In assessing the role of irrigation, one has to take cognizance of integrated crop assemblages rather than the area under individual crops. The delineation of isolated crop regions tends to oblivious the importance of other crops that may either be simultaneously cultivated or rotated with the crop concerned. An increase in any crop area due to irrigation or otherwise will inevitably be at the expense of other crops. This will be reflected only when crop associations are considered. Moreover, identification of crop combination regions is of fundamental importance in analysing the agricultural system of an area. Since the requirements of crops vary individually, their spatial distribution tends to reflect the diversities of the physico-ecological and socio-economic variables of an area. These factors do not operate in isolation but play inter-related roles, thus imparting a certain degree of homogeneity in moulding an agricultural region.

In a general sense, tangible benefits have been conferred upon the cropping pattern in West Bengal by permitting the cultivation of high water consuming but more lucrative crops. Despite the continuing importance of the rainfed 'aman' rice, new dimensions have been ushered in. This is reflected in the contribution of this crop to gross cropped area which
has declined steadily along with other non-irrigated crops like jute and pulses. These have been simultaneously replaced by the irrigated crops of wheat, 'boro' rice and potato (Table 15).

Table 15a

Cropping Pattern of West Bengal (1950 - 80)

<table>
<thead>
<tr>
<th>Year</th>
<th>Cropping Pattern (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>A (63.27), Ps (10.37), As (9.55), J (4.34)</td>
</tr>
<tr>
<td>1960s</td>
<td>A (60.22), Ps (11.74), As (9.01), J (6.85)</td>
</tr>
<tr>
<td>1970s</td>
<td>A (54.26), As (11.28), Ps (8.84), J (5.61)</td>
</tr>
<tr>
<td>1980s</td>
<td>A (52.46), As (9.16), B (6.61), J (5.89)</td>
</tr>
</tbody>
</table>

As = Aus, A = Aman, B = Boro, Ps = Pulses, J = Jute

Table 15b

Percent contribution of other crops to GCA in W.B. (1950-80)

<table>
<thead>
<tr>
<th></th>
<th>Pulses</th>
<th>Wheat</th>
<th>Boro</th>
<th>Potato</th>
<th>Oilseeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>8.69</td>
<td>0.93</td>
<td>0.31</td>
<td>0.73</td>
<td>1.33</td>
</tr>
<tr>
<td>1960s</td>
<td>11.74</td>
<td>0.84</td>
<td>0.38</td>
<td>1.01</td>
<td>2.12</td>
</tr>
<tr>
<td>1970s</td>
<td>8.84</td>
<td>4.42</td>
<td>4.36</td>
<td>1.08</td>
<td>2.62</td>
</tr>
<tr>
<td>1980s</td>
<td>5.05</td>
<td>4.18</td>
<td>5.61</td>
<td>1.85</td>
<td>4.57</td>
</tr>
</tbody>
</table>

Source (Bureau of App. Eco. & Statistics)
Crop Combination regions have been analysed from the point of view of both dominant and distinctive crops.

DOMINANT CROP REGIONS

Dominant crop implies that which covers a substantial share of gross cropped area (GCA) in the component unit. Such an identification is of great relevance since the most dominant crop is usually a response to generally favourable geo-economic factors within that unit.

Methodology for Identification of Dominant Crop Regions

Several methods are utilized for identification of dominant crop regions. The Ranking Method is a simple, descriptive non-quantitative approach with the crop constituting the largest percent share to GCA forming the first ranking crop, that with the next largest share the second ranking one and so on. This method tends to ignore the magnitude of the difference between the percentage share of the various crops. For example in Darjiling district the first ranking crop is maize (29.61%), and second is aman (28.10%), whereas in 24 Parganas South aman is the first (86.55%) and boro the second ranking crop (4.85%).

The use of statistical methods, which considers the magnitude of difference between the crops, are more acceptable. Weaver's method (1954) basically involves the comparison of the actual percentage area under each crop with a theoretical
percentage the latter changing under different hypothetical situations. The formula is \( \sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n} = \frac{\sum d^2}{n} \)

\( \bar{x} \) = theoretical p.c., \( x_i \) = actual p.c., \( n \) = number of crops included in that particular situation.

The variation of actual percentage from theoretical values are calculated, the best fit being established by the method of least squares. The chief defect as pointed out by Weaver himself is that it occasionally tends to show the lowest deviation for a crop combination that includes every crop occupying as much as 1% of total harvested cropland.

Pol's Method (1957) is a modification of Weaver's method, excluding crops occupying less than 1% of GCA. He used the same theoretical values but substituted \( \frac{\sum d^2}{n} \) by \( \sum d^2 \). The combination having the smallest \( \sum d^2 \) values is considered as best fit. However in areas with a moderate to large percentage share of first ranking crop as in West Bengal, it lays an exaggerated degree of dominance on one crop. Moreover it tends to ignore the signs of the deviations.

Rafiullah's Method (1965) is another distinct modification of Weaver's method. It takes into consideration the signs of deviations from theoretical percentages. For hypothetical situation he considers the halved values of Weaver's theoretical percentage. Moreover, the squared values of 'n' are taken to provide a more correct picture \( \sigma^2 = \frac{\sum d^2}{n^2} \)

\( \sum d^2 \) = arithmetical sum of squared deviations
\( n \) = no of crops included.
The combination possessing the highest value is chosen. By reducing the theoretical percentage areas with a more diversified cropping pattern are brought under a more reasonable, smaller group than by Weaver's method. However in a State like West Bengal, where most regions possess a large percentage share within the first ranking crop, this appears as a demerit. Yet it hardly affects the crop combination pattern as these areas still remain mono-cultural. Hence, considering all the methods, it may be stated that Rafiullah's method appears well suited in West Bengal.

**Dominant Crop Regions - Generalized Pattern**

District level dominant crop regions have been computed by Rafiullah's method for the four decades 1950s, 1960s, 1970s, 1980s to present a comprehensive analysis of changes in cropping pattern. Since this involves more than one value, each decade has been dealt with separately (Table 16).

**Cropping Pattern in 1950s**: This reflects the situation immediately after independence and transfer of agricultural lands, viz. jute lands to East Pakistan (Bangladesh) in 1947. Most of the districts, chiefly the dry western plateau and plateau fringe tracts, emerge as monocropped zones with rainfed 'aman' rice as the main crop. Even in multi-cropped districts, aman rice is the first ranking crop. The districts of Hughli, W. Dinajpur, K. Bihar and Jalpaiguri form 2 crop regions, specializing in pulses in Hughli, tea in Jalpaiguri and the
Table 16

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Purulia</td>
<td>Monocropped A (85.45)</td>
<td>Monocropped A (76.71)</td>
<td>Monocropped A (80.01)</td>
<td>Monocropped A (85.59)</td>
</tr>
<tr>
<td>Bankura</td>
<td>Monocropped A (73.45)</td>
<td>Monocropped A (79.45)</td>
<td>Monocropped A (79.91)</td>
<td>Monocropped A (78.92)</td>
</tr>
<tr>
<td>Birbhum</td>
<td>2 crops A (70.12) PS (11.68)</td>
<td>2 crops A (61.19) AS (11.84)</td>
<td>2 crops A (65.80) AS (11.82)</td>
<td>2 crops A (71.10) AS (11.42)</td>
</tr>
<tr>
<td>Bardhaman W</td>
<td>Monocropped A (85.18)</td>
<td>Monocropped A (77.79)</td>
<td>Monocropped A (75.08)</td>
<td>Monocropped A (74.06)</td>
</tr>
<tr>
<td>Bardhaman E</td>
<td>Monocropped A (80.15)</td>
<td>Monocropped A (78.29)</td>
<td>Monocropped A (75.08)</td>
<td>Monocropped A (75.08)</td>
</tr>
<tr>
<td>Haorah</td>
<td>Monocropped A (74.57)</td>
<td>Monocropped A (74.67)</td>
<td>2 crops A (69.12) B (9.08)</td>
<td>2 crops A (62.66) J (31.55)</td>
</tr>
<tr>
<td>24 Parganas S N</td>
<td>Monocropped A (75.20)</td>
<td>Monocropped A (73.74)</td>
<td>2 crops A (79.40) J (6.13)</td>
<td>2 crops A (86.55)</td>
</tr>
<tr>
<td>Hugli</td>
<td>2 crops A (65.91) PS (10.74)</td>
<td>2 crops A (65.15) J (14.05)</td>
<td>2 crops A (69.74) B (16.98)</td>
<td>2 crops A (52.64) B (15.68)</td>
</tr>
<tr>
<td>Nadia</td>
<td>3 crops PS (25.96)</td>
<td>3 crops PS (26.55) AS (19.43)</td>
<td>4 crops A (29.70) AS (14.97)</td>
<td>4 crops A (29.70) AS (14.97)</td>
</tr>
<tr>
<td>Murshidabad</td>
<td>2 crops A (50.72) AS (12.68)</td>
<td>2 crops A (50.17) PS (27.60)</td>
<td>2 crops A (27.08) PS (20.50)</td>
<td>2 crops A (27.08) PS (20.50)</td>
</tr>
<tr>
<td>Naldah</td>
<td>3 crops A (31.33) AS (15.59)</td>
<td>3 crops A (31.09) PS (23.59)</td>
<td>3 crops A (27.52) AS (11.81)</td>
<td>3 crops A (27.52) AS (11.81)</td>
</tr>
<tr>
<td>W. Dinajpur</td>
<td>2 crops A (11.42) J (10.56)</td>
<td>2 crops A (11.42) J (10.56)</td>
<td>2 crops A (47.79) A (17.74)</td>
<td>2 crops A (48.30) A (17.25)</td>
</tr>
<tr>
<td>K. Bhatar</td>
<td>2 crops A (51.10) AS (11.45)</td>
<td>3 crops A (52.10) AS (15.26)</td>
<td>3 crops A (46.84) AS (23.79) J (12.63)</td>
<td>3 crops A (46.84) AS (23.79) J (12.63)</td>
</tr>
<tr>
<td>Jalpaiguri</td>
<td>2 crops A (57.57) J (16.19)</td>
<td>3 crops A (55.22) J (12.87)</td>
<td>3 crops A (49.11) A (17.46) T (15.05)</td>
<td>3 crops A (49.11) A (17.46) T (15.05)</td>
</tr>
<tr>
<td>Darjeeling</td>
<td>3 crops A (27.61) OCs (27.01) T (24.93)</td>
<td>3 crops A (31.73) T (29.50)</td>
<td>3 crops A (29.33) T (24.03) OCs (18.91)</td>
<td>3 crops A (29.33) T (24.03) OCs (18.91)</td>
</tr>
</tbody>
</table>

Source (Bureau of App. Economics & Statistics)

NB: A = Amm, AS = As, B = Boro, W = Wheat, OCs = Other Cereals, PS = Pulses, OS = Oilseeds, J = Jute, OFs = Other Fibres, SC = Sugarcane, S = Spices, P = Potato, T = Tea, Tb = Tobacco, Vs = Vegetables.
other rainfed crop 'aus' rice in the rest. In the remaining districts, with the exception of Darjiling, aman-pulses-aus form the characteristic 3 crop combinations. The northern district of Darjiling forms a 3-crop region with aman-other cereals (maize) and tea being the component crops. The overall pattern is therefore essentially aman, followed by tea and maize in the hilly north and less water consuming pulses as well as 'aus' rice in the humid, deltaic-riverine plains of the east.

Cropping Pattern during 1960s: This decade witnessed the inception of the DVC project, hence canal irrigation; but with no considerable impact upon the cropping pattern. The monocropped districts, with the exception of Birbhum, continued to retain their former positions. Pulses gained ground in Birbhum. Cropping pattern remained essentially similar to that of 1950s. One significant trend can, however be noted. The 2 crop and 3 crop regions were transformed into 3 and 4 crop combinations respectively due to the introduction of jute. This trend was a direct consequence of partition. The transfer of two-thirds of Bengal's jute lands to E. Pakistan created a crisis in West Bengal, as a maximum share of jute mills are concentrated along the Hughli-Haorah industrial belt. The jute crop did not occupy any significant position in the cropping pattern. Subsequently, stress began to be given on jute cultivation in West Bengal to cater to the demands of raw materials in the industry. As jute is a rainfed crop, irrigation was not necessary for extending its cultivation.
Cropping Pattern during 1970s: During this decade the New Agricultural Strategy with its emphasis on irrigation had actually been implemented. Canal irrigation from the three major river valley projects had been introduced effectively during 1970s. The use of groundwater in irrigation had been initiated in the eastern part of the State during this period. The impact of irrigation could now be visualized. The hitherto mono-cropped western district of Bardhaman along with Haorah now emerged as 2 crop regions with highly water consuming summer or 'boro' rice as the second ranking crop. In Hugli district pulses and jute yielded place to 'boro' rice. It is observed that these three districts come within the perview of the DVC command area. As 'boro' is a summer season crop, irrigation is an essential pre-requisite for its success. Cropping pattern remained similar to that of 1960s in other parts of the State.

Cropping Pattern during 1980s: Besides recording a progressive increase in gross irrigated area, this decade also witnessed the development of groundwater irrigation. The non-irrigated or tank-irrigated districts of Puruliya, Bankura, Medinipur W. and 24 Parganas South continue to remain mono-cropped with aman rice. A reverse trend is observed in Birbhum under the Mayurakshi command area, where mono-culture has been replaced by double cropping. Probably, assured supply of irrigation water from canals even during monsoons, has made possible the cultivation of 'aman' rice along the higher tracts hitherto devoted to aus. Cropping pattern remains more or less similar
in the rest of the districts, with jute lands vying with pulses and 'aus' rice in response to fluctuating prices, rather than irrigation. Another important fact is the introduction of irrigated HYV 'wheat', which has begun to replace pulses along the moribund deltaic tracts as in Murshidabad and Nadia. Thus the areas previously noted for aman-aus-jute-pulses combination have been converted to aman-aus-jute/pulses-wheat combination. Boro rice appears to be gaining ground in the districts of Bardhaman, Hugli and even 24 Parganas North. In 24 Parganas North it is the outcome of the availability of ground-water irrigation. The industrial district of registers replacement of 'boro' by jute. This, however, is attributable to economic factors rather than irrigation. In Nadia, aman ceases to be the leading crop yielding place to either aus or jute. The northern hills and foothill regions continue to be 3 crop regions with aman-aus-jute and aman-aus-tea or other cereals-aman-tea combinations, due to favourable climatic and soil conditions.

To bring into perspective the influence of varied irrigation types along with the divergent physico-climatic attributes, a detailed analysis has been worked out of selected ecological regions, based upon police station level data for 1960s and 1980s. One representative region from each geomorphic unit, as indicated in the initial chapter, has been chosen, since it would be difficult to depict all the police stations simultaneously, as crop combinations rather than
individual crops are being considered (Appendix Table 17).

**Dominant Crop Regions of Plateau & Plateau Fringe Tracts**

This is best exemplified by the two adjacent districts of Puruliya and Bankura with the former along with the western parts of Bankura district (Khatra, Onda, Ranibandh, Indpur P.S.) constituting the essentially hilly tracts. Plateau fringe zone with buried-exposed lateritic occurrences is confined to the eastern and central portions of Bankura district.

**Cropping Pattern in 1960s**: The spatial pattern for most parts, during 1960s is dominated by two crops viz. 'aman' rice and other inferior cereals. It generally signifies that these interior regions with meagre rainfall, undulating terrain, and coarse leached soils, is incapable of sustaining the water-consuming 'aman' rice. However, the cultural factors also play important role. This forested part is dominated by tribal population who are dependent upon the forest products for their livelihood. They usually practise shifting cultivation, sufficient to support sparse population. Lack of knowledge led to the cultivation of inferior, less water demanding cereals. In the eastern and north-eastern border the more favourable terrain as along Neturia, Santuri P.S. (Puruliya district) bordering the Damodar river, 'aman' rice assumed significance.

The plateau fringe tract emerge as two-crop regions of 'aman' and 'aus' rice. This area with its comparatively gentle terrain, less leached soils and higher rainfall is conducive to
the cultivation of 'aus' rice whose water-consumption is higher
than other inferior cereals. Moreover, this region has always
remained well settled and historically significant with a
greater proportion of non-tribal population. Traditional irri-
gation was practised here since ancient times through the use
of 'bandh' or tank waters, exemplified by the extensive Jamuna
bandh, Lalbandh, etc. constructed by ancient Kings. These tanks
served the purpose of meeting the local irrigation requirements.
The police stations, directly impinging upon the Damodar river
(Saltora, Mejia), record 2-crop combination of 'aman' rice and
pulse.

Cropping Pattern in 1980s: This decade reflects slight impact
of irrigation on cropping pattern. Due to population pressure
along the eastern districts of West Bengal, immigration occu-
rrred in these tracts, leading to depletion of forests and ex-
tension of farm lands. This influx constituted non-tribal
people, well versed with cultivation along the humid districts.
Stress is thus being given upon extending 'aman' rice, their
chief diet, aided by their inherent knowledge of irrigation
practices. The State Government has put up reservoirs on jhors,
along the plateau tracts, functioning during the rainy season.
They thus form an assured source of irrigation during the cul-
tivation of 'aman' rice especially during times of low rainfall.
RLI has been developed in certain areas. All this has facili-
tated slight diversification as in the hilly Baghmundi P.S.
(Puruliya district) where the 3 crop combination of 'aman'—
pulses-vegetables has been introduced. Vegetable cultivation has been fostered due to its demand in the bordering industrial belt of Bihar as direct railway linkages have provided additional stimulus. In other parts inferior cereals have been replaced by 'aus' rice forming aman-aus combination.

The plateau fringe zone lies within the Kangsabati project command area. With better availability of irrigation water from canals, minor RLI and 'bandh' schemes, it has resorted to monocropping of 'aman'. More high lying areas hitherto under 'aus' rice has been brought under early varieties of this more remunerative rice crop. The police stations lying directly south of the Damodar river (Sonamukhi, Patrasayer) are traversed by the southern main branch canals of the DVC project. Since 1970s some blocks have been brought under the Intensive Agricultural Area Programme (IAAP). All these factors, along with assured supply of water by the DVC, have provided incentives for either extending 'aman' cultivation or forming 2 crop regions with 'aman' and irrigated 'boro' rice or wheat.

Dominant Crop Regions along the Old Alluvium Tract

Maldah district has been selected to represent this ecological niche as it is only here (Gajole, Habibpur, Baman-gola P.S.) that extensive 'barind' blocks occur. In W. Dinajpur, they become transitional in nature because of the presence of a number of river valleys passing through it. Conditions
along the truly 'barind' tract, facilitate tank irrigation, which forms the chief source of irrigation, but only on a localized scale. Here 'aus' rice tends to be cultivated along the lower lands at times overlapping 'aman' crop. During the 1960s these areas emerge as aman-aus regions. In direct contrast, are the multicropped P.S. of the lowlying and marshy 'tal' and 'diara' lands with their moribund drainage conditions. Besides 'aman' and 'aus' rice, jute and pulses become significant. Most of them are recorded as 3-4 crop regions, rabi crops utilizing the residual soil moisture. Yearly inundations along rivers replenish soil fertility. In case of jute, the human factor has also played a decisive role. The immigrants from the erstwhile E. Pakistan specialized in jute cultivation, hence preferred to propagate this crop, the lowlying tracts forming ideal settings for retting. Besides this, Government encouraged the cultivation of both jute and pulses, the latter the only major source of protein of the common people.

The role of irrigation can be inferred from the cropping pattern of the 1980s. The relative absence of irrigation facilities along the 'barind' blocks has been responsible for 'aman' and 'aus' rice combination. The 'tal' and 'diara' lands continue to be multi-cropped. Introduction of RLI has ushered in changes in the crop types. In addition to 'aus', pulses and jute, more lucrative irrigated crops like wheat and even 'boro' rice have been introduced. In fact, the latter two tend to replace jute and pulses in certain regions. The relative
decline in pulses is a notable feature; further, the occurrence of a few showers (6-8 cm rainfall) from the Western Disturbances are favourable for wheat cultivation.

**Dominant Crop regions along the Riverine-Deltaic Plains**

A comprehensive appraisal of the crop assemblages of this zone is provided by Hughli and Nadia districts. Most of Hughli, with the exception of the eastern part, constitutes an integral part of the Damodar riverine tract, with comparatively coarse alluvium. Nadia and eastern Hughli form parts of the Gangetic 'moribund' deltaic zone. Incidentally these two regions are located around the Hughli-Haora industrial belt and Calcutta conurbation.

**Cropping Pattern in 1960s**: Prior to the implementation of the NAS during the 1960s, the cropping pattern of the Damodar riverine plains was dominated by 2 crops viz., 'aman' rice and jute. On the whole, the ecological conditions are favourable such as the moderately heavy rainfall and fertile, well-drained but moisture-retentive sandy loams. The depressed zones form effective sites for retting of jute. Pulses utilizing residual moisture come next in importance. As truck services were not so frequent, there was the risk of the jute fibre rotting away prior to reaching the mills. Hence jute cultivation predominated here due to the vicinity of jute mills in Hughli-Haorah districts. An additional crop, potato, assumed importance in certain areas only.
In contrast, the moribund deltaic plains, east of the Hughli river, record a crop combination of pulses-aus-aman with pulses emerging as the leading crop, similar to that of the 'tal' and 'diara' lands of Maldah district. The fertile, fine textured, moisture retentive clayey loams are the causes for this multi-cropping. Relatively less importance of aman may be explained by the following facts. The prevalence of extensive 'bheels' or depressions in the alluvium create drainage problems aggravated by the clayey texture. Cultivation of long growing traditional variety of 'aman' is faced with excessive water requiring to be drained, thus incurring additional costs. On the other hand, these conditions are ideal for the pre-monsoon and post-monsoon crops such as aus rice, and pulses requiring less water. In the absence of 'aman' rice, three to four crops may be cultivated. 'Aus' rice, as a replacement for 'aman' is much preferred inspite of its coarse quality, as it can be followed by Kharif pulses and vegetables. Pulses are the only source of cheap protein for the poor cultivators.

**Cropping Pattern in 1980s** : The period witnessed the impact of irrigation. The Damodar riverine plains started receiving DVC canal water more effectively since 1970s and more recently from RLI, STW and DTW system as well. Most of the police stations of the central and eastern zones, record 2 crop regions of aman and irrigated HYV 'boro' rice. Jute has considerably declined in importance. Only Balagarh P.S. (Hughli
district) along the levee of the Hughli river and Pursurah P.S. (Hughli district) along the Mundeswari river are important jute growing areas due to their coarse textured loam and situation along higher land. Price fluctuations of this export crop, have set in with competition from synthetic fibres in the international and national markets, thus providing psychological disincentives. Synthetic products have captured about 40% of the domestic market for jute products (Statesman, 1987). Next come potato and vegetables due to the presence of the large markets of Calcutta Metropolitan Region. However their importance is reflected in distinctive crop regions as their proportionate share of GCA is relatively small.

The moribund deltaic plains of Nadia district, record an increase in the number of dominant crops and a relative decline in the importance of pulses. This may be attributed to the New Agricultural Strategy and the development of groundwater irrigation facilities. Emphasis has now been laid upon irrigated crops like wheat and 'boro' rice, drastically reducing pulse area. In fact, due to this trend, the State as well as the nation is undergoing a crisis, having to import this main source of protein. Since 1980s, stress is laid upon revitalizing its cultivation. 'Aman' continues to be secondary in importance.

Dominant Crop Regions of the Saline Coast

The district of 24 Parganas South with its numerous
tidal creeks and channels as well as low lying inter-riverine tracts best reflects this physical unit. This district has always remained poorly irrigated where the gross irrigated area is negligible. Only tank irrigation prevails in isolated pockets. This refers strictly to the coastal police stations as the administrative divisions include some of the northern moribund deltaic tracts, thus providing a misleading picture.

**Cropping Pattern in 1960s**: 'Aman' is the single dominant crop, with jute/pulses as a second crop only in the extreme northern moribund part. The chief constraint is soil and water salinity. As 'aman' is a rainfed crop, there is no necessity of fresh water during its cultivation.

**Cropping Pattern in 1980s**: A similar pattern emerges due to absence of fresh water irrigation. Tapping of deep, fresh water aquifers is most expensive compared to its returns. The only major change is the recent introduction of salt resistant varieties of 'aman' rice like SRS, etc. In the north, around CMDA, double cropping has begun with groundwater irrigation. 'Boro' rice has replaced jute/pulses.

**Dominant Crop Regions of the Northern Foothill Zone**

This constitutes both the piedmont or 'bhabar' zone represented by parts of Jalpaiguri district as well as the active plains formed by Koch Bihar district.
Cropping Pattern in 1960s: All the districts emerge as 2 crop regions namely 'aman' and tea along the north and north western police stations and 'aman' and jute in the south. Higher altitude, heavy rainfall and well drained acidic, fertile sandy loams favour tea cultivation along the former region. Towards the south, as temperatures are higher, jute assumes importance. As has been stated, the influx of population from E. Pakistan with a tradition in jute-growing as well as encouragement from the Government enhanced its cultivation. Although soils are coarse textured the excessively heavy rainfall facilitated 'aman' cultivation.

Along the active plains crop combination is characterized by the two crops 'aman' jute or 'aman-aus'. The comparatively gentle slopes and fine textured, moisture retentive soils are responsible for the cultivation of 'aus' rice. The high population density necessitated giving stress on rice production.

Cropping Pattern in 1980s: This decade experienced an increase in tea cultivation along the northern parts at the expense of forest lands. The southern part of the 'bhabar' zone now switched over to 'aus' cultivation. Even wheat has been introduced with STW irrigation facilities. The jute area has declined due to fluctuating prices. Increasing stress on 'aus' could be explained by the following facts. Previously, the population consisted mostly of tea garden labourers who used to get sufficient ration to maintain themselves. They also
has to depend on forest products. But with the influx of population mostly from the 'barind' tracts of Bangladesh, foodgrain shortage arose. Emphasis is now given on 'aus' cultivation, a coarse variety of rice.

Furthur south, along the active plains the pattern remains more or less similar. Slight diversification has occurred due to small scale introduction of STW and RLI irrigation schemes. Three crop regions with combination of aman-aus-jute, aman-aus-tobacco and even aman-aus-wheat is observed. This is indicative of feasible benefits of irrigation in this region.

Dominant Crop Regions of Northern Hills

This is represented by Darjiling district lying along the Lesser Himalaya. Both, the 1960s as well as 1980s depict this district as a 3 crop region with other cereals (maize), aman rice and tea constituting the main crops. This pattern has been essentially determined by its cool climate, due to higher altitude. Furthur the leached acidic soils favour tea cultivation.

DISTINCTIVE CROP REGIONS

As stated, a 'distinctive' crop is a specialized crop, with a proportionate share of TCA in a component unit, being above the regional average. This indicates a strong positive correlation between the crop and certain characteristic geo-economic variables, characteristic of the component unit. If
returns from these crops are remunerative and if their areal extension or intensified production is economically viable, the future agricultural prosperity of the region may lie in them. Crops which may not have been included in dominant crop regions due to their insignificant share in GCA, are reflected in distinctive crop regions.

Methodology for Identification of Distinctive Crop Regions

The absence of any specific method necessitates the application of methods used for functional classification of cities. In this context, two most prevalent methods may be cited, namely those of Nelson (1955) and Mattila and Thompson (1955).

Nelson (1955) has propagated a logical scheme which distinguishes as specialized functions only those activities with a percentage share of labour above regional average. The degree of specialization is derived by calculating the standard deviation and arranging them in classes of \( \bar{x} + 1 \sigma_n \), \( \bar{x} + 2 \sigma_n \), etc. The further the percentage share is away from the mean, the greater the degree of specialization. However this method fails to provide an intra-unit ranking of distinctive crops as the basis of regionalization.

Mattila and Thompson's Method (1955) takes into consideration this aspect. Here absolute values are considered and an 'Index of Surplus Workers' is derived, i.e., any particular
manufacturing activity in an unit which is above the critical value at which it becomes diagnostically important. The formula is as follows:

\[ S = \frac{e_i - e_t}{E_t} \times E_i \]

- \( e_i \) = regional employment in any industrial activity
- \( e_t \) = total regional employment in all industries
- \( E_i \) = national employment in the industry concerned
- \( E_t \) = national employment in all industries

The 'Index of Surplus Crop Area' can thus be calculated by replacing employment figures with absolute area of each crop and ranked according to their index values. This method has been selected for the present analysis.

**Distinctive Crop Regions - Generalized Pattern**

District level distinctive crop regions have been computed for the four decades 1950s, 1960s, 1970s and 1980s (Table 18).

**Cropping Pattern during 1950s**: Two most important features that come to the fore are: i) the incidence of 'aman' rice as the most distinctive crop in the western districts as in Puruliya, Bankura, etc. and ii) the emergence of the multi-cropped districts as Nadia, Murshidabad and Maldah as the ones with the largest number of distinctive crops. Other cereals, wheat, aus, sugarcane and potato assume importance in the western zones, with 'boro' rice, potato and jute
## Table 18

Distinctive Crop Regions of W. Bengal, 1955-56 to 1985-86 (After Mattila & Thompson, 1955)

<table>
<thead>
<tr>
<th></th>
<th>1955-56</th>
<th>1965-66</th>
</tr>
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<tbody>
<tr>
<td>Puruliya</td>
<td>A, Ocs</td>
<td>A, Ocs</td>
</tr>
<tr>
<td>Bankura</td>
<td>A, W, As</td>
<td>A, AS, W, Sc</td>
</tr>
<tr>
<td>Birbhum</td>
<td>A, W, Sc, P</td>
<td>A, W, Sc, P, As</td>
</tr>
<tr>
<td>Bardhaman</td>
<td>A, P, Sc</td>
<td>A, P, Sc, W</td>
</tr>
<tr>
<td>Medinipur</td>
<td>A, B</td>
<td>A, B, S</td>
</tr>
<tr>
<td>Haorah</td>
<td>A, Ps, B</td>
<td>A, P</td>
</tr>
<tr>
<td>24 Parganas</td>
<td>A, OFs, S</td>
<td>A, S, OFs</td>
</tr>
<tr>
<td>Hughli</td>
<td>J, P, A, B</td>
<td>J, P, A</td>
</tr>
<tr>
<td>Nadia</td>
<td>Ps,As,J,Sc,Os,OFs,S</td>
<td>Ps,As,J,OFs, Os, Sc</td>
</tr>
<tr>
<td>Murshidabad</td>
<td>Ps,As,W,Os,J,Sc,Ocs</td>
<td>Ps,J,As,Os,W,Sc, B</td>
</tr>
<tr>
<td>Maldah</td>
<td>As,Ps,Os,Ocs,J,B,WC,OFs</td>
<td>Ps,As,Ocs,B,Os,OFs,Sc,J</td>
</tr>
<tr>
<td>W. Dinajpur</td>
<td>Os,J,A,W,As</td>
<td>J,OFs, As,S</td>
</tr>
<tr>
<td>K. Bihar</td>
<td>As,J,Tb,Os</td>
<td>J,As,Tb,OFs,S</td>
</tr>
<tr>
<td>Jalpaiguri</td>
<td>T,J,OS,Tb</td>
<td>J,T,Tb,OFs,W</td>
</tr>
<tr>
<td>Darjiling</td>
<td>Ocs,T</td>
<td>Ocs, P, T</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1975</th>
<th>1985</th>
</tr>
</thead>
<tbody>
<tr>
<td>Puruliya</td>
<td>A, Ocs, Sc</td>
<td>A, Ocs, OFs, Ps</td>
</tr>
<tr>
<td>Bankura</td>
<td>A, W, Sc</td>
<td>A, Ocs, Os, OFs</td>
</tr>
<tr>
<td>Birbhum</td>
<td>A, W, P, As, Sc</td>
<td>A, Os, W, Sc,</td>
</tr>
<tr>
<td>Bardhaman</td>
<td>A, B, W</td>
<td>A, B, P, Os</td>
</tr>
<tr>
<td>Medinipur(W)</td>
<td>A, B, P</td>
<td>A, As, B, P</td>
</tr>
<tr>
<td>Haorah</td>
<td>A, B, P</td>
<td>B, A, Ps, P</td>
</tr>
<tr>
<td>24 Parganas(S)</td>
<td>A, J, S</td>
<td>A, S</td>
</tr>
<tr>
<td>Hughli</td>
<td>B, J, P</td>
<td>B, J, Os</td>
</tr>
<tr>
<td>Nadia</td>
<td>Ps, J, As, Os, Sc, OFs, Ocs</td>
<td>J, Ps, As, W, Os, B, Sc, OFs</td>
</tr>
<tr>
<td>Murshidabad</td>
<td>Ps, W, J, As, Os, Ocs, Sc</td>
<td>Ps, As, J, Os, Sc</td>
</tr>
<tr>
<td>Maldah</td>
<td>Ps, As, Ocs, W, Os, B, Sc</td>
<td>Ps, As, W, J, Sc</td>
</tr>
<tr>
<td>W. Dinajpur</td>
<td>As, OFs, J, Ocs, Os, S</td>
<td>As, Os, J, W, J</td>
</tr>
<tr>
<td>K. Bihar</td>
<td>As, J, Tb, OFs, S, Os</td>
<td>As, J, Tb, OFs, Ocs</td>
</tr>
<tr>
<td>Jalpaiguri</td>
<td>T, As, J, Tb</td>
<td>T, As, J, Ocs, Tb, S, OFs</td>
</tr>
<tr>
<td>Darjiling</td>
<td>T, Ocs, P</td>
<td>Ocs, P, S</td>
</tr>
</tbody>
</table>
concentrated along the humid eastern districts of Haorah, Hughli, and Nadia. Nadia along with Murshidabad and Maldah district are characterized by the absence of aman rice as a distinctive crop, and its replacement by pulses, 'aus' rice, fibres, oilseeds and wheat implying greater diversification. Along the northern districts, besides jute and 'aus', tobacco and tea are distinctive crops. An exception occurs in Darjiling where other cereals (maize) and tea are the two most distinctive crops. Mention must be made of spices (chillies) which appear in 24 Parganas.

**Cropping Pattern during 1960s** : The pattern remains essentially similar to that of 1950s. The only significant trend is the emergence of jute as the leading distinctive crop in the north-central and northern districts, due to the emphasis laid upon this crop after independence. Besides this, potato occurs as a distinctive crop in Darjiling.

**Cropping Pattern during 1970s** : The main notable feature is the decline in the importance of jute in the aforesaid districts due to fluctuating prices and introduction of HYV crops like 'boro' rice and 'Sonalika' variety of wheat.

**Cropping Pattern during 1980s** : 'Aman' rice continues to be the leading distinctive crop in the dry western districts and in 24 Parganas South. With introduction of dry farming other cereals, pulses and oilseeds are being stressed upon in the former districts; Whereas spices retain their importance in
the saline 24 Parganas South, jute continues to yield its place to 'boro' rice and potato in Hugli, Medinipur East and Naorah. The areas with low lying pockets favour 'boro' cultivation and nearby markets offer incentives for potato cultivation. The pattern remains more or less similar in the other regions.

Distinctive Crop Regions of Plateau & Plateau Fringe Tracts

As in the case of dominant crop regions Puruliya and Bankura districts have been selected as representative regions (Appl. - Table 19).

Cropping Pattern during 1960s: The essentially hilly tracts of Puruliya district, are characterized by 'amani' rice as the distinctive crop. It is only along the Damodar river pulses and sugarcane thrive due to favourable terrain. One important fact that needs to be mentioned is the simultaneous prevalence of other cereals as revealed by the district level figures. In contrast, the plateau fringe zones of Bankura district, depict 'aus' rice as the second most distinctive crop after 'aman' rice followed by wheat. However this refers to the traditional variety of wheat, which requires less water. This crop is distinctive of those P.S. directly impinging upon the Damodar river and those lying along the eastern border where the terrain becomes transitional, merging into the gentler riverine plains. Moreover, rainfall is slightly higher. All these factors favour slight diversification.
Cropping Pattern during 1980s: Although 'aman' rice continues to remain the most distinctive crop the position of other inferior cereals have slightly declined, now being concentrated in the western margin, where terrain and climate are less favourable. Wheat has now been introduced. Sugarcane remains a distinctive crop in certain regions. The overall change is the stress upon 'aman' rice instead of inferior cereals. As the 'aman' crops is in excess of its local requirement, and such lands remain fallow during rest of the year, some cultivators experiment with sugarcane crop to meet local requirements of 'gur' (jaggery). Needless to say, its quality is poor because of inadequate water. Yet additional benefits are derived such as cattle fodder from the straw.

The impact of irrigation is witnessed in the plateau fringe zones mostly within the DVC command areas. Whereas 'aman' remains the distinctive crop, 'aus' rice is losing its importance to HYV wheat. Potato emerges as an important crop in the DVC and Kangsabati canal irrigated areas. However, the potential of irrigation in transforming the cropping pattern is best visualized in Simlapal and Raipur P.S. Here the recent allocation of the water of the Kangsabati river on an experimental basis have made 'boro' rice a third ranking distinctive crop, in an otherwise drought prone region.
Distinctive Crop Regions of the Old Alluvium

Cropping Pattern during 1960s: In Maldah district Gajole, Habibpur, Bamangola and Old Maldah P.S. form the purely old alluvium. The 'barind' region possesses two distinctive crops viz., 'aman' and 'aus' rice for the reasons already stated. The marshy 'tal' and 'diara' lands are characterized by 3 distinctive crops of jute, aus and pulses. However Kaliachak P.S. with its unreclaimed marshes cultivates mostly 'aus' rice during dry season. In almost all these regions aman rice loses significance as they become transformed into small lakes during the monsoon season with villages remaining as islands, accessible only by boats. During the pre-monsoon season the residual soil moisture sustains 'aus' and jute cultivation without irrigation. Pulses also utilize residual moisture.

Cropping Pattern during 1980s: With the recent introduction of RLI and STWs the number of distinctive crops have increased in the 'tal' and 'diara' lands. Irrigated crops like 'boro' rice, and wheat have become leading crops. Other cereals are also being introduced. Jute is no longer the leading distinctive crop. However the relatively less irrigated barind blocks still retain the previous pattern.

Distinctive Crop Regions of the Riverine-Deltaic Plain

Cropping Pattern during 1960s: For most parts, the Damodar
riverine plains are characterized by two distinctive crops viz., potato and jute, with Pursúaah, Tarakeswar, Haripal P.S. etc. specialized in potato. The large market of CMD no doubt is the chief incentive in this respect. This is due to favourable ecological environment. Hence potato has become popular here. The fertile silt, deposited earlier during the 'overflow' irrigation system, has been found beneficial for this crop. Along the eastern parts the innumerable tanks are able to meet the water requirements of this crop, being endowed with excess flood and river water along with silt. During winter these tanks were desilted to provide fertile soils to sustain potato cultivation.

Jute appears to be another distinctive crop along the entire region due to reasons already stated. A third distinctive crop is pulse utilizing residual moisture, being confined to the southern low lying tracts. Aman appears to be the distinctive crop in Goghat P.S. which is a relatively dry, non-irrigated tract with coarse alluvium. This also accounts for its specialization in 'aus' rice.

Along the deltaic plains the largest number of distinctive crops are recorded, indicative of multiple cropping. Pulse is the leading distinctive crop, followed by aus and jute. An interesting feature is the occurrence of wheat, sugarcane and oilseeds as distinctive crops. The traditional variety of wheat requiring less water could be grown with the residual
soil moisture. Oilseeds, besides favourable ecological conditions, are grown to meet the demands of urban oil mills. Mention must be made of sugarcane. Prior to independence most of the sugar mills were located in this ecological zone, as sugarcane is a weight losing material. Further this is a self refuelling industry. The vicinity of large urban markets create additional demand. Moreover, the presence of paper mills around CMD is an additional advantage as they utilize the bagasse. 'Boro' rice was also of importance but this does not refer to modern HYV rice but a local type of 'aman' suited for the marshy zones. 'Aman' rice has been replaced here by this swamp rice.

Cropping Pattern during 1980s: The main feature along the Damodar riverine plains is the emergence of modern HYV 'boro' rice as the second major distinctive crop after potato, replacing jute. The assured supply of DVC waters as well as groundwater irrigation has been responsible for this. Regarding potato the following may be mentioned. During past years, both the local varieties of 'aman' rice and potato, with longer growing seasons, were cultivated. Hence cultivation of potato curtailed the growing period of 'aman' rice. Moreover, its maturity was during the water deficit period. These problems have been solved through the increased use of irrigation water and use of HYV seeds with short growing periods. Constant incentives provided by the Government towards the building of cold storages have reduced seasonal price fluctua-
tions of this crop. Moreover cold storages are exempt from income taxes. Potato cultivation has thus increased along with growing demand.

In the deltaic plains, the number of distinctive crops remains more or less the same as in previous decades. The impact of irrigation is evident in the change in crop types. During 1960s pulse was the distinctive crop type. But during 1980s, aus rice has assumed importance, at the expense of the other pre-monsoon crop jute. Nevertheless, even a fluctuating crop like jute precedes pulse in order of importance, in certain cases. The reason is the replacement of winter and summer season pulses by wheat and boro rice respectively. The significance of STW and DTW irrigation is thus obvious. Oilseeds continue to remain a significant crop.

Distinctive Crop Regions of the Saline Coastal Tract

Cropping Pattern during 1960s: Aman appears to be the only distinctive crop due to reasons already stated. Only in one of the P.S. bordering CMD, does jute emerge as a significant crop.

Cropping Pattern during 1980s: Slight diversification has set in along the northern parts, lying within the moribund delta. Due to introduction of DTW irrigation in recent years, pulses, 'boro' rice and vegetables are being cultivated to cater to the demand of the CMD region. In the actual saline tracts of the
coasts there is little diversification. 'Aman' rice continues to remain the distinctive crop. The use of salt tolerant varieties tend to perpetuate this pattern. A second distinctive crop is chillies. In fact, in recent years, the Central Saline Soil Research Institute is encouraging farmers to experiment with salt resistant vegetables, spices and fruits. Hence chillies are being increasingly cultivated.

Distinctive Crop Regions of the Northern Foothills

Cropping Pattern during 1960s: Tea and jute form the distinctive crops, with tea assuming prominence along the northern part and jute in the southern plain, along with other fibres and 'aus' rice. An interesting feature is the occurrence of tobacco as a distinctive crop along the river valleys, as this crop requires light textured, porous, sandy soils. Grown in winter, it utilizes residual soil moisture.

Cropping Pattern during 1980s: Although this region is poorly irrigated, the use of mobile, temporary STWs and minor scale RLI have resulted slight diversification. Tobacco is now being increasingly cultivated with assured STW irrigation. Moreover irrigated HYV wheat is being introduced as the climate is favourable. With increase in population, aus rice has replaced jute in the cropland pattern.

Distinctive Crop Regions of the Northern Hills

Along this hilly, relatively unirrigated tract, tea,
other cereals like maize, assume importance due to the cold climate. Potato is also a distinctive crop but it is cultivated here as a summer crop, in contrast to the plains, as the winter climate is favourable.

Thus it is observed that in addition to few crops, both dominant and distinctive crop regions imply similar situations.

IMPACT OF IRRIGATION ON THE SPATIAL DISTRIBUTION OF SOME SELECTED CROPS

In this section two major crops of the State which are favoured with irrigation facilities, namely boro rice and wheat, and two others grown under natural conditions, namely 'aman' and 'aus' rice, have been selected for detailed analysis. Incidentally these crops are grown in different seasons of the year. Therefore their spatial distribution has been studied in detail taking P.S. level data as the base of study. The purpose is to cover all the districts so as to decipher the specific regions of their occurrence within all the districts. This aspect has not been brought out in the crop combination analysis as the entire State has not been covered. The previous analysis is based basically with the objective of identifying the pattern in selected ecological units. In the present context, the objective is to derive a more detailed scenario of the performance of irrigation on the distribution of crops grown in various seasons of the year of this State.
Pl 57. Extensive patches of derelict land over laterite terrain.

Pl 58. Bamboo orchards competing with farm lands, irrigated and non-irrigated, in the plateau fringe areas.
Pl 59. Mango orchards cover substantial areas in the moribund riverine deltaic tracts.

Pl 60. Irrigated potato fields being the outcome of intensive irrigation facilities in the multi-cropped zones, Hooghli.
Pl 61. Intensive cultivation during winter in the highly irrigated Damodar-Hughli riverine plain.

Pl 62. Boro seedlings raised on dried up Mundeswari river bed.
Pl 63. Farmlands lying fallow during winter and summer in the non-irrigated tracts of Puruliya Dist.

Pl 64. Water stored in artificial channel has limited use in farming.
Pl. 65. Cultivation of HYV Boro is now possible in Bardhaman Dist due to irrigation facilities.

Pl. 66. Furrow irrigation is applied to raise Boro in nursery beds.
Pl. 67. Level-border method of irrigation is practised for wheat cultivation.

Pl. 68. HYV Wheat cultivation in Bardhaman Dist with limited irrigation facilities.
Pl 69. Initial sprinkling of water for irrigating potato.

Pl 70. Ridge-furrow irrigation for potato cultivation
Pl 71. Level-border method of irrigation practised for vegetable cultivation.

Pl 72. Level-border method of irrigation for raising ladies'-finger.
Pl. 73. Bumper aman rice ready for harvesting.

Pl. 74. Tea plantation along terraced hill slopes in Darjiling Dist.
Aman Rice

This constitutes the most important crop in West Bengal, with an areal spread of 4,130,940 ha, about 52.46% of GCA and as such forms the main diet of the people. It is essentially a rainfed crop cultivated during June/July to November/December. It may be assumed that a decrease in the share of this crop signifies an increase in cropping intensity or cultivation of other remunerative crops at its expense through irrigation. The correlation coefficient 'r' between the percentages of GIA and GCA under 'aman', has been worked out as +0.174 on the district level.

The district level and decadewise dynamics since 1950s reveal stable to negative trends. It is only in the districts of Puruliya and Maldah that slight increase has been recorded. (Table 20).

With regard to the spatial pattern, the plateau and plateau fringe tracts record highest values (>70% GCA) as in Puruliya, Bankura, etc. as well as in the coastal areas 24 Parganas district. Values decrease towards the moribund deltaic tracts of Nadia and Murshidabad as well as in the northern hills and foothills.

The detailed pattern, based on police station level data, for 1965 and 1985 confirms the previous statement. It is observed that along the plateau and plateau-fringe zones
which are mostly 'amani mono-cropped regions, a slight increase has occurred. These are regions, specializing in inferior cereals. With water conservation practices like 'jhor' bandh and RL irrigation schemes and recent availability of Kangsabati water, more area has been brought under 'amani rice which is a comparatively superior cereal than others. As these types of irrigation function only during rainy season, it is beneficial to this rainfed crop by modifying the influence of irregular rainfall in this inherently dry zone. However Birbhum is an exception, where due to availability of Mayurakshi canal water and the occasional winter showers other crops are also cultivated. In the old alluvium Tracts of Maldah and W. Dinajpur, though irrigation facilities are poor, 'amani rice still retains its importance. The decrease is maximum along the Damodar riverine plains in central and eastern Bardhaman and in Hughli district due to assured supply of water from the DVC canal and, in recent years, due to conjunctive use of STW and DTW water. Here aman has been replaced by lucrative irrigated crops. The moribund deltaic zone continues to remain insignificant. In the coastal saline zone of 24 Parganas South high values are recorded due to absence of adequate fresh water. This prevents multi-cropping. However, in Medinipur East, a slight decrease has occurred due to introduction of groundwater irrigation. Such a decrease is also apparent in the northern foothills due to similar reasons.
Aus rice and jute forms the chief pre-monsoon crops, mainly dependent on nor'wester showers. Irrigation facilities however, are beneficial to these crops. Aus, however, is a coarse grained variety of rice preferred for its low water requirement and low cost of cultivation. Its 'r' value is recorded as -0.451 signifying its low dependence on irrigation.

The overall district level picture, however, depicts decreasing trends in the districts of Bankura, Birbhum, Bardhaman as well as in Nadia, Murshidabad and Maldah. Positive trends are observed along the northern districts of Jalpaiguri and K. Bihar. The spatial concentration is towards the central-eastern districts of Nadia, Murshidabad, Maldah and in the northern districts of this State. (Table 20).

The plateau and plateau fringe zones record mostly medium values (4-16 %) with the exception of Puruliya where values are very low (< 2%). With respect to percent change in 'aus' area, a contradictory pattern emerges. Puruliya registers an increase, as 'aus' rice replaces the inferior cereals, whereas the canal irrigated Tracts of Medinipur West, Bankura, and Birbhum, record decrease due to cultivation of irrigated winter crops. In the old alluvium areas 'aus' still retains its previous position as lack of irrigation prevents cultivation of other crops. Along the Damodar riverine and
moribund deltaic plains, the trend is somewhat stable. In densely irrigated zones, aus rice has always remained insignificant, whereas in the latter aus has always remained one of the leading crop. The district level pattern however portrays its decreasing share in GCA. This may be attributed to increasing emphasis being given by the Government on the cultivation of pulses and oilseeds during recent years. In the non-irrigated to poorly irrigated coastal areas, aus area is negligible. The only noticeable increase has been experienced in the northern foothill zones, where growth of population has necessitated aus cultivation on the traditional jute areas.

Boro Rice

At present 'boro' is the third ranking crop after aman and aus constituting 6.6% of GCA of the State. In general, boro is a poor variety of rice. It is usually grown due to its high yield. In fact, the modern HYV boro rice was practically non-existent prior to the implementation of the New Agricultural Strategy. The districtwise figures of 'boro' rice actually refers to a local variety of coarse, swamp rice flourishing under marshy conditions. The new HYV boro rice refers to its high consumption of water requiring sufficient irrigation input, because of its cultivation during the dry summer season (December to May). Thus 'r' records a high value of + 0.530 on the district level.
The effect of irrigation is well illustrated by this crop. It is cultivated mostly in the highly irrigated districts of Hughli, Bardhaman and 24 Parganas North, being followed by Haorah, Medinipur East and Maldah. Since 1970s an overall positive increase in 'boro' area is discernible in the State. (Table 20).

The absence of police station level data for the 1960s prevents the detailed analysis of its percent change. Hence, the spatial distribution of this crop for the 1980s has been analysed. Temporal analysis cannot be depicted due to lack of relevant P.S. level data for 1960s.

The P.S. level data reflects a similar pattern with only localized variations corresponding to sources and varied allocation of irrigation waters. In the plateau and plateau fringe areas, in general, boro is of negligible importance viz. in Puruliya. However in the Kangsabati Project irrigated P.S. of Raipur and Simlipal as well as the DVC irrigated P.S. of Barjora, Sonamukhi and Patrasayer (Bankura dt.) a discrepancy is noted. Comparatively speaking boro area is noticeable. In the two former P.S., recent allocation of adequate canal waters, specifically for this crop, has been responsible for this. In Birbhum, a highly irrigated district, the lowlying areas of the east and clayey loams of the north east have made successful the use of Mayurakshi waters. Western part of Bardhaman as well as most parts of Medinipur West fall within the low category, due to coarse textured soils and lack of irrigation facilities.

Overall pattern coincides with that of the district level pattern, with fertile, DVC irrigated riverine plains of Bardhaman
(Gals, Bardhaman P.S.) and Hughli district emerging important. Despite being moderately irrigated the moribund riverine-deltaic tracts of Maldah, Nadia and 24 Parganas North districts are significant boro cultivating areas due to favourable ecological setting. Mention must be made of the impact of the more assured RLI, STW and DTW irrigation in these regions as well as in Hughli and low lying zones of Medinipur East (Moyna, Egra, Daspur P.S.). Values decline along the coastal areas. It is only in those P.S. bordering the CMDA region, where infrastructural facilities are available and cropping intensity high that boro appears on the scene.

**Wheat**

Wheat is another important irrigated crop whose cultivation is confined in winter season (November to February) in West Bengal. Although the water requirement of this crop is much less than that of boro, yet the HYV variety 'Sonalika' wheat cannot be successfully cultivated with residual moisture. At present it occupies about 5% of the GCA of the State. The 'r' value amounts to a low positive value of +0.011 on the district level.

During the last few decades almost all the districts have registered considerable increase in area of this crop, from 0.93% in 1950s to 5% during 1980s. The moribund deltaic districts of Murshidabad and Nadia have now become the leading wheat areas in West Bengal, being followed by the northern districts. Slightly decreasing trends are noticed in the districts of Birbhum and Bardhaman (Table 20).

The P. S. level pattern implies a more or less similar situation. The plateau and plateau fringe areas record 2-4%
GCA under wheat. The impact of irrigation can be comprehended by comparing 1960s pattern. Wheat was non-existent in the plateau zone during 1960s and along the plateau-fringe areas its share was considerably less. Maximum increase is recorded in the Mayurakshi canal irrigated zone of Birbhum district. In the old alluvium tracts which at present register medium values (4-8%), wheat was not cultivated before. The Damodar riverine plains also depict an increase but here this has been superseded by boro, potato and other irrigated crops. The moribund-deltaic tracts record maximum increase, due mainly to moisture retentive soils along with assured groundwater supply. In fact wheat was not cultivated in 24 Parganas North during 1960s. The plains of the north form the second major wheat growing area. The cooler climate, residual soil moisture as well as irrigation in the form of STWs have played deterministic roles.

Thus it may be stated that the beneficial impact of irrigation is best visualized with respect to winter and summer season crops of wheat and 'boro' rice, respectively. However, favourable ecological settings have formed the basis with irrigation confirming this pattern.