

# COTTON CULTIVATION IN SIND.

## I.

### INTRODUCTION.

Cotton cultivation in Sind appears to be of ancient date, but previous to the British conquest all indications suggest that its area must have been very small. Its growth received much stimulus from the general development of trade after the conquest. Previous to that time the whole of the clothing of both rich and poor seems to have been prepared from Sind grown cotton, hand spun and hand woven, and there are parts of several Talukas of Upper Sind, notably Ubauro, Ghatki, and Pano Akil, where this is still the case.

Though actually not extensively grown, there was no doubt of the suitability of Sind for the cotton crop, and Watt quotes a statement of Mahomed Masum that the cotton plants of Sehwan grew as large as trees and were picked by mounted men.

At present cotton occupies, in point of area, the fourth position among the crops grown in the *Kharif* season, being only exceeded by rice, *bajri* (*Pennisetum typhoideum*) and *jowar* (*Andropogon sorgham*). Its rise to this position is comparatively recent. Previous to 1900 the area was much smaller and was almost limited to the land under the irrigation canals of the present Hyderabad and Nawabshah Districts. In recent years there has, however, been considerable extension, among the causes of this extension being the following:—

(1) Opening of the high level Jamrao Canal in 1900.

(2) Reformation and extension of the Nasrat and Dad Canal systems.

(3) Conversion of some of the paddy lands into dry crop lands on the Eastern Nara system due to shortage of water consequent upon the Jamrao system sharing a part of its original supply of water.

(4) Improvements in the inundation canals of Hyderabad District.

These factors coupled with a cotton market ruling high since the first decade of the present century (Rs. 10 to Rs. 23 per Bengal maund) have brought the area as under:—

1911-12	...	331,705
1912-13	...	280,502
1913-14	...	324,921
1914-15	...	325,431
1915-16	...	155,269
1916-17	...	233,373
1917-18	...	259,873
1918-19	...	306,018
1923-24	...	339,317

Seed cotton (*phutties*) rates for 18 years ending 1922 were as under:—

1905-06	.. Rs 5-0-0 per maund of 82½ lbs.	
1906-07	... Do	do.
1907-08	...Rs. 5-8-0 to Rs. 6-10-0	do.
1908-09	... Do	do.
1909-10	...Rs. 7-0-0 to Rs. 9-8 0	do.
1910-11	.. Rs. 9-0-0	do.
1911-12	Rs. 9-0-0 to Rs. 10-0-0	do.
1912-13	... Do.	do.
1913-14	... Do.	do.
1914-15	... Do.	do.
1915-16	...Rs. 8-4-0	do.
1916-17	Rs. 9-0-0	do.
1917-18	...Rs. 15-0-0 to Rs. 20-0-0	do.
1918-19	...Rs. 23-0-0	do.
1919-20	.. Rs. 16-12-0	do.
1920-21	...Rs. 15-0-0	do.
1921-22	...Rs. 15-0-0 to Rs. 17-0-0	do.
1922-23	...Rs. 13-0-0 to Rs. 16-8-0	do.

Further extension of cotton cultivation must be limited till after the more assured supply of water becomes available with the construction of the Sukkur Barrage canals, because the present canals in Sind depend upon the state of the river and as the latter is never steady the late flow of the canals and consequently late sowings may expose cotton to the risk of damage by frost in the cold weather, or the earlier fall of the river may result in only partial maturing of the crop.

A slump in prices has also been found to affect the area adversely as was proved during the commencement of the great war when the area in the year 1915-16 came down to



155,269 as against 325,431 in the present shortage of labour also to a degree comes in the way of the extension in area.

The variety of commercial importance usually grown in Sind is a mixture of several types of *Gossypium neglectum*, a short stapled cotton showing with "Bengals" the lowest position on the Indian market. This variety, however, suits Sind admirably being hardy, early maturing and prolific, capable of yielding 25 maunds (2,000 pounds or over) per acre under very favourable conditions. For these reasons it is very popular with the people and rice is the only crop which the people of the cotton zone would care to substitute for it. This latter, however, is not practicable owing to the limited water supply and also restriction of its cultivation on the modern canals.

## II.

### DISTRIBUTION AND AREA.

The chief cotton growing districts in which the variety of chief commercial importance is grown are:--

Thar Parkar, Hyderabad and Nawabshah.

In the Thar Parkar District the whole tract, commanded by the Jamrao canal comprising the talukas of Mirpurkhas, Jamesabad, and Digri, is devoted to cotton cultivation and the proportion of this cultivation to the total area of cultivation is about 48.75 per cent. in Mirpurkhas and Digri talukas. In the Nara Valley Sub-Division of the same District the tract, comprising the talukas of Pithoro, Khipro and Sanghar, irrigated by the Mithrao canal, is also devoted to cotton cultivation which has begun to extend recently owing to deficient water supply for rice, the staple crop of the tract.

In the Hyderabad District, cotton is grown in all talukas except the southern parts of Badin and Tando Mohamed Khan which being within the influence of the sea are supposed not to be suitable for cotton cultivation while the general contour of the tract being low the lands are subject to floods during high inundation and occasional heavy rains. Of the cotton talukas in the Hyderabad District the neighbourhood of Maldasi and Bhitshah in the Hala Taluka grow the best crop in Sind. The excellent condition of the crop appears to be due to more careful selection of seed and better cultivation. In the bordering district of Nawabshah to the

north, the tract to which the cotton cultivation is confined, comprises the talukas of Shahdadpur, Nasrat, Sinjhora and parts of Naushahro. Beyond the boundary of Pad-idan in Naushahro Taluka the cultivation abruptly falls and except some area in the Khairpur State, cotton cultivation is either insignificant or absent.

Thus North Sind, comprising the Districts of Sukkur, Larkana and Upper Sind Frontier, does not grow any cotton except in patches here and there. The produce even is generally used for home consumption such as stuffing quilts and making cloth.

The area under cotton averaged for the last nine years is 285,045 acres on Government canals. The statement given in the Appendix shows the distribution of area under various canals. It will be noticed that cotton is grown mostly on the left bank of the Indus while the area on the right bank is very small.

### III.

#### CLASSIFICATION AND DESCRIPTION.

Though the main crop consists of the type already described, there are three distinct species of cotton met with in Sind. These are:—

(1) *Gossypium neglectum* which gives a tall plant with simple wand-like stem tapering from base to apex. The lower branches are sparse but long and spreading; the middle branches are short and the uppermost very short. The leaves are dark green, and the bracteoles, triangular entire or slightly toothed upwards. The flower petals are reflex.

(2) *Gossypium obtusifolium* which is characterised by ascending branches, green leaves with basal lobes and lateral folds in the sinuses. The bracteoles are entire or slightly toothed, and the flowers have a small yellow corolla. The bolls are small.

(3) *Gossypium stocksii* or the wild cotton of Sind. This is a perennial shrub with thick leathery leaves matted with stellate hairs. The bracteoles are quite free, clawed and there are five toothed seeds closely compacted together, coated with a rich golden fuzz.

The variety of commercial importance (*Gossypium neglectum*) as cultivated in Sind is composed of the following species: -

	Colour of flower.	Shape of leaf.
Rosea	... White	Narrow lobed.
Cutchica	... Do.	Broad lobed.
Vera	... Yellow	Narrow lobed.
Malvensis	... Do.	Broad lobed.

The plant grows very luxuriantly and attains a considerable height up to 8 feet under irrigation and sometimes lodges under the weight of fruit and rich foliage. The yellow flowered forms have proved to have a better staple than the white flowered forms but give low ginning percentage, as has been the experience during the past few years of test. They do not appear to be so prolific as the white flowered types.

The *Obtusifolium* type found in Sind is not commonly met with. It is found in parts of Sukkur and Upper Sind Frontier Districts along the riverian tract on wells and on moisture holding kacha lands.

*Gossypium stocksii* is found growing on the sandy lime stone soils in raised places round about the hills situated at a distance of 8 to 10 miles from Malir (Karachi) towards the Hub plains. Plants grow singly and widely scattered under shelter of other bushes. The plant spreads on the ground and forms a small bush with broad lobed leaves and small yellow flowers with a brilliant eye at the base of the petals. It bears small fruits enclosing fuzzy-coated seeds. Certain plants have purple red stem and branches. Boll worm is noticed in the boll. Seed being enclosed in a hard seed coat takes a long time to germinate. The stubbles sprout on the advent of monsoon rains, and produce flowers and bolls in August-September and the cotton is ready in October-November. The plants are usually grazed on by goats and camels and the seed cannot be easily gathered.

#### IV.

#### COTTON SOILS.

Cotton grows on various kinds of soils but it thrives best on "dasar" (loam) or varyasi dasar (sandy loam). Stiff soils (khuhuri) are not desirable, as the soil surface cakes and hardens after irrigation and the growth of the young seedlings

is consequently retarded, but with a little extra care and cultivation a good crop of cotton is often raised. Such soils are popularly known to be very fertile and take longer to exhaust than any other kinds of soils.

*Kalar* (salt) lands are not suited to cotton cultivation but if the soil is only slightly impregnated with salt, and if germination takes place the crop makes a wonderful growth under irrigation on such soils and branches very freely.

Sandy soils (*Varyasi*) are unfit for cotton but with an addition of much organic matter such soils often carry tolerable crops of cotton. "Buth" soils, with coarse bright sand underlying the surface soil, are unfit for cotton cultivation.

Soils along the bank of the river receiving a considerable amount of silt annually during high inundation of the river are often utilized for growing cotton in Upper Sind. These soils are very retentive of moisture and the plants put on a lot of vegetative growth.

## V.

### SEASON AND CLIMATE.

Cotton is essentially a *kharif* crop. The *kharif* season extends normally from June to October and coincides for the first 3 months with the height of the inundation. The time of sowing on inundation canals is normally June and on the Mithrao and Jamrao canals May to June; but when the rise of the river to a high and steady level is late (which is not uncommon) the sowings are correspondingly delayed. After about the middle of July cotton sowings are stopped and replaced by *bajri*. Sind agriculture depends for all practical purposes upon canals for its water supply as the rainfall is almost negligible. Any delay in the rise of the river may, therefore, bring about a reduction in area under *kharif* crops, or a premature termination to the inundation season may leave crops unmaturing. Again it may narrow down the season to an extent demanding almost immediate sowing regardless of quality of cultivation. All these conditions impose serious limitations upon the agriculture of the country.

If the water supply is available early in the season, as is sometimes the case on the Jamrao and Eastern Nara systems, a small area is sown with cotton in April-May and

the crop sown at this time is called "Arhari". This crop is ready for picking early and consequently escapes possible damage from frost but is subject to the rigour of the hot and scorching winds which blow in April and May.

Northern winds which normally begin from the end of October are popularly considered to be very beneficial for cotton because thereby not only does the crop recover from any disease from which it may be suffering but it stimulates additional production of flowers and bolls.

## VI.

### ROTATION, FALLOWS, AND MANURE.

Rotation of crops based on any regular system is not practised in the cotton zone. Fallowing is commonly observed as a result of limited water supply. On the Jamrao canal according to irrigation rules only one-fifth of the commanded area can be cultivated in the *kharif* season, and one-eighth in the *rabi* season only. Thus only 1/3rd of the total area can be cultivated in one year. Similarly on the inundation canals a large portion of the land has to be left fallow except on small holdings on the lands along the canals where irrigation is comparatively easy, and on the lands near villages. These lands are cultivated year after year with a good dressing of manure. Cotton will not thrive on the same land for two successive years. Accordingly cotton is followed by bajri in the second year and cotton again in the third year. On larger holdings in the inundation canal tracts, and on lands on the Jamrao, Dad, Nasrat, and Mithrao canal systems the following rotation of crops will indicate the general practice wherever possible. Cotton is sown the first year, the land is then left fallow the second year, and in the third year it is devoted to *bajri* in the *kharif* season or wheat in the *rabi* season followed again by cotton in the fourth year.

Farm yard manure wherever available is often taken advantage of by resourceful cultivators and applied to the cotton land. Another fertilizer which is in great demand is the earth from the mounds that mark the sites of old towns and villages. It is very rich in nitrates. It is sprinkled over the field as a top dressing when the young plants are about a foot high at an average rate of three tons per acre and its first effect is to wither the leaves. Water is then let over the land and the crop springs up with redoubled vigour.

Canal silt and earth blown by wind and collected near the base of jungle bushes are also valued for manure. Sheep and goat folding is also practised particularly on the Jamrao and in the Eastern Nara tract and in the Nawabshah District. Herds of goats and sheep either owned by the cultivator himself or by the "*bakrars*" (professional shepherds) who may have come to temporarily settle on the land for grazing, keep their herd in the field so that the land may get the advantage of the urine and solid excreta of the animals. Usually the herd is removed every day from one bed of the field to another and an acre of land is thus sufficiently manured in from six to eight days by a herd consisting of about 100 animals.

Goat manure is said to be very effective on light lands and the crop responds to it very quickly.

## VII.

### METHODS OF CULTIVATION.

The methods of cultivation in all cotton growing districts do not differ very materially from each other. Sowing the seed broadcast is the feature of the prevailing system but in Hyderabad District cotton cultivation is more advanced than in the recently colonized tract of the Jamrao and the areas commanded by Dad Nasrat canals in the Nawabshah District. However, much depends upon the energy and the means of the cultivators and thus it is not unusual to find badly cultivated lands in tracts having a reputation for good cultivation.

In the Hyderabad tract the cotton fields in addition to preparatory tillage receive a good dressing of farm yard manure or silt or soil from old village sites specially when it has not been fallowed. The preliminary preparations begin by February when the first operation is to remove the old stubbles and the roots of weeds, &c. This work involves considerable time and labour, but is nevertheless carried out by the cultivator and his family.

The land is next ploughed in a dry condition once or twice with the local plough fitted with an iron share having a short and narrow point specially prepared for the purpose. Big clods are produced when the land is ploughed dry but these are often broken with the "*watahar*" (wooden hammer) one by one. The carting of manure is next begun. The



manure is generally carried on the back of donkeys and camels and this work is generally done at night when it is cool preferably by moonlit nights. The manure is put at the rate of 250 donkeys per acre. Each donkey load weighs from 30 to 40 pounds. The cost of manure per 100 loads is about Rs. 3 to Rs. 4. The land is then divided into small compartments according to the level of the land, for the purpose of irrigation. The number of compartments is greater on land to which the water has to be lifted ("lift land") than on the land getting water by flow. Immediately on the flowing of the canals if the land is lift land, a Persian Wheel erected in advance is worked to give a preliminary watering (*Rej*). The field is watered bit by bit so that only a portion of the field sufficient to be dealt with by the cultivators with a limited number of plough cattle is ready day by day till the whole field is sown. Usually two preliminary waterings, locally called "*katcha*" and "*paka rej*" are given to allow the land to get sufficient moisture. The second watering follows the first immediately on the drying up of the latter. As soon as the land comes into a friable condition, cotton seed which is previously prepared by mixing it with mud is broadcasted on the land and ploughed in. Usually one ploughing is given to cover the seed but sometimes two are given.

"*Sammaring*" is generally not practised to level the ploughed up land. The crop is then not watered for three to four weeks after which it is watered at intervals of twelve to fifteen days, till the canals dry up in September or early in October. The crop is required to be weeded twice or thrice at intervals of a month. The first weeding is either done before the crop is watered for the first time (*suki gud*) when the soil is still loose or after it is watered. The charges for "*suki gud*" are less than those for weeding the crop after irrigation. The weeding operation is either done by the cultivator himself and his family or by a hired labour—mostly by the latter agency at a cost of about Rs. 4 to Rs. 8 per acre each time, the "*suki gud*" costing about Rs. 3 per acre, and the other about Rs 5 per acre. If the growth of weeds is strong and the soil stiff, the cultivator gets a regular cultivation done to a couple of inches with a *kodal* and pays for the operations higher wages than for the ordinary hand weeding. Interculturing with bullock power has not been possible in the past as the crop has been universally sown broadcast.

Cotton comes into flower by September and the outturn is considerably affected by the character of the weather at this period.

Cotton picking begins from the end of October or early in November and lasts till January or even February, provided the crop is not damaged by frost in December or January. The pickings take place at short intervals because the cultivators fear that their fields will be robbed at night. During the picking period the cultivators go round the cotton field once or twice during the night to scare away any thief who may have come to pilfer cotton.

The ridge method of sowing cotton is also to some extent practised almost exclusively by Hindu cultivators in villages of the Mahar, Khebar Khandoo (Jagir) and Sekhat and Bhitshah dehs, all in Hala Taluka. The main object in resorting to this method is to gain on the sowing time. After the usual preparatory tillage and manuring, the field is thrown into ridges either with the hand or by the plough fitted with a bundle of grass or a wooden board inserted in the angle of the plough.

As soon as the water arrives in the canals the seed is dibbled by hand just an inch below the top of the ridge and the furrows watered. The water is regulated in such a way that it does not rise above the dibbled seed. The seed germinates in four to six days, and by the time the crop with the ordinary broadcast method is sown in other fields, the ridge sown crop is several inches high. The after treatment of the crop with regard to the weeding and watering is practically the same as with the crop sown broadcast. This method of sowing gives an excellent crop but requires much more labour than the crop sown in the usual way.

It must be noted, however, that preparatory tillage for cotton fields is by no means universal. On larger holdings this operation is seldom carried out and as the fields on such holdings generally lie fallow for two or three years the item of manuring does not enter into the programme of the cultivation of such lands.

On the Jamrao canal (in the Thar Parkar District) where the development of cotton cultivation is of comparatively recent date, the preparatory tillage as practised in Hyderabad is not, as a rule, done nor is the cotton land generally manured, but Punjabi colonists generally give preparatory tillage to cotton lands and sow the crop more

carefully than their Sindhi brothers. The water supply in the canal is normally available earlier and lasts longer than on the inundation canals of Hyderabad and Nawabshah Districts and therefore the sowings are done somewhat earlier. "Arhari" sowings are practised here and there but by far the largest area is cultivated in May and June. Waterings to cotton ordinarily last till November but if water is available the Sindhi will not hesitate watering his crop even up to December. In view of this and in view of the fact that nearly 75 per cent. of the land commanded by these canals is irrigated by flow the crops in a normal year generally suffer from over irrigation and consequently the seed cotton fetches about Re. 1 or Rs. 2 less per maund than the seed cotton produced in the Hyderabad District. On the other hand as Jamrao cotton can be watered longer a greater number of pickings can be obtained from it than is usually possible on the inundation canals.

The hand weeding of the crop is the rule and the charges for these operations do not ordinarily differ from those prevailing in the other cotton zones. The Punjabi colonist who sows his cotton crop more thinly than his Sindhi brother sometimes runs a plough once or twice in the crop before it comes into flower in addition to the usual hand weeding. By thus running a plough in the broadcast crop a few plants get damaged but the benefit accrued therefrom more than compensates for the loss of plants.

The mode of irrigation on the Jamrao differs from that on the inundation canals as most of the lands are commanded by flow water supply and consequently Persian wheels are rare. Two preliminary waterings are given in the same way as on inundation canals but the volume of each watering, being heavier under flow conditions, the land retains moisture for a longer period; consequently the first watering after sowing is given after four to six weeks; subsequent waterings are given at intervals of ten to fifteen days.

The cultivation on the Dad and Nasrat canals in the Nawabshah District does not differ materially from that practised in the Jamrao tract. From the point of irrigation, however, this tract is less favoured than the Jamrao, because the canals here do not flow so early as the Jamrao and Mithraonor does the supply last for the same period. Moreover this tract being recently colonised like the Jamrao, lacks in population and hence there is a scarcity of field labour. Owing to

the fact that two to three years fallow is usually given, the lands produce a normal crop in a normal inundation year. The quality of the soil is much the same as in the Jamrao tract with a tendency to be more sandy.

The riverian tract of Upper Sind extending from Rohri through Pano Akil, Ghotki and Ubauro talukas, which depends chiefly upon well irrigation in the *rabi* season for wheat and garden crops, is reputed for growing on a small scale an indigenous variety of Sindhi cotton of the *obtusifolium* type.

There are small scattered villages owning a number of wells on which a few patches of cotton may be noticed growing, *e.g.*, important cotton villages in Pano Akil taluka are Nauraja Bhela, Sarah, Bhutta, Ghunja, Soomra, Rawan, etc. Each village may own say about a dozen or more wells. The cotton area on each well varies from four gunthas to one acre. The average over about ten wells in a village came to 23 gunthas approximately per well. In February or March, when wheat is, in general, flowering, patches allotted to cotton are irrigated, ploughed twice or even thrice and pulverized with "*Watahars*" (wooden hammers). Usually garden fields are intensively cultivated on wells, cotton patches being rotated thus:—

1st year.—Garden crop, *viz.*, tobacco, brinjal, onion, etc., which are heavily manured.

2nd year.—Cotton which is not usually manured but is top-dressed with "sheep dung".

3rd year.—Fallow.

4th year.—Wheat.

In many cases cotton immediately follows the fallow and some cultivators manure the fallowed land before preparatory tillage but this is not common.

In this well cultivation in Upper Sind, the seed is either sown on the flat on ridges or in pits. In the first case small beds about eight feet by ten feet are formed and holes one foot apart are made with the *kodal*. Three to seven seeds are put in each hole and lightly covered. The seeds germinate on the moisture conserved in the soil. In the ridge system the ridges are made with the *kodal* about two feet apart and three to seven seeds are dibbled one foot apart on ridges. Water is at once applied and the crop germinates within a week. In river *katchas* where there is a sub-soil

moisture (sek), raised situations unaffected by the summer inundation are selected, ploughed and the seeds dibbled in holes about five feet apart. Melons and musk melons are also drilled in the rows five feet apart. The seeds are sown in February or March. The melon crop is ready in June-July. Cotton receives no watering and gets ready for picking in July-August. This practice is noticed in katchas.

Apart from this last peculiar and uncommon practice, the crop of Upper Sind now being described receives well water from March till June, when canal water arrives. By June the crop is five to six feet high and begins to put on flower and bolls. If grass grows between March to June, it is removed with the *kodal* or the hand khurpi. A handful of rotten sheep and goat manure is given to each plant to give it a good start. After June, canal water is availed of till September. During this interval the crop is well established and grows to a height of about eight feet. In some places like Ghotki where cotton seed is dibbled wide apart, say about five feet each way, chillies are transplanted early in March or April into the intervening spaces and come to bearing in August-September.

The crop in Upper Sind now being described usually matures for picking by July-August, and picking continues till the end of October. After October the crop is allowed to be grazed off by goats. In many cases the crop is ratooned. The stems are cut, the root stumps irrigated in February, and manure given with a hoeing. Only one ratoon crop is usually taken after which the field is ploughed up.

In this peculiar method of cultivation in Upper Sind the crop is usually picked by women. The entire boll is plucked and the seed cotton is cleaned off the bolls at home. Empty bolls make a good food for goats. It is very difficult to give accurate figures of outturns as the cultivators (*haris*) do not weigh the crop; they measure the produce invariably. As a rule, the family of *haris* picks the crop, the picking intervals being every third or fourth day. The picking charges are in kind, one-twelfth to one-seventeenth of the whole produce. The *batai* terms are usually one-fourth to the *zamindar* or landlord, and three-fourth to the *hari*, or one-third to the *zamindar* and a two-thirds to the *hari* according to mutual agreement. On well manured soil a guntha is capable of yielding one maund ( $82\frac{1}{2}$  pounds) of seed cotton (phutties) or 40 maunds per acre. The average figure should, however, be taken at half a maund per guntha or 20 maunds per acre.

The seed cotton (phutties) never comes into commerce. It is used locally, and is sold at three to four seers per rupee.

Cultivators generally do not sell their crop. They gin the cotton at home and use the seed for their live stock. The cotton is spun in "*Charkhas*" at home by women and the yarn is given to weavers. Four pounds of cotton will be enough to produce yarn for preparing a "*jori*" (2½ cubits by 1 cubit) for home made cloth. The weaver's charges are about Rs. 1-4-0 for preparing one *jori* of *khaddar* cloth. Two *jories* can provide a complete dress, *viz.*, one pair trousers, 1 shirt, 1 turban, and 1 *chaddar* or covering sheet. This cloth forms the dress of the local cultivators. A good *jori* costs from Rs. 3 to Rs. 4-8-0 according to the size and quality. It is dyed with variegated colours to make dresses for women. The local cotton is also largely used for stuffing quilts, pillows and thick bedding coverings for the people.

## VIII.

### SEED AND SEED RATE.

The seed rate differs according to the nature of the soil and according to how the land is worked before sowing. Stiff soils require thick seeding whereas sandy loams need thin seeding. Soils thoroughly worked previous to sowing require about three-quarters of the seed put in soils not worked well. Again the crop sown on ridges, as is done in a part of Hala taluka of the Hyderabad District, requires much less seed rate than the crop sown broadcast.

Punjabi colonists on the Jamrao canal believe that thinner the cotton crop the more outturn will it give and consequently do not use more than twelve to twenty pounds of seed per acre. Sindhis on the other hand prefer a thick crop and therefore use as much as half a Bengal maund per acre for stiff soils and about twenty-four to thirty pounds for light soils. It should, however, be noted that the Punjabis generally give preparatory tillage to their lands whereas the Sindhis do not. Soils containing *kalar* or salt patches receive a larger quantity of seed than sweet soils. This is done because on *kalar* patches the germination is very uncertain.

The seed rate is also determined by the quality of the seed. If the seed is obtained from hand gins or from a specially reserved stock of seed in ginning factories, the allowance per acre is from half to three-fourths of that from the ordinary power-ginned seed. It is prepared for sowing

by soaking it in water a few hours and then removing the fuzz by rubbing it in the dust and sometimes mixing it with a thin plaster of cow dung. This practice is however not by any means universal. Seed is often sown in its original dry state.

By far the largest quantity of seed for sowing purposes is procured from ginning factories. The ginning factories usually stock two sorts of seeds. One sort, which is said to have been obtained from the first two or three pickings and ginned separately, is sold at from eight annas to a rupee per maund more than the ordinary ginned seed. There is, however, no guarantee whether this seed is from healthy and mature bolls; the seed may consist even of broken stuff which is usual in ginning factories.

In Bhitshah and the surrounding villages in the Hala taluka seed is obtained from hand gins. For this, specially picked *phutties* from the second and third pickings are procured and ginned. This stuff, when ginned by hand, fetches about twice the price of the ordinary seed and the allowance per acre of this seed is little more than one-half of the ordinary seed. Hand ginned seed of the ordinary *phutties* is also used, but this seed is considered much inferior to that obtained from the carefully selected *phutties* from the field and is worth only a few annas more than the power-ginned seed.

The Bhitshah hand ginned seed has a wide reputation and the demand for it is said to have led the seed from inferior bolls pass off as the produce from best bolls and also led to adulteration with seed from power-ginning factories.

The "Artion" (hand gins) are bought at Rs. 4 to Rs. 6 each by professional cotton seed-dealers in villages. About forty hand gins are allotted to a spacious hall where the best quality of *phutties* (seed cotton) purchased from cultivators at a premium price is ginned. A contract usually prevails, and the coolies employed are Marwari immigrants who come to Sind for employment in the slack cold season. The rate of ginning is about one and a half to three annas per seer of lint.

## IX.

### THE IRRIGATION OF COTTON.

The irrigation of cotton in Sind, and no cotton is grown without irrigation, is carried on by means of canals which

draw their supply from the river Indus. These canals flow during the inundation season, the beginning and end of which varies considerably each year. Except in the more recently constructed high level canals like the Jamrao and Mithrao canals in East Sind which are less dependent on the immediate variations in the level of the river, the level of water in these canals is never steady but varies immediately with the variations in the level of the river Indus.

According to the level of the canal and of the land, irrigation is either by flow directly on to the land, by flow during part of the season aided by lift during the remainder, or entirely by lift, where the land is high. "Flow lands" are those on which water will flow by gravitation, while "lift lands" are those to which water has to be raised by artificial means even during the height of the inundation season.

Cotton is sown under all these three methods of irrigation. The Hyderabad District is almost wholly served by inundation canals, and these supply a very small area with flow water, consequently, in the district, cotton cultivation is usually under lift, and irrigation is of course very much more costly under these conditions, for more bullocks or camels as well as more men are required to keep the Persian Wheel or other irrigation contrivance moving, and their feeding or wages are entirely an additional expense. The respective cost of these two methods is given later. Lift irrigation though costly is nevertheless beneficial to the crops and land because in this method there is no chance of applying too much water to the crop as is generally the case in flow irrigation.

The usual number of waterings given to the cotton crop vary between five and ten excluding the preliminary waterings and each watering amounts approximately to 8,000/10,000 cubic feet per acre on flow land and about one-quarter of this amount on lift lands. This number of waterings is not however constant but varies from district to district and the number generally adopted in the different districts is as follows:—

Jamrao (flow)	...	8 to 10 irrigations.
Nawabshah (flow)	...	6 to 8 irrigations.
Hyderabad (lift)	...	6 to 10 irrigations.
Jamrao (lift)	...	8 to 10 irrigations.
Nawabshah (lift)	...	7 to 10 irrigations.



There are two kinds of Persian Wheels used for lift irrigation—one known as “*Nar*” used for higher lifts and for irrigating larger areas, and the other termed “*Hurla*”. The *nar* costs more than the *hurla* and is useful where the water level fluctuates widely and lifting of water is adjusted by increasing correspondingly the length of the rope encircling the drum.

The average area irrigated in twelve hours in case of the first watering is ten gunthas by the *nar* and seven gunthas by the *hurla*, whereas in the case of second watering, the area covered in twelve hours is respectively twenty gunthas by the *nar* and twelve gunthas by the *hurla*.

## X.

### CROP MIXTURES.

Cotton is generally grown with a sprinkling of *jowar*, *bajri*, maize and *til* (sesamum). These latter crops, having a shorter growing period, grow more rapidly than cotton, and by the time the main crop is about a foot or so high they are about twice its size or even more. They are then gradually removed for fodder for the plough and the wheel cattle. *Til* and *moth* (*Phaseolus Aconitifolius*) unless sown for seed along the border of the field, and water channels, are also cut and fed green to camels working on the Persian Wheels. A few plants of maize are often left to form grain, and the cobs either removed in an unripe condition, roasted as a vegetable or the grain when ripe is harvested in the usual way. *Guar* (*Cyamopsis Psora lioides*) is also sometimes seen growing along the embankments and water channels in a cotton field. This is also removed green for fodder. All these mixtures are, however, removed before the cotton crop has begun to flower.

The Pathan and Punjabi colonists settled on the Jamrao canal often sow musk (*cucumis melo*) and water melons along with cotton in the month of March-April or even May, provided water is available. Sindhis also grow them here and there, though rarely. With one irrigation given after about a month after sowing, the melon crop begins flowering and giving fruit which is removed every evening and carted to the nearest market for sale. The melon crop lasts for about a couple of months or so after which the cotton crop is given the usual weedings and waterings. The melons are often sold from Rs. 2 to Rs. 3 per Bengal maund according to their quality.

On inundation canals an inferior variety of melon called *Rebhri* and cucumbers are sprinkled in cotton. This fruit is ready by about August and forms a part of the food of the cultivators.

Tur (*Cajanus indicus*), bhindi or Lady's finger (*Hibiscus esculentus*) and castor are also sometimes grown along a cotton field to serve as a wind break and the last of these is also stated by the cultivators to be a remedy against white ants.

## XI.

### WEEDS, DISEASES, AND PESTS.

Weeds associated with cotton are common to other kharif crops as well. The following are some of the more important ones, which form serious pests of cultivation:—

*Oin* (*Cressa cretica*)

*Chabbar* (*Cynodon dactylon*)

*Sawari* (*Panicum colonum*)

*Dubh* (*Eragrostis Cynosuroides*)

Most of these weeds have their economic value as they are utilised as fodder for cattle, horse and goats.

#### *Disease and Pests.*

The principal cotton diseases and pests which cause damage in Sind may be described in order of importance as follows:—

1. *Spotted Boll Worm*.—This disease has been known to affect cotton for a long time but has not until recently been considered as very serious. It was in 1906 with the failure of the cotton crop in Sind that the disease came into prominence. Since then its attack has been sporadic. Both species of spotted boll worm, *Earras fabia* and *Eras insulana*, are found, but the latter preponderates. Adverse winds and a damp atmosphere seem to favour this pest.

2. *Wilt*.—The wilt disease of cotton is said to be caused by a fungus called *Fusarium vasinfectum* which enters the roots of the plants from the soil. It grows in the water carrying vessels of the plants plugging them and thus shutting off the water supply and causing the plants finally to wilt, and die. It occurs in patches in the cotton field and appears to prevail most generally in soils of bad texture through which water cannot pass freely.

3. *White Ants*.—This pest is commonly known as *Murahi* and appears to attack the plant when the main stalk has sufficiently grown to be woody. Constant application of water to the crop at short intervals is said to reduce the attack. There is no other practical remedy known. The cultivator often invokes blessings of religious devotee who gives him a little charmed earth to be distributed in the field.

4. *Red Cotton Bug*.—This is not a serious pest. This insect pierces the boll with its long beak and sucks the seeds. It damages the seed and stains the lint, but is seldom noticed.

5. *Anthraxnose*.—This is commonly known as the boll rot, and is mostly visible on the boll. The lint from such bolls is usually stained and rotten. Diseased bolls often fail to open because the locks get stuck together. This disease occurs from season to season in a greater or less degree, being worse in a wet season. It has occurred widely on exotic (chiefly American) cottons recently introduced and is insignificant in case of Sindh cotton.

6. *Migratory Locust (*Acridium perigrinum*)* has been found to do considerable damage in some years specially when the crop is young. The crop is entirely denuded of its leaves.

7. *Rats* sometimes damage the crop when the bolls have matured. They climb the plant, pull out the seed cotton from the boll and feed on the seed.

## XII.

### PICKING AND MARKETING.

Cotton occupies land for six to eight months according to the availability of water and also according to the nature of the season, that is to say, to its freedom from frost. On the Jamrao canal the crop remains normally longer than on the inundation canals because on the former canal the crop goes on receiving water up to November or December. On the other hand, the inundation canals normally dry up in October and hence the crop has no other source of irrigation there.

Cotton pickings of spring sown crop (Arhari) begin by about September and last until the middle of December. The crop sown in May or June begins to yield from October and by Christmas three to four good pickings are obtained.

If the crop is not affected by frost, which often occurs late in December or early in January, it goes on giving small pickings till February. These latter pickings are, however very small in quantity and inferior in quality. The second and third pickings are usually the most important ones. The work of picking is begun in the morning and is carried on throughout the day. It is generally done by women and boys but sometimes men also do the work; women, however, do the work more sharply than men. Picking is generally done on a share system. For the first three to four pickings of a good crop one-sixteenth to one-twentieth of the seed cotton picked is given to a picker. For subsequent pickings and in case of poor crops a higher share is charged. For the minor pickings the pickers sometimes get as much as one-half the total quantity picked. These minor pickings are often, however, done by the cultivator's family. The quantity of seed cotton picked per day per picker from a fairly full field is about half a Bengal maund.

Each picker takes his bundle of "*phutties*" picked in the day to the threshing floor and divides it into 12, 16 or 20 equal parts according to the terms of contract. The zamindar goes round the small heaps thus made, to see if all are approximately equal and then gives choice to the picker to take away one of these heaps as his or her share for picking. As soon as the pickers have received their share the whole stuff is thrown into one heap and stored pending the division of the produce between the *zamindar* and the *hari* or tenant. The pickers then take their shares to the village *bania* or shopkeeper who buys them at a price which is ordinarily less than the prevalent wholesale rate. The village *bania* often makes a very good bargain out of these purchases and in villages where there is no *bania*, shops are opened temporarily for the harvest season only to purchase cotton.

When cotton is finally picked cattle are turned to graze on the leaves of the cotton plant and any unopened bolls which may have left on the plant. The stalks are either allowed to remain in the field till the next crop is grown after one or two years, or are gradually cut and used as fuel, or utilised for making huts for the use of the *haris* and labourers.

#### *Outturn.*

It is very difficult to give any accurate idea as to the average outturn per acre of seed cotton (*phutties*) because it chiefly depends upon the soil which varies considerably from

place to place and also upon irrigation, fallow and manure conditions. Under *very* favourable conditions an acre may yield as much as twenty-five Bengal maunds (2,050 pounds).

On the Mirpurkhas farms, which have the advantage of adequate water supply, superior methods of cultivation and high yielding types of seed, the outturns have varied from five to twenty-one Bengal maunds per acre: and the average figures worked out at about 11 maunds per acre. This of course is much higher than the average outturn under normal district conditions. Probably the average outturn on fairly good land and in a normal season may be put down from 5 to 6 maunds (410 to 500 lbs.) per acre on the Jamrao canal, and about as much in the Nawabshah District. In Hyderabad District and parts of Nawabshah where the cultivation under lift irrigation is superior the average per acre may be put down from 8 to 10 maunds (660 to 820 pounds) in a normal season.

The following figures are indicative of the outturns under different crop tests conducted in various parts of cotton zone:—

Year.	Localit	Kind of irrigation.	Manure.	Outturn of Phutties.	Fallow or previous crop.	Cultivation, good or poor.
	<i>Hyderabad.</i>			lbs.		
1917-18	Nasarpur, <i>Tal.</i> Tando Allahyar.	Lift.	Cow dung: 200 donkey loads	872	2 years fallow.	Good.
1918-19	<i>Tal.</i> Hyderabad.	Lift.	Nil.	926	Do.	Do.
1920-21	Tando Jam, <i>Tal.</i> Hyderabad.	Lift.	100 donkey loads.	191	Do.	Poor.
	<i>Nawabshah.</i>					
1917-18	Nawabshah taluka.	Flow.	Nil.	447	2 years fallow.	Ordinary.
Do.	Shahdampur, <i>Tal.</i> Nawabshah.	Lift.	250 donkey loads.	226	<i>Bajri.</i>	
Do.	Do.	Lift.	Do.	297	<i>Bajri.</i>	Do.
1919-20	Nasrat, <i>Tal.</i> Nawabshah.	Flow.	Nil.	275	2 years fallow.	Do.
Do.	Do.	Do.	Nil.	253	Do.	Do.
Do.	Shahdampur...	Lift.	200 donkey loads.	332	<i>Bajri</i>	Do.
Do.	Shahdampur...	Lift.	200 donkey loads.	340	<i>Bajri</i>	Do.
	<i>Jamrao.</i>					
1917-18	<i>Tal.</i> Sinjhor...	Lift.	Nil.	250	2 years fallow.	Poor.
Do.	<i>Tal.</i> Mirpurkhas.	Lift.	300 donkey loads.	1,710	<i>Bajri.</i>	Good.

### Marketing.

There are broadly speaking no cotton markets in Sind as the term "market" is understood elsewhere. The practice of growers bringing in their cotton to some central place and bartering with brokers and buyers is not in vogue in this province.

The methods of sale in vogue of cotton are as follows:—

(1) The produce of seed cotton as it is picked or when all pickings have been gathered is sold out to small traders who are to be found in all villages of any size and serve as retail dealers for the supply of local wants, and as middle men between the cultivators and owners of cotton ginning factories, or through the paid agents of the factories or in rare cases direct in the ginning factories. The terms of sale provide whether delivery is to be given on the produce yard or in the factories. The cultivator prefers the former term as it saves him the trouble of cartage and avoids the various opportunities for leakage such as happens in the practice of handling and in turn accepts a few annas less in rate to allow of the cartage to be paid for by the purchaser.

(2) Another method is that of forward sale. In this sale a certain fixed quantity is sold much before harvest time when the market rules high. The grower executes a "*kabala*" (agreement) in which the number of maunds from the first two or three pickings to be delivered is stated as well as the purchase rate in rupees per maund. The vender receives at the time of executing this *kabala* an advance of Rs. 2 per maund of *phutties* and the balance at the time of final delivery. This advance the cultivator utilizes for his current expenses.

The advantages of this system both to the cultivator and to the buyer are that the former gets money at the time when it is badly required to pay for cultivation charges including hand weeding and the latter gets *phutties* of the first two or three pickings which is superior in quality to the pickings done subsequently. Sometimes this system of sale proves financially beneficial to the cultivator because in the event of the market falling he claims the price at which the original business was contracted. There are, however, the chances of the prices going higher also at the harvest time but this the cultivator does not usually worry

about. This kind of business is, however, carried on with such of the growers of cotton as have good credit to enable the buyer to recover the quantity of seed cotton purchased. European firms do not seem to make this kind of bargain.

(3) A third method is to sell a certain quantity by forward sale at from half or three-fourths of the current price and take the whole amount as an advance. The delivery is made at the harvest time. Very few such sales, however, take place and the quantity of cotton sold is comparatively small. Only such cultivators make these sales as are in sore need of money and have very little credit.

(4) A fourth method of sale and purchase recently introduced by some of the largest buyers, is called the "45 days system". In this system delivery of a certain quantity of cotton is taken by the firm from a seller in return for an advance. The seller is then at liberty to fix the selling price any time he likes during the succeeding period of forty-five days at the current rate of the day selected. On a rising market he stands to gain and on a falling market to lose. The object of this system is to enable the firm to compete with dealers who advance money to zamindars on the security of their cotton. This method of sale does not seem to have yet attained much popularity.

The seed cotton (*phutties*) is sold by the maund of  $41\frac{1}{2}$  seers, *i.e.*,  $1\frac{1}{2}$  seers more are taken for every maund than the usual maund weight ( $82\frac{1}{2}$  lbs.). Reductions are made for dirt or discoloration (due to bollworm) in the cotton.

The merchants after ginning send the lint to Karachi for export to Europe, and sell the seed locally as cattle food, for sowing, for export to other parts of Sind, or for oil pressing to Gujarat or elsewhere.

### XIII.

#### ORGANIZATION OF COTTON CULTIVATION.

Cotton cultivation, in common with that of other crops, is carried on under the "*hari* system". The *hari* is a tenant-at-will, who has his cattle, and he cultivates the land for one year or longer and in return pays the landlord in the shape of rent a certain portion of the produce depending on the character of the irrigation which the situation of the

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\*A seer = 80 tolas, that is to say, approximately 2 lbs.

land allows or requires. Where the land is above the level of water, irrigation is costly because of the expense and labour of lifting water by means of the Persian Wheel, and hence the rent paid by the *hari* is low, but when the land can be watered without the cost of lifting, the rents are higher. The prevailing rent for land cultivated by life is one-third of the produce and that cultivated by flow is half of the produce, and this rent is locally termed "*batai*". The necessary plough cattle and the cattle for working the Persian Wheel are possessed by the *hari* and all cultivation work such as clearing of stalks and scrub growth of previous years from the field, ploughing, sowing, irrigating, etc., is done by the *hari* and his family. Weeding operations are also done by the *hari* or the charges for having it done by hired labour borne by him, and the supply of seed and manure also paid for by him. As to the duty of the landlord or zamindar he pays the assessment and keeps the water courses clear from the point at which they leave the Government canals. The picking charges of cotton are paid in kind and are borne by the landlord and the *hari* equally. Sometimes the landlord or even the *hari* engages a man possessing no cattle of his own and locally called as *siririo hari* meaning single worker without cattle. He works as a field labourer and mortgages his services for a season or for a year in the first instance in return for an advance of a sum of money which he may require for some social undertaking or for paying off his old debts. This sum together with such other expenses which he may incur on feeding and clothing himself and his family during the period of his engagement is debited to his account and is recovered at the harvest time from his share of produce which is often equal to the share assigned to a pair of bullocks. The produce is divided as under:

Half the produce goes to the landlord if the land is flow and one-third if the land is lift. The other half or two-thirds as the case may be, after deducting field expenses, are divided in equal shares as under: -

1 part to each pair of bullocks (thus, if there are three pairs, three equal parts are assigned to them) and the remaining part goes to the *siririo hari*, but if there are more than one *siririo haris* the part is split up into as many shares. In the case of a *hari* who either takes land on cash rent or on rent in kind the landlord's rent is first taken out from the whole produce and the remaining is then shared.



Cash rents are also in use, and are fixed by the area to be cultivated either by a *hurta* (Persian Wheel) or by flow. The amount of cash payable varies between Rs. 8 to Rs. 20 an acre according to the quality of the soil, the facilities of water, the demand for land and lastly the relations between the zamindar and his tenant. The rent may be high if the zamindar has given the *hari* an advance of money to meet the cultivation charges and the expenses for his maintenance. Land in the vicinity of a village fetches more rent than land away because of the greater ease with which the manure can be obtained and applied and the proximity to market. Land on a Government canal fetches more than land on a private water course unless the latter is unusually good and well cleared. Well-to-do *haris* prefer a fixed money rent because this frees them from all petty exactions under the excuse of incidental charges.

The tenure of cash rent does not, however, prevail to any great extent. On the Jamrao, Eastern Nara, Dad and Nasrat canals, the *batai* system (division of the produce) is almost universal as a result of a large increase in the price of cotton since the first decade of the present century and also because much of the irrigation is by flow. In the Hyderabad District the tendency of giving out land on cash rent appears to be on the decline due largely to the price of cotton ruling high, but there are still certain tracts, for instance the Tando Allahyar taluka where the precariousness of the water supply owing to its situation on the tails of irrigation canals induces zamindars to prefer a small but certain return in the shape of cash payment rather than to gamble on the chance of a greater one in *batai*. Again, the lift lands far away from villages which an absentee zamindar cannot supervise or where he cannot be present at the time of the picking of cotton or at "batai" time, are given out on cash rent and this is specially done in the case of cotton which, unlike cereal crops, is gathered at frequent intervals and hence there is a greater chance of its being pilfered either in the field or from the threshing floor. Only such *haris* take land on cash rent as have a credit of their own to enable them to borrow a certain sum direct from a *bania* for the expense of his Persian Wheel, purchases of rations for the working cattle and other numerous expenses, and also to advance money to the *siriro hari* whom he often engages to work with him. Such men pay less rent to the landlord (zamindar) than those who either depend upon the zamindar for their maintenance during the

working season or cannot get advance of food and the money for cultivation expenses without the security of the *zamindar* pledged with the *bania*. Another system of *batai* or division of produce peculiar to certain villages in the Hala taluka where cotton and other cultivation is carried on by the *banias* is as under.

The *bania hari* pays the landlord Rs. 12 to 14 per acre as rent for the land. This he does from the gross produce of the crop. The produce is then divided into two equal shares, one going to the landlord in addition to the cash rent and the other to the *hari*. The landlord in return undertakes to lift water for the crop and supply and maintain the cattle for working the Persian Wheel, as well as cattle for ploughing. The *hari's* duty is to do all field operations from the beginning to the end including the ploughing with the cattle supplied by the *zamindar*. Charges for seed, weeding, etc., are borne exclusively by the *hari*.

The combined rent and *batai* system is not applicable to cotton cultivation alone. *Bajri* and other crops are also grown under this system.

It has been shown that the only charges borne by a *zamindar* from his share of the produce are the land assessment and the clearance of water course, together with the harvesting charges which are shared equally. Charges on account of manure are sometimes borne by the *zamindar* and the *hari* in equal proportion when the cultivation is done on the *batai* system and if the land has been taken on rent by the *hari* alone, but by far the largest proportion of cotton cultivation is done without the aid of manure and hence no separate calculation has been made for this sort of cultivation.

It will be seen from the statements that the earning of the Sind *hari* from the *khari* crop is ordinarily not sufficient to enable him to live for a year with a family of say three persons; therefore, unless he is able to engage himself in rabi cultivation also, he finds some other work during the winter and spring such as road making or canal clearance or else makes a living by using his camel for hire purposes to carry travellers in the district.

## XIV.

EFFORTS AT IMPROVEMENT IN COTTON  
CULTIVATION IN SIND.

So far we have dealt with cotton cultivation as generally carried on in the province of Sind up to the present. It is obvious that in many directions there are possibilities of improvement, in the type of cotton grown, in the method of cultivation, and in the organization of soil. The present section of the present bulletin is intended to give a very short sketch of the attempts made by the Agricultural Department to obtain and extend the use of a type of cotton more profitable than that now grown, either by the introduction of exotic varieties or by the improvement of that generally cultivated. The other necessary lines of improvement have not been forgotten and a description of what has been done in one necessary direction for the improvement of cultivation is noted. A discussion of improvements in the organisation of sale must be reserved for another publication.

In the years from 1904 to 1912, efforts were largely concentrated on the introduction and extension of Egyptian cotton at least on the areas like the Jamrao canal where water was available at an early date in the year. After showing great promise at first this cotton finally proved a failure chiefly because of the great length of the growing period and of its susceptibility to bollworm. Hence its cultivation was finally abandoned about 1912, when the decision was reached that, as far as exotics are concerned. American cotton showed far greater promise. Egyptian cotton, as a matter of fact, needed to be sown in February to March, so as to get the first picking by the latter part of October, and, even on the Jamrao, water has rarely been available as early as the required sowing time.

After 1912, a number of American varieties were tested and, among these, the *Triumph* type was selected as most suitable to Sind conditions, its early maturity being a strong point in its favour. After extending over several thousand acres and becoming very popular, this variety seemed to become subject very seriously to red leaf blight and to lose the characteristic of producing very large bolls which had recommended it in the first instance.

In 1916 American varieties called F.4 and F.285, evolved by the Punjab Agricultural Department, maturing

early and with considerable resistance to red leaf blight, were introduced into Sind, and have since attained very considerable popularity due to the characteristic described and to the fact that their yield has proved equal to that of local cotton. The area under these types in 1924 on the Jamrao canal reached about 20,000 acres. The hindrance to their further extension are two in number. The first is the necessity for early sowing preferably in April or early May. In 1925 there has been much sowing in June with success, but this must be considered as risky, though many cultivators on the Jamrao are now prepared to take the risk. The second hindrance is that the ginning percentage is lower than with the best form of Sindhi cotton and hence the price of seed cotton is not so much higher than that of the latter as the intrinsic greater value of the lint would appear to justify. The ginning outturn of the best types of Sindhi cotton will reach 37 to 38 per cent. of lint while that of American F.4 is not above 34 per cent. and of American F.285 is not above 31 to 32 per cent. All the same there is now a substantial premium of anything from 8 annas to Rs. 1-8-0 per maund of seed cotton in favour of the American types mentioned.

These American types have two substantial advantages apart from the premium just mentioned. If they can be sown early the crop is essentially complete before the end of November or early in December, and so there is no serious danger of frost. Further, once they are established, the irrigation required is very little, and they do not suffer very much from long intervals in watering. In fact the danger of over-irrigation in American cotton is greater than it is usually realised.

Other exotic cottons, whether from other parts of India or from abroad have little promise, except perhaps some other American varieties now under test. Indian types have proved unsuitable, the following having been tried: Broach, Kumpta, Goghari, *Bani*. All these are slow maturing varieties compared with the Sind types, and yield relatively a small crop.

#### *Improvement of Sindhi Cotton.*

The indigenous cotton is a mixture of several types of *Gossypium neglectum*. Analyses of the crop grown from the Bhitshah seed, recognised as one of the best in the country, revealed the following percentages of the principal types.

The variability even in this small known seed is very great, as will be seen :—

Type Characteristics.	Place at which grown.		
	Mirpurkhas.		in hamido village.
	Experimen- tal Farm.	Seed Farm.	
	Per cent.	Per cent.	Per cent.
1. White flowers, leaves narrow ...	13	26	23
2. White flowers, leaves broad ...	4	21	4
3. Yellow flowers, leaves narrow ...	42	25	23
4. Yellow flowers, leaves intermediate and broad.	41	28	50

Plant to plant selection in which the seed of the individual plants was kept separate, was initiated in the year 1915-16 and continued for three years. The large number of strains thus obtained were critically studied every year with reference to agricultural characters, chiefly the yield and ginning percentage, and only the best of them, named 27 W. N., has been retained for multiplication and distribution. This has been found by test to be more prolific than the local mixture and has a ginning percentage of nearly 40, as against an average of not much more than 33 for the strains locally grown. It has a bright white colour and rough feel, important characteristic of Sindhi cotton for which it is valued by the trade. Hence it is very popular and so far in spite of all that we have been able to do so far, the demand exceeds the supply.

#### *Improvements in methods of cultivation.*

It has already been said in this note that one of the common features of Sind agriculture is the sowing of all irrigated crops broadcast. This method of sowing rules out any method of clearing the field of weeds other than hand weeding. The weeding operation may not be so necessary in the case of cereal crops but it is one of the most important operation in cotton cultivation and is in the ordinary course carried out at least twice during the growing period of the crop.

In recent years owing to the general rise in wages and also owing to the labour being far from plentiful the hand hoeing costs from Rs. 5 to Rs. 6 per acre for one weeding. In the last season when the growth of annual weeds is very vigorous and rank, hand hoeing does not only become more costly but even impossible at times, for the reason that people

from the Thar desert and from Marwar who form the bulk of field labour, return to their homes when rain falls and consequently the available labour supply is much reduced. It is then a common sight to see cotton fields nearly choked with weeds, the removal of which may either be beyond the purse of the farmer, or impossible on account of the absence of labour to do the work.

The advantages of sowing cotton in lines are that it enables the work of hoeing and weeding to be largely done by bullock power instead of by manual labour thus solving the labour problem and making a saving in money and time. Moreover the surface of all soils cakes and hardens after irrigation. The bullock hoe not only breaks the crust but also exposes the particles to aeration and other beneficial influences, a condition highly beneficial to the soil and the crop. Further these operations help in the conservation of soil moisture by reducing evaporation which is very considerable when the hardened surface remains unbroken.

It has been seen that except on uneven lands and on stiff soils and on soils impregnated with salt on which sufficiently fine tilth cannot be obtained with a reasonable outlay of labour, the sowing of cotton in lines gives excellent result. Extensive demonstrations have been started in this method of sowing since 1916 and it is rapidly attaining popularity in many parts of the cotton area in Sind.

The relative cost of each method as worked out under district conditions is as follows:—

*Drilling Method.*

	Rs.	a.	p.
2 Preliminary waterings ( $\frac{1}{2}$ man) ...	0	6	0
2 Ploughings (2 men, 4 bullocks) ...	3	8	0
2 Samarings (1 man, 2 bullocks) ...	1	12	0
Drilling seed ( $\frac{1}{2}$ man 1 bullock) ...	0	14	0
Interculturing twice ( $\frac{1}{2}$ man, 1 bullock each time) ...	1	12	0
	<u>8</u>	<u>4</u>	<u>0</u>

*Broadcasting Method.*

2 Preliminary waterings ( $\frac{1}{2}$ man) ...	0	6	0
Broadcasting and ploughing (1 man and 2 bullocks) ...	0	12	0
2 Hand weedings ...	10	0	0
	<u>11</u>	<u>2</u>	<u>0</u>

It will be seen from the above figures that the broadcast method costs Rs. 3-14-0 more per acre than the line sowing method. These savings are even more significant than the actual figures indicate because the saving is in cash and the raising of which for hoeing often presents considerable difficulty to the cotton grower. This is in addition to the increased crop resulting from the mere complete absence of weeds.

In this connection the *zamindar* gains more than the *hari*, because he has to find the finance, and when no cash is required for hoeing, this represents a net saving to the *zamindar* who otherwise would have to contribute his share to the expenditure in the same proportion as he divides the produce at the time of *batai*.

Exact comparisons to test the influence upon yield of the drilling method as compared with the broadcasting method are not available, but it is a simple operation to inter-cultivate the cotton crop sown in lines, and the good effect upon the plants brought about by the aeration to the soil and the destruction of weeds is often very marked, and hence there is no doubt that the cotton grower also stands to benefit from an increased outturn when he drills his crop.

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APPENDIX I.

A.—BALANCE SHEET ON JAMRAO AND NAWABSHAH.

*Lift Land.*

Area:—

8 acres of cotton with 2 acres of Bajri, requiring 2 men and 4 cattle to work it.

Expenditure:—	Rs. a. p.
1. Contingent charges ( <i>see</i> below) at Rs. 3-6-0 per acre or cost per ten acres	... 33 12 0
2. Cotton seed 3 maunds at 15 seers per acre at Rs. 4-4 per maund	... 12 12 0
3. Depreciation and maintenance ( <i>see</i> below) of 2 pairs of bullocks at Rs. 38-8 per pair	... 77 0 0
4. Two hoeings of 8 acres at Rs. 8 per acre per 2 hoeings	... 64 0 0
5. Bajri seed at 12 seers per acre (24 seers at Rs. 3 per maund)	... 1 12 9
Total	... 189 4 9

Return:—

1. Yield of cotton at 6 maunds per acre = 48 maunds.	
<i>less</i> —	
(a) Picking charges = 4 maunds.	
(b) Zamindari share $\frac{1}{3}$ rd = 14 maunds 27 srs.	
(c) Haq, etc., from Hari's share, 1 seer per maund = 29 seers.	
Hari's share nett 28 maunds 24 seers at Rs. 10 per maund of 41 seers	Rs. a. p. ... 280 0 0
2. Minor produce (mixed crop, Bajri, Maize, Til, etc.) estimated at	... 20 0 0
3. Yield of Bajri at 6 maunds per acre of grain and 60 bundles of fodder per acre: Total yield grain 12 maunds, fodder 120 bundles	
<i>less</i> zamindari share of grain $\frac{1}{3}$ rd—Hari's share nett:—	
grain 8 maunds, at Rs. 3 per maund	... 24 0 0
fodder 120 bundles at Rs. 20 per 100 bundles...	24 0 0
Total	... 548 0 0

As cotton is a long season crop, which requires water *late* in the season, very little rabi cultivation can be undertaken on lift land in Nawabshah or Hyderabad. Hence the nett return to two haris will be Rs. 158-11-3 or to each hari will be Rs. 79-6 about. This allows



nothing for interest and this will be correct if the finance is taken from a Mahomedan zamindar: if from a bania, this must be added to the expenditure.

Details of expenditure :—

	Rs.	a.	p.
Contingent expenditure per acre, cutting jungle and fencing where needed	...	0	8 0
Hurla rent for season, Rs. 5 for 8 acres	...	0	10 0
Pots for hurla (80 per annum at Rs. 4)	...	0	8 0
Rope for hurla	..	0	12 0
Carpenter for fixing and repairing hurla	...	0	12 0
Depreciation of plough and hand tool at 25 per cent. of value	...	0	10 0
Incidental charges	...	0	4 0
Total	...	3	6 0

Details of plough and hand tools :—

	Rs.	a.	p.
Plough	...	6	0 0
2 yokes at Rs. 3 each	...	6	0 0
Rambas, sickles, kodals, etc.	...	8	0 0
Total	...	20	0 0

2. Depreciation and maintenance of one pair of cattle :—

Depreciation of pair of cattle costing Rs. 120 and lasting for 12 years	...	10	0 0
Kadbi for feeding bullocks for 2 months: 2 bundles or 20 seers daily means 120 bundles for 2 months at Rs. 20 per 100 bundles	...	24	0 0
Oil cake for 2 months at 1 lb. per day costing Rs. 6 per maund	...	4	8 0
Total	...	38	8 0

It is open to question whether a hari can maintain himself and his family on such a small income as shown above (Rs. 79 per year). It is true that his income is very poor, but he has other engagements which bring in enough income to make both the ends of the year meet. He and his family engage themselves in hoeing of cotton not only on their own fields, but on the neighbour's fields; they also pick cotton and harvest cereal crops on wages. Besides these he possesses a cart and owns a camel and engages himself in carting the produce from the Godown to the Railway Station or *vice versa*. He conveys passengers on his camel from Station to villages, etc.

It may however be explained that unremunerative as the production of crops proves to him, it is his sentimentalism or what may be termed his innate attachment to the surroundings, he is born in, that keeps him attached to the land cultivation.

## B.—BALANCE SHEET ON JAMBRAO AND NAWABSHAH.

*Flow land.*

Area :—

8 acres of cotton with 2 acres of Bajri requiring one man and two bullocks to work it.

Expenditure:—	Rs.	a.	p.
1. Contingent charges per ten acres ( <i>see below</i> ) ...	13	12	0
2. Cotton seed, 3 maunds at 15 seers per acre at Rs. 4-4-0 per maund ...	12	12	0
3. Depreciation and maintenance of one pair of bullocks ( <i>see below</i> ) ...	24	4	0
4. Two hoeings of 8 acres at Rs. 8 per acre ...	64	0	0
5. Bajri seed at 12 seers per acre (24 seers at Rs. 3 per maund) ...	1	12	9
Total ...	116	8	9

Return :—

1. Yield of cotton at 4 maunds per acre = 32 maunds <i>less</i> —			
(a) Picking charges, 2 maunds 6 seers			
(b) Zamindar's share (half) 14 „ 27 „			
(c) Haq, etc., from hari's share (1 seer per maund) 0 „ 14 „			
Hari's share nett (14 maunds 13 seers) at Rs. 10 per maund of 41 seers ...	143	4	0
2. Yield of Bajri at 5 maunds per acre of grain and 60 bundles of fodder per acre —			
Total yield grain 10 maunds			
„ fodder 120 bundles			
Less zamindari share of grain $\frac{1}{2}$			
Hari's share nett—			
Grain 5 maunds at Rs. 3 a maund ...	15	0	0
Fodder 120 bundles at Rs. 12 per 100 ...	15	0	0
	173	4	0

The Hari's nett revenue—

Income ...	173	4	0
Expenditure ...	116	8	9
	56	11	3

Details of expenditure :—		Rs.	a.	p.
(1) Contingent expenditure per acre, cutting				
jungle and fencing	...	0	8	0
Incidental charges	...	0	4	0
Depreciation of plough and hand tools at				
25 per cent. of value	...	0	10	0
		<hr/>		
		1	6	0
		<hr/>		
Details of plough and hand tools—				
1 plough	...	6	0	0
2 yokes at Rs. 3	...	6	0	0
Rambas, sickles, kodals, etc.	...	8	0	0
		<hr/>		
		20	0	0
		<hr/>		
(2) Depreciation and maintenance of one pair of				
cattle costing Rs. 120 lasting for 12 years				
(2/3rd for cotton and 1/3rd for wheat)	...	7	0	0
Kadbi for feeding bullocks for 2 months at 2				
bundles or 20 seers daily means 120 bundles				
for 2 months	...	15	0	0
Oil cake for 1 month at 1 lb. per pair per				
day costing Rs. 6 per maund	...	7	4	0
		<hr/>		
		24	4	0
		<hr/>		

*Note.*—The note attached to A applies here too.