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TIPAN

Transformation and Integration of the Provincial Agricultural Network

Northwest Frontier Province, Pakistan

Office of International Agriculture
University of Illinois at Urbana-Champaign

In collaboration with
Southern Illinois University at Carbondale

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AGRICULTURAL MECHANIZATION

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TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS	1
INTRODUCTION	1
OBJECTIVE AND SCOPE	1
ACTIVITIES, OBSERVATIONS AND RECOMMENDATIONS	1
AGRICULTURAL ENGINEERING AND AGRICULTURAL MECHANIZATION	2
STUDENTS AND CAREER OPPORTUNITIES	2
FACULTY AND STAFF IN AGRICULTURAL MECHANIZATION	3
THE AGRICULTURAL MECHANIZATION CURRICULUM	4
A General Introductory Course	6
Power and Machinery	6
Soil and Water Management	7
Agricultural Structures	8
Agricultural Materials Handling, Processing and Storage	9
Graduate (M.S.) Program in Agricultural Mechanization	9
Graduate Level Courses	11
OTHER RECOMMENDATIONS	12
SUMMARY	13

ACKNOWLEDGMENTS

I wish to express my appreciation and a sincere thank you to Dr. Rodda, Mr. Tariq, the Transformation and Integration of the Provincial Agricultural Network (TIPAN) Project personnel, the agricultural mechanization faculty and all other faculty and staff at the Northwest Frontier Province Agricultural University (NWFP AU) in Peshawar, Pakistan, for their gracious help. Your concern, gracious hospitality and helpfulness made my short-term stay in Pakistan a very pleasant experience.

INTRODUCTION

The request for short-term technical assistance in agricultural mechanization for the TIPAN Project at the NWFP AU was proposed and approved in December, 1985. Selection committee approval occurred in the latter part of April, 1986. The duration of the assignment including arrival and departure dates was May 12, 1986, to June 5, 1986.

Although formal university education in agriculture began in Peshawar in 1933, instruction in agricultural mechanics and mechanization subjects was not included in the agricultural studies until after 1957. From 1957 to 1981, two courses in farm mechanics were required of B.S. Honors students studying agriculture during the second and third years of their program. In 1981 changes were made in the curriculum to a four-year program of study in agriculture and the offerings in farm mechanics were expanded to include farm machines and maintenance, mechanization, electrification, surveying, and workshop technology. At this time (1981) the area of study was renamed to agricultural mechanization.

Further program expansion and development was proposed by the design team for the TIPAN Project of agricultural mechanization at the NWFP AU in 1983. Additional areas of study in farm power, agricultural structures, soil and water management, crop processing and storage and a graduate studies program were planned. Implementation of program expansion has occurred and it is within this effort that external technical assistance was requested.

OBJECTIVE AND SCOPE

The major objective of the technical assistance was to assist in strengthening of faculty and upgrading teaching, research and outreach programs. The scope of work was to work closely with the department head and agricultural mechanization faculty to develop new courses, new research programs, and new outreach activities.

ACTIVITIES, OBSERVATIONS AND RECOMMENDATIONS

The activities to achieve the objective of the technical assistance for agricultural mechanization included: (1) on site reviews, (2) discussions with agricultural administration and faculty, (3) review and discussions with TIPAN Project personnel (4) discussions with

university and/or industry related personnel and (5) related documents prepared by TIPAN and university personnel. The following items are selected points that should be considered in the further expansion of the agricultural mechanization program at the NWFP AU. Recommendations and suggestions are underlined for emphasis.

AGRICULTURAL ENGINEERING AND AGRICULTURAL MECHANIZATION

Agricultural engineering and agricultural mechanization in Peshawar have been closely associated for the past 20 years. During this period of time facilities and equipment have been shared and faculty have cooperated in program offerings. This cooperation has most likely been to the benefit of students. The future expansion plans of agricultural mechanization through teaching, research and outreach should enhance the capacity for the wise and efficient application of technology for agricultural production in Pakistan. It is equally as important, if not more important, for Pakistan to develop technology appropriate for the agriculture and conditions. It is my opinion that agricultural engineers should be best qualified to assume that responsibility.

Careful consideration should be given to the future relationship of the department of agricultural engineering with the agricultural mechanization program and the agricultural university. It seems logical that agricultural engineering should also be fully or at least partially administratively a part of the NWFP AU.

STUDENTS AND CAREER OPPORTUNITIES

Based on discussions with the administration and agricultural mechanization faculty, most students in agricultural mechanization are from village areas and familiar with the status of mechanization in their regions. Career opportunities seem not clearly defined for students that will graduate from the agricultural mechanization program. Careers in government jobs seem to be the most likely opportunities. General observations, however, suggest that there is ample need for well-educated and trained agricultural mechanization graduates. Logical career opportunities should, however, include jobs in the various experiment stations, outreach program, private industry and self-employment.

In my visitation to the NWFP AU agricultural crops research stations at Tarnab, Pirsabak, Mardan, and Mingora it was obvious and expressed that well-qualified individuals in agricultural mechanization could make a substantial contribution. It is my recommendations that these opportunities be recognized, responsibilities defined and every effort possible be made by the agricultural mechanization administration, staff and appropriate university administration to establish responsible employment assignment(s) in each of the experiment stations now under the administration of the agricultural university. A similar effort is recommended in the outreach program. As in the research stations qualified agricultural mechanization trained personnel should be able to make a

substantial contribution in the application of appropriate technology in the farming community.

The agricultural mechanization staff and administration will also need to make contact, discuss needs, request input, and establish inroads for employment in the industries and sales and service businesses now manufacturing and providing technology for agriculture in Pakistan. The faculty member in agricultural mechanization responsible for outreach from the university should provide the major leadership in this effort.

The student intern study requirement, which is now a part of the new training program, would provide an excellent opportunity for career oriented students to develop practical skills, prove their potential productivity and gain entry employment in selected private firms.

FACULTY AND STAFF IN AGRICULTURAL MECHANIZATION

An adequate number of faculty positions appear to exist in agricultural mechanization to conduct a comprehensive program.

Based on information from the department head, the following positions now exist.

TEACHING AND ADMINISTRATION

Rank	Number	Filled	Vacant
Associate Professor	3	1	2
Assistant Professor	2	0	2
Lecturer	6	5*	1
Total	11	6	5

*Two on leave for study in U.S.

SUPPORT STAFF

Position Title	Number	Rank
Shop Assistant	1	11
Tractor Supervisor	1	11
Diesel Mechanic	1	11
Electrician*	1	11
Tractor Driver**	1	7
Carpenter	1	7
Blacksmith	1	7
Electrician	1	7
Shop Attendant	1	3
Total	9	

*Position vacant.
**Works at University Farm.

Two staff members are currently studying in the U.S.

Name	University	Area
Mr. Rehman	University of Wyoming	Power and Machinery
Mr. Jamal	Purdue University	Soil and Water

Other opportunities exist for study in the U.S. and I have encouraged the agricultural mechanization staff to prepare and take their TOEFL exams in order to be eligible. With the study in U.S. universities in graduate degree programs, research capabilities should be developed within the program. Currently, the capabilities of the staff, based on their training and/or experience should be in the areas of (1) power and machinery, (2) soil and water and (3) shop skills.

If the broad areas of agriculture structures and materials handling and processing are to be a part of the agricultural mechanization program, then recruitment of staff in these areas and/or further training will be required. It is recommended that a staffing and/or education plan be prepared to meet the instruction, research and outreach needs in the areas of agricultural structures and materials handling, processing and storage.

The staffing plan should be prepared through a joint effort including TIPAN personnel so either long- or short-term study in a U.S. institution may be included as an option to meet the future staffing needs in agricultural structures and materials handling, processing, and storage. Technical support, in terms of staff numbers, is certainly adequate. As faculty return from U.S. programs and research activities expand, strong consideration should be given for in-service training and position reclassification of the current support staff positions for direct support in teaching, research and outreach activities.

In addition at this time there appears to be no secretarial support help for the agricultural mechanization staff. Strong consideration should be given for secretarial support. In the agricultural mechanization program time now used for typing and clerical work could most likely be used more effectively for teaching, research and outreach and program building activities by both agricultural mechanization administration and staff.

THE AGRICULTURAL MECHANIZATION CURRICULUM

Considering the potential staffing four to five years hence, and a new agricultural mechanization facility six years hence, excellent teaching potential and opportunities exist for students majoring in agricultural mechanization. Well qualified students, resulting from a practical education in the application of agricultural technology in specialized areas should have excellent career opportunities.

The curriculum in agricultural mechanization is now in transition. Some students are completing their courses of study under the old system and a new group of approximately 150 students are completing the second term of the new semester plan. Under the previous plan of study leading to a B.S. degree often a variety of subject matter topics were included in the

one year courses. Although some of the new courses have already been approved by the university committees, and others are in the process of being developed, strong consideration should be given to specializing courses in the four specific areas with the exception of the beginning course title "Engineering Applications in Agriculture".

The following listed courses have been discussed in terms of purpose, content and possible text and reference materials with the staff. It is suggested that these courses be considered in the future expansion of the agricultural mechanization program.

A more detailed course description of specific courses listed previously follows.

Suggested courses in agricultural mechanization are:

An Introduction to Agricultural Mechanization*
(4 cr) (*General introductory course.)

Power and Machinery
Shop Maintenance and Repair Skills (3 cr)
Power and Machinery Management (3 cr)
Engine, Tractor and Machinery Maintenance and Repair (3 cr)
Advanced Power and Machinery (3 cr)
Advanced Agricultural Machinery (3 cr)

Soil and Water Management
Surveying (3 cr)
Soil and Water Conservation (3 cr)
Irrigation Principles and Practices (3 cr)
Advanced Soil and Water Management (3 cr)
Waste and Water Management (3 cr)

Agricultural Structures
Agricultural Drawing (3 cr)
Agricultural Construction Skills (3 cr)
Agricultural Structures Planning (3 cr)
Advanced Agricultural Structures (4 cr)

Agricultural Material Handling and Storage
Material Handling Principles (3 cr)
Crop Processing, Drying and Storage (3 cr)
Advanced Agricultural Electricity (3 cr)
Advanced Shop-Special Problems (3 cr)

Graduate Level Courses
Readings (3 cr)
Research Planning and Design (3 cr)
Seminar I (1 cr)
Research (3 cr)
Thesis (3 cr)
Seminar II (1 cr)
Special Problems in Agricultural Mechanization (1-4 cr)

A General Introductory Course

An Introduction to Agricultural Mechanization (suggested title change from Engineering Applications in Agriculture). 4 cr; 3 hr lecture and 2 hr lab/wk.

The course provides an overview of the various areas of agricultural mechanization to include power and machinery, soil and water management, agricultural structures and materials handling, processing and storage. More specifically the following topics are suggested for the course.

Power and Machinery
Engine types and principles
Tractor and machinery performance and capacity
Tractor operation and maintenance
Tractor and tillage tool adjustments
Machine mechanics and calibration

Soil and Water Management
Land measurement leveling
Differential principles
Water flow principles
Irrigation principles

Agricultural Structures
A basic review of structural materials
Structure requirements and types
Basic sketching and drawing
Reading blueprints
Determining building materials for a simple structure

Materials Handling, Processing and Storage
Physical characteristics of materials
Materials handling options
Storage requirement examples
An introduction to system analysis

Power and Machinery

Shop Maintenance and Repair Skills
3 cr; 1 hr lecture and 4 hr lab/wk

The course includes instruction demonstrations and skill development Shop procedures, hand and power tool safety is emphasized. Skill development in welding, layout, cutting, shaping, drilling, grinding, welding (gas and arc), soldering and heat treating are included. Lathe work and metal finishing and painting are also included in the course.

Power and Machinery Management
3 cr; 2 hr lecture and 2 hr lab/wk

The course includes a study of machinery management principles. Power and machinery performance, capacities and field efficiency are included

with tillage, planting, fertilizer distribution, chemical applicators and cultivation machines. Field performance tests and evaluations are made in the course in addition to a machinery system analysis study.

Engine, Tractor and Machinery, Maintenance and Repair
3 cr; 1 hr lecture and 4 hr lab/wk

The course includes an overview of the various systems of the tractor and engines. Maintenance and maintenance schedules are performed and prepared. Tractor, machinery and engine repair is included in the course.

Advanced Power and Machinery (A detailed outline of this course has been provided however not included herewith).
4 cr; 2 hr lecture and 4 hr lab/wk

The course includes a study of tractor development, types and application. Tractor performance, efficiency, selection, hitching and tractor and machinery matching is included. Engine and tractor system analysis and testing are also included in the course.

Advanced Agricultural Machinery
3 cr; 2 lecture and 2 hr lab/wk

The course includes a study of power transfer and machine mechanisms. A study of more complex machines such as threshers, seed cleaners, combines, balers and forage harvesting machines are included in terms of systems adjustments, operation and performance evaluations.

Soil and Water Management

Soil and Water Conservation
3 cr; 2 hr lecture and 2 hr lab/wk

A study of the principles in conserving water and soil. Erosion control, systems and structures reclamation and managing natural rainfall for water supplies are included.

Surveying
3 cr; 1 hr lecture and 4 hr lab/wk

The course includes a study of instruments and equipment for land measurement and surveying. Skill development in recording notes, land measurement, differential leveling, workbooks, contouring, terracing, waterway planning and preparing maps are included.

Irrigation Principles and Practices
3 cr; 2 hr lecture and 2 hr lab/wk

A study of the physical requirements, equipment, and performance of irrigation by gravity, sprinkler, furrow, subsurface and drip systems.

Advanced Soil and Water Management
3 cr; 2 hr lecture and 2 hr lab/wk

An advanced study of plant, soil and water relationships. Evaluation of water requirements, management of water supply and scheduling irrigation for optimum benefits. Problems associated with irrigation are included in the course.

Waste and Water Management
3 cr; 2 hr lecture and 2 hr lab/wk

The course includes a study of animal, human and industrial waste disposal in relation to safe, clean potable water for human and animal consumption. Waste disposal, sewage systems, water testing and purification methods and system are included in the course.

Agricultural Structures

Agricultural Construction Skills
3 cr; 1 hr lecture and 4 hr lab/wk

The course is intended to develop understanding and specific skills in woodworking, masonry construction, concrete work, plumbing installation and repair, electrical wiring and repair, and electric motor testing and repair. Painting, glazing, and roofing are also included.

Agricultural Drawing
3 cr; 1 hr lecture and 4 hr lab/wk

The course includes a study and skill development with basic drafting equipment. Included are pictorial, sectional, exploded views, floor plans and finished working drawings that are ready to be transferred to blue prints. Standard lettering is included in the course.

Agricultural Structures Planning
3 cr; 2 hr lecture and 2 hr lab/wk

The course includes farmstead lay-out planning and rearrangement to best meet production requirement. Building materials are studied and compared. Materials required and construction procedures and time tables are determined. A scale model of an agricultural building and a term report are required.

Advanced Agricultural Structures
4 cr; 3 hr lecture and 2 hr lab/wk

The course includes more advanced planning and design of structural components in agricultural building. Environmental control in terms of ventilation, heating, cooling, and lighting is included. Design of water supply and waste disposal requirements are also included, in addition to solar heating possibilities and their benefits.

Agricultural Materials Handling, Processing and Storage

Materials Handling Principles
3 cr; 2 hr lecture and 2 hr lab/wk

The course includes a study of the physical characteristics of agricultural food, feed and other commonly used materials. Requirements for human, animal and power transport for movement of materials is examined. A detailed study of mechanical materials handling equipment, to include air, liquid, drag, auger, belt and gravity conveyor systems. System planning for specific products is also included.

Crop Processing, Drying and Storage
3 cr; 2 hr lecture and 2 hr lab/wk

An analysis of handling and storage requirements for commonly used seed and food crops. Sun, batch and continuous air drying methods and equipment are included. Equipment for environmental control for both short- and long-term storage are studied. Special attention is given to refrigeration, principles and equipment.

Advanced Agricultural Electricity
3 cr; 2 hr lecture and 2 hr lab/wk

A detailed advanced study of electrical power for materials handling equipment. The course includes system and circuit planning for electric motors and environmental and automated environmental systems.

Advanced Shop - Special Problems
3 cr; 1 hr lecture and 4 hr lab/wk

The course includes the development of selected advanced skills such as refrigeration system repair and maintenance, tig and mig welding, machine shop skills. A group project including the planning and construction of a labor saving device or structure is required. Faculty committee approval is required.

Graduate (M.S.) Program in Agricultural Mechanization

Currently there are three students working toward the M.S. degree in agricultural mechanization. It is my understanding that these students are working on the following problems: (1) wheat threshing losses, (2) irrigation channel problems and (3) wheat stem strength problems. There should be close collaboration and cooperation with the plant science faculty in the research on wheat stem strength. I worked closely with Mr. Mohammad Amin, who is working on wheat threshing losses. With a moderate amount of help in the statistical analysis, I think Mr. Amin will complete a very good study.

The M.S. program should probably continue with a limited number of students (1 to 3) until faculty return from U.S. degree programs with advanced degrees. At that time three graduate students per graduate faculty member would be a reasonable number of students to expand the agricultural mechanization M.S. program.

Concerning researchable problems for M.S. students and faculty in agricultural mechanization, it is obvious that there are numerous problems that could be investigated on the university farm, at the various research stations, in the farming community and in the new agricultural mechanization facility when completed.

A discussion was conducted for the agricultural mechanization faculty and graduate students on developing and conducting research in agricultural mechanization. In addition, a seminar was also presented to the agricultural faculty on my recent research efforts in the development of an air assisted sprayer to improve row crop spraying. I am hopeful that this effort will be of benefit in conducting future research in agricultural mechanization. The following suggested program and courses were developed and discussed with the agricultural mechanization faculty and are included herewith. They should be given consideration with the future expansion of a M.S. program in agricultural mechanization.

Suggested M.S. schedule for agricultural mechanization program:

A. Preliminary

1. Approval of student for graduate studies.
2. Appointment of major advisor.

B. First Term

1. Readings . . . . . 3 cr
   Research Planning and Design . . . . . 3 cr
   Approved Course(s) . . . . . 3 cr
   9 cr
2. Action:
   Appoint of select committee.

C. Second Term

1. Courses:
   Statistics . . . . . 3 cr
   Computer Analysis. . . . . 3 cr
   Approved Course(s) . . . . . 3 cr
   Seminar I. . . . . 1 cr
   10 cr
2. Action:
   Committee decision on research.
   Topic and course of study.

D. Third Term

1. Courses:
   Research . . . . . 3 cr
   Approved Courses . . . . . 3 cr
   6 cr

E. Fourth Term

1. Courses:

Thesis	3 cr
Approved course	3 cr
Seminar II	1 cr
	7 cr
Total	32 cr

2. Action:
   Final examination and defense of research.

Graduate Level Courses

Readings
3 cr

An independent study course under the supervision of a major advisor intended for library review of published research. Efforts of the course are directed at identifying related research to students research problem. An annotated bibliography, report and oral presentation are required. Graded as S, U, or DEF.

Research Planning and Design
3 cr; 3 hr lecture/wk

The course includes research planning and proposal development, experimental design, data collection methods, statistical analysis and thesis and research report writing.

Research
3 cr

An independent study under the supervision of the major professor that involves the conducting of research and data collection. Graded S, U, or DEF.

Thesis
3 cr

Credit is awarded for the completion and successful defense of the thesis. Graded S, U, or DEF.

Seminar I
1 cr

A seminar given to students and faculty on literature review and the research proposal. Graded by the advisory committee.

Seminar II
1 cr

A seminar given to students and faculty on research results of the thesis study. Graded by the advisory committee.

OTHER RECOMMENDATIONS

I would recommend to the appropriate TIPAN personnel that at least one copy of each of the text and reference materials compiled by Mr. Tariq be purchased and made available in the library. This request is made so that the agricultural mechanization faculty may review and evaluate the various books for future use. I have provided a copy of the following books to the department:

1. "On-Site Waste Water Treatment" by ASAE.
2. "Irrigation Principles and Practices" by V.R. Hansen, et al.
3. "Farm Machinery" by C. Culpin.
4. "Farm Power and Machinery Management" by D. Hunt; 8th Ed.
5. "Engine and Tractor Power" by C.E. Goering; 1st Ed.
6. John Deere FOS. Series Preventative Maintenance Machinery Management.
7. John Deere FMO. Tractors. Tillage. Planting.

Multiple copies of selected textbooks and reference books should be purchased for class use once a determination has been made for specific courses. I have suggested to Mr. Tariq to communicate with the TIPAN office to express his needs. In addition I would suggest that the ASAE standards books be ordered in addition to an ASAE publications list. This should be made available to the agricultural mechanization department for review and request of additional publications that may be useful to the program.

Regarding the future plans for the agricultural mechanization facility location, the current proposal locations does not provide road access. Road access is a must for an agricultural mechanization lab. This is so machinery and equipment may be moved in and out of the facility for practical instruction, demonstrations, and hands-on experiences. As building planning progresses it must be brought to the attention of appropriate personnel that road access is required.

Since students majoring in agricultural mechanization are required to make the decision in the third year of study and are required to take six specialization courses in agricultural mechanization it is recommended that there be careful planning of course offerings and staffing to insure adequate course offering options for students. This planning should include both short-term and long-term course offerings with faculty members identified.

A final recommendation is that the university farm be made available and that the agricultural mechanization faculty utilize practical instruction in the field and in the lab.

SUMMARY

In summary, with the technical and financial support available to assist in the development of the agricultural mechanization program at the NWFP AU there is a tremendous opportunity to develop an excellent agricultural mechanization department. Careful planning of curricula, staff development, research programs and outreach activities and instructional facilities is encouraged. The opportunity is at hand to make significant contributions in the advancement of agriculture through agricultural mechanization.