CHAPTER VIII

AGRICULTURAL METHODS AND TECHNIQUES

The regional economy of the Lower Chambal Valley is dominated by the agricultural and associated activities but the methods and techniques employed in the farming varies from one part to the other. Variation in the agricultural practices are due to several physico-economic factors. The nature of relief, degree of dissection of flood plains, socio-economic background and the degree and extent of mechanisation individually or collectively influence agricultural methods and techniques in the region under study.

The study reveals that the agriculture in the Valley is making shift from dry farming towards irrigation. But still there are some areas as ravine lands and hilly tracts where the methods and techniques of cultivation are old fashioned and more properly are backward in the march of agricultural development. The relief features, nature and extent of slope are main factors which retard the implementation of new methods and improved implements in this part of the country.

This chapter deals with land holding, agricultural implements, manures and fertilizers, improved agricultural practices, research programmes, soil conservation works and water resource development and its effects.
LAND HOLDINGS

The land holding is an important aspect of agricultural methods and techniques. It affects the yield per acre as well as the type and quality of implements with which farmers of the Valley work. The average size of holding in the area varies greatly from one place to another; depending upon the heterogeneity of landforms. The average size of the holding in the Valley comes to 3.6 hectares.

Table XI

<table>
<thead>
<tr>
<th>Type of Land</th>
<th>Average Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canal irrigated lands</td>
<td>2.8 hectares</td>
</tr>
<tr>
<td>Ravine lands</td>
<td>6.0 hectares</td>
</tr>
<tr>
<td>Hilly regions</td>
<td>1.6 hectares</td>
</tr>
</tbody>
</table>

The average size of holding in the Valley is comparatively greater than the Ganga-Yamuna Doab (2-2.4 hectares) but smaller than the Punjab Plain (4.8 - 5.2 hectares). The low average holding in the hilly tahsils of the Lower Chambal Valley seems to be due to the lack of accessibility into small areas that could be brought under cultivation. The average size of the holding is far greater in the ravine infested villages than in the Commanded area and the hilly section.

The personal observations in Khatkar, Guhata, Pipalda, Jalalpur, Basai Neem, Sadbas, Jhatoli, Sagar Pada, Barhi and Naikpura villages reveal that the yield per acre in these
ravine infested villages is very low due to the low fertility and meagre water supply. Hence small farm is uneconomic.

Besides smaller size of the average holding in the Valley, most of the holdings are scattered and fragmented. On account of fragmented small holdings and conventional aversity of farmers it is somewhat difficult to follow new methods and improved agricultural practices and thus modernization is lagging behind in the Valley. Regarding this problem K. M. Mehta (1958) has recommended the adoption of the system of rectangularisation on the lines of Punjab with suitable modification. His recommendations have been executed in the canal irrigated region and this pattern has facilitated the layout of irrigation channels and the efficiency of irrigation.

In a few villages of the Commanded Area the system of rectangularisation is being adopted. For example, in Ballop, Digod and Sultanpur villages most of the advanced cultivators have started changing the pattern of their farms.

AGRICULTURAL IMPLEMENTS

The agricultural implements which are commonly used in the Lower Chambal Valley are old fashioned and the improved agricultural implements as tractors, iron plough razer, sprayer, helho, seed driller, and winnover, have recently come in vogue and are not used so extensively.
A country plough known as 'hal', the bauler, the 'hari', leveller, spade sickle and sorting baskets are the only equipments that the average farmer possesses. Even an iron plough is not in common use in the Valley. This is because of its heaviness and difficulty in repairing locally. The use of tractor in agriculture of course, is very recent, but it is extensively used in the Chambal Commanded area. Lack of labour and grow more food campaign are responsible for the advent of mechanization of cultivation. Due to the reduction in the cost of cultivation tractors are getting more and more popular. But its high price, costly maintenance and operation are beyond the capacity of the average farmers.

The modern implements is not common in the ravine infested area of the Valley. There are several reasons. Firstly, the available land for cultivation in these tracts is undulating so it is difficult to work with tractor in these areas. Secondly, the water table is low, irrigation facilities are limited, and the use of manures and fertilizers are uncommon so these factors collectively affect the crop production adversely. The low crop production means the poor economic status of the peasants. Because of poor status, farmers of ravine infested land are unable to afford the cost and maintenance of tractors and modern implements as well.

Manures and Fertilizers

Use of manures and fertilizers is not a common practice
in the Lower Chambal valley except in the area under irrigation. Low yield of crops in the area at present is largely due to the lack of supply of plant nutrients to the soil. After every harvest the soil becomes poorer in plant nutrients as the nutrients drawn out from the preceding crops are not made up by the application of manures and fertilizers. Most of the areas, specially the ravine lands and hilly areas do not receive any kind of fertilizers either organic or inorganic as has been observed in many villages during the field study.

Among the plant foods nitrogen and phosphorus are by far the most important ones for the soils of the Valley. The following table gives the amount of nitrogen and phosphorus removed by some of the crops every year.

<table>
<thead>
<tr>
<th>Crops</th>
<th>Nitrogen</th>
<th>Phosphorus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jowar</td>
<td>50 lbs.</td>
<td>16 lbs.</td>
</tr>
<tr>
<td>Maize</td>
<td>32 lbs.</td>
<td>21 lbs.</td>
</tr>
<tr>
<td>Wheat</td>
<td>50 lbs.</td>
<td>21 lbs.</td>
</tr>
<tr>
<td>Sugar-cane</td>
<td>30 lbs.</td>
<td>180 lbs.</td>
</tr>
<tr>
<td>Cotton</td>
<td>55 lbs.</td>
<td>30 lbs.</td>
</tr>
<tr>
<td>addy</td>
<td>30 lbs.</td>
<td>20 lbs.</td>
</tr>
<tr>
<td>Oil seeds</td>
<td>18 lbs.</td>
<td>10 lbs.</td>
</tr>
<tr>
<td>Gram</td>
<td>70 lbs.</td>
<td>20 lbs.</td>
</tr>
</tbody>
</table>
From the experiments carried out by the State Agriculture Department, Kota, Rajasthan, and in other area of India doses of nitrogen and phosphorus for different crops have been tentatively fixed\(^1\).

At present, farm yard manure is most commonly used by the average farmers, but unfortunately most of the cow dung produced is used as a fuel due to the lack of firewood supplies. In Sallay, Sultanpur, and Bina villages of the Chambal Command area, Rajasthan, there is a lack of firewood, therefore, most of the cow dung produced is used as a fuel by the average cultivators. In these villages manure is supplied at a rate of 15 to 30 cart load per acre. Use of chemical fertilizers is receiving a great fillip due to the wide propaganda through the Agriculture departments, and block development schemes, yet it is limited to a few.

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1 Requirement of nitrogen and phosphorus in the form of manures and fertilizers, per acre of land for different crops in the Lower Chambal Valley:

<table>
<thead>
<tr>
<th>Crops</th>
<th>N (lbs)</th>
<th>P 2O 5 (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jowar</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Maize</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Reddy</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Cotton</td>
<td></td>
<td>30</td>
</tr>
<tr>
<td>Ground nut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodder (Khurif)</td>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>Cereal</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Legume</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Green manure</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Sugar-cane</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Wheat</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Kabhi pulses</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Oil seeds</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Kabhi fodder</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Cereal</td>
<td>30</td>
<td>15</td>
</tr>
</tbody>
</table>
crops like sugar-cane, wheat, maize, jowar and rice.

After 1956-57 a great stress is being laid on the conservation of organic manures, use of green manures and fertilizers. To start with, 10% of the irrigated area in the Commanded Area, Kota district was kept for growing green manure crops which was to be gradually increased up to 15% by the end of III plan which is evident from the figures below:

<table>
<thead>
<tr>
<th>Year</th>
<th>Hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961</td>
<td>640.0</td>
</tr>
<tr>
<td>1962</td>
<td>960.0</td>
</tr>
<tr>
<td>1963</td>
<td>6000.0</td>
</tr>
</tbody>
</table>

In order to encourage the large scale use of fertilizers and proper doses according to the soil fertility status, the Department of Agriculture, Kota, Rajasthan, has started taking soil samples from all Panchayat Samities of Kota district, so that the cultivators get information about the status of their land and also may know the response of fertilizers in relation to their soils. The Laapura Panchayat Samiti has been covered intensively for such study. It is proposed by the Government to have similar surveys of the land under each Panchayat Samiti at least once every year.

The use of manures and fertilizers is still uncommon in the ravine invested villages as has been observed at
Barhi, Mali, Sagar Pada, and Khatkar. Ignorant farmers of these badly eroded villages of the Lower Chambal Valley even do not know how to conserve manure and how to utilize chemical fertilizers. Besides, State Agriculture Departments have not yet taken concrete steps to popularize the use of chemical fertilizers in these villages. In order to regain the soil fertility of the eroded tracts it is all the more essential to encourage the use of organic and inorganic fertilizers.

IMPROVED CROPS

One of the methods of increasing food production in the Lower Chambal Valley is to introduce improved methods of rice and wheat cultivation and the use of new variety of seeds. After 1960, the Japanese method of paddy cultivation has found some favour in the region. But as the method requires the application of heavy quantities of compost and chemical fertilizers, adequate supply of water, careful selection of seeds and considerable labour in transplanting the seedlings and in the hoeing the field regularly, the area under this method of paddy cultivation in the Valley in 1961-62 was only about 174.0 hectares. It is interesting to note that the Japanese method of rice cultivation is wholly concentrated in Baran and Ladpura tahsils of the Commanded Area.

The 'sanker' jowar and maize have also found some
favour in the Valley particularly in Kota and Bundi districts respectively. The yield per acre of this variety has been reported larger than 'desi' (local) variety. In some villages, as Digod, Sultampur, Ballop and Mangrol, new varieties of wheat have also been introduced by the State Agriculture Departments of Rajasthan. Common varieties of wheat in this part are C 581, NP 718, Malvi, Kalyansona and C 236. A few advanced cultivators have started growing these new varieties. The results have been found encouraging.

It is worthwhile to mention here that in some villages of the Commanded Area as Digod and Mangrol, the author has found that in heavy soils the yield per acre has gone down due to the increasing wetness in the soil and of salinity. In spite of this, it is surprising why Kota district has been taken as an area of intensive jowar cultivation in the Valley by the State Agriculture Department, Kota.

In the ravine infested villages of the Valley the new varieties of wheat, hybride, maize, and jowar have not yet come into the general use. In some villages (as Malkpura, Morena district) where soil conservation work has been completed new varieties of hybrid jowar have been introduced. But due to low fertility, lack of organic and inorganic fertilizers and meagre water supply, the results of these varieties are not satisfactory.

**Research Programmes and Demonstration**

In the recent years in order to get an answer to all
the needs due to change from dry to wet cultivation in the Commanded Area, research farms and demonstration centres have been established. The following research farms are significant which are being studied for the problem of irrigation agriculture:

<table>
<thead>
<tr>
<th>District</th>
<th>Farm</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Kota</td>
<td>Seed multiplication farms</td>
<td></td>
</tr>
<tr>
<td>Kota</td>
<td>Seed multiplication farms</td>
<td></td>
</tr>
<tr>
<td>Badi</td>
<td>Research farms</td>
<td></td>
</tr>
<tr>
<td>Kota</td>
<td>Research farms</td>
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</tr>
<tr>
<td>Kota</td>
<td>Research farms</td>
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<td>Kota</td>
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<tr>
<td>Kota</td>
<td>Research farms</td>
<td></td>
</tr>
<tr>
<td>Kota</td>
<td>Research farms</td>
<td></td>
</tr>
</tbody>
</table>

On these farms are all types of problems related to irrigation are being undertaken. These include:

1. Selection of new variety of paddy, wheat, ground nut, sugar-cane etc.

2. Working out water requirements of important crops and the study of different methods of irrigation.

3. Working out cultural methods like time of sowing, seed rates, spacing, and optimum doses of fertilizers for all the important crops.

4. Study of different types of crop rotation with 100% to 300% intensity.

5. Study of change in physical and chemical nature of soils as affected by different methods of irrigation and crop pattern.
6 Study of diseases and pests for the newly introduced crops, and,
7 Study of seepage losses along the Chambal Canal system.

The author's personal investigations at Sultanganj, Bhopal, Chatarpur, and Bangrol farms reveal that very useful and interesting results from the researches on these farms have been obtained regarding utilization of canal water for wheat, gram and linseed. These results are being gained wide publicity amongst the farmers of the valley. Moreover, to make the farmers familiar with the improved practices at the earliest, it is essential that simple demonstration trials regarding improved varieties, fertilizers, methods and rate of water application should be done on cultivators' fields on a large scale. This will not only educate peasants but will confirm the results obtained on government farms.

SOIL CONSERVATION WORK

Soil conservation work in the Lower Chambal Valley has recently been started with the mutual cooperation and collaboration of the forest and agriculture departments. It is at present confined to the physical survey of ravine lands and afforestation of a very few of the easily accessible ravines and gullies near Kota, Bawaria, Bhojpur and Naikpur.
Government efforts

Keeping in view the devastation of land by ravine

Prior to 1956, the importance of the ravine problem was only realized by the Government of Madhya Pradesh. In the year 1919, Gwalior state, realized the problem and had appointed a committee under the Chairmanship of S.R. Swarn. The recommendations of the committee were follows:

1. 1,98,000 acres of the ravine area should be considered as reserved forest.
2. Out of the area referred 40,000 acres in Bhind and Ambah tahsils' to be put under regular afforestation.
3. The remaining area of 63,943 hectares or 1,56,000 acres to be closed against cattle grazing, and removal of forest vegetation thereon.

For actual reclamation work of ravine lands, the committee suggested that no land revenue was to be charged for a period 15 to 20 years from the farmers who raised protective bunds. As a result of this nearly 10,000 acres of the ravine lands were reclaimed in Madhya Pradesh (in the Valley).

Later on in 1941-22 Kota state government realized the problem of ravine extension near Berua village on the bank of the Kali-Sindh. By the efforts of the government some earthen bunds had been constructed along the periphery of the ravines. These bunds have been proved very helpful in stabilizing the ravine heads.

In the year 1945, Dr. Schubert, an American expert on soil conservation was invited by the Government of India. He visited the ravine affected areas of the Chambal and made the following suggestions to protect the land and prevent further losses:

1. Contour bunding, starting from the ridges
2. Control grazing, and,
3. Afforestation.

Again in 1948, the Government of Madhya Pradesh, Agricultural Department, invited Major Bensur, Mechanical Engineer, and then Dr. J.I. Basu, the soil physicist of the Government of Bombay. Their recommendations were as follows:

continued
erosion, an ad hoc conference of state ministers in charge was held in April 1956 at New Delhi and the problem of survey and reclamation of ravines was discussed. The conference fully appreciated the seriousness of the problem and stressed the desirability of taking adequate effective measures for ravine reclamation.

maha committee

In the year 1956, the Government of India with the request of Madya Pradesh Government appointed a committee under the Chairmanship of Shri Ahuja, Director of Hydrology and Statistics of Central Water and Power Commission, to go further into the problem of ravine reclamation. The committee estimated the area under ravine lands as 2.43 lakh hectares (6 lakh acres) in Morena, Shind, and Jwalior districts of Madya Pradesh.

1. Reclamation should be restricted only to the low basins of the ravines which were sufficiently wide for reclamation of sizable plots for cultivation.
2. The existing 4.6 to 6.1 metres (15' to 20') wide ravines should be used for diverting rain water for the protection of reclaimed areas.
3. Top cultivated areas should be protected against further soil erosion, and,
4. The lower reclaimed basins should be given adequate protection against soil erosion.

maha reclamation scheme: A splendid programme to assess the spread of the Chambal ravine and to reclaim them by afforestation and other measures was established by the Uttar Pradesh Government under the Maha reclamation scheme in 1952. As a result of this the Odi (Uttar Pradesh) the planting work has been done. Julliflora and sisam are the main species which have been introduced here.
In the long term plan, the committee recommended that there should be detailed survey in order to prepare realistic plans and specific schemes. It was also suggested that on the basis of survey, the entire ravine area should be classified into lightly eroded area and intensely eroded area and then on this basis priorities of work should be fixed.

As a result of this enquiry, the Government of India has sanctioned a scheme for survey of ravine lands to estimate the extent of ravines in Madhya Pradesh. The State Agricultural Department took up with an annual target of 486 hectares (12,000 acres) in which catchments are being selected at the interval of each 80 kilometres (50 miles) of river length on the right bank of the Chambal. Naikpura block has been surveyed and also reclaimed by the Central Tractor Organisation. Barhi village block has also been undertaken for survey and reclamation works.

Kakkar committee

In the year 1960, the Government of Rajasthan appointed a committee popularly known as Kakkar committee to submit a detailed scheme for reclamation of ravine lands along the Chambal banks. The committee in its report made the following recommendations:

1. The committee estimated that about 2.8 to 3.2 lakh hectares of cultivable lands are affected by the
ravines in the state. Out of which about 1.6 lakh hectares are found along the Chambal and its major tributaries.

2 The committee further suggested that as a first step the table-lands which mostly constitute the cultivated area should be treated with soil conservation measures. Moreover, the committee recommended that along with the Chambal, its tributaries should also be taken into consideration.

3 Marginal areas which are not fit for cultivation should be brought under pasture and afforestation. In the opinion of the committee, it will be economical in any case to reclaim ravines for agricultural purposes alone.

The recommendations of the committee were forwarded to the Government of India for acceptance as a centrally sponsored scheme. The Government of India, however, agreed only to the survey part of the scheme and allotted a sum of Rs. 20,000 for 1961-62 and an equal amount of work during 1962-63.

The Forest Department, Rajasthan took up the scheme at the fag of the first year of the IIIrd Five Year Plan i.e. March, 1962 to assess the magnitude of the problem and to provide basic data for planning future programme for ravine reclamation. The actual work on ravine survey was taken up after September, 1962.

During 1962-66, 63,116.766 hectares of ravine lands have been surveyed in the following districts on various
river systems of Rajasthan along the Chambal.

Table A7

<table>
<thead>
<tr>
<th>Districts</th>
<th>Area in hectares</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kota</td>
<td>32,864.550</td>
</tr>
<tr>
<td>Bundi</td>
<td>9,501.324</td>
</tr>
<tr>
<td>Sawai Madhopur</td>
<td>12,450.974</td>
</tr>
<tr>
<td>Bharatpur</td>
<td>9,699.918</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63,116.766</strong></td>
</tr>
</tbody>
</table>

Soil conservation and research centre, Kota

The Chambal ravines do not seem to have attracted the attention of the State or the Central Government until the end of 1954 when realising the importance of such a magnitude and national importance, the Government of India, Ministry of Food and Agriculture, stabilized a Soil Conservation and Research Centre at Kota, on the bank of one of the tributary of the Chambal and to evolve suitable soil conservation techniques for the same. The farm of this centre consists of an area of 56 hectares comprising of 20 hectares of cultivate and 28 hectares of ravine lands.

The work on ravine control was started in 1956. A marginal bund was constructed along the periphery of ravines to control the runoff from the tablelands and agricultural fields passing over the ravine heads. Along with this, farm area was surveyed and classified into
different land use capability classes (Sehha, 56).

Due to the above measures, within two years the entire area was covered by thick natural vegetation consisting of Acacia arabica, Prosopsis juliflora, Balanites robusi, and Cenchrus setigerus etc. In the bottom of the barren ravines, brush wood and bolder check dams were put which functioned well in reducing the flow of the water. The vertical sides of the ravines in this centre were stabilized by providing vegetative cover. Ipomea Carnea has proved to be very effective on the toe of the side walls.

Experts, who are working, on the Centre (Mishra, Rajbans, and Varma) have suggested to introduce Malopobia integrifolia (80% survival), Vangamia glabra (75% survival), Glyricida maculata (65% survival), Albizia leble (80%) and Azadirchta indica as a useful economic forest species in the ravine lands. In 1957 bamboo was introduced in the graded ravine bottom, one year old seedling were planted in 1½' x 1½' x 1½' pit dug at the bottom of ravine and have given 73% survival.

In 1962 experiment trials to introduced hybrid eucalyptus species and teak have been started on the marginal and ravine lands. Survival percentage has been good and the results were quite encouraging.

Experiments on soil and water loss studies under different vegetative covers on 0.5% and 1.0% slope have
been made by Ramesh Singh, Rajbans and Omola (1968) at Kota. Among the various kinds of vegetative covers on which the authors tried were - natural cover, cultivated fallow, Cynodon dactylon, ground nut, black gram and jowar. Natural cover and Cynodon dactylon gave minimum soil and water loss; black gram and ground nut gave intermediate loss; while maximum soil loss was recorded in jowar and cultivated fallow plots. Among the cultivated crops ground nut gave the minimum soil and water loss and thus this was recommended for the introduction into the cropping pattern so as to reduce the erosion losses.

The recommendations of the Soil Conservation and Research Centre, Kota were as follows:-

1. Because of the heavy cost of ravine reclamation, the existing valuable and productive agricultural lands, that stand at the threat to be engulfed by the ravines, deserve to be protected. Ravine extension control, therefore, deserves priority. A peripheral bund all along the periphery of the ravines has been found to be most effective in checking the extension of ravines.

2. For the safe disposal arrangements of water from the agricultural lands, suitable structure should be provided.

3. Ravines up to 3 metres deep can be reclaimed for agricultural use with the help of bullock driven implements and manual labour in some of the villages of the Chambal Command where irrigation facilities are easily available.

4. Green manuring should be done in the reclaimed area.
for about three years for improving the physical conditions and for restoring the soil fertility.

5 Provision for assured irrigation facilities, and government subsidy to provide incentive to the villagers will go a long way in solving the problem of reclamation.

6 Deep ravines by heavy earth moving machinery can be reclaimed profitably around Kota for housing purposes where the price of land per hectare is much more than the cost of reclamation involved. These reclaimed lands will also meet the growing demand of the increased population of Kota by providing vegetables and fruits, specially when irrigation facilities are available.

7 Soil conservation works should be concentrated on the catchment of the ravine area on the priority basis.

8 Deep ravines and other degraded ravines where the 'murrama' layer (banker layer) has been exposed, should be brought under forests.

9 Bamboo has been found to one of the most common species for afforestation in the ravine areas which can give commensurate return within the shortest possible span of time.

10 Among other species which have been found doing well are babul, sissoo, neem and siris, khair, holleptelia integrefolia, simul, prospis juliflora etc.

11 Cenchrus ciliaris, dichanthium amalatum are the grass species which have been found doing well.

12 No reclamation should be allowed up to the width equal
to the double the depth of the ravines.

13. Over grazing has been found to be detrimental and as such only grass-cutting should be allowed in the afforested area.

14. Ground nut has been found to the most suitable for minimum loss of soil and water and recommended for cultivations.

As a result of recommendations of the Soil Conservation and Demonstration Training Centre, gully and ravine reclamation works in a number of villages of Ratan, Ambi, Nigod, Ladpur and Pipalda have been completed. The soil conservation work at present is confined to those gullies and ravines which are up to 5 metres depth. Contour bunding, levelling and graded contouring are most commonly used method of reclamation in the Valley.

The author’s field study reveals that out of the ten sample villages, the physical survey in seven villages (Jabalpur, Babas, Jhatoli, Pipalda, Basai Neem, Khata and Naikpura) has been completed. The physical survey includes the estimation of total ravine land in a village, classification of ravines into G 1, G 2 and G 3, collection of data on soil, slope and hydrological features. In Naikpura village, the reclamation work had been completed in 1955 by the Central Tractor organization. Out of the remaining three villages, two villages (Khata and Sarhi) have been covered by soil conservation works like contour bunding and levelling by the State Agriculture Department, Ambi, and Chini. In the remaining village (Sager Pada)
no attention has yet been given by the government. In this village due to ravine formation the agricultural land has gone out of cultivation. As a matter of fact, the economy of the cultivators is now mainly dependent on shoe making industry. Their products have market in near by Sholapur town.

Cost of reclamation: The experience of the soil conservation works at many places in the valley have revealed that ravine and gully reclamation is a costly affair. The Rajasthan soil and agriculture departments estimated the cost of reclamation as Rs. 445 per hectares for the ravine lands, Rs. 371 for the marginal lands and Rs. 111 for the tablands in the Valley.

The agriculture department of Uttar Pradesh has estimated the cost according to the depth of ravines. The minimum cost comes out to be Rs. 610 per hectare for per metre depth of ravine.

A pilot project of ravine reclamation has been completed at Bajlpura in 1955, District Morena, Madhya Pradesh under the Central Tractor Organisation (C.T.O.). In this work bulldozing was done by Central Tractor Organisation and the check dams were provided by the state government. The expenditure incurred under this scheme was as high as Rs. 2, 220 per hectare or 850 per acre.

The state agriculture and forest departments of Madhya
Pradesh and Rajasthan have undertaken surveys, classification and reclamation of ravine lands in the various parts of the valley. The Soil Conservation Department of Jumla (Rajasthan) intends to complete reclamation work of a village per year.

WATER RESOURCE DEVELOPMENT

As has been mentioned in the chapter of the fluvial morphology that the Chambal is a perennial river and the possibility of harnessing the water resource is sufficiently good. Because of this considerable work on the water resource development has taken place in the valley since after 1947.

National development plan and water resources

The importance of the development of water resources of the Valley has been appreciated by the Government of Rajasthan and Madhya Pradesh, and in the first five year plan (1951-56) priority was given to the agriculture and water resources development particularly for irrigation and water supply. During the first five year plan new major and minor projects were started and old dams were repaired. The Chambal project which was taken during the first plan is an inter-state project of Rajasthan and Madhya Pradesh. From the viewpoint of irrigation it has
THE LOWER CHAMBAL VALLEY: IRRIGATION

Fig. 33

Fig. 34

PERCENTAGE TO NET SOWN AREA

- 10 - 40
- 20 - 30
- 10 - 20
- 5 - 10
- BELOW 5
great significance and how it irrigates about 1 lakh hectares of agricultural land in an out side of the Lower Chambal Valley.

The Chambal project: The idea of harnessing the Chambal came into the mind of Mahrao Barel Singh of Kota state some forty years ago. Twenty years later, the Government of India got interested in the exploitation of zinc and lead mines of Zawar in Udaipur. The main difficulty in doing so was non-availability of power to work the mines. The Government of India prepared a scheme and completed a preliminary survey to construct a power house on the Chambal to meet the demand of power for the exploitation of these minerals. In June 1948, the Government of Rajasthan and Madhya Bharat agreed to harness the Chambal both for irrigation and power generation. The Chambal valley development project report was prepared firstly by the Government of two states and was submitted to the Government of India in 1953 for approval. The scheme later on under went subsequent modification and finally, the scheme of construction of four dams on the Chambal was approved. Out of these dams, three dams are for water power generation and one for taking out canal (Fig.33).

The fourth dam Kota barrage which is important from the point of view of agriculture, needs description. It is located just up stream of Kota city near Garh Palace. At this place the river scoops out of the gorge. The Kota barrage consists of an earth dam across the river with a spillway on the
left bank. The work on this project started in the last week of December 1955 and ended in 1961 consequently the work on the canals and the distribution channels was also completed in 1960.

**Shimlat Project:** Another project of irrigation is the Shimlat project construction of a dam of 15 metres high across the river Kangali in Mandi tahsil was started in the first five year plan (1953-54) and is now complete. The canal system has also been completed and it consists of 5 kilometres of main canal and 8 kilometres of minor canals. It is estimated that the final irrigation capacity will be 1240.00 hectares (3,100 acres) of land; in 1959-60 the area irrigated amounted to 360.0 hectares (95 acres).

**Source of irrigation:** The main sources of irrigation in the Valley are canals, wells and tanks. The percentage of irrigated area to total irrigated area by different sources is given in the appendix table.

Amongst the various sources of irrigation the canals accounts for the largest area under command. While wells occupy second place to the canals.

**Canals:** Canals are the main source of irrigation in the Valley. Following are the main tahsils which come wholly or partially under the commanded area of the Chambal.
<table>
<thead>
<tr>
<th>5. Tehsils</th>
<th>Canal system (Chambal)</th>
<th>1956-57</th>
<th>Percentage to canal irrigated area to total irrigated area</th>
<th>1966-67</th>
<th>Total canal irrigated area in hectares</th>
<th>Percent of canal irrigated area to total irrigated area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Lodhra</td>
<td>Wholly</td>
<td>13842.8</td>
<td>12202.4</td>
<td>88.58</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Digod</td>
<td>Wholly</td>
<td>16243.2</td>
<td>17993.6</td>
<td>98.63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Ripalsa</td>
<td>Wholly</td>
<td>14568.8</td>
<td>14324.0</td>
<td>98.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Mangrol</td>
<td>Wholly</td>
<td>12350.8</td>
<td>12119.6</td>
<td>98.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Antah</td>
<td>Wholly</td>
<td>6116.8</td>
<td>5386.0</td>
<td>88.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Jitra</td>
<td>Partially</td>
<td>25.40</td>
<td>3465.6</td>
<td>74.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Jangod</td>
<td>Partially</td>
<td>3546.0</td>
<td>1988.0</td>
<td>56.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Sandi</td>
<td>Partially</td>
<td>23946.4</td>
<td>10940.0</td>
<td>73.82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Fatna</td>
<td>Partially</td>
<td>15420.8</td>
<td>15052.8</td>
<td>97.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The table AVI indicates that within the last decade the percentage of canal irrigated area to total irrigated area has increased tremendously in the south western tahsils of the Valley.

The north eastern tahsils of the ravine and hilly sections are insignificant from the point of view of the canal irrigation. This is chiefly because of the complicated relief features for constructing canals and limited agricultural land.

Canal irrigation and agricultural development

As has been emphasized in the preceding chapter that after the introduction of canal irrigation the agriculture is making shift from dry farming towards irrigated farming. Due to the expansion of canal irrigation facilities the following changes in the agricultural pattern have been noticed in the Lower Chambal Valley.

1 The significant change that has been noticed in the Chambal Commanded Area is the increase in the double-cropped area. The tahsilwise statistics of double-cropped area reveal that in Digod, Pipalda, Sangod, Mundi, Patan, Antah, Atru and Mangrol tahsils there has been a marked increase in double-cropped area. This increase is due to three factors: availability of water for irrigation, use of manures and the nature of crops. In these tahsils there has been an overall progress as regards irrigation facilities,
therefore, the double cropping has become a common practice in this compact block.

The village-wise statistics also indicate the expansion of double cropped area after the provision of canal water. In Sultanpur, Digod and Sallap villages both net sown area and double cropped area have shown an increasing trend. In Sallap village the double cropped area in 1956-57 was only 4.8 hectares while after the introduction of the canal irrigation in 1966-67 it increased to 32.6 hectares. Similarly in Digod village the area under double cropping in 1956-57 was 81.6 hectares but in 1966-67 it increased to 123.6 hectares. All these facts make it evident that in the canal irrigated parts of the valley there has been an overall increase in the double cropped area.

2 After the introduction of canal irrigation new crops like paddy, sugarcane, cotton, hybrid maize, jowar and fodder crops have been introduced in some villages of the Commanded area. Although the change in the cropping pattern is very slow but it is hoped that as a result of extensive efforts of the Agriculture department, these new crops shall gradually replace the old crops in the canal irrigated tracts. It is also expected that this change will accentuate to use the canal water properly.

3 Per acre yield of wheat, hybrid maize and jowar has also increased with the expansion of irrigation facilities. The field study at Sallap reveals that per acre yield of wheat in 1956-57 was about 5 to 10 mounds while it increased
to 15 mounds in 1966-67. Similarly in Digod village the
per acre yield of gram was 7 to 10 mounds in 1955-56 but
in 1966-67 it increased to 10 to 12 mounds. The increase
in yield per acre is due to the expansion of irrigation
facilities, use of fertilizers and introduction of new
varieties of wheat, hybride, maize and jowar. The yield
per acre in most of the villages has increased but where
the problem of water-loggings has emerged, there has been
a decrease in per acre yield of wheat, jowar, maize, and
gram. The author could observe this trend at Ballop, Digod
and Sultanpur villages during his field study.

4 After the introduction of the Chambal canal system
there has been a change in the attitude of farmers or the
ravine lands. It has been observed that in the Chambal
Commanded area or the valley, the value of land is increasing
rapidly. The farmers are awaking to a new consciousness.
Their tie with land is becoming stronger with the increase
in yield. Canals running quite close tempted them to make
their ravine infested land level and to utilize canal water
for increasing production.

Introduction of canal in some of the villages of the
Chambal Command is working like a motivating force that
is slowly but steadily breaking down the age old indifferent
attitude of the farmers to ravine problem and leading them
towards adoption of ravine control measures without persuasion.

The above indication is perceptible in Abatgar, Sultanpur,
and in those villages which are near to Kota city and where irrigation water is available. This change provides a new avenue for tackling the ravine problem.

**Problem of water-logging**

Water-logging is the main problem of irrigation and agriculture. In the canal irrigated parts of the valley the problem of water logging has emerged soon after the introduction of canals. Nearly 13.3% of the total canal irrigated land is affected by this problem. The map (Fig.40) indicates that water-logged areas are found along the irrigation branches, channel and distributaries in the tahsils of Mangrol, Digod, Ladpura, Bundi and Patan.

During the field investigation the author could notice that this problem is most critical around Mangrol, Digod and Sultanpur. In these parts the soil is heavy clays and the permeability is very slow in the subsurface. Around Ballop village due to this phenomena some pieces of good quality land have converted into medium quality. Same is the case around Digod (Sharma, N.S. 1968)

The study shows that water-logging in these villages creates unfavourable conditions for crop growth by affecting root development adversely. As a result crop yields have come down and due to wetness in the fields even cultivation has become difficult. Besides, evaporation as a de-watering agency brings salts from subsurface to surface which leads
to the development of salinity and alkalinity in varying degree around nagroli, bhop and sultanpur. Reclamation of saline soil development at an alarming rate is another threatening problem that has emerged with waterlogging.

Wells and tanks

Wells have been found most reliable source of irrigation and occupy second position in terms of irrigated land. Prior to 1956 wells were the main source of irrigation. After canal irrigation their position have become insignificant but still in ravine lands and hilly tracts, well forms a main source of irrigation as indicated from the table below:

Table VII

<table>
<thead>
<tr>
<th>S.No. Talsils</th>
<th>Percentage of well irrigated area to total irrigated area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1956-57</td>
</tr>
<tr>
<td>1 sonpur</td>
<td>86.67</td>
</tr>
<tr>
<td>2 bari</td>
<td>57.53</td>
</tr>
<tr>
<td>3 baseri</td>
<td>97.38</td>
</tr>
<tr>
<td>4 rajkhera</td>
<td>99.05</td>
</tr>
<tr>
<td>5 sawai bhadur</td>
<td>94.45</td>
</tr>
<tr>
<td>6 sapota</td>
<td>66.13</td>
</tr>
<tr>
<td>7 khandar</td>
<td>38.61</td>
</tr>
<tr>
<td>8 sheopur</td>
<td></td>
</tr>
<tr>
<td>9 vijaipur</td>
<td></td>
</tr>
</tbody>
</table>
The table A/II indicates that Bholpur, Sari, Jasari, Sawai Madhopur, Rajeshwar, Saputra, and Khandar tahsils are significant as regards well irrigation. In these tahsils wells form more than 60% of the total irrigated area except Saputra and Jasari. In Sawai Madhopur and Khandar tahsils percentage of well irrigated area to total irrigated area is even above 90.

The table also indicates that within the last decade (1956-57 to 1966-67) there has been a marked decrease in the percentage of well irrigated area to total irrigated area except Khandar and Sari tahsils. Due to this declining trend in the irrigated area, the tahsils of the ravine and hilly tracts are lagging behind in the march of agricultural development.

Water from the wells in the region is lifted in either of the following two ways: (1) the first is by means of Persian wheel (naurat). It is used where water level is high; (2) the second is by means of buckets known as 'Charas' which are either made up of leather or iron. It is used where water table is low.

Total area irrigated

A detailed study of the irrigation intensity map (Fig. 34) of the Lower Chambal valley reveals that (1) the highest percentage of area under irrigation by all sources is concentrated in the area between the north western
Vindhyan hills and the Harbatı river, (2) percentage is highest in those tahsils where the preponderance of canals exist, (3) the areas growing wheat, jowar, wheat, maize cover highest percentage under irrigation, (4) areas which are either hilly or ravine infested have lowest area under irrigation.

The total irrigated area in the Lower Chambal has increased in all the tahsils (Appendix table VIII). The expansion is conspicuous in the tahsils of the Chambal Commanded area. It is because of the provision on expansion of canals. On the contrary, there has been a little progress as regards irrigated area in the hilly and ravine infested tahsils of north west and north east. The table VIII shows the expansion of total irrigated area in the tahsils of the Commanded area.

Table VIII

<table>
<thead>
<tr>
<th>Tahsil</th>
<th>1956-57</th>
<th>1966-67</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2332.0</td>
<td>13842.0</td>
</tr>
<tr>
<td>2</td>
<td>547.6</td>
<td>16245.2</td>
</tr>
<tr>
<td>3</td>
<td>233.2</td>
<td>14566.0</td>
</tr>
<tr>
<td>4</td>
<td>1457.6</td>
<td>12350.6</td>
</tr>
<tr>
<td>5</td>
<td>867.2</td>
<td>6116.3</td>
</tr>
<tr>
<td>6</td>
<td>1995.2</td>
<td>3485.0</td>
</tr>
<tr>
<td>7</td>
<td>2003.0</td>
<td>3546.9</td>
</tr>
<tr>
<td>8</td>
<td>6553.2</td>
<td>22344.4</td>
</tr>
<tr>
<td>9</td>
<td>410.8</td>
<td>15420.8</td>
</tr>
</tbody>
</table>
Other projects

Apart from the projects described above, the Irrigation Department of Rajasthan has undertaken surveys for the following river projects in the Valley.

1 Garda - Bundi tahsil
2 Harihur - Bundi tahsil
3 Bankia - Khurd - Bundi tahsil

Ground water

Very little work has been done on the availability and use of ground water in the Lower Chambal Valley. However, the Under Ground Water Department is considering the possibility of investigation and use of ground water in those parts of the area where there is a scarcity of canal water and surface water.

The investigation pertaining to the water table in the Valley indicates that the ground water level fluctuates with the rhythm of rainfall. It also depends on the local lithological condition, porosity of subsoils. The water table in the plain areas varies from 9 metres to more than 30 metres. The water level near dams and canals is usually high. While in the ravine infested regions of Dholpur, Bhind, Morena and Bah tahsils it seldom occurs below 30 metres. The low water table to a great extent retards irrigation development. As a matter of fact, the wells are few and far between.

In the hilly sections of the Valley too, the wells
are few because of the stony nature of the terrain. So in these tracts underground water resources should be developed along the piedmont zones, where the possibility of sub-surface water is immense. Investigations in this direction are needed.

**Literature cited in the text**


4. Gurmal Singh, Rajbans and Bhola (1967): Soil and water loss studies under different vegetative cover on 0.5% and 1.0% slopes with reference to Chambal Commanded Area Rajasthan. *Paper presented in the Seminar on Soil Conservation in India, New Delhi.*


7 Study on Survey and Reclamation of Ravines in India, Report Planning Commission, Government India, New Delhi.
