THE PRESENT SITUATION AND THE FUTURE OF DRY OAK FOREST ZONE IN PAKISTAN

by

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Abstract. *By extending observations made on vegetation in Swat valley and on climate in Drosh, both lying in the dry oak forest zone, to other parts of Pakistan, actual biogeographical limits of the zone were determined. Dry oak forests were found to indicate mediterranean climate as elsewhere in the world. They, however, comprise of two sub-types in this country: the pure dry oak forests with true mediterranean climate and the dry oak-chir ecotonal forests with transitional mediterranean climate. Four plant communities have also been described in the zone.*

Introduction. Forests of *Quercus baloot* Griffith (dry oak forests, evergreen oak, ban oak, serai, banj, baloot, shah baloot), an extremely slow growing crooked tree, once occurred over a large area in Pakistan. They provided a watershed cover over the generally steep mountainous slopes and a habitat for big game, black mushrooms and some medicinal plants. They have, however, since been universally destroyed, by felling and lopping, to provide timber and fuelwood and to create cultivated land and rangelands, obliterating, particularly the lower limits and making it difficult to determine its biogeographical limits in the country. Whatever remains to-day occurs as a low scrub and only provides fuel and some forage.

With a view to provide informaion for greater timber and fruit production in this habitat in the country, as a case study, rapid survey of the status of dry oak forests and its climate in Swat was made to understand its real potential. Opportunity was also seized to stratify the landscape into isopotential land units as indicated by plant communities.

Occupying a considerable mountainous area, mostly on steep rocky slopes at 900-2550 m and roughly replacing the subtropical pine forests, beyond the effective reach of the south-west monsoons, as a type of dry temperate forest group, the dry oak forests of Champion et al. (1965) or Quercus ilex steppe forests of Schweinfurth (1957) occur in Hazara, Swat, Dir, Chitral, Parachinar, Neelam valley, Chilas (Northern Area) and nearly all the Afghan-bordering tribal area of N.W.F.P. Among the tree species in association with dry oak forests are found *Cedrus deodara*, *Pinus gerardiana*, *Juniperus excelsa*, and *Pinus wallichiana* in top canopy in the upper limits, *Fraxinus xanthoxyloides* and *Acer pentapomicum* throughout, and *Olea ferruginea*, *Reptonia buxifolia* and *Pinus roxburghii* (the last-named over most of the area now generally extinct) in the lower. In the flat riverain tract, too, occur remnants of *Populus-Salix* or *Populus-Alnus* forests.

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The forests are found on several types of rocks, granites, schists and limestones, and on a variety of generally stony soils-gravelly to stony sandy loams, gravelly sandy clay loams or clay loams.

Materials and Methods. Climate was analysed, using the pluviothermic quotient of Emberger (1952) and climagramme of Sauvage (1963). Vegetation was surveyed for the major tree species here and there in the main Swat and lateral valleys and studied in some detail in June and August, 1979, by laying a total of 20 sample plots of 200 m^2 each. The vegetation analysis was done following the system of Braun-Blanquet (1965). Life forms were determined after Raunkiaer (1934) and plant nomenclature after Stewart (1972).

Results. Results of the study on climate and vegetation are given below:

Climate. Climatic data is not available for any station in the dry oak zone of Swat valley. Lying in the same zone, in a rather drier North-western Kunar valley, Drosh (1413 m) is fairly representative of the area understudy. Climatic data of Drosh was, therefore, considered for the purpose. Mean monthly and other values of precipitation and temperature for a period of 40 years were employed for study of the bioclimate.

The mean annual rainfall of Drosh is 455 mm, most of which is received during the cold period. The westerly disturbances also bring some snow but it melts away soon. The mean values of annual precipitation do not reflect the variation from year to year which is of great consequence for the natural vegetation. The lowest annual rainfall recorded was 215 mm in 1905 and the highest 665 mm in 1931. The rainfall is rather un-evenly distributed over the year: spring 242.5 mm, autumn 105.0 mm, winter 57.5 mm and summer 50 mm. Such a pattern of rainfall is typically mediterranean (Beg, 1974).

Winters are long and cold, with frost. The mean monthly minimum temperature of the coldest month (m) and mean monthly maximum temperature of the hottest month (M) are the most important among the values of temperature. In Drosh, January is the coldest month and July the hottest. The mean monthly minimum temperature of the coldest month is —0.3 °C and mean monthly maximum temperature of the hottest is 35.9 °C. Annual thermic amplitude (M-m) is, therefore 36.2°C. According to Debrach (1953) climate with such a thermic amplitude is continental. Absolute values of minimum and maximum temperature are equally very important. Frost on one hand and high temperatures on the other are destructive for the plants The absolute minimum temperature was —12.2 °C. and absolute maximum 43.3 °C.

For precisely determining the climate of the area pluviothermic quotient of Emberger (1952) was worked out, using the climatic data mentioned above.

The pluviothermic quotient is given by the following formula:

$$Q_2 = \frac{2000\ P}{M_2 - m_2}$$

where P = mean annual rainfall in mm (455 mm)
M = mean monthly maximum of the hottest month in K° (309.1°)
m = mean monthly minimum of the coldest month in K° (272.8°)

$$\text{Drosh, } Q_2 = \frac{2000 \times 455}{(309.1)^2 - (272.8)^2} = 43.1$$

Thus for

As per climagramme, established by Sauvage (1963), based on quotients of Emberger, Drosh (with Q_2 = 43.1 and m = — 0.3° C) falls in the semiarid cold mediterranean climate with continental character and lies pretty close to Madrid (Spain).

As compared to Drosh, the climate of evergreen oak belt in Swat is rather more humid and even partly transitional mediterranean in the southern portion, as is expressed by the vegetation. The climate of the entire dry oak zone in Pakistan is, therefore, mediterranean as elsewhere in the world.

Vegetation. The upper limit of dry oak forest zone is not an issue which, in Swat valley, is at 2100 m. It is rather the lower limit which, being obliterated all over its biogeographical area in the country, is not clearly under-stood. The lower limit in Swat valley lies at 1000 m, if not still lower, as evidenced from the occurrence of two well-preserved dry oak forest patches in old graveyards on the Saidu Sharif-Murghuzar Road. One of them is an oak-olive forest with some *Acacia modesta* (phulai) and the other a pure dry oak forest with some scattered olive trees and a few shrubby plants of *phulai* in the lower storey and a solitary semi-mature chir pine in the top canopy. Just above this oak forest, on a rocky site, was seen to grow a low Monotheca scrub (Champion et al. 1965), thus putting together in the same zone, five dominant tree species, viz. *Quercus baloot*, *Olea ferruginea*, *Acacia modesta*, *Pinus roxburghii* and *Reptonia buxifolia.* On the opposite slope closeby was growing a pure forest of poor quality chir pine at 1100-1500 m, touching blue pine (*Pinus* wallichiana) above. In the Murghuzar blue pine forests, some trees of deodar (*Cedrus deodara*) of medium-poor quality, too, are reported to occur at the Ranzar Sar. Generally speaking over most of the main and the lateral valleys at lower altitudes, both the evergreen oak and the chir pine are extinct except for solitary specimens of the later in the Malam Jabba-Miadam-Madyan area, touching blue pine above at about 1500 m. While in the inner summer-dry high altitude portion of the main valley, beyond Madyan-Bahrain area, chir pine does not appear to penetrate, patches of pure dry oak forests still occur under protection upto 1500 m, touching deodar above. Thus Madyan-Bahrain area roughly marks the limit between the mediterranean and the transitional mediterranean belts. While no deodar is reported for Malam Jabba forests, some trees are said to grow in the Miandam forests. In the upper middle portion of the valley near Kedam at 1500 m, deodar makes its appearance in the upper limit of dry oak forests and increases in abundance higher up and north-wards upto Kalam and beyond. Not far from Ushu on the Kalam-Ushu Road at about 2100 m, suddenly again appears a large pure forest of evergeen oak.

From the above account it appears that as a climax formation, dry oak forests comprise of two subtypes-the inner drier high altitude type and the outer moister low altitude

type. The former is a pure dry oak forest, indicating true mediterranean climate, while the latter is a mixed oak-chir ecotonal forest, indicating transitional mediterrane an climate. Thus, the dry oak forests originally invariably had some element of chir pine in the lower altitudinal belt throughout their biogeographical range in the country.

On analysis of vegetation data of sample plots, the following four plant communities were recognised:

1. *Quercus baloot-Viola serpens community*. The plant community grows at high altitudes on steep slopes on granites on rather cool moist sites. Soils are deep, moist, non-calcareous sandy loams with a well-developed profile, intact B horizon, and a pH of 6.0—7.5.

The community is rich in species with a well-developed tree and herb layers and a poorly developed shrub layer. Grasses are poorly represented. (Table 1) The following is the biological spectrum:—

MM	=	3.6%	H	=	25.6%
M	=	3.6%	G	=	3.6%
N	=	14.3%	Th	=	46.6%
Ch	=	3.6%			

The community is rich in forbs and browse species and provides summer grazing to the livestock, sheep and goats. *Parrotia* and *Viola* indicate cool moist sites with deep soil. *Rumex nepalensis*, *Malva neglecta*, *Cannabis sativa*, *Urtica dioica* and *Chenopodium botrys* indicate heavy grazing and trampling in the habitat. Two medicinal plants, *Viola serpens* and *Dioscorea deltoidea* occur in the habitat, the latter being only feebly represented. Heavy grazing seems the cause of their scarcity. Also in consequence of heavy grazing and trampling, the regeneration, particularly of the climax species is typically lacking as was also reported by Khan (1978).

These deep moist rich soils are suitable for growing apples, apricots, peaches, Japanese persimon, sweet cherry and grapevines.

2. *Prunus prostrata-Quercus baloot community*. This plant community is found at high altitudes on moderate to steep slopes on granites on rather degraded sites. Soils are deep moist non-calcareous sandy loams with a well-developed profile but with a disturbed B horizon and a pH of 6.0 to 6.5.

The community is rich in species with a poorly developed tree and herb layers and a well-developed shrub layer. Grasses are poorly represented. (Table 2) The following is the biological spectrum:

MM	=	4.0%	Ch	=	8.0%
M	=	4.0%	G	=	4.0%
N	=	16.0%	Th	=	28.0%
H	=	36.0%			

Table 1

Quercus baloot-Viola serpens community

No. of quadrat	1	7	9	10	11	Pre-	Fre-	Cons-
Area (m^2)	200	200	200	200	200	sence	quency	tancy
Altitude (m)	1700	1700	1750	1750	1800		(%)	class
Aspect	N	S	NW	NE	SW			
Slope (%)	80	70	80	80	70			
Parent rock	granite	granite	granite	granite	granite			
HCl reaction	Nil	Nil	Nil	Nil	Nil			
Soil pH	6.5	6.0	7.5	7.5	7.5			
Vegetation Coverage(%)	80	70	80	90	80			
Total No. of species	12	19	14	18	16		L.F.I	
1st layer								
Quercus baloot	3	4	4	5	4	5	100	V	MM
Parrotia jacquemontiana	2	1	1	+	—	4	80	IV	M
2nd layer								
Idigofera heterantha	2	1	+	1	—	4	80	IV	N
Rosa ecae	+	1	—	+	—	3	60	III	N
Daphne oleoides	+	+	—	1	—	3	60	III	N
Prunus prostrata	—	+	+	1	—	3	60	III	N
3rd layer								
Viola serpens	4	4	3	4	5	5	100	V	H
Chenopodium botrys	2	1	1	+	—	4	80	IV	Th
Artemisia parviflora	—	+	1	—	1	4	80	IV	H
Rumex nepalensis	+	+	1	—	1	4	80	IV	Th
Sambucus wightiana	—	1	2	+	1	4	80	IV	H
Cannabis sativa	+	—	1	—	1	3	60	III	Th
Calamintha vulgare	1	+	—	—	+	3	60	III	H
Galium asperifolium	—	+	—	1	+	3	60	III	Th
Urtica dioica	—	1	+	1	—	3	60	III	Th
Impatiens bicolor	—	1	+	1	—	3	60	III	Th
Malva neglecta	+	—	1	—	+	3	60	III	Th

Andrachne cordifolia	+	1	—	—	+	3	60	III	H
Plectranthus rugosus	1	+	—	—	1	3	60	III	Ch
Lactuca serriola	+	+	—	—	1	3	60	III	Th
Phleum himalaicum	+	—	—	—	1	2	40	II	Th
Galium tenuisissimum	—	—	—	+	1	2	40	II	Th
Dioscorea deltoidea	—	—	—	+	1	2	40	II	G
Arabidopsis wallichii	+	—	—	+	—	2	40	II	Th
Taraxacum sp.	+	—	—	+	—	2	40	II	H
Plantago lanceolata	+	—	—	+	—	2	40	II	Th
Poa annua	—	+	—	—	+	2	40	II	Th
Trifolium repens	—	—	+	+	—	2	40	II	H

[1]) MM = Meso-and megaphanerophyte
M = Microphanerophyte
N = Nanophanerophyte
Ch = Chamaephyte
H = Hemicryptophyte
G = Geophyte
Th = Therophyte

Table 2

Prunus prostrata-Quercus baloot community

No of quadrat	22	25	30	35	40	Pre-	Fre-	Cons-	
Area (m^2)	200	200	200	200	200	sence	quency	tancy	
Altitude (m)	1800	1800	1800	1850	1850		(%)	class	
Aspect	W	N	SW	SE	NW				
Slope (%)	80	70	70	80	60				
Parent rock	granite	granite	granite	granite	granite				
HCl reaction	Nil	Nil	Nil	Nil	Nil				
Soil pH	6.0	6.5	6.0	6.0	6.0				
Vegetation coverage (%)	80	85	80	80	90				
Total No. of species	18	20	20	15	5			L.F.	
1st layer									
Quercus baloot	1	2	3	3	2	5	100	V	MM
Fraxinus xanthoxyloides	1	+	+	=	=	3	60	III	M
2nd layer									
Prunus prostrata	2	3	4	2	3	5	100	V	N
Daphne oleoides	+	1	+	1	—	4	80	IV	N
Astragalus grahamianus	+	1	1	+	—	4	80	IV	N
Jasminum officinale	—	1	+	1	—	3	60	III	N
3rd layer									
Cynodon dactylon	+	+	+	+	+	5	100	V	H
Oxytropis mollis	+	1	1	+	—	4	80	IV	H
Artemisia parviflora	1	+	—	1	—	3	60	III	Th
Viola serpens	—	1	+	+	—	3	60	III	H
Origanum vulgare	+	1	+	—	—	3	60	III	Ch
Verbascum thapsus	+	1	—	—	+	3	60	III	Th
Calamintha vulgare	+	—	+	+	—	3	60	III	H
Plectranthus rugosus	+	1	+	—	—	3	60	III	Ch
Polygonatum multiflorum	—	+	+	+	—	3	60	III	G
Malva neglecta	1	+	+	—	—	3	60	III	Th
Senecio sp.	+	—	+	+	—	3	60	III	Th
Oxalis corniculata	+	+	+	—	—	3	60	III	H
Polygonum paronychioides	+	—	+	+	—	3	60	III	Th
Thymus serpyllum	1	+	—	—	—	2	40	II	H
Bupleurum tenue	—	—	—	+	+	2	40	II	H
Duchesnea indica	—	+	+	—	—	2	40	II	H
Galium asperifolium	—	+	+	—	—	2	40	II	Th
Ranunculus muricatus	+	—	—	+	—	2	40	II	Th
Oryzopsis munroi	—	+	+	—	—	2	40	II	H

The oak is generally bushy as a result of browsing following cutting. The community is rich in forbs and browse species and provides some summer grazing to livestock, sheep and goats. Presence of *Thymus serpyllum* indicates degradation of the habitat by erosion, and of *Verbascum thapsus* and *Malva neglecta* heavy grazing. Because of grazing and trampling and degradation of the habitat, regeneration of the climax species is missing. There is just one medicinal plant, *Viola serpens* and, that too, feebly represented.

3. *Indigofera heterantha-Prunus prostrata community*. This plant community, too, grows at high altitudes on gentle slope on granites. Soils are deep, moist-wet, non-calcareous, sandy clay loams with eroded compact B horizon and a pH of 6.0-7.5.

The community is rich in species with a well-developed shrub layer and poorly developed tree and herb layers. Grasses are poorly represented. (Table 3). *Parrotia indicates* cool moist sites with deep soil. No medicinal plant is represented in this community. *Sorbaria tomentosa* indicates constant supply of seepage water to the habitat and *Chenopodium botrys* grazing in the area.

4. *Plectranthus rugosus community*. The plant community is found at relatively low altitudes on moderately steep slopes on granites on warm dry sites. Soils are dry non-calcareous shallow stony, excessively drained loamy sands with a poorly developed profile and a pH of 7.0-8.5.

Table 3

Indigofera heterantha-Prunus prostrata community

No. of quadrat	12	15	17	19	21	Pre-	Fre-	Con-	
Area (m^2)	200	200	200	200	200	sence	quency	stancy	
Altitude (m)	1760	1780	1790	2000	2200		(%)	class	
Aspect	S	N	NW	SW	NE				
Slope (%)	50	60	60	50	45				
Parent rock	granite	granite	granite	granite	granite				
HCl reaction	Nil	Nil	Nil	Nil	Nil				
Soil pH	7.5	7.0	6.5	6.0	7.0				
Vegetation Coverage (%)	70	80	90	70	80				
Total No. of species	26	17	16	24	17			L.F	
1st layer									
Parrotia jacquemontiana	1	+	—	1	1	4	80	IV	M
Quercus baloot	1	2	3	—	—	3	60	III	MM
Fraxinus xanthoxyloides	+	—	—	1	—	2	40	II	M

2nd layer									
Indigofera heterantha	4	4	4	5	4	5	100	V	N
Prunus prostrata	3	2	1	—	+	4	80	IV	M
Astragalus grahamianus	1	1	+	1	—	4	80	IV	N
3rd layer									
Impatiens bicolor	+	1	1	+	—	4	80	IV	Th
Artemisia parviflora	+	—	+	+	1	4	80	IV	Th
Salvia moorcroftiana	+	—	1	+	+	4	80	IV	Th
Sorbaria tomentosa	1	—	+	+	+	4	80	IV	Ch
Chenopodium botrys	+	—	1	+	+	4	80	IV	Th
Myosotis sp.	+	+	—	1	+	4	80	IV	Th
Atriplex tatarica	+	1	—	1	+	4	80	IV	Ch
Origanum vulgare	1	+	—	1	+	4	80	IV	Ch
Ajuga bracteosa	+	1	—	+	+	4	80	IV	Th
Lotus corniculatus	+	—	—	1	+	3	60	III	Th
Calamintha vulgare	+	—	—	+	1	3	60	III	Th
Geranium sp.	+	+	—	—	+	3	60	III	Th
Vicia sp.	+	1	+	—	—	3	60	III	Th
Minuartia sp.	+	—	+	+	—	3	60	III	Th
Youngia sp.	+	—	+	+	—	3	60	III	Th
Impatiens brachycentra	+	—	—	+	+	3	60	III	Th
Herniaria sp.	—	+	—	+	+	3	60	III	Th
Silene moorcroftiana	—	+	+	—	+	3	60	III	Th
Medicago minima	—	+	+	+	—	3	60	III	Th
Rumex hastatus	+	+	—	+	—	3	60	III	Th
Oxalis corniculata	+	—	+	+	—	3	60	III	H
Campanula colorata	+	—	—	+	—	2	40	II	Th
Oryzopsis munroi	+	—	+	—	—	2	40	II	H
Silene sp.	—	+	—	+	—	2	40	II	Th

Table 4

Plectranthus rugosus community

No. of quadrat	1	2	3	4	5	Pre-	Fre-	Con-	
Area (m^2)	200	200	200	200	200	sence	quency	stancy	
Altitude (m)	1500	1520	1360	1550	1360		(%)	class	
Aspect	SE	NW	W	NW	W				
Slope (%)	60	60	60	70	60				
Parent rock	granite	granite	granite	granite	granite				
HCl reaction	Ni	Nil	Nil	Nil	Nil				
Soil pH	7.0	7.0	7.0	7.5	8.5				
Vegetation coverage%	60	80	90	95	85				
Total No. of species	17	8	13	12	17				L.F.
1st layer									
Quercus ilex	1	1	—	—	1	3	60	III	MM
Fraxinus xanthoxyloides	—	—	—	—	1	1	20	I	M
2nd layer									
Prunus prostrata	+	1	1	+	1	5	100	V	N
Clematis sp.	+	—	—		—	2	40	II	N
Buddleia crispa	+	—	—	—	—	1	20	I	N
Cotoneaster nummularia	—	—	—	—	1	1	20	I	N
Rosa macrophylla	—	—	—	—	1	1	20	I	N
3rd layer									
Plectranthus rugosus	3	3	5	5	3	5	100	V	Ch
Andrachne cordifolia	+	+	+	+	+	5	100	V	Ch
Oxalis corniculata	+	+	+	+	+	5	100	V	H
Calamintha vulgare	+	+	+	+	+	5	100	V	H
Youngia japonica	+	+	+	+	+	5	100	V	Th
Origanum vulgare	+	+	1	—	1	4	80	IV	Ch
Arenaria serpyllifolia	+	—	+	—	+	3	60	III	Th
Filago spathulata	+	—	+	—	+	3	60	III	Th
Ajuga bracteosa	+	—	+	—	+	3	60	III	Th
Cynodon dactylon	+	—	+	—	+	3	60	III	H
Geranium rotundifolium	+	—	+	—	+	3	60	III	Th
Galium asperifolium	+	—	+	—	+	3	60	III	Th
Dioscorea deltoidea	+	—	—	+	—	2	40	II	G
Lactuca serriola	—	—	—	+	—	1	20	I	
Oryzopsis munroi	—	—	—	+	—	1	20	I	H

As compared to the other three plant communities studied, this one is poorer in plant species with no tree layer and poorly developed shrub and herb layers. Grasses, too, are poorly represented. (Table 4) The following is the biological spectrum:

MM	=	4.5%	H	=	18.2%
M	=	4.5%	G	=	4.5%
N	=	22.8%	Th	=	31.9%
Ch	=	13.6%			

The community is moderately rich in forbs and browse species and provides some grazing to livestock, sheep and goats. There is just one medicinal plant, *Dioscorea deltoidea*, and that, too, is feebly represented.

Discussion. The study has yielded some useful information on the true nature of dry oak forests, extent of their distribution and prospects of development of this zone in the country.

Biogeographic limits and nature of dry oak forests in Pakistan. The study revealed that, occurring beyond the effective reach of the south-east monsoon at 900-2550 m or even lower still dry oak forests originally occupied a much extensive area than do actually to-day. While in the inner drier limits under the true mediterranean climate evergreen oak formed pure forests, in the outer moister limits under transitional mediterranean climate, it invariably had an element of chir pine together with a number of other subtropical elements, forming oak-chir ecotonal forests. While, as remnants, patches of pure dry oak forests are not inferquently met with to-day on protected sites, the oak-chir forests have since times immemorial been totally destroyed and replaced mostly by the present-day disclimaxes of Reptonia-Olea-Acacia scrub (Monotheca scrub, Champion et al.) and poor quality chir pine forests (Siwalik chir pine forests, Champion et al.)

Generally occupying rocky sites, Monotheca scrub (unless destroyed) often grows like a zone below the present-day dry oak forests (unless destoryed), throughout the country, *Reptonia* marking transition from the tropical to the mediterranean climatic conditions as was also earlier suggested by Zeller and Beg (1969). *Reptonia*, therefore, is a reliable indicator of the former oak-chir belt in the country. Occurring from all along the Pak-Afghan border into Pakistan territory at suitable altitudes, *Reptonia* grows in Chitral, Dir, Swat Buner, Hazara (rare), and Bajaur, Mohmand, Malakand, Khyber and Orakzai Agencies, North and South Waziristan, Kohat-Thall area, Cherat and Kalachitta Hills, Western Salt Range, D.G. Khan-Fort Munro area, Zhob and Loralai Districts and Sind (Stewart) and roughly marks the transitional mediterranean belt in the country.

Though on different sites, mazri palm scrub (*Nannorrhops ritchieana*), too, occupies the same climatic belt as *Reptonia*, being reported at Margalla (Stewart), Missa and Pabbi Hills (Hanif-probably planted), Western Salt Range, Kalachitta Hills, Kohat. Tall area, Khyber Hills, D.G. Khan-Fort Munro area, Sibi. Loralai, Kalat, Mekran, Kharan and Sind

(Stewart). Being a retrogressive stage of Monotheca scrub, Rhazya-(Withania) scrub (Champion et al.), too, is indicatve of *Reptonia* climate. That is why all the four viz *Reptonia* sp., *Nannorrnhops* sp., *Rhazya* sp. and *Withania* sp. are often found to grow in the same climatic belt down to about 600 m, and the last two-named at still lower altitudes in the country. The summer-thirsty sickly stunted often branchy crooked chir pine of Swat-Buner-Malakand and Dir-Bajaur-Khyber area, a remnant of the former oak-chir ecotonal forests, reflects the transitional mediterranean climate wherever it grows in the country. Thus, all the tract to-day occupied by *Reptonia*, *Nannorrhops*, *Rhazya*, *Withania* and the poor quality chir represents the dry oak-chir belt between about 600 and 1350 m in the country.

As to *Olea ferruginea*, it appears to have a wider ecological amplitude in terms of moisture and flourishes rather equally well in both the subtropical (Rawalpindi-Azad Kashmir sector) and transitional mediterranean (Kohat-Thall sector) belts. Accordingly, its occurrence anywhere, therefore, is not indicative of a restricted set of conditions.

Prospects of development of dry oak forest zone. This steep mountainous belt is not producing as much as its potential. Priority in this respect goes to rehabilitation of the watersheds. Being of little forestry importance, the native slow-growing broad-leaved species and the poor quality chir are out as candidates for afforestation of this tract. Choice of better tree species is, therefore, of prime importance.

In the entire mediterranean basin, where dry oak forests are found, is also grown aleppo pine, *Pinus eldarica* (Repp and Roman, 1969). Elsewhere, took, these forests have been replaced over large areas by plantations of aleppo pine (Castri and Mooney, 1973). In Pakistan, though grown casually, aleppo pine is already doing fairly well in Quetta, Zeran Village in Kurram, Peshawar and Torkham custom post (in the Afghan territory). Aleppo pine is, therefore, recommended throughout the belt between 600 and 1300 m as was earlier suggested by Zeller and Beg (1969). Being a low rainfall dry-summer species it can successfully replace the poor quality chir throughout its western belt. *Acer pentapomicum* and *Fraxinus excelsior* are proposed for growth throughout the zone, while *Ceratonia siliqua*, an evergreen fodder tree, and *Ailanthus altissima* and *Robinia pseudoacacia* both good soil binders, and *Eucalyptus camaldulensis* and *E. gomphocephala* in the lower belt. *Populus ciliata*, *P. caspica*, *P. euramericana* CvI-214 and *P. deltoides* I-63/51, *Alnus nitlda* and *Platanus orientalis* are recommended along the streams and flat gravelly riverbeds.

There is also a great scope for growing temperate and sub-tropical fruit trees in this zone. At the present, most of the fruit cultivations are casual, although apple cultivation in Swat, Parachinar and Quetta is gradually increasing. With a little more effort on the vast belt we have in the country, we should be able to produce enough fruits for our consumption and even for export. While apricots, peaches, pears, plums, european olive and grapes can economically be grown throughout the zone, walnut, apple and sweet cherry have high prospects for growth in the upper zone and almond, pomegranate, fig, japanese persimon, guava and *Citrus sinensis* (red blood malta) in the lower. Pistachio nut could also be tried in the upper subzone in the inner drier ranges.

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References

1. BEG, A.R. and ILAHI BAKHSH 1974. Vegetation of Scree slopes in Chitral Gol. Pak. Jour. For. 24(4): 393-402.
2. BEG, A.R. and MAHMOOD IQBAL SHAIKH. 1975. Cultivation prospects of exotic and indigenous poplars in Pakistan. Pak. Jour. For. 25(3): 145-52.
3. BRAUN-BLANQUET, J. 1965. Pant Sociology. Translated by Fuller and Conard. Hanker Publishing Co., New York.
4. BURKILL, I. 1921. A list of plants of Baluchistan. Suptd. Government Printing Press, Quetta.
5. CASTRI, F. and H.A. MOONEY 1973. Mediterranean type ecosytem, Springer Verlag, Berlin.
6. CHAMPION, H.G., S.K. SETH and G.M. KHATTAK 1965. Forest types of Pakistan. Pakistan Forest Institute, Peshawar.
7. DEBRACH, J. 1953. Notes sur les climats du Maroc occidental. Maroc medical 32 (342): 1122-1134.
8. EMBERGER, L. 1952. Sur le quotient pluviothermique. C.R.Ac.Sc., 234: 2508-2510.
9. FREITAG, H. 1976. Competitive behaviour of *Quercus ilex* and *Q. pubescens* in a humid mediterranean climate. Syst. Geol. Inst., Univ. Goett.
10. HANIF, M. 1980 Personal communication.
11. JAN, M.Q. and R.A.K. TAHIRKHELI 1969. The geology of the lower parts of Indus Kohistan (Swat). West Pak. Geol. Bull. Univ. Pesh. 4: 1-13.
12. KHAN, F.M. 1971 Integrated resource survey and development potentials of Swat river watershed. N.W. Frontier Forest Record Inventory series No. 2. Aerial Forest Inventory Project, Pakistan Forest Institute, Peshawar. pp. 7-8, 15-20, 93-94.
13. KHAN, MIRZA HAKIM (1978) Phytosociological Studies in Chitral Gol. Pak. J. For. 28 (2): 99-110.
14. MARISCO, D.F. 1974. Olive cultivation in the countries of the Mediterranean Basin and the Near East. F.A.O. Report No. TA 3159. Report submitted to the governments participating in the FAO International programme for the improvement of olive cultivation. FAO, Rome.
15. MILLIKAN, D.F. 1969 North American nut trees. W.F. Humphrey Press, Inc. New York.
16. PARKER, R.N. 1924. A Forest Flora for the Punjab with Hazara and Delhi, Suptd. Govt. Printing, Punjab, Lahore. pp. 496.
17. RAFI, M. 1973. Vegetation types of Quetta-Kalat Region. Punjab Forestry Department, Lahore.

18. RAUNKIAER, C. 1934. The life forms of plants and statistical plant geography. 1-632. Clarendon Press, Oxford.

19. REPP. M. and F. ROMAN 1969. Egoutement du precipitation sous des peuplements de *Quercus ilex* L. et de *Pinus halepensis* Mill. Oecol. Plant, 4, 271-284.

20. SAUVAGE, CH. 1963. Etages bioclimatiques. Comite National de geographie du Maroc. Notices explicatives, section II, Physique du Globe et Meteorologie. planch No. 6 b, pp 1-44.

21. SCHWEINFURTH, U. 1957. Die horizontale und vertikale Verbreitung der Vegetation im Himalaya. Bonn. Geo. Abh XX. Ferd. Dummlers Verlag, Bonn. pp. 9-72, 277.

22. STEWART, R.R. 1972. Annotated catalogue of the vascular plants of West Pakistan and Kashmir. Gordon College, Rawalpindi.

23. TROUP, R.S. 1921. The Silviculture of Indian trees. Vol. III. Clarenden Press, Oxford.

24. ZELLER W. and A.R. BEG 1968. The contribution of upper course riverain forests to watershed management. Proc. Ist. West Pak. Watershed Management Conf. 1968, pp. 295-296.

25. ———— 1969 Review of some vegetation types of Dir and Chitral. UNDP-FAO Pak. Nat. For. Res. and Train. Proj. Report No. 11, Ecological papers 1968-69. Pakistan Forest Institute, Peshawar. pp. 9-25.