

## TREE GROWTH ON THE FARMLANDS OF THE PUNJAB

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### ABSTRACT

The farmlands of the Punjab have about 200 million trees of which 95% are in irrigated areas. The number of trees per ha is 16.9 for all areas; 18.7 in irrigated and 6.2 in un-irrigated areas. Shisham (42%), phulai (20%), kiker (11%), bakain (7%) and mango (6%) are the main species in irrigated areas. Ber (31%), phulai (20%), kiker (19%) and shisham (7%) are the predominant species in un-irrigated areas. Tree stock mostly consists of young trees. About 75% of all trees have diameter smaller than 24cm. The total estimated volume of growing stock is 46.6 million m<sup>3</sup> of which 44.1 million m<sup>3</sup> (95%) is in irrigated areas. The per ha volume of growing stock is 3.9 m<sup>3</sup> for all areas, 4.4 m<sup>3</sup> for irrigated areas and 1.4 m<sup>3</sup> for un-irrigated areas. The farmers felled about 14.8 million trees (7.4% of the total tree stock) and removed 9.4 million m<sup>3</sup> of wood (20% of the total growing stock) from their farmlands during 1990-91 for meeting their own requirements and for the purpose of sale. The stumpage value of annual wood removals from farmlands is estimated at 5.7 billion rupees. The tree stock is equivalent to 0.73 million ha of plantation forests.

### INTRODUCTION

Tree growth on farmlands is an

important source of timber and fire wood supplies in the country. It has been estimated that farmlands provide about 90% of firewood and 50% of timber supplies (Amjad *et al* 1992). Most of the wood based industries procure their raw material from trees grown on farmlands. In addition to meeting their own requirements, farmers have also started planting of trees for commercial purposes to supplement their incomes. However, this resource is scattered over vast area and is exclusively in private sector. As a result, information on its magnitude, species composition and location is lacking. This has hampered effective planning for the promotion of farm forestry in the country. It has also prevented optimum utilization of the resource and many promising investment opportunities in the wood based industries went unexploited. The contribution of forestry sector to G.D.P also could not be realistically assessed. In view of paramount importance of this data, the Pakistan Forest Institute launched a project (National Wood Resources Inventory) in 1989-90 to carry out a scientifically designed sample survey of tree growth on farmlands in all four provinces of the country. The main objective was to estimate the existing growing stock on farmlands by species and diameter and to develop estimates of annual wood removals from farmlands. A survey report of NWFP (Amjad, 1991) was published in 1991 and the data on tree growth



on farmlands of Punjab were collected in 1990-91 under the Project (Amjad, *et al* 1992). This article presents the main findings of the survey conducted in the Punjab under National Wood Resources and Forestry Planning and Development Projects.

## METHODOLOGY

A stratified random sampling scheme was used for the survey. The province was divided into two main blocks viz un-irrigated and irrigated cultivated areas. Then on the basis of climatic factors, each block was subdivided into 3 strata. Thus 6 strata were formed. Over all sampling intensity was set at 0.001 or 1 per 1000 farms. Thus total sample size was 2596 farms. As variation in data was greater in un-irrigated areas, the un-irrigated farms were sampled more intensively than the irrigated farms. Thus out of 2596 farms, 897 farms were in un-irrigated areas and 1699 farms in irrigated areas respectively. In case of

un-irrigated areas, the number of sampled farms were allocated to various strata in proportion to their cultivated areas. Against this, in irrigated areas, a separate sample was drawn for each stratum. The sample was selected through 3 stage sampling procedure. Depending upon the total number of tehsils and the required number of sampled farms, a number of tehsils were selected in each stratum and then from each selected tehsil, a number of villages were selected. In all 42 tehsils and 239 villages were selected. In each village 10 farms were selected at random using voters list. The data were collected using a questionnaire through enumerators who visited each sampled farm and counted all trees of 5cm and above and recorded their diameter. Volume of standing trees and trees felled was computed using the available volume tables. The delimitation of strata, number of sampled farms and cultivated area is given in Table 1 below (Anon, 1988; Anon, 1980).

Table 1. Delimitation of strata and number of sampled farms

Block/stratum	Administrative units	Cultivated area (million ha)	Total number of farms	Number of sampled farms
<u>un-irrigated block</u>		<u>1.718</u>	<u>437909</u>	<u>897</u>
Stratum I	Rawalpindi civil Division, Gujrat and Sialkot Districts of Gujranwala Civil Division	0.933	330397	468
Stratum II	Sargodha and D.G.Khan Civil Division	0.727	95693	368



Stratum III	Lahore ,Faisalabad,Multan and Bahawalpur Civil Divisions and Gujranwala District of Gujranwala Civil Division	0.058	11819	61
<u>Irrigated Block</u>		<u>10.116</u>	<u>2069862</u>	<u>1699</u>
Stratum IV	Rawalpindi Civil Division and Gujrat District of Gujranwala Civil Division	0.669	135749	434
Stratum V	Lahore ,Faisalabad ,Sargodha Civil Divisions, Sialkot and Gujranwala Districts of Gujranwala Civil Division	4829	912035	675
Stratum VI	Multan, Bahawalpur and D.G.Khan Civil Division	4.618	1022078	590
Grand Total		11.834	2507771	2596

## RESULTS AND DISCUSSION

**Tree Stock:** The total tree stock on the farmlands of the punjab is estimated at 200.33 million of which 189.69 million (95%) is in irrigated areas and the rest 10.64 million (5%) in un-irrigated areas. The per ha number of

trees is 16.93 for all areas; 6.19 for un-irrigated and 18.75 for irrigated areas respectively. The distribution of tree stock by strata is given in Table 2.

Table 2. Distribution of tree stock by strata

Block/Stratum	Total tree stock (million)	Percent	No of trees per ha
<u>Unirrigated Block</u>	<u>10.642</u>	<u>5.3</u>	<u>6.195</u>
Stratum I	7.897	3.9	8.464
Stratum II	2.571	1.3	3.536
Stratum III	0.174	0.1	3.005



<u>Irrigated Block</u>	<u>189.691</u>	<u>94.7</u>	<u>18.751</u>
Stratum IV	26.368	13.2	39.415
Stratum V	84.111	42.0	17.418
Stratum VI	79.212	39.5	17.153
Grand Total	200.333	100.00	16.928

The above table shows that about 95% of the tree stock occurs in irrigated areas. The availability of irrigation facilities is one of the major determinants of tree growth on farmlands. On the basis of per ha number of trees, irrigated farms have 3 time greater tree stock density as compared to the un-irrigated farms. The difference in number of trees per ha in un-irrigated strata is perhaps attributable to the difference in the rainfall (Anon, 1979) received in various strata. Against this, the difference in various strata of irrigated areas is probably due to the difference in the attitude of the farmers towards growing of trees and the extension programmes that are underway.

**Species Composition:** The species composition is significantly different between un-irrigated and irrigated areas. The main species in un-irrigated areas are ber, phulai, kikar, shisham, bakain and tamarix. These species account for 86% of the tree stock. In irrigated areas, the predominant species are shisham, kikar, bakain, mango, mulberry and ber. These species together account for 75% of the tree stock. The species composition is also different in various strata of un-irrigated and irrigated areas. Table 3 and 4 show the comparative species composition in different strata in un-irrigated and irrigated areas respectively.

Table 3. Species composition in different strata/zones of un-irrigated block

Species	Botanical Name	Stratum I (%)	Stratum II (%)	Stratum III (%)	Un-irrigated Block (%)
Ber	<i>Zizyphus jujuba</i>	29.4	38.5	15.2	31.4
Phulai	<i>Acacia modesta</i>	26.7	0.3	0.0	19.9
Kikar	<i>Acacia nilotica</i>	20.7	15.9	12.3	19.4
Shisham	<i>Dalbergia Sissoo</i>	7.8	4.2	45.9	7.5
Bakain	<i>Melia azadarach</i>	5.6	0.4	0.4	4.3
Mulberry	<i>Morus alba</i>	3.2	0.0	0.0	2.4
Eucalyptus	<i>Eucalyptus cammaldulensis</i>	1.9	0.0	0.0	1.4
Tamarix	<i>Tamarix articulata</i>	1.1	13.8	0.0	4.1
Fig	<i>Ficus palmata</i>	1.0	0.0	0.0	0.7
Poplar	<i>Populus spp</i>	0.9	0.1	0.0	0.7
Mango	<i>Mangifera indica</i>	0.8	0.0	0.0	0.6

Lasoorā	<i>Cordia myxa</i>	0.6	0.1	0.0	0.5
Jand	<i>Prosopis cineraria</i>	0.2	15.3	1.8	3.9
Mesquite	<i>Prosopis juliflora</i>	0.2	0.0	24.1	0.5
Karir	<i>Capparis decidua</i>	0.1	4.4	0.0	1.1
Salvadora	<i>Salvadora Oleoides</i>	0.0	3.87	0.0	0.9
Khajoor	<i>Phoenix sylvestris</i>	0.0	0.95	0.2	0.23
Neem	<i>Azadirachta indica</i>	0.0	0.15	0.2	0.04
Kao	<i>Olea cuspidata</i>	0.04	0.0	0.0	0.03
Amaltas	<i>Cassia fistula</i>	0.04	0.0	0.0	0.03
Siris	<i>Albizzia lebbek</i>	0.01	1.7	0.0	0.4
Ailanthus	<i>Ailanthus glandulosa</i>	0.0	0.3	0.0	0.07
Chinar	<i>Platanus orientalis</i>	0.0	0.02	0.02	0.01
Total		100.0	100.0	100.0	100.0
Tree stock (million)		7.897	2.571	0.174	10.642

Table 4. Comparative species composition in different strata/zones of irrigated block

Species	Botanical Name	Stratum IV (%)	Stratum V (%)	Stratum VI (%)	Irrigated Block (%)
Shisham	<i>Dalbergia sissoo</i>	11.8	45.1	49.1	42.1
Kikar	<i>Acacia nilotica</i>	5.5	18.8	18.9	11.0
Bakain	<i>Melia azadarach</i>	38.5	4.1	0.2	7.3
Mulberry	<i>Morus alba</i>	17.6	4.2	2.4	5.3
Ber	<i>Zizyphus jujuba</i>	9.1	4.6	1.9	4.1
Poplar	<i>Populus spp</i>	4.3	4.3	0.2	2.6
Eucalyptus	<i>Eucalyptus cammaldulensis</i>	8.1	0.8	1.8	2.2
Siris	<i>Albizzia lebbek</i>	1.1	1.3	4.4	2.5
Tamarix	<i>Tamarix articulata</i>	1.2	7.3	0.4	3.6
Willow	<i>Salix tetrasperma</i>	0.5	0.2	0.0	0.2
Fig	<i>Ficus palmata</i>	0.2	0.0	0.0	0.03
Mango	<i>Mangifera indica</i>	0.2	1.9	12.4	6.03
Phulai	<i>Acacia modesta</i>	0.7	0.01	0.01	0.1



Ailanthus	<i>Ailanthus glandulosa</i>	0.3	0.01	0.01	0.05
Lasoor	<i>Cordia myxa</i>	0.2	0.3	0.1	0.21
Semal	<i>Bombax malabaricum</i>	0.2	4.4	3.3	3.33
Pipal	<i>Ficus religiosa</i>	0.1	0.2	0.2	0.20
Jand	<i>Prosopis cineraria</i>	0.1	0.3	0.1	0.18
Jaman	<i>Eugenia jambolana</i>	0.04	0.8	0.4	0.51
Khajoor	<i>Phoenix sylvestris</i>	0.03	1.0	3.8	2.06
Kao	<i>Olea cuspidata</i>	0.02	0.0	Negligible	Negligible
Mesquite	<i>Prosopis juliflora</i>	0.0	0.2	0.0	0.07
Karir	<i>Capparis decidua</i>	0.0	0.01	0.02	0.03
Amaltas	<i>Cassia fistula</i>	0.0	0.01	0.0	Negligible
Tecoma	<i>Tecoma undulata</i>	0.0	0.04	0.2	0.10
Salvadora	<i>Salvadora oleoides</i>	0.0	0.06	0.0	0.03
Neem	<i>Azadirachta indica</i>	0.0	0.0	0.2	0.08
		100.00	100.00	100.00	100.00
Tree stock (million)		26.368	84.111	79.212	189.691

**Diameter distribution:** The tree stock is mostly concentrated in lower diameter classes. The first two diameter classes (5-24 cm) account for about 75% of tree stock in both the areas. The diameter classes of 5-14 and 15-25 cm account for

48% and 27% in un-irrigated areas and 41% and 36% in irrigated areas of the total tree stock respectively. The diameter distribution of tree stock is given in Table 5.

Table 5. Diameter distribution of tree stock

Diameter class (cm)	Stratum I (%)	Stratum II (%)	Stratum III (%)	Un-irrigated (%)	Stratum IV (%)	Stratum V (%)	Stratum VI (%)	Irrigated (%)
5-14	49.4	44.2	60.2	48.3	57.3	41.1	34.8	40.7
15-24	24.9	32.9	27.2	26.9	24.2	39.1	35.8	35.6
25-34	15.1	9.8	8.9	13.8	12.2	12.3	16.0	13.8
35-44	6.8	9.8	2.8	7.4	4.1	5.8	10.5	7.5
45 +	3.8	3.3	0.9	3.6	2.2	1.8	2.9	2.3



**Growing Stock:** The estimated volume of growing stock is 46.583 million m<sup>3</sup> of which 44.142 million m<sup>3</sup> (94.8%) is in irrigated areas and 2.441 million (5.2%) in un-irrigated areas. The per ha volume of growing stock is 3.936 m<sup>3</sup> for all area, 4.364 m<sup>3</sup> for irrigated areas and

1.421 m<sup>3</sup> for un-irrigated areas. It is highest (6.703 m<sup>3</sup>) in stratum IV and lowest (0.345 m<sup>3</sup>) in stratum III. The estimated volume of growing stock in various strata/zones is given in Table 6.

Table 6. Distribution of growing stock by strata/zones

Block/Stratum	Area (million ha)	Per ha volume(m <sup>3</sup> )	Total volume (million m <sup>3</sup> )	Percent
<u>Un-irrigated block</u>	<u>1718</u>	<u>1.421</u>	<u>2.441</u>	<u>5.24</u>
Stratum I	0.933	1.929	1.800	3.86
Stratum II	0.727	0.854	0.621	1.33
Stratum III	0.058	0.345	0.020	0.04
<u>Irrigated block</u>	<u>10.116</u>	<u>4.364</u>	<u>44.142</u>	<u>94.76</u>
Stratum IV	0.669	6.703	4.484	9.62
Stratum V	4.829	3.658	17.663	37.92
Stratum VI	4.618	4.763	21.995	47.22
All Areas	11.834	3.936	46.583	100.00

The growing stock mainly consists of shisham (35%), kikar (16%), mango (12%) khajoor 9%, mulberry and ber (5%) each. These species together account for 82% of the total growing stock. In un-irrigated areas, ber is the main species which accounts for 35% of the growing stock volume followed by kikar (28%),

phulai (11%) and shisham (8%). These species account for 82% of the growing stock. In irrigated areas, shisham (37%), kikar (15%), mango (12%), khajoor (10%) and mulberry (5%) are the main species accounting for 79% of the growing stock. The distribution of growing stock by species is given in Table 7.

Table 7. Distribution of growing stock by species

Sl. No.	Species	Un-irrigated areas (%)	Irrigated areas (%)	All areas (%)
1.	Shisham	7.45	36.77	35.23
2.	Kikar	28.45	15.00	15.71
3.	Mango	1.36	12.33	11.75
4.	Khajoor	1.03	9.76	9.30
5.	Mulberry	2.61	5.20	5.06
6.	Ber	34.68	3.71	5.34
7.	Siris	0.25	3.27	3.11
8.	Tamarix	1.70	3.83	3.72
9.	Bakain	1.30	2.74	2.66
10.	Semal	-	1.96	1.86
11.	Eucalyptus	0.34	1.28	1.23
12.	Poplar	0.58	1.23	1.20
13.	Jaman	-	1.15	1.09
14.	Tecoma	-	0.48	0.46
15.	Lasoor	0.73	0.46	0.48
16.	Phulai	10.94	0.05	0.62
17.	Pipal	-	0.30	0.34
18.	Salvadora	4.23	0.06	0.27
19.	Jand	2.84	0.14	0.28
20.	Fig	0.80	0.03	0.07
21.	Neem	0.12	0.06	0.06
22.	Willow	-	0.05	0.05
23.	Karir	0.40	0.01	0.04
24.	Ailanthus	0.04	0.04	0.04
25.	Mesquite	0.05	0.01	0.01
26.	Kao	0.1	0.08	0.01
27.	Chinar	-	-	-
Total		100.00	100.00	100.00



**Fellings:** The farmers fell trees to meet their requirements of fuel wood and small timber as well as for the purpose of sale to have extra income. The farmers in Punjab during 1990-91 felled about 14.792 million trees which work out to be 7.4% of total estimated tree stock of 200.333 million. The trees felled were 13.874 million in irrigated areas as compared to the 0.918 million in un-irrigated areas. Farmers removed 9.386 million m<sup>3</sup> of wood through felling of trees, of which 0.448 million m<sup>3</sup> was in un-irrigated areas and 8.938 million m<sup>3</sup> in

irrigated areas. The per ha number of trees felled is 1.250, 1.372 in irrigated areas and 0.535 in un-irrigated areas. The per ha volume removed is one third in un-irrigated areas as compared to the irrigated areas. This is attributable to the fewer trees felled per ha in un-irrigated areas. Per ha volume removed is highest in stratum VI (1.07 m<sup>3</sup>) which is due to predominance of large size trees felled in this stratum. The trees felled and volume removed in different strata is given in Table 8.

Table 8. Distribution of trees felled and volume removed by strata

Block/stratum	Area (million ha)	Total trees felled (million)	Trees felled per ha (Number)	Total Removed volume (million m <sup>3</sup> )	Volume removed per ha (m <sup>3</sup> )
<u>Un-irrigated block</u>	<u>1.718</u>	<u>0.918</u>	<u>0.535</u>	<u>0.448</u>	<u>0.26</u>
Stratum I	0.933	0.598	0.641	0.257	0.28
Stratum II	0.727	0.265	0.365	0.174	0.24
Stratum III	0.058	0.055	0.948	0.017	0.30
<u>Irrigated block</u>	<u>10.116</u>	<u>13.874</u>	<u>1.372</u>	<u>8.938</u>	<u>0.88</u>
Stratum IV	0.669	1.070	1.599	0.521	0.78
Stratum V	4.828	7.089	1.468	3.467	0.72
Stratum VI	4.618	5.715	1.238	4.950	1.07
All areas	11.834	14.792	1.250	9.386	0.79

The farmers felled about 14.8 million trees during 1990-91. The species composition indicates that shisham (53%) and kikar (20%) are the main trees which are felled in large number and both account for 73% of the total trees felled. Of the 13.9 million trees felled in irrigated areas, shisham accounted for 56%,

kikar 20%, poplar and tamrix 6% each. In un-irrigated areas, phulai accounted for 19%, tamrix, eucalyptus and ber 15% each, shisham and kikar 13% respectively. Shisham is the major species which accounts for 63.5% or 2/3 of all wood removal. The distribution of trees felled and volume removed by species is given in Table 9.



Table 9. Distribution of trees felled and volume removed by species

Species	Trees felled			Volume removed all areas	
	Un-irrigated areas (%)	Irrigated areas (%)	All areas (%)	(million m <sup>3</sup> )	(%)
Shisham	12.49	56.19	53.48	5.958	63.5
Kikar	13.48	20.35	19.93	1.415	15.1
Tamrix	15.49	5.80	6.40	0.275	2.9
Poplar	0.49	6.06	5.70	0.285	3.0
Bakain	1.89	3.34	3.25	0.119	1.3
Ber	14.46	1.20	2.03	0.194	2.1
Siris	0.07	2.40	3.25	0.390	4.1
Khajoor	-	1.56	1.40	0.189	2.0
Mango	-	1.33	1.25	0.282	3.0
Eucalyptus	15.30	0.06	1.00	0.063	0.7
Phulai	19.08	-	1.18	0.035	0.4
Mulberry	-	0.72	0.67	0.063	0.7
Semal	-	0.55	0.52	0.020	0.2
Jand	7.25	-	0.45	0.048	0.5
Jaman	-	0.35	0.33	0.029	0.3
Pipal	-	0.03	0.02	0.005	0.1
Lasoor	-	0.03	0.02	0.003	0.03
Willow	-	0.03	0.02	0.003	0.02
Total	100.00	100.00	100.00	9.375	100.00
No. of trees felled (million)	0.918	13.874	14.792		



**Stumpage Value:** The stumpage value of standing trees on farmlands varies with species, tree size, proximity of market and number of other factors. The total value of wood removed through

felling works out on the basis of conservative estimates to Rs. 5681 million of which shisham wood accounts for Rs. 4533 million (79%). The number of trees felled and their stumpage value by species is given in Table 10.

Table 10. Estimated stumpage value of wood removals

Species	Number of trees felled (million)	Volume removed (million m <sup>3</sup> )	Value (million Rs)
Shisham	7.910	5.958	4533.78
Kikar	2.948	1.415	679.20
Siris	0.333	0.390	126.80
Tamarix	0.946	0.275	67.42
Poplar	0.843	0.285	57.98
Mango	0.185	0.282	53.17
Ber	0.301	0.194	46.18
Bakain	0.480	0.119	25.14
Khajoor	0.218	0.189	23.71
Mulberry	0.099	0.063	16.81
Jand	0.067	0.048	16.25
Semal	0.076	0.020	9.93
Phulai	0.175	0.035	8.88
Eucalyptus	0.149	0.063	7.31
Jaman	0.049	0.029	6.95
Pipal	0.004	0.005	0.99
Willow	0.004	0.002	0.54
Lasoor	0.003	0.003	0.53
Total	14.79	9.375	5681.57



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## CONCLUSION

The farmlands of the Punjab carry a tree stock of about 200 million trees with the estimated volume of 46.6 million m<sup>3</sup>. Annual wood removal from farmlands is about 9.4 million m<sup>3</sup> which is roughly valued at 5.7 billion rupees. The tree growth on farmlands is equivalent to 0.73 million ha (Amjad, M. et al 1992) of plantation forests. There is a great potential for increasing tree growth on farmlands both in irrigated and un-irrigated areas. Given proper technical assistance and financial incentives, tree growth on farmlands can be increased manifold. Comprehensive and well conceived extension programmes can go a long way in ensuring participation of the farmers in tree growing.

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