

HISTORY OF FOREST MANAGEMENT IN PAKISTAN—III IRRIGATED PLANTATION AND RIVERAIN FORESTS

THE IRRIGATED PLANTATIONS

The irrigated plantations of the Punjab

by

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Changa Manga was the first irrigated plantation, started in 1866 (CHOPRA, 1949). It was followed by Chichawatni (1913), Khanewal (1917), Daphar (1919), Kamalia (1946), Shorkot (1947), and Wanbachran (1948). (KHAN MUHAMMAD, 1950; BASHIR AHMAD, 1957; MUSHTAQ AHMAD, 1938; KHAN MUHAMMAD, 1951; AFZAL, 1961; KHAN MUHAMMAD, 1951). Although intermittent and largely unsuccessful attempts had been made to raise irrigated plantation in the former Bahawalpur State since 1870, systematic work was only started in 1955, after the Bahawalpur Forest Division had been created (QAZI, 1967). With the exception of Changa Manga, all the plantations of the Punjab were raised by leasing out land for temporary cultivation in which the lessees cleared the existing tree growth, uprooted the stumps and levelled the area free of charge besides paying lease money to the Forest Department.

The technique of raising irrigated plantations has developed by trial and error. Originally plantations were started by flood irrigation on the analogy of agriculture. Later the practice was changed to trench-cum-flood for conserving irrigation water. The choice of species in all the Punjab plantations has been confined to shisham (*Dalbergia sissoo*) and mulberry (*Morus alba*.) Almost since the start of the present century sporadic efforts have been made to try other species beside shisham and mulberry: *Eucalyptus* spp. *Melia azaderach*, *Salmaia malabaricum*, *Albizia lebbek*, *Prosopis juliflora*, *P. glandulosa*, *Acacia arabica*, *A. catechu*, *Tamarix aphylla*, *Broussonetia papyrifera*, *Dendrocalamus strictus*, and in recent years, *Populus X euramericana*. None of these, however, proved capable of replacing shisham and mulberry under existing conditions. Although the working plan of Chichawatni (KHAN MUHAMMAD, 1962) has prescribed field scale planting of *Populus X euramericana*, *Salmaia malabaricum*, *Eucalyptus* spp., *Gmelina arborea*, *Kydia calicina*, *Albizia lebbek*, *Trewia nudiflora* and *Broussonetia papyrifera* in the Mesquite Eradication Working Circle, all attempts to introduce them have failed. So, shisham and mulberry remain the principal species in the Punjab plantation, although small scale trials with various species of *Eucalyptus* and of *Populus X euramericana* are still going on and about 700 acres have so far been planted to the latter. The introduction of mesquite (*Prosopis juliflora* and *P. glandulosa*) is now considered a costly mistake because it has taken over a number of plantations e.g., Chichawatni and Khanewal where special measures are required to keep this invasive exotic in check.

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Till 1927, shisham seed was sown direct but subsequently planting by root-shoot cuttings has been universally adopted as the surer method. Mulberry was originally introduced accidentally by starlings, but since 1917, it has been deliberately propagated by stump planting. Till 1925 coppice and natural seedlings were relied upon to regenerate the plantations but since then wholesale planting has been universally adopted to obtain full stock (KHAN MOHAMMAD, 1962).

The silvicultural system all along has been two-storeyed high forest with shisham standards in the top storey and a mixture of shisham and mulberry in the lower storey—ideally in the proportion of 60:40. Bokhari (1972) has proposed that in Changa Manga this proportion be not observed and mulberry be considered as the principal species instead of shisham. The rotation has varied from 15 years to 22 years for the main crop. The standards are usually retained for three rotations. In recent years opinion seems to have veered in favour of a drift away from this traditional pattern in response to the need to manage plantations primarily for growing timber instead of firewood for which purpose the plantations were originally started. This trend is reflected in the working plans revised recently (MUHAMMAD AFZAL, 1961; KHAN MUHAMMAD, 1962) in which separate Timber and Firewood Working Circles have been distinguished—the former comprising areas of high site quality, to be used for growing shisham timber on a rotation of 50-60 years; the latter comprising compartments of poorer site quality where firewood will be grown under simple coppice system on 16 years rotation. A third working circle has been constituted to reclaim areas now infested with mesquite, and to plant them with the exotic fast growing species already mentioned. Bokhari (1972) also, has constituted a poplar working circle to be planted to hybrid poplar and managed under clear felling and planting on a rotation of eleven years.

The principal object of management of all irrigated plantations continues to be maximum wood production because unlike hill forests the plantations have no protective functions. The final and intermediate yields are prescribed by area and their quantities estimated from past experience. No allowance is made for variation in site quality in constituting annual coupes.

The irrigated plantations of Sind

Before the construction of protective embankments along both banks of the river Indus, its water used to overflow the banks and sustain tree growth in adjacent areas. With the construction of protective embankments the forests cut off from inundation began deteriorating. Sporadic efforts were made to irrigate parts of these 'inland forests' by sluices in the river embankments, or through inundation canals. After the commissioning of the Lloyds Barrage in 1932, piece-meal efforts were started in about 1934 to convert individual inland forests into irrigated plantations.

Because of the practice then in vogue in the irrigated plantations of the Punjab, and due to the long established tradition of agri-forestry for regenerating the riverain forests of Sind, the most common method of approach was through temporary cultivation leases of different durations. The lessees were expected to level the land, lay out an irrigated system

and grow forest trees. Initially a wide assortment of species was tried: shisham, mulberry, *Salmaal*, bamboo, *Acacia catechu*, *Dalbergia latifolia*, teak, *Hardwickia binta*, and *Gmelina arborea*, etc., but the choice was ultimately narrowed down to babul (*Acacia arabica*), because no other species could survive the adverse local conditions, especially high soil salinity. Up to 1955 the success of these efforts was patchy. In most areas the cultivators farmed only the best part of the land leaving the rest undeveloped. They also carried out the minimum possible levelling, and developed irrigation layouts adequate only for their own immediate needs. So even if they tried to raise forest trees along with their crops, which few did, the trees soon died due to inadequate irrigation after the expiry of the lease period.

After the integration of Sind into the Province of West Pakistan in 1955, great concern was felt that although land and irrigation water were available, no success had been achieved in raising irrigated plantations in a systematic manner. Work was started on a number of working plans in an attempt to raise irrigated plantations successfully, (NABI, 1962; AHMAD, 1963; etc.). Their provisions included clear-felling the existing irregular tree growth, largely of babul, leasing out for cultivation for 3 years; laying out the Punjab system of irrigation after the lessees had left the areas; and planting up with 'valuable fast growing species, of industrial value', e.g., shisham, mulberry, *Salmaal*, *Acacia catechu*, *Populus X euramericana*, *P. casale*, *Albizia lebbek*, *Kydia calycine*, *Eucalyptus* spp., *Trewia nudiflora*, *Ailanthus* spp., *Gmelina arborea*, *Alstonia scholaris* and *Broussonetia papyrifera*. Babul—the sheet rock of Sind forestry so far—was completely banished from these plantations except from areas where the soil was too saline for the survival of any other species. But none of the new species succeeded and management soon reverted to babul as the major species for the irrigated plantations of Sind.

Summary. *Traditionally the irrigated plantations of the Punjab have been managed under the two storeyed high forest system with an understorey of shisham and mulberry and an overstorey of shisham standards. The lower storey has been managed on a rotation of 16 to 22 years at different times. Shisham standards have been retained for three rotations. Yield is regulated by areas without allowing for variation in site quality.*

The Sind plantations are still in their formative stage, their special problems are:

- (i) *soil salinity combined with a high water table in the Ghulam Mohammad Barrage zone;*
- (ii) *heavy work involved in levelling land;*
- (iii) *lack of as intense a demand for temporary cultivation as in the Punjab.*

In recent years there has been a massive return to babul as the principal species in the irrigated plantations.

The riverain forests

The riverain forests of Sind. The riverain forests of Sind are situated between the river Indus and its protective embankments. The existence of the forests is entirely depen-

dent on regular inundations. The major tree species in the northern zone is kandi (*Prosopis spicigera*) and in the southern, babul. Bahan (*Populus euphratica*) and lai (*Tamarix* spp.) occur in both zones—the former on fresh alluvium and the latter in low lying areas. Babul requires inundation of about two to four feet annually for adequate growth and is replaced by kandi in high lying areas which do not get inundated to this depth. Kandi predominates in the northern zone because of the higher incidence of frost and inadequate inundation as compared to the southern zone.

Because the species composition and site productivity in the riverain forests is determined primarily by edaphic factors, and these are constantly changing, the forestry situation is always in a state of flux, posing a major challenge to long-term planning. Large areas of land bearing babul and kandi may be eroded by river action and in their stead, fresh alluvial deposits may appear, capable only of bearing bahan and lai. In time the level of these deposits is raised by the deposition of silt, making conditions favourable for the growth of babul. When the level is raised still higher, beyond the reach of adequate inundation, babul yields place to kandi. Thus the vagaries of the river Indus have been a problem to all foresters who have sought to introduce a semblance of order into the management of the riverain forests of Sind.

The importance of the riverain forests of Sind for supplying fuel to the steamers, and later the railways, has already been alluded to under the section on early history. The following note on the history of management of these forests up to 1950 is based on Abichandani's working plans:

Till 1875 these forests were exploited unsystematically. From 1875 to 1895 a number of schemes were introduced which prescribed clear-felling of babul, kandi, and lai on equal adjacent coupes and selection felling of bahan. Regular working plans were introduced in both the Lower and Upper Sind forests towards 1900. The major prescriptions of these plans in force from 1900 to 1935 were as follows:

- (i) Division of the area into a large number of felling series, each averaging about 2,000 acres in area. These numerous small-sized felling series were necessary because of scarcity of local labour and of the difficulties in disposing of the produce from these scattered forests.
- (ii) Clear-felling on equal adjacent areas on a rotation of 30 years for all species.
- (iii) Reservation of all babul in the northern zone for meeting timber requirements, and in the southern zone retention of advance growth up to 9 inches girth at the base.
- (iv) Exclusion of 10% of the gross area of each riverain forest from the annual coupes as a safeguard against river bank erosion.

The application of the policy of clear cutting on equal adjacent coupes to these irregular forests entailed considerable financial sacrifice in cutting immature trees and not cutting the over-mature. The revised working plan, which remained in force from about 1915 to about 1935, therefore switched over to annual felling coupes according to the

condition of the growing stock. The main objective was to harvest the over-mature trees which were deteriorating. The annual coupe comprised both the stocked and unstocked areas to equalize annual yields, and blanks were to be regenerated artificially. The working plan for the forests of the southern zone increased the size of advance growth to be retained to 15 inches girth. About 15 selected babul trees per acre of 16-36 inches girth were reserved to meet the requirements for timber. In the northern zone wholesale reservation of babul was replaced by retention of babul advance growth up to 12 inches girth and all dense groups of babul up to 3 feet girth. Regeneration in both zones was by coppice, root suckers, and broadcasting sowing.

By about 1935, the over-mature stock had been harvested and it was no longer considered justifiable to continue with the uneconomic practice of working small annual coupes scattered far apart. Under Abichandani's working plans which remained current from 1935 to 1950, management therefore reverted to clear-felling of equal adjacent annual coupes. To concentrate work the size of the felling series was doubled which also doubled the size of the annual coupe. Due to scattered working during 1915-1935, the crop had become irregular and clear cutting equal adjacent annual coupes would have entailed too heavy a sacrifice. A conversion period of 15 years was therefore proposed for the southern zone and of 18 years for the northern to steer the growing stock towards regularity. Fellings during this period were to be carried out according to the following principles:

- (i) The annual coupe would equal about 1/18th and 1/15th the area of each felling series in the northern and the southern zones respectively. The areas under fresh accretions and under bahan and lai would be excluded from this calculation.
- (ii) While allotting coupes to different years of the conversion period, the order of priority should be: crops over 25 years, 18-25 years, and 9-18 years of age.
- (iii) Because long-term planning would not have been realistic in view of river action, coupes were allotted only for the next 5 years in the northern zone and 4 years in the southern. As a further element of flexibility, areas felled annually could vary, provided the total was made up by the end of the period.
- (iv) Advance growth of babul up to 15 inches girth and of kandi up to 9 inches girth was to be retained.
- (v) In the northern zone, groups of babul not less than one acre in extent and in the southern zone 1/2 to 4 acres in extent, in crops above 18 inches girth, were to be reserved.
- (vi) The regeneration of babul patches reserved as above in the northern zone was to be brought up and tended under a shelterwood to save it from forest injury.

Artificial regeneration by sowing mixed seed of babul and kandi before, during and after the floods was provided in those exploited areas which lacked adequate established regeneration.

Ahsan Ahmad's (1972) working plan for the riverain forests of Hyderabad Forest Division aims at the maximum sustained production of timber and planting of blanks which receive inundation or can be lift irrigated. The stocked areas which are inundated annually are to be managed under the clear-felling system with the following sequence of operations:

- (i) fell by the end of May;
- (ii) lease out for temporary cultivation for one winter crop;
- (iii) after the land is ploughed by the lessee in September, broadcast babul and kandi seed in 75:25 ratio;
- (iv) if lessee is not available, carry out soil working yourself;
- (v) continue broadcasting seed in flood waters for three years;
- (vi) protect from grazing for five years.

Rotation prescribed is 20 years for babul and 30 for kandi. Yield is regulated by reduced area with a volume check. The annual harvest is made up by felling in the following order of priority:

Erosion strips (areas threatened by river action); burnt areas; dead wood; windfalls, special purpose fellings; felling in the annual coupe.

Felling will be stopped when the prescribed yield is completed but burnt areas are to be harvested even over the prescribed yield and the excess worked off in the future years.

Since 1974 (KERMANI, 1974) the riverain forests are being sown by aerial seeding.

The riverain forests of the Punjab. The riverain forests of the Punjab comprise unculturable land on the banks of rivers which appear to have been acquired by Government towards the sixties of the past century for raising fuelwood for the railways. These lands were originally under the Civil administration and have been intermittently transferred to the Forest Department for planting and management. Experimental work on planting the 'belas'¹ was probably first started by Steward, then Chief Conservator of Forests, in Jhok and Sadhanwali 'belas' near Lahore (MALIK, 1961). The lands were given out on cultivation leases for levelling and clearing of coarse grasses, and shisham seed was sown along with field crops. The tree seedlings were irrigated from shallow temporary wells. Interest in this type of work dwindled after about 1890, probably because the railways switched over to coal but appears to have revived again about 1920.

Belas of Muzaffargarh Forest Division: The first working plan for these bahan (*Populus euphratica*) forests was prepared by Kashyap and remained in force from 1922 to 1947. It constituted two working circles—the Northern and the Southern. The Northern prescribed clear-felling on a rotation of 25 years with regeneration from root suckers. Yield was regulated by area. In the Southern only improvement felling were to be conducted. Kashyap's plan was followed by Sohan Singh's (1948 to 1968), which instituted

1. Punjabi term for riverain areas.

four working circles—Poplar, Conversion, Afforestation, and Protection. The Poplar Working Circle comprised those areas which were adequately stocked with bahan and shisham. Clean-felling was prescribed on rotations of 60 years for shisham and 20 for bahan, with provision for the retention of 4-5 mother trees in addition to advance growth. Yield was regulated by area, regeneration from root suckers. The Conversion Working Circle included poorly stocked bahan forests, to be clear-felled and replaced by shisham and babul, depending on site. The Afforestation Working Circle was formed out of areas devoid of trees, to be stocked with bahan, shisham and kikar (*Acacia arabica*) according to site. The rest of the area, fit neither for exploitation nor planting, was relegated to the Protection Working Circle (GHANI, 1967).

Ghani (1967) in his revision of the above-mentioned plan, has made a break with the past tradition by prescribing the raising of irrigated plantations in areas where canal water is available. For this purpose he has created the Plantation, and Conversion Working Circles—the former for sand dune areas bearing desert scrub and the latter for areas under inadequately stocked crops of bahan, shisham, and kikar. The principal species in both these working circles will be shisham, constituting 70% of the crop.

A Bela Working Circle has been formed for well stocked crops of shisham, kikar and bahan which subsist on inundation or sub-soil water. The area is to be clear-felled during the ten-years of the plan, according to a year-wise felling programme, and regenerated with shisham by planting, kikar by direct sowing and bahan by root suckers, according to site conditions.

Belas of Gujranwala-Sheikhupura Forest Division: The first working plan for these forests by Fazal Muhammad Khan remained in force from 1923 to 1953. He divided the area into three working circles: Shisham, Sarkana and Kacha—the first for better stocked areas, and the last for areas under water or unstable new accretions. Clear-felling was prescribed in the Shisham Working Circle and planting in the Sarkana Working Circle and no prescriptions were given for the Kacha Working Circle. Malik (1961), in his revision of the above-mentioned plan for 1957-1967, retained these working circles but altered their names to Shisham, Afforestation and Kachi. Since the Shisham crop in the Shisham Working Circle was mostly young, it was to be tended during the currency of the plan. The area in the Afforestation Working Circle was to be planted according to the plan's yearly schedule.

Belas of Gujrat and Lyallpur-Jhang Forest Division: The first working plan for these forests was written by Jaswant Sing for 1939-1954. He divided the area into three working circles—Shisham, Afforestation and Unregulated. The Shisham Working Circle comprised predominantly Shisham crops to be worked under the clear-felling system, with regeneration from coppice and root suckers, supplemented by planting shisham by the 'bela' technique (CHAMPION, SETH and KHATTAK, 1965). One-third of the area was to be regenerated during the 15-year currency of the plan, the rest of the area had to be thinned on 10 years cycle. The prescriptions of the Afforestation Working Circle required its planting by shisham using the 'bela' technique. The size of the annual planting coupe was not prescribed and the Divisional Forest Officer had to prepare a three-year planting

programme and have it approved by the Conservator of Forests. The Unregulated Working Circle consisted of areas under water or areas still unstable (MANZUR AHMAD, 1962).

Manzur Ahmad (1962) retained the same working circles in his current working plan for 1957-72 but reduced Jaswant Singh's five felling series for the Shisham Working Circle to two—one for the 'belas' of Gujrat West Forest Division and the other for those of Lyallpur-Jhang. The silvicultural system prescribed is clear-felling with reservation of ten standards per acre below 5 feet girth at breast height. Yield is regulated by area. During each year of the plan, 1/15th of the area of mature forest in each felling series has to be clear-felled and regenerated by root suckers and planting. The prescriptions of the Afforestation and Unregulated Working Circles remain the same as in the previous plan, except that land levelling by cultivation leases in the Afforestation Working Circle has been taken over by the Forest Department.

Belas of Dera Ghazi Khan Forest Division: The riverain forests of the present Dera Ghazi Khan Forest Division were transferred to the Forest Department in 1952 from the control of the Civil administration. Till 1965, their planting by the 'bela' technique was carried out under annual afforestation programmes sanctioned by the Chief Conservator of Forests. Hameed Ahmad (1967) wrote the first working plan for the forests of Dera Ghazi Khan for 1965-85. He formed a Bela Working Circle for the approximately 5,000 acres of young shisham and kikar plantations and the 21,000 acres of land covered mostly with coarse grasses. The plan prescribes the tending of the young crop, and the stocking of the bare areas by the 'bela' technique.

Summary. *The Sind riverain forests of babul and kandi are managed under the clear-felling system with broad-cast sowing in receding flood water. Aerial seeding is being increasingly employed since 1974.*

Yield regulation is by area. Areas threatened by river action are given the highest preference in cutting followed by burnt areas, dead-wood, windfalls and special purpose fellings and the balance of the year's prescribed yield is taken out of that year's coupe.

The riverain areas now under the control of the Punjab Forest Department usually represent scattered lands transferred from the control of the Civil administration, mostly in a piece-meal manner. Most of the area is blank, some of it still unstable. The major species are shisham and bahan with some kikar. The present management aims for these area are as follows:

- (i) *Conversion into irrigated plantations where canal irrigation is available.*
- (ii) *Conversion of existing wooded areas to high forest of shisham, bahan and kikar.*
- (iii) *Planting of areas devoid of trees with the above-mentioned species according to site conditions.*

Sub-tropical broad-leaved forests

Haripur Forest Division. The first working plan for the forests now comprising the Haripur Forest Division was made by Baden Powell in 1879, who prescribed the coppice

with standards system for the sub-tropical broad-leaved forests of kau (*Olea cuspidata*), phulai (*Acacia modesta*), and santha (*Dodonea viscosa*). But the prescriptions of the plan were not followed and the lessees cut what they liked. Monro (1904) retained the coppice with standards system for the Brushwood Working Circle in his revision of Baden Powell's working plan. A rotation of 30 years was prescribed and all 'snatha' 6 inches and above in girth at ground level, and all 'kau' and 'phulai' above 18 ft. girth at stump level, were to be felled in the year's felling coupe (SHAFIQUE, 1961). Mehr Chand (1926) also retained the Brushwood Working Circle for the commercially exploitable broad-leaved forests and prescribed coppice with standards system on 20 years rotation. In the year's felling coupe, all 'snatha' over 3 inches girth at the base was to be clear-felled, leaving groups of 3 to 4 bushes above the exploitable size spaced, 20-25 feet apart for seed production. Kau and phulai were not to be cut. The yield was regulated by area.

Shafique (1961) in his current working plan (1960-75) has prescribed the selection coppice system for the Brushwood Working Circle on a felling cycle of 15 years. The prescribed exploitable sizes are 3 inches girth at the base for snatha, and 6 and 8 inches diameter at one foot above ground level for kau and phulai respectively. A yield of 100 cubic feet per acre stacked has been prescribed, on the basis of yields obtained in the past.

Attock Forest Division. The control of the Kalachitta Reserved Forests was transferred from the Deputy Commissioner to the Forest Department in 1879. In 1890 the browsing of camels was stopped and sheep and goat grazing confined to areas where such rights had been admitted under settlement. From 1879 to 1895 no regular fellings were executed; the produce was sold when there was demand for it. The contractor clear-felled the coupe leaving 5 to 6 standards per acre. With the implementation of Reuther's plan in 1895, the area was divided into eight working circles, 5 of them with exploitable tree growth to be worked on coppice with standards system. Each working circle was divided into thirty annual coupes of equal area. In the remaining area only grazing and browsing were controlled. Kitchingman's plan replaced Reuther's and remained in force till 1957. It constituted a Coppice and a Protection Working Circle. To the former were allotted Reuther's five working circles which were now termed felling series. The Protection Working Circle was to be worked on selection system with a 30 year cutting cycle. Natural regeneration of coppice and seedling origin was to be relied on. The exploitable diameters of the two major constituent species—kau and phulai—were prescribed at 8 and 18 inches at stump height respectively. For the latter species, it was reduced to 8 inches in 1945 (QURESHI, 1968).

Qureshi (1968), revising Kitchingman's plan, divided the forests of the Attock Forest Division into Coppice and Afforestation Working Circles. The Coppice Working Circle has been divided into 6 felling series, five of them the same as Kitchingman's and the sixth comprising a new area transferred to the working plan. The yield is regulated by area and each year 1/30th of each felling series will be gone over in selection fellings guided by the following rules:

- (i) remove dead trees;
- (ii) cut kau and phulai if 8 inches and over in diameter one foot above ground level and snatha if 3 inches and over in diameter at ground level.

- (iii) thin lightly clumps of kau and phulai along with the main fellings;
- (iv) do not fell these on precipitous ground unless standing over established regeneration.

After exploitation the blank areas will be stocked by sowing on contour trenches or in pits. The areas exploited will be protected from grazing for ten years.

The Afforestation Working Circle will be afforested in the period of the plan by sowing phulai and snatha in conjunction with water conservation measures such as contour trenches and furrows, and check dams. Seedlings of kau will be transplanted into trenches. Castor will be sown in areas with deep soil.

Jhelum, Mianwali and Shahpur Forest Division. The forests of the Jhelum, Mianwali and Shahpur Forest Divisions were transferred to the Forest Department in 1870. The first regular working plan for the forest was prepared by Said (1956). It distinguished three working circles: Coppice, including fairly well stocked areas; Afforestation, where stocking was poor but the soil was deep enough to support tree growth; and Protection, where the soil was too shallow for raising tree crops. The Coppice Working Circle is divided into eight felling series. Yield regulation is by area and each felling series is divided into 30 annual coupes. The silvicultural system is selection coppice. The exploitable size for kau and phulai is 6 and 8 inches diameter one foot above ground respectively. While going over the annual coupe for felling, the blanks will be stocked using dry-zone afforestation methods.

The Afforestation Working Circle will be restocked with xerophytic species e.g. phulai, mesquite, ber (*Zizyphus* spp.) using dry-zone afforestation methods.

The Protection Working Circle comprises areas which are too rocky for large scale afforestation. 1/30th of the area will be taken up every year for closure to grazing and browsing for a period of ten years.

Summary. *The sub-tropical broad-leaved forests have all along been worked on the selection coppice system in which the felling series is divided into coupes of about the same area, equal in number to the years in the felling cycle—usually 30. Each year an annual coupe is gone over for felling of trees of exploitable size: usually 6 inches and 8 inches diameter at one foot above ground level, respectively, for kau and phulai—the two main component species of these forests.*

References

- ABICHANDANI, C.G., Revised Working Plan for the Hyderabad and Karachi Forest Divisions. Government Printing Press, Karachi. (1937).
- ABICHANDANI, C.G., Revised Working Plan for the Upper Sind Forests. Government Printing Press, Karachi. (1940).
- AFZAL, K. MUHAMMAD., Revised Working Plan of the Daphar Irrigated Plantation and Pakhowal Forests. Punjab Government Printing Press, Lahore. (1961).

- AHMAD, AHSAN., Working Plan for the Irrigated Plantations in the Ghulam Muhammad Barrage Zone. Government of West Pakistan Printing Press, Lahore. (1963).
- AHMAD, AHSAN., Draft Working Plan for Riverain Forests of Hyderabad Forest Division for the Period from 1966-67—1985-86.
- AHMAD, BASHIR., Revised Working Plan for the Khanewal Irrigated Plantation. West Pakistan Government Printing Press, Lahore. (1957).
- AHMAD, MANZUR., Revised Working Plan for the Bela Forests of Gujrat West and Lyallpur Jhang Forest Divisions. West Pakistan Government Printing Press, Lahore. (1962).
- AHMAD, MIAN MUSHTAQ., Working Plan for the Khanewal Irrigated Plantations. Punjab Government Printing Press, Lahore. (1935).
- AHMAD, MIAN MUSHTAQ., Revised Working Plan for the Changa Manga Irrigated Plantation. Punjab Government Printing Press, Lahore. (1938).
- AHMAD, MIAN MUSHTAQ., Working Plan for the Daphar Irrigated Plantation. Punjab Government Printing Press, Lahore. (1938).
- CHAMPION, HARRY G, S.K. SETH and G.M. KHATTAK., Manual of Silviculture for Pakistan, M/S Ferozsons Limited, Peshawar. (1973).
- CHOPRA, R.S., Revised Working Plan for Changa Manga Irrigated Plantation. Punjab Government Printing Press, Lahore. (1949).
- GHANI, ABDUL., Revised Working Plan for the Forests of Muzaffargarh Forest Division. West Pakistan Government Printing Press, Bahawalpur. (1967).
- KERMANI, W.A., Aerial Seed Sowing in Riverain Forest Areas of Sind. Proceedings of the Pak. For. Conf., 1974.
- KHAN MUHAMMAD., Working Scheme of Shorkot Plantation. Punjab Government Printing Press, Lahore. (1950).
- KHAN MUHAMMAD., Working Scheme of Kamalia (Burala) Plantation. Punjab Government Printing Press, Lahore. (1951).
- KHAN MUHAMMAD., Revised Working Plan for the Chichawatni Irrigated Forest Plantation. West Pakistan Government Printing Press, Lahore. (1962).
- MALIK, ABDUL QAYUM., Revised Working Plan for the Bela Forests of Jhok, Sadhanwali, Korotana Faizpur and Katarband. West Pakistan Government Printing Press, Karachi. (1961).
- NABI, S.G., Working Plan of Irrigated Plantations of Nawabshah Division, West Pakistan Government Printing Press, Lahore. (1962).
- QAZI, I.A., Working Plan for the Plantations of Bahawalpur Forest Division. West Pakistan Government Printing Press, Bahawalpur. (1967).