Further, PTO shaft standards used in Europe and America are available in the CIAE library and could be used to assist interested manufacturers in developing these shafts here.

#### g. Agro Industrial Extension

The FEMTC would be the responsibility of the Agro Industrial

Extension Division of CIAE. This requires that additional personnel be assigned to the division at all levels. Assuming a redistribution of machine tools from the research and development workshop and a redefinition of the functions of these workshops, skilled labor would transfer with the machines. This will place a great management load on the head of the division. Additionally, agro industrial extension requires dynamic leadership to respond to both industry needs and farmer needs as well as to interact with the research and development divisions effectively.

Agro industrial extension work has a much greater reactive component which makes planning and budgeting more complex and difficult if funds are to be available to effectively respond to needs. There must be much greater funding and expenditure flexibility for the extension division if it is to respond to needs that arise on short notice. Current government procedures make it nearly impossible for the agro industrial extension division to respond on short notice and with appropriate funds to requests for farmer demonstrations. By the time approval and funding is received, the need or desire for the demonstration has vanished for at least one cropping season and possible forever. The government system does not recognize the difference between a research project that can be planned and budgeted in advance in reasonable detail to permit bureaucracy to move at its usual pace and an agro industrial extension projects that must be reactive and responsive. Thus, it seems that CIAE and ICAR must develop some procedure that will permit greater flexibility of funding and expenditure and on site decision regarding agro industrial extension responsiveness if the FEMTC is to meet the expectations of government.

Though the plan is to construct one FEMTC at Bhopal, the two sub-centers at Coimbatore and Ludhiana should not be ignored. I do not believe it is wise to construct similar facilities at these locations in the near term future but they should be staffed to permit effective liaison with industry, conduct field

demonstrations and testing and evaluation of machines in their areas. Though a small facility for equipment modification is desirable, each location has sufficient access to manufacturing facilities to have prototypes built and modifications made on a cost only contract basis. This reduces staffing costs and management problems. However, they must be provided with the funding flexibility to respond promptly to demonstration requests and for field evaluation of machines. Assignment of appropriate vehicles for demonstration and field test is a must along with a driver, technicians, and support personnel.

Based on discussions with the Coimbatore project personnel and other observations, I believe it is desirable to equip these sub-centers with a video camera, VCR and television for use not only in the villages but for training and technology transfer to manufacturers. Too often, farmers request an equipment demonstration for the sole purposes of have their crop harvested free of some other field operation performed free. This is a drain on resources for no benefit to the project or manufacturers of the equipment. Video tapes of demonstrations and equipment performance could be used in response to these requests. If the farmer is truly interested in the machine, he can contact the manufacturer and purchase same. With the suggested video equipment, movies or other attention generating films could be shown in conjunction with tapes of machines and new developments in the villages. At some point, field demonstrations of the specific machines become the responsibility of the manufacturer and the agro industrial extension unit goes on to newer developments.

Additionally, the video equipment could be used in conjunction with testing to document how and why "more iron" may not be the answer to quality problems. Tapes of manufacturing processes and procedures could also be used in the training of the manufacturers.

Effective communication with the farmers or others who may be illiterate is a problem for everyone. Preparation of machine

operation manuals in a form useable to the farmer is a task that most manufacturers are not prepared to meet. I have seen some very effective safety and energy conservation messages and operation procedures conveyed through comic books with little or no narrative. I believe this form of communication should be considered for farmer communications from the extension division as well as the manufacturers.

It should be remembered by all concerned, that only if Agro Industrial Extension effectively performs all tasks required of it will the research and development divisions be able to also point to their success.

### III. RECOMMENDATIONS

1. A final listing of machine tools to be transferred from the existing workshop and those to be purchased should be finalized as soon as possible. Space needs templates of these machines should be prepared to permit a final building design layout with most effective space use plan. Construction plan development can then be completed at an early date.

2. Redefine workshop tasks between the FEMTC and the research and development workshop and assign personnel accordingly. In line with the assignment of existing personnel, complete a full staffing analysis for the FEMTC and Agro Industrial Extension Division and reallocate personnel to meet the requirements of this division to perform the assigned tasks.

3. Initiate greater contact with the various manufacturing associations and manufacturers to determine methods of more effective communication, cooperation, information and personnel exchanges. Personnel exchanges could be viewed as short term training exchanges and be of benefit to all concerned.

4. Increase industry, business and manufacturing reference and current production technology information availability via subscription to business magazines and industry journals.

5. Plan and develop a small business management training course as the initial training program for small manufacturers.

Manufacturing technology training can be provided when appropriate means and incentives for training the contract labor force used in small scale industry has been developed.

6. Require all research project proposals be prepared with reasonable sketches or drawings of the machines to be developed prior to approval for research funding.

7 Include in the individual staff appraisal an evaluation of the number of projects and designs that have achieved successful commercial production to instill a greater sense of the commercial goal of the applied research.

8. When machinery development in industry runs ahead of the research and development community, plan and budget for the hiring of some manufacturers contract labor to work within the workshops of CIAE to quickly fabricate the latest machine design. CIAE engineers can then use their engineering knowledge to further develop and improve the machines in a much short time and reduced cost to the government.

9. Continue to encourage small and medium scale industry to enter component manufacturing and use joint efforts, especially in marketing, to meet market demand with higher economic returns to the manufacturers.

10. Study the manufacturer-contract laborer relationship with the goal of developing some means of providing incentives to both in the effort to raise product quality standards.

11. Staff the Agro Industrial Extension Division with appropriately trained and experienced personnel while recognizing and extending a degree of funding and expenditure flexibility required for the division to be reactive and responsive to farmer and industry needs.

12. Continue to support the sub-centers at Coimbatore and Ludhiana and in particular provide needed staff and a video camera, VCR and television for greater effectiveness in communicating to farmers and industry.

#### IV. SUMMARY

The consultant visited India from 4-30 May 1992 and interacted with the CIAE Director and Staff and the manufacturers in Bhopal, Indore, Bombay and Coimbatore in accomplishing the objectives defined in the terms of reference. The FEMTC building plans and equipment lists were reviewed and suggestions made for arriving at a final building plan and equipment list. Additional suggestions for functions within the FEMTC were made and discussed with CIAE personnel.

Three design projects were evaluated with the project engineers and suggestions made for modifications to possible improve function and greatly reduce manufacturing cost.

Visits to manufacturers in the various locations revealed a considerable degree of optimism regarding their future and the future of agricultural machinery manufacture in India. Quality remains a problem for many but there is clear evidence that farmers do know and look at product quality, will pay additional for a quality product and are making their purchase decisions accordingly. However, there is the problem that farmers and the small manufacturer equate quality with heavier construction, i.e. more iron. This may not be the answer and could be counter productive. This presents an opportunity for the research and development engineers of CIAE to use their engineering skills to demonstrate other means of providing quality and desired durability.

Construction of the FEMTC is recommended along with appropriate staffing and modification of funding and operating procedures to permit effective and timely response to the farmer and industry needs.

Training is discussed and it is suggested that business management training be conducted prior to initiating technical training for manufacturers. Most small businesses fail from poor business management and not their technical or product failure. CIAE staff training is also discussed with suggestions for increasing awareness of manufacturing requirements, exchange

training with manufacturing firms and staff evaluation procedures that include an evaluation of how many projects achieved commercial production.

Business, manufacturing and production engineering references and publications were lacking in the CIAE library and recommendations made for correcting this deficiency.

Manufacturer-contract labor relationships are considered with the impact they have on product quality improvement and the training programs. It is proposed that a study project be initiated to determine how an incentive program could be developed that would provide sufficient reward to each party to improve quality, productivity and skill levels through training.

The sub-centers at Coimbatore and Ludhiana were considered and suggestions were made on their staffing, function and equipment needed to fulfill their suggested role.

TERMS OF REFERENCE

TERMS OF REFERENCE  
FOR  
FRED E. NICHOLS

Consultant on Farm Equipment  
Manufacturing Technology

Considerable progress has been made by the Central Institute of Agricultural Engineering, Bhopal and other centres of agricultural engineering in India towards the development of working prototypes for small-scale farm eqpt (exclude tractors). Many of these prototypes have been perfected to the level of becoming field worthy but have not progressed further to the stage of manufacturing models in many cases. The FEMTC will endeavour to fill this gap between the working prototypes and commercial production models and development of their marketing thru:

1. Upgrading prototype production and feasibility testing of small-scale farm eqpt.
2. Demand generation.
3. Training activities.

AAA. The Consultant is expected to assist the Central Institute of Agricultural Engineering, Bhopal in the following:

1. Production development of selected items of small-scale farm machinery.
2. Development of jigs and fixtures for the manufacture of selected small-scale farm machinery developed by the CIAE and having commercial potential.
3. Further strengthening of the prototype manufacturing capabilities of the CIAE thru manpower trng, indentification of production eqpt and technology transfer.

## ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Dr. N.S.L. Srivastava, Director, CIAE for making all facilities and staff of the Institute fully accessible and readily assisting me in fulfilling this assignment. A special thanks to Dr. P.K. Das, Head, Industrial Extension Division, for accompanying me in visits to manufacturers, sharing his studies of the industry, and the exchange of ideas as we searched for solutions to the problems presented. Also, a special appreciation to Mr. P. Datt, my old friend and colleague of Coimbatore days, for sharing ideas, advances, future directions to consider and advising me when my ideas were far afield.

I would be remiss if I did not express a sincere thank you to Dr. Gyanendra Singh, Assistant Director General (Engr) ICAR, for the confidence expressed in inviting me to perform this assignment and in providing ICAR and CIAE support.

It was a pleasure to see the progress made in the last few years and participate again in the developments of the future.

## ITINERARY AND PERSONS VISITED

- 2 May 1992      Depart Home for India; International air travel
- 3 May            International air travel
- 4 May            Arrive New Delhi; Meetings with Winrock Staff and Dr.(s) G. Singh, T.P.Ojha, and N.S. Randhawa, ICAR
- 5 May            Travel to Bhopal; Meet with CIAE staff
- 6 May            Meet with Dr. N.S.L. Srivastava, Dir. CIAE, Interview staff and review ref. materials
- 7 May            Study reports and discuss ideas with CIAE staff
- 8 May            Check machine shops, equipment, and discuss needs with shop foreman and other staff
- 9 May            Prepare notes on weeks activities, thoughts, and outline material for report
- 10 May           Weekend
- 11 May           Study equipment designs, jig and fixture needs and discuss with various staff
- 12 May           Review training programs with P. Datt and future plans. Travel to Bombay postponed due to flight delays.
- 13 May           Day spent in attempted travel to Madras and Coimbatore. Terminated travel in Bombay late p.m.
- 14 May           Visit B.K.S. Jain and Associates for discussions on industry developments and directions. Study reports and information provided.
- 15 May           Visit American Spring and Press Works and other small component manufacturers.
- 16 May           Return to Bhopal. Prepare notes on trip and draft ideas and thoughts for report.
- 17 May           Weekend
- 18 May           Continue interview staff, sharing of ideas and modifications for equipment.
- 19 May           Prepare suggestions on building plan and general equipment layout with details for specific siting of equipment.

20 May Visit Bhopal manufacturers--Laxmi Industries; Prakash Agro Industries; Lalwani Industries (2 sites); Fine Fabrication Works and Tesla Technocrat.

21 May Review machine designs and possible modifications. Continue report draft.

22 May Discuss jigs, fixtures, tools with CIAE staff and review work with Dr. G. Singh.

23 May Travel by road to Indore. Visit Baheti Machinery Stores, Surya Engineering Works and Solanki Loha Laghu Udhog Kendra & Ganesh Iron Works.

24 May Weekend

25 May Review Indore visit and outline of report and recommendations with Director, CIAE and staff. Discuss possible new projects and design ideas.

26 May Travel Bhopal to New Delhi. Write on report. Meet with Dr. T.P. Ojha and Dr. G. Singh to review work and ideas from report. Meet with Dr. Peter van Schaik to discuss areas of mutual concern.

27 May Travel to Coimbatore. Meet with manufacturers that area and hold discussions with Industrial Extension Project personnel.

28 May Continue visits to Coimbatore manufacturers, review designs and plans of CIAE Industrial Extension Project. Return to New Delhi late night.

29 May Report preparation.

30 May Complete report and prepare separate materials for CIAE staff on Industrial Extension Project.

31 May Travel to United States of America and home.