CHAPTER VII

IMPACT OF IRRIGATION ON THE CHANGING CROPPING PATTERN

OF THE UPPER GAGA-YAMUNA DOAB (1951-1975)

Agriculture has been the major source of livelihood for the inhabitants of the Upper Doab and this region undoubtedly owes its' agricultural prosperity to the timely supply of irrigation. In greater part of the Upper Doab the uncertain advent of the monsoons coupled with the fact that bulk of the rainfall in this area is confined to the four summer months only, make it imperative to supplement the erratic supply of rain water with irrigation. Hence, it logically follows that an expansion in area under irrigation in the last couple of decades has also affected the cropping pattern of the area under study. Therefore, an attempt has been made here to ascertain the extent to which increased irrigation facilities have exerted an influence over the cropping patterns by studying the changes in crop land use in the years 1950-51, 1960-61, 1970-71 and 1975-76.

CHANGING CROPPING PATTERNS OF THE UPPER GAGA-YAMUNA DOAB

In order to study the various changes in the cropping patterns of the Upper Doab the statistical data of the 4 districts has been taken separately for every year. The crops
UPPER GANGA-YAMUNA DOAB
AREA UNDER DIFFERENT CROPS
1950-51

SOURCE: DIRECTORATE OF AGRICULTURE, LUCKNOW, U.P.

FIG. 12
have been ranked in order of importance by calculating the percentage value of each crop in relation to the total cultivated area in the above mentioned years. The crops thus ranked will show to what extent the increased irrigation facilities have affected the crop land use. The lands which have yielded two or three crops a year have been counted only once.

**First ranking crops**

In all the districts of the Upper Doab wheat and sugarcane are the major crops. As is evident from Table VI area under wheat has steadily increased since 1950-51.

**Table VI**

**Distribution of Wheat in the Upper Doab**

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>PERCENTAGE OF AREA UNDER WHEAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saharanpur</td>
<td>34.4%</td>
</tr>
<tr>
<td>Muzaffarnagar</td>
<td>35.6%</td>
</tr>
<tr>
<td>Meerut</td>
<td>34.8%</td>
</tr>
<tr>
<td>Bulandshahr</td>
<td>24.8%</td>
</tr>
</tbody>
</table>
The Distribution of Wheat in the Upper Doab

In the year 1950-51 wheat was the first ranking crop in the 4 districts of the Upper Doab, occupying an area of 31.23%, 35.60%, 34.8% and 24.8% respectively.

Wheat has maintained its rank almost throughout the 25 years under study. Moreover, there has been a general increase in the area under wheat since 1950-51.

In the year 1960-61 the area under wheat went upto 33.9% in Saharanpur, 36.1% in Musaffarnagar, 36.47% in Meerut and 30.42% in Bulandshahr.

The year 1970-71 saw a further expansion of area under wheat in the Upper Doab when it rose to 41.3% in Saharanpur, 42.35% in the district of Musaffarnagar, 43.32% in Meerut and 43.44% in Bulandshahr.

In the year 1975-76 on the other hand no further increase in land under wheat was witnessed in the two districts of Saharanpur and Meerut, its position remaining more or less static. In the districts of Bulandshahr and Musaffarnagar, however, there was a slight decrease in the area under wheat which has been reduced to 41% and 40% respectively. In the district of Musaffarnagar in the year 1975-76 sugarcane became the first ranking crop.
TABLE VII

THE DISTRIBUTION OF SUGARCANE IN THE UPPER DOAB

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>PERCENTAGE OF AREA UNDER SUGARCANE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saharanpur</td>
<td>21.23%</td>
</tr>
<tr>
<td>Muzaffarnagar</td>
<td>23.81%</td>
</tr>
<tr>
<td>Meerut</td>
<td>25.81%</td>
</tr>
<tr>
<td>Bulandshahr</td>
<td>13.37%</td>
</tr>
</tbody>
</table>

Second ranking crops

There are 4 different crops which are included in this rank. These crops are wheat, sugarcane, barley and maize.

Data for the year 1950-51 indicate that sugarcane ranked second in the districts of Saharanpur, Muzaffarnagar and Meerut.

This year the cultivated areas under sugarcane in these 3 districts were 21.23%, 23.94% and 25.81% respectively. In Bulandshahr however, barley ranked second in the year under discussion. It occupied 19.21% of the total cultivated area of the district.
UPPER GANGA-YAMUNA DOAB
AREA UNDER DIFFERENT CROPS
1975-76

INDEX
WHEAT
SUGARCANE
GRAM
MAIZE
RICE
BAJRA
BARLEY

SOURCE: DIRECTORATE OF AGRICULTURE, LUCKNOW, U.P.

FIG. 13
Sugarcane not only continued to hold its' position in the 3 districts of Saharanpur, Muzaffarnagar and Meerut in the year 1960-61, there was even a general increase in the area under it, which went up to 22.5% in the district of Saharanpur, 27.25% in Muzaffarnagar and 27.46 in Meerut. Moreover, in the same year its' cultivation also increased in Bulandshahr where it occupied the second rank in place of barley.

According to the available data sugarcane was the major crop of this rank in the year 1970-71 also in the 3 districts of Upper Doab barring Bulandshahr where maize now hold this rank with 24.6% of the total cropped land under its' cultivation.

In the year 1975-76 again sugarcane was the second ranking with its' area further expanding to occupy 27.95% and 42.03% of the total cultivated land in Saharanpur and Muzaffarnagar respectively to 32.77% in Meerut from 31.4% in 1970-71. In the district of Bulandshahr, however, maize continued to hold the second rank its' area going upto 25.09% in the year 1975-76.
TABLE VIII

DISTRIBUTION OF MAIZE IN THE UPPER DOAB

<table>
<thead>
<tr>
<th>DISTRICT</th>
<th>PERCENTAGE OF AREA UNDER MAIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saharanpur</td>
<td>7.25%</td>
</tr>
<tr>
<td>Muzaffarnagar</td>
<td>5.6%</td>
</tr>
<tr>
<td>Meerut</td>
<td>9.3%</td>
</tr>
<tr>
<td>Bulandshahr</td>
<td>15.9%</td>
</tr>
</tbody>
</table>

Third ranking crops

According to the statistical data the crops included in
this rank are gram, maize, rice and sugarcane. In the district
of Saharanpur rice has held this rank since 1950-51.

In the year 1950-51, gram was the third ranking crop in
the districts of Muzaffarnagar and Meerut where its' area was
18.75% and 14.39% respectively. In Bulandshahr in the same
year maize held this rank occupying 15.9% of the total
cultivated area.
Gram, continued to be the third ranking crop in Muzaffarnagar in the year 1960-61 also. In Meerut however, there was a shift from gram to maize which became the third ranking crop. Its' area in the above mentioned year was 10.9% in this district. Maize continued to hold its' rank in the district of Bulandshahr, occupying 16.07% of the total cropped land.

The year 1970-71 saw a slight change in the cropping trend of the Upper Doab. Rice took the place of gram in the District of Muzaffarnagar with 10.9% of the net cultivated area. In Bulandshahr on the other hand maize was replaced by sugarcane as the third ranking crop, its' cultivated area being 10.58% in the same year. There was however no appreciable change in the positions of maize and rice in the districts of Meerut and Saharanpur respectively. Area under maize in the in the Meerut district was 14.94% whereas area under rice in Saharanpur was 22% of the total cultivated land.

It is evident from the statistical data that rice maintained its' third rank in Saharanpur and Muzaffarnagar in the year 1975-76 also. Data indicates that rice had retained this rank since the agricultural year of 1970-71 and even before. This year the cultivated area of maize in Meerut was 13.72%, Sugarcane continued to be the third ranking crop this year also in Bulandshahr occupying 12.03% of the net cultivated land of the district.
UPPER GANGA-YAMUNA DOAB CROP COMBINATION REGIONS 1950-51

INDEX
- THREE CROP COMBINATION REGION (WHEAT, GRAM, AND SUGARCANE)
- FIVE CROP COMBINATION REGION (BAJRA, WHEAT, BARLEY, GRAM)

SOURCE: DIRECTORATE OF AGRICULTURE, LUCKNOW, U.P.
Fourth ranking crops

The 6 crops that fall under this category are maize, barley, rice, gram and bajra.

In the district of Musaffarnagar rice held this rank in 1950-51 with 9.23%, maize had occupied this place in the Meerut and Saharanpur districts. The cultivated area of maize in these districts was 9.31% and 7.25% respectively. In the district of Bulandshahr however, bajra and barley jointly occupied this rank both crops together covering an area of 13.43%.

Rice continued to hold its position through 1960-61. In Meerut, however, maize increased its acreage and came to occupy the third rank, its place having been taken by gram and barley. In the Bulandshahr district in the same year barley took the place of bajra.

In the year 1970-71 maize retained this rank in Saharanpur with a cultivated area of 10.2%. In the district of Musaffarnagar area under rice had increased placing it in the third rank. Its place was taken by maize occupying 7.61% of the total cropped land of the district in the same year. There was a remarkable expansion in the acreage under rice in Meerut and for the first time it held this fourth rank in this district. Gram and barley lost their acreage in Bulandshahr in this year being replaced by bajra with a cultivated area of 8.25%.
UPPER GANGA-YAMUNA DOAB CROP COMBINATION REGIONS 1975-76

INDEX

- **Two Crop Combination Region** (Wheat and Sugarcane)
- **Three Crop Combination Region** (Wheat, Maize, and Sugarcane)

Source: Directorate of Agriculture, Lucknow, U.P.

Fig. 15
The rank of maize was the same in the district of Meerut. Barley gained in acreage again in the district of Bulandshahr and occupied the fourth rank along with maize the same year.

CROP COMBINATION REGIONS

Most of the crops grown in this region are cultivated in combination with other crops. Hence, in order to understand the general cropping patterns it is necessary to divide the whole area into crop combination regions. An effort has been made to demarcate these regions on the basis of Doi's method for the period 1951 to 1975. He has introduced the formula $E_d^2$ for this purpose, which is a slight modification over Weaver's formula of $d_2$.

In the year 1950-51, Saharanpur which is the Western most district of the Upper Doab was a 3 crop combination region. These crops were wheat, sugarcane and rice. The districts of Muzaffarnagar and Meerut were also 3 crops combination regions with wheat, sugarcane and gram. Bulandshahr that year showed 5 crop combination, the crops being wheat, barley, maize, bajra and sugarcane in order of their production. Saharanpur to be a 3 crop combination region even in the year 1960-61 with the same crops. The crop combination in Muzaffarnagar, however, changed from 3 to 2 crop combination region. These crops were wheat and sugarcane. Meerut remained a 3 crop combination region as before. But this year the crops were wheat, sugarcane, maize, barley and bajra.
PROPORTION OF THE NET CROPPED AREA UNDER IRRIGATION IN THE DISTRICT OF SAHARANPUR IN THE YEARS 1950-51 AND 1975-76

SOURCE: 1. BOARD OF REVENUE, U.P.
2. DIRECTORATE OF AGRICULTURE, U.P.

FIG. 16
The pattern of crop combinations remained the same in the district of Saharanpur in 1970-71 also, Musaffarnagar continued to be a 2 crop combination region, in the same order of production. In Meerut also crop combination pattern was the same as in the year 1960-61. The crops this year were wheat, sugarcane and maize. Bulandshahr however, became a 2 crop combination region. The crops were wheat and maize.

In the year 1975-76 witnessed no change in the crop combination of Saharanpur and Musaffarnagar. Meerut in the same year however had a 2 crop combination i.e. wheat and sugarcane. Bulandshahr had a 3 crop combination. The crops were wheat, maize and sugarcane.

**IMPACT OF IRRIGATION ON THE CHANGING CROPPING PATTERNS OF THE UPPER DOAB**

It is demonstrated by the above commentary on changes taking place in the cropping patterns that there has been a general shift towards production of irrigated food crops as well as sugarcane. This has shown a positive impact that expanding irrigation facilities have had on the changes in cropping patterns of this area, within a period of 25 years from 1950-51 to the year 1975-76.

The advantages of increasing irrigation in the Upper Doab have been manifold. Irrigation which was earlier used only to ward off famines has now become responsible for
MUZAFFARNAGAR

<table>
<thead>
<tr>
<th></th>
<th>1950-51</th>
<th>1975-76</th>
</tr>
</thead>
<tbody>
<tr>
<td>NET CROPPED AREA</td>
<td>700</td>
<td>900</td>
</tr>
<tr>
<td>NET IRRIGATED AREA</td>
<td>500</td>
<td>300</td>
</tr>
</tbody>
</table>

PROPORTION OF NET CROPPED AREA UNDER IRRIGATION IN THE DISTRICT OF MUZAFFARNAGAR IN THE YEARS 1950-51 & 1975-76

SOURCE: 1. BOARD OF REVENUE, U.P.
2. DIRECTORATE OF AGRICULTURE, U.P.

FIG. 17
increasing the output by enabling a second or third crop being raised on the land provided with irrigation. Moreover, it was due to the development of irrigation facilities especially canal and tubewell irrigation that sugarcane and wheat have become the dominant crops of this area. Wheat, a rabi crop is totally dependent upon various irrigation facilities for its water requirements. A remarkable increase in area under wheat cultivation since 1950-51, directly coincides with a phenomenal increase in irrigation facilities. Furthermore, irrigation has also enabled the new hybrid varieties of wheat especially the dwarf mexican variety (which requires more irrigation than the local one) to be cultivated in the Upper Doab, resulting in higher yields. Sugarcane, another crop with high water requirements has been constantly expanding its area. This has also been made possible greatly due to more land being brought under irrigation, as sugarcane requires 93.0 acre inches of water. The increase in area under sugarcane and wheat has been the most phenomenal in the district of Meerut. Another remarkable change in the district of Meerut was the reduction in acreage under gram, which was the fourth ranking crop in Meerut in the year 1960-61 and an increase in area under rice cultivation which held this rank in 1970-71 as well as in 1975-76. This change can justifiably be attributed to the increase in canal and tubewell irrigation facilities, as rice requires more water than any other crop.
Figure 18

Proportion of net cropped area under irrigation in the district of Meerut in the years 1950-51 and 1975-76.

Source: 1. Board of Revenue, U.P.
2. Directorate of Agriculture, U.P.
and would have been impossible to grow under the semiarid conditions of this area without adequate water supply.

A similar increase in the cultivated land under wheat, sugarcane and rice were witnessed in Saharanpur. In the district of Muzaffarnagar where rice was a fourth ranking crop both in the years 1950-51 and 1960-61 had increased its acreage by 1970-71 to become a third ranking crop. This increase in area under rice cultivation could well be a result of increased land being brought under tubewell irrigation from 29.7% in 1960-61 to 42.4% of the total cultivated land in the year 1970-71 and 46.99% in 1975-76.

Bulandshahr is another district which has benefitted greatly from an increase in irrigation facilities since 1950-51 as not only large tracts of Usar land were reclaimed for cultivation, there was also a gradual shift from the less profitable gram with much less water requirements to other more profitable grams like maize etc. as well as high yielding varieties of wheat.
BULANDSHAHR

(000) HECTARES

1200
1100
1000
900
800
700
600
500
400
300
200
100

0

1950-51
1975-76

YEARS

11.9%

22%

NET CROPPED AREA

NET IRRIGATED AREA

PROPORTION OF NET CROPPED AREA UNDER IRRIGATION IN THE DISTRICT OF BULANDSHAHR IN THE YEARS 1950-51 AND 1975-76

SOURCE: 1. BOARD OF REVENUE, U.P.
2. DIRECTORATE OF AGRICULTURE, U.P.

FIG. 19