

HISTORY OF FOREST MANAGEMENT IN PAKISTAN—I

by

Ghaus Mohammed Khattak*

Early History. Using relics of vegetation in areas specially protected for some reason, it is possible to reconstruct the vegetation map of Pakistan some thousands of years ago (CHAMPION, SETH AND KHATTAK, 1965). Except for deserts, the country must then have been under different forest types, depending on locality: Moist and dry temperate in the high hills, sub-tropical pine and sub-tropical broad-leaved lower down, and tropical thorn in the plains with dense stands of 'shisham' (*Dalbergia sissoo*), 'kandi' (*Prosopis spicigera*) and 'babul' (*Acacia arabica*) along the rivers.

Although Pakistan has been the cradle of ancient civilizations since 2000 years B.C., probably not much forest destruction occurred during the Brahmin and Budhist eras. The population at that time was small, subsisting mainly on cultivation along the river valleys. But towards 1500 B.C., started the recurrent invasions of the Aryans from Central Asia into the area now forming Pakistan. The Aryans were a pastoral and agricultural people and started large scale cutting, burning and grazing. Every major invasion of the main valleys was followed by the retreat of the local inhabitants into inaccessible hills where they had to clear forests to make a living. Despite such localised destruction, forests still survived over the greater part of the country.

We have no early history of forest conservancy. Till the British conquest of pre-partition India, the only forest conservancy known was by local rulers for maintaining game reserves. At the end of the 18th century, though forests were nominally considered the property of the ruler of the tract, anyone could cut, burn, graze and break up land for cultivation (STEBBING, 1921). This was the state of affairs at the advent of British rule in pre-partition India.

Forest conservancy during the early days of the British rule. Sind was occupied by the British in 1843 and Punjab in 1849. Under the British rule the demand for forest products started increasing rapidly. The so-called 'Indian mutiny' (1847) emphasized to the British the need for quick means of communication. And the rapid extension of roads and railways which followed this realization put a tremendous strain on all accessible forests. In the north western hills the troubled days of 'sikhashahi' (Sikh rule) were now over and the people started settling down in farming communities which inevitably required the clearing of forests and the breaking up of sloping land for cultivation. Though pre-partition India then had large areas under forests and the total demand of forest products was small, local shortages of timber and firewood started occurring because of inadequate means of communication, and brought home to the far-sighted the consequences of large-

*The author is Director General, Pakistan Forest Institute, Peshawar.

scale deforestation. Consequently, at the instance of Dr. Cleghorn, a plea for forest conservancy in India was made by the British Association which met in Edinburgh in 1851. They recommended that arrangements be made for protecting the forests of India from indiscriminate cutting; for regenerating areas which had to be cut to meet present needs; and for disseminating among the local people a knowledge of the importance of forests to wean them away from the destructive practices of un-systematic cutting, burning and shifting cultivation.

In 1856 rules were promulgated by Major T.G. Cracroft, the then Deputy Commissioner of Rawalpindi District, for conserving trees and brushwood in the area under his jurisdiction in order to ensure future supplies of forest products to Rawalpindi town and to Murree, which was developing into a hill station. All the trees and shrubs in the mountains of Rawalpindi were declared Government property. Trees selected by Civil Officers could be cut on payment of tax varying from one to five rupees per tree depending on species. Firewood could also be cut on payment of tax. Burning of forests was prohibited except for improving grazing. One eighth of the amount collected as tax was paid to the local inhabitants. The forests remained under the control of the Civil authorities till 1870. During this period fellings were un-systematic and only the largest and the best trees were removed from the most easily accessible areas.

Forest conservancy in Hazara started in 1857 with the promulgation of rules for forest conservancy in Hazara by the Deputy Commissioner. All forests in Hazara were declared the property of Government. But local villagers and right holders could, with the permission of the Deputy Commissioner, cut trees for their personal use and break up new land for cultivation. Non-right-holders also could obtain trees on payment of tax to the Government, half of which was paid to the local villagers. Grazing was allowed but forests could not be set on fire.

Till 1872, when certain forests were declared as Reserved and handed over to the Forest Department, the fellings were carried out in an un-systematic manner in which only the best trees of the then marketable species were removed from the most accessible areas. This was the state of affairs in Kagan, Galis, Siran and the forests of the then princely State of Swat. The forests of Chitral and Dir were safe from commercial exploitation—in Chitral due to lack of means of transportation to the timber markets, and in Dir due to absence of any law and order. But the forests of Chitral were open to large scale damage from cutting and burning by migratory graziers.

The riverain forests of Sind were raised by the local rulers as game reserves. The technique was to fence in riverain areas in which 'babul' seed had been disseminated by livestock. The management of Sind forests was started soon after the British occupation to ensure the supply of fuelwood to the two Indus Flotilla companies which were the sole means of communication between the Punjab and Karachi. In 1857 about 700 square miles of forests were being managed for this purpose. 'Babul' timber was also supplied to the gun carriage factory in Bombay and for the construction of the Karachi Port Trust. (STEBBING, 1923).

The increasing shortage of large-sized timber for railways and public works, and of fuel for the railways and river steamers, created the need for perpetuating forests under control. Sir Dietrich Brandis was appointed as the first Inspector General of Forests for pre-partition India in 1864. Dr. Cleghorn, during this time, was organizing forestry in the Punjab. He and Brandis worked together on laying the foundations of forestry in the country during 1864 and 1865 and were designated as 'Commissioners of Forests'.

The first Forest Act, Act VII of 1865, was passed in 1865. Rules were framed under this Act for the reservation of forests and their protection from cutting, fire, grazing and cultivation without prior permission. In 1866 William Schlich and B. Ribbentrop, two German foresters, were recruited to assist the untrained Conservators of Forests working in the Provinces.

To ensure a perpetual supply of firewood to the railways and the river steamers, it was decided to raise plantations in the Punjab plains. The Changa Managa irrigated plantation was started in 1866 and the planting of riverain areas in the Punjab was also initiated during the sixties.

The Hazara Forest Regulation was passed in 1872. Under the amended Regulation (No. II of 1873) the tree bearing lands of Hazara were divided into two categories: The Government Reserved Forests and the public wastelands, later called the 'guzara' forests. The Reserved Forests were handed over to the Forest Department for management and the 'guzara' forests were set aside to meet the domestic requirements of the local people, under the general supervision of the Deputy Commissioner. But Government retained the right to conserve and manage them and charged a share on their sale proceeds known as the 'seigniorage fee' (JAN, 1966).

To sum up, the closing decades of the 19th century (1871-1900) were marked by the passing of forest legislation, reservation of forests, forest settlement, demarcation, survey and protection. The work of the preparation of working plans was being pursued vigorously all over pre-partition India. Only officers of exceptional ability and considerable experience were posted as working plan officers (STEBBING, 1923).

Chir-Pine Forests 1900 to about 1925. The management of the chir-pine forests of Pakistan and Azad Kashmir was initiated under selection fellings in which trees above the exploitable size were removed in addition to dead, dying and diseased trees. These were the general prescriptions of the working plans in operation till about the first quarter of the present century (KHANNA, 1942; MALIK, 1965). The uniform system was first applied to the chir-pine forests of Murree by Jerram's working plan for 1915-27 (KHANNA, 1942). Greswell (1923), Mehr Chand (1924), and Khan Muhammad Khan (1926) soon followed suite with their working plans for Lower Siran, Khanpur, and Giddarpur (guzara) forests respectively. All these working plans were similar in broad outlines and had the following features in common:

1. The area under chir-pine was divided into two working circles: Regular and Unregulated. The former comprised the better stocked forests growing on easier slopes,

to be worked under the uniform system on a rotation of 100 years, with a regeneration period of 25 years, and approximately equal areas allotted to four periodic blocks. (In Giddarpur, allotment was only made to P.Bs. I and II). The growing stock in P.B.I. was enumerated into 6 inch diameter classes down to 12 inches d.b.h. The annual yield from P.B.I. was calculated by dividing the volume of existing exploitable trees plus half their increment (estimated from ring countings on stumps), by the regeneration period. Intermediate yield from the rest of the working circle was prescribed by area and estimated from past experience.

The Unregulated Working Circle comprised the forests which could not be exploited economically due to poor stocking or steep terrain. These forests were to be afforded protection. But dead, dying, diseased and over-mature trees could be removed for supply to right holders. Since the entire area of Giddarpur forests was exploitable, no Unregulated Working Circle was distinguished in its working plan.

After about 1925. Glover (1927) in his working plan for Murree-Kahuta (1927-40), like his predecessors, divided the forest area into the Regular and Unregulated Working Circles. The Regular Working Circle was to be managed under the Punjab shelterwood system (CHAMPION, SETH, and KHATTAK, 1965), with a rotation of 120 years, a regeneration period of 30 years and allocation of compartments to four periodic blocks of approximately equal area. Yield was prescribed by volume of all trees over 4.5 feet girth in P.B.I. and all trees over 6 feet girth in the rest of the working circle. Increment was not taken into account while calculating yield.

Pring's working plan (1927-40) for the forests of Murree Tehsil prescribed the same broad outlines as Glover. In addition to a Regular and Unregulated Working Circle he also distinguished a Selection Working Circle for immature forests not easily accessible to markets. These were to be subjected to selection fellings in which over-mature trees above 6 feet girth standing over advance growth would be removed. Yield was prescribed on the basis of trees of 7.5 feet girth and over.

Dean's Working Plan (1928) prescribed the uniform system for the first time for the chir-pine forests of the present Muzaffarabad Forest Division of Azad Kashmir with a rotation of 120 years, a regeneration period of 30 years and allotment to four periodic blocks of equal area. Gupta (1938) left these prescriptions materially unchanged in his revision, except that the rotation was increased to 150 years (HAQUE, 1956).

From 1932-33, the prescriptions of the working plans of Lower Siran, Haripur, and Giddarpur (guzara) forests were amended under orders of C.G. Trevor, the then Chief Conservator of Forests Punjab and N.W.F.P., increasing the length of rotation to 120 years, the regeneration period to 30 years and omitting increment from yield calculations. This was necessitated by the failure of regeneration to keep pace with the removal of over-wood. This basic framework for the management of chir-pine forests still continues.

Wright (1935) in his working plan for the Lower Siran and Agror retained Greswell's division into Regular and Unregulated Working Circles. The Punjab shelterwood system

was applied to the Regular Working Circle and a rotation of 120 years was prescribed. But instead of allotting compartments to four periodic blocks, he allotted them to two broad units: The regeneration block and the rest of the working circle. The same practice was followed in his working plan for Giddarpur forests (1939-51). To the regeneration block were allotted compartments bearing the following types of crops:

- (i) seeding felling completed under earlier plans but adequate regeneration not yet established;
- (ii) trees mostly mature, requiring seeding felling;
- (iii) seeding felling completed under earlier plans, adequate regeneration established;
- (iv) trees so near maturity as to require seeding felling early in the next regeneration period;
- (v) adequate advance growth under over-mature seed bearers.

Thus Wright's regeneration block comprised areas which would be allotted to periodic blocks I and IV and part of II of the conventional method with four periodic blocks. The remaining compartments of the working circle were either under predominantly young crops (conventional P.B. II and III areas), or under stands nearing maturity (conventional P.B. IV areas), which did not need to be regenerated at the very commencement of the next regeneration period. Individual compartments were allotted to the regeneration block at the time of the preparation of the working plan and from the total area so allotted the period in which this area had to be regenerated was calculated as follows:

$$p = \frac{a \times R}{A}$$

Where

- p = regeneration period
- A = area of the working circle
- a = area of the regeneration block
- R = rotation

The prescribed yield was calculated in the following manner:

$$\text{Total yield from the working circle} = \frac{2(V_1 - v_1 - v_2)}{R} \quad (1)$$

Where

- V_1 = volume of enumerated trees (above 12 inches d.b.h.) in the entire working circle
- v_1 = volume of trees upto 16 inches d.b.h. in P.B.I. type compartments (categories i and ii of the regeneration block)
- v_2 = volume of trees upto 20 inches diameter in P.B. IV type compartments (categories iv and v of the regenerated block)
- R = rotation

$$\text{Yield from the regeneration block} = \frac{V_2 - v_1 - v_2}{p} \quad (2)$$

Where

V_2 = volume of enumerated trees (above 12 inches d.b.h.) in the regeneration block

p = regeneration period, as worked out already

v_1 and v_2 have the same meanings as assigned to them in (1) above.

$$\text{Yield from the rest of the working circle} = (1) - (2)$$

Trees 16 inches d.b.h. and over felled in the regeneration block, and 12 inches and over in the rest of working circle, were to count towards the prescribed yield. The Divisional Forest Officer was to prepare a three year's programme showing the order in which the compartments were to be worked and have it approved by the Conservator.

Wright's broad prescriptions were retained by Yusuf Khan (1950) for Lower Siran and Agror, and by Khattak (1951) and Ghulam Mohyuddin (1962) for Giddarpur forests. His Regular and Unregulated Working Circles were renamed as Conversion and Protection Working Circles.

Khanna (1942) in his revision of the working plan for the forests of Murree Hill retained the broad outlines of Glover's and Pring's plans. The working plan area was divided into two working circles—The Chir Shelterwood for better stocked forests capable of concentrated exploitation, and the Chir Selection for poorly stocked forests growing on steep slopes which could not be subjected to concentrated fellings for fear of soil erosion. The Punjab shelterwood system was adopted for the Shelterwood Working Circle. A rotation of 120 years was prescribed with a regeneration period of 30 years and the compartments were allotted to four periodic blocks. All trees in the working circle were enumerated down to 12 inches d.b.h. in four inches diameter classes.

The final yield was controlled by volume and the annual possibility was calculated as the sum of the following:

- | | |
|----------|--|
| P.B.I. | 75% of the volume of trees of 16 inches minimum d.b.h. divided by 30 (length of regeneration period) ¹ |
| P.B. II | 5% of volume of exploitable trees (24 inches minimum d.b.h.) divided by 30 ² . |
| P.B. III | two thirds of the volume of exploitable trees divided by 30 ³ . |
| P.B. IV | two thirds of the volume of exploitable trees divided by 10, and the remaining volume divided by 20 ⁴ . |

-
1. 25% of the trees were retained till the next period as fire insurance and for putting on rapid value increment.
 2. Mature trees were to be conserved in P.B.II and only those trees of d.b.h. 24 inches and over removed which were dead and dying, or had stopped growth.
 3. It might not be possible to remove all the mature trees as there were still some areas where regeneration was not fully established.
 4. Two thirds of the volume of exploitable trees was to be removed during the first 10 years of the regeneration period and the remaining during the rest of the 20 years.

It was ascertained that a sufficient number of trees of the diameter class next below the exploitable would grow into the exploitable size during the regeneration period to take the place of trees being exploited, by assuming a survival of 70% and a time of passage of 30 years. An annual deviation of 10% was permitted from the prescribed yield. Further deviation could be sanctioned by the Chief Conservator of Forests but the accumulated surplus or deficit was not to exceed the annual prescribed yield at any time. The intermediate yield was controlled by area and was estimated on the basis of past experience.

The Chir Selection Working Circle was distinguished for chir-pine growing on steep slopes, hot aspects, and in mixture with broad leaved species at low elevations and 'kail' (*Pinus wallichiana*) or broad leaved species at high elevations. Fellings in this working circle were prescribed according to the modified selection system, as then practiced in pre-partition India and now in Pakistan (CHAMPION, SETH and KHATTAK, 1965). All 'Chir' and 'kail' trees above 12 inches d.b.h. were enumerated into 4 inch diameter classes. The annual yield was prescribed by the number of trees of exploitable size (24 inches d.b.h.) and over at the time of inventory divided by the number of years in which trees of 20-24 inch size class were expected to reach the exploitable size. A check was applied to ascertain that the number of trees in the 20-42 inches size class were adequate to replace the trees being removed.

Bashir Ahmad (1959) has retained Khanna's broad outlines of management and methods of yield calculation for both the Shelterwood and Selection Working Circles. But he inventoried the crop down to 8 inches d.b.h. instead of the earlier 12 inches.

The current working plan for the Muzaffarabad Forest Division of Azad Kashmir (HAQUE, 1956) includes the chir-pine forests in the Chir-Kail Uniform Working Circle, with a rotation of 150 years, a regeneration period of 30 years, and 5 nominal periodic blocks. But allotment of compartments is made only to blocks I and V. The Azad Kashmir variant of the Punjab shelterwood system has been prescribed in which only those compartments are allotted to P.B.I. which bear adequate advance growth. And trees up to 18 inches d.b.h. qualify as advance growth if growing singly, and upto 24 inches if occurring in stands over a quarter of an acre or more.

Enumeration is by 6 inch diameter classes down to a minimum d.b.h. of 12 inches. The annual yield from P.B.I. is calculated by dividing the volume of trees of 18-24 inches diameter class growing in this periodic block by 30—their assumed time of passage to the exploitable size. No allowance is made for mortality, assuming it would equal increment in the trees of exploitable size. Yield from unallotted area is calculated the same way, and reduced by 20% to allow for errors in enumerations and for illicit damage. This yield is not to be harvested for commercial purposes but may be utilized for meeting the demands of the concessionists and the Army. Thinnings may be carried out over the unallotted area and in P.B.V. Separate yield for thinnings has not been prescribed due to the difficulty of disposing of small sized material.

Chaudhri (1959) in his current working plan for the Mirpur Forest Division of Azad Kashmir, has distinguished Regular, Selection and Unregulated Working Circles for

the chir-pine forests. In the Regular and Selection Working Circles the crop has been enumerated into six inch diameter classes down to 12 inches d.b.h. The Azad Kashmir variant of the Punjab shelterwood system has been prescribed for the Regular Working Circle with a rotation of 120 years, an exploitable size of 24 inches d.b.h., a regeneration period of 30 years, four nominal periodic blocks, but allotment of compartments only to periodic blocks I and IV.

The annual yield from the exploitable trees of the entire working circle has been calculated by dividing their volume by the regeneration period. Annual yield from periodic blocks I and IV is taken as 90% of the volume of exploitable trees growing in these blocks, divided by the regeneration period. Annual yield from the rest of the working circle is the former minus the latter. From the yield calculated in the above-mentioned manner for the exploitable trees in periodic blocks I and IV and the unallotted areas, are deducted the estimated requirements of the concessionists and the Army. The reduced figures are further subjected to another 20% cut to allow for illicit damage.

To calculate the yield from the growing stock below the exploitable size, the total yield from all sizes over the entire working circle is calculated by von Mantel's formula. From this is deducted the yield of exploitable sized stock for the whole working circle as worked out above, and the resultant figure is subjected to a 25% cut to allow for illicit damage. The yield thus worked out is spread over periodic blocks I and IV and unallotted area in proportion to the occurrence of trees of 12-24 inches d.b.h. in their original inventory data.

The working plan thus exhibits the following theoretically available yields separately.

- (i) from exploitable trees in blocks I and IV;
- (ii) from trees of 12-24 inches d.b.h., in the above blocks;
- (iii) from exploitable trees in the rest of the working circle;
- (iv) from trees of 12-24 inches d.b.h. in the rest of the working circle.

But only the following yields are available for commercial purposes:

- P.B. I yield from trees of exploitable size.
- P.B. IV yield from the entire enumerated growing stock.

The yield from the unallotted area, and from the growing stock below exploitable size in P.B.I., is held in reserve for meeting local requirements and for any other purpose approved by the Chief Conservator of Forests.

For the Selection Working Circle the modified selection system is prescribed with an exploitable size of 24 inches d.b.h. and the condition that thinning will only be carried out if specially authorised by the Chief Conservator of Forests for meeting local requirements. The yield has been prescribed by assuming that one third of the volume of exploitable trees will be available for removal during a period of 30 years (assumed time of passage

from 18-24 inch d.b.h. class to the exploitable size). Annual yield is therefore one-thirtieth of the volume expected to be available for removal—this is not meant for commercial exploitation but mainly for meeting the demand of local concessionists.

Under the Unregulated Working Circle have been included demarcated forests which are not fit for working. They are either very poorly stocked—often altogether blank or very remote. No fellings are permitted in this working circle except to meet the requirements of concessionists or other local inhabitants. Marking for this purpose is done under single tree selection.

Malik (1965), while revising Yusaf Khan's (1950) working plan for Lower Siran and Agror forests reverts back from the regeneration area method, initiated by Wright, to the revocable periodic block system. He retains 120 years rotation and 30 years regeneration period and allots compartments to four periodic blocks according to their condition. Since the area allotted to P.B.I. is 21% of the total area instead of 25%, the regeneration period is reduced as follows:

$$p = \frac{a \times R}{A}$$

Where

- p = regeneration period
- a = area of P.B.I.
- R = Rotation
- A = area of the working circle

Growing stock is enumerated in four inch diameter classes down to 8 inches d.b.h., and yield calculated by the following methods:

1. Current growth: From Yusaf Khan's inventory (1950), his own (1962), he estimates the periodic net annual growth using the method of Arthur Meyer (1932). This per acre current growth is multiplied by a reducing factor of .6 to give the per acre yield.

2. Von Mantel's formula

3. Yield by the above formula corrected for partial stocking by multiplying it

with the factor $\frac{V_a}{V_d}$, V_a and V_d representing per acre volume of actual and desired growing stock respectively.

4. Hundeshagen formula

5. Austrian formula, using the current growth determined under method 1 as increment and assuming 80 years as the adjustment period.

6. From his inventory, as the sum of the following volumes assumed by him to be realizable as yield from the different periodic blocks during the 10 years currency of his plan:

Final yield

- P.B. I. 75% of the volume of trees 16 inch d.b.h. and above.
- P.B. II 2-1/2% of the volume of exploitable trees.
- P.B. III 6% of the volume of exploitable trees.
- P.B. IV 50% of the volume of exploitable trees.

Intermediate yield

6% of the volume of trees upto 16 inches d.b.h. in P.B.I. and upto 24 inches d.b.h. in the rest of the working circle.

The yield by current growth method has been prescribed because it is the lowest. The conventional check was applied to ensure that recruitment from the 20-24 inches d.b.h., class would be sufficient to take the place of the trees exploited during the regeneration period.

A deviation of 20% is permissible in the final and intermediate yields from each periodic block separately; for a higher deviation the sanction of the Chief Conservator of Forests is required. The accumulated surplus is not to exceed the annual prescribed yield at any time. The Chief Conservator of Forests may review the position every three years and wipe out deficits completely in favour of the forest.

Malik has also distinguished a Protection Working Circle where the main treatment is protection from any damage. Fellings in this working circle are confined to the removal of dead, dying, diseased and over-mature trees and thinning and cleaning to meet the domestic requirements of right-holders.

Guzara forests. Regular working plans for the management of the chir-pine 'guzara'¹ forests for Siran, Kagan and Haripur were prepared in 1966 and 1967 (JAN, 1966; KHALID, 1966; and RAHIM, 1967). All these prescribe two working circles—Selection and Protection, the former for commercially exploitable areas and the latter for forests which are too poor in stocking to admit commercial exploitation.

Because the 'guzaras' are generally poorly stocked and have an irregular size class distribution, the selection system has been prescribed in the Selection Working Circle, requiring the removal of dead, dying, diseased and defective trees in addition to some of the sound trees of exploitable size. Felling of healthy trees of exploitable size (24 inches d.b.h. and over) is governed by felling rules which seek to conserve their number by laying down various conditions: removal of one out of every three exploitable trees if standing over adequate and established regeneration, and one out of every five if regeneration is inadequate

-
1. Desired growing stock assumed to be equal to normal growing stock volume according to Howard's 1926 Dehra Dun yield tables.
 1. Communally owned forests managed by the Forest Department since 1950.

or unestablished or both. No healthy trees of 20-24 inch size can be felled. All areas gone over for felling must be closed to grazing for 10 years and agreements to this effect under Section 15 of Hazara Forest Act 1936 must be obtained from the owners of the 'guzaras' before their areas are taken up for felling.

For calculating annual yield, Jan (1966) has divided the volume of trees of 20-24 inch size class by 50* and multiplied by .85 to allow for mortality (assumed at 15%) of trees in transition to the exploitable size. The prescribed yield has been sub-divided into two portions—available only to right holders for domestic use and available for commercial exploitation. Khalid (1966) and Rahim (1967) have first calculated annual yields by Von Mantel's and Simmon's formulae respectively and have then reduced them by multiplying with the factor. V_a/V_d

Summary. *The management of chir-pine forests was first initiated towards 1900 under selection fellings. Since 1915 in the Punjab and 1923 in the forests now included in the North West Frontier Province, the commercially exploitable forests growing on moderately steep slopes have been managed under the uniform system. Till 1927 the forests were worked under the standard uniform system: rotation 100 years regeneration period 25 years, allotment of compartments to four periodic blocks, and calculation of the prescribed final annual yield by Cotta's formula. Since then, the Punjab shelterwood system has been adopted and the most common pattern of management comprises a rotation of 120 years, a regeneration period of 30 years, allotment of compartments to four periodic blocks, and exclusion of increment from yield calculation. The recommended order of fellings in the P.B.I. may or may not be indicated in the working plan. The Divisional Forest Officer is expected to prepare a three year's programme of felling each year and get it approved by his Conservator or Chief Conservator. The permissible deviation is generally 10%. The intermediate yields are usually prescribed by area and their volume estimated from past experience.*

Adequately stocked Reserved Forests growing on steep slopes vulnerable to soil erosion, and the 'guzara' forests, are worked under the modified selection system. Felling of trees of exploitable size is further restricted in the 'guzara' forests by special marking rules. The final yield is usually calculated by dividing the volume of trees of exploitable size (24 inches d.b.h. and over) by the assumed time of passage of trees of 20-40 inch d.b.h. class to the exploitable size. An additional arbitrary cut may be applied on the calculated yield from the 'guzara' forests. Inadequately stocked forests which cannot be worked profitably are relegated to the protection working circle. Only dead, dying and diseased trees may be removed from these areas or thinnings carried out in congested crops.

References

- CHAMPION, H.G., S.K. SETH and G.M. KHATTAK, Forest Types of Pakistan. Pakistan Forest Institute, Peshawar.
 DEAN, H.S., Revised Working Plan for the forests of Muzaffarabad Forest Division. (1928-37).

*Number of years in which chir-pine trees of 20 inches average d.b.h. would grow to 24 inches d.b.h. according to site quality III of Howard's (1926) yield tables.

- GLOVER, H.M., Revised Working Plan for the Chir and Brushwood Forests of Rawalpindi East Division. The Punjab Government Printing Press, Lahore. (1927).
- GRESWELL, E.A., Revised Working Plan of the Chil Forests of the Lower Siran Range, Siran Division, Hazara. North-West Frontier Province, Government Printing Press. (1925).
- GUPTA, F.C., Revised Working Plan for the Forests of Muzaffarabad Forest Division. (1938-47).
- HAQUE, MAZHAR-UL., Revised Working Plan for the Forests of Muzaffarabad Forest Division, Azad Kashmir. (1956).
- JAN, ABEEDULLAH., Amended Working Plan for Guzara Forests of Haripur Forest Division. Ferozsons Limited, Peshawar. (1966).
- KHALID, M., Working Plan of Galis Guzara Forests. West Pakistan Government Printing Press, Peshawar. (1968).
- KHAN, MUHAMMAD KHAN., Working Plan for Giddarpur Forests, Siran Forest Division, North-West Frontier Province Government Printing Press, Peshawar. (1926).
- KHANNA, H.C., Revised Working Plan for the Forests of the Murree and Revised Working Plan for the Forests of the Murree and Kahuta Tehsils. Government Printing Press, Punjab, Lahore, (1942).
- MALIK, MUHAMMAD AZAM., Revised Working Plan for Chir Reserved Forest of the Lower Siran and Agror Valleys. Ferozsons Limited, Peshawar (1966).
- MEHR CHAND, PANDIT. Revised Working Plan for the Forests of the Khanpur Range, Lower Hazara South Division. North-West Frontier Province Government Printing Press, Peshawar. (1926).
- MOHYUDDIN, Q.G. Revised Working Plan for the Giddarpur Forests, Siran Forest Division. West Pakistan Government Printing Press, Peshawar. (1962).
- PRING, Revised Working Plan for the forests of Murree Tehsil of the Rawalpindi West Division. The Punjab Government Printing Press, Lahore (1927).
- STEBBING, E.P., The Forests of India volume I. John Lane The Bodley Head Limited, London. (1921).
- STEBBING, E.P., The Forests of India, volume II. John Lane The Bodley Head Limited, London. (1923).
- WRIGHT, H.L. Revised Working Plan of the Lower Siran and Agror Chir Forests Government Printing Press, North-West Frontier Province, Peshawar (1935).