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TIPAN

Transformation and
Integration of the
Provincial
Agricultural
Network



Northwest Frontier Province, Pakistan

Office of International Agriculture
University of Illinois at Urbana-Champaign

In collaboration with
Southern Illinois University at Carbondale

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CONSULTANT REPORT - HERBERT L. PORTZ

FORAGES

9 MARCH - 6 APRIL 1987

Submitted to
the Northwest Frontier Province
Agricultural University
Peshawar, NWFP, Pakistan

and

the U.S. Agency for International Development
Mission to Pakistan

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TRAVELER

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ITINERARY

6 March 1987 Depart Carbondale
9 March 1987 Arrive Islamabad
10 March 1987 Arrive Peshawar
6 April 1987 Depart Peshawar

PURPOSE

To consult on a forage program and turf management program for the Northwest Frontier Province Agricultural University (NWFP AU), Peshawar, Pakistan, and the off-campus research stations and institutes.

REQUEST FOR SHORT-TERM TECHNICAL ASSISTANCE BY THE AGRONOMY DEPARTMENT

1. Assist in developing forage courses.
2. Assist in establishing a "living field lab".
3. Work with staff at the livestock stations to help establish a forage research program.
4. Present a seminar to the faculty on forage research.
5. Assist in development of linkages with forestry and other agencies responsible for range management.
6. Assist the A & E contractor in selecting turf species for the playing fields and campus grounds.

SUMMARY

Assessment of the forage situation in the Northwest Frontier Province of Pakistan involved nearly the total period of four weeks. I observed three major problems or constraints relative to forage production and utilization in the NWFP. First, the low status or priority of this crop or subject, second, its fragmentation in the Agricultural University's teaching, research and outreach programs and third, the lack of assigned or trained personnel in forage teaching and research.

Nearly all outlying research stations and institutes now being brought under the NWFP AU were visited. I was accompanied by Muslim Shah now stationed at the Agriculture (Horticulture) Research Institute at Tarnab. In addition, I met with on-campus personnel relative to teaching and research and worked with Baz Mohammad on improvement of the playing

fields and campus grounds. In addition to the above stations, visits were made to the National Agricultural Research Center, Islamabad, the Pakistan Forest Institute, Peshawar, the Animal Husbandry Department at the Veterinary Research Institute in Peshawar and the Dairy at Horichand.

A progress memorandum was prepared on 29 March and a seminar was given on 1 April entitled "Forages in Pakistan." There was considerable discussion about fuller utilization of perennial grass and legume species, especially alfalfa. Memoranda on 24 March and 6 April detailed recommendations for improving the playing fields and campus grounds.

An oral report was made to the Vice Chancellor, Research Station Directors, Dr. Cragle and Joe Marion on 4 April. The major recommendation was to establish a Forage Sector or Section to coordinate forage research at the University Farm Center and outlying stations with Muslim Shah as the initial leader. Also, there should be two courses specifically related to forages; in the 3rd year "Forage Production" taught by Agronomy; and in the 4th year "Forage Utilization" taught jointly by Agronomy and Animal Husbandry faculty.

I regret that weather and late arrival of certain seeds and inoculant prevented more progress in establishing a forage crops identification garden and other research plots. However, over 21 kilograms of many forage species and cultivars are there for future teaching and research activities. Most of the cool season legumes and grasses will best be established in the fall.

The overall assistance of the TIPAN team, especially Joe Marion, was greatly appreciated. Host-country personnel were very hospitable and cooperative and hopefully some progress will be made in improving forage production and utilization in the NWFP.

ASSESSMENT OF FORAGE PROGRAM

Introduction

Contacts were made with NARC, the various NWFP AU departments, outlying stations, the Provincial Department of Animal Husbandry and the Forest Institute, to assess their involvement and support of a forage program in research, teaching and outreach in the Northwest Frontier Province of Pakistan.

Although plans called for immediate contacts with Sherin Khan to set up the teaching and demonstration plots at the University Farm Center (Malakandhar Farm), Sherin was no longer farm manager and was considering leaving the agronomy department to work at the Institute of Development Studies (IDS).

During the second week, Muslim Shah, the tobacco botanist at Tarnab, met me at the university and he became my major guide and counterpart. He is a well-qualified individual with an M.S. in forages from Fresno

State. At Tarnab, he is doing some research on forages - mostly with fodder crops and also works with oil seed crops. We visited livestock and crop production stations and institutes throughout the Province.

It soon became clear that forages were a low priority in most of the departments in the university as well as on the stations and farms in the Province. This multi-discipline subject had no real home and emphases were on food, oil and sugar crops. Fodder, such as annual grasses and legumes, along with chopped straw (bhusa), is used to feed the primarily-confined livestock.

Although the weather was pleasantly cool during the month of March, constant rainfall hampered land preparation and actual seeding of the forages at any locations. Forage seeds for an "Identification Garden" and an additional 21 Kg of appropriate grass and legume species and cultivars for research purposes were sent via pouch prior to the consultant's arrival. Recommendations for their use when land is ready and season is appropriate, have been made.

An appraisal was made of the turfgrass on the present playing fields. The dominant grass is a fine-textured Bermudagrass which is well adapted to this climate when irrigated. I found it to be of low density due to heavy wear, close and frequent clipping and little fertilization. Much of it, however, can be used for sodding the new playing fields.

The Forage Situation in the NWFP

There appear to be three major problems or constraints relating to forage production and utilization in the Northwest Frontier Province of Pakistan. First is the low status or priority of this crop or subject. Second, its fragmentation in the agricultural university's teaching, research and outreach program and third, the lack of assigned or trained personnel in forage teaching and research.

Perhaps the most important factor leading to the low status of forages is the emphasis by the farmer and the nation as a whole on the high-income food, oil, sugar and fiber crops. These take precedence over forages, especially on the irrigated lands. There are few large herds of beef or dairy; most farmers and even landless villagers have several buffaloes, goats or cattle for home use. The cows are tethered and forage (fodder) is brought to them. In the case of sheep, the assembled flocks are often large and overgrazing of dry, rainfed (barani) land and foraging on trees, shrubs and roadside browse is disastrous to existing vegetation. Even on the few commercial livestock farms, there is poor utilization of forages; mostly green shop (fodder) and quantity rather than quality is the goal. Liberal amounts of chopped straw (bhusa) are included to dilute the high moisture berseem and to 'fill' the ruminant animal.

The second problem or constraint, fragmentation, is because the responsibility for teaching and research is divided among several university departments and government agencies and there is little coordination or cooperation between them. At the NWFP AU the following departments are involved:

Agronomy - forage production, mostly fodder. A few research projects, mostly by B.S. (Honors) or M.S. students.

Animal Husbandry - forage utilization, again mostly fodder with limited information on grazing and feeding trials and minimal preservation.

Forestry - (actually a separate Forest Institute, not part of the University) range management with more emphasis on grasses and shrubs for soil conservation and watershed management than animal grazing and, even here, the use of these forage plants is primarily through hand cutting as fodder.

Plant Breeding - emphasis on wheat, maize and oil crops and developing new hybrids and biotech methods rather than selection from the diverse germ pool available such as the indigenous buffelgrass and Medicago spp. Excellent progress has been made in developing good fodder-type annuals but little in the perennial grasses and legumes.

Crop Protection - only weed control is presently in the department. Plant pathology and entomology are still operating as separate departments. Again, the emphasis is on high income food and fiber crops with little attention to the forage crops.

Other departments and institutes that should be involved with forages, either in production, economics or information dissemination are:

Soils and Irrigation - appropriate fertility and irrigation practices but now are involved in raising high income crops as noted earlier.

Agricultural Economics and Rural Sociology - little on economics of forages etc., however, there is increasing concern about the economic plight of the small rural farmer and the need for information dissemination.

Agricultural Engineering and Mechanization - minimal emphasis on mechanical harvesting or preservation and this department is still housed in Peshawar University.

Institute of Developmental Studies (IDS) - technically part of the AU but primarily classical economics and sociology and is attempting to develop a separate outreach program.

Extension Training Institute - training of extension specialists is entirely separate from the AU. This is an important program in many rural areas and should be coordinated with the AU's outreach program.

The third constraint, lack of assigned or trained personnel needs to be approached in two ways. One, assigning specific personnel such as Muslim Shah or other qualified people to a forage position and two, sending qualified candidates for advanced training in forages or related areas such as forage crop breeding, animal specialist in forage utilization etc. This is being done and will help in the future.

THE FORAGE RESEARCH PROGRAM AT OUTLYING STATIONS AND INSTITUTES

Dairy and Sheep Locations

The dairy station at Surezai has a modest forage program with emphasis on fodder production. Alfalfa (lucerne) was established in 1984 and last year 8 cuts were obtained with a total yield of 14 tons/ha of air dry weight. They also obtained good yields from a bajra-napiergrass hybrid. There were some problems with dodder infestation that came with the alfalfa seed. No formal yield trials or feeding experiments on the forage crops have been conducted to date but Director Bashir Qureshi and others are interested in expanding the perennial forages to help in a year-around-feed supply including silage and hay.

The Dutch-initiated dairy at Horichand has a large Friesen herd of 75 milking cows and both heifer and bull calves for herd increase and sale to local farmers. They were feeding mostly cut barley, berseem and wheat straw although an excellent but weedy crop of alfalfa was available. Alfalfa weevils and weather damage to the standing and ready-to-cut crop were noted. Several bunker silo structures were available but awaited maize later in the summer while the alfalfa deteriorated in the field. The need for a forage-knowledgeable agronomist or animal husbandman was evident.

The Jaba sheep station is making good use of oats for fodder, silage and later grain. The overstocked range, however, needs help. A good but sparse stand of alfalfa along with several native grasses was found on a protected hillside - mostly cut rather than grazed. The Range Section of the Pakistan Forest Institute has introduced some species of range grasses but the experiments are not well supervised. Nearly two hectares had been recently hand-prepared and fertilized for seeding of alfalfa. A portion of these sloping terrace strips are designated for legume/grass trails that will be rotationally grazed. Some rotational grazing is practiced; more is planned. Director Jamshed Khan is most interested in cooperating in grass/legume trails.

The small dairy on campus is completely enclosed and the fodder, mostly berseem and oats is cut from the nearby University Farm Center. Chopped wheat straw is included as per custom throughout the Province.

A small, privately-owned dairy farm (7 buffalo and 5 dairy mixed cows) was visited. The owner Sahabzada Neamatullah, a M.S. chemist, had just planted millet and was ready to plant a forage sorghum. He is interested in trying a non-hardy alfalfa.

Field and Horticulture Crop Stations and Institutes

The institute at Tarnab is primarily for oil seed, pulses and horticultural crops. They have 93 varieties of peaches and nectarines plus several vegetable crops. Director Abdul Quadim Syed is interested in increasing the forage section, however, the present forage area is very poorly drained with only berseem and oats doing well. Muslim Shah has some perennial grasses such as a pearl millet (Rajra)-Napier grass cross and others. There are several alfalfa varieties but the high water table greatly restricts research on this crop.

Two stations were visited on the way to D. I. Khan, one near Karok was primarily with gram (chickpea) and Serai Naurung, where there are several oil crops, wheat and pulses. This station is small but well run.

The large station at D. I. Khan, nearly 1,000 acres with about 300 being used, has good potential for both irrigated and non-irrigated forages, especially salt tolerant grasses. Mahmood Jan is in charge of an Adaptive Research Program at D. I. Khan but has maintained several forage grasses; the Bajra-Napier cross, Rhodesgrass and lemongrass. A non-irrigated portion of the station, 179 acres, is designated as an Arid Zone Research Sub-Station under PARC and ICARDA. Deputy Director K. N. Baber has a 10-species perennial range grass experiment and another area where several native grasses have been recently planted without irrigation.

The Cereal Crops Research Institute (CCRI) at Pirsabak is a wheat and maize breeding and seed production unit. Also some forage oats is being tested.

No formal visit was made to the Swat area but the use of Persian clover in this cooler climate was noted and other fodder crops are being raised with real potential for intercropping orchards with various legumes.

University Farm Center (Malakandhar Farm)

The University Farm Center, which lies on the other side of a gravelly nulla from the university, is destined to be the premier crop and livestock center for the AU. Its close proximity to the campus will facilitate faculty and student usage both in teaching and research. Small plots, an aging irrigation system and poor drainage need to be corrected. A laser-leveler was requested and briefly used before rains came in December. This machine would greatly accelerate the leveling and renovation process so more precise irrigation and larger plots could be

used for the planned mechanization and modernization of the center (similar to CCRI). The new livestock center will be extremely important in forage research and teaching both in production and utilization.

Pakistan Forest Institute

Forage and range management is under the Forest Institute in Pakistan with emphasis on afforestation, soil conservation and watershed management with only limited utilization of this protected land by livestock. Dr. Sultan Maqsood Khan heads up a four nation mountain program and has major interest in testing different introduced and native perennial grasses for conservation and grazing purposes. Controlled grazing is minimally allowed - much more utilization of perennial grasses and legumes is needed. Also I met with Ken McNabb who works with the Forestry Planning and Development Project with USAID (also called Farm and Energy Forestry) where wood and fodder crops are combined.

The University Athletic Fields and Grounds

The predominately bermudagrass turf on the campus is a fine-textured, tight sod former which grows well in the hot Peshawar climate. The university grounds and playing fields are closely clipped and all clippings are collected and fed to livestock as fodder. Relocation of several athletic fields occasioned by the construction of new buildings has been initiated. The bermudagrass sod can be used for sodding of the new athletic fields. Several meetings were held with Baz Mohammad and others to discuss the procedures et al. Other turfgrass species are to be tested in a trial at one end of the new hockey field. Two memos are included in the Appendix detailing these procedures.

Problems in Forage Production and Utilization

Several older documents prepared by consultants and survey team on the problems of forage production and utilization in Pakistan were closely inspected. These documents, along with personal observations formed the nucleus for a seminar presentation on "Forages in Pakistan" on 1 April 1987. Although the documents were prepared in 1969 and 1973, the problems described are essentially the same today -- lack of trained personnel, superficial research and little effective outreach. More recent publications (the National Forage and Pasture Programme, 1986 Pakistan Agricultural Research Council, Islamabad) and consultants reports (Howard H. Olson, Animal Husbandry, November-December 1985) continue to stress the need that more attention be given to forage problems. A copy of the seminar outline without visual aids is appended. In summary, much discussion and many words have been written but little progress has been made to provide livestock with year-around nutritious roughage.

RECOMMENDATIONS

Forage Section

A forage section or sector should be established with a project leader to help initiate and coordinate forage and fodder research throughout the NWFP. The University Farm Center would be the major location along with Surezai and Jaba as primary livestock stations for forage utilization along with other stations and institutes for forage and fodder production, research and outreach. The organization should be similar to CCRI's leadership in research on maize and wheat. The major difference is the inclusion and cooperation of several on-campus departments, i.e. agronomy, animal husbandry, plant breeding, and other supporting departments such as soils, pathology, entomology, plant protection and agricultural economics. There also should be coordination with the Forest Institute, PARC, ICARDA, MART and other countries working on similar forage problems. The outreach and extension programs should be enlisted to help disseminate appropriate research to the farmer. Departmental faculty should look to the forage section for meaningful teaching aid such as practicums and for help in forage production and research.

Forage Research

Research in forage production and utilization should be expanded and accelerated. The present emphasis on fodder crops as the major feed for livestock results in uneven yearly distribution with scarcity periods in late summer and winter as well as a constantly changing animal diet. Neither situation optimizes milk, meat or wool production. The overview presented in the 1 April seminar, emphasized the limitations in the forage and range research programs and problems in development of forage resources. It was stressed that additional perennial grasses and legumes, especially alfalfa, along with better harvest and preservation methods are needed. Also forage research and evaluation should include animal acceptance, TDN, digestible protein, animal gains and milk production in addition to total green weight.

Specific recommendations for forage research at the University Farm Center and several outlying stations follows.

Note Appendix VII and some of the pertinent studies at NARC. Many are applicable to the NWFP.

A. University Farm Center (Malakandhar Farm)

1. Alfalfa and alfalfa/grass mixtures expt. Hardy and non-hardy alfalfa alone and with smooth brome grass, orchardgrass, timothy, tall fescue and perennial ryegrass.

2. Alfalfa irrigation expt. Part or all of 1. above with full irrigation for one block or blocks and limited irrigation of other block(s), all with adequate drainage. Also P & K variables or
3. A separate fertility experiment involving P & K variables. Starter and maintenance (after 2nd cut etc.) fertilizer.
4. Weed and insect control in forage legumes; alfalfa, red clover, sweet clover, crown vetch, and berseem seeded alone and with an oat companion crop and with and without herbicides and insecticides. Possibly plant in rows for weeding.
5. Silage and hay preservation. a) Silages from 1, 2, 3 or 4 above with different % moisture (i.e. direct cut vs wilting and with and without bhusa or molasses. Fine chop vs coarse chop etc.) b) Silage (as in a.) but different containers such as bunker, trench, stack or plastic bags or pipe. c) Hay making. Different cutting, drying and pickup methods, open vs covered stack, baling, pelleting or wafers.
6. Animal feeding trials. a) Use hay and silage from 5 above for animal gains, milk production or other trials. b) Run laboratory analyses for crude fiber, crude protein and other proximate analyses. c) Compare fodder production (green chop) with hay or silage in DM, yield and feeding trials.
7. Animal grazing trials. a) Utilize portion of alfalfa and alfalfa mixture expt. or have separate pasture area. Compare species preference, animal gain, etc., under rotational vs continuous grazing and different stocking rates. b) Determine resulting recovery and species shift from different grazing pressures. c) Use different livestock classes for a and b.
8. Irrigation and drainage studies with alfalfa and other legumes. Select poor drainage area or hold excess irrigation water vs good drainage. Orient rows down slope to provide rapid drainage after irrigation or rainfall.
9. Forage establishment experiments. a) Seeding rates, b) Seeding method, include depth, compaction, etc., c) Seeding times, d) Pre-and Post-emergence herbicides, e) Other.
10. Any of above and other experiments for faculty, B.S. (Honors) and M.S. students.
11. Forage identification plots for teaching. See forage production course.

B. Surezai

1. Alfalfa and alfalfa/grass mixtures expt. (Similar or complementary to University Farm Center experiment).

2. Alfalfa irrigation expt. Most important because of more limited water supply.

3. Preservation expts. Comparing annual grasses and legumes for hay and silage.

4. Animal utilization studies. TDN, crude fiber and corresponding milk production. Prepare silage, hay and fodder from the same forage crops.

5. Warm season forage expt. (Limited irrigation for summer forage.) Switchgrass and Sericea Lespedeza, Buffalograss, Wheatgrass, annuals (pearl millet, sudan, maize, BN cross).

6. Other experiments similar to University Farm Center - especially since the land and livestock can be utilized immediately. Again can use for faculty and students.

C. Jaba Sheep Station

1. Legumes, grasses and mixture expt. (to be seeded April 1987).

2. Preservation expts. Use 1. above along with oats and maize for silage and hay. Molasses or chopped sugarcane for grass/legume silage.

3. Rotational grazing expts.

4. Feeding trials.

D. Dairy Farm near Serai Nurung (Kosti Farm)

1. Alfalfa and alfalfa/grass mixtures. Compare yields and silage preservation quality.

2. Sorghum and BN crosses.

E. D. I. Khan

1. Warm season grasses for rainfed (Barani) areas.

2. Salt-tolerant grasses. Alkali sacaton, Kellar grass etc.

3. Non-hardy alfalfas with irrigation for year around forage production.

4. Range management studies with Arid Zone Research Sub-station.

F. Agricultural Institute - Tarnab

1. Continue fodder production studies with berseem, oats, Rhodesgrass and Bajra-Napier hybrids.

2. Introduce legumes and grasses into orchards.
3. Study relation of alfalfa production to high water table/drainage problems. Elevate an area or use well-drained location.
4. Utilize entomology section for insect studies on forages.

G. Mingora-Swat area

1. Legumes and grasses for intercropping in orchards - for fodder production, etc. Utilize red clover, birdsfoot trefoil, Persian clover, perennial ryegrass, orchardgrass and Kentucky bluegrass.

In general the warm season grasses should be seeded in late spring; the cool season grasses and legumes in fall. Some exceptions if in cooler, more humid regions or if irrigation is provided.

Forage Teaching

Two courses dealing directly with forages are recommended; one in the 3rd year and one in the 4th year. A forage production course including fodder production taught in the agronomy department should precede a course in forage utilization to be taught jointly by Animal Husbandry and Agronomy faculty.

A. Forage Production - 3rd Year. Should include major production practices including selection of appropriate grasses and legumes, soil preparation, seeding, pest control and other cultural practices. Although the emphasis might be on fodder crops, there should be full discussion of forages for pastures and rangeland; hay and silage making and seed production. The laboratories and practicums should include plant and seed identification, seeding to harvest practices, yield and other forage quality determinations and production and use of quality seed. Various research projects for advanced students can fit into the teaching faculty's overall research program.

B. Forage Utilization - 4th Year. Should include the total "forage for livestock" concept with emphasis on quality forages and the need for year-around production using annuals and perennials along with preservation. The ruminant animal, TDN and protein requirements, the ensiling process and additional concentrates needed to balance a ration, etc. Laboratories and practicums should include proximate analysis of different forages "in vitro" and "in vivo" experiments if possible, grazing trials including rotational grazing and animal performance, silage and hay making procedures and assessment of product quality. Various research projects for advanced students can fit into the faculty's overall research program.

C. Introductory and Supporting Courses. The introductory courses in crop production, plant breeding, animal husbandry and agricultural economics as well as botany and chemistry should include the fundamentals

of plant growth and physiology and nutritional needs of animals. Advanced courses in plant breeding, animal nutrition, irrigation and drainage and soils and fertility would have major references and units on development, production and utilization of major forage species.

Outreach

The proof of good research and teaching is final acceptance by the farmer. The researcher and teacher must present an economic and practical solution that farmers can understand and afford before they will give up traditional methods of forage/fodder production. We must use demonstrations, on-farm research, field days, workshops, seminars and good media to sell a forage program. It is best to work through and with the extension and other community agencies to get the job done.

FORAGES IN PAKISTAN
Seminar
1 April 1987 at NWFP AU

Dr. H. L. Portz, TDY, TIPAN PROJECT

Objectives:

- 1) To define "forages" and its importance in livestock production.
- 2) To indicate problems and limitations in the development of forages resources in Pakistan.
- 3) To suggest several methods for improving forage production and utilization in Pakistan.
- 4) To emphasize the role of the NWFP-Agricultural University in this effort through Research, Teaching and Outreach.

I. INTRODUCTION

A. Forages - a broader concept

Includes all roughage for ruminant animals - with high fiber and cellulose and low TDN. When animal harvest direct=foraging or grazing of pastures and rangelands. When man harvests for the animal=fodder, stover, or stores as hay, silage, pulp, etc.

1. Other definitions - Kharif, Rabi, etc.
2. Livestock needs - total of feed units from forages dairy cattle, 61.2%; beef cattle, 83%; sheep and goats, 91.1% (from CAST).
3. Forages and soil conservation.

B. Limitations in the Forage and Range Research Program

1. Lack of trained personnel to do research.
2. Lack of effective organization for carrying out forage research.
3. Limited species for year long forage production.

4. Lack of research on forage conservation, i.e. hay and silage.

5. Limited animal evaluation of forages.

6. Fertilizer, cultural practices and management research deficiencies.

7. Lack of range management research and surveys of Pakistan range resources.

II. PROBLEMS AND LIMITATIONS IN THE DEVELOPMENT OF FORAGE RESOURCES IN PAKISTAN

Limited Application of Known Technology (1973 report by Cornelius & Ream)

1. Varieties developed but not widely distributed.

2. Fertilizers not used by many farmers.

3. Quantity (green wt.) rather than quality (TDN, protein).

4. Improved seeds and plant materials limited.

5. Poor water management.

6. Overgrazing and improper management of rangelands.

7. Absence of national range policy - lack of defined range management objectives and provision of means to achieve them.

8. Lack of an organized outreach forage program and trained personnel.

III. IMPROVING FORAGE PRODUCTION AND UTILIZATION

A. Grasses, legumes and mixtures.

B. Lucerne (alfalfa); an example.

C. Harvest and preservation

D. Livestock Utilization

IV. SUMMARY - A CHALLENGE TO THE NWFP AGRICULTURAL UNIVERSITY

A. Research in forages and related areas. University Farm Center - faculty, MSc. students, etc. Outlying Research Stations - Cooperation with PARC, Forest Institute and Provincial and Country Organizations. Interchange with other research in-country, and ICARDA, FAO, etc. See attached Coordination and Organization of Fodder Research in Pakistan by Cornelius & Crowder.

B. Teaching of forages and related courses. Well-planned and presented courses - lectures, laboratories and practicals. Other departments with supporting courses. Cooperative teaching of forages; agronomy and animal husbandry.

C. Outreach. Get practical information to the farmers - field demonstrations, seminars, media.

Questions??

Glossary of terms

Bajra = pearl millet, Pennisetum typhoides.

Bajra-napier hybrid = Pennisetum purpureum crossed with P. typhoides.

Barani (rainfed) = land dependent on rainfall.

Bermudagrass = a subtropical, perennial grass. Cynodon dactylon.

Berseem-Egyptian clover = Trifolium alexandrinum, a winter annual legume.

Bhusa = wheat or rice straw.

Buffelgrass = Cenchrus ciliaris.

Bund = Embankment for holding water.

Dofasli (dosal) = a rotation of fields.

Elephantgrass = a tall growing, perennial, tropical grass. Pennisetum purpureum.

Elephantgrass-Napier, a variety of above.

Gram-chickpea = a pulse - Cicer arietinum.

Guara-Guar-field vetch = Cyamopsis psoralioides.

Guineagrass = a tropical perennial grass, Panicum maximum.

Jowar = sorghum for forage or grain - Sorghum bicolor.

Kharif = summer cropping season.

Lucerne-alfalfa = Medicago sativa.

Maize-corn = Zea mays.

Maund = 82.28 pounds.

Pulses = legume seeds such as peas, beans, gram, lentils used for food.

Rabi = winter cropping season.

Sadabar = Sorghum-Sudangrass hybrid.

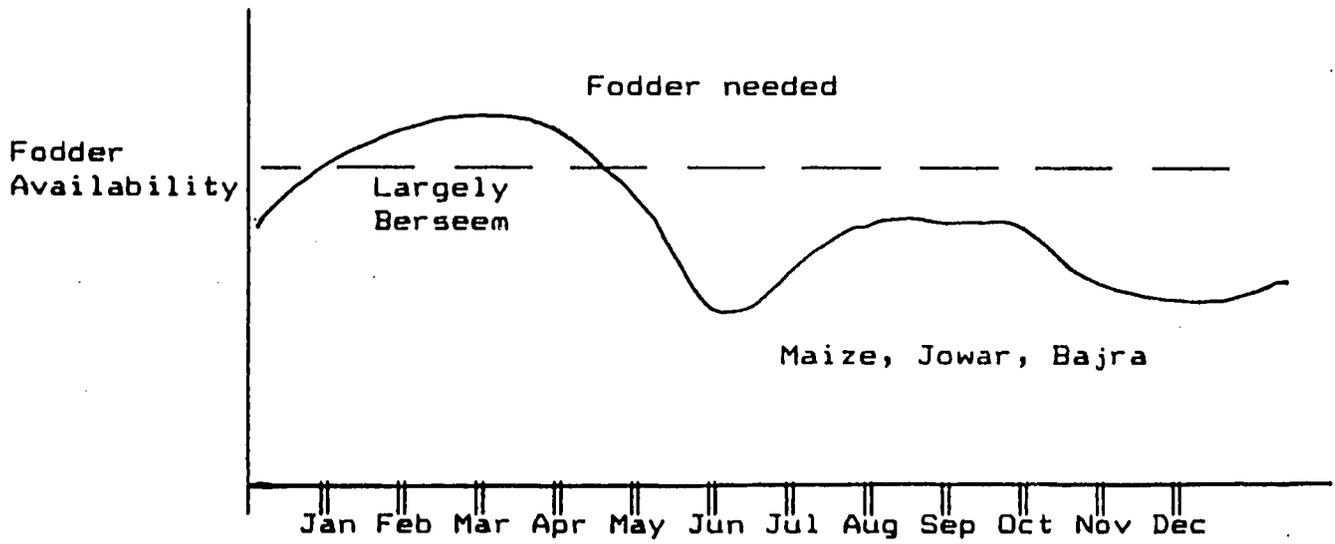
Sarson = oilseed Brassica campestris.

Senji-Indian clover = a summer annual legume.
Melilotus parviflora.

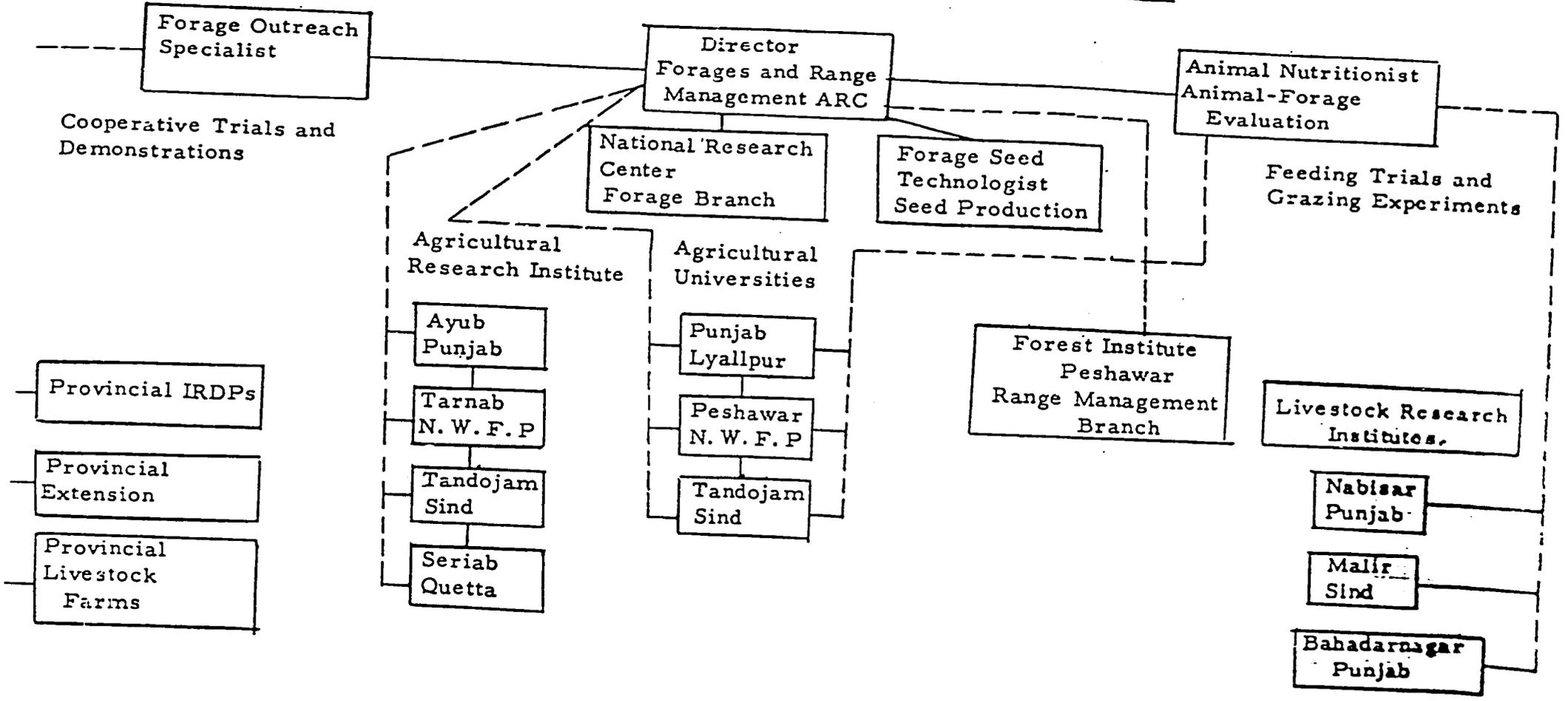
Shaftal-Persian clover = a winter annual legume -
trifolium resupinatum.

FORAGE SUPPLY

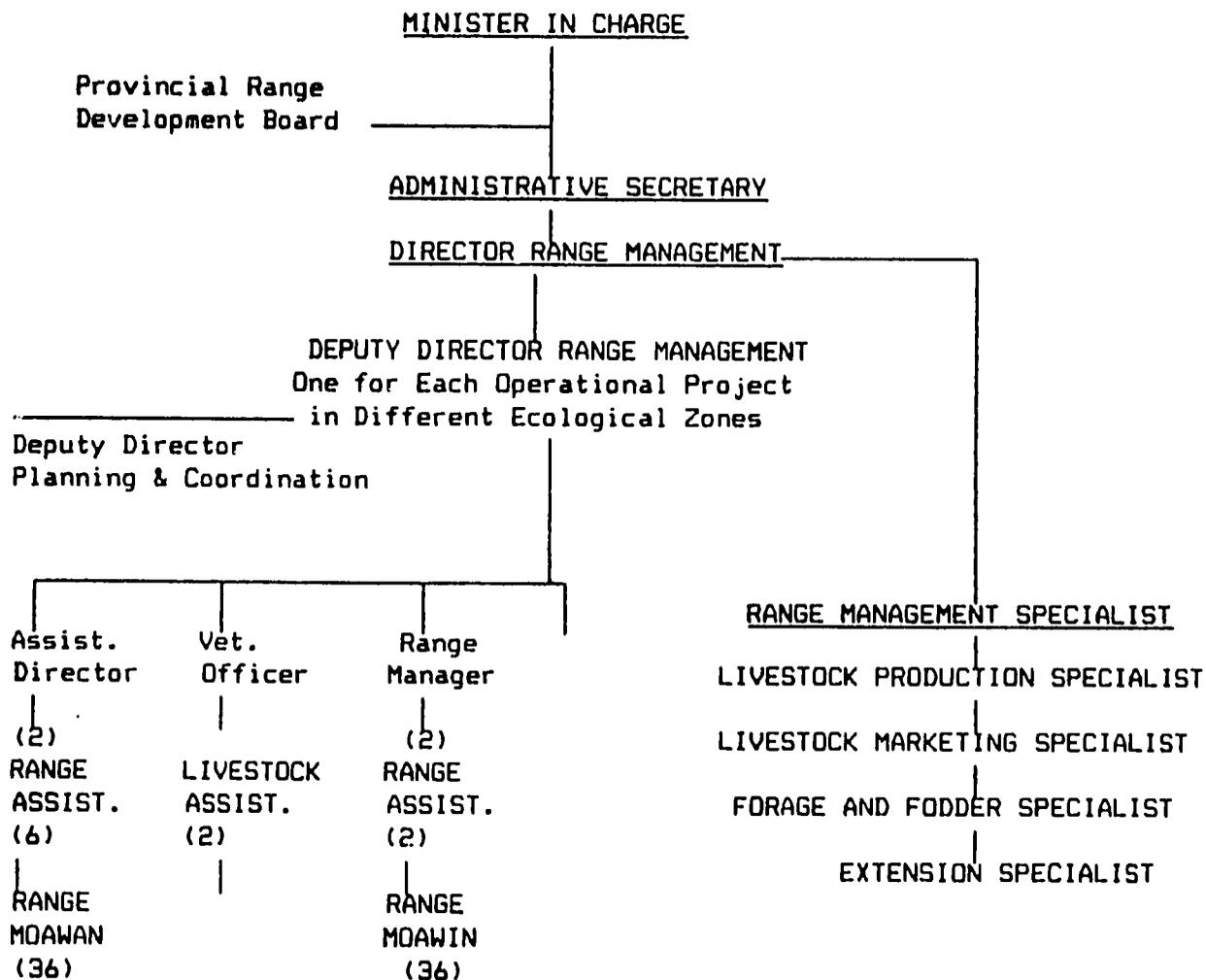
Animal Fodder from the major "Kharif" and "Rabi" crops



Coordination and Organization of Fodder Research in Pakistan



* A Recommended Provincial Range Management Agency
 by Dr. Sultan Maqsood Khan - Pakistan Forest Institute



TIPAN

24 March 1987

a project of
NWFP Agricultural University
University of Illinois at Urbana-Champaign
Southern Illinois University at Carbondale

APPENDIX II
TIPAN FIELD OFFICE
NWFP Agricultural University
Peshawar, Pakistan
Project Office : 41136
Telex : 52399 USAID PK

MEMORANDUM

TO : Prof. Mohammad Karim Khan, Dean, Plant Sciences
Prof. Mir Hatam, Chairman, Agron. Dept.

FROM : Prof. H.L. Portz *H.L. Portz*
Forage Production Specialist

SUBJECT : Proposed scope of work and other responsibilities

Attached are several items concerning my TDY at your University. I regret we did not have more discussion on this matter when I first arrived - although I did meet with you and Mohammad Karim in the first week.

The scope of work noted in the two REQUESTS FOR SHORT-TERM TECHNICAL ASSISTANCE were quite detailed so I proceeded with matters at hand. In addition, in meetings with V.C. Khattak and Maurice Fleming, they requested early action on No.5 in the Revised Jan.12,1987 PROPOSED SCOPE OF WORK. Also the V.C. noted the following:

"Minimum Expectations from Dr. Portz
Setup for Fodder and Forages Research to be established
i. at Campus
ii. at Research Institutes and Stations
a. all?
b. some (which)?
How many persons?
Provision for advanced education?"

To carry out these responsibilities, I had hoped to work closely with Pakistani counterparts as well as with Joe Marion.

Item 1. I have met several times with Shad Khan. The minimum syllabus and no outline or textbook assignments used in the first Forage Production course were inadequate and disappointing. In discussion of the Fibre & Fodder course it appears unacceptable for a 2nd course to attract Animal Science Majors or meet with needs of Agronomy Majors interested in Forage Utilization. Hence the request to have a cooperatively taught course with an Animal Science Professor. This also follows Dr. Howard Olson's recommendation in his consultant report - Note his remarks on Forage Program enclosed.

Item 2. Establishment of a "living field lab" and design a forage research program at the farm. Mr. Mohammad Sherin was specifically sent to the U.S. to observe the operation and management of University Research Centers (Farm or Expt. Stations). I provided him with 26 samples of different grasses and legumes (and have brought more with me) to establish the "living field lab" and have additional seed for research purposes (for the Farm Center and outlying Stations). Subsequently, Mr. Sherin

Cont'd.

MEMORANDUM
Prof. Khan &
Prof. Hatam
Cont.

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appears to have elected to go with IDS. Mr. Muslim Shah was suggested as the forage researcher for the outlying stations by Joe Marion and Dr. Olson since he is presently doing forage & fodder research at Tarnab. Who will carry on the forage research at Malakandar Farm?

Item 3. Work with staff at livestock stations - I have met with Dr. Mohammad Jan, Director of An. Husbandry at the Veterinary Institute and visited Surezai & Horichand as well as the several research stations to the south (D.I.Khan, Serai Naurang, etc.) and am scheduled for Jaba Sheep Farm on Thursday, Friday of this next week. Muslim Shah has been my guide, interpreter etc, on these visits.

Item 4,5. I will present a faculty seminar on forage research and forage production as per your request.

Item 4. Assist in the development of linkages with forestry or other agencies responsible for range management - (Part of initial request). I have met once with a Forest Institute Staff member and will meet with Dr. Sultan Maqsood Khan on Monday. He will help identify some native range grasses I have collected and will discuss the range (forage) grasses he has planted at the Jaba Sheep Farm. I also visited at NARC on 10 March and met a number of researchers such as Dr. Noor Mohammad. Note NATIONAL FORAGE AND PASTURE PROGRAMME.

Item 5. (Revised Jan 12, 1987) A full recommendation has been submitted to the V.C. and the TIPAN Director Dr. Cragle. Mr. Afridi and Baz Mohammad will be carrying out the sodding of the new football field and seeding of the other athletic field as well as a turfgrass nursery.

Detailed recommendations are being formulated (hopefully with as much help as I can get from your NWFP faculty and other forage-interested individuals in An.Science, Forestry, Plant Breeding and PARC). I am available in Rm. 29 - please, see or call me to arrange any meeting you would like - i.e. with An. Science faculty - Mr.Fazam etc. Your help will be appreciated.

cc. Dr. Ray Cragle, TIPAN
Dr. Khattak, V.C.NWFP-AU

Encls.

/ama

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24 March 1987

MEMORANDUM

TO : Dr. G.M.Khattak
 Vice Chancellor, A.U.

Dr. R.G. Cragle
 Interim Team Leader, TIPAN

Mr. Maurice Fleming
 USAID, TIPAN Project Officer

FROM : H.L. Portz
 Forage and Turfgrass Specialist
 TIPAN

Re: Report on Proposed Scope of Work
 Item 5. Assist A & E Contractor in selecting turf
 species for playing fields and campus grounds.
 Appraise present turf---recommendations for other
 spp ----.

I. Introduction

A. Present species at AUP, Peshawar lawns, army soccer fields & local golf course.

1. Primarily Bermudagrass; a fine-textured common-type found everywhere, quite poor density from heavy wear, close cutting and little or no fertilizer, poor shade tolerance and cut frequently for livestock feed. Bermudagrass is very good in drought, heat and wear tolerance with some winter dormancy.

2. Other Grass Species; some buffelgrass and other coarse native grasses, considerable annual bluegrass, especially in the shade and where irrigated and also predominate in the winter season. Probably will die out in hot summer.

3. Broadleaf or Other Weeds; Oxalis (esp. in the shade), dandelion, annual lucerne (similar to Black Medic. in U.S. but a different species) chickweed, and some yellow nutsedge in low, wet areas.

B. Present Status of New Playing Fields

1. Two fields; one for soccer (football) and one for field hockey, have been roughly formed.

2. Size of both are limited due to expected proximity of hostel buildings, guest housing and roads. Would be preferable to extend width of fields so goals could be moved to one side, then the other to minimize wear, etc.

10. Start mowing at 3 to 4 cm. at no lower than 2.5 cm.
11. Use herbicide if available - Surflan or equivalent.
12. Use N several times in summer/fall.

C. Seeding of Second Field

1. Land preparation, leveling, etc, as A1-3.
2. Seed annual or perennial ryegrass at (66 lbs/1000 sq.ft)
250 kg/ha.
3. Mow at 3 to 3.5 cm. - use N fertilizer.
4. Later (next year) plug in zoysiagrass at about 15-20 cm.
on center.

III Establishment of a Turfgrass Nursery for Testing of Selected
Bermudagrass and other Turfgrass/Forage Species for Lawn and
Playing Fields.

A. Selected Species

1. Bermudagrass (Cynodon dactylon) More vigorous local selections
or/import Veg. 'Midwest', 'Tufcote' 'Tifgreen', 'Midland' a forage
species, Seeded cultivators; 'Ariz.Com.' Guymon (limited supply).

** As noted earlier, bermudagrass has proven to be very adaptable to
most areas in Pakistan and is very wear tolerant and has vigorous
growth if well fertilized.

2. Bahiagrass (Paspalum notatum) 'Pensacola' Medium texture with
short, stout rhizomes forming a dense sod. More productive than
common bermudagrass (clippings or grazing). Good wear tolerance,
some winter dormancy. Seed availability good.

3. Zoysiagrass (Zoysia japonica) 'Korean Common' Medium to coarse
texture, vigorous and productive but not as palatable as 1 and 2.
Good shade tolerance, fair drought tolerance, excellent heat
tolerance. Forms a dense turf and may hold green color all winter
if N is used in late fall. Must buy NaOH - treated seed from
Korea or can harvest seed and treat locally (30% NaOH [lye] solution
for 25 min.) Can use for plugs later on ryegrass playing field.

4. Centipedegrass (Eremochloa ophiuroides) Medium texture,
grows on wide range of soils. Has lower nutritive value than
Bahiagrass. Needs more moisture and fertility than bahiagrass.

Cont'd.

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5. Buffalograss (Buchloe dactyloides) Fine textured, low growing and drought resistant, spreads by stolons to form a dense sod. It is adapted to soils with higher clay content and does not do well on sandy soils. Buffalograss is primarily dioecious, to break dormancy, soak seed in a 0.5% solution of KNO_3 for 24 hrs, followed by chilling at 5 C° for six hours.

6. Tall fescue (Festuca arundinacea) 'Falcon'. A medium-textured, cool season, bunch grass. This turf-type cultivar is more dense than Ky-31 (a field fescue). Will withstand somewhat closer cutting than Ky-31 but probably not under 4 cm. Is very good in drought tolerance and will remain green and productive all winter. Difficult to maintain full stand if overused.

C. Suggest Testing of Turfgrass/Forage Species in Nursery.

1. Establish plots of the six species (perhaps can locate a vigorous, medium-textured bermudagrass in Pakistan and use vegetative material and/or can use Arizona Common seed.
2. Can establish in late March or early April using good establishment practices and fertility.
3. Establish two blocks, irrigated and non-irrigated (barani) and three replications in each block if possible.
4. Minimum size 2x8 (or 12) meters. Can vary cutting height, frequency and fertility as subplots. See diagram of field layout and treatment variables.
5. Might consider addition of legumes!

D. Selection of Appropriate Turfgrass/Forage Species.

1. Based on performance as determined in C.
2. Based on availability and cost of seed.
3. Based on expected locations, use and maintenance level.
 - a. Irrigated or non-irrigated areas
 - b. Athletic fields-select more wear tolerant spp.
 - c. Clipping yields.
 - d. Maintenance level to be used.
 - e. Other criteria

E. Equipment needed

1. Mowers
 - a. Small hand reel mowers are available with baskets. Need one set for low and one for high cut for nursery.

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- b. For use on total area (athletic fields, lawn etc.) Should have a good John Deere triplex or equi. with baskets. Definitely order two so one can be under repair, sharpened, et al.

2. Fertilizer and Seed Spreader

- a. Small (3ft) drop spreader for initial expt. plus small areas around flower beds, bldgs, etc.
- b. Cyclone seeder for larger open areas.

3. Back lapper

4. Sod cutter

- a. Prefer 12" or 18" width, self-propelled sod cutter.
- b. Will attempt in-country construction.

F. Manpower

- 1. Trained gardener
- 2. Trained mechanic/driver
- 3. Laborers to weed, collect clippings, etc.

cc: Sirajuddin Afridi
Baz Mohammad

/ama

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6 April 1987

MEMORANDUM

TO : G.M. Khattak
 R.G. Cragle
 M.E. Fleming
 Baz Mohammad

FROM : H.L. Portz
 Forage and Turfgrass Specialist

SUBJECT : Selecting turf species for playing fields & campus grounds. Supplement to Memo 24 March 1987.

The specific area to be sodded with bermudagrass and for the turfgrass nursery was discussed with Baz Mohammad and Sports Director Ghulam Ahmad on 5 and 6 April. Joe Marion and I visited the Swiss Small Implement Project in Mardan to enlist their help in fabricating a sod cutter. Therefore the following additional recommendations are submitted:

1. Spray the football field with Roundup (glyphosate) to kill most of the broadleaf and grassy weeds. It should then be reworked, leveled, and prepared for sodding as per original memo.
2. The intended hockey field next to dormitory should be reworked and releveled for sodding. Use west end for turfgrass nursery. Note, after establishment, one side is to be irrigated as needed while the other side is to receive minimum irrigation.
3. Raise mowing height to at least 1" on all areas and a minimum of 1.5" on the present athletic fields, so bermudagrass can establish a better root system. Also this will give more competition to the weeds - therefore better weed control.
4. Baz Mohammad has indicated his willingness to monitor the turfgrass nursery.

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6 April 1987

Memorandum of Understanding
 Concerning Forage Sector and Muslim Shah

TO : Dr. Ray Cragle
 Dr. G.M. Khattak
 Dr. Iqbal Shah

FROM : Dr. H.L. Portz *H.L. Portz*
 TDY, TIPAN

SUBJECT : Forage Sector Designation

On 4 April, a presentation was made to the Vice Chancellor G.M. Khattak, Directors of the Research Stations and Dr. Cragle requesting a Forage Section be established.

At a short meeting held on 5 April with Dr's. Khattak, Cragle and Portz it was agreed that such a section be established at the NWFP AU with Muslim Shah as Leader (Director or whatever designation is appropriate) subject to approval of Dr. Iqbal Shah.

HLP:ama

FORAGE SPECIES FOR RESEARCH AND TEACHING IN NWFP

Botanical Name	Common Name(s)	Annual Bienn. Perenn.	Found in Pak.	Seed Sent -g-
<u>LEGUMES</u>				
<u>Coronilla varia</u>	Crownvetch	P		386
<u>Lespedeza cuneata</u>	Sericea lespedeza	P		sm#
<u>L. stipulacea</u>	Korean lespedeza	A	Y	sm
<u>Lotus corniculatus</u>	Birdsfoot trefoil	P		166
<u>Medicago arabica</u>	Burclover	A	Y	-
<u>M. dentaculata</u>	Annual Clover	A	Y	-
<u>M. falcata</u>	Alfalfa, Lucerne (yell.)	A	Y	-
<u>M. lanciniata</u>	?	A	Y	-
<u>M. lupulina</u>	Black medic	A	Y	-
<u>M. sativa</u>	Alfalfa, Lucerne (purple) (non-hardy) 'Lew', 'Masa Cera'	P		1095
<u>M. sativa/falcata</u>	Alfalfa, Lucerne (varieg.) (hardy) 'WL 300', 'WL 306'	P		1400
<u>M. truncata</u>	?	A/P	Y	-
<u>Melilotus alba</u>	Sweetclover (white)	B	Y	sm
<u>M. officinalis</u>	Sweetclover (yell.)	B	Y	454
<u>M. parviflora</u>	Indian clover	A	Y	-
<u>Trifolium alexandrinum</u>	Berseem	A	Y	-
<u>T. hydridum</u>	Alsike clover	P		sm
<u>T. incarnatum</u>	Crimson clover	P		sm
<u>T. pratense</u>	Red clover	P	Y	745
<u>T. repens</u>	White clover	P		sm
<u>T. repens (Tetraploid)</u>	Ladino clover	P		sm
<u>T. resupinatum</u>	Persian clover	A	Y	-
<u>T. semipilosum</u>	Kenya white clover	P	Y	-
<u>Vicia dasycarpa</u>	Vetch	A	Y	-
<u>V. sativa</u>	Common vetch	A	Y	-
<u>V. villosa</u>	Hairy vetch	A		186
<u>GRASSES</u>				
<u>Agropyrum cristatum</u>	Crested wheatgrass	P		-
<u>A. desertorum</u>	Crested wheatgrass	P	Y*	500
<u>A. smithi</u>	Western wheatgrass	P		sm
<u>A. ?</u>	Wheatgrass	P	Y	-
<u>Agrostis alba</u>	Redtop	P		sm
<u>Alopecurus myosuroides</u>	Foxtail	P	Y	-
<u>Andropogon sp</u>	Beardgrass, Bluestem	P	Y	-
<u>Aristida sp</u>	Three-awn grass	A/P	Y	-
<u>Astragalus sp</u>	?	?	Y	-
<u>Bouteloua gracilis</u>	Blue grama	PW	Y*	-
<u>Briza maxima</u>	Quaking grass	AW	Y	-
<u>Bromus inermis</u>	Smooth brome grass	P		108
<u>Buchloe dactyloides (T)</u>	Buffalograss	PW		1000
<u>Cenchrus ciliaris</u>	Buffelgrass	PW	Y*	-
<u>Chloris gayana</u>	Rhodesgrass	PW	Y*	-
<u>Chrysopogon aucheri</u>	Beardgrass, Saba	PW	Y*	-

Botanical Name	Common Name(s)	Annual Found Seed		
		Bienn. Peren.	in Pak.	Sent -g-
<u>Cynodon dactylon</u> (T)	Bermudagrass 'Ariz. Common'	PW	Y*	- 246
<u>Dactylis glomerata</u>	Orchardgrass, Cocksfoot	P		sm
<u>Digeteria decumbens</u>	Pangola digitgrass	PW	Y*	-
<u>D. sp</u>	Crabgrass, etc.	A/PW	Y	-
<u>Elymus junceus</u>	Russian wild rye	P	Y	-
<u>Eragrostis choromelas</u>	Boer lovegrass	PW		100
<u>E. lehmanniana</u> x <u>Trichophora</u>	Cohise lovegrass	PW		100
<u>E. lehmanniana</u>	Lehmann lovegrass	PW		100
<u>E. superba</u>	Lovegrass	PW	Y	-
<u>Eremochla ophiuroides</u> (T)	Centipedegrass	PW		280
<u>Festuca arundinacea</u>	Tall fescue 'Ky 31'	P		280
<u>F. arundinacea</u> (T)	Tall fescue 'Falcon'	P		400
<u>F. rubra var. rubra</u> (T)	Creeping red fescue	P		sm
<u>Lasuirus indicus</u>	Gorkha		Y	-
<u>Lolium multiflorum</u>	Italian/annual ryegrass	A	Y	580
<u>L. perenne</u> (T)	Perennial ryegrass 'Palmer'	P	Y	431
<u>Macroptilium atropurpureum</u>	Siratire	PW	Y*	-
<u>Myosuroides sp</u>	?		Y	-
<u>Panicum antidotale</u>	Blue panicgrass	PW	Y*	100
<u>P. maximum</u>	Guineagrass	PW	Y	-
<u>P. virgatum</u>	Switchgrass	PW		500
<u>Paspalum notatum</u> (T)	Bahiagrass, Kellargrass?	PW		280
<u>Pennesitum orientale</u>	Kazah (salt tol.)	PW	Y*	-
<u>P. purpureum</u>	Napier or Elephant grass	PW	Y*	-
<u>P. glaucum</u>	Pearl Millet, Bajra	AW	Y*	-
<u>P. ?</u>	Bajra/Napier Cross (BN)	PW	Y*	-
<u>Phalaris arundinacea</u>	Reed canarygrass	P		-
<u>Phleum pratense</u>	Timothy	P		437
<u>Poa alpina</u>	Alpine bluegrass	P	Y	-
<u>P. annua</u>	Annual bluegrass	A	Y	-
<u>P. pratensis</u> (T)	Kentucky bluegrass 'Georgetown'	-		- 325
<u>P. ?</u>	Others	A/P	Y	-
<u>Sorghum alnum</u>	Wild cane	PW	Y	-
<u>S. halapense</u>	Johnson grass	PW	Y	-
<u>Sporobolus airoides</u>	Alkali sacaton (salt tol.)	PW	Y	-
<u>Themeda quadrivalvis</u>	Kangaro grass, Loondar	PW		100
<u>Zoysia japonica</u> (T)	Zoysiagrass	PW		50

= 5 - 30 g.

* = Highly recommended and used in Pakistan.

(T) = Also for turfgrass can be clipped and fed to livestock or grazed.

W = Considered warm season species.

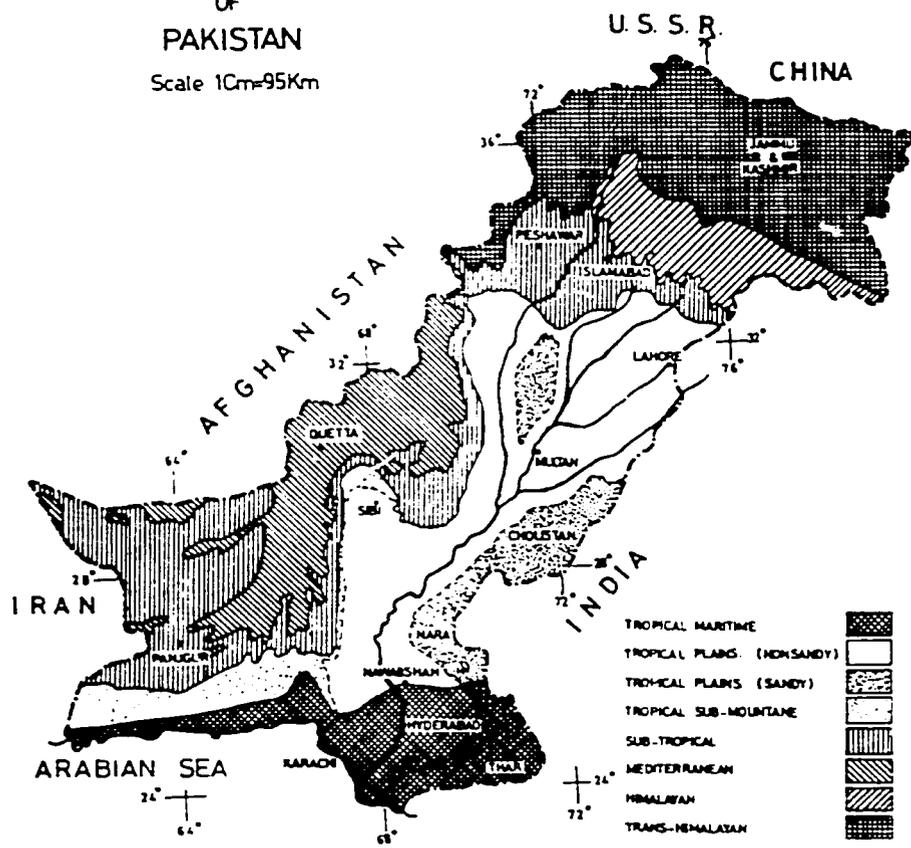
Botanical Name	Common Name(s)
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CEREALS AND OTHER SUMMER ANNUAL GRASSES
(food, fodder, and pasture)

<u>Avena sativa</u>	Oats
<u>Eleusine coracana</u>	Finger millet
<u>Echinochla crusgalli</u>	Japanese millet
<u>Hordeum vulgare</u>	Barley
<u>Pennisetum glaucum</u> (also <u>typhoides</u>)	Pearl millet
<u>Secale cereale</u>	Rye
<u>Setaria italica</u>	Italian/foxtail millet
<u>Sorghum bicolor</u> (also <u>vulgare</u>)	Sudangrass
<u>S. bicolor</u>	Sudax (sudan x F. sorghum)
<u>S. bicolor</u>	Forage and grain sorghum
<u>Triticum vulgare</u>	Common wheat
<u>T. aestivum</u>	Durum, Persian, etc.
<u>Triticum x Secale</u>	Triticale
<u>Zea mays</u>	Maize, corn

RANGE ECOLOGICAL REGIONS OF PAKISTAN

Scale 1Cm=95Km



SOURCE IQBAL (1974)

NATIONAL FORAGE AND PASTURE PROGRAMME

INTRODUCTION

Forages are the major source of feed for livestock in Pakistan and are produced on rangelands, permanent pastures, meadows and cultivated lands. Some 60 to 65 percent area of Pakistan is categorized as rangelands. At present, rangelands provide about 60 percent of the total requirement of feed for sheep and goats, about 40 percent for horses, donkeys, camels and only 5 percent for the cattle and buffaloes. In addition to serving as production base for livestock which provide meat and milk for human consumption and products such as hides and skins, wool, bones and manure, rangelands also provide fuel, building material, medicinal plants and habitat for wildlife. In the northern and north-western parts of the country, they constitute about 40 percent of watersheds which drain into a number of big dams of Tarbela and Mangla. Revegetation and management of watershed ranges is essential for checking soil erosion and production of good quality water for increasing life-span of these dams. About 48 million hectare of rangelands are located in the arid and semi-arid areas of the Punjab, Sind and Baluchistan provinces.

Because of over-grazing and unscientific use of the resource in the past, rangelands are producing only 10 to 50 percent of their potential. Rangelands, at present, are stocked with twice the number of animals that these areas can support. Therefore, it is necessary to manage this vast resource on scientific lines so that rangelands could be grazed by livestock on sustained basis without causing downward trend in the natural resources.

Recognizing the importance of forages, Pakistan Agricultural Research Council (PARC) initiated the cooperative research programme on Fodder and Forages in 1975 to achieve the following objectives:

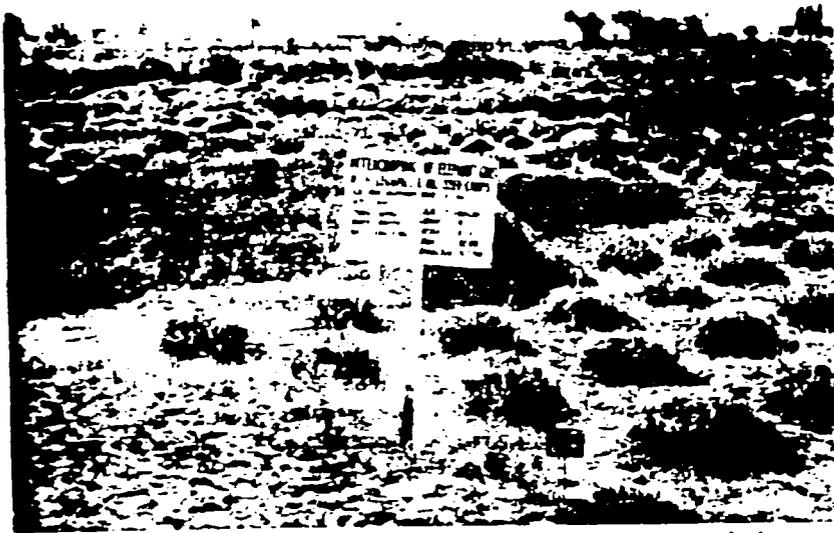
OBJECTIVES

- Collection and selection of forage germplasm adapted to different ecological conditions of Pakistan.
- Development of range improvement techniques and grazing systems suited to different range ecological zones.
- Evaluation of forage quality through bio-chemical analysis, feeding and digestion trials.
- Integration of improved forage and range technology into the economically viable farming systems.

PLAN OF WORK

- Forage germplasm evaluation under different ecological conditions.
- Uniform agronomic trials on the improved varieties of grasses and legumes.
- Ecophysiological studies on range plants.
- Test adaptation trials of shrubs and trees for fodder, fuel and soil improvement.
- Evaluation of nutritional value of forages.

- Establishment of pastures of selected grasses and legumes for simulated and/or animal grazing trials.
- Seed multiplication of promising forages and their distribution to farmers.



Grass-legume intercropping trial at NARC Forage and Pasture Block

SALIENT ACHIEVEMENTS

- Forage and pasture research units were established in all the provinces. Before initiation of this programme, only Pakistan Forest Institute (PFI) had a Range Research Unit.
- Out of more than 500 exotic and indigenous species introduced at different cooperating units, a few promising grasses and legumes have been selected for large-scale seeding in different range ecological zones (Table 1).
- Introduction trials of indigenous and exotic forage trees and shrubs have led to the selection of a few promising species for planting in different ecological zones (Table 2).
- Grazing trials with sheep and goats are being conducted at Lohibher, Thal (Punjab) and Dhabeji (Sind) range areas to select a suitable grazing system for these rangelands. Increase in forage production led to substantial weight gain in sheep and goats.
- Demonstration of improved forage varieties was conducted in major range areas of Pothwar, Thal, Tharparkar, Mastung, Jamrud and Neelam Valley.

At least 10000 ha were seeded with promising grasses and legumes by the Provincial Forest Departments.

- During past 10 years of the programme, training facilities were provided leading to four Ph.D, four M.S. and several short training courses in range management and forage production. A National Training Course on Range Management and Forage Production was organized at NARC in 1983, during which 35 professionals were trained.
- The programme is collaborating with ICARDA, Utah State University, CIMOD, ILCA and CIAT for exchange of germplasm, forage literature and short-term training.



Spineless cactus proved to be excellent forage for range livestock in the tropical arid rangelands of Dhabeji, Sind

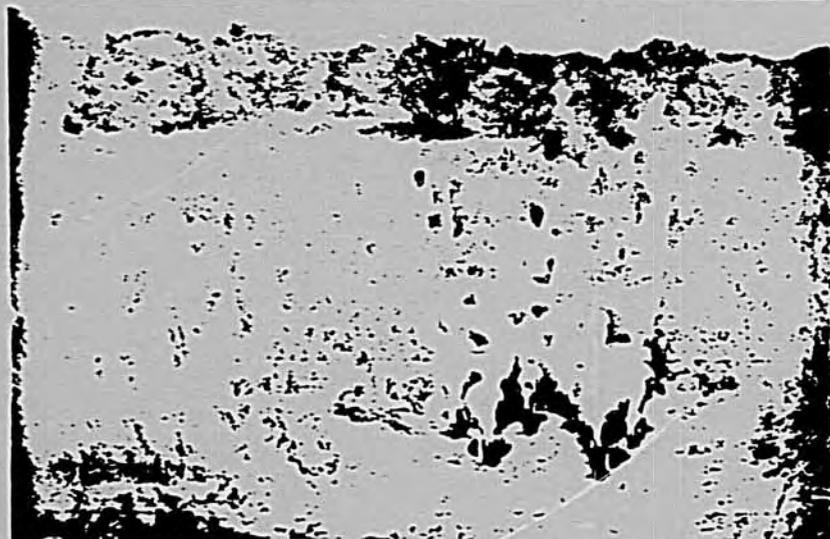
Table 1. Promising grasses and legumes

Range Ecological Zone	Recommended species	
	Common name	Technical name
Sub-alpine and temperate	Tall fescue	<i>Festuca arundinacea</i>
	Italian rye grass	<i>Lolium multiflorum</i>

-Continued

- Continued

	Lucerne	<i>Medicago sativa</i>
	Potarium	<i>Potarium sanguiserba</i>
Sub-tropical humid	Saba	<i>Chrysopogon aucheri</i>
	Rhodes grass	<i>Chloris gayana</i>
	Murglia	<i>Dicanthium annulatum</i>
	Siratro	<i>Macroptilium atropurpureum</i>
Sub-tropical sub-humid	Saba	<i>Chrysopogon aucheri</i>
	Blue panic	<i>Panicum antidotale</i>
	Buffel grass	<i>Cenchrus ciliaris</i>
	Elephant grass	<i>Pennisetum purpureum</i>
	Lucerne	<i>Medicago sativa</i>
Tropical and semi-arid desert plains	Buffel grass	<i>Cenchrus ciliaris</i>
	Gorkha	<i>Lasiurus sylvicus</i>
	Kazah	<i>Pennisetum orientale</i>
Mediterranean	Crested wheat grass	<i>Agropyron desertorum</i>
	Saba	<i>Chrysopogon aucheri</i>
	Russian wild rye	<i>Elymus pincus</i>



Sheep grazing in the improved pastures doubled weight-gains at Lohi Bher Range

Table 2. Suitable fodder trees and shrubs

Range Ecological Zone	Local name	Technical name
Sub-alpine and temperate	Indigo	<i>Indigofera gerardiana</i>
	Jamoi	<i>Prunus padus</i>
	—	<i>Fraxinus excelsior</i>
	Horse chestnut Oak	<i>Aesculus indica</i> <i>Quercus dilatata</i>
Sub-tropical humid	Grewia	<i>Grewia oppositifolia</i>
	Jamoi	<i>Prunus padus</i>
	Ain-ul Asl	<i>Robinia pseudoacacia</i>
Sub-tropical sub-humid	Phulai	<i>Acacia modesta</i>
	Carob	<i>Ceratonia siliqua</i>
	Ipil-Ipil	<i>Leucaena leucocephala</i>
	Kau	<i>Olea cuspidata</i>
	Ain-ul Asl	<i>Robinia pseudoacacia</i>
Arid and semi-arid desert plains	Kikar	<i>Acacia arabica</i>
	Phulai	<i>Acacia modesta</i>
	Khor	<i>Acacia senegal</i>
	Jand	<i>Prosopis cineraria</i>
	Lahura	<i>Tecoma undulata</i>
	Beri	<i>Ziziphus mauritania</i>
Mediterranean	Fourwing	<i>Atriplex canescens</i>
	Saltbush	<i>Pistacia khinjuk</i>
	Pistachio	



Love-grass has high potential for arid range lands



Kenyan Rhodes grass well suited to the subtropical subhumid Pothwar tract

RESEARCH STUDIES AT NARC

Title	Objective
Pasture germplasm evaluation.	To determine the germination capacity and growth responses of local as well as exotic forage species, including grasses and legumes under subtropical climate
Economic evaluation of agronomic trials such as fertilizer, seeding rate, clipping intensities and	To find out the economical dose of fertilizer, seed rate and proper clipping intensities for maximum forage production of <i>Cenchrus ciliaris</i> , <i>Chloris gayana</i> , <i>Panicum antidotale</i> and <i>Pennisetum purpureum</i>
Agronomic trials on mixture cropping: a) grass-legumes b) Winter forage legumes	To investigate economic returns of different tropical grasses when grown alone and in mixture with legumes
Establishment of demonstration plots	To demonstrate and highlight the performance of different grasses and legumes at farmers' fields

Title	Objectives
Biochemical analysis of forages	To determine the nutritive value of important range forages
Testing deferred rotation for sheep grazing in Pothwar	To evaluate performance of sheep under deferred rotation grazing system
Forage digestibility trials on sheep	To determine the percent retention of different forages by in-vivo digestibility trials on sheep
Forage preference and grazing behaviour of sheep and goats	To study the preference of sheep and goats for browse and grass species
Hay and silage making	i) To develop suitable techniques for making hay and silage of Elephant grass, Buffel grass and Blue panic ii) Nutritional quality of hay and silage

Title	Objectives
Impact of range improvement practices on sheep weight gain * Jaba	i) To raise sheep under optimum management on improved and developed range area. ii) To study and quantify the performance of animals raised and managed on improved range area with particular reference to unimproved area under similar conditions
Effect of sunlight direction on plant growth and forage yield	To find out suitable direction of line sowing for obtaining maximum yield of Elephant, Blue Panic and Buffel grasses
Effect of water stress on forage production *	To determine water requirement during seed germination and seedling establishment of Elephant, Blue panic and Buffel grasses
Salt tolerant range plants * sactor	To identify the adaptation characteristics of salt tolerant species in different rangelands of Pakistan
Biological nitrogen fixation in medics	To make diverse collections of <i>Medicago falcata</i> / <i>M. sativa</i> and their associated <i>Rhizobia</i> in rangelands and marginal cropland areas of Pakistan. To culture <i>Rhizobia</i> isolates from the diverse <i>Medicago falcata</i> / <i>M. sativa</i> collectiveness and nitrogen fixation activity of the <i>Medicago falcata</i> / <i>M. Sativa</i> collections and their associated <i>Rhizobium</i> states in comparison with <i>Rhizobium inoculi</i> commercially available for alfalfa. To increase the seed cultures of the most effective <i>Medicago falcata</i> / <i>M. sativa</i> and <i>Rhizobium</i> combination for testing on representative rangeland and marginal cropland areas in Pakistan

Title	Objectives
Development of range resource evaluation and utilization models for Pothwar,	i) To develop management model for major range-lands based on socio-ecological evaluation and utilization ii) To prepare range management plans for major range areas
Development of forage prediction models for i) Buffel grass ii) Blue panic and iii) Elephant grass in high rainfall Pothwar *	To predict forage yield of Buffel grass, Blue panic and Elephant grass using bio-climatic parameters
Develop techniques for biological, mechanical and chemical control of undesirable plants * mixtures	To evaluate the effect of different control methods to arrive at most economic techniques for control of undesirable plants
To determine impact of fire on species composition, forage yield and quality of native range plant	i) To determine whether new species appear in vegetation and how many old species disappear after burning ii) To see the effect of burning on palatability and forage production
To determine changes in species composition along altitudinal gradients	To determine the species response curves to the environmental gradient in Margalla hills
* Plants of rangelands	To prepare list of forage plants of all major range ecological zones of Pakistan with characteristics
Impact of sheep grazing on runoff, erosion and sedimentation control	To determine effect of different intensities of grazing on the quantity and quality of runoff and sediment flow

THRUSTS FOR FUTURE

- Selection of new species for saline and arid lands.
- Testing suitable grazing systems for major range ecological zones.
- Determining the economic feasibility of ranching in the high potential range areas.

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