CHAPTER IV

CHANGES IN CROPPING PATTERNS

The dynamism of Punjab's agriculture during 1951-66 is reflected not only in a considerable extension of its cultivated area and improvement in irrigation but also in the notable changes which have taken place in its cropping patterns. There have been shifts in the relative position of crops in the total crop-complex. The acreage under different crops showed varying trends, modifying the cropping patterns and crop combinations as existing in 1951. Methods and intensity of cultivation also recorded notable improvement during this period. The commercial element in farming assumed a new significance.

The supremacy of wheat as a first ranking crop remained unchallenged during this period. In fact, wheat acreage both in absolute and relative terms received a special spurt. In response to greater demand, cotton, maize, rice, groundnut and sugarcane picked up further strength (Table 3). On the other hand, wheat-gram, gram, barley-gram, pulses, oilseeds other than groundnut, bajra, etc., went down in absolute acreage as well as in relative position. For understanding these changes comprehensively, a systematic study of the spatio-temporal variations of individual crops is attempted first which is to be followed by a regional synthesis and identification of crop-combination regions. However, before taking up this study a
### Table 3

**PUNJAB**


<table>
<thead>
<tr>
<th>Crops</th>
<th>Area under different crops as percentage of total cropped area</th>
<th>Change in percentage 1951-66.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1951</td>
<td>1966</td>
</tr>
<tr>
<td>Wheat</td>
<td>20.4</td>
<td>25.3</td>
</tr>
<tr>
<td>Fodder</td>
<td>16.6</td>
<td>16.2</td>
</tr>
<tr>
<td>Cotton</td>
<td>6.0</td>
<td>8.2</td>
</tr>
<tr>
<td>Maize</td>
<td>5.5</td>
<td>8.2</td>
</tr>
<tr>
<td>Wheat-gram</td>
<td>12.9</td>
<td>8.0</td>
</tr>
<tr>
<td>Gram</td>
<td>11.9</td>
<td>7.2</td>
</tr>
<tr>
<td>Rice</td>
<td>2.6</td>
<td>5.9</td>
</tr>
<tr>
<td>Groundnut</td>
<td>1.3</td>
<td>3.7</td>
</tr>
<tr>
<td>Bajra</td>
<td>4.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>2.2</td>
<td>3.0</td>
</tr>
<tr>
<td>Barley-gram</td>
<td>5.9</td>
<td>2.3</td>
</tr>
<tr>
<td>Oilseeds (except groundnut) Both Seasons.</td>
<td>3.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Vegetables</td>
<td>0.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Pulses (Both Seasons)</td>
<td>2.8</td>
<td>1.0</td>
</tr>
<tr>
<td>Others</td>
<td>3.1</td>
<td>2.9</td>
</tr>
</tbody>
</table>

SOURCE: Calculated from the data collected from unpublished revenue records.
brief mention may be made of the two prominent crop seasons recognised in Punjab as in other parts of the Northern Plains of India.

(i) **Rabi Season**

This crop season coincides with the winter months. Rabi crops are sown in October-November and their harvesting is done in March-April. Associated with winter depressions, nearly 5 to 6 inches of the rainfall of Punjab comes during this season. Occasional frost during the months of December and January checks plant growth for short durations and is injurious especially to sensitive crops such as vegetables and fruits. Wheat, gram, barley, and harseem (Egyptian clover; used as fodder) are the major crops of this season.

(ii) **Kharif Season**

Extending from July to September, this crop season coincides with the summer monsoon period. Kharif crops are sown mostly with the first shower of the monsoon rains breaking usually during the first week of July. The crops are harvested in late September or early October. About 80 per cent (20 inches) of the state's annual average rainfall is concentrated within this season. High temperatures (around 80°F) and high relative humidity (60 to 70 per cent) are some of its other characteristics. Rice, maize, cotton, bajra, groundnut are the outstanding crops raised during this season. Of all the kharif crops, cotton
Punjab
Percentage Change in Area
under Wheat
1951—66
DATA BY ASSESSMENT CIRCLES

PERCENTAGE CHANGE

Source of Data: Unpublished Revenue Records
(Lal Kitabs)
slightly differs in its sowing and harvesting period. It is sown in May-June while its picking starts in September and continues upto December.

Apart from these two well defined crop seasons, a few crops are also raised during their intervening periods. These crops are known as Zaid Rabi and Zaid Kharif. Such crops, depending upon their nature, have been included in either of the two crop seasons in the present study. Sugarcane is a whole-year crop. It extends over both the crop seasons. As such, it has been treated separately.

**RABI SEASON CROPS**

**WHEAT**

*(Triticum aestivum)*

Accounting for 20 per cent of India's wheat production from 12 per cent of its area, Punjab stands distinct in the country in the cultivation of this crop. Covering 25.3 per cent (as against the national average of 9.6) of the total cropped area of the state, wheat is by far the leading food and cash crop of Punjab (Maps 43 to 47). It occupies nearly three times the area covered by cotton, the next important crop in areal coverage. This crop ranks first in as many as 81 assessment circles out of a total of 120 in the state. Wheat cultivation is embedded so deeply in the cultural life of the people that even *Bhangra*, the famous folk dance of Punjab,
depicts actions relating to its cultivation. Unique
position of this crop in the cropping pattern of the state
is largely attributable to (i) deep, loamy and clay-loamy,
well drained, fertile alluvial soils which are highly
suitable for wheat cultivation; (ii) well developed
irrigation system which provides a cover against uncertain
and inadequate rainfall; (iii) higher net profits from
wheat than from many other crops; (iv) traditional
association of the farmers with this crop by virtue of
which they have acquired a specialized skill in its
cultivation; and (v) its preference over other grains for
preparing bread (chapatis). This apart, wheat furnishes
excellent rotational association with kharif crops, such
as maize, rice and groundnut. Wheat is raised under
intensive irrigation in the state. Nearly three-fourth
of the total wheat acreage in Punjab receives irrigation.
Although wheat cultivation is ubiquitous, yet regional
variations in the proportion of wheat acreage in Punjab
are striking (Map 44).

The flood plains of the Sutlej, the Beas and the
Ravi, where Wheat acreage ranges from 30 to 54 per cent
of the total cropped area, stand out distinctly in this
regard. In no other part of the state, wheat concentrates
so heavily. The preponderance of wheat cultivation in
these tracts is largely related to (i) the occurrence
of floods during rainy season which interfere with the sowing of kharif crops as a result of which large areas have to be left fallow during that season for sowing wheat in the rabi season, and (ii) heavy, moisture-retentive soils of these areas which are not conducive for the cultivation of other rabi crops such as gram, oilseeds, pulses etc, but are suitable for wheat. Due to the same reason nearly two-fifth of wheat in the flood plains is raised without irrigation. The upland plains of the Bist and Upper Bari Doabs are the other areas of the state where wheat occupies more than one-fourth (25 to 40 per cent) of the total cropped acreage. Fine loamy soils and a well developed irrigation system furnish favourable conditions for wheat cultivation in these areas. In northern Punjab (north of the Sutlej river) wheat fields extend over miles and miles together to be interrupted only by a few patches of sugarcane and barseem here and there. Wheat, in fact, constitutes the countryside landscape of these plains during this season. Northern Malwa, comprising the whole of Ludhiana district and northern parts of Bhatinda and Ferozepur districts also show considerably high (25 to 30 per cent) proportion of their cropped acreage under wheat. In this tract irrigation is well developed but soils are relatively lighter than in northern Punjab. That is why, northern Malwa forms a transitional zone between the areas lying to its north where wheat is
extensively cultivated and the south where it is relatively less important.

By comparison, the Siwalik hills and the chlo-infested foothill plain in Hoshiarpur and Ropar districts have less than 25 per cent (2 to 24 per cent) of their cropland under wheat. Large tracts of light and exposed soils and limited irrigation do not favour wheat cultivation in this belt. Under such conditions, mixed cultivation of wheat-gram does better. Southern Malwa and southwestern tip of Upper Bari Doab are the other areas of the state where wheat occupies only 14 to 25 per cent of the total cropped acreage in view of their light soils, inadequate irrigation and semi-arid conditions. Besides, wheat faces serious competition from gram and oilseeds under the prevailing environmental setting in these areas.

In sum, wheat concentrates more heavily in (i) the flood plains where relatively heavy and moist soils suit more to the cultivation of wheat than many other rabi crops and (ii) the upland plains of the Bist and Upper Bari Doabs where well developed irrigation and fertile alluvial soils furnish excellent conditions for its culture. By comparison, the sub-montane zone with exposed soils and limited irrigation, and southern Punjab having lighter soils, deficient rains and inadequate irrigation lag considerably behind in this regard.
Changes in Wheat Acreage

Area under wheat in Punjab increased from 2,094,340 acres (20.4 per cent of the total cropped area) in 1951 to 3,171,189 acres (25.3 per cent) in 1966, giving an absolute acreage increase of 1,076,849. No other crop of the state recorded such a massive increase. Such a large expansion in the area under this crop is mainly the result of an increase in the intensity and extent of irrigation, ever growing demand for this cereal and the introduction of high yielding wheat varieties (C 513, C 591). With extension of irrigation, wheat acreage has expanded at the cost of gram, wheat-gram and oilseeds. Besides, a large part of the newly reclaimed lands, especially where irrigation facilities were introduced, have also been pressed under this crop. The changes in wheat acreage within the state, however, vary considerably from area to area (Map 45).

Almost the whole of the Malwa, central Bist Doab and parts of the Upper Bari Doab recorded an increase in the proportion of wheat acreage by 0.5 to 20.0. Improvement in irrigation was largely instrumental in bringing about this positive change. As soon as irrigation is extended or

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1 These improved varieties of wheat were released in the canal colonies (now in West Pakistan) in the thirties. Their cultivation in Indian Punjab, however, is a post-partition phenomenon. Their popularity over here is largely associated with the influx of refugees from West Pakistan.
intensified, farmers shift over from less profitable crops such as gram, wheat-gram, oilseeds, pulses etc., to wheat. Out of all these areas, the increase in wheat cultivation has been the highest in the Malwa region. This is primarily related to the development and further extension of irrigation in this tract during recent years. Within Malwa, exceptionally high increase in the percentage of wheat acreage (by 10 to 20) has been recorded in those areas where soils are relatively heavy and hence more conducive for wheat cultivation. On the other hand, parts of the Upper Bari Doab and the Bist Doab being already under intensive wheat cultivation, registered only a small increase,

By contrast, the flood plains of the Ravi and the Beas and parts of the flood plain of the Sutlej suffered decline. These tracts, similar to the upland plains, were already under intensive wheat cultivation. As a result, absolute acreage under wheat could gain only marginally. However, check on floods brought about a considerable increase in cultivated area and facilitated multiple cropping. This resulted in a substantial increase in total cropped acreage. Thus, larger increase in total cropped area vis-a-vis area under wheat accounts for the decline in the percentage of wheat acreage in these tracts. The sub-montane zone forms another belt where wheat recorded decline in absolute acreage and in relative position among crops.
Appearance of rust and kungi, the two serious wheat diseases, in this humid zone during the period under review brought about a decline in wheat acreage in some of the assessment circles. A few other assessment circles registered a little increase. Thus, either decline or small gain in absolute acreage under wheat against larger increase in total cropped area accounts for the decrease in percentage of wheat acreage in this tract.

In brief, leaving a few parts of the humid sub-montane zone, area under wheat has recorded substantial increase in the state. The increase, however, has been larger in the Malwa region where irrigation facilities have considerably improved since 1961. On the other hand wheat suffered decline in its relative position in the flood plains, where total cropped area increased more than that under wheat.

**WHEAT-GRAM**

The practice of mixed-cultivation in the state is traditional. Many a time, two or three crops having different moisture requirements are grown together in the same field hoping that at least one out of them will do well under highly variable rainfall conditions. In fact, it is an interesting example of adjustment against the environmental vagaries and an attempt to make the best of the limited land. Mixed cropping or interculture provides a variety of products from
PUNJAB
Area under Wheat—Gram as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lot Kitabs)

Change in Percentage of Area Under Wheat—Gram: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lot Kitabs)

Absolute Change in Acreage Under Wheat—Gram: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lot Kitabs)
Punjab
Percentage Change in Area
under Wheat—Gram
1951–66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records
(Lai Kitabs)
the same field and yields more than any of the crops grown exclusively. Out of all the mixed crop practices in Punjab, cultivation of wheat-gram is the most important (Maps 48 to 52). Occupying 8.0 per cent (1,001,215 acres) of the total cropped area of the state (14.6 per cent of the rabi cropped acreage) in 1966, wheat-gram ranked fourth among various crops raised in Punjab. It is generally grown in those areas of the state where dependence on rainfall is heavy and soils are relatively light. It is also grown in irrigated tracts but only as a second crop of the year from the same field. Some of the inferior soils in such areas have also been put under this crop. In 1966, only about two-fifth of the wheat-gram acreage in Punjab received irrigation.

Wheat-gram cultivation in Punjab varies markedly from area to area (Map 49). In general, this crop is more prominent in northern Punjab and eastern half of Malwa. Its heaviest concentration, however, is found in the Siwalik hills and in the kho-infested foothill plain. It occupies 15 to 30 per cent of the total cropped acreage of this belt. Such an emphasis on its cultivation here is related largely to lack of (less than 10 per cent of the net area sown of this belt receives irrigation) irrigation and consequent dependence on uncertain rains. Exposed and hence less fertile soils also favour its cultivation. Under uncertain
climatic conditions each one of the two crops, if grown separately, may face risk of failure. Similarly, Nakodar, Jagraon and Barnala tahsilas and a few isolated assessment circles in the Upper Bari Doab, where soils are lighter and irrigation less developed, also show high (8 to 22 per cent) percentage of their total cropped area under this crop.

By contrast, wheat-gram cultivation nowhere exceeds 4 per cent of the total cropland in western Malwa. Here wheat is grown separately on irrigated and relatively more fertile fields, while gram is pushed on to lighter and mostly unirrigated parts. Flood plains of the state also show low percentage of their cropped acreage under wheat-gram. The moist soils of these tracts are not favourable for wheat-gram combination.

Changes in Wheat-gram Acreage

Mixed cultivation of wheat-gram in Punjab registered a sharp decline during 1951-66, its acreage shrinking from 1,322,432 acres (12.9 per cent) in 1951 to 1,001,215 acres (8.0 per cent) in 1966. Expansion and intensification of irrigation facilities largely account for this decline. As already mentioned, mixed cultivation of wheat-gram is not a choice but is an adjustment against uncertain climatic conditions. As soon as the dependence on rainfall is reduced through the provision of adequate irrigation, most of the
farmers shift over to the cultivation of wheat, which requires more moisture than gram. Under satisfactory water supply conditions, wheat-gram combination is avoided also because the separation of the two types of grains is a cumbersome, labour consuming process. Barring a few assessment circles, the whole of Punjab recorded decline in wheat-gram cultivation during 1951-66 (Map 50). However, the decline was relatively high (5 to 12 per cent) in most of the Bist Doab, northeastern and southwestern Malwa, parts of the sub-montane zone and in a few isolated units of the Upper Bari Doab where irrigation has considerably increased since 1951. Upto 1951, the wheat-gram combination occupied a large part of the total cropland in these areas.

Contrary to the general trend, a few assessment circles in the state have registered increase in wheat-gram cultivation. The increase, however, was only marginal in most of them. None the less, Patiala tahsil, Manjaki circle of Nakodar tahsil and Mairan Kiran Circle of Ajnala tahsil recorded an increase of 5 to 18 in the percentage of acreage under this crop. It happened mostly on tracts of newly reclaimed unirrigated lands.

In brief, expansion and intensification of irrigation has brought about considerable decline in the area under wheat-gram in almost all parts of the state during 1951-66. The combination has largely been replaced by wheat.
PUNJAB
Area under Gram as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

PUNJAB
Area under Gram as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

PUNJAB
Change in Percentage of Area Under Gram: 1951—66
DATA BY ASSESSMENT CIRCLES

PUNJAB
Absolute Change in Acreage Under Gram: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lal Kitabs)
Covering 7.8 per cent (976,333 acres) of the total cropped area, gram is one of the prominent cash and food crops of the state (Maps 53 to 56). It is mainly consumed as a pulse. Some of this crop is also used as a concentrate feed for livestock. Gram does better on well drained light loamy soils particularly in semi-dry climates. Continuous cloud cover for a week or so associated with high humidity and lightening especially at the time of its flowering, are highly injurious to this crop. Gram is a leguminous crop which restores nitrogenous matter to the soil and thus enhances its fertility. Because of its drought resistant qualities, gram is a popular crop in unirrigated areas having light soils. However, one or two waterings to this crop in semi-dry and sandy areas ensure better yields. Gram is largely grown in rotation with maize, bajra, jowar and guara.

Gram is raised in all parts of the state. However, it is concentrated rather heavily in southern and southwestern Punjab, where 9 to 29 per cent of the cropped area is devoted to this crop (Map 54). Such a high concentration is largely associated with the semi-dry climate, inadequate provision for irrigation and large tracts of light sandy soils. Within the region, while the well irrigated fertile loamy fields are generally devoted to the more remunerative
wheat, the dune sites and other areas of marginal productivity are given over to grams. Similarly, several of the newly reclaimed and unirrigated areas in southeastern Punjab show larger (6 to 10 per cent) percentage of their cropland under gram. Siwalik hills and the pho-infested foothill plain in Ropar district, and Garhshankar tahsil of Hoshiarpur district form another tract where gram occupies 4 to 12 per cent of the total cropped area. Poor, exposed sandy soils and limited irrigation in most of its parts mainly account for this phenomenon. But southwestern Punjab is the core area of gram cultivation. From here, its importance gradually declines to the north and northeast along with the increase in rainfall. In north Punjab, gram nowhere covers more than 3 per cent of the cropland. Because of the well developed system of irrigation and relatively heavy soils in the north, the first choice of the farmers rests on wheat. Gram is practically missing in the flood plains and areas otherwise affected by waterlogging. In these tracts moist soils do not favour gram cultivation.

Changes in Gram Acreage

Area under gram in Punjab decreased from 11.9 per cent (1,216,862 acres) in 1951, to 7.8 per cent (976,333 acres) in 1966. Expansion of irrigation and emergence of waterlogging in parts largely account for this decrease. Under assured
irrigation, wheat, which is more profitable has replaced gram in many areas of the state. Barring a few assessment circles, gram cultivation in Punjab has suffered decline everywhere in absolute acreage as well as in relative position (Maps 55 and 56). The decline, however, was larger (4 to 29 per cent) in most of the Malwa region where gram occupied a substantial proportion of the cropland in 1951 and where irrigation has notably increased ever since. On the other hand, a few assessment circles in the state recorded increase both in absolute acreage and percentage area under gram. In most of them the gain was only marginal. None the less, Bhatinda tahsil and southern sections of Fazilka and Muktsar tahsils, where physical conditions are highly conducive for gram cultivation and irrigation water is in short, have recorded larger (3 to 8 per cent) increase. Under limited irrigation, farmers prefer to extend gram cultivation even on some of the fertile fields, which otherwise suite more to the cultivation of wheat (water required to raise an acre of wheat is sufficient to raise two to three acres of gram). Patiala tahsil in the southeast forms another tract where percentage of area under gram recorded an increase of 4.6. Under the limited facilities of irrigation, a significant part of the newly reclaimed lands in this tahsil have been put under gram cultivation.

In short, southwestern Punjab, having relatively dry climate, light soils and less developed irrigation, emphasizes
more on gram cultivation than the rest of the state. With extension of irrigation, gram acreage witnessed a sharp decline during the period under review. The decline has been higher in those parts of the state where it occupied larger area in 1951.

BARLEY

(Hordeum vulgare)

Barley occupied only 1.2 per cent (149,459 acres) of the total cropped area of Punjab in 1966. This crop is of relatively shorter duration (130 to 140 days), has lower water requirements and greater tolerance for lighter soils than that of wheat. That is why, barley is complementary to wheat in its distributional pattern. Besides, some of the fields where sowing of wheat is delayed for one reason or another are devoted to this crop. Being an inferior grain to wheat, both in terms of yield per acre and market price, barley is rarely cultivated on fertile irrigated lands. Distilleries consume bulk of the state's barley production. A part of it is used as feed and food. Green barley is also used as a fodder crop. The cultivation of barley in Punjab is largely confined to the lower flood plain of the Sutlej, the whole of the flood plain of the Ravi and a few other isolated areas (Map 57).

Barley cultivation in Punjab came down from 1.8
per cent of the total cropped acreage (187,865 acres) in 1951 to 1.2 per cent (149,459 acres) in 1966. As a result of the increase in irrigation, many parts of the state suffered loss in barley acreage. Larger decline in percentage area, ranging from 1 to 10, however, has been a feature of southwestern Malwa and of Kapurthala tahsil (Map 58). These are the areas of the state where barley occupied a considerable part of the cropland in 1951 and where irrigation has subsequently improved. This crop has been largely replaced by wheat. None the less, quite a few assessment circles in the state also recorded increase in area under this crop. Notable among the areas of increase is the lower flood plain of the Sutlej, where barley cultivation improved its position from 1 to 6 per cent during 1951-66. As a result of the rise in sub-soll water in this tract, barley has replaced gram in many fields.

In short, barley occupied only a small proportion of the state's cropland in 1951, which further went down with increase in irrigation. Southwestern Malwa and Kapurthala tahsil registered marked decline in barley cultivation while the lower flood plain of the Sutlej witnessed a significant increase.

BARLEY-GRAM

The mixed cultivation of barley and gram is similar to that of wheat-gram, except that it is grown in relatively
drier areas. Barley, being less moisture demanding than wheat, forms a better combination with gram in semi-dry areas (Map 59). It is mostly grown for feed. Cultivation of barley-gram in Punjab is on the decline. The area under this crop shrank from 603,072 acres (5.9 per cent) in 1951 to 288,480 acres (2.3 per cent) in 1966. Under increased and assured irrigation, mixed cultivation of barley-gram has been considerably replaced by more paying wheat. The decline, however, was much higher (5 to 28 per cent) in Ferozepur district, where more than 90 per cent of the state's barley-gram acreage was concentrated in 1951 (Map 60).

Despite a notable decline in area under this crop, Ferozepur district continued to enjoy superior position in the cultivation of barley-gram. Light loamy soils, semi-dry climate and inadequacy of irrigation water largely explains this fact.

OILSEEDS

Sarson (Brassica campestris L.) toria (Brassica campestris, Indian rape), taramira (Eruca sativa, rocket) and alsi (Linum usitatissimum, linseed), are the major oilseed crops grown in Punjab during the rabi season. In 1966 oilseeds jointly occupied nearly 2.0 per cent (245,170 acres) of the state's total cropped area. These are raised


**PUNJAB**

Area under Rabi Oilseeds as Percentage of Total Cropped Area: 1966

*DATA BY ASSESSMENT CIRCLES*

Source of Data: Unpublished Revenue Records (Lai Kitabs)

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**PUNJAB**

Area under Kharif Oilseeds as Percentage of Total Cropped Area: 1966

*DATA BY ASSESSMENT CIRCLES*

Source of Data: Unpublished Revenue Records (Lai Kitabs)

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**PUNJAB**

Change in Percentage of Area Under Rabi Oilseeds: 1951–66

*DATA BY ASSESSMENT CIRCLES*

Source of Data: Unpublished Revenue Records (Lai Kitabs)

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**PUNJAB**

Change in Percentage of Area Under Kharif Oilseeds: 1951–66

*DATA BY ASSESSMENT CIRCLES*

Source of Data: Unpublished Revenue Records (Lai Kitabs)
largely without irrigation. But one or two waterings in dry areas, or during bad rainfall years, ensure better returns. Cultivation of oilseeds is relatively more important in the semi-arid southwestern Malwa and southern Upper Bari Doab where they occupy 2 to 7 per cent of the total cropped area (Map 61). These areas are environmentally more conducive for their cultivation. Moreover, large landholdings in these tracts also permit farmers to devote some of their fields to oilseeds. In the remaining sections of Punjab, area under oilseeds nowhere exceeds 2.0 per cent of the total cropped acreage.

Oilseed cultivation in the state registered downward trend during 1951-66. Area under these crops came down from 2.7 per cent (288,171 acres) in 1951 to 1.9 per cent (245,170 acres) in 1966. With improving irrigation, wheat has replaced oilseeds from many fields. Notable decline in the percentage of oilseeds acreage, ranging from 1 to 7, has been a characteristic of a large part of the Ropar district, central sections of the Upper Bari Doab, Moga tahsil and parts of Muktsar tahsil (Map 62). By contrast, parts of the flood plain of the Sutlej recorded increase in the percentage by 1 to 3. This increase has been typical of those parts of the flood plain where riverine lands were reclaimed but irrigation has not been extended.

In short, oilseeds covered only a small part of the
PUNJAB
Area under Rabi Pulses as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

PUNJAB
Area under Kharif Pulses as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

PUNJAB
Change in Percentage of Area Under Rabi Pulses: 1951—66
DATA BY ASSESSMENT CIRCLES

PUNJAB
Change in Percentage of Area Under Kharif Pulses: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lati Kithabs)

MAP—65

MAP—67

MAP—66

MAP—68
total cropped area of the state in 1951, which was further reduced during the ensuing 15-year period. Greater competition from more profitable wheat has been instrumental in bringing about this trend. Nevertheless, oilseeds continue to hold significant proportion of the cropland in semi-dry southwestern parts of the state, which also have relatively large landholdings.

PULSES

Pulses are used both as substitute and a supplement to vegetables in the state. These form a major source of protein in the daily diet of the peasantry. Consumption of pulses in rural areas, in fact, is far greater than that of vegetables. During rabi season, massar (*Ervum lens*) is the only pulse grown in Punjab. It occupied hardly 0.46 per cent of the total cropped area of the state in 1966. Although massar can be grown on all types of soils, except those affected by waterlogging and salts, yet it is largely cultivated on less fertile soils. Sometimes massar may also be grown in the fields where timely sowing of crops such as wheat and gram is delayed due to the late harvest of the previous crop. This crop is grown in almost all parts of the state (Maps 65 and 66). Its cultivation, however, is more prominent in Upper Bari Doab and in a belt in southeastern Malwa comprising Patiala and Rajpura tahsils. In these areas, massar accounts for 1 to 4 per cent of the total cropped acreage. It is grown largely
in rotation with rice. Besides, this crop is also important in parts of the cho-infested foothill zone in Hoshiarpur and Ropar districts. Some of the poor soils of this tract support **massar** better than the other **rabi** crops such as wheat, gram, barley, etc. Area under this crop in Punjab recorded a marginal decrease during 1951-66. However, the decline was more pronounced in parts of Ropar district where extension of irrigation helped replacing **massar** by more profitable crops and in Gurdaspur district where the emergence of waterlogging in large tracts discouraged its cultivation. Most of the Malwa and the Bist Doab either experienced no change or registered only a marginal increase.

**FODDER CROPS**

With 16.2 per cent of the total cropped area under fodder crops in 1966, Punjab ranked first in the country in this regard. Such a higher proportion of fodder in a state like Punjab, where pastures are almost unknown and nearly 7.5 million livestock heads are to be supported, is only expected. Out of the total fodder acreage of the state, **rabi** fodder crops cover nearly one-third (5.3 per cent) and the **kharif** fodder crops the remaining two-third (10.4 per cent). Relatively low proportion of area under fodder during the **rabi** season is largely attributable to the severe competition from food crops like wheat and gram during this
season. Moreover, barseem which is the main fodder crop of rabi season has higher yields per acre, as this crop gives five to six cuttings from a single sowing. Besides, the use of sugarcane-tops, as also certain other interculture crops for fodder, meets part of the requirement (Maps 69 and 70).

Barseem (Egyptian clover), senii (Indian clover) mathe (Fenugreek) are the major fodder crops raised in Punjab during the rabi season. Barley, gram, toria, sarson and taramira are also used for the purpose. Out of all the fodder crops grown during this season, barseem is by far the most important, both in areal coverage and nutritive value. Barseem demands irrigation every week during its vegetative period. It does better on heavier loamy soils and can withstand alkalinity. It has strong rotational association with paddy. Not only barseem but senii and mathe also demand relatively heavier loamy soils. In general, the area north of the Sutlej river and parts of northcentral and eastern Malwa show relatively high (6 to 24 per cent) concentration of rabi fodder. Heavier loamy soils, well developed irrigation and higher density of livestock population largely account for this. By comparison, southwestern Malwa comprising Bhatinda and Ferozepur districts and an elongated strip south of the flood plain of the Sutlej in Ludhiana and Ropar districts have relatively low (less
than 6 per cent) percentage of their cropland under fodder. This is largely related with the limited irrigation and lighter soils in parts of these areas. Besides, these areas have a low density of livestock population. Similarly the Siwalik hills and their adjacent cho-infested foothill plain also have low (0.2 to 4 per cent) proportion of their area under fodder.

The area under rabi fodder crops in the state increased from 542,271 acres (5.1 per cent) in 1951 to 739,360 acres (5.9 per cent) in 1966. Increasing pressure of livestock population and consequent demand for fodder largely explains this fact. Among the various fodder crops, barseem has been the major gainer. Extension of barseem cultivation in the state has been largely facilitated by the improvement in irrigation. The increase, however, was relatively high (1.5 to 7 per cent) in western Malwa, parts of Dasuya and Gurdaspur tahsils and in the whole of Patiala tahsil. These are the areas where the proportion of fodder acreage in 1951 was low, and where irrigation has since been considerably extended. By contrast, most of the Upper Bari Doab, western Bist Doab and eastern Malwa, where fodder occupied a substantial share of the cropland in 1951, registered a decline. This downward trend is largely associated with growing competition from wheat. Despite this decrease, these areas continued to enjoy superior position in the cultivation of fodder.
Punjab
Percentage Change in Area under Sugarcane
1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
as compared to western Malwa, cho-infested foothill plain and the hilly tract.

**SUGARCANE**

*(Saccharum officinarum)*

Sugarcane is an annual crop. It matures in a time period ranging from 9 to 12 months. It is sown in March-April and is harvested through December-April. Its growing period extends over both the crop seasons. That is why, sugarcane cannot be associated with any of the crop seasons exclusively. For this reason, this crop is being discussed separately.

Covering 3.0 per cent (376,672 acres) of the total cropped area of Punjab in 1966, sugarcane occupied a notable place in the cropping pattern of the state (Maps 73 to 77). It is an important commercial crop. The practice of preparing *Gur* and *Shakar* (semi-refined brown sugar) from sugarcane is traditional in Punjab. In the past, most of the cane was marketed in the form of semi-refined sugar rather than the cane itself. However, with the coming up of a few modern sugarmills during recent years, quite a bit of the cane is marketed directly to the mill sites or the nearest collection centres. With the improving living standards of the people, the use of white sugar is on the increase. However, *Gur* and *Shakar* continue to sweeten most of the
rural dishes even to-day.

Sugarcane gives two to three ratoon crops from a single sowing in Punjab. Such a character of this crop makes it labour as well as seed saving (10 to 15 per cent of the original cane crop is to be ploughed back for seed) However, its yield goes on decreasing with increasing ratoons. Environmental conditions for the cultivation of sugarcane in Punjab are not very conducive. The requisite hot and wet climate is confined only to the monsoon months. Loamy and fertile soils of the state are excellent for cane culture, but occasional frost in December-January is harmful. Hot and dry climate during its early growth (March-June), and low temperature during the later stages (November-February) retard its growth. That is why, nearly 80 per cent of the growth of this plant takes place during the monsoon months. As a result of the less conducive environment for cane cultivation, in Punjab, it yields only 3129 pounds of refined sugar per acre as against the national average of 4362. The state's position, in this regard is dwarfed further if compared with Karnataka, Tamil Nadu and Andhra Pradesh where its yields are 8560, 7738 and 7657 pounds of refined sugar per acre, respectively.

Although sugarcane is grown in all parts of the state, its relative importance varies significantly from area to area. In general, cane cultivation is more prominent in
northern Punjab and eastern Malwa where it occupies 2 to 15 per cent of the cropland (Map 74). Fertile loamy, moisture-retentive soils and heavier rainfall in these areas largely explains this phenomenon. By comparison, semi-dry western Malwa has hardly 2 per cent of its cropped acreage under sugarcane. In northern Punjab and eastern Malwa, cane cultivation is concentrated mostly around the sugarmills. As a matter of fact, commercial cultivation of sugarcane is largely confined to the catchment areas of these mills. Ready market, well developed network of roads, guarantee of purchase for the produce and extension services provided by the mill managements largely account for the intensive cane cultivation around the refineries. There are three such cane concentration areas in Punjab where its proportions range from 4 to 14 per cent: (i) around Morinda sugarmill (Ropar) in eastern Malwa; (ii) surrounding Bhogpur, Phagwara and Nawanshehr refineries in Bist Doab; and (iii) around Batala sugarfactory in northern Upper Bari Doab. Another concentration around Dhuri sugarmill (Sangrur) however, does not emerge on the map so sharply because of the large enumeration unit in which it is located.

Changes in Sugarcane Acreage

Expansion of cane cultivation has remained the
consistent policy of the state since Independence. Such a policy can be justified in the context of the increasing internal demand for sugar due to the fast growing population and improving living standards of the people and urgency to earn much needed foreign exchange through the export of this commodity. Four new sugarmills (Dhuri, 1955-56; Bhogpur, 1957-58; Batala, 1963-64 and Morinda, 1963-64) were established during 1951-66 to boost sugar production, which also stimulated cane cultivation. Besides, the increase in irrigation and replacement of low yielding desi (indigenous) cane with higher yielding disease-resistant and superior ratoon varieties also helped the expansion of area under this crop. As a result, 154,963 acres of additional area was brought under cane cultivation during 1951-66. This increase, however, is not impressive. Rising competition from more urgently required food crops, such as rice, wheat and maize, appearance of serious cane diseases like red rot, top and tarai borer, bottlenecks in marketing and less attractive prices offered by the mill managements kept the pace of its expansion rather sluggish. However, changes (difference in percentage of 1951 and 1966) in area under cane cultivation within the state areally vary (Map 75). Almost the whole of the Malwa, southwestern Upper Bari Doab and areas where new sugarmills have been recently established recorded increase. The gain, however, was relatively high
(1 to 5.8 per cent) around the recently built refineries of Batala, Morinda and Dhuri. By contrast, a large number of assessment circles in the state registered decrease, though only by a marginal amount. However, two small tracts - one in central Upper Bari Doab and another in central Bist Doab - showed relatively high (1 to 4 per cent) decline. Appearance of some serious cane diseases such as red rot, top and tarai borer and emergence of waterlogging in these tracts either reduced absolute acreage under cane or kept the expansion of its cultivation much slower in the context of faster increase in total cropped area.

In sum, northeastern Punjab having a well developed system of irrigation, heavier rainfall and fine textured soils, grows more of sugarcane than the southern and southwestern Punjab. Within the environmental framework, the role of sugarmills in intensive cane cultivation in the state is real. Area under this crop in Punjab recorded gradual upward trend. Most of the gain in acreage was around the newly established sugarmills. Appearance of some diseases and rising competition from food cereals pose a serious threat to sugarcane cultivation in Punjab. More attractive cane prices, intensive research in controlling cane diseases, evolvement of better yielding and disease resistant varieties which adjust properly to their local environments, and removal of hurdles in marketing are likely to help further increase in
PUNJAB

Area under Cotton as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

Area under Cotton as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

Change in Percentage of Area Under Cotton: 1951—66
DATA BY ASSESSMENT CIRCLES

Absolute Change in Acreage Under Cotton: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
Punjab
Percentage Change in Area under Cotton
1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records
(Lai Kitabs)
cane cultivation in the state.

KHARIF SEASON CROPS

COTTON

(*Gossypium species*)

Accounting for 14.0 per cent of India's cotton production from only 5.2 per cent of the national cotton acreage, Punjab occupies a significant place on the cotton map of India. Higher yield of cotton in the state, which is 299 pounds per acre as against the national average of 111, accounts for this distinction. Cotton is the most outstanding commercial crop of Punjab. Covering 8.8 per cent (1,110,222 acres) of the total cropped acreage in 1966, it ranked second in the total crop complex and first among the crops grown during the *kharif* season (Maps 78 to 82). Nearly one-half of the cotton produced in the state is long-staple fine quality American type.

Cotton is grown in all parts of Punjab. Its distributional pattern within the state, however, displays marked areal variations, ranging from as low as 0.1 per cent of the cropped area in Bit Mansowal assessment circle of Garhshankar tahsil to as high as 35.7 per cent in Hathar Fazilka assessment circle of Fazilka tahsil (Map 79). Southwestern Malwa is the most outstanding cotton growing area of the state, where 9 to 37.7 per cent of the total
Cropland is devoted to this crop. Cotton ranks first in as many as 9 assessment circles in this area. Semi-dry climate (rainfall ranges from 7 to 15 inches during its growing season), light loamy soils and a well developed system of canal irrigation together create excellent conditions for cotton culture in this area. This apart, relatively large size of landholdings (average size ranges from 17 to 23 acres; Map 126) here enables the farmers to reserve enough of land for this cash crop\textsuperscript{2}. Most of the cotton grown in this tract is long-staple American type (major varieties grown are L.S.S., 322 F and J 205). The fertile and irrigated fields of this tract are largely devoted to cotton while slightly elevated unirrigated dune-sites are put to rainfed baira and guara cultivation. During the kharif season, one can observe cotton fields stretching almost endlessly in all directions.

Likewise, southwestern Upper Bari Doab comprising Patti and Tarn Taran tahsils of Amritsar district forms another zone of notable cotton concentration (9 to 20 per cent). However, it could not achieve dimensions comparable to that of southwestern Malwa in the cultivation of this crop. Here, stronger competition from other crops such as maize and rice takes away a part of the area from cotton.

\textsuperscript{2} Farm size and cotton acreage bear a positive correlation of 0.517.
Separated by the flood plain of the Sutlej, southwestern Malwa and southwestern Upper Bari Doab, in fact, form two core areas of cotton cultivation in Punjab. From these core areas the emphasis on cotton cultivation declines gradually towards the east and northeast.

Cotton covers fairly high proportion (6 to 9 per cent) of the cropped acreage in Malerkotla, Nabha and Sangrur tahsils and southern half of Ludhiana district. However, most of the cotton raised in this tract, unlike the previous region, is desi (indigenous), as it does better even in slightly humid conditions. In the remaining parts of the state, cotton rarely constitutes more than 3 per cent of the cropped area. It avoids especially those areas which are affected by waterlogging, have moisture retentive heavier soils and those receiving rainfall of over 35 inches. Under moist conditions, cotton is highly susceptible to diseases like wilt, blight, root rot, etc. The cotton of these areas is again of desi variety and is raised almost exclusively for domestic use.

Changes in Cotton Acreage

Cotton acreage in Punjab increased from 6.0 per cent (621,299 acres) in 1951 to 8.8 per cent (1,110,222 acres) in 1966. Mounting demand for this fibre crop by the fast expanding cotton textile industry in the country and the introduction of high yielding fine quality American cotton in the early fifties largely accounts for this increase.
However, the extension of cotton cultivation was largely facilitated by the expansion and intensification of irrigation. Area under American as well as desi cotton recorded an increase during the period under review. The increase, however, was larger in the areas of long staple American varieties. The proportion of American cotton to the total cotton acreage of the state improved from 35 per cent in 1951 to 48 per cent in 1966, while the proportion of desi cotton declined from 65 to 52 per cent. This is largely associated with (i) the partition of India consequent upon which most of the quality cotton areas of the country went to Pakistan necessitating the extension of area under long staple cotton on the Indian side in order to reduce dependence on imports; and (ii) the influx of refugees from Pakistan who had a long experience of growing superior varieties of cotton in Montgomery and Lyallpur districts. In addition, its higher yields, more remunerative nature and lower requirements of labour for picking\(^3\) (it requires only two to three pickings as against 5 to 6 in the case of desi cotton) also helped the replacement of desi cotton in many fields.

Dynamics of cotton cultivation in the state is characterised by striking regional variations, ranging from an increase of 14.0 in the percentage of cotton acreage in

\(^3\) Desi cotton falls if picking is delayed while American cotton sticks to the balls for longer duration after opening.
Rohi Muktsar assessment circle of Muktsar tahsil to a
decline of 8.4 per cent in Dheora Guru Harsahai assessment
circle of Ferozepur tahsil (Map 80). This crop registered
increase in nearly the whole of the Malwa region, western
Bist Doab, and southwestern tip of the Upper Bari Doab.
The increase in percentage, however, was much higher (4 to
14) in southwestern parts of Punjab comprising Bhatinda and
large sections of Ferozepur districts and Patti tahsil of
Amritsar district. Other conditions being favourable,
increase in canal irrigation played a major role in bringing
this positive change. With the extension of irrigation, the
less profitable crops such as bajra, guara, pulses and
oilseeds have given place to cotton. It may be noted that
the significant increase in the percentage of cotton acreage
in these areas resulted mainly from the introduction of the
American varieties. Availability of irrigation water proved
to be a limiting factor for the further extension of its
cultivation in this region. Tarn Taran tahsil and parts
of Barnala, Mansa and Jagraon tahsils also recorded notable
increase. However, unlike the region described above, the
increase in cotton acreage in these areas was mainly of the
desi variety.

By contrast, the Siwalik hills and oho-infested
foothill plain which are relatively humid and thus more
prone to cotton diseases registered decline in cotton
cultivation. Decline in cotton acreage in a few sections of the central and northern Upper Bari Doab resulted mainly from the emergence of waterlogging conditions. Such conditions stimulated the cultivation of rice and maize instead. Similarly, decline in cotton acreage in a small area in southern Ferozepur tahsil is associated with the rise in sub-soil water.

In brief, cotton emerged as the second most important crop of the state in areal coverage as well as in cash returns. Its cultivation is highly concentrated in the drier but well irrigated southwest. From here it declines gradually towards the northeast and east in correspondence with increase in rainfall. Cotton cultivation in Punjab increased substantially during the period under review. Growing demand of this crop from the fast expanding cotton textile industry in the country, improvement in its yields with the introduction of American varieties and adoption of better farming practices provided an incentive, while increase in irrigation largely facilitated its expansion. Southwestern Punjab experienced maximum expansion of cotton acreage. By contrast, the relatively wet northeastern parts of the state recorded decline. Evidently, cotton has strengthened its position mainly within areas having favourable environmental conditions for the crop.
PUNJAB

Area under Maize as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

Change in Percentage of Area Under Maize: 1951—66
DATA BY ASSESSMENT CIRCLES

PUNJAB

Area under Maize as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

Aggregate Change in Acreage Under Maize: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
Punjab
Percentage Change in Area under Maize
1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
MAIZE
(Zea Mays)

As a food cereal, maize comes next only to wheat in Punjab. A small quantity of maize is also used as poultry feed and in distilleries. Punjab produces 12.5 per cent of India's maize although its area under this crop is only 8.5 per cent of the total in the country. It is one of the major maize producing states of India. Covering 8.2 per cent (1,031,989 acres) of the total cropped area of Punjab in 1966, maize ranked next only to wheat and cotton in areal coverage (Maps 83 to 87). Its cultivation, however, is not equally important all over the state. The Siwalik hills and the adjoining chen-infested foothill plain constitute the main tract of maize concentration (Map 84). It occupies 15 to 42 per cent of the total cropped area of this tract. Gently sloping well drained soils coupled with high rainfall (35 to 45 inches) a large part of which comes during its growing season are major factors accounting for the importance of this crop in this zone. The cultivation of maize gradually declines from this tract towards the west and southwest in correspondence with decrease in rainfall. Maize also occupies a prominent position (8 to 22 per cent) in the cropping pattern of the Bist Doab and northeastern Malwa. The well-drained, fertile loamy soils and an annual average rainfall of 20 to 35 inches coming mostly during its growing season (July-September) provide a favourable environmental framework for
maize cultivation in these areas. However, in the context of a well developed system of irrigation, maize has to compete with crops like rice and sugarcane in these areas, as also in the Upper Bari Doab. On the other hand, southwestern Punjab has exceptionally low (less than 2 per cent) proportion of its cropland under maize. Dry conditions have remained a serious obstacle in the extension of this crop in this tract.

Changes in Maize Acreage

Maize acreage in Punjab increased from 5.5 per cent (561,360 acres) in 1951 to 8.2 per cent (1,031,989 acres) in 1966. In areal extension, maize is excelled only by wheat and cotton. Such a large expansion in its cultivation is mainly associated with the growing demand of this food cereal. The introduction of a few improved varieties of maize, such as 'Ganga hybrid 5' and 'Composite Vijay' also helped the extension of area under its cultivation. This apart, some of the fields which previously used to remain without crops during the kharif season because of lack of adequate rainfall were also pressed under maize with the expansion of irrigation and the adoption of improved agronomic practices. The Siwalik hills, cho-infested foothill plain, northeastern Malwa and a few isolated assessment circles in the Upper Bari Doab, where physical conditions for maize
cultivation are conducive, recorded a notable increase in percentage of area (by 4 to 11) under maize (Map 85). By comparison, southcentral and southwestern Malwa registered only a small (less than 2 per cent) increase in this regard. Maize cultivation in this region continued to be handicapped by environmental limitations such as semi-dry climate and light sandy soils. Whatever small increase recorded in these parts is due to the extension of irrigation. By contrast, a few assessment circles in central Upper Bari Doab and northern Bist Doab recorded relative decline. In some of them even the actual area under maize decreased. In a few others, maize acreage increased but only a little. But in all of them total cropped area increased substantially. Thus, fast increase in total cropped area as against either decline or a small gain in area under maize accounts for the decline in percentage of maize cultivation in these units.

In short, the Siwalik hills, chq-infested foothill plain, the Bist Doab and northeastern Malwa have emerged as the outstanding areas of maize cultivation in Punjab. On the other hand, semi-dry and sandy southwestern Punjab and areas affected by waterlogging in the Upper Bari Doab remained far less important for this crop. Although maize cultivation in the state as a whole increased substantially during the period under review, only those areas experienced significant expansion in its acreage as have been traditionally important for it.
PUNJAB
Area under Rice as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

PUNJAB
Area under Rice as Percentage of Total Cropped Area: 1966
DATA BY ASSESSMENT CIRCLES

PUNJAB
Change in Percentage of Area Under Rice: 1951–66
DATA BY ASSESSMENT CIRCLES

PUNJAB
Absolute Change in Acreage Under Rice: 1951–66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lai Kitabs)
Punjab
Percentage Change in Area
under Rice
1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records
(Lal Kitabs)
Although Punjab produces only 1.1 per cent of India's rice, yet it spares enough of the cereal for food-deficit rice consuming states of the country. The people of Punjab are traditionally wheat eaters. The use of maize is seasonal (winter months) and that of rice is only occasional. As a result, only a small part of the total rice production is consumed within the state. Thus, most of the rice produced is sent to the market. However, with improvement in living standards, and growing awareness about the usefulness of diversified food, the consumption of rice is on the increase. Such a trend is expected to relieve the overwhelming dependence of the people on wheat and maize.

In 1966, Punjab had 5.9 per cent (736,035 acres) of its total cropped area under rice (Maps 88 to 92). This proportion, though significantly high for the state, is very low if compared with the national average of 25 per cent. It is largely because of the fact that hot and wet climate required for paddy cultivation is neither met in all parts of the state nor during all seasons of the year. Secondly, heavy soils with an impervious sub-soil layer which favour rice cultivation, are met with only in a few areas of Punjab. Rainy season, extending from July to September, is the only period which furnishes somewhat favourable climatic conditions.
for rice culture. That is why, only one crop of rice is raised in Punjab as against 2 to 3 in Assam, West Bengal, Bihar and Orissa where more than one-half of the total cropped area is devoted to rice. Even rainy season does not bring enough of rain for rice cultivation in the state, nor is the distribution of rain within the rainy season regular. As a result, nearly 84 per cent of Punjab's rice is grown under irrigation. Rice cultivation in the state varies according to the types of soils, degree of adequacy of irrigation and sub-soil water depths (Map 89). The Upper Bari Doab stands distinct in rice cultivation, as in a majority of the assessment circles of this region, 8 to 28 per cent of the total cropped area is devoted to this crop alone. High water-table facilitating tubewell irrigation, heavy loamy soils and well developed canal irrigation largely account for the dominance of rice in this region. Under moist conditions, other crops of the kharif season such as maize and cotton fail to yield good returns. Rice occupies the same place in Upper Bari Doab as cotton in the southwestern Malwa and maize in the sub-montane and the cho-infested zones. The Maira assessment circle of Dasuya tahsil along the Beas river too has conditions similar to that of the Upper Bari Doab and thus lay considerable emphasis on rice cultivation. Excessively wet, frequently flooded and having silt-loamy soils, the flood plains also support considerably high (5 to 15 per cent) proportion of rice acreage.
Likewise, rice cultivation in Phagwara tahsil, Dhak circle of Nawanshehr tahsil, Patiala district and Dakar circle of Kharar tahsil is mainly associated with the clay-loamy soils and well developed tubewell irrigation.

By comparison, the Siwalik hills and the sloping cho-infested foothill plain, despite relatively heavy rains, remained considerably backward (less than 2 per cent) in rice cultivation. Among other factors, the coarse and sandy soils of this zone are a major handicap in the extension of area under this crop. Whatever rice is grown in these tracts is confined largely to the low lying areas located along the stream beds. Rice cultivation is practically missing (below one percent) in central Bist Doab and most of the Malwa region, due to the low incidence of rains and light percolatory soils.

Thus, rice cultivation in Punjab is directly related with the amount of clay content in the soils, available irrigation and the amount of precipitation, and is inversely related with the sub-soil water depths.

Changes in Rice Acreage

Cultivation of rice in Punjab, like that of cotton and maize, extended quite widely during the study period, its area increasing from 2.6 per cent of the total cropland (270,716 acres) in 1961 to 5.9 per cent (736,035 acres)
in 1966. The three fold increase in rice acreage is related, among other factors, with the emergence of waterlogging in parts and extension of irrigation in some others. Also under adequate water supply, it is more remunerative than other kharif crops. Barring a few assessment circles, the whole of the state experienced increase in absolute acreage as well as in percentage of area under rice (Map 90). The increase (difference in percentage of 1951 and 1966) in percentage of area under rice, however, was relatively high (by 5 to 16) in most parts of the Upper Bari Doab, the flood plain of the Beas in Kapurthala tahsil and western half of Dasuya tahsil. A few other areas, such as Phagwara tahsil, Dhak circle of Nawanshehr tahsil and the whole of the Patiala district, where soils are fine textured and irrigation has notably increased, also recorded significant gain in rice acreage. By contrast, rice cultivation has suffered decline in a few assessment circles of the state. The decrease in most of them, however, was only marginal. None the less, the lower flood plain of the Sutlej in Ferozepur district registered relatively high decrease in the percentage of area under rice (by 3 to 9). In this tract, which is semi-arid, rice was grown in the active flood plain. But with the reduced incidence of floods as a consequence of flood control measures, many of the rice fields were replaced by maize and cotton. On the other hand, parts of this tract experienced considerable
PUNJAB
Area under Bajra as Percentage of Total Cropped Area: 1951

DATA BY ASSESSMENT CIRCLES

- Source of Data: Unpublished Revenue Records (Lai Kitabs)

PUNJAB
Area under Bajra as Percentage of Total Cropped Area: 1966

DATA BY ASSESSMENT CIRCLES

- Source of Data: Unpublished Revenue Records (Lai Kitabs)

PUNJAB
Change in Percentage of Area Under Bajra: 1951—66

DATA BY ASSESSMENT CIRCLES

- Source of Data: Unpublished Revenue Records (Lai Kitabs)

PUNJAB
Absolute Change in Acreage Under Bajra: 1951—66

DATA BY ASSESSMENT CIRCLES

- Source of Data: Unpublished Revenue Records (Lai Kitabs)
Panjab
Percentage Change in Area under Bajra
1951—66
DATA BY ASSESSMENT CIRCLES

PERCENTAGE CHANGE

80
40

INCREASE

DECREE

n.a.: data not available

Source of Data: Unpublished Revenue Records (Lai Kitabs)
increase in the total cropped area as a result of reclamation of waste lands but without corresponding increase in rice acreage. As such the percentage area under rice suffered decline. Due to similar reasons Andhar circle of Pathankot tahsil also recorded decrease in the proportion of rice acreage.

In sum, rice cultivation in most parts of Punjab recorded increase during 1951-66. The expansion, however, was larger in nearly the whole of the Upper Bari Doab where waterlogging extended its fold to many new areas, and in eastern Malwa where expansion of irrigation over heavy soils facilitated rice cultivation.

**BAJRA**

*(Pennisetum typhoidesum)*

*bajra* (pearl millet) occupied 3.5 per cent (443,181 acres) of Punjab's total cropped acreage in 1966 (Maps 93 to 97). Although this grain is as nutritive as wheat and maize, yet its use as a cereal is deemed inferior. It is grown as a food crop only where maize cultivation is not possible. A small part of this grain is also used as poultry and livestock feed. Because of its drought resistant qualities, *bajra* is largely raised on sandy to sandy-loamy soils of southwestern Punjab where 4 to 16 per cent of the total cropped area is devoted to this millet (Map 94). As mentioned earlier,
relatively elevated dune-sites and sandy fields are devoted to rainfed *baira* cultivation, while the fertile irrigated fields are spared for the more remunerative cotton. From this region, the proportion of *baira* acreage declines to the north and northeast with the increase in rainfall. That is why, the Bist Doab, northeastern Malwa and most areas of the Upper Bari Doab where rainfall is relatively heavy have less than 2 per cent of their cropland under *baira*. Moreover, the fine textured soils of these areas are more suitable for maize, rice and sugarcane. It may be noted that the pattern of *baira* cultivation in Punjab is complementary to that of maize (correlation negative 0.28).

The proportion of area under *baira* in Punjab diminished from 4.7 per cent (478,494 acres) in 1951 to 3.5 per cent (443,181 acres) in 1966 (Map 95). This decline is largely associated with the expansion of irrigation. Menace of birds who eat a substantial part of the standing crop is another discouraging factor in its cultivation. The decrease, however, was higher in southwestern Punjab, Hoshiarpur and Kapurthala tahsils, parts of Dasuya, Jullundur, Amritsar and Ajnala tahsils i.e. areas where *baira* cultivation was more prominent in 1951 (Map 93). By contrast, a few assessment circles recorded increase. The increase in percentage of *baira* acreage was relatively more pronounced (by 2 to 5) in Faridkot, southern Ferozepur and northern Muktsar tahsils and in Hathar circle of
Area under Groundnut as Percentage of Total Cropped Area: 1951
DATA BY ASSESSMENT CIRCLES

Change in Percentage of Area Under Groundnut: 1951—66
DATA BY ASSESSMENT CIRCLES

Absolute Change in Area Under Groundnut: 1951—66
DATA BY ASSESSMENT CIRCLES

Source of Data: Unpublished Revenue Records (Lal Kifabs)
Patti tahsil. It is attributable mainly to its more comfortable adjustment in rotational association with wheat. As a result of the expansion of wheat cultivation in these areas, a part of the cotton acreage was diverted to bajra because it fits better in rotation with wheat than cotton (picking season of cotton somewhat overlaps with the sowing of wheat).

In short, bajra cultivation in Punjab is concentrated in the semi-dry southwest. Its position in the crop complex of the state is inversely related to the amount of rainfall during its growing season. With increasing irrigation bajra is encountering severe competition from more remunerative crops such as cotton, maize and groundnut. As a result, its cultivation is declining.

**OILSEEDS**

(a) **GROUNDNUT**

(Arachis hypogaea)

Accounting for 3.7 per cent (468,356 acres) of Punjab's total cropped area, groundnut (peanut) is the most outstanding oilseed crop grown in the state (Maps 98 to 101). Groundnut is a major source of fine quality, commonly used cooking oil (vanaspati ghee). Besides, its cakes furnish a concentrated feed for milch cattle and the roasted nuts form a table nicety. It is one of the major cash crops of the state. Groundnut does well only on sandy to sandy-loamy well-drained soils,
especially in areas of well distributed rainfall of about 20 inches within the kharif season (July to September). Under excessively damp atmospheric and soil conditions, nuts rot and diseases become more active. Groundnut cultivation in Punjab is almost exclusively rainfed. Wheat, wheat-gram, gram and barley generally appear in rotation with this crop.

With about 95 per cent of this crop being concentrated in only one-third of the state's area, groundnut cultivation in Punjab is unique in its distributional pattern. Two regions distinguish themselves on the groundnut map of Punjab: (i) Eastern half of Malwa, and (ii) the Dona belt of the Bist Doab (Map 99). Eastern Malwa accounts for nearly three-fourth of the groundnut acreage of the state. Sandy to sandy-loamy soils associated with numerous dune-sites, less developed irrigation and rainfall of 20 to 40 inches coming during its growing season (July-September) constitute the most favourable environment for groundnut cultivation in this zone. Under such conditions no other kharif crop does as well as the groundnut do, nor is any other crop so remunerative. Within this region, groundnut concentrates more heavily (5 to 48 per cent) in the whole of the Ludhiana district and the adjoining tahsils of Malerkotla, Nabha, Ropar and Kharar. This distributional pattern is distinctly associated with the occurrence of sandy soils. The Dona belt of the Bist Doab forms another area of higher groundnut
concentration where it occupies 5 to 26 per cent of the total cropped area. This region is similar to the one previously discussed in physical setting and development of irrigation and as such furnishes excellent conditions for groundnut cultivation. In the remaining parts of the state this crop is either altogether missing or has insignificant areal coverage. Groundnut is practically unknown in the Upper Bari Doab where soils are heavy and moist. Western half of Malwa has enough of light sandy soils associated with dune sites, but is unfavourable because of semi-dry climate. As a result, groundnut acreage nowhere exceeds one per cent of the cropland here. Excessive rainfall discourages its cultivation in the Siwalik hills and the oho-infested foothill plain. However, large tracts of sandy soils along the seasonal streams traversing the foothill plain furnish ample potential for groundnut cultivation provided new disease-resistant varieties, which adjust better to slightly wetter climatic conditions, are evolved.

Groundnut cultivation in Punjab is a post-World War II phenomenon. Ever since its acreage is on the increase. During 1951-66 area under this crop has increased by about three times (135,663 to 468,356 acres). Increasing demand for vegetable oil and consequent rise in its price, introduction of improved varieties (M 13, M 145, PG No.1) and adoption of better agronomic practices mainly account
for such a high increase in its acreage. This expansion has been largely at the cost of bajra, pulses and til (Sesamum indicum). The gain in groundnut acreage has been the highest in those areas where it was already a prominent crop in 1951 (Maps 98 and 100).

By contrast, Daha Neecha circle of Samrala tahsil, Daha circle of Ropar tahsil, Daha bet circle of Nawanshehr tahsil, Dakar and Charsa circles of Kharar tahsil and the whole of the Sirhind tahsil have registered relative decline. Here, with the extension of tubewell irrigation, sugarcane has emerged as the main cash crop, particularly after the establishment of a sugarmill at Morinda in 1963.

Thus, environmentally suited to groundnut cultivation, eastern Malwa and the Dona tract of Bist Doab account for most of the groundnut cultivation in the state. These tracts have further improved upon their position in this regard during 1951-66.

Til
(Sesamum indicum)

Til is primarily used for extracting oil. A part of this crop is also fed to the milch cattle. It occupied only 0.3 per cent (34,409 acres) of the state's total cropped area in 1966. Because of its low yields, til is less paying than the other kharif oilseed crops. As a result of the increasing
competition from more profitable and acutely needed food and cash crops, area under this crop has declined by 23,850 acres in the state during 1951-66. However, it continues to occupy significant (0.6 to 4 per cent) proportion of the cropped area in the Upper Bari Doab where it is cultivated on the unirrigated but relatively coarse and well drained soils. Til cultivation is also associated with the higher densities of dairy cattle in this region (Maps 63 and 64).

**PULSES**

Mash (*Phaseolus radiatus*), mung (*Phaseolus mungo*), moth (*Phaseolus aconitifolius*) and arhar (*Cajanus indicus*) are the *kharif* pulses grown in Punjab. These jointly occupied only 0.56 per cent (70,336 acres) of the state's total cropped area in 1966. As already stated, pulses form a major source of protein food, particularly of the rural masses. These are mostly grown on poor soils without irrigation. *Moth* and *mung* are drought-resistant, do better on light, sandy-loamy, well-drained soils, and are generally raised in interculture with *Charar* (fodder) and melons. During their early growth, *moth* and *mung* are sometimes pruned for fodder but are left to mature for grain later on. *Mash*, unlike *moth* and *mung*, requires hot and humid climate similar to maize. That is why, it is grown during July-October. *Mash* is grown separately as well as in interculture with maize. *Arhar* covers only an
insignificant part of the cropland under pulses. It is either pushed on to the extremely poor soils not suitable for any other crop or is grown in rows along the hedges of cane fields.

Area under kharif pulses in the state diminished from 230,649 acres (2.2 per cent) in 1951 to 70,336 acres (0.56 per cent) in 1966. This decrease is largely associated with rising competition from more profitable crops such as cotton, rice, maize and sugarcane and increasing use of vegetables even in rural areas following extension of irrigation. Area under pulses recorded decline in almost all parts of the state (Map 68). Despite this, pulses continued to occupy 1 to 6 per cent of the cropped acreage in most of the Gurdaspur district and upto 3 per cent in parts of the Hoshiarpur, Ropar, Patiala and Ludhiana districts (Map 67). Mash is more popular in Gurdaspur district while moth and mung are largely grown in Hoshiarpur and Ropar districts.

Thus, area under pulses in Punjab suffered a marked decline subsequent to the extension of irrigation during the period under review. Other factors which facilitated this downward trend are the rising competition from cotton, maize, rice, and sugarcane, and changing food habits of the people.

FODDER

Jointly covering 10.7 per cent (1,333,369 acres) of the Punjab's total cropped area, chari (Sorghum vulgare) guara (Culster beans) and hajra are the major fodder crops grown
in the state during the kharif season. As already stated, such a high proportion of fodder can be understood in the context of the large (7.5 million heads) cattle population and near absence of pastures in the state. The crops mentioned above, in general, are raised separately. Sometimes these may also be grown mixed together. Two or three of them, if grown in a mixed form, provide more nutritive and tasty fodder. As livestock form an integral part of every farming household, fodder is grown in all parts of the state. However, stress on its cultivation is relatively high (12 to 26 per cent) in those parts of the Sivalik hills and the cho-infested foothill plain which lie in Ropar and Hoshiarpur districts (Map 71). Exposed soils in the hills and sandy soils along the seasonal streams in the foothill plain, in the near absence of irrigation, are largely devoted to fodder. However, all the area denoted as fodder is not harvested green. Some of it is left to mature for grain which may later on be used as feed. Its dry stalk is preserved for lean periods. Low yields of fodder under rainfed conditions make it necessary to devote considerable amount of land to grow the required quantity of fodder. Western Malwa constitutes another area where fodder occupies 12 to 19 per cent of the cropland. A large number of elevated dune-sites in this tract, which do not support superior crops, are largely devoted to rainfed fodder cultivation. A few other isolated assessment circles
in the state also show higher fodder acreage due to similar reasons. However, unlike other parts of the state, fodder is a commercial crop around the urban centres. In order to cope with the huge fodder requirements of the dairy cattle kept within towns and cities, a large proportion of the cropland in villages adjoining urban centres is devoted to these crops.

The area under kharif fodder in Punjab increased from 1,159,868 to 1,338,369 acres, while its percentage to total cropped area came down from 11.3 to 10.7 during 1951-66. The decline in percentage, despite absolute increase in acreage, is the result of the larger increase in total cropped area vis-a-vis area under fodder crops. Changes in fodder cultivation within the state, however, vary significantly (Map 72). Many areas in Punjab recorded decline in the proportion of area under fodder. Large decrease in percentage (by 3 to 15), however, has been a feature of eastern Malwa and most of the Bist Doab. The main reason for this decline is that with extension of irrigation it is now possible to produce the required fodder from smaller acreage than was the case under unirrigated conditions. Increasing mechanization and higher per acre yields of irrigated fodder also have gone a long way in reducing the area under fodder crops. By contrast, northwestern Malwa
registered a notable increase in fodder cultivation. This gain is largely definitional, as the area which previously was denoted under the column of guara has now been merged into the category of fodder.

In short, areas around big urban centres, where dairy cattle are stall fed, have registered increase in fodder acreage. With expansion of irrigation, and rising competition from food and industrial crops, on the other hand, the relative position of fodder among crops in many parts of the state has come down. The decline, however, has been more pronounced in eastern Malwa and western Bist Doab, where fodder cultivation was already prominent and where irrigation has been extended considerably since 1961.

**VEGETABLES**

Potatoes, cabbage, tomatoes, brinjal, onion, carrot, chilly, ladyfingers, garlic, turnip and pumpkin are the major vegetable crops grown in Punjab. All these vegetables jointly accounted for only 1.1 per cent of the state's total cropped acreage in 1966. Lack of consumption of vegetables in the villages and their small acreage are directly related with the low living standards of the people, traditional dependence of the masses on pulses and low degree of urbanization. However, the significance of vegetable cultivation is to be viewed in terms of their
contribution to the farm economy rather than their areal extent. An acre of vegetables, at the prevailing prices, yields four to five times more net profits than an acre of food grains. Vegetable cultivation involves skill and is an intensive (in terms of labour and capital) type of farming activity. As a result of lack of cold storage facilities, poor marketing organisation and relatively slow transport, vegetable production in the state remains confined largely to areas adjoining urban centres. However, some of the less perishable and non-perishable vegetables, such as potatoes, onion, garlic and chilly are raised even far away from the urban markets. Apart from the factor of distance from the market, size of landholdings, provision of dependable irrigation, availability of labour and capital also play a role in vegetable cultivation. Vegetable growing in Punjab is relatively more popular in Saini and Kamboj villages. By a popular notion, these communities are traditionally associated with vegetable culture. However, investigations have revealed that these agricultural castes resorted to this activity due to their small landholdings. Rule of universal marriage and equal inheritance of ancestral property among all the sons in Sainis and Kamboj communities reduced their landholdings to small parcels at an early date. As a result,

By contrast, the tradition of not marrying all the sons in a Jat family kept the landholdings of the Jats, who constitute the bulk of Punjab's farm population, from being too much sub-divided.
they had to resort to the more rewarding intensive vegetable cultivation. However, there is a need for further investigation to establish this fact fully.

Vegetable cultivation for domestic use on small plots around wells, tubewells and water pumps is a common practice in all parts of the state. However, their commercial farming, as pointed earlier, is localized only to areas around urban centres and in areas where landholdings are small and dependable well/tubewell irrigation is adequately developed. Emphasis on potato cultivation in parts of Jullundur and Hoshiarpur districts is attributable, apart from the above factors, to easily workable sandy-loams. Cultivation of chillies is widespread in Patiala and Rajpura tahsils. In Punjab as a whole, area under vegetables increased by 2021 acres during 1951-66. The increase, however, was relatively large in the uplands of the large cities of Jullundur, Ludhiana and Amritsar.

_Crop Combination Regions_

The previous discussion was focussed mainly on the spatio-temporal patterns of the individual crops. But no crop, important or unimportant, is ever grown in isolation in any area. It is particularly true of subsistence agricultural economies where the farmers try to raise a large number of crops to meet their varied domestic needs. These crops may be cultivated in different fields side by side during a season or in the same field during different
seasons. Such crop associations are an integrated reality of the agricultural land-use. In order to comprehend the cropland use in its entirety, the study of crops as associated with each other is rather inescapable. This necessitates the identification of crop combination regions.

Theoretically every enumeration unit, it may be an individual farm, a village, an assessment circle or a tahsil, in which a large number of crops are raised, constitutes a crop combination region. Such a crop association region is total, unique and complex. However, for having a broad regional picture of the cropping patterns, some degree of generalization is essential. While doing so, some less prominent crops (prominence here is measured in terms of areal coverage) are to be dropped out of the total combinations. For delineating such crop combination regions several methods have been put forward by different authors. John O. Weaver's minimum deviation method failed to give simple crop combinations in the case of Punjab. Majid Hussain opted for maximum positive deviation method. This technique gives relatively simple


Unlike the Middle West, a diversity of crops are grown in Punjab. Many crops occupy a substantial proportion of the cropland without any sharp break in the data. That is why, the value of the minimum deviation for each tested combination in the case of Punjab goes on decreasing with the increase in number of crops, resulting in complex combinations.

results as it succeeds in eliminating some of the minor crops which are retained by the first method. However, crop combination regions arrived at by this method in the case of Punjab once again are sufficiently complex. Dyal\(^8\) decided for a "lower limit method" to demarcate such regions for the Punjab Plains. Treating the crops rankwise, he took all those crops in each unit which jointly occupy at least 50 per cent of the total cropped area to delineate such crop association regions. His basic unit of work was a tahsil, which is much larger than that of an assessment circle used in this study. That is why, he arrived at generalised crop combination regions. However, the same technique when applied on assessment circle basis fails to portray simple combinations. The serious limitation of this method is that it picks up only a first few crops without giving due weightage to the rest. Secondly, its lower limit of 50 per cent may be questioned. A few other authors also attempted at crop combination regions of different areas by employing varied methods. However, none of the techniques could afford to ignore the first few high ranking crops. In the present study, therefore, crop combination regions have been demarcated by combining the first three crops taken rankwise. By doing so it has been found that in no assessment circle of the state, area occupied by the first three crops thus combined, is

less than 50 per cent of the total cropped acreage. In some of the units it goes even up to the extent of 90 per cent.

This method gives a simple scheme of three crop combination regions. Although this method is simple in procedure and in ultimate crop combinations, yet it fails to give weightage to the remaining crops, as is the case with Dyal's method. However, before listing a scheme of the crop combination regions thus arrived at, an attempt on the spatio-temporal study of the ranking of crops will be useful.

**First Ranking Crops**

Out of all the crops grown in the state, wheat, cotton, fodder, maize, wheat-gram, gram, barley-gram, rice, groundnut and vegetables appear on the map showing first ranking crops (Map 103). Foodgrains emerge at the top in 100 out of a total of 120 assessment circles of the state. Their dominance in the cropping pattern of Punjab can be understood in the context of a large food demand in the state and in the country. Foodgrains are also the outstanding cash earners of the farmers. Among the first ranking crops wheat is by far the most important, holding first position in 81 assessment circles. It failed to appear at the top only in the semi-dry southwest where cotton and gram rank first, the Siwalik hills and the cho-infested foothill plain where wheat-gram, maize and fodder emerge at the top, and in an elongated
PUNJAB
First Ranking Crops
1951
DATA BY ASSESSMENT CIRCLES

PUNJAB
First Ranking Crops
1966
DATA BY ASSESSMENT CIRCLES

PUNJAB
Second Ranking Crops
1951
DATA BY ASSESSMENT CIRCLES

PUNJAB
Second Ranking Crops
1966
DATA BY ASSESSMENT CIRCLES

SOURCE OF DATA: UNPUBLISHED REVENUE RECORDS (LAL KITABS)
strip south of the flood plain of the Sutlej where groundnut, wheat-gram and barley-gram occupy the first position.

Different crops not only differ in their relative strength from area to area but also from time to time. The number of crops on the first ranking map declined from 12 in 1951 to 10 in 1966 (Maps 102 and 103). Bajra and oilseeds were the two which lost this distinction. Wheat, however, is the largest gainer in relative position. This crop extended its area as a first ranking crop from 50 assessment circles in 1951 to 81 assessment circles in 1966. It has come up from a lower to the first position in most of the assessment circles in central Bist Doab and northern and eastern Malwa. These are the areas where physical conditions are more conducive for wheat culture and where irrigation has considerably increased since 1951. The gain in its relative position was largely at the cost of fodder, gram and barley-gram. Cotton is another notable gainer in the semi-dry and extensively irrigated southwest. Rice, maize, groundnut and wheat-gram, on the other hand, had not recorded any apparent change in their relative position among the first ranking crops during the period under study.

Second Ranking Crops

Out of the ten first ranking crops in 1966, eight appear once again on the map showing second ranking crops for the same year (Map 105). Gram and vegetables were the
two which failed to find any place among second ranking crops. Fodder occupied more area than any other crop on the map showing second ranking crops. It appeared as a second ranking crop in 41 assessment circles, located largely in the southwestern Upper Bari Doab, western Bist Doab, and eastern and northeastern Malwa. Such a significant position of fodder in the crop complex can be understood in the context of the state's large livestock population and near absence of pastures. Ranking second in 20, 18, 12 and 6 assessment circles respectively, wheat, rice, maize, wheat-gram and groundnut are the other major crops appearing on this map. Wheat ranks second only to cotton and gram in most of the semi-dry southwestern Punjab. Rice ranks second to wheat in most of the central and northern Upper Bari Doab where waterlogging has emerged in extensive areas. Maize ranks second in almost all the assessment circles in the Siwalik hills and cho-infested foothill plain where well drained soils and adequate rainfall during its growing season provide favourable conditions for its cultivation. Groundnut ranks second in the sandy areas of northeastern Malwa, and the Dona belt of Bist Doab.

Bajra, gram and pulses, which were among the second ranking crops in 1951 failed to retain their position on the corresponding map for 1966 (Maps 104 to 105). Wheat shrank in areal coverage as a second ranking crop during 1951-66.
Improvement in its position in a large number of assessment circles from second to first but in a small number of units from third to second largely account for this fact. Fodder, maize and rice gained in areal coverage on a map of second ranking crops from 30 to 40, 10 to 18 and 9 to 18 assessment circles respectively during 1951-66. Increase in fodder coverage as a second ranking crop is largely associated with its decline from first to second position as a result of rising competition from wheat. It is also partly related with the increase in yields of fodder with extension of irrigation as the requirements of this commodity could be met from smaller acreage than before. Maize improved its rank in the Siwalik hills, sho-infested foothill plain and the Upper flood plain of the Sutlej. Groundnut gained in pockets of northern Malwa and western Bist Doab which are environmentally favourable for its cultivation.

Third Ranking Crops

Twelve crops emerge on the map showing third ranking crops as against 10 and 8 respectively on the corresponding maps showing first and second ranking crops (Map 107). Sugarcane and baira are the new entrants in the series. Occupying 46 assessment circles, fodder covers larger area than any of the third ranking crops. Maize appears as a third ranking crop in most of the central Bist Doab, in a
PUNJAB
Third Ranking Crops
1951
DATA BY ASSESSMENT CIRCLES

PUNJAB
Crop Combination Regions
1951
DATA BY ASSESSMENT CIRCLES

SOURCE OF DATA: UN PUBLISHED REVENUE RECORDS (PAKISTAN)
few assessment circles in the cho-infested foothill plain and in parts of the Upper flood plains. In the flood plains, it occupies third position only where soils are well drained and floods are not a serious menace. Rice emerges third in parts of the flood plains and in the waterlogged sections of the Upper Bari Doab. Mixed culture of barley-gram ranks third in a few assessment circles in the semi-dry southwest.

Fodder, maize and rice gained notably in their areal coverage as the third ranking crops during 1951-66 (Maps 106 and 107). Improvement in the relative position of rice and maize from lower to third rank and fall of fodder, from second to third position in many units are inter-related. Gram on the other hand has lost in its areal spread as a third ranking crop during the period under review. It went down to lower ranks in as many as 9 assessment circles.

This study clearly reveals that wheat, fodder, cotton, wheat-gram, maize, gram, rice and groundnut enjoy superior position in the total crop complex of the state. These jointly cover about 85 per cent of the total cropped area. Wheat and fodder appear extensively among the first three ranking crops, while the other crops show their presence only in segments conducive for their culture. As a result of the increase in irrigation, mounting demand for food and agro-industrial crops and emergence of waterlogging in parts, traditional
but more paying crops of the state such as wheat, maize, rice, cotton and groundnut have improved their relative position in the cropping pattern of Punjab while bajra, gram, wheat-gram, barley-gram and oilseeds have gone down.

The crop combination regions which are arrived at by superimposing maps showing the first three ranking crops are listed below (Maps 108 and 109).

**Crop Combination Regions : 1951**

<table>
<thead>
<tr>
<th>No.</th>
<th>Crop Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wheat, Rice, Maize.</td>
</tr>
<tr>
<td>2</td>
<td>Wheat, Rice, Fodder.</td>
</tr>
<tr>
<td>3</td>
<td>Wheat, Rice, Wheat-gram.</td>
</tr>
<tr>
<td>4</td>
<td>Wheat, Maize, Pulses.</td>
</tr>
<tr>
<td>5</td>
<td>Wheat, Maize, Rice.</td>
</tr>
<tr>
<td>6</td>
<td>Wheat, Maize, Fodder.</td>
</tr>
<tr>
<td>7</td>
<td>Wheat, Maize, Wheat-gram</td>
</tr>
<tr>
<td>8</td>
<td>Wheat, Wheat-gram, Maize.</td>
</tr>
<tr>
<td>9</td>
<td>Wheat, Barley-gram, Rice.</td>
</tr>
<tr>
<td>10</td>
<td>Wheat, Fodder, Maize.</td>
</tr>
<tr>
<td>11</td>
<td>Wheat, Fodder, Rice.</td>
</tr>
<tr>
<td>12</td>
<td>Wheat, Fodder, Gram</td>
</tr>
<tr>
<td>13</td>
<td>Wheat, Fodder, Wheat-gram.</td>
</tr>
<tr>
<td>14</td>
<td>Wheat, Fodder, Pulses.</td>
</tr>
<tr>
<td>15</td>
<td>Wheat, Gram, Fodder.</td>
</tr>
<tr>
<td>16</td>
<td>Wheat, Gram, Maize.</td>
</tr>
<tr>
<td>17</td>
<td>Wheat, Cotton, Fodder.</td>
</tr>
<tr>
<td>18</td>
<td>Cotton, Wheat, Fodder.</td>
</tr>
<tr>
<td>19</td>
<td>Cotton, Barley-gram, Wheat.</td>
</tr>
<tr>
<td>20</td>
<td>Cotton, Barley-gram, Rice.</td>
</tr>
<tr>
<td>21</td>
<td>Wheat-gram, Wheat, Fodder.</td>
</tr>
<tr>
<td>22</td>
<td>Wheat-gram, Wheat, Maize.</td>
</tr>
<tr>
<td>23</td>
<td>Wheat-gram, Gram, Wheat.</td>
</tr>
<tr>
<td>24</td>
<td>Wheat-gram, Fodder, Maize.</td>
</tr>
<tr>
<td>25</td>
<td>Wheat-gram, Fodder, Wheat.</td>
</tr>
<tr>
<td>26</td>
<td>Wheat-gram, Groundnut, Gram.</td>
</tr>
<tr>
<td>27</td>
<td>Fodder, Wheat, Vegetables.</td>
</tr>
<tr>
<td>28</td>
<td>Fodder, Wheat, Oilseeds.</td>
</tr>
<tr>
<td>29</td>
<td>Fodder, Wheat, Maize.</td>
</tr>
</tbody>
</table>
Crop Combination Regions: 1966

1  Wheat, Rice, Maize.
2  Wheat, Rice, Fodder.
3  Wheat, Rice, Wheat-gram.
4  Wheat, Maize, Rice.
5  Wheat, Maize, Wheat-gram.
6  Wheat, Maize, Fodder.
7  Wheat, Maize, Gram.
8  Wheat, Fodder, Maize.
9  Wheat, Fodder, Rice.
10 Wheat, Fodder, Sugarcane.
11 Wheat, Fodder, Gram.
12 Wheat, Fodder, Wheat-gram.
13 Wheat, Fodder, Barley-gram.
14 Wheat, Fodder, Groundnut.
15 Wheat, Fodder, Bajra.
16 Wheat, Fodder, Cotton.
17 Wheat, Wheat-gram, Maize.
18 Wheat, Wheat-gram, Rice.
19 Wheat, Wheat-gram, Fodder.
20 Wheat, Barley-gram, Fodder.
21 Wheat, Barley-gram, Rice.
22 Wheat, Groundnut, Fodder.
23 Wheat, Groundnut, Maize.
24 Wheat, Cotton, Barley-gram.
25 Wheat, Gram, Fodder.
26 Cotton, Wheat, Fodder.
27 Cotton, Wheat, Gram.
28 Cotton, Fodder, Wheat.
29 Wheat-gram, Maize, Wheat.
30 Wheat-gram, Maize, Fodder.
31 Wheat-gram, Fodder, Maize.
32 Wheat-gram, Wheat, Fodder.
33 Wheat-gram, Gram, Wheat.
34 Fodder, Rice, Wheat-gram.
35 Fodder, Wheat-gram, Maize.
36 Fodder, Maize, Wheat-gram.
37 Fodder, Wheat, Vegetables.
38 Fodder, Wheat, Rice.
39 Fodder, Wheat, Cotton.
40 Gram, Wheat, Fodder.
41 Gram, Fodder, Barley-gram.
42 Gram, Fodder, Wheat.
43 Rice, Wheat, Fodder.
44 Rice, Wheat, Maize.
45 Maize, Wheat-gram, Wheat.
46 Maize, Wheat-gram, Gram.
47 Maize, Wheat, Fodder.
48 Maize, Wheat, Wheat-gram.
49 Maize, Fodder, Wheat-gram.
50 Barley-gram, Wheat, Fodder.
51 Groundnut, Wheat, Fodder.
52 Vegetables, Wheat, Fodder.
CONCLUSIONS

With two-third of its total cropped area devoted to food grains, Punjab is not much different from the rest of the country as far as the stress on food grain cultivation is concerned. This similarity, however, does not go very far. While in most of India, food grains are cultivated for subsistence purposes, in Punjab, these constitute the most important component of the state's commercial agriculture. Of all the food grain crops raised in the state, wheat is by far the most important in area, consumption and marketable surplus. Nearly one-fourth of the total cropped acreage (about one-half of the rabi cropland) of Punjab in 1966, was devoted to this crop alone. Gram and wheat-gram of rabi and maize and rice of kharif season are the other outstanding food grain crops of the state. Among the non-foodgrains, fodder accounts for nearly one-sixth of the cropped area of the state and cash crops such as cotton, sugarcane and groundnut for the remaining one-seventh.

Environmental factors, such as surface configuration, amount and variability of rainfall, type of soils and depth of sub-soil water exert primary influence on the cropping pattern of the state. That is why, distributional patterns of various crops in Punjab show a large degree of conformity with the physical set-up. None the less, the role of economic and cultural factors, within the environmental framework, is
not less significant. Availability of irrigation, location of agro-based industries, relative variance in net profits, distance from urban centres, size of landholdings and long-held traditional practices of the people also played an important role in moulding the agricultural land-use of the state. This apart, distance from tubewell, canal outlet and village settlement, and field to field variations in soil texture and composition, too exercise a visible influence on the cropping pattern of the state at local level.

Expansion and intensification of irrigation, establishment of new agro-based industries, increasing population pressure, improving farm husbandry practices, changing sub-soil water depths and control on floods, among other factors, have played a significant role in modifying the cropping pattern of Punjab. Relatively more in demand and hence profitable crops, such as wheat, cotton, maize, rice, groundnut and sugarcane registered increase, both in absolute acreage and relative position, in the crop complex of the state. On the other hand, bajra, gram, pulses, oilseeds (except groundnut) and mixed culture crops of wheat-gram and barley-gram suffered decline in both these aspects. Expansion of wheat cultivation by a substantial amount in almost all parts of the state was largely at the cost of wheat-gram, gram and barley-gram. Cotton improved its position in semi-dry southwestern
Punjab largely by replacing less paying baiga, gram and guara in many fields. Rice captured some of the areas previously devoted to maize, cotton and oilseeds in those parts of the state which were abundantly irrigated and were seriously affected by waterlogging such as, the Upper Bari Doab and the flood plains. Maize did the same in well drained but relatively humid Siwalik hills and ocho-infested foothill plain. This is a clear indication of the rationalization and consolidation of the traditional but more remunerative crops of the state within the environmental setting during the period under review.

The Malwa region where irrigation considerably improved, and the flood plains where flood control measures reduced waterlogging and brought security to the crops, experienced considerable changes in the cropping pattern. By contrast, the sub-montane zone where irrigation could not be extended due to the undulating topography and deep underground water recorded only an insignificant change in this regard. The intensively cultivated upland plains of the Upper Bari Doab and Bist Doab where cropping pattern had already adjusted to the local resource base displayed only a moderate degree of change in this regard.

Although, Punjab is marked by its well developed agriculture and more rational cropping pattern, yet the scope
for further improvement on this front is fairly high. Under fast increasing pressure on land and no major possibility of pressing new areas under the plough, the need for more intensive use of the available land is rather imperative. Diversification of agriculture by emphasizing more on poultry, piggery and dairy and greater stress on mechanization to reduce dependence on animate power for farm operations are likely to improve the agricultural economy of the state. Second ranking position of fodder in the cropping pattern of Punjab is a clear index of the significance of livestock in the farm economy of the state.
total cropped area of Punjab is devoted to fodder crops. As a matter of fact, Punjab ranks first in the country in fodder cultivation. As such, by way of their fodder and feed requirements, the livestock strongly compete with the acutely needed food and agro-industrial crops. Inspite of the fact that fodder covers a substantial part of the total cropped acreage of the state, the supply falls short of the total requirements. This necessitates the use of less nutritive dry stalk of wheat (turi), maize (karab), rice (parali), baira and jowar for the purpose. Apart from the inferior animal breeds, the shortage of green fodder, open grazing grounds and feed crops account for the poor quality of livestock in the state.

Comprising nearly 82 per cent of the total livestock population, cows, bullocks and bulls (42.3 per cent) and buffaloes (39.9 per cent) are the most important cattle raised in the state. (Table 4)\(^1\). Farmers' preference for she-buffaloes as milch and bullocks as draft cattle largely

\(^1\) Data relating to livestock have been computed from the Livestock Census Punjab. The first livestock census in Punjab after Independence was conducted in 1951, taking district as the enumeration unit. However, from 1956 onwards the data are available on tahsil basis. Thus, for the convenience of comparability changes in livestock patterns have been investigated for the period extending only from 1956 to 1966. Livestock heads rather than livestock units have been taken for the analysis of the data in this study. In doing so, each livestock head,
## Table 4

Kinds of Livestock As Percentage of Total Livestock Heads in Various States of India

1966

<table>
<thead>
<tr>
<th>STATE</th>
<th>Cows, Bull-</th>
<th>Buffales</th>
<th>Sheep</th>
<th>Goats and Live-</th>
<th>Horses</th>
<th>Other Poultry</th>
<th>Livestock Heads per 100 Acres of Cultivated Area (excluding poultry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andhra Pradesh</td>
<td>39.0</td>
<td>21.4</td>
<td>25.3</td>
<td>11.9</td>
<td>0.1</td>
<td>2.1</td>
<td>14,715</td>
</tr>
<tr>
<td>Assam</td>
<td>70.7</td>
<td>6.3</td>
<td>0.8</td>
<td>17.1</td>
<td>0.5</td>
<td>4.5</td>
<td>10,984</td>
</tr>
<tr>
<td>Bihar</td>
<td>52.8</td>
<td>12.7</td>
<td>4.3</td>
<td>27.2</td>
<td>0.4</td>
<td>2.4</td>
<td>10,850</td>
</tr>
<tr>
<td>Gujarat</td>
<td>45.6</td>
<td>21.9</td>
<td>11.5</td>
<td>19.3</td>
<td>0.5</td>
<td>1.1</td>
<td>2,324</td>
</tr>
<tr>
<td>Haryana</td>
<td>40.3</td>
<td>35.1</td>
<td>9.4</td>
<td>9.2</td>
<td>0.4</td>
<td>5.6</td>
<td>476</td>
</tr>
<tr>
<td>Jammu &amp; Kashmir</td>
<td>43.9</td>
<td>10.5</td>
<td>28.2</td>
<td>14.8</td>
<td>1.6</td>
<td>0.9</td>
<td>1,535</td>
</tr>
<tr>
<td>Kerala</td>
<td>61.6</td>
<td>10.1</td>
<td>0.3</td>
<td>25.6</td>
<td>-</td>
<td>2.4</td>
<td>9,909</td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td>64.0</td>
<td>14.6</td>
<td>2.6</td>
<td>17.2</td>
<td>0.4</td>
<td>1.2</td>
<td>5,739</td>
</tr>
<tr>
<td>Madras</td>
<td>44.2</td>
<td>11.1</td>
<td>26.9</td>
<td>15.3</td>
<td>0.1</td>
<td>2.3</td>
<td>11,226</td>
</tr>
<tr>
<td>Maharashtra</td>
<td>57.9</td>
<td>11.9</td>
<td>5.7</td>
<td>20.1</td>
<td>0.4</td>
<td>1.0</td>
<td>9,887</td>
</tr>
<tr>
<td>Orissa</td>
<td>64.2</td>
<td>7.9</td>
<td>7.3</td>
<td>18.9</td>
<td>0.4</td>
<td>1.2</td>
<td>7,681</td>
</tr>
<tr>
<td>Karnataka</td>
<td>47.3</td>
<td>14.4</td>
<td>23.2</td>
<td>13.6</td>
<td>0.3</td>
<td>1.2</td>
<td>8,277</td>
</tr>
<tr>
<td>Punjab</td>
<td>42.3</td>
<td>39.9</td>
<td>5.9</td>
<td>8.3</td>
<td>0.5</td>
<td>3.1</td>
<td>1,680</td>
</tr>
<tr>
<td>Rajasthan</td>
<td>34.8</td>
<td>11.1</td>
<td>23.3</td>
<td>28.0</td>
<td>0.2</td>
<td>2.5</td>
<td>876</td>
</tr>
<tr>
<td>Uttar Pradesh</td>
<td>52.1</td>
<td>22.9</td>
<td>5.1</td>
<td>16.3</td>
<td>0.5</td>
<td>3.0</td>
<td>3,647</td>
</tr>
<tr>
<td>West Bengal</td>
<td>65.3</td>
<td>5.4</td>
<td>3.3</td>
<td>25.1</td>
<td>0.1</td>
<td>0.7</td>
<td>12,818</td>
</tr>
<tr>
<td>Nagaland</td>
<td>35.3</td>
<td>1.9</td>
<td>-</td>
<td>5.6</td>
<td>0.4</td>
<td>56.7</td>
<td>438</td>
</tr>
<tr>
<td><em><strong>INDIA</strong></em></td>
<td><strong>51.1</strong></td>
<td><strong>15.5</strong></td>
<td><strong>12.1</strong></td>
<td><strong>18.9</strong></td>
<td><strong>0.3</strong></td>
<td><strong>2.1</strong></td>
<td><strong>1,13,062</strong></td>
</tr>
</tbody>
</table>

**SOURCE:** Computed from data in Statistical Abstract, Punjab, 1968.
explains this phenomenon. Every farmer, big or small, has to keep at least a milch cattle and a pair of draft animals to meet the needs of his farm house. Goats and sheep constitute 8.3 and 5.9 per cent of the livestock population respectively. Goats furnish bulk of the meat requirements while sheep are mostly raised for wool.

Continued...

irrespective of age and kind, has been given equal weightage, which in fact is its serious limitation. Although, the use of livestock units is free from such a drawback, yet it suffers from a few other limitations. Firstly, the conversion scale, which generally is based on the standard feed recommendations for various kinds and age groups of animals is questionable. The type of feed on which such a scale is generally devised, is rarely the feed consumed by the farm animals in reality. Secondly, by converting livestock heads into livestock units, the importance of those animals whose feed requirements are small but contribution to the farm economy is significant, is reduced considerably. Visualizing all the aspects of this problem, it was finally decided to use livestock heads for calculating ratios and percentages in this study. Moreover, this monograph deals with agricultural land-use rather than the study of livestock as such. Nevertheless, livestock heads have been converted into livestock units, according to the following scale, for the purpose of visualizing the pressure of livestock on land (Maps 122 and 123).

For the conversion of 'livestock heads' into 'livestock units', use has been made of the recommended animal feed for various livestock types of different age groups in terms of digestible crude protein (D.C.P) and total digestible nutrients (T.D.N) (Indian Council of Agricultural Research, 1971, and Division of Breeding and Genetics, National Dairy Research Institute, Karnal). For
Camels account for 1.6 per cent of the state's livestock. This animal is exclusively raised for draft. Horses, ponies, donkeys and pigs comprise another 2 per cent of the livestock population. Besides, Punjab had about 1.7 million poultry birds in 1966.

The livestock population of Punjab (excluding poultry) increased from 7,047,243 to 7,481,100 during 1956-66. This addition of about 0.43 million heads in the livestock wealth of the state has been largely contributed by she-buffaloes and bullocks. Growing demand for draft and dairy cattle with the continuing sub-division of landholdings and multiplying

Continued...

1 India, the conversion scale thus derived is based on standard animal feed as follows:

<table>
<thead>
<tr>
<th>Livestock</th>
<th>Age Group (In years)</th>
<th>Live- stock Heads</th>
<th>Livestock Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cows</td>
<td>Over 3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>She-buffaloes</td>
<td>Over 3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Bullocks and Bulls</td>
<td>Over 3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Male-buffaloes</td>
<td>Over 3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Horses, ponies and mules</td>
<td>Over 3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Camels</td>
<td>Over 4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Young stock of Cows, bullocks, bulls, buffaloes, horses, ponies and mules.</td>
<td>1-3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Young stock of cows, bullocks, bulls, buffaloes, horses, ponies and mules.</td>
<td>Under 1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Young stock of camels</td>
<td>4 and under</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Sheep and Goats</td>
<td>Over 1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Sheep and goats</td>
<td>Upto 1</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Donkeys</td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Pigs</td>
<td></td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td>100</td>
<td>1</td>
</tr>
</tbody>
</table>
population largely account for this fact. However, such a positive trend has been largely facilitated by the declining mortality rate of the animals with the improvement in veterinary facilities (veterinary institutions increased from 500 to 807 during 1951-66) and greater animal care by the farmers. The goat and sheep population, on the other hand, declined from 971,446 to 621,440 and from 490,450 to 444,000 respectively during this period. Shrinkage of pastures and growing demand for meat resulting in slaughtering of an increasing number of animals are responsible for this decrease. With the increase in road mileage (from 1619 miles in 1951 to 4292 miles in 1966) and improvement in mechanical transport (from 1057 tractors in 1951 to 10,363 tractors in 1966) horses, donkeys and camels as transport media are becoming unpopular. Piggery and poultry, on the other hand, have gained momentum during recent years. Growing demand for meat and eggs and diminishing size of landholdings have induced the farmers to look to these subsidiary activities. The incentives provided by the government in the form of liberal credit and training facilities for the purpose also have gone a long way in giving a fillip to these activities.

Cows, Bullocks and Bulls
Cows, bullocks and bulls numbering over three million heads (42.3 per cent of the total livestock) are the leading
Cows—Bullocks—Bulls as Percentage of Total Livestock Heads, 1966
DATA BY TAHSILS

Buffaloes as Percentage of Total Livestock Heads, 1966
DATA BY TAHSILS

Percentage Change in Cows, Bullocks & Bulls Population 1956—66
DATA BY TAHSILS

Percentage Change in Buffalo Population 1956—66
DATA BY TAHSILS
type of domesticated animals raised in Punjab. Of this, 40.6 per cent (1,286,200) are bullocks and bulls over 3 years of age; 26.2 per cent (828,400) are cows (in milk or dry) over 3 years and the rest are young stock (calves below 3 years). Universal use of bullocks for draft and of cows for milk largely account for their superior numerical position. Of all the draft animals (bullocks, he-buffaloes and camels over 3 years of age) raised in Punjab, bullocks alone constitute about four-fifth. The preference of this draft cattle over others is largely associated with its faster movement, prestigious status and adjustability to a wider range of environmental conditions. Nevertheless, cows also constitute a significant proportion of this livestock type. Of the milch cattle (she-buffaloes and cows of over 3 years age) of Punjab, cows account for nearly one-third. Apart from milk, cows are kept for giving birth to much needed bullocks as well. Cows are less popular than she-buffaloes as dairy cattle largely because of the low yield and lower fat contents of their milk. However, this milch cattle is cheaper and consumes less of fodder. That is why, cows are mostly kept by small farmers and landless people.

Cows, bullocks and bulls are raised in all parts of the state. Their position in the total livestock complex, however, varies from area to area (Map 110). Parts of the
flood plain of the Sutlej and the Beas, hilly sections of Pathankot tahsil and southeastern Punjab are the areas which show relatively high (45 to 58 per cent) concentration of this livestock type. Availability of grazing facilities on culturable waste lands in these tracts largely explain this phenomenon. Unlike buffaloes, this livestock type can live well even on grazing alone. By comparison, cows, bullocks and bulls constitute only 29 to 39 per cent of the total livestock population in southwestern parts of the state. Higher degree of mechanization and greater competition from the camel as a draft animal in these semi-dry areas partly explain their smaller numbers.

The whole of the Ropar district and the adjoining tahsils of Garhshankar and Nawanshehr, form another tract where the proportion of cows, bullocks and bulls is low (30 to 38 per cent).

The number of cows, bullocks and bulls increased from 3,014,814 in 1956 to 3,161,800 in 1966, giving a percentage increase of only 4.8\(^2\). A large part of this increase is shared by the bullocks. The continuing subdivision of landholdings and consequent increase in the demand for bullocks largely explains this trend. Percentage change in this livestock type within the state, however,

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\(^2\) Percentage change (change on the base year) has been taken as an index of change in this chapter.
varies from area to area (Map 111). While most of the Malwa and the Upper Bari Doab recorded increase, the other areas witnessed decline. The increase ranging from 8 to 29 per cent in most of the Malwa region is largely associated with the growing demand for draft and dairy cattle as a result of the recent reclamation of new lands and in-migration of the people respectively. Notable increase in cows, bullocks and bulls in most of the Upper Bari Doab is mainly the outcome of the initiation of artificial insemination programme in Amritsar district during early sixties. The number of improved cow breeds which yield more milk than the indigenous breeds has risen steeply. In the remaining parts of the state, cows, bullocks and bulls registered decline. Shrinkage of pastures, preference for she-buffaloes for milk and the export of dry cows to the neighbouring state of Uttar Pradesh for slaughtering mainly account for this decrease.3

In sum, those areas of the state where grazing facilities on culturable waste lands are found in larger measure show somewhat higher concentration of cows, bullocks and bulls. Only those sections of the Upper Bari Doab where intensive breeding programme has been recently initiated and those parts of the Malwa where reclamation of new lands have

3 Although killing of cows is prohibited in Hindu religion, yet some of them are slaughtered unofficially in Uttar Pradesh where most of the country's Muslim population is concentrated.
taken place recently registered some increase in the population of this livestock type. In other areas, their numbers came down.

**Buffaloes**

With 39.9 per cent (2,983,300 heads) of the total livestock population (as against the national average of 15.5), buffalo is the second largest domesticated animal of Punjab. Out of the state's total buffalo stock, nearly 51 per cent (1,514,300) are she-buffaloes (in milk or dry) of over 3 years of age; about 8 per cent (251,200) are he-buffaloes of over 3 years of age and the remaining 41 percent are young ones below 3 years. The significant position of this livestock type in the livestock complex of the state is largely associated with the importance of she-buffaloes for milk. This animal constitutes nearly two-third of the Punjab's dairy cattle. The preference of the farmers for she-buffaloes over other milch cattle is largely due to its higher yield of fat-rich milk.

Distributional pattern of this livestock type shows significant areal variations, ranging from 19 per cent of the total livestock heads in Pathankot tahsil to 52 per cent in Phagwara tahsil (Map 112). Buffaloes are concentrated more heavily (38 to 51 per cent) in northern Malwa and in Punjab north of the Sutlej river. This is largely associated with (1) relatively wet climate which furnishes a better habitat
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for this animal; (ii) higher degree of urbanization and high density of rural population demanding more of dairy products; (iii) well developed irrigation which supports green fodder during most of the year; (iv) traditional association of draft buffaloes with people coming from Sialkot district of West Pakistan who settled largely in the flood plain of the Beas and in parts of the Upper Bari Doab, and (v) its preference over bullocks for paddy cultivation. Nearly 75 per cent of the draft buffaloes are concentrated in northern Punjab (Map 118). By comparison, the relatively dry, inadequately irrigated, less populated and predominantly rural southern Punjab is less important for buffaloes. He-buffalo, though slow and sensitive to sun, is cheaper to maintain, is more energetic and is particularly suited to mud ploughing which is essential for paddy cultivation. That is why this animal is more popular in the rice growing areas of the north (rice acreage and he-buffaloes show a positive correlation of 0.497). Because of their lower prices than those of the bullocks, the he-buffaloes are more common with small cultivators.

Buffalo population in Punjab increased from 2,247,201 (31.8 per cent of the total livestock) in 1956 to 2,983,300 (39.9 per cent) in 1966. Nearly half (367,873) of this increase was due to the increase in she-buffaloes, 3.6 per cent (26,781) due to he-buffaloes and the rest was
contributed by the young stock. Larger increase in the population of she-buffaloes is mainly associated with the growing demand for fresh milk and milk products from the growing urban and rural population and improving living standards of the people. Increase in the number of he-buffaloes is largely related with the increasing emphasis on paddy cultivation (area under rice increased by about 3 times during 1951-66). Almost all parts of Punjab registered increase in buffalo population (Map 113). The growth, however, was relatively high (15 to 64 per cent) in the Malwa region where irrigation has been greatly extended and the density of population is not high. On the other hand, most of the northern Punjab facing a severe population pressure recorded small increase (8 to 40 per cent) in this livestock type. A tract in the central Upper Bari Doab in the north, however, is an exception. Growth ranging from 47 to 50 per cent in this tract has been due to the rising demand for milk from the expanding Amritsar city and from the newly established milk food plant at Verka.

In sum, universal acceptance of she-buffaloes as milch cattle accounts for the outstanding position of Punjab in the country in raising this livestock type. Numerically and relatively, buffaloes registered increase in all parts of the state. The increase, however, was larger in those areas where irrigation has been extended recently, where new milk plants have been established and where the pace of
PUNJAB
Goats as Percentage of Total Livestock Heads
1966
DATA BY TAHSILS

PUNJAB
Sheep as Percentage of Total Livestock Heads
1966
DATA BY TAHSILS

PUNJAB
Percentage Change in Goat Population
1956—66
DATA BY TAHSILS

PUNJAB
Percentage Change in Sheep Population
1956—66
DATA BY TAHSILS

Source of data: Livestock Census Punjab

Percentage Change
\[\begin{array}{c}
10\% \\
5\% \\
3\%
\end{array}\]

Percentage Change
\[\begin{array}{c}
60\%
25\% \\
10\% \\
25\% \\
10\%
\end{array}\]
Goats

Accounting for 8.3 per cent (620,400 heads) of the state's livestock, goats are the most important meat cattle of Punjab. As a result of the prohibition of beef in Hindu religion, lack of taste for pork and sheep meat, and high price of chicken, the choice of the people for meat largely rests on goat. The landless people, especially the scheduled castes, also raise goats for milk. Goat raising is considered an inferior occupation by the cultivators. That is why, this animal is largely associated with the landless scheduled caste people. However, economic necessities are gradually bringing about changes in social attitudes. With the sub-division of landholdings, some of the small cultivators have started raising goats. Their position in the livestock complex, however, varies markedly from area to area (Maps 114 and 121). Southwestern Punjab, where goat rearing is related largely to the availability of bush pastures, has a relatively dense (9 to 17 per cent) goat population (Map 121). Here goats are raised generally in combination with sheep. Its association with sheep herds eliminates extra labour for grazing and gives additional advantage of milk and meat to the herders. Sheep does well on grasses, while goat on bushes. The Siwalik hills is...
another tract where emphasis on goat raising is considerable. The percentage of goat population to the total livestock heads here ranges from 10 to 25 per cent. The availability of bush pastures on the dissected hill slopes and backward state of agriculture in this tract has induced the landless and the small cultivators alike to go in for goat raising as a secondary source of income.

Goat population in Punjab has come down from 971,446 (13.7 per cent) in 1956 to 620,400 (8.3 per cent) in 1966, resulting in a decline of about 36 per cent. Restrictions imposed by the government on grazing in the hills as a soil conservation measure, and declining culturable waste land because of mounting population pressure have reduced the area under grazing resulting in the decline of goat population. Also, consistent with the increasing demand for meat, the slaughtering of goats has occurred in increasing number, thereby bringing decline in their population. Spatially, all parts of the state, except Ropar district, have registered this decline (Map 115). Decrease, however, was relatively high in the southwest where dry farming has gradually been replaced by irrigation agriculture and grazing facilities cut down. By contrast, the growth of goat population in Ropar district is attributable to the availability of grazing grounds in the foothill zone and a ready market at Chandigarh.
PUNJAB
Distribution of Male Working Buffaloes
1966
DATA BY TAHSILS

One dot represents 500 Male Working Buffaloes

Source of data: Livestock Census, Punjab

PUNJAB
Distribution of Sheep
1966
DATA BY TAHSILS

One dot represents 1000 sheep

Source of data: Livestock Census, Punjab

PUNJAB
Distribution of Camels
1966
DATA BY TAHSILS

One dot represents 1000 Camels

Source of data: Livestock Census, Punjab

PUNJAB
Distribution of Goats
1966
DATA BY TAHSILS

One dot represents 1000 Goats

Source of data: Livestock Census, Punjab
In short, shrinkage of grazing grounds and accelerated rate of slaughtering of goats for meat has sharply brought down the population of this livestock type in the whole state, excepting the foothill zone in Ropar district.

Sheep

Numbering 444,000, sheep constitute 5.9 per cent of Punjab's livestock population. This animal is largely raised for wool, though some of them are also slaughtered for meat. However, sheep farming in Punjab can in no way be compared with the highly specialized and commercialized sheep rearing in Australia and Argentina. Quality and yields of wool in Punjab are poor. Inferior sheep breeds, dearth of pastures and lack of proper animal care mainly are responsible for such a state of affairs. Rearing of sheep, like that of goats, is treated as an inferior activity by the cultivators. No wonder, this animal is largely raised by landless scheduled caste families. Environmental conditions also influence the distributional pattern of sheep in the state. They are concentrated heavily in southwestern and southcentral Punjab. About three-fourth of Punjab's sheep is concentrated in the three districts of Sangrur, Bhatinda and Ferozepur (Maps 116 and 119). There semi-dry climate under which sheep are less prone to diseases and yield more wool, largely explains this phenomenon. The presence of pastures,
though of poor quality, on dune sites is another favourable factor. Harvested fields and fallow lands are also used for grazing. Sometimes a flock of sheep may be confined to a field for a day or two, to enrich the soil with their refuse. Occasionally farmers ask for such favours from the herdsmen even on payment. In fact, the southwest constitutes a nucleus of sheep farming in the state. From here, the emphasis on sheep raising declines towards the north and the east. In the northern and eastern sections of the state, it constitutes less than 3 per cent of the livestock population. Relatively heavy rainfall, more pressure on land and consequent dearth of pastures discourage sheep rearing in these areas. Pathankot tahsil in the north, however, is an exception. Sheep constitute 10.4 per cent of the livestock population of this tahsil. The hilly terrain, considerable amount of grazing grounds and poor economic condition of small cultivators inducing them to look to this activity as a supplementary source of income largely account for higher concentration of sheep here.

Sheep population in the state has declined from 490,450 to 444,000 during 1956-66. This is largely related to the increasing pressure on land and consequent dwindling of area under pastures. Southcentral Malwa, Fazilka and Ferozepur tahsils in the southwest, Ropar and its adjoining parts of Patiala, Ludhiana and Hoshiarpur districts in the
east, are the areas where sheep have suffered decline in their numerical strength (Map 117). The increase in their numbers in some of the remaining areas of the state was, however, only marginal.

In sum, sheep farming in Punjab is commercial in nature and is largely carried on by the scheduled caste landless people. This animal concentrates heavily in semi-dry southwestern Punjab. Sheep population, which is already on the decline, is likely to go down further with increasing pressure on land, and extension of irrigation.

Camels

Camels comprise only 1.6 per cent (118,600) of the state's livestock population. This animal is largely kept for draft purposes. Camel is spotted in all parts of the state. However, 96 per cent of its population is concentrated in Malwa region alone (Map 120). Even within this region the three districts of Sangrur, Bhatinda and Ferozepur account for about three-fourth of Punjab's camel population. Such a heavy concentration is related to semi-dry conditions with which the camel shows better adaptation. From this region, camel thins out to the north and northeast. In northern Punjab (north of the Sutlej river), the proportion of camels to the total livestock heads
nowhere exceeds 0.2 per cent. Here the camel is raised largely for working irrigation wells. By virtue of its faster movement, camel draws more water from the Persian wheel wells than a pair of bullocks. Also, it saves the labour of a worker otherwise required to keep the well working if bullocks are used. That is why the camel is preferred for this purpose. With increasing mechanization on the farms, improving modes of transport and shifting emphasis from well to tubewell irrigation, camel population in the state has declined from 122,167 to 118,600 during 1956-66. The decrease was, however, relatively high in those areas of Malwa where sub-soil water has come near the surface during recent years. On the other hand, environmentally favourable for camel, the Bhatinda district and parts of Ferozepur district recorded a marginal increase in camel population.

Thus, semi-dry and sandy southwestern Punjab shows the highest concentration of camel population. With growing mechanization, its numbers have been on the decline.

**Horses, Ponies, Donkeys, and Pigs**

Horses, ponies, donkeys, and pigs jointly comprise about 2.0 per cent (147,200 heads) of the state's livestock population. While horses, ponies and donkeys are employed in transport, pigs are coming up as a source of meat. Raising a fine breed horse for ride in a rural house was considered
a symbol of status in the past. In the near absence of motor transport, this animal was largely used for cross country movements. Besides, it provided cart transport. Donkeys and ponies in Punjab are largely raised by kumhars (a backward class). They are traditionally known for donkey transport. These animals generally carry loads of earth and bricks. However, with the development of roads and efficient motor transport, these animals are gradually declining in importance.

Pig population in the state increased from 20,416 to 44,900 during 1956-66, giving a percentage increase of about 120. Increasing demand for meat, introduction of improved Russian and U.S. pig breeds and increased credit facilities offered by the government for the purpose largely account for this development. However, lack of feed grains and greater dependence of this animal on garbage has kept the quality of pork poor. As a result, pork is not so popularly in demand as it should have been otherwise. Pig raising is treated an inferior activity and thus is largely adopted by the scheduled castes. None the less, with increasing awareness about the commercial significance of this activity, some small cultivators and ex-servicemen are gradually turning to this vocation.

Poultry

Raising a few poultry birds of indigenous breeds in
rural homes to meet the egg and meat requirements at the household has been the common practice in Punjab since long. However, the emergence of commercial poultry farming in the state is only a recent phenomenon. In 1956, Punjab had 1.1 million poultry birds. This figure increased to about 1.7 million by 1966. This addition of about 0.6 million birds during 1956-66 is largely associated with the growing demand for eggs and meat, declining size of landholdings, advancement of easy term credit for the purpose by the government and free training facilities provided by the state to the interested people. Poultry farming has come up fast in the proximity of towns, particularly in northern Punjab where landholdings are small. Also, large scale commercial poultry farming has recently been started by well-to-do people, particularly retired military officers. The poultry refuse furnishes an excellent manure.

CONCLUSIONS

With a density of 1.5 livestock heads every two acres of cultivated land, Punjab is one of the richest states in the country in livestock wealth. Nearly three-fourth of the livestock population of the state is comprised of cows, bullocks, bulls and buffaloes. Almost universal raising of she-buffaloes and cows for milk and draft animals largely explains their outstanding position in the state. Dairy farming as known in the western world, however, is
altogether missing in Punjab. It is more a semi-commercial type of activity with the individual farmers and that too largely around urban centres and milk plants. Punjab is practically devoid of beef industry. Prohibition of beef in Hindu religion is a major hurdle in this regard. That is why goats, sheep and pigs, which jointly constitute about one-seventh of the state's livestock, furnish almost the whole of the meat supply.

Size of landholdings, degree of mechanization and urbanization, density of population, availability of pastures and physical environment largely determine the distributional pattern of livestock in the state. Sheep and camel concentrate heavily in the semi-dry southwestern Punjab. He-buffaloes show higher proportions only in the relatively wet and paddy growing northern Punjab. Goats are more popular either in the southwest, where they are raised in association with sheep or in the Siwalik hills where enough of bush pastures are available. By comparison, universally accepted she-buffaloes and bullocks show more even distribution.

Poultry farming, as a commercial phase of agriculture, is recent and is largely developing around urban centres and in areas having small landholdings. In general, Punjab north of the Sutlej river, where landholdings are small, population density is high, and irrigation is well developed, show larger concentration of livestock than the south.
Despite a notable decline in the numerical strength of goat, sheep and camel, livestock population (excluding poultry) in Punjab has increased by a little less than half a million during 1956-66. Largest contribution to this increase has come from she-buffaloes and bullocks. Growing demand for draft and dairy animals in the context of growing population, increasing urbanization, improving living standards and the sub-division of landholdings largely account for this phenomenon. The increase in she-buffalo population, however, was proportionately larger than that of bullocks. That is why, buffaloes have improved their relative strength in the total livestock complex, by dislodging "cows, bullocks and bulls" from first to second rank during 1956-66, in as many as 17 tahsils of the state. Shrinkage of pastures and increasing demand for meat have come down heavily on the sheep and goat population of the state. Growth of livestock population, on the whole, was higher in the Malwa region of the state where extension of irrigation improved the supply of green fodder. By comparison, the northern Punjab, being already under severe population and livestock pressure, only maintained its previous position.

Raising of sheep, goats and pigs, which once was considered an inferior activity by the cultivators, is being gradually adopted by them. Taboos against milk selling too are disappearing. Diversification of agriculture in the
form of poultry, dairy and piggery is in the offing. Improvement of animal breeds for higher yields of milk, meat and wool need to be given more attention than has been the case so far. For maintaining better health standards, meat supply at cheap rates is a pre-requisite which requires an urgent state level planning.