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DEVELOPMENT OF
AN INTEGRATED MODEL FARM FOR
THE IMPROVEMENT OF SCRUB FORESTS
IN JHELUM DISTRICT

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Project Title ; Development of an Integrated
Model Farm for the Improvement
of Scrub Forests in Jhelum
District.

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FINAL TECHNICAL REPORT ON THE RESEARCH PROJECT
"DEVELOPMENT OF AN INTEGRATED MODEL FARM FOR
THE IMPROVEMENT OF SCRUB FORESTS IN JHELUM DISTRICT"

Summary

The Project titled "Development of an Integrated Model Farm for the Improvement of Scrub Forests in Jhelum District" commenced theoretically from July, 1986 and was supposed to end in December, 1987. But due to late release of funds and non-availability of suitable area, practically it was put into operation in January, 1987 and was closed on 31st October, 1987 due to non-availability of funds. Total area proposed in the project was 125 acres. Out of which 62.5 acres was reserved for Range experiments while the remaining 62.5 acres was allocated to Forestry experiments. Due to shortage of labour and time limitation only 16.5 acres area was tackled in spring planting with a view to take the remaining area in Monsoon season. Four experiments were laid out at Batali Dher Reserve Forest to test the survival and growth of different tree species using different mulching techniques, wetting agents, micro-catchment techniques and different doses of NPK. Five tree species were tested in these four experiments. Observations on the survival were recorded during the project period.

In addition to the above four experiments, seven range experiments were also laid out in June/July 1987 to test the effect of different seeding techniques,

spacings, seed rates, cultural practices, season of seeding, different doses of Nitrogenous and phosphatic fertilizers on the forage production of Cenchrus ciliaris, Sorghum almum and Medicago sativa. Moreover an experiment was also laid out to select suitable herbicide for the elimination of undesirable species from the natural grasses. But due to negligible rainfall and extra ordinary long hot season, very poor germination of the above species was observed. It was not possible to collect the data from Range experiments because there was no germination of grass seed worth the name. A project nursery was established near the project area at Dina. 32644 plants of various species were raised in the polythene tubes to meet the planting requirements of the project.

To estimate the population pressure of local people on the Scrub Forests in district Jhelum, a survey was conducted by interviewing 144 households. Considering two elements i.e. firewood and grazing of livestock as major factors affecting viability of forests, these were studied with few basic socio economic variables and their ultimate effect on adjoining forests was accounted. The survey indicated that out of the total population living around the Scrub Forests, 60% and 96% depend on forests upto varying degree for their needs of firewood and grazing of livestock respectively. Growing of multipurpose species in these forests for production of fuelwood and fodder can go a long way in improving the

socio-economic conditions of the people of the tract.

It has been concluded that under the site factors described later on it is not possible to grow the species like Dalbergia sissoo, Eucalyptus camaldulensis, Robinia pseudoacacia and Acacia nilotica under pure barani conditions depending upon the rainfall only or even with 2-4 artificial irrigations. It is also concluded that experimentation need to be done in Pothwar tract to determine the water requirements of different species for successful afforestation of such vast tracts.

Introduction

Geographically, Pakistan is not very favourably situated. Broadly it lies between 25° to 35° East latitude and 62.5° to 75° North longitude and forms one of the arid and semiarid zones of the world. Pakistan in general and the Pothwar tract in Punjab in particular is extremely poor in renewable natural resources. In the past, this tract was an abode and habitat for big animals like Elephants and Rhinoceros etc. This indicates not only thick and every green vegetative composition but also plain topography. Some geological upheavals and biotic disturbances brought about drastic changes. The original flora and fauna has almost become extinct. Due to accelerated erosion during past few centuries, the peak ridges have culminated in precipices.

The above mentioned geological and biotic factors are not conducive for vegetative improvement of the area under natural conditions and by conventional methods. The rehabilitation of wild lands of the tract can only be achieved by adopting latest techniques of regeneration of forest trees/fodder species, watershed management and principles of soil conservation. In the recent past, research organizations including, Pakistan Agricultural Research Council, Pakistan Forest Institute Peshawar, Punjab Forest Department have been conducting research and experimentation to tackle these problems with commendable achievements. These efforts were,

however, limited to small areas. The results were not tested under field conditions

Keeping in view the above situation, a project was proposed to start aiming at testing all those research findings and applying techniques on field scale level which were previously tested on a very small scale. The title of the project was proposed as "Development of an Integrated Model Farm for the Improvement of Scrub Forests in Jhelum District" with a view that it will cover all aspects of forestry, range and watershed. The objective was to establish a demonstration point for the people of the area for managing their lands. To achieve this objective, the following investigations were proposed.

- (i) Test and evolve techniques of dry afforestation.
 - a) Use of Micro-catchment techniques.
 - b) Testing various mulching techniques.
 - c) Testing various wetting agents.
 - d) Testing fertilization of plants with various doses of fertilizers.
- (ii) Testing various exotic species for energy and fodder production.
- (iii) Biomass studies on various species.
- (iv) To conduct land use and socio-economic survey with a view to review the present management practices and possible production of forage for livestock in the project area and to estimate the dependence of local population on the project area for their fuelwood and grazing needs.
- (v) Apply and test various techniques for regeneration of grasses, forbs, fodder, shrubs and legumes.
- (vi) Study the effect on forage production of fertilization and canopy opening.

- (vii) Improvement of range lands by eliminating the undesirable species by using herbicides.
- (viii) To evolve high yielding grass variety through method of selection.

Brief Background of Implementation of the Project

(i) Approval of the Project

The original project which was prepared and submitted to PARC and approved in 1985 was costing Rs. 16.01 lac over a period of 3 years. As per advice of PARC, its original title "Operational Research Project on Forestry, Range management and Watershed management for the Scrub Forests in Jhelum District", was changed to its present title of "Development of an Integrated Model Farm for the Improvement of Scrub Forests in Jhelum District" and it was split into two phases each of 18 months. The cost of 1st phase commencing from 1-7-1986 was 3.76 lac. The completion of formalities took some time and budget was released for the first quarter of the year during the last week of November, 1986.

(ii) Selection of site

While selecting the site for commencing the field work during November, 1986 it was found that the area which was suitable for the project and had been originally proposed in the scheme had been tackled to a considerable extent by the territorial staff under their normal afforestation programme and therefore, a new site had to be searched out. A site was selected by the Senior Research Officer in Jundiala Reserve Forest near Rohtass and earth work was started during December, 1986. It was jointly visited on 13-1-1987 by

Director (P&E) Mr. Manzoor Ali, World Bank Project Secretary and Director P.F.R.I and the site was rejected because it was too off the way. This team then selected a site in Batali Dher R.F, 7 K.M. away from Dina along G.T. Road towards Rawalpindi on the same day i.e. 13-1-1987.

(iii) Lay out of the Experiments

The field work for the lay out of the experiment according to the scheme provisions and experimental plans was started immediately on 14-1-1987. In spite of the shortage of labour and other difficulties and problems, the layout of the spring phase of the forestry experiments on 16.5 acres was completed by the end of February. As the target for Monsoon planting was high, earth work continued during April upto 1st week of July, 1987. The project was discussed by Director, P.F.R.I with Director (P&E) and Member Natural Resources at Islamabad on 6-7-1987 and it was decided to keep the experimental area to the minimum. Therefore, further earth work was stopped and Forestry experimentation area was reduced from 62.5 to 52 acres while for the Range experiments it was reduced from 62.5 to 30 acres only i.e. the area which had already been tackled upto 6th July, 1987. For the protection of experiments it was desired to fence the area by barbed wire and angle iron but due to non-availability of funds for this purpose a Chowkidar was employed on daily wages but with the passage of time it appeared that his presence was of no use from protection point of view. Then he was removed.

(iv) Hand watering of plants

For the watering of plants, Divisional Forest Officer Jhelum was requested verbally and also in writing to provide water tanker for irrigating the plants in the experimental area. In addition to this, efforts were also made to procure water tanker from Range Management Sub-Division Kharian but availability of water tanker from these two sources was very inadequate to meet experimental requirements because they had also got huge targets of afforestation of their own. Moreover there had been extra ordinary dry and hot long season this year which resulted in higher mortality of plants than what was normally expected.

(v) Constraints in Implementation

However, after waiting for proper rainy season to start, restocking of the failures in spring phase was also done in the Monsoon phase only on 13 acres in the last week of August. A water tanker was hired for the irrigation of these plants. Difficulties like, shortage of labour, protection of Research experimental plots and lack of suitable facilities for hand watering the plants, in conducting these experiments were further aggravated due to extra ordinary dry and hot summer season. Whatever data has been collected, has been analysed to draw some very valuable results. Although these results will not be applicable to normal years in the Pothwar tract but really useful conclusions have been drawn from this short period project.

FORESTRY EXPERIMENTS

Experiment No.1

Mulching techniques for dry afforestation.

An experiment was laid out during January, 1987 in split plot design to determine the effect of different mulches on the survival of Eucalyptus camaldulensis and Leucaena leucocephala for dry afforestation. Species were in main plots while the mulching techniques were in the sub-plots at random. The different mulches were plastic mulch, straw mulch and stone mulch. The experiment was laid out over 4 acres in four replication. Each replication had two plots, each of which was further split into four sub-plots. There were thus 8 sub-plots in each replication and each sub plot had 25 plants at 15'x15' spacing. Three mulches were used at random in three sub-plots for the comparison. For Monsoon planting 9 acres area was also planted in the month of August for the application of same mulching techniques.

Data for survival %age was collected two months, six months and nine months after planting. One watering was applied at the time of planting and two waterings were subsequently applied. 95% restocking was done in the month of August which was also immediately followed by watering. Tables I, II and III show the survival %age of the two species under various mulching techniques. The data indicated that generally Eucalyptus camaldulensis has low survival as compared to Leucaena leucocephala while plastic mulching showed better survival than stone and straw mulching.

Table - I

SURVIVAL PERCENTAGE UNDER DIFFERENT MULCHING TECHNIQUES

Number of plants alive per sub-plot

Treatment	R1		R2		R3		R4		Total	Average survival %age.	
	E	L	E	L	E	L	E	L		E	L
Plastic mulching	20	23	19	24	22	21	20	25	81	93	81% 93%
Straw mulching	19	22	16	19	19	23	18	24	72	88	72% 88%
Stone mulching	18	17	16	14	19	18	23	25	76	74	76% 74%
Control	19	21	16	14	15	20	15	25	65	65	65% 80%

Note :-

1. Number of plants in each sub-plot = 25
2. Planting done in January, 1987 and observations taken in March, 1987 (Two months after planting).
3. Only one watering was given at the time of planting.
4. Total rainfall during this period was 144 mm.
5. Minimum and maximum temperature during this period was 58 °C and 29.8 °C respectively.

E = Eucalyptus camaldulensis

L = Leucaena leucecephala

Table - II

SURVIVAL UNDER DIFFERENT MULCHING TECHNIQUES

Treatment	Number of plants alive per sub plot										Average survival %age.	
	R ₁	R ₂	R ₃	R ₄	Total							
Plastic mulching	E 3	L 4	E -	L 7	E 2	L 2	E 1	L 2	E 6	L 15	E 6%	L 15%
Straw mulching	2	-	5	2	-	-	-	-	7	2	7%	2%
Stone mulching	-	1	-	-	2	-	-	2	2	3	2%	3%
Control	1	-	-	4	-	2	-	1	1	7	1%	7%

Note :-

1. No. of plants in each sub-plot = 25
2. Planting done in January, 1987 and observations recorded in August, 1987 (Six months after planting)
3. One watering was given at the time of planting and two were subsequently applied.
4. Total rainfall during this period was 36.12 mm.
5. Minimum and maximum temperature during this period was 5.8C^o and 45.6C^o respectively.

E = Eucalyptus camaldulensis
 L = Leucaena leucocephala

Table - III

SURVIVAL UNDER DIFFERENT MULCHING TECHNIQUES

Treatment	Number of plants alive per sub-plot												Total	Average survival %age.	
	R ₁			R ₂			R ₃			R ₄				L	E
	E	L		E	L		E	L		E	L		E		
Plastic mulching	-	10	-	-	20	-	-	12	-	-	13	-	55	-	55%
Straw mulching	-	11	-	-	12	-	-	6	-	-	16	-	45	-	45%
Stone mulching	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note :-

1. No. of plants in each sub-plot (after restocking) = 25
2. Planting was done in January 1987, and nearly 95% mortality was restocked in August, 1987 and observations were recorded during November, 1987 (three months after fully restocking).
3. Only one watering was done at the time of planting/restocking.
4. Total rainfall upto November after 95% restocking was 286.4 mm.
5. Minimum and maximum temperature after restocking was 11.7 °C and 42.2 °C.

EXPERIMENT NO. II

Fertilization of plants with various doses of NPK

The experiment was proposed to be laid out in split plot design to determine the effect of different doses of NPK on the growth of Dalbergia sissoo and Eucalyptus camaldulensis during February, 1987. The experiment was replicated for four times. Each replication had two plots one for each species. No. of plants per plot was 88, planted at 15'x15' spacing. Fertilization was proposed to be done during Monsoon season after the establishment of roots of plants. One watering was given at the time of planting and two waterings were subsequently applied. 95% restocking was done in the month of August, 1987. One watering was also applied at the time of restocking. Due to dry Monsoon season it was not feasible to apply the NPK doses to the plants because there had been more than ninety percent mortality of plants.

Survival data of the two species was collected two months and six months after planting to study the performance of these species under such dry condition. When the experiment was visited nine months after planting almost all the plants had died due to hot climatic conditions, Tables IV and V show the survival %age of two species. Survival %age of Eucalyptus camaldulensis was higher than that of Dalbergia sissoo.

Table -IV

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SURVIVAL %AGE OF PLANTS

Treatments	No. of plants alive per plot				Average survival %age.
	R ₁	R ₂	R ₃	R ₄	
<u>Dalbergia</u> <u>sissoo</u>	77	64	68	55	75%
<u>Eucalyptus</u> <u>camaldulensis</u>	65	70	70	65	76.70%

Note :-

1. No. of plants in each plot =88
2. Planting was done in February, 1987 and observations were recorded in April, 1987 (Two months after planting)
3. One watering was given at the time of planting and one watering was subsequently applied.
4. Total rainfall during this period was 77.7 mm.
5. Minimum and maximum temperature during this period was 10°C and 39.4°C.

Table - V
SURVIVAL %AGE OF PLANTS

Treatment	No. of plants alive per plot				Average survival %age
	R ₁	R ₂	R ₃	R ₄	
<u>Dalbergia sissoo</u>	4	-	3	3	2.8%
<u>Eucalyptus camaldulensis</u>	8	2	9	2	6.0%

Note :-

1. No. of plants in each plot = 88
2. Planting was done in February, 1987 and observations were recorded in August, 1987 (Six months after planting)
3. One handwatering was given at the time of planting and two were subsequently applied.
4. Total rainfall during this period was 517.5 mm
5. Minimum and maximum temperature during this period was 10 C and 45.6 C respectively.

EXPERIMENT NO. III

Use of wetting agents for dry afforestation.

An experiment was laid out in split plot design to determine the effect of wetting agents like Alcosorb - AB₃ and Terra - sorb on the survival and establishment of Robinia pseudoacacia and Acacia nilotica during February, 1987. The tree species were in the main plots while doses of wetting agents were in the sub-plots.

The different doses of wetting agents tried were :-

- | | | | |
|----------------|---|----------------------------|-------------------------------|
| T ₁ | - | Alcosorb - AB ₃ | one gm/plant |
| T ₂ | - | Alcosorb- AB ₃ | 2 gms/plant |
| T ₃ | - | Alcosorb- AB ₃ | 3 gms/plant |
| T ₄ | - | Terra-sorb | 20 gms/plant |
| T ₅ | - | Terra-sorb | 25 gms/plant |
| T ₆ | - | Terra-sorb | 30 gms/plant |
| T ₇ | - | Control | no wetting agent was applied. |

The experiment was replicated for four times. Each replication was divided into two plots and each plot was further sub-divided into 7 sub-plots. In each sub-plot there were 12 plants at a spacing of 15x15 ft. Various treatments were randomly allocated to plots and sub-plots.

Method of application of wetting agents

In the first treatment T₁, one gram of Alcosorb AB₃ was mixed in one litre of water. After half an hour, this jel was applied in the hole of the pit where the plant was to be planted. Then the polythene tube of the plant was removed and the entire plant with the ball

of earth was placed in the hole, filled with the
jel. Then hole was filled up with earth. The same
method was used for various treatments of Alcosorb-
AB₃. In the fourth treatment T₄, Terra-sorb was used
in the dry form. 20 grams of Terra-sorb was taken
and it was mixed in ½ cft of dry soil, then it was used
as back-fill and the plant was irrigated. Same procedure
was adopted for other doses of Terra-sorb.

In the seventh treatment T₇, no wetting
agent was used which served as control. Single watering
was applied at the time of planting and later on no watering
was given.

Survival data was collected two months, six
months and nine months after planting. 100% restocking
was done during August, 1987 and was followed by watering.
Tables VI and VII show the survival %age of two species
under various doses of Alcosorb-AB₃ and Terra-sorb.
Acacia nilotica showed higher survival as compared to
Robinia pseudoacacia while 1 gm of alcosorb AB₃ and
20 grams of Terra-sorb showed the best survival.

Table - VI

SURVIVAL %AGE WITH VARIOUS WETTING AGENTS

Treatments	No. of plants alive per sub plot								Average survival %age.		
	R ₁	A	R	A	R ₂	A	R	A	Total	Average survival %age.	
T ₁	1	2	5	7	2	10	3	4	11	23	22.91%
T ₂	4	4	2	-	5	6	7	3	18	13	37.5%
T ₃	2	8	1	4	4	6	3	2	10	20	20.83%
T ₄	2	6	8	6	2	7	3	6	15	25	31.25%
T ₅	3	7	4	9	-	1	4	4	11	21	22.91%
T ₆	3	1	5	8	6	4	-	2	14	15	29.16%
T ₇	4	4	2	5	3	4	5	-	14	13	29.16%

Note :-

- T₁ 1 gms. Alcosorb AB3/plant
 - T₂ 2 " " " "
 - T₃ 3 " " " "
 - T₄ 20 gms Terra-sorb per plant
 - T₅ 25 " " " "
 - T₆ 30 " " " "
 - T₇ No wetting agent.
1. No. of plants in each sub-plots = 12
 2. Planting was done in February 1987 and observations recorded in April, 1987 (two month after planting)
 3. Only one watering was given at the time of planting
 4. Total rainfall during this period was 77.7 mm.
 5. Minimum and maximum temperature during this period was 10 C and 39.4 C.

R = Robinia pseudoacacia
 A = Acacia nilotica

Table - VII

SURVIVAL %AGE WITH VARIOUS WETTING AGENTS

Treatments	No. of plants alive per sub-plot								Average survival %age.	
	R ₁	R ₂	R ₃	R ₄	Total	R	A			
T ₁	6	-	7	3	-	-	16	-	33.3%	
T ₂	2	-	-	4	1	-	7	-	14.5%	
T ₃	2	-	5	1	3	-	11	-	22.91%	
T ₄	1	-	7	2	6	-	16	-	35.41%	
T ₅	4	-	1	6	-	-	11	-	22.91%	
T ₆	-	-	-	-	-	-	-	-	-	
T ₇	-	-	-	-	-	-	-	-	-	

Note :-

- T₁ = 1 gm Alcosorb Ab3/plant
- T₂ = 2 " " "
- T₃ = 3 " " "
- T₄ = 20 gms Terrasorb /plant
- T₅ = 25 " " "
- T₆ = 30 " " "
- T₇ = Control

1. No. of plants in each sub plot (after restocking = 12)
 2. Planting was done in Feb. 1987 and 100% restocking was done in Aug. 1987. Observations were recorded in Nov. 1987 (Three months after restocking)
 3. Single watering was applied at the time of planting/restocking.
 4. Total rainfall upto Nov. 1987 after restocking was 286.4 mm.
 5. Minimum and maximum temperature after restocking was 11.7°C and 42.2°C.
- R = Robinia pseudoacacia A = Acacia nilotica

EXPERIMENT NO. IV

Use of different micro-catchment techniques for dry afforestation.

The experiment was laid out in split plot design to determine the effect of different micro-catchment techniques on the survival of Eucalyptus camaldulensis and Leucaena leucocephala for dry afforestation during February, 1987. The species were in the main plots while the micro-catchment techniques were in the sub-plots. Each replication was divided into two plots and each plot was again sub-divided into three sub-plots. The three micro-catchment techniques studied are :-

- i) Simple pits with size $\left(\frac{2.5'+1.5'}{2} \times \frac{2.5'+1.5'}{2}\right)^2 \times 3.14 \times 1.5' = 4.71$ Cft
- ii) Trenches with size $4' \times \frac{1.5'+1'}{2} \times 1.5' = 7.5$ Cft
- iii) Trough with size $3' \times 3' \times \frac{2+1/2}{2} = 9$ Cft

These techniques were randomly allocated to various sub-plots. There were 28 pits/trenches/troughs per sub-plot at 15'x15' spacing. The experiment was replicated for four times. One watering was given at the time of planting, two were subsequently applied.

Survival data was collected two months, six months and nine months after planting. 92% restocking was done during August, 1987 which was followed by watering. Tables VIII, IX and X show the survival %age of the two species under various micro-catchment techniques. Very heavy mortality (92%) was the result of complete failure of monsoon rains. The data indicate that generally

Leucacena leucocephala had higher survival as compared to Eucalyptus camaldulensis while trench planting showed the best survival, second was the trough planting and pit planting was the poorest.

Table - VIII

SURVIVAL %AGE UNDER MICRO-CATCHMENT TECHNIQUES

Treatments	No. of plants alive in sub-plots												Average survival %age			
	R ₁			R ₂			R ₃			R ₄				Total		
	E	L	T	E	L	T	E	L	T	E	L	T	E	L	T	
Troughs	17	21	13	18	15	18	17	18	17	18	14	14	49	68	43.75%	60.71%
Trenches	18	16	20	16	16	22	16	16	16	70	71	62.50%	71	62.50%	63.39%	
Pits	15	19	9	18	12	17	13	14	14	49	68	43.75%	68	43.75%	60.71%	

Note :-

1. No. of plants in each sub-plot = 28
2. Planting was done in February, 1987 and observations were recorded in April, 1987 (two months after planting)
3. Only one watering was given at the time of planting.
4. Total rainfall during this period was 77.7 mm.
5. Minimum and maximum temperature during this period was 10 C° and 39.4 C°

E = Eucalyptus camaldulensis

L = Leucaena leucocephala

Table - IX

SURVIVAL %AGE UNDER MICRO-CATCHMENT TECHNIQUES

Treatments	No. of plants alive in sub-plots								Average survival %age.	
	R ₁	R ₂		R ₃		R ₄		Total	E	L
Troughs	E	L	E	L	E	L	E	L	E	L
	-	2	4	-	5	6	3	10	10	8.92%
Trenches	1	-	4	5	2	-	3	7	10	8.92%
	1	-	4	5	2	-	3	7	10	10.71%
Pits	2	5	-	-	6	-	-	8	5	7.14%
	2	5	-	-	6	-	-	8	5	4.46%

Note :-

1. No. of plants in each sub-plot = 28
2. Planting was done in February, 1987 and observations were recorded in August, 1987 (six months after planting).
3. One watering was given at the time of planting and two waterings were subsequently applied.
4. Total rainfall during this period was 517.50 mm.
5. Minimum and maximum temperature during this period was 10 C° and 45.6 C°.

E = Eucalyptus camaldulensis

L = Leucaena leucocephala

Table - I

SURVIVAL %AGE UNDER MICRO-CATCHMENT TECHNIQUES

No. of plants alive in sub-plots

Treatment	R ₁		R ₂		R ₃		R ₄		Total		Average survival %age.	
	E	L	E	L	E	L	E	L	E	L	E	L
Troughs	-	2	-	13	-	3	-	13	-	31	-	27.76%
Trenches	-	8	-	10	-	7	-	15	-	40	-	35.71%
Pits	-	10	-	6	-	12	-	-	-	28	-	25%

Note :-

1. No. of plants in each sub-plot = 28
2. Planting was done in February, 1987 and 92% restocking was done in August, 1987. Observations were recorded in November, 1987 (Three months after restocking).
3. Single watering was applied at the time of planting/restocking.
4. Total rainfall during this period was 42.6 mm.
5. Minimum and maximum temperature during this period was 11.7 C° and 42.2 C°

E = Eucalyptus camaldulensis
 L = Leucaena leucocephala

RANGE EXPERIMENTS

In order to develop and standardize the techniques for the improvement of range lands, seven studies were proposed. The site was selected in Girat Reserve Forest near Dina in Jhelum Forest Division. The detail of the experiments is as under :-

Experiment No.1

Seeding techniques for grasses.

An experiment was laid out in July, 1987 in split plot design to determine the best method of reseeding for the maximum yield of grasses viz; Cenchrus ciliaris and Medicago sativa. The two techniques of reseeding were broadcasting and line sowing (by drill). The experiment was laid out over 1.5 acres in three replications. Each replication was divided into two sub-plots. The species were in the main plots and the seeding techniques were in the sub-plots at random. The size of each sub-plot was 121'x45'. The soil was well prepared by tractor and various treatments were applied. The experiment remained under observation upto October, 1987. When it was visited to collect data, it was observed that due to very low rainfall the germination of the grasses was almost nil. No data worth statistical analysis could be collected.

Experiment No.2

Spacing between lines for sowing of grasses.

An experiment was laid out in July, 1987 in split plot design to determine the best spacing for line sowing to get maximum forage production. The two species Cenchrus ciliaris and Medicago sativa were used. The experiment was laid out over 1.5 acres in three replications. Each replication was divided into two plots. Each plot was further sub-divided into four sub-plots. Size of each sub-plot was 60.50'x45'. The species were in the main plots while the spacings of the lines were allocated to sub-plots at random. The four spacings tried were 20 cm, 30 cm, 40 cm and 50 cm between lines. Soil was well prepared by tractor before sowing of grasses. The experiment remained under observation upto October, 1987. It was noticed that due to very low rainfall and hot dry season, germination of grasses was very poor. No useful data could be collected for statistical analysis.

Experiment No.3

Season of seeding.

An experiment was laid out during June, 1987 in split plot design to select the best season of seeding for the maximum forage production. Two species used were Cenchrus ciliaris and Sorghum alnum. Two seasons to be tested were monsoon and spring. The experiment was laid out over 4 acres in 4 replications. Each replication was divided into two plots. Size of each plot was 110'x198'. The species of grasses were randomly allocated to the plots. Soil was prepared by tractor before

broadcasting the grasses. The experiment was maintained upto October, 1987. When it was visited to collect data, very poor germination was observed due to low rainfall. So no data was available to derive meaningful results.

Experiment No.4

Different seeding rates of grasses.

An experiment was laid out in July, 1987 in RCB design to select the optimum seed rate for the maximum production of forage. Different seed rates i.e. 2 kgs; 3 kgs; 4 kgs; and 5 kgs, per acre were used for Cenchrus ciliaris. The experiment was laid out over 6 acres in three replications. Each replication was divided into four plots. The size of each plot was 110'x198'. The four seed rates were used at random in the four plots in each replication. Soil was well prepared by tractor. The experiment remained under observation upto October, 1987. Due to low rainfall, the germination of the grass was so poor that it was impossible to collect data to derive meaningful results.

Experiment No.5

Cultural Practices for grass sowing.

An experiment was laid out in July, 1987 in split plot design to select the optimum number of ploughings for the maximum forage production using the two species Cenchrus ciliaris and Medicago sativa. The number of ploughings tried were 2, 3, 4 and 5. The experiment was carried out over 10 acres in five replications.

Each replication was divided into two plots. Then each plot was further sub-divided into four sub-plots. Size of each sub-plot was 110'x99'. The species were in the main plots while different number of ploughings were in the sub-plots at random. The soil was ploughed by cultivator. The experiment was maintained upto October, 1987. When it was visited in the month of October, very poor germination of grasses was observed due to low rainfall. It was impossible to collect data for statistical analysis.

Experiment No.6

Effect of different doses of N & P on the yield of grasses.

An experiment was laid out in July, 1987 in split plot design to determine the effect of different doses of N and P in combination and separately on the yield of two grass species i.e. Cenchrus ciliaris and Sorghum alnum. The experiment was carried out over four acres in four replications. Each replication was divided into two plots. Size of each sub-plot was 220'x11'. The grass species were in the main plots while the fertilizer doses were in the sub-plots at random. Different doses of fertilizer tried were as under :-

T1	-	N1	=	20 kgs/acre
T2	-	N2	=	40 kgs/acre
T3	-	P1	=	40 kgs/acre
T4	-	P2	=	80 kgs/acre
T5	-	P1+N1	=	40+20 kgs/acre

T6	=	P2+N1	=	80+20 kgs/acre
T7	=	N2+P1	=	40+40 kgs/acre
T8	=	N2+P2	=	40+80 kgs/acre
T9	=	Control	=	No fertilizer.

The soil was well prepared before sowing of grasses. The experiment remained under observation upto October, 1987. When it was visited in the month of October, very poor germination was observed due to very low rainfall. It was not possible to collect data for statistical analysis.

Experiment No.7

Selection of suitable herbicide for the elimination of undesirable species from the range lands.

An experiment was laid out in June, 1987 in split plot design to select a suitable herbicide for the elimination of undesirable species from the range lands. The two species used were Cenchrus ciliaris and Sorghum alnum while the proposed herbicides were 2-4D, Banvel-M, Dicuran-MA and Arelon. The experiment was laid out over three acres in four replications. Each replication was divided into two plots and each plot was further subdivided into 4 sub-plots. Size of each sub-plot was 90'x45.5'. The grass species were broadcasted in the main plots while the four herbicides were proposed to be used in the sub-plots at random after germination of grasses alongwith some undesirable plants. But unfortunately due to low rainfall in monsoon season, germination of

grasses was so poor that application of herbicides was considered to be a wastage and was therefore not done.

- (1) ... to determine the water requirements of different species for the successful afforestation of wasteland areas.
- (2) ... of each species in forest tract by artificial irrigation by hand watering will be also to be considered for consideration in large scale afforestation programs.
- (3) Large scale afforestation work in forest tract in the past under different development project should be surveyed, evaluated and conclusions should be drawn for the future. Probably some results of past afforestation work will also be ...

CONCLUSION

Inspite of lack of adequate facilities for proper experimentation and exceptionally unfavourable climatic conditions in this barani tract, very valuable results and conclusions have been obtained as under :-

- i) Experimentation need to be done in Pothwar tract to determine the water requirements of different species for the successful afforestation of such vast tracts.
- ii) Economics of such species in Pothwar tract by artificial irrigation by hand watering will have also to be calculated for consideration in large scale afforestation programme.
- iii) Large scale afforestation done in Pothwar tract in the past under different development projects should be surveyed, evaluated and conclusions should be drawn for the future. Probably such results of past afforestation would also be disappointing.
- iv) The dependence for firewood on the adjoining forests goes on increasing or decreasing with the decrease or increase in annual income of the people.
- v) The demand for firewood from forest area increases with the decrease in number of trees on agricultural farms and vice versa in the neighbouring areas.
- vi) As the family size increases, their dependence on jungle for firewood increases proportionately and vice versa.
- vii) The dependence for firewood on the neighbouring forests is in-versely proportional to the size of land holdings of farmers.

- viii) By studying livestock depending on forests for grazing in relation to size of holding, it was observed that with a decrease or increase in size of holding livestock units increase or decrease simultaneously.
- ix) It was concluded as a result of socio-economic survey of the project area that majority of the people have their dependence on forests for firewood and grazing of livestock.
- x) In mulching experiment the survival % of Leucaena leucorrhachis was much higher as compared to Eucalyptus camaldulensis and as far as the effect of mulching techniques is concerned, plastic mulching showed better survival % than other mulching systems. Monthly average rainfall of 77.86 mm with total four irrigations. Maximum and minimum temperature during the project period was 3.8 C° and 45.6 C°.
- xi) In case of different weeding agents, the two treatments i.e. one gram of alachlor 48% per plant and 20 grams of Paraquat per plant showed the best survival %age. In addition to this Leucaena leucorrhachis showed higher survival %age as compared to Eucalyptus camaldulensis under monthly average of 62.23 mm rainfall with total two hand watering. Minimum and maximum temperature during the project period was 3.8 C° and 45.6 C° respectively.
- xii) In case of different micro-plotting techniques, trench planting showed the best survival, second was the trough planting, and pit planting was the poorest. Leucaena leucorrhachis showed higher survival as compared to Eucalyptus camaldulensis under monthly average of 62.23 mm rainfall with total 4 hand waterings. Minimum and maximum temperature during the project period was 3.8 C° and 45.6 C° respectively.

- xiii) In case of fertilization of plants with NPK doses, no fertilizer was applied due to low rainfall and poor establishment of plants. However, survival %age of Eucalyptus camaldulensis was higher than that of Dalbergia sissoo under monthly average of 62.23 mm rainfall and with total 4 hand watering. Minimum and maximum temperature during the project period was 5.8 C^o and 45.6 C^o.
- xiv) Under the site factors described earlier, it is not possible to grow species like Dalbergia sissoo, Eucalyptus camaldulensis, Robina pseudoacacia and Acacia nilotica under pure narani conditions depending upon rainfall alone or even with 2-4 artificial irrigations.

AnnexureMETEOROLOGICAL DATA

Station : Jhelum

Period : 1987

Month	Mean Max. C°	Temperature			Rainfall	
		Daily Min:°C	Extremes		Mean total mm.	Heaviest fall in 24 hrs mm.
			Max. °C	Min: °C		
Jan.	21.1	5.7	24.7	3.6	5.8	2.5
Feb.	22.6	8.6	26.1	5.8	87.5	54.9
Mar.	25.3	13.8	29.8	10.0	56.5	16.5
Apr.	33.1	17.7	39	1.9	21.2	7.6
May.	32.2	20.4	41.7	3.6	77.8	20.0
Jun.	40.3	24.4	45.2	21.7	13.2	7.1
Jul;	39.1	26.2	45.6	21.6	105.0	37.0
Aug.	36.3	25.5	42.2	21.7	243.8	70.3
Sep.	36.2	24.1	28.9	19.0	20.8	14.7
Oct.	32.3	17.3	36.7	11.7	21.8	10.9
Nov.	29.5	8.9	9	4.8	0.0	0.0
Dec.	23.4	5.4	26.6	3.6	Trace	Trace