CHAPTER VII

IMPACT OF IRRIGATION ON CROPPING PATTERN

The common connotation of the phrase "irrigation impact" or the impact of irrigation is one of the contribution of irrigation. Alone to a change in particular form characteristic or farmer behaviour (say in regard to price responsiveness) or any other parameter of the economy such as output instability, structure of crops prices agricultural labour income, and in qualities of farm income. In practice it is be well high impossible to accurately assess the "ceteris paribus" impact of irrigation. What is being more after often referred to an literature as irrigation impact is the total alteration in a farm parameter following a change over from rainfed to irrigated farming. Having a side the questionable empirical attempts by some scholars (e.g. S.P. Pal 1985 and Vidyasager 1977) to isolate the pure contribution of irrigation to a given expansion in farm out-put, the usual allusion to out-put impact of irrigation is in terms of an addition to farm out-put as consequence of switching from rainfed to irrigation farming. (Dhawan B.D. 1988, pp. 31).

In this study the discussion have been made, the very concept of irrigation impact, the issue of one to one correspondence between irrigation and multiple cropping of land resources as well as the related issue of relationship between gross crop area and irrigation and the external output effects of irrigation.
Complete analysis of irrigation impact in field economy may be seen in two ways. First is external impact of irrigation and second is internal effect of irrigation. It is very difficult to come to grips with the problems of complements or interactions, between irrigation and other factors. One can seldom measure it satisfactorily in practice. The cost–benefit expert surmounts the problem by deducting from incremental output the incremental associated costs of cultivation to reduce the income contribution of irrigation.

This tantamounts to assuming that factors other than irrigation, say chemical, fertilizer and pesticides contribute to the production process neither less nor on them by an irrigation. The intractable nature of the problem of decomposition of total output into irrigation and fertilizer effects alone is brought out with aid of simple mathematics. Impact of irrigation on cropping pattern, growth of irrigation area under crops also be inferred in this analysis.

In the particular case of irrigation discerning analysis of its impact have shown remarkable awareness of the external effect. A few concrete instances from literature would illustrate the ramifying nature of these external effects within the agricultural sector. D.R. Gadgil (1948) found that the introduction of canal irrigation in a tract of western Maharashtra, led to steep rise in the demand for farm yard manure. This rise was
attributed to the radical change in crop pattern due to canal irrigation as a result of which the farmers started growing a heavily manured crop viz. sugarcane.

Irrigation not only affect the cropping pattern but also it changes the landuse pattern. The spatial temporal changes in crop pattern due to irrigation, have been tried to analysis in Upper Betwa Basin, in this chapter.

Spatial Distribution of Crop and Cropping Pattern:

From the point of view of cropping pattern the region holds first position in rabi crops and then it has second in Kharif crops. The south-eastern and the middle region belongs to rabi crops. While the north-western region has to be in kharif crops. About 67.4 percent area covered by rabi crops among other crops, pulses and oil seeds are most significant occupying nearly 42.0 percent of total cropped area in 1988-89 Table. Another 27.8 percent of total cropped area is under pulses. Thus, the cropping structure in the basin is dominated by cereals and pulses among non food crops commercial non food crops as cotton, tobacco, hemp etc. not are significant.

WHEAT:

Wheat occupies first position in areal extent among all crops in the basin. About 43.3 per cent area is under wheat in this basin. From total cropped area spatial
variation in the area of wheat ranges from 75.6 percent in total cropped area in Khurai block in Sagar district. While highest is in Vidisha district. Three categories clearly come out from the area under wheat in the basin. In the first category which ranges from 63.2 percent to above cropped area under wheat comprises 75.0 percent in Khurai and Malthone 62.7 percent in Sagar district, Khaniachhana block 62.7 percent in Shivpuri district, shown in Plate 12.

Second category falls in 11 blocks of the basin. In Sagar district there is only Bina block (54.5 percent), while in Vidisha district there are four blocks, Vidisha (46.5 percent), Basoda (46.1 percent), Khurwai (49.6 percent) and Lateri (59.0 percent). The area belongs to Malwa plateau and is of Deccan trap of black cotton soils favourably good for the cultivation of wheat. Raisen (50.2 percent), Obedullaganj (46.9 percent), Cairatganj (39.4 percent) of Raisen district, falls in the same category. The area has good facilities of irrigation proportionately.

Third category found in 8 blocks of whole basin namely, Isagarh (33.7 percent), Chanderi (33.6 percent) in Guna district, Rahatgarh (27.2 percent) in Sagar district, Barasia (21.2 percent) in Bhopal district, Begamganj (23.9 percent) in Raisen district, Sirajn (36.7 percent), Gyarspur (18.9 percent) in Vidisha district.

IRRIGATED AREA UNDER WHEAT:

Wheat is the first irrigated crops of the basin. It occupies 49.8 percent
irrigated area under wheat. While the total area under wheat is 43.3 per cent of total cropped area. About \( \frac{1}{3} \) area under wheat is irrigated.

At a glance on the map of irrigated wheat, there are clearly three categories can be seen. First category belongs to 8 blocks of the basin namely Bina (69.7 per cent), Khurai (74.9 per cent) in Sagar district, Raisen (83 per cent), Obulleganj (74.6 per cent), Begampurj (69.7 per cent), Gafratganj (69.7 per cent) in Raisen district, Shopal (78.7 per cent) in Sagar district. These blocks having good opportunities of irrigation facilities. Irrigation is done by canal and wells. While in Vidisha and Raisen blocks are facilitate by canal of Upper Betwa river.

The second category is too belongs to the 8 blocks of the basin namely, Isagarra (53.0 per cent), Chanderi (54.6 per cent), Nagawali (54.6 per cent), Ashoknagar (55.1 per cent) in Guna district, Siraj (43.5 per cent), Nateran (42.9 per cent) in Vidisha district, Serasia (47.9 per cent) in Sagar district.

The third category comprises 6 blocks of the basin namely Khanadihana (24.3 per cent) in Sagar district, Malthone (34.9 per cent), Rahatgarh (16.9 per cent) in Sagar district, Baroda (38.5 percent), Lateri (23.8 per cent), Kurwai (22.6 per cent) in Vidisha.

Irrigation is generally practiced by wells,
but in northern part the canals is being made to irrigate the fields by Rajghat Pariyojna. While in southern part where little development occurs, so the wells are the common device of irrigation. In southern extreme of Upper Betwa basin, the irrigation department of State has developed some minor and medium projects and tried to develop the irrigated area.

GRAM:

Gram is the principal food pulse grown for cash returns. It is an important sources of nutrition food for live stock especially for draught force which takes a fair proportion of the produce. Its consumption as a human food is also significant along with food cereals and millets. Gram is a leguminous pulse used by all classes of people as a vegetable in green form and as a pulse in dry form. It is an important and cheap source of protein and being a legume, it is also of considerable utility in enriching the soil productivity through the fixation of atmospheric nitrogen. Gram is an important winter pulses and comes at second place among the food grains after wheat in the basin. It occupies 399.1 thousand hectares (7.79 percent) of total cropped area. Gram is grown throughout the basin but its concentration is in the central and northern parts where low and moderate rainfall condition and light black soil are available.
There are 9 blocks having very high proportion of gram area (more than 27.5 per cent of total cropped area under irrigation). They are distributed into two belts, and make three compact belt most important of these extend from Ashoknagar, Mungawali of Guna district and covering Nateran, Gyaraspur, Vidiha of Vidiha district, Begamghanj, Gairatganj in Raisen district and Bina, Khurai, Rahatgarh blocks in Sagar district. This belt is located in the central and north middle part of the basin.

Secondly the area which have maximum concentration of this crop is of light soils and low amount of rainfall, the area having low intensity of irrigation. There are 4 blocks namely, Isagarh (15.6 per cent), Chanderi (11.0 per cent) in Guna district, Kusai (14.5 per cent) in Vidiha district and Serasia (14.3 per cent) in Bhopal district.

The third area comprises 9 blocks of the basin namely Raisen (8.5 per cent) in Raisen district, Siroaj (5.6 per cent), Lateri (8.3 per cent), Basoda (6.4 per cent) block of Vidiha district, Bhopal block (8.3 per cent) in Bhopal district, Khaniachana (5.9 per cent) block in Shivpuri district, and Malthone (8.0 per cent) in Sagar district.
JOWAR:

Jowar is the third most important crop of kharif season. It is preferably grown on lighter and poor soils where other food crops, like wheat and gram cannot be grown. Though its water requirement is less than wheat. There are 145.0 thousand hectares (6.5 percent of total cropped area) under this crop (as shown in figure 12).

There are three categories of Jowar area in the map. Jowar is generally not irrigated, due to the season in which it is grown. The first category belongs to the 5 blocks in the basin namely Lateri (42.4 percent) in Vidisha district, Ashoknagar (19.7 percent), Chanderi (12.7 percent), Mungawali (12.7 percent) in Guna district, Barasia (15.4 percent) in Bhopal district.

The second category encompasses the blocks of the basin namely Khaniadhana (7.60 percent) in Shivpuri district, Isagarh (9.8 percent) in Guna district, Bina (3.4 percent), Malthone (4.2 percent), Khurai (3.3 percent) in Sagar district, Kurwai (5.1 percent), Basoda (2.4 percent) in Vidisha district, Bhopal (2.5 percent) in Bhopal district.

The third category falls in 9 blocks of the basin, where the percentage to the total cropped area is less than 1 percent. These blocks are scattered in the basin namely Sironj (0.7 percent), Nateran (0.6 percent), Cyarasour (0.8 percent), Vidisha (0.2 percent) in Vidisha district, Raisen (0.9 percent),
Gairatganj (0.3 per cent), Begamganj (0.7 per cent),
Obadulleyanj (0.16 per cent) in Raisen district, Rahatgarh
(0.9 per cent) in Sagar district.

PULSES:

Pulses are next cereals in area occupying 27.4
per cent of total cropped area in the basin. The basin
grows a variety of pulses, among them gram 18.4 per cent.
Toora, Moong, Urd, Tur are important. In order of
significant are lentil, masoor and peas.

These are 9 blocks having very high proportion
of pulses area above 43.3 per cent the blocks are not make
a compact belt they are unevenly distributed in the whole
basin. The blocks having higher percentage are Chanderi
(43.4 per cent) in Guna district. While blocks in Vidisha
district make compact belt of having higher to highest
percentage from cropped area under pulses.

In medium category which is of 21.3 to 36.3
percent comprises to the blocks of the basin. These are
Chanderi (33.6 per cent), Mungawali (34.6 per cent) in
Guna district. Other blocks are Khurai (25.7 per cent),
Rahatgarh (26.2 per cent) in Sagar district, Gairatganj
(22.3 per cent), Begamganj (28.1 per cent) in Raisen
district and one block cover in Vidisha district. Nateran
(32.0 per cent) are the blocks which have medium.
Third category which is having 15.2 to 21.3 percent of total area under pulses from total cropped area. Contain five blocks of Basin namely Bina (16.2 per cent), Malthone (12.8 per cent), Rahatgarh (15.5 per cent) in Sagar district, Bhopal (16.1 per cent) in Bhopal district, Vidiisha (11.9 per cent) in Vidiisha district. The area is mainly wheat producing area of black cotton soil. Where farmer have no interest is growing of pulses. (As shown in plate 12).

OIL SEEDS:

Traditionally oil seed are classed as cash crops of course farmer sells oil seeds as he does other commodities also, but it is hard to accept that trade is sole motive behind the production of oil seeds. However, there are certain physically favourable areas for large scale production of certain oil seeds. Which has facilitated establishment of industries based on them. All oil seeds occupying nearly 171.2 thousand hectares or 19.9 per cent of the total cropped area, in this basin. Area under oil seeds irrigated very limited. Only 4.0 per cent area is irrigated of total area under oil seeds. Soysbean, the first ranking oil seeds occupies 95.4 thousand hectares (10.1 percent of the total cropped area). It is followed by ground-nut 23.9 thousand hectares (2.5 per cent), Linseed 54.9 thousand hectares (3.71 per cent).

Oil seed producing areas can be categorized into three divisions, highest percentage found in two
blocks of Vidisha district, these are Nataran (12.3 per cent) and Gyanaspur (12.2 per cent). 7 to 10 per cent area under oil seeds may be seen in blocks of the district from North to south. 3 blocks of Guna district namely Isagarh (6.5 per cent), Chandari (7.4 per cent), Ashoknagar (10.0 per cent). Second tract found in Vidisha and Raisen district. Below 7 per cent area under oil seeds are found in rest of 12 blocks which make the surrounding boundary of Upper Betwa Basin. This area have very low percentage, hence it is wheat growing area.

CHANGES IN CROPPING PATTERN:

It has been seen that the agricultural landuse has witnessed enormous changes during the planned period, so has been in the case of extent of the crops. Total cropped area increased by 292.8 per cent during 1951 to 1967 and 1988, with exception of wheat, barley tobacco and few oil seeds which recorded decline in actual area all other crops have gained. These changes in areal extent of crops are associated with the socio-economic development such as urbanization, industrialisation by growth of population and means of transport.

These have necessitated and facilitated the development of agriculture. Consequently, farmer is coming out of the bound of self-sufficiency and tries to squeeze maximum return for which he adjust the cropping pattern according to the potentiality of land and demand
of the market. Changes in spatial pattern of major crops are described here.

CHANGES IN THE AREAL EXTENT OF THE CROPS:

During last 37 years gross cultivated area increased from 905.377 thousand hectares in 1950-51 to 26514 thousand hectares in 1988 thus annexing 1946.0 thousand hectares to non food crops. This addition works an increase 249.3 to 1064.7 per cent for respective crop groups. Even in food-crops, increase rate is much higher for pulses (167.8 per cent) than for cereals and millets.

TABLE 7.1

UPPER BETWA BASIN: CHANGES IN AREAL EXTENT OF CROPS 1987-89

<table>
<thead>
<tr>
<th>Crops</th>
<th>1950-51 Area (000)</th>
<th>Percentage</th>
<th>1987-89 Area (000)</th>
<th>Percentage</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>11900</td>
<td>13.1</td>
<td>969.700</td>
<td>36.5</td>
<td>814.6</td>
</tr>
<tr>
<td>Gram</td>
<td>29385</td>
<td>3.2</td>
<td>520.300</td>
<td>19.6</td>
<td>1770.6</td>
</tr>
<tr>
<td>Jowar</td>
<td>83</td>
<td>0.1</td>
<td>228.400</td>
<td>8.6</td>
<td>27.5</td>
</tr>
<tr>
<td>Total Pulses</td>
<td>41065</td>
<td>4.5</td>
<td>77.150</td>
<td>2.9</td>
<td>187.8</td>
</tr>
<tr>
<td>Total food crop</td>
<td>857110</td>
<td>94.6</td>
<td>2137.600</td>
<td>80.6</td>
<td>249.3</td>
</tr>
<tr>
<td>Total non-food</td>
<td>48297</td>
<td>5.3</td>
<td>513.800</td>
<td>19.3</td>
<td>1064.7</td>
</tr>
<tr>
<td>All crop</td>
<td>905377</td>
<td></td>
<td>2651.400</td>
<td></td>
<td>292.8</td>
</tr>
</tbody>
</table>

Source: Agricultural Statistics of Madhya Pradesh.
Among cereals, the area under wheat has been recorded highest change 814.8 per cent during the 1951-to 1986. In millets, Jowar is recorded only 27.5 per cent change in area during last 37 years.

Considerable increase has been recorded in the area under pulses. The area under various pulses crops went up by 167.8 percent. Other pulses 1770.6 per cent ranked first followed by gram, due to its market value and the demand.

RELATIVE CHANGES IN PROPORTION OF CROPS:

Differential growth rates of crops have also caused shift in their significance in total array of crops of the region. Change in proportion of crops is another way of expression of over all change in cropping pattern (T.C Weaver, 1954, pp. 34-35). Proportionate increase in wheat area (+362.3 points), proportionate increase in Jowar area (+97.8 counts) cereals).

Increase in share of pulses from 27.4 to 42.0 percent is economically significant. Gram increase at high rate while such pulses gram area (+41.82 counts). Contrary to the pulses, oilseeds have lost their share in total cropped area from 9.91 per cent. Despite this share of Soyabean, Linseed Groundnut, Rose substantially.

From the proceeding analysis it is clear that such crops which are more remunerative have grown
appreciably under existing conditions and this number can further be increased by providing better irrigation and agricultural facilities by way of intensification of cultivation and by bringing fallows under cultivation.

ADOPTION OF INNOVATIONS:

Among the measures adopted to enhance the yield of crops, irrigation was given first priority. It was tried to maintain and even enhance the fertility of soils not only by the use of manures but also application of chemical fertilizers. To maximize the benefits, improved seeds were popularized. Along with these several protectional measures were taken to ensure production. Development of some of these measure are reviewed in the following paragraphs.

IRRIGATION:

As discussed in earlier chapter in detail proportion of irrigated area is 9.0 per cent of the total cropped area in this basin and it has increased by 422.5 per cent, from 69622 hectares in 1950-51 to 2942 percent in 1987-88. There is wide spatial variation in proportion and growth of irrigated area. However, Shivrampur have 25.1 percent, Bhopal and Raisen districts are certainly high percentage of irrigated area as far facilities of irrigation while Vindisha, Sagar and Guna districts are far behind in irrigation facilities.
USE OF HIGH YIELDING VARIETY OF SEEDS:

Comparatively much recent phenomenon is the use of high yielding variety of seeds. Actually the use of these miracle seeds was the soul of the green revolution. It was proclaimed that yield would increase by four to six folds with the use of these seeds.

This proclamation has been criticised at length (Dasgupta, 1977, pp. 241-60) on several counts nevertheless, it cannot be denied that production increased rapidly by their use. Along with the other parts of the country, use of improved seeds increased very rapidly after IV - five plan in this region also. Which increased high yielding variety variety of seeds to 404.0 thousand hectares in 1987-88. Most significant growth has been in the case of wheat. Spatial variation in the coverage of high yielding variety of seeds is clear from Table 7.2.

**Table 7.2**


<table>
<thead>
<tr>
<th>District</th>
<th>Wheat A</th>
<th>B</th>
<th>Jowar A</th>
<th>B</th>
<th>Maize A</th>
<th>B</th>
<th>Paddy A</th>
<th>B</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shopep</td>
<td>50.9</td>
<td>1.9</td>
<td>6.0</td>
<td>0.2</td>
<td>2.0</td>
<td>0.07</td>
<td>1.0</td>
<td>0.03</td>
<td>59.9</td>
</tr>
<tr>
<td>Raipur</td>
<td>42.3</td>
<td>1.5</td>
<td>7.0</td>
<td>0.26</td>
<td>-</td>
<td>-</td>
<td>5.0</td>
<td>0.1</td>
<td>54.3</td>
</tr>
<tr>
<td>Vindhania</td>
<td>41.0</td>
<td>1.5</td>
<td>27.0</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>0.03</td>
<td>69.0</td>
</tr>
<tr>
<td>Guna</td>
<td>30.8</td>
<td>1.1</td>
<td>20.0</td>
<td>0.7</td>
<td>-</td>
<td>-</td>
<td>1.0</td>
<td>0.03</td>
<td>51.8</td>
</tr>
<tr>
<td>Shippuri</td>
<td>60.0</td>
<td>2.2</td>
<td>13.0</td>
<td>0.4</td>
<td>5.0</td>
<td>0.1</td>
<td>4.0</td>
<td>0.15</td>
<td>82.0</td>
</tr>
<tr>
<td>Sagar</td>
<td>75.0</td>
<td>2.8</td>
<td>5.0</td>
<td>0.16</td>
<td>1.0</td>
<td>0.03</td>
<td>6.0</td>
<td>0.2</td>
<td>87.0</td>
</tr>
<tr>
<td></td>
<td>300</td>
<td>11.0</td>
<td>78.0</td>
<td>0.16</td>
<td>8.0</td>
<td>0.01</td>
<td>18.0</td>
<td>0.14</td>
<td>404.0</td>
</tr>
</tbody>
</table>

A = Area under Hyv in 00 ha.
B = % of Hyv area to total area under the crop.
It is evident from the table that unlike the growth of irrigation. Use of improved seeds could not be made so popular in this basin as in other parts of the State.

Consequently proportion of wheat and Jowar area under improved seeds are lower than the respective average for the State. Since present irrigated area is lower than the State average. Lack of irrigation cannot be responsible for such low adoption of these crops; though non availability of timely water supply is one of the major constraints. The major problem as far as the use of these miracle seeds are concerned, are imitation of physical environment productivity of climate rhythm economic conditions of farmers which prevent purchasing of seeds and distribution system of seeds. Despite of all these, if seeds are made available timely these can acquire more area under them. Provision of water supply can further help their adoption.

USE OF CHEMICAL FERTILIZERS:

Modern agriculture relies on adequate and timely supplies of inputs. Fertilizer being a key input, directly affects agricultural production and development of rural areas. It becomes therefore, imperative to identify the bottle necks in fertilizer consumption and chalk out strategies to accelerate the pace of fertilizer consumption.
Use of fertilizers to replenish fertility of the soil cannot be said as a popular measure in this basin, on average 3.31 kg of fertilizer (Nitrogen, Phosphate, Potash) are applied per hectare of cropped area in this basin. Poverty of farmers lack of ensured timely water supply and subsistence nature of cropping may be reason of this region, of affairs. In fact use of chemical fertilizers is linked with irrigation. Which included 21752 tonnes nitrogenous and 21945 tonnes phosphatic fertilizer i.e. use of potassic fertilizer less than 1372 tonnes of total consumption of fertilizer in the basin. Spatial variation in the coverage of fertilizers is clear from the table 7.3.

### TABLE 7.3

**UPPER BETWA BASIN : CONSUMPTION OF FERTILIZERS 1987-88**

<table>
<thead>
<tr>
<th>District</th>
<th>Nitrogen</th>
<th>Phosphate</th>
<th>Potash</th>
<th>Total N.</th>
<th>P.</th>
<th>K</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bhopal</td>
<td>2459</td>
<td>2117</td>
<td>204</td>
<td>4780</td>
<td>10.78</td>
<td>9.28</td>
<td>0.61</td>
</tr>
<tr>
<td>Raisen</td>
<td>5447</td>
<td>5550</td>
<td>134</td>
<td>11131</td>
<td>11.27</td>
<td>11.21</td>
<td>0.42</td>
</tr>
<tr>
<td>Vidisha</td>
<td>3704</td>
<td>4391</td>
<td>165</td>
<td>8260</td>
<td>7.09</td>
<td>7.94</td>
<td>0.31</td>
</tr>
<tr>
<td>Guna</td>
<td>2505</td>
<td>2075</td>
<td>154</td>
<td>4734</td>
<td>2.10</td>
<td>2.37</td>
<td>0.22</td>
</tr>
<tr>
<td>Shivpuri</td>
<td>2144</td>
<td>2253</td>
<td>151</td>
<td>4548</td>
<td>5.27</td>
<td>5.70</td>
<td>0.29</td>
</tr>
<tr>
<td>Sagar</td>
<td>5493</td>
<td>5559</td>
<td>964</td>
<td>11616</td>
<td>6.45</td>
<td>6.13</td>
<td>0.74</td>
</tr>
</tbody>
</table>

**Total** 21752 21945 1375

Sources: Directorate of Agricultural Bhopal,

*Agricultural Statistics 1987-88.*

On an average 3.31 kg/ha. of chemical fertiliser per hectare cropped area is used in this region. It is evident from this fact also that Raisen with highest proportion of irrigated area 39.9 per cent has most intensive use of chemical fertilisers (22.9 kg/ha.) followed by Vindisha (34.5%) (14.4 kg/ha.).

It has been observed that people accepted fertilisers very rapidly in the IV five years plan, but there after its use has declined.

ADOPTION OF OTHER INNOVATIONS :

As in the case of irrigation and applications of fertilisers so is from the point of view of adoption of improved technology this basin is not far behind the other regions of the State. Situation in respect of some of these aids are summarised in the following paragraphs.

TRACTORS :

In this region where agricultural labour are not easily available and where dominant require intensive human care, use of tractors is popular. There were total 10203 tractors in use in 1967-68 thus, their density works to be 1.08 tractors per thousand hectare of cropped area. This average varies from 1.0 tractors in Obculagunj of Raisen district to 6.37 tractors in Giaraspur block of Vindisha district. It is to be noted that as far as the use of tractors is concerned Vindisha and Bina plateau is most significant.
In the Upper Betwa Basin, Raipur, Vidisha and Sagar is another area worth mentioning.

**ELECTRIC PUMPING SETS**

Though 20.4 per cent blocks are electrified diesel pumps out number electric pump sets. There are 19216 electric pumps working in the region, in 1987-88 as against 28285 oil pumps.

The average density of electric pumps per thousand hectare of the cropped area is 1.77 pumps which ranges from 7.1 pumps in Vidisha block to 2.72 pumps in Cuna district. Concentration of electric pumping sets is closely associated with the electrification of villages low. For instance in Vidisha district nearly 12.0 per cent of villages are provided with electricity which is highest proportion among districts of this basin and density of electric pumping sets per thousand hectare of cropped area is 7.11 being highest followed by Raipsen (6.37).

There are more than 22 out of one thousand irrigation wells provided with electric pumps in Vidisha and 14.1 in Raipsen. In other districts only few blocks have higher density than the average, Ashoknagar, Isagarh, Chanderi, Mungawali, Cyaraspur, Sasoda, Natera, Lateri, Begamganj, Gairatganj, Obudulganj and Nalthona are development blocks where density of electric pumping sets is very low ranging between 0.2 to 0.77 per thousand hectare of cropped area.
DIESEL PUMPS:

There are 28285 diesel pumps in operation in this region. Their average density per thousand hectare of cropped area is 3.06 pumps. Density is as high 11.15 pumps per thousand hectare of cropped area in Bina block and as low as 1.0 in Ashoknagar block of Guna district. The density is higher than mean in 4 blocks of Vidisha, 3 blocks of Raisen and 3 blocks of Sagar and 2 blocks of Shopeal and only one of Ashoknagar in Guna district.

LEVELS OF AGRICULTURAL DEVELOPMENT:

To obtain a general appreciation about the variation in the levels of agricultural development, we used 5 variables as indicators. These are (i) use of chemical fertilizers kg/ha, (ii) irrigated area as percentage of total cropped area, (iii) number of tractors per thousand hectare percent of cropped area, (iv) number of pumping sets (oil pumps) and (v) number of electric pumps per thousand hectare of cropped area. Though these are indicatives of input variables and are not capable of presenting the level of productivity; however, since most of them have direct relationship with productivity, they can be reflective indicatives of the levels of agricultural development. For the determination of levels of development Kendall's (1939) ranking method has been used. This method requires data in ranked form. Accordingly 22 blocks of the region are ranked for each variable in descending order. Three ranks for three variables, thus
obtained for each blocks are summed and these some are ranked again from 1 to 12 but in ascending order.

The block ranked first has the highest level of development while the 12 blocks has the lowest level. These ranks are grouped into three classes by quartile method and mapped to depict the regional pattern (plate). There are seven blocks (Khaniadhana, Rahatgarh, Shhopal, Raisen, Cenullagenj, Barasia, Bina,) with highest level of agricultural development. There are 5 blocks (Khural, Vindisha, Sasoda, Segamganj, Caiatganj) with highest medium level of agricultural developing. These are concentrated in Raisen, Shhopal, Shivpuri and Sagar district. One in each remaining blocks (Isagarh, Canderi, Ashoknagar, Mungawali, Sironj, Lateri, Materam, Kurval, Gyaraapur, Malthone) falling in upper quartile are located in the Guna and Vindisha uplands.

These areas are most prone to adopt new agricultural innovations. Contrary to them there is remarkably low level of adoption in Guna and Vindisha districts.