

No. 1

MINISTRY OF EDUCATION  
THE ISLAMIC REPUBLIC OF PAKISTAN

**BASIC DESIGN STUDY REPORT  
ON  
THE PROJECT FOR IMPROVEMENT OF  
EDUCATIONAL EQUIPMENT  
FOR  
THE UNIVERSITY OF AGRICULTURE, FAISALABAD  
IN  
THE ISLAMIC REPUBLIC OF PAKISTAN**

MARCH 1996

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UNICO INTERNATIONAL CORPORATION**

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## PREFACE

In response to a request from the Government of the Islamic Republic of Pakistan the Government of Japan decided to conduct a Basic Design Study on the Project for Improvement of the Educational Equipment for the University of Agriculture, Faisalabad and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Pakistan a study team from December 1 to 30, 1995.

The team held discussions with the officials concerned of the Government of Pakistan and conducted a field study at the study area. After the team returned to Japan, further studies were made, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Islamic Republic of Pakistan for their close cooperation extended to the team.

March 1996



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Kimio Fujita

President

Japan International Cooperation Agency





March 1996

## LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Improvement of the Educational Equipment for the University of Agriculture, Faisalabad in the Islamic Republic of Pakistan.

This study was conducted by UNICO International Corporation, under a contract to JICA, during the period from November 24, 1995 to March 29, 1996. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Pakistan and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,



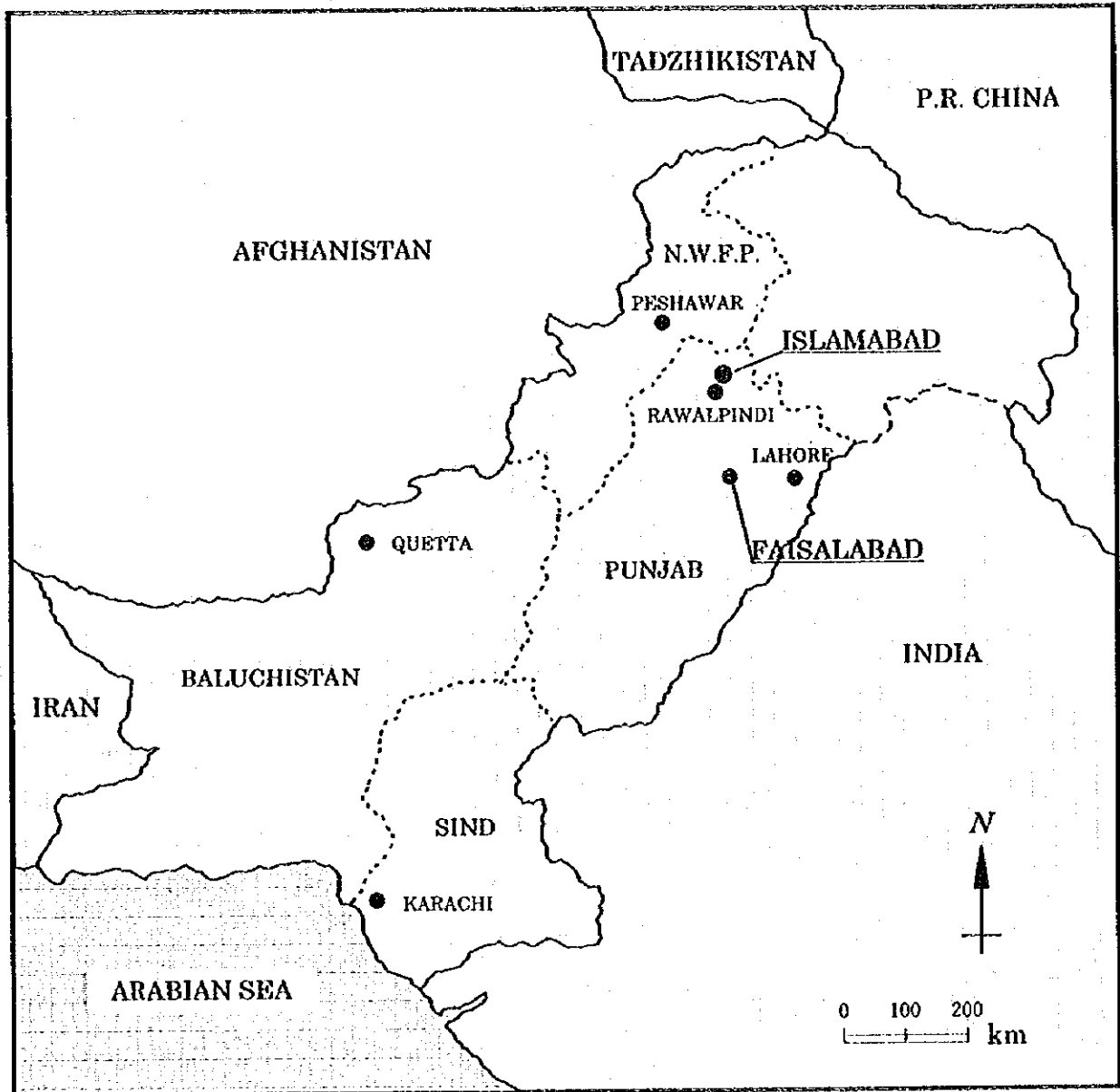
Wataru Shiga

Project Manager,

Basic design study team on the Project for  
Improvement of the Educational Equipment for the  
University of Agriculture, Faisalabad,  
UNICO International Corporation



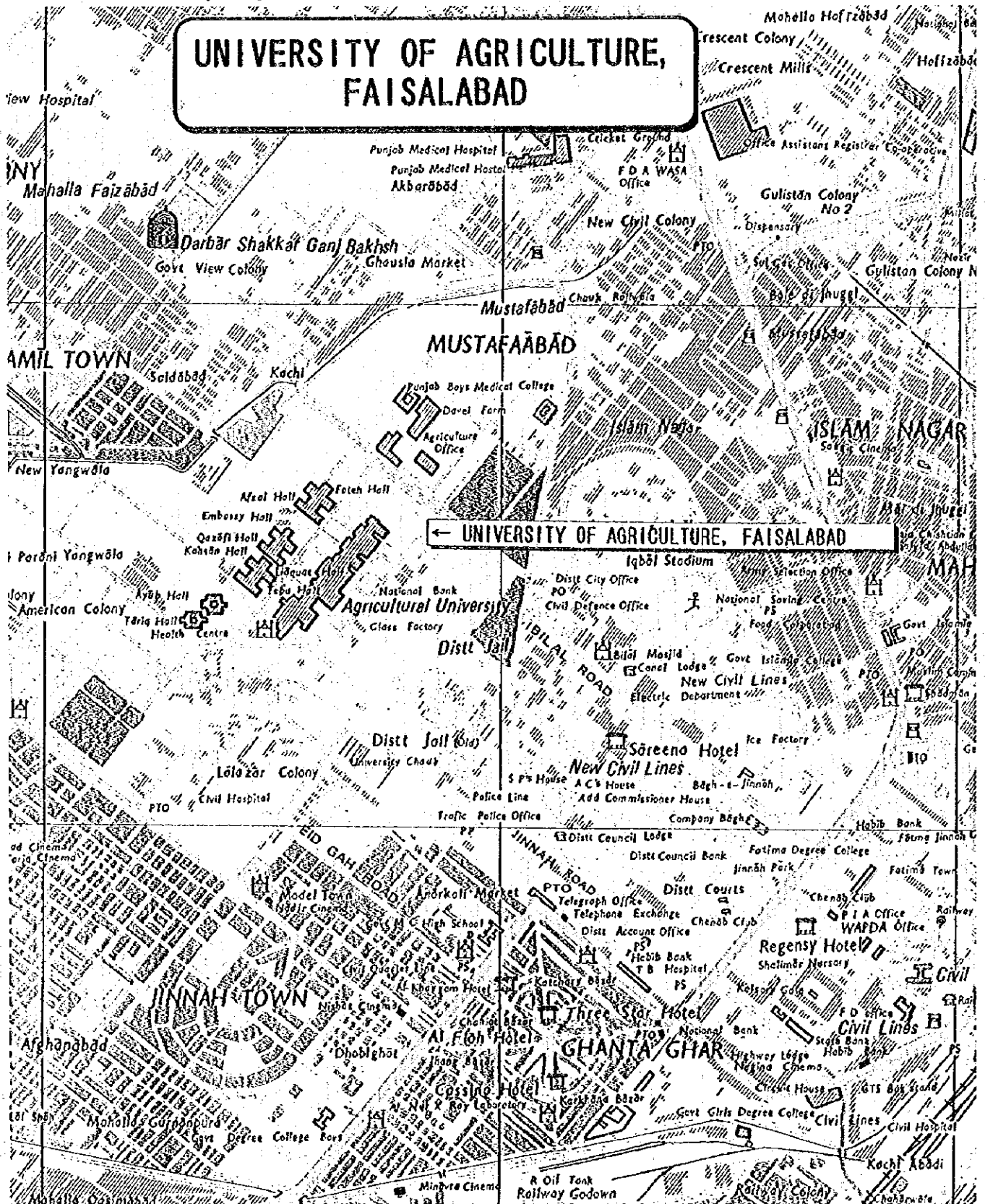
THE ISLAMIC REPUBLIC OF PAKISTAN



# LOCATION MAP

(University of Agriculture, Faisalabad)

## UNIVERSITY OF AGRICULTURE, FAISALABAD

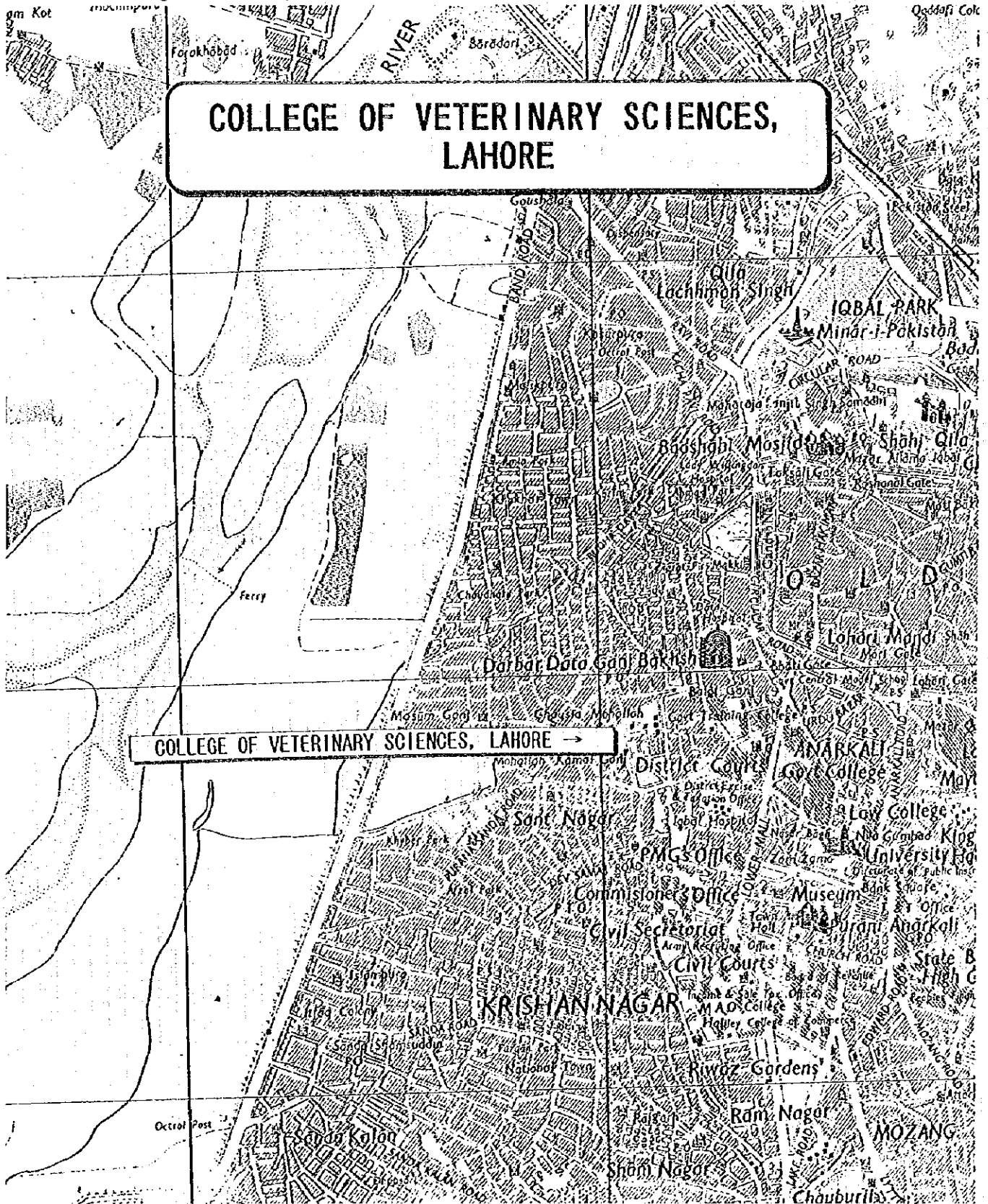


# LOCATION MAP

(College of Veterinary Sciences, Lahore)

## COLLEGE OF VETERINARY SCIENCES, LAHORE

COLLEGE OF VETERINARY SCIENCES, LAHORE →





## ABBREVIATIONS

ACIAR	:	Australian Center for International Agricultural Research
AIDAB	:	Australian International Development Assistance Bureau
AJK	:	Azad Jammu and Kashmir
A/V	:	Audio-visual
AVR	:	Automatic Voltage Regulator
B.Sc.	:	Bachelor of Science
B.Sc.Agric.	:	Bachelor of Science, Agriculture
B.Sc.A.E.	:	Bachelor of Science, Agricultural Engineering
B.Sc.A.H.	:	Bachelor of Science, Animal Husbandry
B.Sc.H.E.	:	Bachelor of Science, Home Economics
BHN	:	Basic Human Needs
CCTV	:	Closed-circuit Television
CDA	:	Capital Development Authority
CD-ROM	:	Compact Disc Read-only Memory
CIDA	:	Canadian International Development Agency
CPU	:	Central Processing Unit
CVS	:	College of Veterinary Sciences, Lahore
DNA	:	Deoxyribonucleic Acid
DSR	:	Debt Service Ratio
D.V.M.	:	Doctor of Veterinary Medicine
EAD	:	Economic Affairs Division
FAO	:	Food and Agriculture Organization
FDA	:	Faisalabad Development Authority
GDP	:	Gross Domestic Product
GNP	:	Gross National Product
Hons.	:	Honours
IDA	:	International Development Association
IMF	:	International Monetary Fund
JICA	:	Japan International Cooperation Agency
KDA	:	Karachi Development Authority
LDA	:	Lahore Development Authority
M.A.	:	Master of Arts
MART	:	Management of Agricultural Research and Training Project
M.Phil.	:	Master of Philosophy

<b>M.Sc.</b>	: Master of Science
<b>NARC</b>	: National Agricultural Research Centre
<b>NIAB</b>	: Nuclear Institute for Agriculture and Biology
<b>NIBGE</b>	: National Institute of Biotechnology and Genetic Engineering
<b>NIH</b>	: National Institute of Health
<b>NSRDB</b>	: National Scientific Research and Development Board
<b>ODA</b>	: Overseas Development Administration
<b>PARC</b>	: Pakistan Agricultural Research Council
<b>PARS</b>	: Postgraduate Agricultural Research Station
<b>PC-1</b>	: Planning Commission Proforma-1
<b>Ph.D.</b>	: Doctor of Philosophy
<b>PINSTECH</b>	: Pakistan Institute of Nuclear Science and Technology
<b>PSF</b>	: Pakistan Science Foundation
<b>RAM</b>	: Random Access Memory
<b>SAF</b>	: Structural Adjustment Facility
<b>UAF</b>	: University of Agriculture, Faisalabad
<b>UGC</b>	: University Grants Commission
<b>UNDP</b>	: United Nations Development Program
<b>UNESCO</b>	: United Nations Educational, Scientific and Cultural Organization
<b>UPS</b>	: Uninterruptible Power Source
<b>USAID</b>	: United States Agency for International Development
<b>VTR</b>	: Video Tape Recorder



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## **CHAPTER 1 BACKGROUND OF THE PROJECT**



## CHAPTER 1 BACKGROUND OF THE PROJECT

### (1) General Situation in Pakistan

The Government of the Islamic Republic of Pakistan has been implementing a series of development plans focusing on the industrialisation of the country while maintaining the agricultural sector as the base of the country's economy since her independence in August 1947. The Government of Pakistan which, from 1955 to around 1960, had placed importance on the building up of physical infrastructure, including improvement of that in the agricultural sector, began to implement industrialisation plans with emphasis on the manufacture of consumer goods to replace imports in the 1960s. Although the pace of industrialisation slowed down in the 1970s due to the federal government's policy to promote the nationalisation of large-size enterprises, it was once again accelerated in the 1980s through the rapid growth of the private sector, the active introduction of foreign private capital, the promotion of growth of export-oriented industries, and the growth of industries that utilise domestic resources and other key industries. As a result, the Pakistan economy grew rapidly in the 1980s, averaging a real annual economic growth rate of 6.4 percent in terms of GDP. The first half of the 1990s was a period of stable economic growth, the economy growing about 5 percent annually on average. It is said that such high economic growth rates were attributable largely to the steady growth of the agricultural sector which has been achieving growth at an average annual rate of 3.6 percent for more than 25 years.

In recent years, on the other hand, the Pakistan economy has been characterised by structural fiscal deficits, which have resulted from steep price increases due to rapid inflation (average annual inflation rates were 6.7 percent in the 1980s and about 10 percent in the first half of the 1990s), the weak tax collection system and the rigidity of ordinary expenditure, as well as by deficits in the balance of international payments due to limitation of the types of goods which can be exported and a decrease in remittances by overseas workers. These factors are bringing pressure to bear on the economy of the country.

### (2) Present State of the Agricultural Sector in Pakistan

Agriculture forms the base of the Pakistan economy. As shown in Table 1-1, agriculture sector accounted for 24 percent (staple crops: 10.4 percent; other crops: 4.2 percent, livestock farming: 8 percent; forestry: 0.2 percent) of Pakistan's GDP for 1994-95 (provisional figures), followed by manufacturing sector at 18.5 percent and wholesale & retail trade sector at 16.1 percent.

Agriculture is far ahead of manufacturing and trade in terms of job creation, accounting for 47.5 percent of the country's employed work force.

**Table 1- 1 Sector- wise Shares in GDP**

Sector	1969- 70	1993- 94	1994- 95
		(R)	(P)
<b>Agriculture</b>	<b>38.9</b>	<b>24</b>	<b>24</b>
Major Crops	23.4	10.4	10.4
Minor Crops	4.2	4.3	4.2
Livestock	10.6	8	8
Fishing	0.5	1	0.9
Forestry	0.1	0.2	0.2
Manufacturing	16	18.6	18.5
Construction	4.2	4.1	4.1
Transport, Storage & Communication	6.3	10.2	10.2
Wholesale & Retail Trade	13.8	16.3	16.1
Services	6.7	8.1	8.2
Others	14.1	18.7	18.9

R: Revised P: Provisional

Source: Economic Survey 1994- 95

Farm products that support the country's agricultural sector include staple crops such as wheat, cotton, rice, sugarcane, maize, etc., other crops such as pulses, potatoes, onions, chillies, garlic, etc., livestock products such as milk, beef, mutton, poultry meat, eggs and wool, fish and other marine products, and forest products such as timber and firewood. They are very important sources of supply of food and processed materials. It should be noted that the agricultural sector is the supply source of raw materials to the textile, food processing, leather and timber industries, and agricultural products including processed agricultural products represent more than 70 percent of the country's total exports. Main exported agricultural products are raw cotton and rice, while main export processed agricultural products being cotton yarn, cotton fabrics, cloths and leather goods. As is clear from the above, agricultural products as primary products or processed products makes great contributions to the growth of the Pakistan economy. Being vulnerable to changes in weather conditions, however, agriculture is a fragile economic base. It is imperative to make the country's agricultural sector more productive if the Pakistan economy is to become more stable.

Trends in annual rates of growth of the Pakistan economy over the past 5 years are as shown in Table 1- 2. As can be seen from the table, in the years when agricultural production suffered minus growth, the growth of such staple crops as rice and wheat was adversely affected by unforeseen

weather condition such as heavy rainfalls and economic farm products like raw cotton were damaged by harmful insects and viruses.

**Table 1- 2 Economic Growth Rates (%)**

	1990- 91	1991- 92	1992- 93	1993- 94	1994- 95
GDP	5.6	7.7	2.3	3.8	4.7
Agriculture	5	9.5	-5.3	2.9	4.9
Manufacturing	6.3	8.1	5.4	5.4	4.4

Source: Economic Survey 1994- 95

Pakistan has already achieved self- sufficiency in production of rice, exporting certain quantity of its output every year, but it is far from being self- sufficient in wheat, which is the staple food of the nation. Despite the fact that it is an agricultural country, Pakistan is still importing agricultural products such as wheat, edible oil, etc. in a considerable quantity. It should also be noted that in Pakistan demand for meat and dairy products is increasing due to enhanced consumer purchasing power, which is attributed to the rapid growth of the country's economy. Establishing and streamlining of marketing and distribution system for livestock products is one of the challenges facing the country's livestock farming sector. Furthermore, the country's high annual population growth rate of 3.1 percent, coupled with the inflow of more than 3 million refugees from Afghanistan at its peak, is putting pressure on the supply and demand of food in the country.

Under such circumstances, the National Commission on Agriculture, which is an advisory body to address national agricultural policies, made a wide range of recommendations on agricultural technologies and systems with the aim of realising a stable growth of agricultural productivity which meets the people's needs. Its recommendations concern, among others, such issues as selective breeding to develop new varieties which are highly resistant to changes in weather conditions and harmful insects and viruses, development of more prolific breeds and high- yielding varieties, rationalisation of cultivation through farm mechanisation, and steady supply of water for agricultural use through the expansion and improvement of irrigation facilities. The need for agricultural research institutions, universities and other institutions of higher education and government agencies responsible for agricultural education and extension to take concerted problem- solving approaches to these issues in order to make remedial measures taken to overcome these problems effectively has recently been recognised. There is an urgent need, therefore, to nurture technical experts to deal with these issues.

In Pakistan, the Ministry of Food, Agriculture and Livestock is the federal government agency responsible for agricultural administration, which includes the management of agricultural

inputs, the promotion of their use and agricultural training. Each province has a department of agriculture, a department of food, a department of agricultural education and extension, a department of livestock farming, a department of fisheries, a department of forestry, a department of irrigation, etc. These provincial government agencies are responsible for the management of agricultural inputs, farmer support activities and the management of agricultural products. Based on the understanding that close collaboration between the government agencies concerned and public research organisations is indispensable for the growth of the country's agriculture, the Pakistan Agricultural Research Council (PARC), other research institutions and the University of Agriculture, Faisalabad, are considered important organisations to assist the federal government and the provincial governments in carrying out these activities.

On the other hand, social problems of the agricultural sector have surfaced. According to the 1990 UNDP statistics, the rate of literacy for adults was 36.4 percent (49 percent for males and 22 percent for females) in Pakistan, the enrolment ratio at primary school level being 42 percent (30 percent for girls). It should also be noted that 72 percent of the total labour force is concentrated in rural areas. Petty farmers who represented 81 percent of the total number of farmers accounted for only 39 percent of the total farmland area, while large farmers who represented only 7 percent of the total number of farmers made up 40 percent of the total farmland area. It can be seen from these figures that many uneducated farmers are engaged in relatively small-scale farming. It is a well-known fact that farmers' productivity varies widely according to their educational background and agricultural expertise. In light of these facts, the Government of Pakistan has been taking measures to promote the spread of advanced agricultural technologies and techniques while encouraging macro research conducive to the enhancement of the technical level of farmers of the country.

### (3) Present State of Education in Pakistan

Pakistan ranks 132nd in the world in terms of the UNDP's human development index. Reflecting this, utmost emphasis is placed on the dissemination of basic education in the Government of Pakistan's educational policy. The federal government is also in the process of introducing vocational education subjects (agriculture and engineering) in the secondary education curriculum with a view to enhancing the vocational aptitude of graduates of schools of varying educational levels. Against such a background, the high unemployment rate for university graduates has once become a social problem in the country. This was attributable to a sharp increase in the number of graduates of institutions of higher education as a result of the government's higher education policy and students' growing tendency to choose faculties of liberal arts, for graduates of which there are not



many job offers. For these reasons, greater importance is attached to the improvement of the quality of higher education and the higher education curricula's greater consistency with the needs of business and industry under the federal government's recent national development plans. Under these circumstances, it is considered imperative to improve the quality of education carried out at the universities of agriculture, that are expected to supply able technological manpower to the leading sector of the country's economy.

#### (4) University of Agriculture, Faisalabad

The University of Agriculture, Faisalabad, is Pakistan's oldest institution of higher agricultural education. Its predecessor, the Punjab Agricultural College and Research Institute, was founded in 1909. In the Punjab flow 5 branches of the Indus. A wide network of canals to connect these branches was developed by British technologies. As a result, the province is rich with water for agricultural use and has long been known as the country's most important granary. The City of Faisalabad, which is the country's third largest city, is situated in the middle of the Punjab. Cotton is grown on a large scale and there are many spinning mills, weaving factories and dyeing and finishing mills inside and on the outskirts of the city. Faisalabad is thus popularly known as the "Manchester of Pakistan." Reflecting such an environment, there are many agriculture-related research facilities operating under the control of the federal and provincial government agencies in and around the city. In light of these facts, Faisalabad is a city best suited for agricultural education. At present, the University of Agriculture, Faisalabad has the following faculties and departments.

##### A) Faculty of Agriculture

This faculty is providing undergraduate and postgraduate courses in agriculture and conducting research in the discipline with the aim of promoting crop farming. It has 8 departments, namely, the departments of crop physiology, horticulture, agronomy, forestry, range management and wild life, plant pathology, plant breeding and genetics, soil science, and agricultural entomology. It has an agricultural research station for postgraduate studies and an estate management division in addition to these departments. This faculty is the first to be established and plays a pivotal role of the University of Agriculture, Faisalabad.

##### B) Faculty of Agricultural Engineering and Technology

This faculty is providing undergraduate and postgraduate courses in agricultural engineering and technology and is conducting research in this discipline. It has 5 departments, namely, the departments of food technology, irrigation and drainage, fibre technology, basic engineering, and farm machinery and power. As is reflected in the list of the requested items of equipment,

emphasis is placed on the utilisation of water in agriculture (hydraulics, soil mechanics, groundwater hydrology) and farm machinery, which concerns farm mechanisation.

#### C) Faculty of Basic Science

This faculty is providing undergraduate and postgraduate courses in basic sciences closely related to agriculture and is conducting research in these disciplines. It has 9 departments, namely, the departments of botany, zoology and fisheries, physics, chemistry/biochemistry, agricultural meteorology, mathematics and statistics, sociology/humanities, Islamic studies, and human environmental science. The aforesaid 4 departments and the department of human environmental science are requesting equipment.

#### D) Faculty of Animal Husbandry

This faculty comprises 4 departments, namely, the departments of livestock management, animal breeding and genetics, animal nutrition, and poultry husbandry. It is providing undergraduate and graduate courses in these disciplines and is conducting research as well. The Department of Livestock Management's facilities include a wool laboratory, a dairy laboratory, a meat laboratory and a livestock farm. The Department of Animal Breeding and Genetics' facilities include a cytogenetics research laboratory, a data processing laboratory, a cattle cross breeding project and an artificial insemination/semen processing unit.

#### E) Faculty of Veterinary Science

This faculty comprises 7 departments, namely, the departments of veterinary anatomy, veterinary pathology, veterinary parasitology, clinical medicine and surgery, animal production, physiology and pharmacology, and veterinary microbiology. It is providing undergraduate and postgraduate courses in these disciplines. The items of equipment required by this faculty are those for use in the above- mentioned 7 departments, although special emphasis is placed on those for use in the education and training in veterinary pathology and veterinary microbiology.

#### F) Faculty of Agricultural Economics and Rural Sociology

This faculty is providing courses in branches of the humanities which are closely related to agriculture and rural sociology. It has 5 departments, namely, the departments of agricultural economics, farm management, cooperation and credit, agricultural marketing, and rural sociology. It is providing undergraduate and postgraduate courses in these disciplines, as well as supporting courses in the humanities for the students of other departments.

### G) College of Veterinary Sciences, Lahore

This college was founded in 1882 and therefore has a long history as well as a long-established tradition. It is playing an important role in promoting the spread of livestock farming in the Punjab. It has 10 teaching sections, namely, the sections of animal reproduction, microbiology, veterinary medicine, surgery, veterinary parasitology, poultry husbandry, animal nutrition, veterinary pathology, veterinary anatomy, pharmacology, and physiology, and is providing undergraduate, postgraduate and para- veterinary courses in these disciplines.

### H) Division of Agricultural Education and Extension

This division comprises the departments of agricultural education, agricultural extension, short courses, rural home economics and other incidental facilities. It is providing undergraduate and postgraduate courses in the relevant disciplines, as well as short-term in-service training courses for the personnel of the related government agencies, banks, etc.

The University of Agriculture, Faisalabad, is providing undergraduate and postgraduate courses in a total of 54 disciplines through its Faculty of Agriculture, Faculty of Agricultural Economics and Rural Sociology, Faculty of Agricultural Engineering, Faculty of Animal Husbandry, Faculty of Veterinary Science, Faculty of Basic Science, Division of Agricultural Education and Extension and College of Veterinary Sciences, Lahore.

**Table 1-3 Education Courses**

<u>Undergraduate Course</u>	<u>Semesters</u>	<u>Postgraduate Course</u>	<u>Semesters</u>
B.Sc. Agri.	8	M.Sc., M.Sc. (Hons.)	4
B.Sc. A.H.	8	M.Phil.	4
D.V.M.	8	Ph.D.	4
B.Sc. A.E.	8		
B.Sc. H.E.	4		

\* The semesters for winter and spring each of 19 weeks period

The university is also providing a total of about 90 short-term training courses for students and working members of society every year through the Division of Agricultural Education and Extension, in addition to the above-mentioned undergraduate and postgraduate courses.

The University of Agriculture, Faisalabad, admits about 770 new students every year. At present, the university has a total enrolment of about 4,500 students, 56 percent of whom are undergraduate students (taking B.Sc./D.V.M. courses) and 44 percent postgraduate students (taking M.Sc./M. Phil./Ph. D. courses). Since 1961 when the University of Agriculture was established by

upgrading the former Punjab Agricultural College and Research Institute, more than 20,000 students have graduated from the university. About 95 percent of the students finishing B. Sc. courses take M. Sc. courses as the next stage of their education with exceptions for the veterinary science course graduates, many of whom participate in jobs as D.V.M.s.

**Table 1- 4 Number of Graduates  
(1961 - 1995)**

Course	No.
B.Sc.	11,786
M.Sc.	8,033
M.Phil.	131
Ph.D.	122
Total	20,072

As shown in Table 1- 5, graduates of the University of Agriculture, which is Pakistan's highest seat of learning and training in agriculture, are working mainly at major educational, research and training institutions, as well as federal and provincial government agencies. They are playing an important role in the research, development, education and extension of agricultural technologies as well as the improvement of such technologies. In other words, the effect of educational, research and training activities of the university are extended nationwide.

**Table 1- 5 Potential Employers**

Research/Training Institutions	Government Agencies
Ayub Agri. Research Institute, Faisalabad	Agriculture Dept., Punjab
P.B.R.I., Lahore	Livestock & Dairy Development Dept., Punjab
Agri. Machinery Training Institute, Multan	Education Dept., Punjab
Agriculture Service Academy, Vehari	Irrigation Dept., Punjab
In- service Agri. Training College, Sargodha	Planning & Development Dept., Punjab
Agri. Training Institute, Rahim Yar Khan	Cooperatives Dept., Punjab
Agriculture Training Institute, Dhagal	Forestry & Farms Dept., Punjab
Vocational Training Institutes in Punjab	Corporations (SEED, PASSC, etc.)
Floriculture Training Institute, Lahore	Planning Division, Govt. of Pakistan
NARC Training Institute, Islamabad	Water & Power Development Authority
Rural Development Academy, Islamabad	Pakistan Agricultural Research Council
Agri. Training Centre, Garhi Dopatta, AJK	Ministry of Education, Govt. of Pakistan
ADBP Officers Training Institute, Islamabad	Pakistan International Airlines Corp.
Army School of Food Sciences, Nowshera	Development Authorities (CDA, KDA, LDA, FDA, LMC, FMC, etc.)
Others	Others

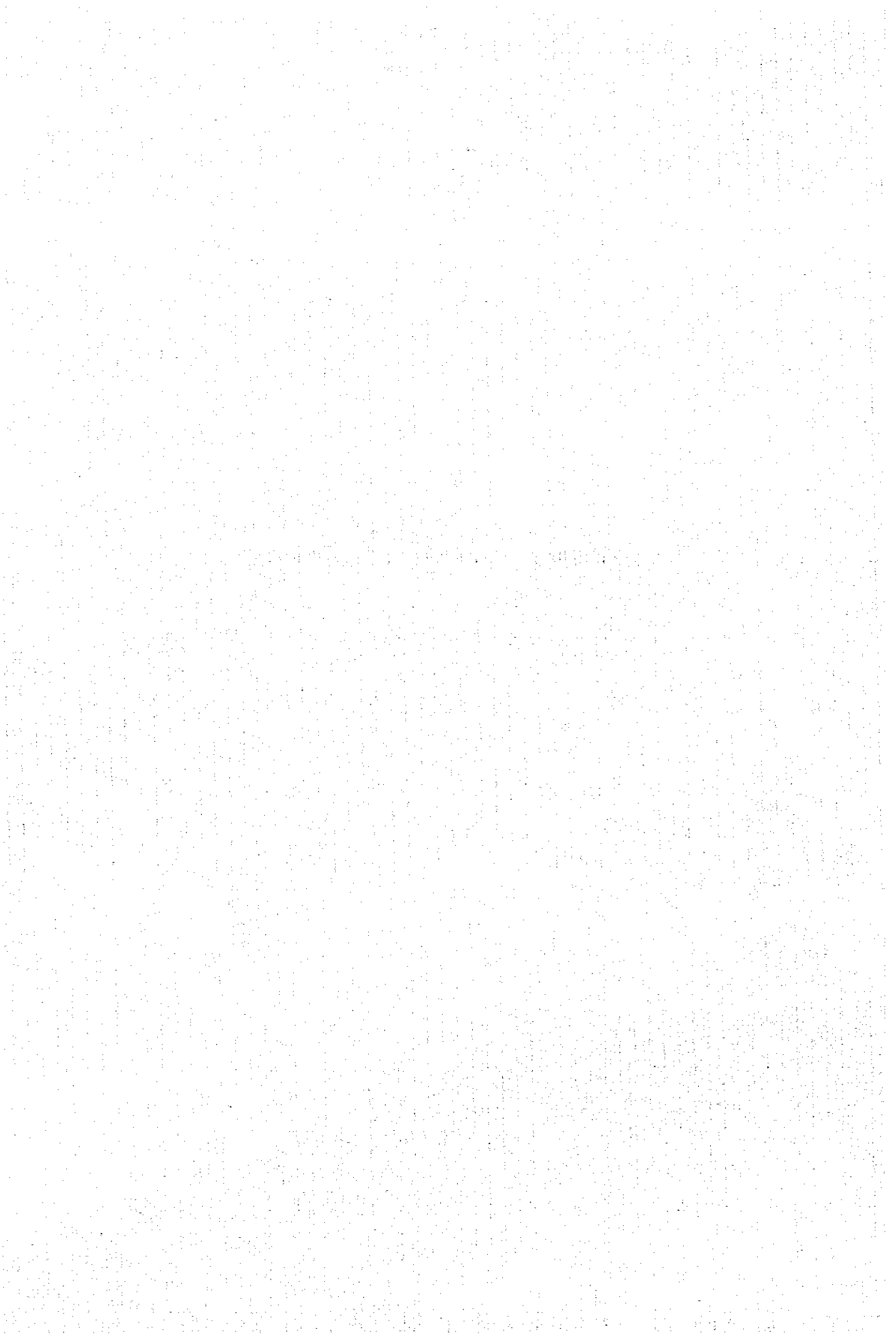
When the former Punjab Agricultural College and Research Institute was reorganised into the University of Agriculture, Lyallpur in 1961, new buildings were constructed on its present campus

and educational equipment was installed in these buildings with the financial assistance of the World Bank. Later on, the university procured some additional items of equipment at its own expense. Some items of teaching equipment and glassware were procured in 1988 under the agricultural research/training project (MART) conducted with USAID's financial aid. But these efforts have fallen short of fully meeting the university's equipment requirements. Now that the university has 5 times more students and 3 times more academic staff than in 1961, there is an absolute shortage of equipment for educational and research use. Even the existing items of equipment have become superannuated. As a result, the university finds it increasingly difficult to nurture human resources to take charge of systematic research, education and extension activities. For this reason, the Government of Pakistan requested the Government of Japan to provide grant aid for a project to make it possible for the University of Agriculture, Faisalabad, to carry out high- quality agricultural education and research as a major institution of higher agricultural education through the improvement of its equipment for educational use. The requested items of equipment are as listed in Table 1- 6.

**Table 1- 6 Summary List of Requested Equipment**

Faculty	Department	Q'ty
A. Agriculture	1 Crop Physiology	1 lot
	2 Horticulture	1 lot
	3 Agronomy	1 lot
	4 Forestry, Range Management & Wildlife	1 lot
	5 Plant Pathology	1 lot
	6 Plant Breeding & Genetics	1 lot
	7 Soil Science	1 lot
	8 Agricultural Entomology	1 lot
B. Agri. Engineering & Technology	9 Food Technology	1 lot
	10 Irrigation & Drainage	1 lot
	11 Fibre Technology	1 lot
	12 Basic Engineering	1 lot
	13 Farm Machinery & Power	1 lot
C. Basic Science	14 Botany	1 lot
	15 Zoology & Fisheries	1 lot
	16 Physics	1 lot
	17 Chemistry/Biochemistry	1 lot
D. Animal Husbandry	18 Mathematics & Statistics	1 lot
	19 Livestock Management	1 lot
	20 Animal Breeding & Genetics	1 lot
	21 Animal Nutrition	1 lot
	22 Poultry Husbandry	1 lot
E. Veterinary Science	23 Veterinary Anatomy	1 lot
	24 Veterinary Pathology	1 lot
	25 Veterinary Parasitology	1 lot
	26 Clinical Medicine & Surgery	1 lot
	27 Animal Reproduction	1 lot
	28 Physiology & Pharmacology	1 lot
	29 Veterinary Microbiology	1 lot
F. College of Vet. Sciences, Lahore	30 Various Sections	1 lot
G. Div. of Agri. Education & Extension	31 Relevant Departments	1 lot
H. General Facilities	32 Health Centre	1 lot
	33 Audio/Video Equipment	1 lot
	34 Hall Warden Office	1 lot
	35 Central Laboratory	1 lot
	36 University Press	1 lot
	37 Elevator	1 set
	I. Central Computer Facility	38 Computer Networks

## **CHAPTER 2 CONTENTS OF THE PROJECT**





## CHAPTER 2 CONTENTS OF THE PROJECT

### 2-1 Objectives of the Project

The University of Agriculture, Faisalabad, where this project is to be implemented, is the country's highest seat of learning and training in agriculture, which is providing supports to the other universities and colleges of agricultural disciplines. Its predecessor, the Punjab Agricultural College and Research Institute, was founded in 1909. When the university was established in 1961 by upgrading its predecessor, its buildings were constructed on its present site and the equipment for teaching use was installed with the financial assistance of the World Bank. Later on, the university procured some additional items of equipment at its own expense. Furthermore, some additional items of teaching equipment, glassware and personal computers were procured in the 1980s with the financial aid of USAID. But these efforts fell short of fully meeting the university's equipment requirements. The university has a total enrolment of about 4,500 students. About 95 percent of the students finishing undergraduate courses take postgraduate courses as the next stage of their education, and the number of students taking postgraduate courses is almost the same as that of those taking undergraduate courses. Courses on a relatively high technical level are offered at the university. This explains why many of its graduates occupy leading positions at the country's major educational and research institutions and government agencies. It can safely be said that the graduates of the university are playing a pivotal role in the research, development and extension of agricultural technologies and techniques and the improvement of their quality.

On the other hand, however, the university has 5 times more students and 3 times more academic staff than in 1961, the year when it was established. As a result, it is faced with an absolute shortage of equipment for teaching and research use. Furthermore, most of the existing items of equipment have become superannuated, making it difficult to carry out education in state-of-the-art agricultural technologies and techniques. In other words, the university is not in a position to nurture human resources to take charge of systematic research, teaching and extension activities. Under such circumstances, the university is in the midst of striving to work out plans to improve its equipment for teaching use in order to nurture human resources to contribute to the strengthening of the foundation of the country's economy. This effort, however, is being stalled by a shortage of necessary funds.

This project is aimed at updating the university's superannuated equipment, making up for the equipment deficiency or procuring new equipment for the improvement, both qualitative and quantitative, of the educational activities carried out at the University of Agriculture, Faisalabad, the updating of the technologies in use at the university, helping the university nurture human resources to play a leading role in agriculture, which is central to the economy of the country, the enhancement of the standard of living and the realisation of social stability in rural areas through the expansion in agricultural productivity and the resultant increase in agricultural production, and the nurturing of human resources to contribute to the realisation of self-sufficiency in staple crops, and a substantial increase in the production of export agricultural products.

## **2-2 Basic Concept of the Project**

### **(1) Overall Concept**

As mentioned above, this is a project to improve the quality of the equipment used in the existing laboratories and related facilities of the University of Agriculture, Faisalabad, which is faced with a serious shortage of teaching equipment, and thereby improve and expand the university's educational activities, as well as update the technologies in use at the university with a view to helping the university train agricultural engineers, whose role is emphasised in the federal government's national plan (the eighth 5-year plan) and agricultural policy, and strengthening the foundation of the agricultural sector, which is central to the economy of the country. For this reason, this project places utmost emphasis on the replacement of the superannuated or outdated equipment and the procurement of new equipment, while paying close attention to the consistency of the equipment to be newly procured with the university's current curricula. In view of the fact that the number of the students taking undergraduate courses is almost the same as that of those taking postgraduate courses, and that these undergraduate and postgraduate courses are on a relatively high technical level, due consideration should be given to the procurement of minimum quantities of equipment for research use which can also be used for teaching, in addition to the procurement of the equipment for teaching use only. In the case of equipment for research use, however, most items are expensive, and in addition it costs a great deal to operate, maintain and manage them. For this reason, equipment for research use should be installed in the central laboratory so that its use, maintenance and management may be shared by all the faculties and departments.

The projected items of equipment are for the use of the academic staff, who numbers a little over 500, and the undergraduate and postgraduate students, who number about 4,500. The operation and management of the equipment during experimentation and practical training is supported by a total of 175 technical staffs. In the case of practical training of the undergraduate students, demonstrations by the instructors are given to classes of 50 to 60 according to the department and the course and experimentation, and practical training is conducted for small classes of 5 to 10 or those of more than 20. While the average class size is about 50, which is almost the same as in 1961 when the university was established, the total number of the students is nearly 5 times as large as in 1961. For this reason, the quantities of the equipment to be procured under this project were determined based on the details of the experimentation programmes conducted at the university, taking into consideration the present condition of the usable existing items of equipment.

The basic concept of this project was developed as follows on the basis of the above-mentioned overall concept and the results of the examination of the contents of the request, which was conducted in the form of a field survey and a post-survey analysis in Japan.

## (2) Examination of the Contents of the Request

The University of Agriculture, Faisalabad requested 1,050 items of equipment for use in its 9 divisions (faculties, a college and others), which cover 38 fields (departments and others) in the initial PC- 1. Later 215 items (for use in 24 fields) were added, increasing the total to 1,220 items. Of the 38 fields requested, the health centre, the hall warden office and the new lift were excluded from this project because their relevance to the university's curricula is open to question and because these should be procured by the Government of Pakistan. This decision was agreed to by the Pakistan side. The initial Pakistan request included the development of a computer network for the use of the Faculty of Basic Science, the Faculty of Veterinary Science, the Faculty of Animal Husbandry, the Library and the Administration Division. However, the costs of initial investment and the operation, maintenance and management of an advanced computer network were judged to be prohibitive. In addition, there would be a need to create a proper system of network management in the whole university. So it was concluded that it would be more effective to procure personal computers for use in the departments concerned and the Faculty of Basic Science's computer centre in light of the high performance of personal computers and the period of their depreciation. The Pakistan side also agreed to this decision. For these reasons, it was decided to exclude these from this project. Those items of equipment which are requested by more than one division or department, those which it will be difficult to maintain and manage and those for which there is no urgent need

were excluded from this project. In the case of those which are requested by more than one division or department and whose use should be shared by more than one department because of their costliness, their quantities were minimised. As to the equipment specifications, those which included nonessential functions were excluded from this project, and only those which will make it possible to maintain and manage the machines continually were selected. In the case of the additional items of equipment, only those which are considered appropriate in terms of necessity and urgency were included in this project, in view of the fact that more than 2 years have passed since the drafting of the initial PC- 1 and the academic staffs' perceptions of the requested items have changed over the period and that there is a need to make changes in the list of the requested items as a result of the teaching staff reshuffle and the subsequent reorganisation of the courses.

The items of equipment which were excluded from this project are:

- those which do not serve teaching purposes (the health centre, the hall warden office, the lift)
- those which are inappropriate in terms of ease of maintenance and management (the computer network)
- those for which there is no urgent need (part of the experimental equipment, including those items requested by the central laboratory)
- those which are requested, but can be shared, by more than one division or department)

The main items of equipment requested by the central laboratory in which expensive items of equipment are concentrated are as shown in the following table.

**Table 2- 1 Request for Equipment in the Central Laboratory**

Name of Major Equipment	No. of Dept. Requested	Q'ty
X-Ray Diffractometer (XRD)	2	1
Scanning Electron Microscope (SEM)	7	1
Transmission Electron Microscope (TEM)	6	1
Inductively Coupled Plasma Photometer (ICP)	5	0
High Performance Liquid Chromatograph (HPLC)	10	3
GC Mass Spectrometer (GCMS)	5	1
Atomic Absorption Spectrophotometer (AASP)	12	2*
Amino Acid Analyser (AAA)	5	1
Ultra Centrifuge (UC)	7	3

\* One (1) set is for College of Veterinary Sciences, Lahore.

As to the copying machines requested by many departments, it was decided to install one unit in each dean's office, whose use should be shared by all the departments concerned so that the academic staff, who has so far used private copying services in the city to make copies of teaching materials, may use the copier installed in the dean's office for the same purpose. Regarding the personal computers, which are also requested by many departments, it was decided to procure a set of a desktop computer, a printer and relevant software for each department which requested a personal computer for the preparation of teaching materials, general academic management or database management. As for the teaching aids like overhead projectors and slide projectors, which are also requested by many departments, it was decided to procure one unit for each department which is in urgent need of one.

### (3) Items of Equipment to Be Procured under the Project

The items of equipment to be procured under this project are those for educational use, which are to be used in the University of Agriculture, Faisalabad. They are divided broadly into those for educational use to be installed in laboratories, those for educational and research use to be installed in the central laboratory and those for use in the library and the university press. The items in the first grouping include those used in analyses, in preparations for analyses, measuring instruments, basic items of experimental equipment and teaching aids. Given below is the outline of the faculties and departments for which these items of equipment are to be procured.

#### A. Faculty of Agriculture

The Faculty of Agriculture, whose predecessor is the Punjab Agricultural College, has the oldest history of all the faculties of the University of Agriculture, Faisalabad. As such, the faculty is playing a central part in the university. It has 8 departments, namely, the departments of crop physiology, horticulture, agronomy, forestry, range management and wild life, plant pathology, plant breeding and genetics, soil science, and agricultural entomology, plus Postgraduate Agricultural Research Station (PARS). It also has two important research units, namely, the Saline Agriculture Research Cell and the Plant Tissue Culture Cell.

The faculty has a teaching staff of 136 (25 professors, 32 associate professors, 25 assistant professors and 54 lecturers), which is supported by 4 researchers and 25 technical staff members. The faculty's undergraduate students are registered according to the courses they take. The total

number of the postgraduate students is 725, which breaks down into 574 taking the M. Sc. course and 151 taking the Ph. D. course.

Most of the existing items of experimental equipment used in the faculty has become superannuated or outdated since they have not been replaced or updated for a long time. It should also be noted that in recent years, there has been an absolute shortage of these items of equipment as a result of a marked increase in the numbers of students and academic staffs. Most departments of this faculty have been better equipped compared to those of other faculties because these departments were able to carry out a number of contract research projects for the Government of Pakistan and international organisations. But this fact alone has not alleviated the serious experimental equipment shortage in the faculty. Shown below is the outline of the faculty's departments.

#### 1) Department of Crop Physiology

This is a new department established recently within the Faculty of Agriculture. At present, this department is providing only undergraduate courses, but it is expected that this department will shortly begin to offer postgraduate courses. This department's students are educated and trained in the general physiology, developmental physiology, physiology crop nutrition, physiology of crop yield, etc. in the process of growth and development of crops. Its teaching staff consists of 1 professor, 2 assistant professors and 2 lecturers.

The items of equipment to be procured for this department include plant growth cabinet, chlorophyll meter, electronic balance, nitrogen analyser, microscope, osmometer, oven, etc., each of which is indispensable for education and training given in this department. As to the atomic absorption spectrophotometer, which was included in the initial request, this department is to share the use of the one to be located in the central laboratory. It was decided to delete the notebook-type computer and the photocopy machine from the list in line with the overall policy for this project. The area meter was deleted from the list because the use of it could be shared with other departments. It was also decided to reduce the number of units of the displacement transducer from 10 to 5 since the equipment is for use in group experiments.

## 2) Department of Horticulture

This department's students are educated and trained in the physiological and biochemical analysis and cultivation techniques in the process of growth, blooming and fructification of vegetables, fruits and flowers. As part of its postgraduate level education and research, the department's teaching staff are actively engaged in biotechnological research. Their recent achievements include those in plant tissue culture and recombinant DNA research. This research work is playing an important role in the Faculty of Agriculture. This department has a teaching staff of 20 - 3 professors, 3 associate professors, 5 assistant professors and 9 lecturers. The total number of its postgraduate students is 45, which breaks down into 35 taking the M. Sc. course and 10 taking the Ph. D. course.

The items of equipment to be procured for this department include microscopes, vertical laminar airflow (clean bench), water purifier, plant growth cabinet, humidifier, drying cabinet, electronic analytical balance, freezer, autoclave, etc., each of which is indispensable for the education and training of the students and the promotion of the spread of biotechnology, a new field. Of the requested items of equipment, it was decided to delete from the list those whose use can be shared with the central laboratory, such as ultracentrifuge, those whose procurement is not urgently needed, such as automatic washer, those whose use can be shared with the other departments, such as ice flakes making machine, and photocopy machine.

## 3) Department of Agronomy

This department, which is the faculty's oldest and largest department, has achieved many successes in the education and research in agronomy. Its students are educated and trained in crop physiology, crop ecology, crop management and crop production. It has a teaching staff of 25 - 3 professors, 9 associate professors, 6 assistant professors and 7 lecturers. The total number of its postgraduate students is 229, which breaks down into 190 taking the M. Sc. course and 39 taking the Ph. D. course.

The items of equipment to be procured for this department include electronic balance, Kjeldahl system, grain moisture meter, grain counter, infrared analyser, flame photometer, projector, oven, ceptometer, thermostatic germinator, plant growth cabinet, chlorophyll meter, etc., each of which is indispensable for the education and training of this department's students. Of the requested items of equipment, it was decided to delete from the list those whose procurement is

not urgently needed, such as radiation measuring unit, and those which are to be procured under the overall policy of the entire project, such as laptop computer and audio-visual equipment.

#### 4) Department of Forestry, Range Management and Wild Life

In Pakistan, arable land accounts for 25 percent, forest land 5.5 percent, pasture (or plains) 62 percent and other 7.5 percent, of the total land area. The increase in the forest land and range areas has important implications for the future of the country. This department's students, both undergraduate and postgraduate, are educated and trained in silviculture of farm trees, agro-forest products, range vegetation physiology/ecology, range livestock and wildlife ecology, and forestry and environmental pollution. It has a teaching staff of 11 - 1 professor, 1 associate professor, 3 assistant professors and 6 lecturers. The total number of its postgraduate students is 23, which breaks down into 21 taking the M. Sc. course and 2 taking the Ph. D. course.

A wide variety of items of equipment are requested by this department because it has not received many equipment under the projects conducted with the financial assistance of international organisations and because this department covers a wide range of educational disciplines. The items of equipment to be procured for this department include surveying instruments, such as altimeter, theodolite, planimeter and compass, afforestation equipment, such as trolley mounted diesel pump, pesticide spraying machine, light meter, relative humidity meter, water flow meter, water gauge and plant water potential apparatus, equipment for use in wild animal management, such as dissecting sets for use with small animals, animal weighing scale, refrigerator, deep freezer, blender, telescopic binoculars, forestry machines (chain saw, electronic hand drill, universal wood testing machine, electric circular saw, electric wood planer, electric sanding machine and wood working hand tools, soil testing equipment, such as soil sampler, soil thermometer, soil pH meter and soil tensiometer, and general items of educational equipment, such as scale, personal computer, microscope, video camera, overhead projector, slide projector and camera for making slides, etc. Almost all of these items of equipment are basic items and therefore it is appropriate to procure them under this project. Of the 70 requested items of equipment for this department under this project, it was decided to delete from the list those whose procurement is not appropriate or urgently needed, such as wood seasoning chamber, plywood tensile, veneer peeling machine, building material combustibility tester, paper making apparatus, equipment for use in production site and air gun, those whose use can be shared with the other departments, such as area meter and plant water potential apparatus, and those which are to be procured for the entire project, such as VTR, TV set and photocopy machine.



#### 5) Department of Plant Pathology

This department's students are educated and trained in those aspects of microbiology which are related to plant diseases, plant pathology, bacteria and virus disease of plant, pest insects related disease of plant, and plant diseases diagnosis. This department has a teaching staff of 16 - 3 professors, 5 associate professors and 8 lecturers. The total number of its postgraduate students is 48, which breaks down into 36 taking the M. Sc. course and 12 taking the Ph. D. course.

The items of equipment to be procured for this department include low temperature incubator, stereoscopic microscope, rotary shaker, spectrophotometer, vacuum filtration system, autoclave, table top centrifuge, growth chamber, automatic slide stainer, etc. each of which is indispensable in educating and training students in plant pathology. Of the requested items of equipment, it was decided to delete from the list those whose use can be shared with the central laboratory, such as ultracentrifuge and high performance liquid chromatograph, and those which are to be procured for the entire project, such as photocopy machine.

#### 6) Department of Plant Breeding and Genetics

This department's students, both undergraduate and postgraduate, are educated and trained in plant breeding, cytogenetics, population genetics, mutation breeding, cereal/maize/cotton breeding and genetics. This department, which is responsible for education and training in those aspects of plant breeding and genetics which are related to selective plant breeding that forms the base of agricultural technology development, occupies an important position within the Faculty of Agriculture. It has a teaching staff of 20 - 5 professors, 6 associate professors, 1 assistant professor and 7 lecturers. The total number of its postgraduate students is 154, which breaks down into 119 taking the M. Sc. course and 35 taking the Ph. D. course. It should be noted that the research activities conducted at this department is characterised by special emphasis placed on the improvement of species of wheat and maize, which are highly adaptive and resistant to saline condition, for their growing in as much as 6 million ha. of saline soil.

The items of equipment to be procured for this department include electronic balance, microscopes, FT- IR spectrophotometer, thermostatic germinator, plant water potential apparatus, digital grain moisture meter, autoclave, low temperature incubator, personal computer, water distillation apparatus, etc. each of which is indispensable for education and training conducted at

this department. Of the requested items of equipment, it was decided to delete from the list those whose use can be shared with the central laboratory, such as high volume instrument, those which are requested for the other department, such as microscope with photomicrographic attachment, and those which are to be procured for the entire project, such as photocopy machine.

#### 7) Department of Soil Science

This department is responsible for the education and training in soil science, which forms the base of agricultural production. This department is playing an important act in the Faculty of Agriculture together with other departments. This department's students are educated and trained in soil chemistry, soil physics, soil classification, soil microbiology and soil fertiliser. It has a teaching staff of 22 - 4 professors, 7 associate professors, 2 assistant professors and 9 lecturers. The total number of its postgraduate students is 99, which breaks down into 71 taking the M. Sc. course and 28 taking the Ph. D. course. The organisation of this department is characterised by a research staff of 8, which is responsible for solving the problems of saline soil, which is spreading widely in the country. The Faculty of Agriculture's project to fight against salinity, which is being implemented at the request of the Government of Pakistan and such international organisations as the ODA, the CIDA, the UNDP and the AIDAB, has achieved considerable successes. This is a very important project which is expected to contribute greatly to the future development of agriculture in the country.

Against such a background, the items of equipment to be procured for this department range very widely, including such analytical instruments as spectrophotometer, flame photometer, Kjeldahl analyser, thin layer chromatograph, ion analyser, gel electrophoresis apparatus and ammonia analyser, equipment for use in preparations for analyses, such as table top centrifuge, high-speed centrifuge, orbital shaker, shaking water bath, muffle furnace, magnetic stirrer, ultrasonic homogenizer and oven, such basic items of experimental equipment as pure water making apparatus, clean bench, air conditioner, freezer, ultrasonic washer, vacuum pump and plant growth cabinet, such measuring instruments as light meter, digital dissolved oxygen meter, digital chloride meter, osmometer, barometer and portable digital conductivity meter, and such general items of equipment as microscopes, balances, overhead projector, slide projector, camera and slide cabinet, etc., each of which is indispensable for education and training conducted at this department. Of these requested items of equipment, it was decided to delete from the list those whose procurement is not appropriate, such as ammonia analyser, those whose use can be shared with the central laboratory, such as atomic absorption spectrophotometer, those which are

requested in duplicate, such as autoclave, high speed refrigerated centrifuge, automatic water distillation apparatus, laser printer and AVR, and those which are to be procured for the entire project, such as VTR and photocopy machine.

#### 8) Department of Agricultural Entomology

This department's students, both undergraduate and postgraduate, are educated and trained in ecology, morphology, physiology, pest management and toxicology of both useful and harmful insects. This department has a teaching staff of 18 - 5 professors, 1 associate professor, 6 assistant professors and 6 lecturers. The total number of its postgraduate students is 127, which breaks down into 102 taking the M. Sc. course and 25 taking the Ph. D. course. This department's existing items of equipment are an atomic absorption spectrophotometer, a gas chromatograph and a high performance liquid chromatograph. Though the atomic absorption spectrophotometer and gas chromatograph are currently lying on the table waiting for supply of necessary spares parts, the department has an ample record of fully making use of these equipment.

Since the requested items of equipment for this department are only basic ones, none of them were deleted from the list. They include student stereomicroscope, low temperature incubator, oven, drying cabinet, humidifier, rotary microtome, paraffin bath, personal computer, slide projector, electronic balance, insect growth chamber, etc. They are all basic items of equipment which are indispensable for the education and training of students.

#### 9) Postgraduate Agricultural Research Station (PARS)

At PARS, field experiments are conducted by this faculty's postgraduate students under the supervision of the dean of the faculty and seed wheat and seed rice for farmers are produced. Its field with an area of about 300 ha. is divided into a macro-plot with an area of 10 ha. and a small micro-plot. In the macro-plot wheat and rice are grown in a cycle of wheat to rice to wheat. At present, wheat and rice are harvested manually by seasonal labourers. Since it is difficult to secure the services of an adequate number of seasonal labourers, however, it is difficult to do harvesting at the right time and the quantities of lost crops are not negligible. In Pakistan, mechanised harvesting has been getting popularity. For these reasons, European and American manufacturers of farm machines are in the process of making preparations for the knockdown production of combines in the country. The main advantages of combine harvesting are;

- it is very efficient, making it possible to do harvesting at the right time and reducing crop losses,
- it makes it possible to conduct education and research in combine harvesting suited for the natural conditions in the country,
- it make it possible to demonstrate a model of mechanised farming,
- it is easy to maintain and manage, and it can be used for a long time if the locally made combine harvester is introduced.

The introduction of combine harvester is important in conducting comprehensive education and training in mechanised farming suited for the natural conditions in the country. Since the Faculty of Agricultural Engineering and Technology is expected to play an important part in their maintenance besides the workshop of PARS, the combines introduced can be utilised with the cooperation of all the faculties and department concerned. In view of the expected positive effects on agricultural education and research, as well as the possible improvement of the quality of services for community farmers, such as distribution of seeds, it was planned to include a combine harvester as a common equipment of the Faculty of Agriculture, although the university requested the procurement of two.

#### B. Faculty of Agricultural Engineering and Technology

This faculty consists of 4 departments, namely, the departments of irrigation and drainage, farm machinery and power, food technology and fibre technology. It has a teaching staff of 48 - 5 professors, 12 associate professors, 10 assistant professors, 20 lecturers and 1 researcher. This faculty's undergraduate courses were launched a little later than the Faculty of Agriculture, in the 1963- 64 educational year. The characteristics of a country's agriculture are clearly reflected in the country's agricultural engineering and technology, which is a discipline giving indirect support to agriculture. In Pakistan, agriculture is the most important sector that supports the economy of the country and utmost emphasis is placed on the production of such cash crops as cotton and livestock products, as well as of staple crops, in the country's agricultural sector. That is why this faculty has such technological departments as the department of fibre technology and the department of food technology in addition to the department of irrigation and drainage and the department of farm machinery and power, both of which are related to the development of the agricultural infrastructure in the country and mechanised farming. To these departments, a new department of basic engineering has been added. The department of fibre technology is the country's only institution offering M. Sc. courses in this discipline. It is credited with nurturing competent engineers to play a

pivotal role in the country's textile industries. The other 4 departments are offering both undergraduate and postgraduate courses. The department of food technology is currently offering a Ph. D. course, and the departments of fibre technology and basic engineering also have plans to open Ph. D. courses.

At present, the country's agricultural sector is faced with such problems as low efficiency in irrigation, saline soil, environmental pollution by fertilisers and insecticides, the need to diversify and improve the quality of processed products, delay in mechanisation of agriculture and the need to improve the quality of cotton and cotton products, and to nurture human resources to take the lead in tackling these problem is one of this faculty's most important missions. However, the faculty is finding it hard to perform this mission because many of its existing items of equipment are superannuated or out of order. Therefore, most of the requested items of equipment for this faculty are those which it is appropriate and urgently necessary to procure. Shown below is the outline of each of the departments of this faculty.

#### 1) Department of Food Technology

This department is responsible for education and research in the technologies and techniques of storage and processing of vegetables, fruits and grains, as well as for the creation of added values through the enhancement of the quality of farm products. Its students, undergraduate and postgraduate, are educated and trained in food chemistry, food microbiology, food enzymology, food additives, food processing, cereal technology, dairy science, edible oils and fat products, and meat product processing. It has a teaching staff of 16 - 1 professor, 6 associate professors, 3 assistant professors and 6 lecturers. The total number of its postgraduate students is 99, which breaks down into 84 taking the M. Sc. course and 15 taking the Ph. D. course. Many of its existing items of equipment, consisting of those for use in food processing and food analyses, are superannuated to be repaired, which fact is a major obstacle to its education and training programmes.

The items of equipment to be procured for this department include electronic balance, colony counter, soxhlet extraction unit, rotary evaporator, magnetic stirrer, slide projector, etc., each of which is necessary for education and training in food testing/analysis. Of these items of equipment, it was decided to eliminate the high performance liquid chromatograph and the NMR analyser because the former is to be moved to the central laboratory so that it may be operated

more efficiently and because it will be very difficult to operate and maintain the latter economically as well as technically.

## 2) Department of Irrigation and Drainage

This department is responsible for the education and research in water supply and drainage which are best suited for crop growing. Its students, both undergraduate and postgraduate, are educated and trained in fluid mechanics, soil mechanics, hydraulic machinery, and irrigation and drainage engineering. Most of the irrigation facilities in the country were large-scale ones constructed by the then British authority. But they are posing such problems as low irrigation efficiency and water logging. One of this department's missions is to nurture human resources capable of dealing with these problems. This department has a teaching staff of 10 - 3 associate professors, 2 assistant professors and 5 lecturers, the post of professor remaining vacant. This department's postgraduate students, who are taking the M. Sc. course, are administered together with those of the department of farm machinery and power and the department of basic engineering. The total number of postgraduate students in these 3 departments is 23.

The items of equipment to be procured for this department include instruments for use in experimentation in fluid mechanics, such as metacentric height apparatus, Osborne Reynolds demonstration unit, laminar flow table, viscometer, fluid friction loss apparatus, instruments for use in experimentation in hydraulic structures, such as flow current meter, seismograph and sand box apparatus, instruments for use in experimentation in soil mechanics, such as motorised direct shear apparatus, motorized liquid limit set, plastic and shrinkage limit set and constant head permeameter, water quality testing instruments, such as pH meter, digital conductivity meter, spectrophotometer and flame photometer, surveying instruments, such as theodolite and laser beam leveller, and general items, such as planimeter, electronic balance, soil moisture tensiometer, overhead projector and personal computer, etc., each of which is a basic item of educational equipment. Of these items of equipment, it was decided to remove from the list the energy loss apparatus and the electric analogue model, whose functions overlap those of the other items. The quantity of calibration of pressure gauge apparatus, viscometer, water hammer apparatus, hydrometer is reduced because they are used in group experiments.

### 3) Department of Fibre Technology

The main objective of this department is to develop technological manpower capable of contributing the improvement of the quality of cotton, yarn and fabrics, all of which are the country's key farm products. Its students are educated and trained in fibre technology, fibre chemistry, fibre physics, quality control, etc. It has a teaching staff of 4 - 2 associate professors, 1 lecturer and 1 researcher who is a retired professor, the post of professor being vacant. It presently offers only an M. Sc. course, but is considering the introduction of a Ph. D. course. The total number of the students taking the M. Sc. course is 34. Many of its existing items of equipment are superannuated. They are considered outdated in light of the recent progress of the textile industry of the country.

The items of equipment requested by this department are cotton fibre measuring system and evenness tester, one unit each, both of which are internationally recognised standard items of equipment for use in the evaluation of the quality of fibres. For this reason, the textile industry and research institutes are required to promote education and research on the basis of the data obtained using these items of equipment. Since most of the graduates of this department are expected to play a leading role in government agencies and major private enterprises, it is desirable that this department's students be educated and trained in the knowledge and use of these items of equipment. The cotton fibre measuring system is capable of measuring the fibre length, fibre micronaire, fibre strength and elongation, colour and trash content of raw cotton and cotton fibres and makes it possible to conduct basic and important analyses. Since there is no problem with the availability of test specimens, this system is suited for the education and training of this department's postgraduate students. The evenness tester, which is for use with yarn, crude yarn and sliver, are suited for use in spinning mills, but it will be inappropriate to install this instrument within a facility of a university in light of the availability of test specimens and ease of equipment maintenance and management. From the standpoint of education based on a specific curriculum, it is desirable to train the students in the use of this instrument on an as needed basis with the cooperation of a private spinning mill operating near the campus of the university. For this reason, this instrument was deleted from the list.

### 4) Department of Basic Engineering

This department's undergraduate students are educated and trained in basic engineering, namely, in drawing, surveying, material science, mechanics of materials and theory of structures.

In its postgraduate course, on the other hand, special emphasis is placed on the interpretation of the effects of agricultural pollution in view of the fact that agriculture- caused water and soil pollution is spreading in the country. This department has a teaching staff of 6 - 2 professors, 1 associate professor, 1 assistant professor and 2 lecturers. Many of its existing items of equipment, which are largely basic ones for use in education and training of students, are superannuated to function properly, which is a major obstacle to education and training conducted at the department.

The items of equipment to be procured for this department include those which to replace the existing ones, such as universal tensile and compressive testing machine and torsion spring testing apparatus, surveying and analytical instruments, such as nitrogen analyser, soil salt meter, water quality checker, chloride content meter and T.D.S. meter, and those which are used to preserve specimens and instruments, such as refrigerator and air conditioner, etc. It is considered appropriate to procure these items of equipment for the purpose of enhancing the quality of its educational courses. Of the requested items of equipment, it was decided to eliminate those which there is no justifiable or urgent need to procure, such as engine test bed and laser beam leveller and those whose functions overlap those of the other items, such as neutron moisture measurement. It was also decided to reduce the number of units of the automatic soil moisture meter and the T.D.S. meter from 2 to 1 in light of the number of the students and the frequency of their use.

#### 5) Department of Farm Machinery and Power

This department is responsible for educating and training undergraduate and postgraduate students in the structures, operation, testing and designing of those farm machines which are required to increase farming efficiency. It has a teaching staff of 12 - 2 professors, 4 assistant professors and 6 lecturers. The main problems facing the country's agricultural sector include the slow pace of mechanisation of farming among petty farmers owning farmlands with areas of 10 ha. or less, farm machine manufacturers' lack of new product development capabilities and no technical standards applicable to farm machines. To overcome such problems is one of the challenges facing this department. Its existing items of equipment includes 3 tractors, a soil tilling/preparing machine in the workshop, engine cut models, testers such as a soil hardness tester and a Brinell hardness tester and machine tools such as a lathe and a milling machine, both of which are outdated. They are inadequate, both qualitatively and quantitatively.



The items of equipment to be procured for this department include forklift for use in transportation of machines and instruments (the forklift is to be used to lift repair parts because it is impossible to install a hoist in the existing repair workshop because of its structural characteristics), sensor to detect displacements, forces, pressures, velocities and accelerations, the instrument to calibrate the sensor, counter and amplifier to process signals from the sensor, strain gauge, strain indicator and recorder set, each of which has a wide range of applications and therefore it is necessary and appropriate to procure to use in education and research. Of these requested items, it was decided to remove from the list those which there is no justifiable or urgent need to procure and those whose functions overlap those of the other items, such as linear voltage differential transformer, flowmeters, rote meter, frequency meter and sensor for speed measurement.

### C. Faculty of Basic Science

This faculty is responsible for education and training of undergraduate and postgraduate students in those aspects of applied/basic sciences which are closely related to other natural sciences, social sciences and the humanities. In recent years, there has been a considerable increase in the number of students applying for admission to this faculty. It has 8 departments, namely, the departments of botany, zoology and fisheries, physics, chemistry/biochemistry, mathematics and statistics, agricultural meteorology, social science/humanities and Islamic studies, of which the first 5 departments are to be covered by this project. At present, the faculty has a teaching staff of 77 - 13 professors, 15 associate professors, 14 assistant professors and 35 lecturers. The total number of its postgraduate students is 478, which breaks down into 335 taking M. Sc. courses, 107 taking M. Phil. courses and 36 taking Ph. D. courses. The present state of the faculty's existing items of equipment for use in education and research is roughly the same with other faculties. They have not been replaced or updated for a long time and most of them are superannuated or outdated to meet basic educational and research requirements, both quantitative and qualitative, in the field of basic science. Shown below is the outline of each of these departments.

#### 1) Department of Botany

This department's undergraduate and postgraduate students are educated and trained in plant morphology, plant physiology, plant ecology and molecular biology. This department has a teaching staff of 9 - 2 professors, 5 associate professors and 2 lecturers. The total number of its postgraduate students is 80, which breaks down into 42 taking the M. Sc. course, 24 taking the M.

Phil. course and 14 taking the Ph. D. course. In recent years, the total number of the students enrolled at this department has been on the rise. The department's existing microscopes for the use of students were manufactured in the 1920s and many of the other existing items of equipment are also superannuated or out of order.

The items of equipment to be procured for this department include general items, such as microscope and electronic balance, analytical instruments, such as double beam UV- VIS spectrophotometer, flame photometer and automatic chloride analyser, measuring instruments, such as photosynthesis measurement system, Kjeldahl system, EC meter and pH meter, and instruments for use in preparations for analyses, such as plant growth cabinet, table top centrifuge, orbital shaker and oven, etc. each of which is indispensable for education and training in botany- related aspects of basic science. Of the requested items of equipment, it was decided to reduce the number of units of the monocular microscope from 20 to 10 since these microscopes are to be used in classes of about 20 and therefore the use of one unit can be shared by two students. It was also decided to delete from the list those whose functions overlap those of the other items, such as high- speed micro centrifuge and voltage stabiliser.

## 2) Department of Zoology and Fisheries

This department's students, undergraduate and postgraduate, are educated and trained in vertebrate biology, invertebrate biology, animal ecology, population biology, fish ecology, fish culture and fishery management. This department has a teaching staff of 10 - 4 professors, 4 assistant professors and 2 lecturers. The total number of its postgraduate students is 79, which breaks down into 34 taking the M. Sc. course, 32 taking the M. Phil. course and 13 taking the Ph. D. course. In recent years, the total number of the students enrolled at this department has been on the increase.

The items of equipment to be procured for this department include general items, such as microscope, projector and balance, and analytical instruments, such as double beam UV- VIS spectrophotometer and electrophoresis equipment, instruments for use in preparations for analyses, such as table top centrifuge, soxhlet extraction unit, muffle furnace and constant temperature circulator, and measuring instruments, such as timer, conductivity meter and dissolved oxygen meter, each of which it is necessary and appropriate to procure for the use of this department's students. Of these requested items of equipment, it was decided to remove from the list those whose use is to be shared with the central laboratory, such as atomic absorption spectrophotometer,

its accessories and high-speed centrifuge, those which can be procured within the limits of the university's budget, such as marker, those whose functions overlap those of the other items, such as portable conductivity meter, incubator and voltage stabiliser, and those which there is no urgent need to procure, such as automatic scanner.

### 3) Department of Physics

This department is responsible for educating and training undergraduate and postgraduate students in various subjects, such as physics, applied physics, electronics, agricultural meteorology, soil physics, etc. It has a teaching staff of 9 - 1 professor, 1 associate professor, 2 assistant professors and 5 lecturers. The total number of its postgraduate students, who are taking the M. Sc. course, is 49. Its main existing items of equipment are basic measuring instruments such as electrical/electronic circuit tester, oscillograph, function generator, etc., many of which are out of order. It cannot be said that these items of equipment are sufficient to cover the broad field of physics.

The items of equipment to be procured for this department include instruments for use in basic experimentation in physics, such as oscilloscope, function generator, frequency counter, power supply, digital multimeter, amplifier, standard resistor, those for use in experimentation in electron spin resonance, those for use in experimentation in heat conduction, those for use in experimentation in electromagnetism, sound level meter, basic microwave optic system, laser beam system, and general items such as projector and personal computer, etc. each of which is basic item. Of the requested items of equipment, it was decided to eliminate those whose functions overlap those of the other items, such as power supply, amplifier, voltage stabiliser, sound level meter, balance and some measuring instruments, and those whose procurement is not urgently needed, such as comprehensive fibre optics apparatus. It was also decided to reduce the number of units of the equipment, the necessary number of units of which is more than one, was reduced on the assumption that their use will be shared by a number of students in classes of about 20.

### 4) Department of Chemistry/Biochemistry

This department, which consists of the chemistry section, the biochemistry section and the human environment section, is responsible for educating and training undergraduate students in basics of chemistry and postgraduate students in inorganic chemistry, organic chemistry,

biochemistry, etc. It has a teaching staff of 18 - 5 professors, 3 associate professors, 4 assistant professors and 6 lecturers. The total number of its postgraduate students is 153, which breaks down into 105 taking the M. Sc. course, 39 taking the M. Phil. course and 9 taking the Ph. D. course. Thus this is the largest department of the Faculty of Basic Science. In view of the fact that the country is faced with various types of pollution, this department's education and research activities are directed towards greater safety of farm and processed products and a cleaner environment. This department's existing items of equipment include microscope, autoclave, oven, muffle furnace, centrifuge, etc. all of which are indispensable for experimentation. But the fact is that there are limited types and quantities of them, making it difficult for this department to fully perform its functions. It should be noted that there are few instruments for use in the new human environment section.

The items of equipment to be procured for this department are mostly analytical instruments, such as centrifuge, muffle furnace, rotary evaporator, spectrophotometer and gas chromatograph. They also include basic items, such as clean bench, autoclave and incubator, and those for use in education and training in enzyme science, such as freezer and fan meter for microorganism. The items of equipment for use in the environmental science course are those used to measure the degree of air and water pollution, such as sampler, BOD and COD analyser and water quality checker. Of the requested items, it was decided to delete from the list those whose use is to be shared with the central laboratory, such as ultra centrifuge, and those which can be replaced by other items, such as double-beam UV- VIS spectrophotometer. The number of units of those items, the requested number of items of which was two each (namely, rotary evaporator, muffle furnace and vacuum drying oven), was reduced to one because one unit each is adequate in light of their functions.

#### 5) Department of Mathematics and Statistics

This department's students, both undergraduate and postgraduate, are educated and trained in algebra, geometry, differential calculus, integral calculus, operations research, econometrics, mathematical physics, computer programming, data analysis, systems analysis/design, statistics, etc. This department has a teaching staff of 16 - 6 associate professors and 10 lecturers. The total number of its postgraduate students is 117, which breaks down into 105 taking the M. Sc. course and 12 taking the M. Phil. course. This department is offering no Ph. D. course.

The items of equipment to be procured for this department include 2 personal computers for use in data processing, 8 personal computers for use in training and printers, all of which are to supplement the existing computer system.

#### D. Faculty of Animal Husbandry

This faculty consists of 4 departments, namely, the departments of livestock management, animal breeding and genetics, animal nutrition and poultry husbandry. The faculty's undergraduate courses were started in 1974- 75. At present, the faculty is offering both undergraduate and postgraduate courses.

This faculty has a teaching staff of 40 - 7 professors, 12 associate professors, 7 assistant professors and 14 lecturers. The total number of its postgraduate students is 93, which breaks down into 59 taking M. Sc. courses and 34 taking Ph. D. courses. This faculty's education and research activities are characterised by special emphasis placed on education and research which are to contribute directly to the growth of the country's livestock industries. The items of equipment to be procured for this faculty are therefore those used for practical purposes.

The present condition of this faculty's experimental equipment is almost the same with the other faculties. Most of its existing items of equipment are out of order or very superannuated. This faculty is faced with a serious equipment shortage as a result of increases in recent years in the number of students and the academic staff. Given below is the outline of each of the departments of this faculty.

##### 1) Office of the Dean

The items of requested equipment for common use include computer- related equipment, video system, video projector, screen and camera. Of these, the video system and the related products, which are essentially teaching aids, are to be procured for the university as a whole. So it was decided to procure only a video camera as teaching material making equipment for common use in this faculty. A photocopy machine is also to be procured for this faculty in accordance with the overall policy of this project.

## 2) Department of Livestock Management

This department, which is the largest department of the Faculty of Animal Husbandry, is responsible for educating and training undergraduate and postgraduate students in the methodology of management of livestock, such as dairy cattle, meat cattle, sheep and goats. It is provided with a wool laboratory, a dairy laboratory, a meat laboratory and a livestock farm. It has a teaching staff of 13 - 2 professors, 3 associate professors, 1 assistant professor and 7 lecturers. The total number of its postgraduate students is 22, which breaks down into 10 taking the M. Sc. course and 12 taking the Ph. D. course.

The items of equipment to be procured for this department include wool fineness meter, fibre tensile strength tester, etc. for the wool laboratory, Kjeldahl method nitrogen/protein analyser, small-size milking machine, milk testing equipment, lactometer, fibrematic analyser, chemical balance, cow model, mastitis and abnormal milk test set, butter fat test set, pH meter, water distillation apparatus, artificial insemination instrument set, oestrus tester, pregnancy detector for cow, bull holder, etc. for the dairy laboratory, electric dehorner, livestock scale, etc. for the livestock laboratory, all of which are indispensable for education and training in livestock management. Of the items of requested equipment, it was decided to eliminate those whose procurement is not urgently needed, such as autosampler fibrograph, crude fibre analyser, crimp tester, microtome, protein measuring apparatus and remote recording thermograph, etc. The number of units of the dipping tank was reduced from two to one based on its necessity.

## 3) Department of Animal Breeding and Genetics

This department's students, both undergraduate and postgraduate, are educated and trained in general genetics, population genetics, animal breeding, animal cytogenetics, etc. This department is provided with a computerised data processing laboratory, a cattle crossbreeding project (project to crossbreed conventional milk cow with Holstein or Jersey), an artificial insemination and semen processing unit and a newly established animal cytogenetics research laboratory. It has a teaching staff of 8 - 1 professor, 2 associate professors, 1 assistant professor and 4 lecturers. The total number of its postgraduate students is 11, which breaks down into 7 taking the M. Sc. course and 4 taking the Ph. D. course.

The items of equipment to be procured for this department include electronic balance, autoclave, water distillation apparatus, touch mixer, filter device for sterilising filtration, etc. (for

the animal cytogenetics laboratory), personal computer (for the data processing laboratory), livestock weighing scale, tattooing apparatus, portable milking machine, mobile sprayer (for the cattle crossbreeding project), microscope, refrigerator, incubator, UV equipment for sterilisation, water bath thermostatic control, liquid nitrogen container, etc. (for the artificial insemination facility), all of which are indispensable in educating students in this discipline. Of the items of requested equipment, it was decided to remove from the list those whose use is to be shared with the central laboratory, such as ultra centrifuge, those which are requested in duplicate, such as refrigerator, those which there is no justifiable or urgent need to procure, such as microscope with video equipment, automatic glassware washer, electric dehorner, etc., and those consumables which can be procured by the university, such as floppy disk, printer ribbon and hard disk.

#### 4) Department of Animal Nutrition

This department's students, both undergraduate and postgraduate, are educated and trained in *animal nutrition, physiology and biochemistry of nutrition, measurement of feeding, feeding management, etc.* Particular emphasis is placed on analytical work conducted from a chemical standpoint in this department's educational and research activities. This department has a teaching staff of 13 - 3 professors, 5 associate professors, 3 assistant professors and 2 lecturers. The total number of its postgraduate students is 36, which breaks down into 22 taking the M. Sc. course and 14 taking the Ph. D. course.

The items of equipment to be procured for this department include gas chromatograph, grain tester, microscope, film evaporator, fluorescence spectrophotometer, lab. scale fermenter, etc. all of which are indispensable for education and training in animal nutrition.

#### 5) Department of Poultry Husbandry

This department is educating and training both undergraduate and postgraduate students in *poultry breeding, poultry feeding, poultry hygiene, poultry housing and environment, etc.* Its existing facilities include a poultry research centre. It has a teaching staff of 6 - 1 professor, 2 associate professors, 2 assistant professors and 1 lecturer. The total number of its postgraduate students is 24, which breaks down into 20 taking the M. Sc. course and 4 taking the Ph. D. course.

The items of equipment to be procured for this department include personal computer for common use, electronic balance, microscope, table top centrifuge, water bath, muffle furnace, etc.

(for the students' laboratories), incubator, deep freezer, automatic drinking unit, automatic tube feeder unit, power sprayer, UV- VIS spectrophotometer, etc. (for the poultry research centre), all of which are indispensable in teaching and training students in animal husbandry. Of these requested items of equipment, it was decided to eliminate those which are to be procured for this project as a whole, such as photocopy machine, those which can be procured by the university, such as floppy disk and hard disk, and those which are not suited for university education, such as poultry processing unit and environment control unit. The number of units of the automatic drinking unit and the automatic tube feeder unit should be reduced from 4 each to 1 each. Furthermore, it is desirable to procure these items locally in light of the water quality, temperatures and other environmental conditions in the country.

#### E. Faculty of Veterinary Science

This faculty is responsible for training veterinary surgeons. It has 7 departments, namely, the departments of veterinary anatomy, veterinary pathology, veterinary parasitology, clinical medicine and surgery, animal reproduction, physiology and pharmacology, and veterinary microbiology.

This faculty has a teaching staff of 54 - 9 professors, 12 associate professors, 17 assistant professors and 16 lecturers, of whom 29 are Ph. D.'s and 25 are M. Sc.'s. It is playing an important role in nurturing veterinary surgeons in the country. Graduates of the faculty include 1,178 D.V.M.'s, 636 M. Sc.'s and 19 Ph. D.'s during the period from 1964 to 1995. The total number of its postgraduate students currently enrolled is 92, which breaks down into 64 taking the M. Sc. course and 28 taking the Ph. D. course.

The present state of equipment for teaching use at this faculty is almost the same with the other faculty. Most of the existing items of equipment have not been replaced or updated for a long time and therefore they have become superannuated or outdated. There is a serious equipment shortage against the background of a considerable increase in the number of students and academic staff, which is a major hindrance to the faculty's education and research activities. Shown below is the outline of each of the departments of this faculty.

##### 1) Department of Veterinary Anatomy

This department's students, both undergraduate and postgraduate, are educated and trained in veterinary anatomy, embryology, histology, comparative anatomy, etc. This department has a



teaching staff of 5 - 1 professor, 1 associate professor and 3 lecturers. At present, it has only one postgraduate student, who is taking the Ph. D. course.

The items of equipment to be procured for this department include vacuum oven, slide projector, vacuum pump, pH meter, microscopes, cryostat, electronic balance, etc., all of which are indispensable for education in veterinary anatomy.

## 2) Department of Veterinary Pathology

This department's students, both undergraduate and postgraduate, are educated and trained in general pathology, clinical pathology, diagnostic pathology, immunopathology and poultry pathology. This department has a teaching staff of 7 - 1 professor, 2 associate professors, 3 assistant professors and 1 lecturer. The total number of its postgraduate students is 26, which breaks down into 19 taking the M. Sc. course and 7 taking the Ph. D. course. This department is an important department of the Faculty of Veterinary Science.

The items of equipment to be procured for this department include microscope, overhead projector, electric incubator, micropipette, dispenser, pH meter, refractometer, double-beam UV- VIS spectrophotometer, hemoglobinometer, microtome, autopsy table, slide projector, etc. all of which are indispensable for education in veterinary pathology. Of the requested items of equipment, it was decided to eliminate those whose functions overlap those of the other items, such as compact balance, microtome knife and centrifuge, and those which there is no urgent need to procure, such as image analyser (trinocular microscope). The number of units of the binocular microscope was reduced from 9 to 5 in consideration of the number of students in group experiments.

## 3) Department of Veterinary Parasitology

This department's students, both undergraduate and postgraduate, are educated and trained in general parasitology, protozoology, veterinary entomology, diagnostic parasitology, meat hygiene and inspection, etc. Special emphasis is placed on education and research of immunoparasitology which is recently getting popularity in this discipline. This department has a teaching staff of 7 - 1 professor, 3 associate professors, 1 assistant professor and 2 lecturers. The total number of its postgraduate students is 9, which breaks down into 6 taking the M. Sc. course and 3 taking the Ph. D. course.

The items of equipment to be procured for this department include electronic balance, deep freezer, pH meter, spectrophotometer, ELISA reader, micropipette, sonicator, ultra homogenizer, CO<sub>2</sub> incubator, microscope, etc. all of which it is appropriate to procure for use in education and training in veterinary parasitology.

#### 4) Department of Clinical Medicine and Surgery

This department's students, both undergraduate and postgraduate, are educated and trained in veterinary medicine, veterinary surgery, medical clinic, surgery clinic, etc. The department has a teaching staff of 9 - 2 professors, 1 associate professor, 2 assistant professors and 4 lecturers. The total number of its postgraduate students is 12, which breaks down into 7 taking the M. Sc. course and 5 taking the Ph. D. course.

The items of equipment to be procured for this department include operating table, ultrasonic diagnostic system, clean bench, spectrophotometer, microscope, autoclave, table top centrifuge, pH meter, metal detector, electrophoresis unit, X- Ray processing unit, etc., all of which it is appropriate to procure for use in education and training in veterinary clinical medicine and surgery. Of the additional requested items of equipment, the ambulance was eliminated because there is no justifiable or urgent need to procure it under this project.

#### 5) Department of Animal Reproduction

This department's undergraduate and postgraduate students are educated and trained in reproduction of farm animal, artificial insemination, animal reproductive clinic, animal gynaecology, semen preservation and embryo transfer techniques, etc. This department has a teaching staff of 12 - 1 professor, 2 associate professor, 5 assistant professor and 4 lecturers. The total number of its postgraduate students is 18, which breaks down into 12 taking the M. Sc. course and 6 taking the Ph. D. course. This department has artificial insemination and embryo transfer facilities, where 3 technical officers are training students in these techniques and at the same are promoting the spread of these techniques. One of the three technical officers received training in artificial insemination and embryo transfer techniques at a training centre of the Ministry of Agriculture, Forestry and Fisheries of Japan.

The items of equipment to be procured for this department include microscope, high speed micro centrifuge, low temperature incubator, magnetic stirrer, spectrophotometer, electronic balance, etc. Of the items of requested equipment, it was decided not to include the notebook computer from this project in light of the overall policy of this project.

Not included in the list are the items of equipment for use in the artificial insemination and embryo transfer facilities. In light of the activities carried out at these facilities and these facilities' existing items of equipment, it seems that some additional items of equipment should be procured for these facilities. Since similar items of equipment are to be procured for the department of animal breeding and genetics of the Faculty of Animal Husbandry, ways to allow this department to share the use of such items with the department of animal breeding and genetics should be considered by the concerned authority.

#### 6) Department of Physiology and Pharmacology

This department's students, both undergraduate and postgraduate, are educated and trained in veterinary physiology, veterinary physiological chemistry, metabolic and endocrine physiology, general pharmacology, toxicology, etc. This department has a teaching staff of 7 - 3 professors, 1 associate professor and 3 assistant professors. The total number of its postgraduate students is 6, which breaks down into 3 taking the M. Sc. course and 3 taking the Ph. D. course.

The items of equipment to be procured for this department include automatic analyser (lab. type), gamma counter, UV- VIS spectrophotometer, single channel physiological recorder, chamber for Langendorf preparation, etc., all of which are indispensable in educating and training students in physiology and pharmacology.

#### 7) Department of Veterinary Microbiology

This department's students, both undergraduate and postgraduate, are educated and trained in microbiology, immunology, bacteriology, virology, veterinary epidemiology, veterinary hygiene, etc. This department has a teaching staff of 7 - 2 associate professors, 3 assistant professors and 2 lecturers, the post of professor being vacant. The total number of its postgraduate students is 20, which breaks down into 17 taking the M. Sc. course and 3 taking the Ph. D. course. This department occupies an important position within the Faculty of Veterinary Science, achieving many success in education and research in veterinary microbiology.

The items of equipment to be procured for this department include microscope, high speed micro centrifuge, mini- gel electrophoresis apparatus, ultraviolet viewing cabinet, gel drying system, electrophoresis gel elutor, incubator, oven, liquid nitrogen container, pH meter, shaker, autoclave, projector, auto pipette, etc., all of which are indispensable for education and training in veterinary microbiology. Of the requested items of equipment, it was decided to eliminate those whose use is to be shared with the central laboratory, such as ultra centrifuge, those whose functions overlap those of the other items, such as CO<sub>2</sub> incubator and inverted microscope, those whose use can be shared with the other departments, such as ELISA reader, and those which there is no justifiable or urgent need to procure, such as fermenter, ultrafreezer, etc.

#### F. College of Veterinary Sciences, Lahore

This college was founded in 1882 as the Punjab Veterinary School. It is a college of veterinary science with the longest history and tradition in Asia. In 1942, it was merged into the University of Punjab, and in 1954, its name was changed to the Punjab College of Veterinary Science. In 1971, it became the constituent college of the University of Agriculture, Faisalabad.

This college consists of 11 sections, namely, the sections of veterinary microbiology, veterinary pathology, veterinary anatomy, veterinary physiology, veterinary pharmacology, veterinary parasitology, veterinary medicine, veterinary surgery, animal reproduction, animal husbandry and animal nutrition. It has a teaching staff of 61 - 5 professors, 19 associate professors, 14 assistant professors and 23 lecturers. This college's educational activities are characterised by education and training in both veterinary science and animal husbandry within a single institution of higher education. It is rated highly as a college with a long history and a long-established tradition, having thus far made great contributions to the growth of the livestock farming sector of the country. At present, the college is offering M. Sc. courses in 10 sections (the only exception being the section of animal husbandry) and Ph. D. courses in three sections, namely, the sections of veterinary microbiology, veterinary physiology and veterinary medicine. In recent years, there has been an increase in the number of the students taking postgraduate courses. According to the 1995 statistics, the number of the students taking M. Sc. courses was 175, that of the students taking Ph. D. courses being 24 - 199 in total.

At the time of the college's inception, basic items of educational equipment were procured basically with funds from the British Government. Since then, instruments and apparatuses for

teaching use have been procured in small quantities. But few of these instruments and apparatuses have been replaced or updated, with the result that most of them have become superannuated or obsolete. Although the total number of the graduates of this college is nearly equal to the combined total number of the graduates of the Faculty of Veterinary Science and the Faculty of Animal Husbandry of the University of Agriculture, Faisalabad, this college does not compare favourably with the University of Agriculture, Faisalabad, in terms of the total number of existing items of equipment. It is imperative for the college to improve its equipment in order to offer higher education that meets the new demands of the times and to cope with the increasing number of students and academic staff. Many of the items of equipment requested by the college are similar to those requested by the departments of veterinary science and animal husbandry of the University of Agriculture, Faisalabad. Although operating under the jurisdiction of the University of Agriculture, Faisalabad, the college is functionally an independent college and is located far away from the university. Thus, the college is not in a position to share the use of equipment with the university.

The items of equipment to be procured for the college include: for the veterinary microbiology section: microscope, autoclave, cellulose acetate electrophoresis apparatus, high speed refrigerated centrifuge, homogenizer, draft chamber, fraction collector, pH meter, water distillation apparatus, incubator, etc.; for the veterinary pathology section: microscope and microtome; for the veterinary parasitology section: microscope; for the veterinary pharmacology section: metabolic manometer and pH meter; for the veterinary physiology section: microscope, electronic balance, pH meter, atomic absorption spectrophotometer, magnetic stirrer, etc.; for the veterinary medicine section: micropipette, magnetic stirrer, microscope, oven, spectrophotometer, incubator; for the veterinary surgery section: X- Ray machine, anaesthesia machine, operating table for small animals, etc.; for the animal reproduction section: microscope, pH meter, water bath; for the anatomy section: microscope, microtome, model of eyeball, model of cow, etc.; for the animal husbandry section: egg incubator; for the animal nutrition section: microscope, livestock scale, flame photometer, crude fibre apparatus, infrared moisture meter, electronic balance, pH meter, gas chromatograph, etc.

The X- Ray machine requested by the department of veterinary surgery is to be procured on condition that the department will be provided with the facility to protect against x- rays. Since the above- mentioned requested items of equipment are mostly basic items indispensable in educating and training undergraduate and postgraduate students, only those which are suited for the educational activities carried out at the college are to be procured under this project. Of the requested items of equipment, it was decided to eliminate those which it is difficult to maintain and manage and which there is no urgent need to procure, such as high performance liquid chromatograph and FT- IR

spectrophotometer, and those which are requested by more than one section and whose use is to be shared by these sections, such as water distillation apparatus, cellulose acetate electrophoresis apparatus, water bath, etc. The number of the operating table for small animals was reduced from two to one in light of the expected frequency of use.

#### G. Division of Agricultural Education and Extension

This division consists of 4 departments, namely, the departments of agricultural education, agricultural extension, short courses and rural home economics. The main objective of this division is to educate students, both undergraduate and postgraduate, in agricultural extension techniques, home economics and domestic science. The division is also responsible for training high school teachers, as well as managerial and technical agricultural extension officers, in agricultural education and extension. In addition, it is carrying out direct extension activities to promote the transfer of agricultural technologies and techniques to farmers and rural residents through the university's short courses, radio broadcasts and publications.

At present, this division has a teaching staff of 23 - 2 professors, 6 associate professors, 5 assistant professors and 10 lecturers. Its students, both undergraduate and postgraduate, are educated and trained in agricultural extension and rural home economics. The total number of its undergraduate students is 63 taking the B. Sc. (home economics) course and that of postgraduate students is 24 taking the M.Sc. (agricultural extension and home economics) course. It is expected that this division will shortly begin to offer a Ph. D. course in agricultural extension.

Given below is the outline of the departments of agricultural extension and rural home economics, both of which are to be covered by this project.

##### 1) Department of Agricultural Extension

This department is responsible for educating and training the university's undergraduate students in agricultural extension, extension educational psychology, administration and supervision techniques, rural development, extension training techniques, etc., and the postgraduate students in extension methods, programme planning, extension evaluation, communication in extension, audio-visual communication, extension administration and management adult education programmes. It has a teaching staff of 8 - 3 assistant professors, 3

lecturers, 1 mass media production officer and 1 subject specialist (who is a retired officer). The total number of its postgraduate students is 4, all taking the M. Sc. course.

The items of equipment to be procured for this department include basic items of audio-visual equipment, such as video camera, VTR, colour monitor, tape recorder and megaphone, still camera, personal computer, photocopy machine and projector. The initial request included relatively advanced items of audio-visual equipment for small studio and outdoor broadcast van. But these items were eliminated because their procurement must be premised on the availability of services of experts in shooting, editing, post-production, audio processing and producers and because there will very likely be problems of their operation and maintenance in light of this department's present technical and financial resources. It is also judged to be more feasible, both technically and financially, to contract out programme production to Allama Iqbal Open University and Pakistan Television 2 (ETV), both of which have been provided with all necessary items of equipment under the grant aid assistance of the Government of Japan.

## 2) Department of Rural Home Economics

This department's students, both undergraduate and postgraduate, are educated and trained in food and nutrition, clothing and textile, home economics education, home nursing, health and sanitation, population studies, human physiology, etc. This department has a teaching staff of 6 - 1 associate professor, 2 assistant professors and 3 lecturers, the post of professor being vacant. The total number of its undergraduate students is 63 (all taking the B. Sc. course in home economics) and that of its postgraduate students is 20 (all taking the M. Sc. course in food and nutrition). The B. Sc. course is a relatively new one which was opened in 1991. Even basic items of equipment for educational use are not available for the course.

The items of equipment to be procured for this department include top loading balance, forced air oven, muffle furnace, soxhlet apparatus, bomb calorimeter, centrifuge, water bath, spectrophotometer, pH meter, refrigerator, freezer, sewing machine, flat knitting machine, gas cooking range, etc., all of which are indispensable for this department's curricula. The number of units of the sewing machine was increased from 10 to 15 on the assumption that two students will share the use of one sewing machine in classes of 30.

## H. General Facilities

### 1) Library

The library, which is located in the centre of the campus, has two stories and a total floor space of 4,100 m<sup>2</sup>, and can accommodate as many as 1,500 students. At present, it houses more than 150,000 books. It also provides 170 journals and magazines, 100 newsletters and 14 newspapers for the students' reading. Its other services include a service to retrieve data from its CD-ROM international agricultural database and a book bank service to lend textbooks to students who cannot afford to buy them. The book bank houses about 30,000 textbooks and lends textbooks to these students at 1 rupee apiece per month. At present, the library has a staff consisting of 1 librarian, 1 deputy librarian, 1 assistant librarian and 3 reference assistants.

Its existing items of equipment include a microfilm camera, a microfilm reader, a photocopy machine and four personal computers, all of which have become superannuated. There is a basic shortage of these items. Four personal computers with Model 80285 CPUs were provided by the university with the financial aid of USAID. But their manufacturer has already stopped manufacturing these personal computers. So they are being nursed and cannot be said to be performing their data retrieving functions. Its existing photocopy machine has to meet an annual demand for 200,000 copies, but in actuality it is difficult for the photocopy machine to meet such a big demand. The library has an audio-visual section to meet the university's audio-visual education requirements, but the section is provided with no audio-visual equipment.

Against such a background, the items of equipment to be procured for this department include photocopy machine and copy printer for use in documentation service, personal computer for use in documentation and book retrieval, projector, camera for slide making and VTR system for use in audio-visual education. The electronic copy board, the video projector and the CCTV system, which were included in the initial request, were eliminated for the reason that there is no urgent need to procure them.

### 2) Central Laboratory

More than half of the students enrolled at the University of Agriculture, Faisalabad, are postgraduate students taking M. Sc. courses, M. Phil. courses or Ph. D. courses. Most of the experiments conducted at the university are closely related to the contents of the students' theses



and are therefore relatively advanced ones. For this reason, expensive items of precision experimental equipment are requested by more than one department. In light of the relatively high costs of operation and maintenance of these items of equipment procured for each of these department, the university is considering these items as those for common use. These items are to be installed in one of the existing facilities of the Faculty of Agriculture after it is repaired on an as needed basis and they are to be used under a time/cost sharing system. Given below is the outline of the system.

**a) Organisation**

Two of the faculty's existing laboratories are to be remodelled into a central laboratory, which is to be managed by an associate professor or an assistant professor with the assistance of technical staff (at least one technical staff is to be assigned to take care of each item of equipment). These technical officers are to be selected from among those who are currently working at the university. They are to be given opportunities to receive training in equipment maintenance and management.

**b) Operating Method**

The schedule for the use of the central laboratory should be so adjusted that the items of equipment installed in the central laboratory may be used for experimentation and training in parallel with the lectures given in adjacent classrooms. The costs of the experiments conducted at the central laboratory at the request of the faculties and departments are to be defrayed by the requesting faculties and department so that such payments may cover the costs of operation, maintenance and management of the items of equipment installed in the central laboratory. The associate professor or assistant professor in charge is to be solely responsible for the schedule adjustment for the smooth operation of the central laboratory.

**c) Use of Equipment**

All the faculties and departments are entitled to use these items of equipment. The departments which requested these items of equipment in the initial request and the uses of these items, including the corresponding courses, are as listed in Table 2- 2.

**Table 2-2 Use of Equipment in the Central Laboratory**

Name of Major Equipment	Dept. to Use Equipment	Educational Courses for which Equipment is used
X-Ray Diffractometer (XRD)	Soil Science, Physics	SS- 701 Laboratory Techniques in Soils, SS- 710 Soil Physics, SS- 713 Clay Mineralogy, PY- 708 Laboratory Course II, PY- 726 Soil Physics, PY- 721 Advanced Electronics & Instrumentation, etc.
Scanning Electron Microscope (SEM)	Crop Physiology, Soil Science, Plant Pathology, Horticulture, Biochemistry, Vet. Microbiology, Vet. Pathology, Vet. Anatomy	C.Phy- 710 Advanced Crop Physiology, C.Phy- 711 Analytical Techniques in Crop Physiology, SS- 701 Laboratory Techniques in Soils, SS- 704 Soil Microbiology, Hort- 710 Plant Tissue Culture, V.Mb- 707 Tissue Culture Techniques in Virus Research, V.Pt- 702 Advanced Clinical Pathology, Biochem- 717 Molecular Biochemistry, V.An- 710 Techniques in Electron Microscopy, etc.
Transmission Electron Microscope (TEM)	Crop Physiology, Soil Science, Plant Pathology, Biochemistry, Vet. Microbiology, Vet. Pathology, Vet. Anatomy	SS- 701 Laboratory Techniques in Soils, C.Phy- 711 Analytical Techniques in Crop Physiology, C.Phy- 712 Plant Molecular Biology, V.Pt- 704 Advanced Diagnostic Pathology, Biochem- 717 Molecular Biochemistry, V.Mb- 709 Molecular Biology of Bacterial Viruses, V.An- 710 Techniques in electron Microscopy, etc.
High Performance Liquid Chromatograph (HPLC)	Crop Physiology, Plant Pathology, Soil Science, Agr. Entomology, Food Technology, Chemistry, Biochemistry, Vet. Physiology & Pharmacology, Animal Nutrition,	C.Phy- 711 Analytical Techniques in Crop Physiology, SS- 715 Soil Plant Relationship, SS- 716 Soil Biochemistry, FT- 702 Food Analysis & Evaluation, Chem- 706 Inorganic Analyses, Chem- 718 Advanced Techniques in Inorganic Chemistry, Chem- 726 Analysis of Industrial Products, V.Phys- 709 Physiological Techniques, V.Pm- 711 General Toxicology, AN- 707 Analytical Techniques in Nutrition, AN- 708 Advanced Analytical Techniques in Nutrition, Ent- 716 Techniques for Testing Insecticides, Biochem- 721 Advanced Biochemical Techniques, SS- 701 Laboratory Techniques in Soils, SS- 605 Pesticides in Soil Environments, etc.
GC Mass Spectrometer (GCMS)	Soil Science, Plant Pathology, Horticulture, Animal Nutrition, Botany	C.Phy- 704 Physiology of Growth Substances, C.Phy- 711 Analytical Techniques in Crop Physiology, Hort- 707 Mineral Nutrition of Horticultural Plants, SS- 605 Pesticides in Soil Environments, SS- 701 Laboratory Techniques in Soils, SS- 715 Soil Plant Relationship, AN- 708 Advanced Analytical Techniques in Nutrition, BOT- 701 Plant Microtechnique, etc.
Atomic Absorption Spectrophotometer (AASP)	Soil Science, Plant Pathology, Horticulture, Agr. Entomology, Food Technology, Botany, Chemistry, Biochemistry, Vet. Physiology & Pharmacology, Animal Nutrition	C.Phy- 704 Physiology of Growth Substances, C.Phy- 711 Analytical Techniques in Crop Physiology, Hort- 707 Mineral Nutrition of Horticultural Plants, SS- 605 Pesticides in Soil Environments, SS- 701 Laboratory Techniques in Soils, SS- 715 Soil Plant Relationship, SS- 716 Soil Biochemistry, FT- 702 Food Analysis & Evaluation, Chem- 706 Inorganic Analyses, Chem- 718 Advanced Techniques in Inorganic Chemistry, Chem- 726 Analysis of Industrial Products, V.Phys- 709 Physiological Techniques, V.Pm- 711 General Toxicology, AN- 707 Analytical Techniques in Nutrition, AN- 708 Advanced Analytical Techniques in Nutrition, Ent- 716 Techniques for Testing Insecticides, Biochem- 721 Advanced Biochemical Techniques, SS- 605 Pesticides in Soil Environments, SS- 701 Laboratory Techniques in Soils, BOT- 701 Plant Microtechnique, etc.

Name of Major Equipment	Dept. to Use Equipment	Educational Courses for which Equipment is used
Amino Acid Analyser (AAA)	Plant Breeding & Genetics, Soil Science, Food Technology, Biochemistry, Animal Nutrition	SS- 701 Laboratory Techniques in Soils, SS- 716 Soil Biochemistry, FT- 703 Food Microbiology, FT- 710 Chemical & Biochemical Aspects of Food Processing, Biochem- 708 Biochemical Analysis, Biochem- 721 Advanced Biochemical Techniques, AN- 704 Protein Metabolism, An- 716 Recent Advances in Animal Nutrition, etc.
Ultra Centrifuge (UC)	Crop Physiology, Plant Pathology, Horticulture, Chemistry, Biochemistry, Animal Breeding & Genetics, Vet. Microbiology	For extraction/preparation of samples for different determinations of three major categories; Agriculture, Veterinary Science/Animal Husbandry, and Basic Science

All these items of equipment have to be operated, maintained and managed very carefully. The university is, therefore, required to ensure that the operation of these items is not stopped due to mishandling or a fund shortage. In the country, many of these items are already used at the following research and education institutions, from where the university may request technical support for proper operation and maintenance of the equipment.

#### **Organisations for Technical Support of the Central Laboratory**

- Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad
- National Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad
- National Agricultural Research Centre (NARC), Islamabad
- Geoscience Laboratory, Geological Survey of Pakistan (GSP), Islamabad
- Quaide Azam University, Islamabad
- National Institute of Health (NIH), Rawalpindi
- Peshawar University (Centre of Excellence, Geology), Peshawar
- Pakistan Institute of Nuclear Science and Technology (PINSTECH), Rawalpindi
- Centre of Solid State Physics, Lahore
- Pakistan Council of Scientific and Industrial Research (PCSIR), Lahore
- HEJ Research Institute of Chemistry, Karachi University, Karachi
- Mehran University of Engineering and Technology, Jamshoro
- Bahauddin Zakaria University, Multan

Judging from the contents of the theses made public by the university, it is obvious that relatively advanced educational and research activities are carried out at the university. It is certain that the university will be able to play a leading part in the technology- based

nurturing of agricultural experts as the country's top institution of higher agricultural education as envisaged by the Government of Pakistan's national agricultural policy. The plan to create a central laboratory as one of the university's general facilities is considered appropriate because it will help to minimise not only the amount of initial investment by concentrating expensive instruments in one facility as the ones for common use but also the costs of their operation, maintenance and management through their centralised management. These instruments are to be used mainly by the university's undergraduate and postgraduate students, but they can also be used for research purposes. Since their consistency with the university's curricula is verified, there is indeed a justifiable need to procure them under this project. There is also an urgent need to procure them in light of the present condition of the university's existing items of equipment and the wide- reaching influences of the graduates of the university on the country's agriculture. It will be appropriate and effective to procure these instruments in view of the planned frequency of use of these items and their planned use (they are for the common use of all the faculties and department). Of the requested items, it was decided to eliminate the inductively coupled plasma photometer since it will be difficult to procure argon gas and the instrument itself requires advanced maintenance and management techniques, consuming about 1 m<sup>3</sup> of argon gas of a very high degree of purity (more than 99.99%). Three high performance liquid chromatographs (HPLCs), instead of the initial request for one, are to be installed in the central laboratory because the HPLCs requested by several faculties and departments have been eliminated and because the HPLCs to be installed in the central laboratory are expected to be used very frequently. The university requested 3 ultra centrifuges, each with the rotating speed of about 100,000 rpm, for three types of disciplines, namely, agriculture, veterinary science/animal husbandry, and basic science. Since the ultra centrifuge is an expensive item, it was decided to procure one unit with the rotating speed of about 100,000 rpm, one unit with about 70,000 rpm and one with about 60,000 rpm, respectively.

### 3) University Press

The university press is still using the German- made cylinder type letterpress, which was manufactured nearly 30 years ago. There has recently been a marked increase in demand for printed matter, such as textbooks, scientific journals, reference books and brochures, including prospectuses, within the university as a result of the expansion of the scope of its educational and research activities. But the existing printing machine's printing speed is not sufficient to meet such demand, and as a result the university is forced to contract out part of its printing operations.

The costs of such outsourcing, however, are more than twice as high as those of internal printing, which include the personnel and expendable supplies expenses. And these costs have become a considerable financial burden on the university. For this reason, the university decided to introduce an offset printing system with the aim of improving the university press' printing capabilities. As shown in the Table 2- 3, there is a strong need for such a system within the university press.

**Table 2- 3 List of University Printings**

Printings	Volume
Prospectus (Undergraduate)	4,000 copies x 150 pages
Prospectus (Postgraduate)	4,000 copies x 100 pages
Student Magazine	5,000 copies x 550 pages
Annual Report	500 copies x 400 pages
6 University Journals (4/annum)	1,000 copies x 100 pages x 4 x 6
Text Books (10/annum)	1,000 copies x 300 pages x 10
Monograph (12/annum)	1,000 copies x 300 pages x 12
Project Report	10 copies x 500 pages
Zari Digest for Farmers (Education & Extension)	150 pages x 12 issues/annum
Answer Sheets	Approx. 150,000 x 2 sessions
Budget Report	500copies x 200 pages
Forms, Bills, etc.	Many

It was decided, therefore, to procure a small- size offset printing machine, a vertical camera, an auto plate maker unit, etc. for the university press. Of the university press' 19 technical staff members, only the publishing manager who has received a degree in offset printing technology in Britain has experience in offset printing. When these items of equipment are introduced in the university press, it will be essential to train 3 to 4 of its senior staff members in state- of- the- art printing technology.

#### 4) University Repair Cell

The maintenance and management works of the equipment, machinery and facilities of the university are undertaken by the repair cell, the farm machinery repair shop and the engineering division. Of these , the repair cell is responsible for the repairs of the educational equipment, such as the personal computers, microscopes, pH meters, electronic balances, water distillation apparatuses, spectrophotometer, calorimeters, refrigerators, air conditioners, etc. which are used at the laboratories. Although provided with simple machine tools, such as lathes and drilling

machines, and some measuring instruments, this cell is still in need of additional machines and instruments to function as a viable workshop. When this project is implemented, this cell is to take charge of the repairs and maintenance of the items of equipment procured under this project. With its existing machines and instruments alone, the cell will be unable to perform its additional function, although it has a sufficient technical staff. For this reason, the study team thought it necessary to procure essential items for this cell and discussed this matter with the Pakistan side. As a result, the university agreed to the study team's proposal and requested necessary items of equipment.

The items of equipment to be procured for this division are very basic ones, including oscilloscope, frequency meter, multimeter, soldering iron, soldering bath, power supply, IC tester, personal computer repair tool kit, etc.

At the time of the field survey, the farm machinery repair shop requested some automated machine tools and other items of equipment. But these items were eliminated because most of them are relatively large-sized, expensive and sophisticated and because there was no urgent or justifiable need to procure them under this project.

## **2-3 Basic Design**

### **2-3-1 Design Policy**

#### **(1) Basic Policy**

As a result of an examination of the contents of the request, which was made on the basis of the details of the discussions held at the time of the field survey, it was decided to adopt the following basic policy in working out the basic design for this project.

#### **1) Items of equipment to receive higher priority**

- Ones to replace those existing items whose functions have declined as a result of parts' deterioration.
- Ones to be procured additionally to those items whose supplies are inadequate for experiments and lectures.

- Ones which are indispensable in implementing the curricula.

## 2) Items of equipment to receive lower priority

- Very sophisticated items for research use only
- Those items which it is difficult to install or use in light of the present condition of the country's social infrastructure
- Those items which are not used frequently and which are expensive
- Those items for which it is difficult geographically or financially to procure expendable supplies and replacement parts

On the basis of the above-mentioned basic policy, the basic design of the technical level and specifications of the items to be procured under this project was worked out in accordance with the following guidelines.

- All the items should be at a technical level suited for university education (undergraduate and postgraduate courses).
- The use of the items requested by more than one department should be shared by the requesting departments as much as possible.
- The costs of equipment operation, maintenance and management should be minimised.
- All the items should meet the applicable local laws, regulations and standards.
- Those items with which only reagents manufactured by certain manufacturers can be used should be excluded.
- Items that are likely to pollute the environment should be avoided.
- Given no significant price differentials, priority should be given to those items which allow of future functional expansion.
- In case of sophisticated items, priority should be given to those for educational use which can also be used for research purposes.

## (2) Points to Note in Working Out the Equipment Plan

In consideration of the present condition of the country's social infrastructure, special attention was paid to the following in drawing up the equipment plan.

- a) A UPS with an appropriate capacity should be attached to each relatively costly item which is provided with a memory retaining feature and which is to be operated for a relatively long time.
- b) An AVR with an appropriate capacity should be attached to each of those electrically- powered machines or instruments which are likely to be damaged by voltage fluctuations (about  $\pm 10\%$ ) and which can not be repaired in a short time in the country.
- c) An air conditioner with an appropriate capacity should be attached to each of those expensive items which are to be operated relatively long and which needs to be operated and managed at a constant temperature.
- d) About two years' supplies of spare parts of the main items should be secured at the time of procurement of the main items.

### **(3) Policy on the Source of Supply**

The suppliers of the items of equipment to be procured under this project should be selected taking into consideration the effective use, and the convenience of maintenance and management, of each item, and also respecting the opinions of the instructors who are to use the equipment. Careful attention should be paid to the followings.

- a) In the case of the items which require routine maintenance, such as printers and photocopy machines, and those which are usually handled roughly, such as farm machines for training use, etc., those which are used most commonly in the country should be procured from local distributors, regardless of whether they are home- made or foreign- made.
- b) Those basic measuring and analytical instruments for use in training in the laboratories which are manufactured neither in Pakistan nor in Japan, to which informative manuals are attached and which need to be examined with special reference to ease of use and applicable measuring standards should be procured in countries other than Pakistan and Japan.



## 2-3-2 Basic Plan

### (1) Overall Plan

#### 1) Project Sites

The project sites are the campus of the University of Agriculture, Faisalabad, which is in the city of Faisalabad, the country's third largest city located in the centre of the country, and the campus of the College of Veterinary Sciences, Lahore, the university's constituent unit located in the city of Lahore, which is the capital of the Punjab and the country's second largest city. The old building of the University of Agriculture, Faisalabad, which was constructed for the university's predecessor, is for the use of the Faculty of Basic Science and the new buildings, which were constructed in the 1960s and after, are for the use of the other faculties. The old building is expected to be repaired shortly, and the Government of Pakistan have already made budgetary appropriations for the repair work. Both the old building and the new buildings are provided with sufficient spaces for laboratories. The buildings of the College of Veterinary Sciences, Lahore, include the strongly- built and durable main building, which was constructed by the Britain in the early 1900s, and other buildings constructed later. These buildings are also provided with sufficient spaces for laboratories. There is no problem, therefore, with the installation of the items of equipment to be procured under this project.

The site maps of these campuses are as shown in Fig. 2- 1 and Fig. 2- 2, respectively.

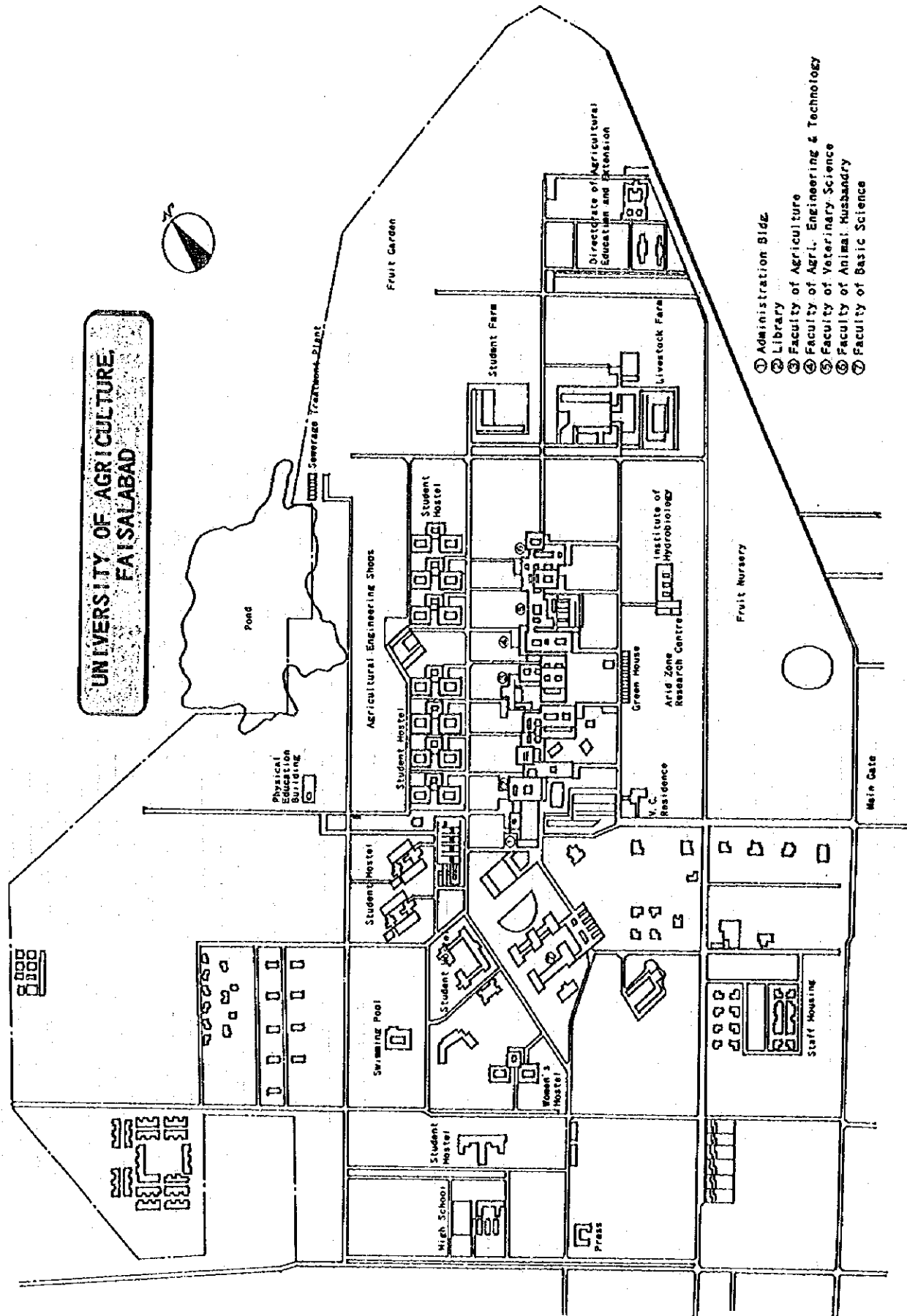


Fig. 2-1 University of Agriculture, Faisalabad

**COLLEGE OF VETERINARY SCIENCES,  
LAHORE**

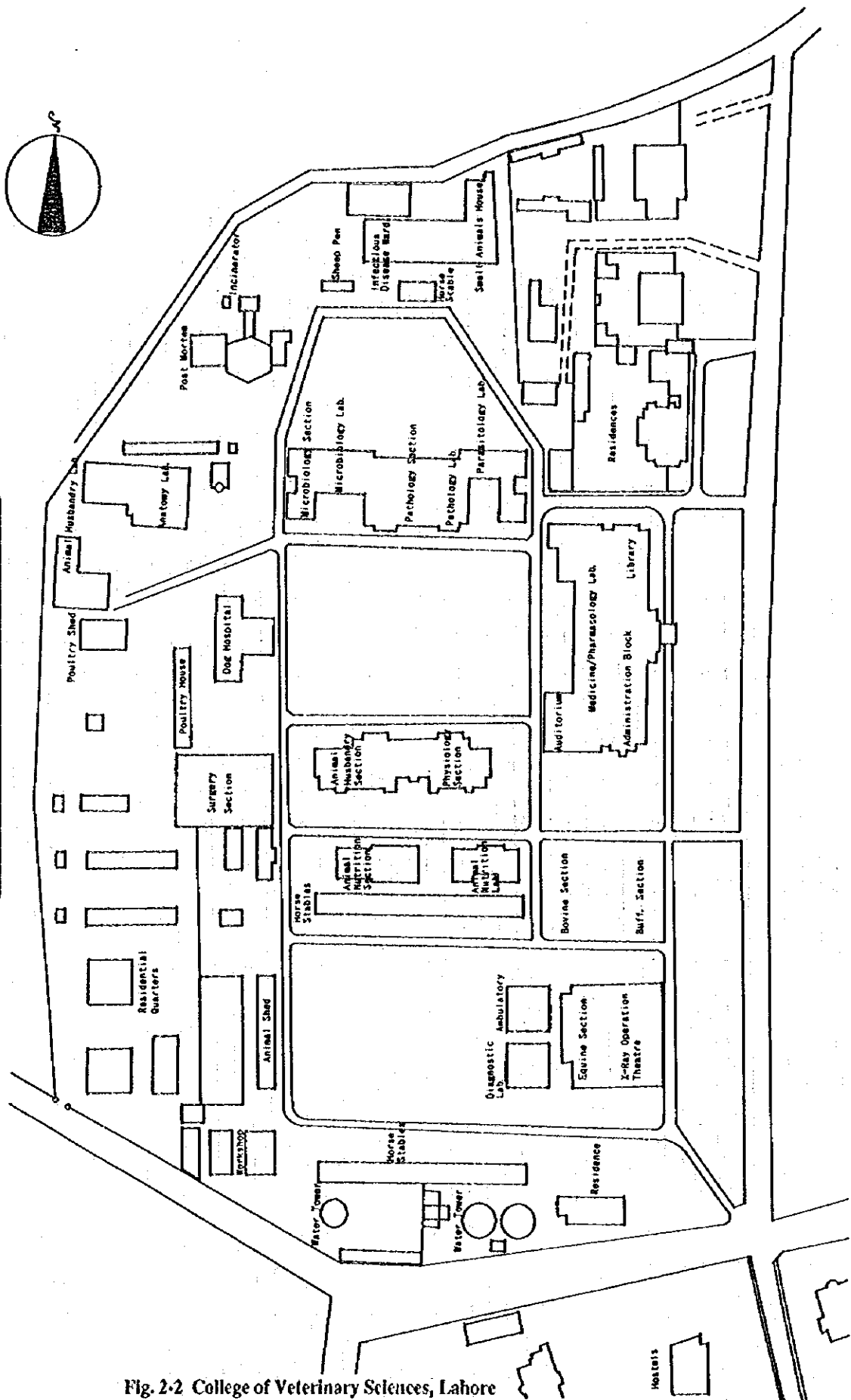


Fig. 2-2 College of Veterinary Sciences, Lahore

## 2) Present Condition of Infrastructure

### a) Electricity:

The rating is 50 Hz, single-phase 220V/three-phase 400V. In actuality, however, the voltage fluctuates from time to time within about a +/- 10% range. In some seasons (particularly during the dry season), power supply is stopped for two hours (one hour in the daytime and one hour in the night) a day subject to prior notice. There are also accidental power supply stoppages. It is therefore necessary to attach AVRs or UPS's to special items of equipment.

### b) Water supply:

City water is water of a high degree of hardness. Distilled water produced using the existing water distillation apparatus (which is presently under repair) is supplied to the laboratories through water pipes. A necessary number of water distillation apparatuses are to be installed in order to prevent city water's adverse effects on certain items of equipment to be procured under this project.

### c) Gas:

Natural gas is supplied to both campuses mainly for heating in winter. There is no problem with natural gas supplies. Certain types of equipment to be procured under this project (such as clean bench) will require some natural gas supplies.

### d) Air conditioning:

Each laboratory can be equipped with a ventilation duct. Currently, some laboratories are air conditioned and some are not, depending on their necessity. Of the items of equipment to be procured under this project, those which need to be operated and managed at a constant temperature are to be installed in air conditioned rooms.

## (2) Equipment Plan

The details of the main items of equipment to be procured under this project are as shown in Table 2- 4. The list of all items of equipment is shown on the Appendix 7, their layout plan on Appendix 8, and the educational courses for B.Sc. and M.Sc. classes on the Appendix 9.

Table 2-4 Outline of Major Items of Equipment

(1/10 pages)

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
<b>A. FACULTY OF AGRICULTURE</b>			
<b>DEAN'S OFFICE</b>			
DA-1	Combine Harvester	To be used for harvesting wheat (kharif & rabi) and rice in experimental farms. Engine output: Approx. 78PS	1
<b>1. DEPARTMENT OF CROP PHYSIOLOGY</b>			
CP-01	Porometer	Used in General Crop Physiology course for study of gas flow through pores, leaf stomata. Standard kit. Measuring range: Approx. 0~50 s/cm (resistance)	1
CP-04	Plant Growth Cabinet	Used in Physiology of Crop Nutrition course for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
CP-10	Nitrogen Analyzer	Used in Biological Nitrogen Fixation course for analysis of nitrogen/protein of grains, feed, food, water, soil, chemicals, etc. by distillation, titration and calculation. Measuring range: ~160 mg nitrogen. Complete with a digester	1
CP-13	Brix Refractometer	Used in Post-harvest Physiology course for measuring refractive index, Brix % and concentration of various liquids. Measuring range: Refractive index (nD) Approx. 1.32500~1.5400, Brix Approx. 0~95%	1
<b>2. DEPARTMENT OF HORTICULTURE</b>			
HOR-07b	Epi-Fluorescence Microscope with Camera Attachment	Used commonly in horticultural studies for observation of sliced plant tissue, etc. With epi-fluorescence and photomicrographic attachments	1
HOR-07c	Inverted Microscope	Used commonly in the Dept., particularly in cytogenetics course for observation of solid samples. Inverted type	1
HOR-37	Growth Chamber	Used commonly in the Dept. for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
HOR-38	Refractometer	Used commonly in the Dept. for measuring refractive index, Brix % and concentration of various liquids. Measuring range: Refractive index (nD) Approx. 1.32500~1.5400, Brix Approx. 0~95%. With printer	1
<b>3. DEPARTMENT OF AGRONOMY</b>			
AGR-01	Area/Root Length Measuring System	Used in the courses of Advanced Agronomy, Crop Management, etc. for determining leaf area and root length in crop plants. Portable type with a printer.	1
AGR-03	CO <sub>2</sub> /H <sub>2</sub> O Analyzer	Used in the courses of Applied Crop Ecology, Advanced Agronomy, Agrometeorology, etc. for measuring CO <sub>2</sub> fixation and water use efficiency for photosynthetic process. Measuring range: CO <sub>2</sub> Approx. 0-3,000ppm, H <sub>2</sub> O Approx. 0-75 mB	1
AGR-04	Infrared Analyzer	Used in the courses of Seed Technology, General Agronomy, etc. for analysing protein, moisture, fat and alcohol content of grains. Measuring range: Approx. 600-1,000 nm at 37 primary wavelength	1
AGR-07	Plant Efficiency Analyser	Used in the courses of Biological Crop Potential, Environmental Physiology & Crop Improvement, etc. for measuring the fluorescence and calculating key parameters to provide a direct measurement of photochemical efficiency. Detector: PIN photodiode with optical filtering. Microprocessor: CMOS type	1

Code No.	Name of Equipment	Purpose of Use / Short Specification	Qty
AGR-08	Plant Water Potential Apparatus	Used in the courses of Advanced Irrigation Agronomy, Crop Management on Problem Soil, etc. for determining water potential of plant leaves. Standard type with pressure source. Portable type.	1
AGR-12	Plant Growth Cabinet	Used in the courses of advanced agronomy, seed technology, etc. for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
AGR-16	Kjeldahl System with Accessories	Used in the courses of Management of Crop Nutrition, Seed Technology, etc. for determination of nitrogen/protein content of soil and plant materials by distillation, titration and calculation. Measuring range: ~160 mg Nitrogen. Complete with a digester	1
AGR-18	Porometer	Used in Advanced Agronomy course, etc. for study of gas flow through pores, leaf stomata. Standard kit. Measuring range: Approx. 0~50 s/cm (resistance)	1
AGR-27	Thermostatic Germinator	Used in the courses of Advanced Agronomy, Seed Technology, etc. for testing seed germination/viability at the desired temperature. Temperature range: Approx. 0~60°C. Volume: Approx. 330 litres. 6 shelves.	1
AGR-29	Salinity Bridge Measuring Instrument	Used in the courses of Advanced Irrigation Agronomy, Crop Management on Problem Soils, etc. for measuring the concentration of solutes in a solution. Resistance ranges: ~100,000 ohms. Battery operated. With salinity sensors	1
<b>4. DEPARTMENT OF FORESTRY, RANGE MANAGEMENT &amp; WILDLIFE</b>			
FRW-24	Trolley Mounted Diesel Pump	Used in Forestry and Environmental Pollution course for irrigating experimental farm from a water channel. With a diesel engine, and casters for moving	1
FRW-25	Hand-Moved Sprinkler	Used in Forestry and Environmental Pollution course for sprinkling water to plants in the experimental field with covering area of Approx. 1,000 square metres	1
<b>5. DEPARTMENT OF PLANT PATHOLOGY</b>			
PP-04	Spectrophotometer	Used commonly in the Dept. for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~900 nm	1
PP-10	Automatic Slide Stainer	Used commonly in the Dept. for preparation of slides for observation of samples by microscopes.	1
PP-12	Growth Chamber	Used commonly in the Dept. for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
<b>6. DEPARTMENT OF PLANT BREEDING AND GENETICS</b>			
PBG-03	FT-IR Spectrophotometer	Used commonly in the Dept. for determination of amino acid, protein, nucleic acid, enzyme, etc. Wavenumber range: Approx. 6,000~400/cm.	1
PBG-22	Thermostatic Germinator	Used in the courses of Cereal Genetics, Breeding Oilseed Crops, etc. for testing seed germination/viability at the desired temperature. Temperature range: Approx. 0~60°C	1
PBG-23	Microscope with Camera Attachment	Used in the courses of Quantitative Genetics, Advanced Cytogenetics, etc. for observation of samples. With photomicrographic attachments	1
<b>7. DEPARTMENT OF SOIL SCIENCE</b>			

Code No.	Name of Equipment	Purpose of Use / Short Specification	Qty
SS-01b	UV-VIS Spectrophotometer	Used commonly in the Dept. for qualitative and quantitative determination of samples. UV-VIS single-beam type. Wavelength range: Approx. 200~1,100 nm	1
SS-05	Kjeldahl Analyzer	Used commonly in the Dept. for determination of nitrogen/protein content of soil, water and plant materials by distillation, titration and calculation. Measuring range: ~ 160 mg Nitrogen. Complete with a digester	1
SS-19	High Speed Refrigerated Centrifuge	Used commonly in the Dept. for separation/extraction of samples. Max. Speed: Approx. 22,000. Refrigerated	1
SS-42	Inverted Microscope	Used commonly in the Dept. for observation of solid samples. With 3CCD camera attachment. Inverted type	1
SS-51	Growth Chamber	Used commonly in the Dept. for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
<b>8. DEPARTMENT OF AGRI. ENTOMOLOGY</b>			
ENT-13	Insect Growth Chamber	Used in Advanced Insect Ecology course for controlling the environmental conditions of insect growth. Temperature range: Approx. Ambient~60°C. 5 sides glazed	1
<b>B. FACULTY OF AGRICULTURAL ENGINEERING &amp; TECHNOLOGY</b>			
<b>DEAN'S OFFICE</b>			
<b>9. DEPARTMENT OF FOOD TECHNOLOGY</b>			
FT-06	Soxhlet Extraction Unit	Used in Food Analysis and Evaluation course for extraction of samples to identify soluble material in food, feed, etc. Extraction time: Approx. 10 min. for 65% solvent recovery. Handling 6 samples simultaneously	1
<b>10. DEPARTMENT OF IRRIGATION AND DRAINAGE</b>			
ID-02	Calibration of Pressure Gauge Apparatus	Used in Fluid Mechanics course for calibration of pressure gauge. Calibrating range: Approx. 0.1~300 bar. Accuracy: Approx. 0.03%	1
ID-04	Laminar Flow Table	Used in the courses of Fluid Mechanics and Ground Water Hydrology for experiments on flow patterns of fluid materials. Table type floor standing unit. Dimension: Approx. 1,100 x 1,300 x 800 mm	1
ID-07	Viscometer	Used in the courses of Fluid Mechanics and Fluid Dynamics for measuring Saybolt viscosity of fluid materials. Measuring temperature range: Approx. 21~99°C	1
ID-09	Fluid Friction Loss Apparatus	Used in the courses of Fluid Mechanics and Ground Water Hydrology for studying fluid friction head losses in pipe fittings and related devices. Standard experimental kit	1
ID-10	Water Hammer Apparatus/Pressure Surge	Used in the courses of Fluid Mechanics and Fluid Dynamics for demonstrating the pipe surge and water hammer. Standard kit with an oscilloscope	1
ID-22	Seismograph	Used in Ground Water Hydrology course for measuring bedrock or water table depth. Survey depth: Approx. 30m. Signal Geophone: 8 Hz vertical component response	1
ID-30	Pressure Membrane Apparatus with Attachments	Used in Irrigation Engineering course etc. for determination of moisture retention properties of soil. With 5-bar pressure plate extractor and 15-bar ceramic plate extractor	1
<b>11. DEPARTMENT OF FIBER TECHNOLOGY</b>			

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
FIBT-01	Cotton Fibre Measuring System	Used in the courses of Cotton Fibre Technology and Textile Testing & Quality Control, etc. for determination of length, strength, elongation, micronaire and trash content of fibre materials in one system. Floor standing type, with a controller	1
<b>12. DEPARTMENT OF BASIC ENGINEERING</b>			
BE-03	Torsion Spring Testing Apparatus	Used in the courses of Mechanics of Materials, Engineering Mechanics, etc. for measuring mechanical properties of torsion springs and spiral springs. Capacity: Approx. 50 kg cm. Min. scale: Approx. 50g cm	1
BE-05	Waste Water Treatment Apparatus	Used in the courses of Wastewater Engineering and Contaminant Transport in Soil for treatment of harmful wastewater. Materials to be treated: Acids, alkalis, heavy metals (copper, leads) etc. Disposing capacity: Approx. 20~50 litres/cycle	1
BE-11	Automatic Soil Moisture Meter	Used in Contaminant Transport in Soil course for measuring soil moisture. Measuring range: 0~10m (water column pressure). Measuring spot: 3	1
BE-18	T.D.S. Meter	Used in the courses of Rural Water Supply & Sewerage, Wastewater Engineering, etc. for determining suspended solid in water. Filtering separation gravimetric analysis. With a printer	1
<b>13. DEPARTMENT OF FARM MACHINERY &amp; POWER</b>			
FMP-01	Fork Lift	Mainly used in the Agricultural Engineering Shop for multipurpose use such as transportation of agricultural machinery and other materials. Capacity: Approx. 3 tons, hydraulic lift, diesel engine powered	1
<b>C. FACULTY OF BASIC SCIENCE</b>			
<b>DEAN'S OFFICE</b>			
<b>14. DEPARTMENT OF BOTANY</b>			
BO-03	Microscope with Camera Attachment & Phase Contrast	Used in Biosystematics and Speciation course for observation of sample materials. With phase contrast equipment set and photomicrographic attachment	1
BO-10	Plant Growth Chamber	Used commonly in the Dept. for environmental control of plant growth. Temperature range: Approx. 4~50°C	1
BO-11	Double Beam UV-VIS Spectrophotometer	Used in Plant Metabolism course for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm	1
BO-13	Porometer	Used in the courses of General Cytology, Photosynthesis, Respiration, etc. for study of gas flow through pores, leaf stomata. Standard kit. Measuring range: Approx. 0~50 s/cm (resistance)	1
BO-14	Photosynthesis Measurement System	Used in Photosynthesis course for measuring photosynthesis rate and stomatal conductance by monitoring changes in CO <sub>2</sub> concentration, relative humidity and other parameters. Portable type	1
BO-17	Kjeldahl System	Used commonly in Plant Metabolism course for analysis of nitrogen/protein of grains, feed, food, water, soil, chemicals, etc. by distillation, titration and calculation. Measuring range: ~160 mg nitrogen. Complete with a digester	1
BO-23	Water Tension Testing Apparatus for plants	Used in Water Relations of Plants course for determining water potential of plant leaves. Standard type with pressure source. Portable type	1



Code No.	Name of Equipment	Purpose of Use / Short Specification	Qty
<b>15. DEPARTMENT OF ZOOLOGY &amp; FISHERIES</b>			
ZF-24	Single-Beam UV-VIS Spectrophotometer	Used in the courses of Physiology of Fish, Limnology, Fisheries Management, etc. for qualitative and quantitative determination of samples. UV-VIS single-beam type. Wavelength range: Approx. 200~1,100 nm	1
ZF-29	Soxhlet Extraction Unit	Used in Food Analysis and Evaluation course for extraction of samples to identify soluble material in food, feed, etc. Extraction time: Approx. 30 min. Handling 2 samples simultaneously	1
<b>16. DEPARTMENT OF PHYSICS</b>			
PHY-06	Electron Spin Resonance System	Used commonly in the lab. courses of the Dept. for verification of electron spin resonance, measurement of the gyromagnetic ratio, etc. With an oscilloscope and a DC ammeter	1
PHY-14	Basic Microwave Optic System	Used commonly in the lab. courses of the Dept. for various experiments on microwave transmission. Microwave transmitter with Klystron. With power supply	1
PHY-28	Liquid Nitrogen Cryostat	Used commonly in the lab. courses of the Dept. for measuring electromagnetic property of materials under controlled temperature. Continuous flow cryostat mounted with 3 temperature controller	1
<b>17. DEPARTMENT OF CHEMISTRY</b>			
CHM-02	FT-IR Spectrophotometer	Used in the courses of Organic Chemistry, Advance Physical Chemistry, Synthetic Organic Process, etc. for determination of amino acid, protein, nucleic acid, enzyme, etc. Wavenumber range: Approx. 6,000~400/cm.	1
CHM-03	Gas Chromatograph	Used in the courses of Synthetic Organic Process and Chromatography for determination of organic materials. Column oven volume: Approx. 14 litres, Max. temperature: Approx. 450°C	1
CHM-04	Double-Beam UV-VIS Spectrophotometer	Used commonly in the courses of Advanced Physical Chemistry, Molecular Spectroscopy, etc. for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~900 nm	1
CHM-06	Water Deionizer	Used commonly in the Dept. for preparation of pure water to be used in experiments. Filtration: Approx. 5 litres/hour. Storage tank: Approx. 50 litres	1
CHM-16	UV-VIS Spectrophotometer	Used in the courses of Organic Chemistry, Organic Analysis, etc. for qualitative and quantitative determination of samples. UV-VIS single-beam type. Wavelength range: Approx. 200~1,100 nm	2
CHM-17	High Speed Refrigerated Centrifuge with rotors	Used commonly in the Dept. for separation/extraction of samples. Max. Speed: Approx. 22,000. Refrigerated. With 2 rotors	1
CHM-19	Microscope with Camera Attachment and Accessories	Used in Biochemical Analysis and Clinical Biochemistry courses for observation of sample materials. With phase contrast equipment set and photomicrographic attachment	1
CHM-22	Fermenter for microorganism	Used in the courses of Enzyme, Environmental Biochemistry, etc. for fermenting microorganism. With a single glass vessel of approx. 10 litres capacity	1
CHM-30	Pollution Monitoring Station	Used in the courses of Environmental Biochemistry, Clinical Biochemistry, etc. for analysis of air pollution. With sensors for windspeed, direction, temperature, gas concentration of SO <sub>2</sub> , NO <sub>2</sub> , CO <sub>2</sub> , etc.	1

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
CHM-31	Water Quality Checker	Used in the courses of Environmental Biochemistry, Clinical Biochemistry, etc. for analysis of water pollution. With sensors for pH, temperature, dissolved oxygen, conductivity, salinity, turbidity, etc.	1
<b>D. FACULTY OF ANIMAL HUSBANDRY</b>			
<b>DEAN'S OFFICE</b>			
<b>19. DEPARTMENT OF LIVESTOCK MANAGEMENT</b>			
<b>1. WOOL LAB.</b>			
LMW-01	Wool Finess Meter with Air Compressor	Used in the courses of Advanced Wool and Hair Science, and Sheep Production for assessing the average fibre diameter of wool in scored, top or sliver form. IWTO test method. With vacuum pump	1
LMW-03	Fibre Tensile Strength Tester	Used in the courses of Advanced Wool and Hair Science, and Sheep Production for testing the tensile properties of single fibres. Measuring range of force: Approx. 0-100 cN	1
<b>2. DAIRY LAB.</b>			
LMD-24	Kjeldahl Method Nitrogen/Protein Analyzer	Used in the courses of Dairy Production, Range Livestock Management, etc. for analysis of nitrogen/protein of grains, feed, food, water, soil, chemicals, etc. by distillation, titration and calculation. Measuring range: ~160 mg nitrogen. Complete with a digester	1
LMD-33	Milk Testing Equipment	Used in Milk Secretion and Lactation course, etc. for determination of fat, protein, lactose, and minerals in the fresh milk. Measuring range: Approx. 0-10% fat	1
LMD-34	Milking Machine Model	Used in Milk Secretion and Lactation course, etc. for milking experiments. Portable type for 1 cow, with vacuum pump and spare claws. Tank capacity: Approx. 28 litre	1
<b>3. LIVESTOCK FARM</b>			
LML-06	Livestock Scale with Dial & Platform, Large	Used commonly for livestock management courses for observation and measurement of large animals. Max. capacity: Approx. 1,000 kg. With a platform	1
LML-07	Dipping Tanks/Vats	Used commonly for livestock management courses for disinfection of small animals. Capacity: Approx. 500 litre	1
<b>20. DEPARTMENT OF ANIMAL BREEDING AND GENETICS</b>			
<b>1. CYTOGENETICS LAB (CRL)</b>			
CCP-05	Portable Milking Machine	Used in the courses of Genetic Principles in Animal Breeding, Selection for Production Traits in Farm Animals, etc. for milking experiments. Portable type for 1 cow, with vacuum pump and spare claws. Tank capacity: Approx. 28 litre	1
<b>21. DEPARTMENT OF ANIMAL NUTRITION</b>			
AN-01	Gas Chromatograph	Used in Advanced Analytical Techniques in Nutrition course for estimation of fatty acid. Single flow line. Column oven volume: Approx. 12 litre. Max. temperature control range: Approx. 400°C. With 2 detectors	1
AN-02	Grain Tester	Used in Analytical Techniques in Nutrition course for determination of moisture, protein and fat in the grain. Near infrared spectroscopy.	1
AN-04	Epi-Fluorescence Microscope	Used commonly in animal nutrition studies for observation of feed materials, etc. With epi-fluorescence and photomicrographic attachments	1

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
AN-06	Fluorescence Spectrophotometer	Used in Advanced Analytical Techniques in Nutrition course for quantitative analyses of vitamins, amino acids, chemicals, etc. Wavelength range: Approx. 220-750 nm	1
AN-07	Fibertech	Used in analytical techniques courses on animal nutrition for extraction and determination of crude fibre and detergent fibres in foods and feeds. Semi-automatic type. With hot and cold extraction units	1
AN-09	Fermenter (7L)	Used commonly in the Dept. for fermenting microorganism. Steam sterilizable laboratory bioreactor of 7 litre capacity	1
<b>E. FACULTY OF VETERINARY SCIENE</b>			
<b>DEAN'S OFFICE</b>			
<b>23. DEPARTMENT OF VETERINARY ANATOMY</b>			
VA-03	Research Microscope with Camera Attachment	Used in Gross Anatomy course for observation of sample materials. With photomicrographic attachment	1
<b>24. DEPARTMENT OF VETERINARY PATHOLOGY</b>			
VP-01	Research Microscope with Camera Attachment	Used in the courses of Advanced General Pathology and Advanced Diagnostic Pathology for observation of sample materials. With multi-teaching heads for 5 and photomicrographic attachment	1
VP-02b	Microscope, Built-in Photomicroscopic System	Used in the courses of Advanced General Pathology, Necropsy Practice, Advanced Systematic Pathology, etc. for observation of histological/cytological samples, etc. With photomicrographic attachment	1
VP-15	Double-Beam UV-VIS Spectrophotometer	Used in the courses of Advanced Clinical Pathology, Advanced Diagnostic Pathology, etc. for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm	1
VP-16	Blood Cell Counter	Used in the courses of Advanced Clinical Pathology, Advanced Diagnostic Pathology, etc. for getting multiparameter haematology results. For 15 parameters, cycle time approx. 42 seconds. Sample volume: Approx. 20 micro litre whole blood	1
VP-20	Tissue Embedding System	Used in the courses of Advanced General Pathology, Advanced Diagnostic Pathology, etc. for embedding of histological specimens. With a magnifier glass and electrically heated forceps	1
VP-26	ELISA Reader Complete Set	Used in the courses of Advanced Clinical Pathology, Advanced Diagnostic Pathology, Immuno-pathology, etc. for colorimetric assays as kinetic ELISA, protein determinations, cytotoxicity, etc. Wavelength: Approx. 340~630 nm	1
<b>25. DEPARTMENT OF VETERINARY PARASITOLOGY</b>			
VPR-07	Double-Beam UV-VIS Spectrophotometer	Used in the courses of Biotechnology for Parasite Control and Techniques in Molecular Parasitology for qualitative and quantitative determination of enzyme, protein, hormones, etc. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm	1
VPR-08	Inverted Microscope	Used in Invertebrate Cultivation of Parasites course for observation of solid samples. With epi-fluorescent and phase contrast, and camera attachment.	1
VPR-09	ELISA Reader	Used in the courses of Biotechnology for Parasite Control, Techniques in Molecular Parasitology, etc. for colorimetric assays as kinetic ELISA, protein determinations, cytotoxicity, etc. Wavelength: Approx. 340~630 nm	1

Code No.	Name of Equipment	Purpose of Use / Short Specification	Qty
<b>26. DEPARTMENT OF CLINICAL MEDICINE AND SURGERY</b>			
CMS-01	Portable Ultrasound Diagnostic System	Used in Medicine Clinic course for ultrasound diagnosis of small and large animals. Probes: 3.5 MHz and 7.5 MHz	1
CMS-02	Double-Beam UV-VIS Spectrophotometer	Used in Clinical Laboratory Aids in Diagnosis course for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm	1
<b>27. DEPARTMENT OF ANIMAL REPRODUCTION</b>			
AR-02	Research Microscope	Used commonly in the Dept. for observation of sample materials. With photomicrographic attachment and phase contrast equipment set	1
AR-03	Inverted Microscope	Used in the courses of Embryo Transfer in Farm Animals, and Obstetrics and Gynaecology for observation of sample materials. With camera attachment	1
AR-04	Stereomicroscope with photographic attachment	Used in Embryo Transfer in Farm Animals course for observation of sample materials. With photomicrographic attachment and teaching head set for 2 observers	1
AR-10	Double-Beam UV-VIS Spectrophotometer	Used in Biochemical Aspects of Semen course for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm. With absorption cells	1
AR-12	Ultrasound Scanner with Transducer & Printer	Used in Infertility and Genital Diseases course for ultrasound diagnosis of animals. Probes: 7.5 MHz. With ecocopter	1
<b>28. DEPARTMENT OF PHYSIOLOGY AND PHARMACOLOGY</b>			
PPH-02	Gamma Counter	Used commonly in the Dept. for gamma counting. Manual operation, 5 detectors	1
PPH-05	Double-Beam UV-VIS Spectrophotometer	Used in the courses of Advanced Pharmacology, Pharmacokinetics, etc. for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100 nm	1
<b>29. DEPARTMENT OF VETERINARY MICROBIOLOGY</b>			
VM-17a	Binocular research microscope	Used in the courses of Advanced Microbiology, Advanced Veterinary Bacteriology, etc. for observation of sample materials. Photomicrographic attachment, phase contrast equipment set, epi-fluorescent attachment, dark field condenser, and multi-teaching head set for 5 observers	1
VM-23	Water Distillation Apparatus	Used commonly in the Dept. for preparation of pure water to be used in experiments. Filtration: Approx. 5 litres/hour. Storage tank: Approx. 50 litres	1
<b>F. COLLEGE OF VETERINARY SCIENCES, LAHORE</b>			
<b>30. EQUIPMENT FOR VARIOUS SECTIONS</b>			
CVS-13	Gas Chromatograph	Used in the courses of Energy Metabolism, Protein Metabolism, etc. for estimation of fatty acid. Column oven volume: Approx. 12 litre. Max. temperature control range: Approx. 400°C. With 2 detectors	1
CVS-15	Atomic Absorption Spectrophotometer	Used in the courses of Physiological Chemistry, Physiology of Digestion and Metabolism, etc. for determination of metal contents in animal tissues. Flame type. Wavelength range: Approx. 190~900 nm	1
CVS-17	Microscope	Used commonly in the College for observation of sample materials. With photomicrographic attachment, phase contrast equipment set, epi-fluorescence attachment	1

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
CVS-18	Cryostat Microtome	Used in the courses of General Pathology, Clinical Pathology, etc. for preparation of sectioned specimen for microscopic observation. Temperature control: Approx. 0~-15°C	1
CVS-23	High-speed Refrigerated Centrifuge	Used commonly in the College for separation/extraction of samples. Max. Speed: Approx. 22,000. Refrigerated	1
CVS-25	Fume Hood	Used commonly in Animal Nutrition section for handling materials with radiation. With windows of tempered glass and sliding doors. Width: Approx. 1,500mm	1
CVS-28	Crude Fiber Apparatus	Used commonly in Animal Nutrition section for extraction and determination of crude fibre and detergent fibres in foods and feeds. Semi-automatic type. With hot and cold extraction units	1
CVS-31	Particle Analyzer	Used commonly in Animal Nutrition section for gravitational/centrifugal sedimentation and photometric detection. Measuring range: Approx. 0.01~550 $\mu$ m. Max. rotation speed: Approx. 11,000rpm	1
CVS-32	Double-Beam UV/VIS Spectrophotometer	Used commonly in Physiology section for qualitative and quantitative determination of samples. UV-VIS double-beam type. Wavelength range: Approx. 190~1,100nm	1
CVS-36	Inverted Microscope	Used commonly in Microbiology section for observation of sample materials. With camera attachment	1
CVS-50	Fluorescence Spectrophotometer	Used commonly in Medicine section for quantitative analyses of vitamins, amino acids, chemicals, etc. Wavelength range: Approx. 220-750nm	1
CVS-60	Operating Table for Small Animals	Used in Surgery section for operation of small animals like goat, sheep, etc. Table size: Approx. 660 x 990 x 900mm. With a filth gutter	1
CVS-63	Micro Kjeldahl Digestion Apparatus	Used commonly in the Animal Nutrition section for determination of nitrogen/protein content of materials by distillation, titration and calculation. Measuring range: ~160mg Nitrogen	1
CVS-65	Large Volume Refrigerated Centrifuge	Used commonly in Microbiology section for separation/extraction of samples. Max. Speed: Approx. 7,000. Refrigerated. Max. capacity: 1,000ml x 6 pcs.	1
CVS-69	X-Ray (500mA)	Used in Surgery section for diagnosis of animals. Ratings of radiography: Approx. 300 mA at 150 kV. With a generator	1
CVS-70	Anesthesia Machine	Used in Surgery section for medical and surgical treatment, and other experiments of small animals. With necessary cylinders	1
<b>G. DIVISION OF AGRI. EDUCATION &amp; EXTENSION</b>			
<b>31. VARIOUS DEPARTMENTS OF DIVISION OF EDUCATION &amp; EXTENSION</b>			
DEE-71	Micro Kjeldahl Digestion & Distillation Assembly (Small)	Used in Food and Nutrition course for determination of nitrogen/protein content of materials by distillation, titration and calculation. With a micro/macro distillation unit, a micro Kjeldahl digestion unit	1
DEE-73	Bomb Calorimeter	Used in Food and Nutrition course for measuring calorie in food materials. Measuring range: Approx. 1,000~8,000 cal	1
<b>H. GENERAL FACILITIES</b>			
<b>32. AUDIO/VIDEO EQUIPMENT FOR LIBRARY</b>			
<b>33. CENTRAL LABORATORY</b>			

Code No.	Name of Equipment	Purpose of Use / Short Specification	Q'ty
CL-01	X-Ray Diffractometer	Used commonly by departments of Soil Science, Physics and others for clay mineral analysis, structural analyses, etc. Focus: Approx. 1 x 10 mm <sup>2</sup> with tubes for Cu, Cr and Fe	1
CL-02	Scanning Electron Microscope	Used commonly by concerned departments for ultra structural observation and determination of elements in plant and animal tissues, etc.. Resolution: Approx. 3.5 nm. Magnification: Approx. 20x~300,000x. With EDX, camera, etc.	1
CL-03	Transmission Electron Microscope	Used commonly by concerned departments for ultra structural studies of plant and animal tissues, for verification of submicroscopic disease organism/agents, etc. by transmission method. Resolution (point): Approx. 0.45 nm. Max. magnification: Approx. 600,000x. With a vacuum evaporator, a microtome, a glass knife maker, etc.	1
CL-05	High Performance Liquid Chromatograph	Used commonly by all the departments for routine determination of organic matters in food and feed materials. Detectors: UV-VIS, conductivity, fluorescence	3
CL-06	GC Mass Spectrometer	Used commonly by concerned departments for quantitative and qualitative analyses of organic compound, especially for studies on N fertilizer use efficiency, etc. Mass range: Approx. 10~700 amu. Selected ion monitoring: 32 channels x 32 ion sets	1
CL-07	Atomic Absorption Spectrophotometer	Used commonly by all the departments for determination of metal contents in plant and animal tissues, foods, feeds and chemicals. Atomization by flame and graphite furnace. Wavelength range: Approx. 190~900 nm. With autosamplers, lamps (15 types), etc.	1
CL-08	Auxiliary Equipment	Used to support the equipment of Central Lab., including a water distiller, an autostill, an oven, a hume food, a generator, an air conditioning unit	1
CL-09	Amino-Acid Analyzer	Used commonly by concerned departments for determination of amino acid quality control of food, feed, etc. and for determination of metabolic disorder, etc. Microprocessor controlled with 10 programmes. Separation column of approx. 3.2 x 250 nm	1
CL-10	Ultra Centrifuge	Used commonly by concerned departments for separation and extraction of various materials. Max. speed: Approx. 100,000 rpm, 70,000 rpm, 60,000 rpm respectively. With spare rotors of 3 types	3
<b>34. UNIVERSITY PRESS</b>			
UP-01	Offset Machine	To be used for printing all the materials of the University. Max. running speed: Approx. 8,000 i.p.h. Max. sheet size: Approx. 400 x 500 mm	1
UP-02	Electronic Vertical Camera	Used for preparation of a negative film. Scale focusing type. Image size: Approx. 400 x 500	1
UP-05	Book Binding Equipment	A line of equipment to be used for book binding, consisting of a cutting machine, a stitching machine, a spring binder, a lamination machine, an embossing machine, etc.	1