PARMARTH, JALAUN **BRITISH HIGH COMMISSION**

COMMUNITY EMPOWERMENT FOR SUSTAINED LIVELIHOOD

STUDY ON TRADITIONAL WATER RESOURCES

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TABLE OF CONTENTS

TABLES

ANNEXURES

1.0 Executive Summary

Jalaun district is one of the resource poor districts of Uttar Pradesh. It is part of Bundelkhand belt, which is water deficient over the centuries. Traditionally the district is meeting its water requirement from Ponds, and Open wells but the over the recent years it has seen rapid shift towards tube wells-either for drinking or for domestic use. The past couple of decades have also witnessed sharp decline in the ground water table ranging from 7-10 meters.

In order to get better feeling about the issue a study has been conducted to know the status of traditional Water Resources; find out the causes for deterioration of traditional water resources and to identify the gap between water requirement and water available. The study has been conducted by collecting the direct field data, interaction with the farmers of 50 villages from 5 blocks. The data has been field collected using questionnaire method and by using focused group discussions. The field situation reveals that on the one hand rainfall has gone down by 213 mm. over the past decade, on the other hand number of rainy days have also gone down. Despite this drop the gap in the demand-supply of the water requirement can easily be met by harvesting 2-3% of the rainfall.

The study reveals that the number of tube well increase is faster than the increase in the number of open wells. Also the use of ponds has gone down very sharply. The maintenance of these structures is also on decline. While climatic change is one of the reasons for this decline but the major cause is changes in the agriculture practices- with a trend towards crops with more water requirements, change in the tillage practices and changes in the fertilizer consumptions. Government policies toward providing subsidies for installing handpumps and exploiting ground water had added fuel to the fire. Besides this, changes in the habitat pattern have also impacted adversely on the use of traditional water bodies.

The study finally recommends – low cost rain water harvesting practices, use of furrow openers, contour farming, awareness generation on the conservation of water resources, carrying out demonstrations for water harvesting, developing model villages on the concept of water harvesting, developing farmers as the master trainers, and finally sound intervention by the government for promoting these.

2.0 Introduction

Air, water and land are the basic necessity for life, without these three necessities no one can even thinks for life on earth. Nature has provided these necessities to human kind free of cost. Increasing demand of human population leads to over exploitation of these natural resources which results in to deterioration of these natural resources. Over exploitation of natural resources has disturbed the natural balance of environment. Imbalance in these natural resources lead towards different problems like desertification of soil, reduction of ground water, deterioration of traditional water resources, uneven distribution of rains, raise in temperature and low crop productivities, and many more problems.

Water is life, it is universally accepted truth. Rainfall is the only available source of water for meeting requirement of human, animal, industry, agriculture, and forest trees. Researches show that the rainfall amount has significantly decreased in last 15 year. It is also clear from research findings that number of rainy days have significantly gone down whereas rainfall intensity has increased in last ten year. All these

factors lead to higher runoff losses. As the amount of runoff increased, amount of effective rainfall has reduced whereas the demand for drinking water, irrigation water, and water for other purposes has tremendously increased. With the increasing demand for water, people have installed numbers of tube wells and hand pumps in last ten to twenty years. Increase in number of tube well and hand pumps have drastically increased pumping of limited available ground water resources. If this trend will continue for next decades, the available ground water resource will exhaust and people will strive for water. It is therefore urgent need for the region to do effort for recharging of ground water and conservation of traditional water bodies. These traditional water bodies may play a major role in maintaining balance between exploitation and recharge of ground water.

Further, the population of India has crossed one billion in the year of 2000. Increasing demand of population has put tremendous pressure on its natural resources. Farmers have started applying more and more chemical fertilizer to their agricultural land. Additional application of chemical fertilizers have indeed improved crop yield, but it has also deteriorated soil heath. Due to poor soil health crop productivity has almost stagnated. Now a days, farmers are not getting as much benefit even by applying higher doses of fertilizer as they were getting 10 years back. This is serious concern for the society.

Jalaun is a district of Uttar Pradesh. Its geographical are is 4590.50 KM^2 and more than 14.5 lakh persons are living in this district. This population is increasing with a decadal rate of 23.4 percent. The increasing population has imparted tremendous pressure on natural resources for meeting the increasing demands. The increasing demand leads to overexploitation of natural resources, which in turn has resulted in the deterioration of natural resources.

Considering annual rainfall of 800-900 mm, **Jalaun is receiving around 2706438 Lakh liters of water every year**. In sixties, major amount of water received trough rainfall was collected in traditional water bodies like pond, kundi, open wells etc. The water stored in traditional water bodies was utilized for meeting their daily requirements. But with the advancement of technologies people's dependence on ground water has increased tremendously. Different ways for exploitation of ground water have been invented. These inventions made water exploitation much easier and cheaper than the traditional system of water exploitation. This has reduced people's dependence on traditional water bodies. Gradually, people have almost stopped utilizing water from these traditional water bodies. It has made negative impact on these traditional water bodies and lead their deterioration. Presently most of these traditional water bodies are in very poor condition and even some of them have disappeared.

3.0 Need of the study

The district Jalaun is having plenty of natural resources. Non-judicial use of these natural resources in past two decades has lead to the deterioration of these natural resources. Numbers of other factors have also contributed for the deterioration of natural resources of the district. Before formulation of any management practices for improving these natural resources, it is essential to know the causes behind the deterioration of natural resources. It will help in designing effective natural resources management strategy. Agro-climatic changes and ground water depletion warrants to address these issues and hence this study has been conducted to build deeper understanding.

3.1 Agro-climatic change

The nature has an automated mechanism to maintain balance between different components of environment. But increasing pressure on natural resources has disturbed the existing mechanism of nature to maintain environmental balance. This lead to negative impact on agro-climatic conditions of the region. In last two decades, the amount of total rain fall is decreasing at a significant rate. A study was conducted at the Indian Grassland and Fodder Research Institute on rainfall pattern of *Bundel Khand* region. The results of study reveals that amount of annual rainfall have decreased by 213 mm in last 15 years, as compared to rainfall in sixties and seventies. The study also reveals that the number of rainy days has significantly reduced and most of the rainfall in the district occurs within 35 to 40 days period. Intensive rain within a limited number of days increases run off percentage and it also promote process of soil erosion. These adverse agro-climatic changes in past years forced us to think seriously and try to find out causes for these adverse changes in agro-climate conditions of *Bundel Khand* region.

3.2 Ground water status

The ground water table of Uttar Pradesh is declining with an alarming rate. In some of the development blocks water table has gone down by 7-10 meters in last ten year. The average annual ground water fall is around 56 cm.

4.0 Purpose and Objectives of the study

The purpose of this study is to collect valuable information on existing traditional water resource structures, its condition and possible ways to bring improvement in these water resource bodies. The findings of this study will be presented to diverse stakeholders for awareness generation. It is expected that the experience sharing will lead to enhanced action towards saving traditional water resources and harnessing its benefits. The specific objectives of the study are as under:

1. To know the status of traditional Water Resources;
2. To find out the causes for deterioration of traditional water resources;
3. To identify the gap between water requirement and water available.

5.0 Area covered

This study has been conducted in Jalaun district of *Bundel Khand* region of Uttar Pradesh.

The study covers both rural as well as urban areas of the district. It is a given fact that most of traditional water resource structures are situated in the rural areas. In urban areas these structures have been exploited for the sake of land, for construction of buildings. Further, in the rural area rainwater intercepts more area for infiltration, whereas in urban areas most of the land is covered by the concrete structures due to which the ground water recharge is also more in the rural areas compared to the urban area. Besides this, the ground water exploitation again is higher in urban areas as compared to rural areas. Thus the water balance is more stressed in the urban areas.

6.0 Sampling

In first stage of sampling, out of nine development blocks five demonstration blocks were selected randomly. Due care was taken to get representative sample for ravine affected area and flat land, where any soil conservation project have been implemented.

Second stage of sampling was done for the selection of villages. Total 50 Villages have been identified from 5 blocks, viz.– Rampur, Madhogarh, Kuthund, Kadaura and Mahewa. All the villages have been selected randomly.

The list of villages selected for study is presented in following table:

Table 1: List of villages covered in the study

Development Blocks				
Rampur	**Madhoghar**	**Kuthund**	**Kadaura**	**Mahewa**
Hanmantpura	Sarr	Bhoja Pur	Chamari	Geeta mau
Rampura	Supanaanaicha	Lar pur mustkil	Jholupur	Damras
Gurha	Gopal pura	Baghuli mustkil	Guru Ka etaura	Palsarini
Mirzapura	Bhimnagar	Masgoun Mustkil	Dhoona	Atra Khurd
Kanjhari	Sorawali	Bichwaha	Bara	Sarsai
Dhuta	Dharmpura	Naurajpur	Sunahta	Satraju
Kanharpura	Ektaura	Harshighpur	Basreri	Binaura
Bhitaura	Rahauli	Rampura Jalaun	Chandarsee	Dahel Khand
	Partula	Jamlapur Junnardar	Sondhi	Kaknaura
		Sirsa Kalar	Bagi	Sekhpur Gurah
		Shabajpur		
		Jugiya Pur		
		Pipri athgainya		

From each village selection of respondent was done randomly.
Among these villages focus group discussions were done in 5 randomly selected villages of each development block. Focus group discussion was done with 20 to 30 farmers of every selected village.

7.0 Methodology

For the study -- survey, focus group discussions and spot checks were done in all the selected villages.

7.1 Questionnaire Designing and its pre-testing

For conducting village survey a questionnaire was used. It was designed to get information on existing water resources of the villages, analyzing gap between demand and supply of water and to know what were the causes for deterioration of traditional water resources. The questions covered - water resources, agriculture and animal husbandry sectors. After two round of field testing of survey formats and discussion with the field staff necessary modifications have been incorporated. The survey questionnaire is attached as **Annex-I.**

A check list was also prepared to collect qualitative information on traditional water resources. A format was also designed for organizing focus group discussion, which was field tested and made necessary correction in it. The final format of FGD was then shared with the field staff of Parmarth. The format for conducting FGD is attached as **Annex-II.**

7.2 Training on Field Data Collection

After finalization of the questionnaire a training of the field staff was organized to develop their deeper understanding of study and survey format. This training was organized at Parmarth's office, in Orai. All the concerned field staff participated in this training. After in house discussion participants have performed field testing, at the near by villages. The completed formats of each field staff were reviewed and feedback was provided.

For focus group discussion on the job guidance was organized. The consultant along with field staff has performed FGD in eight villages, which has developed deeper understanding among the filed staff for each and every question of FGD.

7.3 Data Collection

Two types of data were collected for this study *i.e.* primary data and secondary data. Primary data was collected by the field staff of Parmarth, where as secondary data was collected by the consultant with the help of Parmarth.

The source of primary data was farmers, whereas secondary data was collected from following sources:

- Government Gadget;
- Statistics book of Jalaun;
- Directorate of Agriculture;
- Meteorological Department;
- Internet surfing.

Field survey was conducted in the sampled village. During initial part of the survey the consultant has visited every village to provide technical support to the field staff. After initial three days of survey a review was done for assessing the progress and quality of data collected by staff. This survey was conducted by five persons, for a period of one month. Focus group discussion was conducted by three persons in two weeks time.

8.0 Key Data and its Analysis

Based on the objective of the study, key data of the study can be grouped in to three categories viz. 1 - exiting water resources, 2 - status of water resources and, 3 - demand and supply gap of water resources. Compilation of survey data has been done by Parmarth's staff. The information of focus group discussion was complied and analyzed by Global Ideas (GI). The results of analysis are presented under section result and discussions.

8.1 Existing water resources

In Jalaun district ponds and open wells are the traditional water resources, apart from these traditional water resources tube wells, canals, rivers and hand pumps are other water sources for human kinds. The details of water resources present during 2002-2003 are present in following table:

Table 2: Existing water resources of Jalaun district (as per information of 2002-03)

Development Blocks	Length of Canals (Km.)	Government Tube Wells (Numbers)	Open Wells (Numbers)	*Rahet* (Numbers)	Ground level pump set (Numbers)	Pump set with boring (Numbers)	Privet Tube wells (Numbers)
Rampura	176	26	197	42	208	1114	167
Kuthaund	75	48	191	15	166	1077	146
Madhoghar	78	14	237	301	186	1211	207
Jalaun	303	47	286	139	223	1211	127
Nadigaoun	221	35	280	115	203	1163	110
Konch	184	47	227	78	230	1296	104
Dakor	372	74	276	26	267	1189	84
Mahewa	128	141	261	362	167	989	80
Kadaura	292	76	198	147	222	1053	77
Total Rural	**1829**	**508**	**2153**	**1225**	**1872**	**10303**	**1102**
Total Urban	**87**	**0**	**0**	**0**	**0**	**0**	**0**
Total	**1916**	**508**	**2153**	**1225**	**1872**	**10303**	**1102**

Source: Statistic book of Jalaun published on official website of Jalaun.

8.2 Condition of water resources

The condition of most of the traditional water resources is bad. The existing water resources have divided in to very good, good, average and poor categories based on the following criteria:

- Water Availability of the structures;
- Physical condition of the water resources;
- Maintenance status of water resources;
- Utilization/use of water resources;
- Location of water resources;
- Owner ship of the water resources.

Finding of survey conducted in five villages of Kadaura block, four villages of Mahewa block, two villages of Dakor block, eight villages of Rampura block, twelve villages of Kuthaond block and eight villages of Madhoghar block are presented in following table:

Table 3: Water resource status of sample survey villages of different blocks

Development Blocks	Open well				Tube Wells				Ponds			
	Present Status (nos.)				Present Status (nos.)				Present Status (nos.)			
	Very Good	Good	Average	Poor	Very Good	Good	Average	Poor	Very Good	Good	Average	Poor
Kadaura	6	11	17	14	0	1	4	3	0	0	7	2
Mahewa	13	11	44	18	0	24	10	6	0	0	2	0
Dakor	1	2	3	8	0	2	0	2	0	0	0	1
Rampura	16	24	36	45	12	9	12	5	0	3	0	6
Kuthaound	10	27	59	38	2	14	27	5	0	2	22	15
Madhogarh	11	30	40	22	13	30	14	0	0	0	3	3

Source: Result of survey conducted in selected sample villages of Jalaun district

8.3 Demand and supply gap of water

The water requirement of Jalaun district is little high then the supply of water. With the increasing water demand of different sectors, the gap between supply and demand of water is widening every year. The loss of around sixty percent of total water received is further widening existing gap between demand and supply of water. The existing gap of the district can be easily bridged by harvesting of 2-3 percent of water from total water harvesting potential of the district – **Annexure III**. But if the increasing trend of gap between demand and supply of water continues, for next decades the gap will become so wide that water harvesting of 100 percent of total water harvesting potential of district will not be in position to bridge the gap.

9.0 Results and Discussions

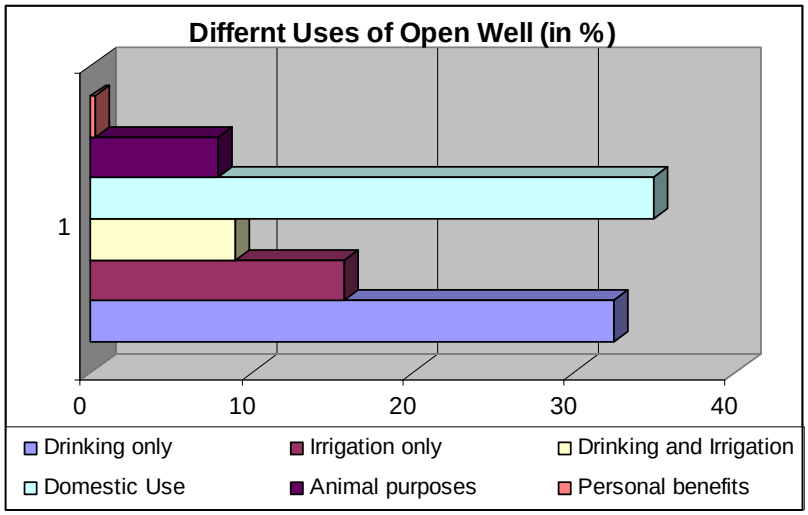
9.1 Water Resources and its major uses

The result shows that open well, pond, artisan well, tube well and hand pump are the present water resources of the district. Out of these water resources, tube wells and hand pumps are meeting around eighty percent of drinking water requirement. This scenario was reverse in seventies and eighties and most of the drinking water used to come from open wells. During that time most of the irrigation and livestock water requirement was met by open wells, ponds and rivers.

In last twenty years, source of irrigation in the district has changed significantly. It has sifted from open well and ponds to canals and tub wells. The coverage area under canal has reached 117287 ha in the district, which is around 74 percent of total irrigated area. Where as the irrigated area under tube wells has also increased and it reached to 29226 ha which is around 20 percent of total irrigated area. Out of this total irrigated area of tube wells 20078 ha (around 70 percent of total area) is irrigated by private tube wells and 9762 ha (around 30 percent of total area) is irrigated by government tube wells.

9.1.1 Open well

The researches have shown that open well plays major role in recharging of ground water and it also plays exceptional role in purification and quality improvement of rain water.



The result of survey shows great variation in numbers of open well present in sample villages. It ranges from one open well to fifty three open well per village. On an average thirteen open wells are still present in these villages. But due to different reasons, only few open well of the region are in use for drinking and domestic purposes.

In last ten years the number of open wells, of district Jalaun, has increased by 0.89%. It has increased from 2134 in 1995 to 2153 in 2004. With this rate the number of open wells, in the next ten years would be 2172 as depicted in the following table:

Table 4: Status of open wells in different blocks

Sl No	Block	Status of Traditional Water Resources			
		Open well			
		Past	Present	%increase	Future*
1	RAMPURA	193	197	2.07	201
2	KUTHAUND	191	191	0.00	191
3	MADHAUGHAR	232	237	2.16	242
4	JALAUN	285	286	0.35	287
5	NADIGAON	276	280	1.45	284
6	KONCH	227	227	0.00	227
7	DAKOR	276	276	0.00	276
8	MAHEWA	258	261	1.16	264
9	KADAURA	196	198	1.02	200
TOTAL		2134	2153	0.89	2172

* Future is for next ten years and it is based on percent increase in last ten years

With the present trend the no new open wells are expected in the coming years. This will seriously affect on the drinking/ domestic water requirement of the rural population. It is therefore urgent need of the that policy makers, government departments, civil society organizations, national and international funding agencies and local people should take immediate steps to conserve existing open wells.

9.1.2 Pond

The history of ponds starts from the period when human started agriculture for their livelihood. Harrappan civilization shows the existence on ponds during 2500 B.C. In south India, numbers of ponds are still

under use for storing and harvesting rain-water. In West Bengal, ponds are constructed near every rural house. Water of these ponds is mainly used for domestic purposes and even in some parts people are using this water for drinking purposes. These small ponds near rural houses also act as water harvesting structure.

The history of ponds goes in Bundelkhand goes backs to the 9th century when Chandela dynasty started ruling the land with Nannuka as its first king in 831 AD. From 851 to 1545, when the dynasty ended with the death of Kirti Singh in a battle with the king of Delhi, Sher Shah Suri, almost every Chandela king had built tanks to various dimensions.

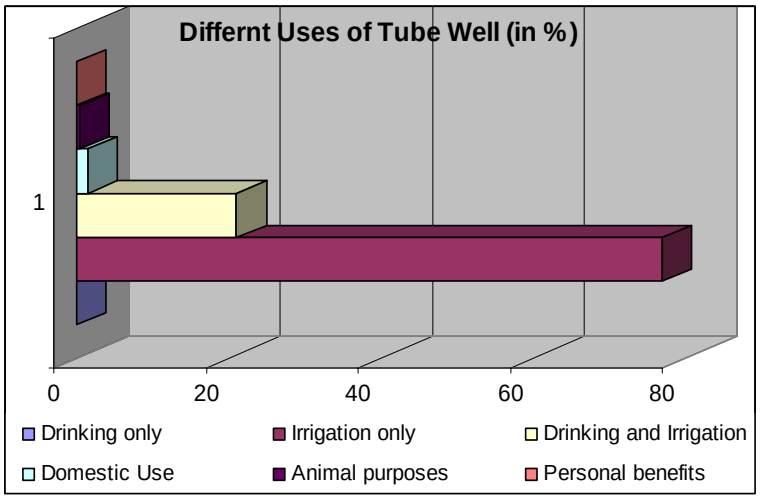
Rahila, the fourth king of the dynasty, built a large tank near Mahoba called Rahilya Sagar. Khajuraho inscriptions of 1056 credit Yasho Verman with the excavation of big tanks which may be identified with the tanks situated in and around the village Khajuraho. Kirti Varman constructed Kirtisagar in Mahoba, Kirtisagar in Chanderi and Budhyia Tal in Kalanyara. There are hundreds of tanks scatted throughout Bundel Khand whose history remains largely unknown. In fact, almost each village in Bundel Khand has a tank whose structure indicates a Chandela origin.

The result of survey shows that number of ponds in sample villages varies from one to eight per village. Most of these ponds are situated on agriculture lands.

The statistics book of Jalaun shows that around 1086 ha area of Jaluan is still getting irrigation water from existing ponds. Out of this total irrigated area 1038 ha, which is around 95 percent of total area, are situated in rural areas and rest situated in urban areas.

On the contrary, the present use of pond is limited to only livestock purposes. Only negligible number of ponds is used for domestic and irrigation purposes. Most of the available ponds remain dry for eight to ten months of the year.

The result of survey and focus group discussion shows that the present condition of pond of the region is dilapidated. Due to less dependence of people on ponds the maintenance is gradually being ignored and the condition of these ponds is further deteriorating. If this trend continues for longer duration, existence of ponds will be in danger and after one or two decades pond would disappear.



9.1.3 Tube well

Tube well is modified form of open well. It reduces the cost for digging new open wells. Due to the reduction of cost of installation and higher benefits, the number of tube well has increased drastically in last ten years.

The tube wells are only extracting ground water from stored ground water where as open wells performs both extracting ground water as well as recharging of ground water. Extraction

of ground water through tube wells has impacted negatively on the ground water and as a result the water table is going down rapidly. If this trend of installation of tube well continues for next few decades, ground water store will shrinkempty and situation will be beyond control.

In Jalaun district total number of tube well is 10303 and it is increasing with a decadal rate of 34.19%, much higher than the rate of increase of open wells.

The result of survey shows that the number of tube well in villages varies from 1 to 20. These tube wells are mostly used for irrigation purposes. More then 90 percent of total tube wells are installed on agriculture fields. Most of privet tube wells are operated by diesel engines whereas most of the government tube wells are operated by electric power.

As ground water is going deeper and deeper, the depth of tub wells is also increasing. In some of the sample villages it has reached to a depth of 400 m!! But if extraction of ground water continues with the same pace, a day will come when tube wells will not be in a position to pump water. Increasing depth of boring is a short term solution, but policy makers must have to think for any sustainable solution for the problem like water harvesting and conservation of water.

9.1.4 Hand Pump

The number of hand pump has increased drastically after government has decided to ensure installation of minimum one hand pump on every 250 persons.

The survey result shows that in some village numbers of hand pump has reached in **three figures**. It is also showing that hand pumps in rural area is becoming major source of drinking water. However, in last two to three years hand pumps are also drying during summers, which is attributed to the lowering of ground water. While it is good that government is trying to target safe drinking water to every person of the nation but on the contrary efforts should also be to maintain balance between extraction and recharge of ground water.

9.1.5 Artisan well

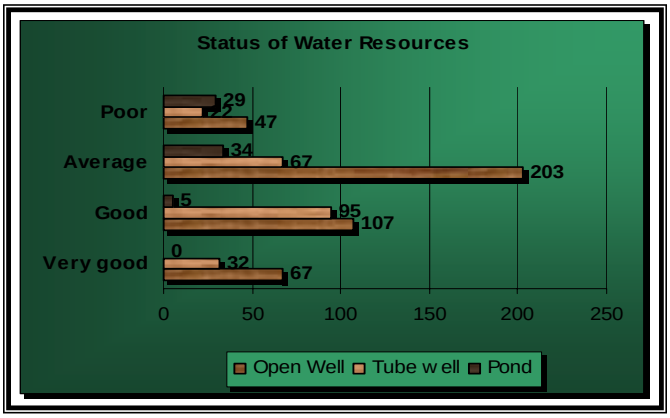
The information of ground water department shows that in the district all the three types of aquifers *i.e.* confined, unconfined, semi-confined are existing. Artisan well in three survey villages proves this fact, because these types of wells are only found in area having confined aquifer.

The survey reveals that water is continuously oozing out from these wells. There is no proper management of water coming out from these artisan wells. A huge amount of ground water is getting lost. Proper management of these artisan wells can save a huge amount of precious ground water, which can be used for other purposes. Since no pumping is needed for the artisan wells this will also lead to power saving and in-turn irrigation cost to the farmers.

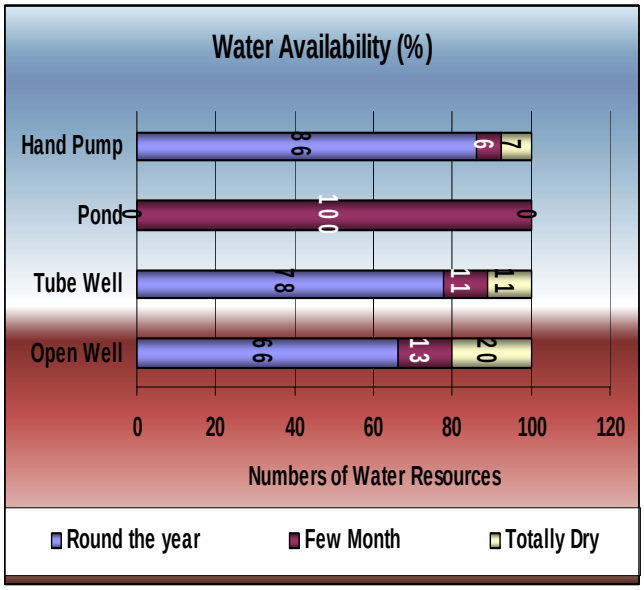
9.2 Condition of water resources

The condition of traditional water resources is continuously deteriorating whereas condition of recent water resources is almost static. But the condition of government tube well and hand pumps are also deteriorating.

The dependence of people, for their water requirement on open well is decreasing and most of the open wells are in poor condition. Out of total 522 open well surveyed, only 12 per cent of open wells are in good condition where as the percentage of open wells are in bad and average condition is around 59 per cent. Around 20 percent of total open wells are totally dry and another 13 percent are hading toward dry condition.



Similarly to open wells, use of ponds has also reduced in the last two decades. Out of the total 74 ponds surveyed only five ponds were found under good condition. Continuous silting of these ponds has reduced the depth of ponds and water carrying capacity.



The dependence of farmers on tube well has increased in the last one decade. Irrigation requirement of farmers are now mainly fulfilled by tube wells and canals. In general, condition of tube well is much better then the condition of open well and ponds. Out of total 217 tube wells surveyed under the study 62 percent are in good condition.

Similarly to tube wells, condition of had pumps are much better then open wells and ponds. Hand pumps supplies around 90 per cent to total drinking water requirement of the survey villages. Out of total 1100 hand pumps, in 81 percent of hand pumps water availability is continuous round the year.

9.3 Water demand and supply Gap

With the increasing population water demand for habitat is continuously on rise. Water pressure is mounting from agriculture and industrial sectors also. On one hand water demand is increasing rapidly, total amount of effective rain fall has decreased in last ten years. Due to increasing demand and reducing rainfall, gap between demand and supply of water is widening.

The situation is becoming worst and worst and it needs immediate attention of policy makers and other organization working for conservation of natural resources. The organizations working for conservation of natural resources should initiate their effort for rain-water harvesting.

Because the rain water harvesting potential of the district is much higher then the gap between demand and supply harvesting of only part of rain water will bridge the existing gap of water demand and supply.

The analysis of 25 project villages shows that these villages need additional water of 6557.36 Lakh liters to meet the water demand of these villages. The agriculture water demand of these villages is highest followed by human demand and animal demand. Gap of water demand and supply can be bridged by harvesting of only 2.33 per cent of total water.

The analysis of secondary data of district shows that out of nine development blocks seven are suffering from water shortage. The situation is worst in Madhogarh and Kuthaund blocks. The total additional water demand of district is 57885.62 lakh liters, which can be met only by harvesting around 2 per cent of total water.

9.4 Causes for Deterioration Water Resources

Above paragraphs shows that the existing condition of traditional water resources in the district is very poor and is further deteriorating. Different factors are responsible for the deterioration of these traditional water resources, as illustrated in the ensuing sections:

9.4.1 Climatic Changes

Climatic changes have imparted negative impact on the condition of traditional water resources of the region. Research conducted at Indian Grassland and Fodder Research Institute revels that the rainfall of the Jalaun district has significantly reduced in last fifteen year.

Table 5: Change in annual rainfall in last fifteen years

Sl No.	Season	Mean Annual Rainfall (mm)		SD*	CV#
		1970-1985	1986-2000		
1	Kharif	929	545	192	26
2	Rabi	159	12	63	84
	Annual	1027	601	213	26

Source: Indian Grassland and Fodder Research Institute

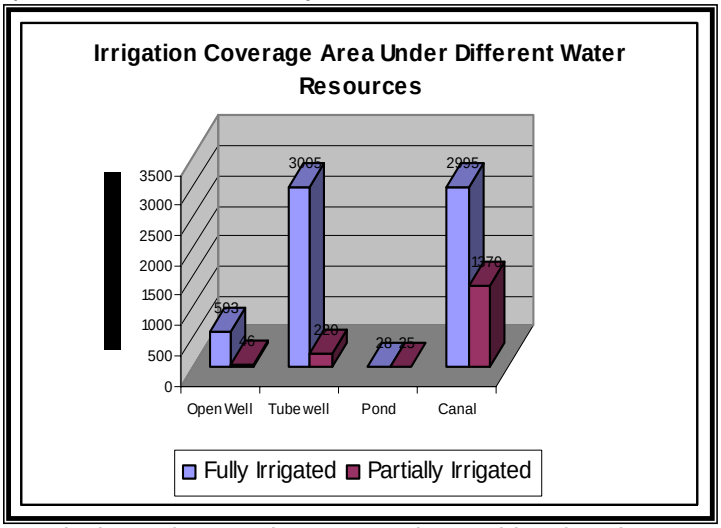
*=Standard Deviation #= Coefficient of Variance

Rainfall data of last three decades indicate that in last ten years number of total rainy days has reduced significantly. Most of the rainfall has been confined within few days, which reduces total amount of effective rainfall and most of the rain water is lost as runoff. The rainfall data also reveals that in last ten year every alternate year is a drought year. Due to all these changes in rainfall traditional water resources have become insufficient to meet the water demand of the region. Due to inefficiency of existing traditional water bodies man kind has started searching for alternate sources and their dependence on traditional water resources has gradually gone down. Once their dependence on traditional water resource has decreased the maintenance of these traditional water bodies have also been adversely affected which has become the cause for deterioration of traditional water resources of the region.

9.4.2 Agriculture Changes

Agriculture is back bone of our nation. Directly of indirectly, it provides source of livelihood for more the 80 percent people of our nation.

In last two decades massive changes has occurred in the field of agriculture. These changes help in achieving food sufficiency of the nation. But apart from food sufficiency, from last decade it has started showing negative impact on our environment and on our natural resources. Most of these negative impacts are the result of overexploitation or non-judicial use of natural resources.



The result of focus group discussion shows a massive change in crop grown in the area. The trend of last twenty years shows a shift from low water requiring crops to high water requiring crops like hybrid pearl millet, sorghum, dwarf wheat etc. Increased acreage under high water requiring crops has increased water demand of agriculture sector. To meet increasing water demand for agriculture, farmers have started searching for alternate options. Gradually, for irrigation, farmers are becoming more and more dependent on improved water resources like tube wells and canals. Due to reduced dependence on traditional water resources farmers have started ignoring maintenance of traditional water bodies.

On the one hand crop grown in the region has sifted from low water requiring crops to high water requiring crops; on the other hand cropped area under high water requiring crops has increased significantly. The crops like kodo, kutki, sanwan and other millets are almost disappeared, in last two decades where as cropped area under dwarf wheat, hybrid pearl millet, sorghum has increased significantly. This also lead to deterioration of existing traditional water bodies.

The change in crop varieties, from traditional to hybrid, of the region has increased the production of the region in last ten years. The water requirement of improved crop varieties are much higher then the water requirement of traditional varieties. The shift in crop varieties has further increased pressure on water resources of the region. The changes in crop varieties have contributed to the deterioration of existing traditional water bodies of the region.

The result of focus group discussion shows change in cropping season. Farmers have sifted from *kharif* crops to *rabi* crops. There are many reasons behind shifting of cropping season from *kharif* to *rabi*. The most important reasons were higher productivity of *rabi* crops, less weed problem during *rabi*, increased irrigation facilities etc. The shift of cropping season has also increased pressure on water resources.

The crop management practice of the region has changed in the last twenty years. In past, cultivation of field was done by bullock drawn implements but gradually it has shifted to tractor drawn implements. Running of heavy machineries like tractor on farmer's field has increased soil compaction. The bulk density and water holding capacity of compacted fields are reduced. As the soil has become more compact, infiltration rate has reduced and runoff loses has increased. Further reduction in bulk density lead to reduction in water holding capacity of soil. Both these factors lead to increased water requirement of the crop grown in the region.

Apart from change in soil tillage practice, farmers have shifted from organic fertilizers like FYM, nadep-compost to chemical fertilizers. Application of less organic fertilizer has reduced porosity of soil and reduced water holding capacity of soil. Ten years back, under water scarcity condition crop wilting used to take place after a long dry spell but now crop shows wilting system within a short dry spell. Organic fertilizers also plays role in stability of soil aggregate. Due to less application of organic fertilizers numbers of stable soil aggregate reduces and number of unstable soil aggregates increases. This process leads to easy detachment of soil particles and increase risk of soil erosion.

All these changes in agriculture lead to significant increase in agriculture production and has helped in achieving food self sufficiency of the nation. But this increase of agriculture production was on the cost of deterioration of water resources. Indiscriminate use of chemicals leads to deterioration of soil health. The changes in agriculture have increased water demand of the sector. The existing water resources are unable to meet increasing water demand of the sector. Due to that, farmers have started searching substitute for these water resources. They have shifted from ponds, open wells, Rahets to tube wells. As the dependence of farmers on traditional water resources has decreased, maintenance of traditional water resources reduces. The lack of maintenance becomes cause for deterioration of traditional water bodies.

9.4.3 Government Policies and projects

Any government prepares policies for the development of nation. Formulation of these policies is always done by the experts and senior persons. There is no doubt these policies play major role in development of any nation. But some time these policies impart some negative impacts also.

Indian constitution says "*provide subsidy to needy peoples of the nation*". The subsidy was started from the first five year plan and it continue till date. Agriculture was the major component of first five year plan. From the first five year plan, policy makers of our nation have started thinking to increase agriculture production and increase irrigated area on the nation. To bring improvement in total irrigated area, government has installed numbers of tube wells and decided to give subsidy on installation of privet tube wells. The subsidy on installation of tube well has drastically increased numbers of tube wells. As the number of tube wells has increased the dependence of farmers on traditional water resources for irrigation and other purposes has reduced. Reduced dependence of farmers on traditional water bodies lead to reduction in maintenance of these water bodies. Due to meager maintenance of traditional water bodies, these water bodies have started deteriorating. Some were the subsidy has played role for deterioration of traditional water bodies.

Two decades back, traditional water bodies like ponds, rivers, open wells etc were the only sources of water for human beings. The accessibility of these water resources was difficult and some time women used to travel a long distance to collect few buckets of drinking water. With the mechanization, the availability of drinking water becomes much easier. Now hand pumps are installed in every village and most of the towns are connected with municipality supply. As the accessibility become easier, wastage of water has increased drastically. The wastage of ground water has started showing its impact from last decades. Some of the tube wells and hand pumps have become dry. Most of the ponds were encroached either for construction of buildings or for cultivation of crops is also a cause of deterioration of water bodies.

9.4.4 Location of Water Resources:

The result of survey conducted in selected villages shows that most of the water resources structures situated near domestic area are in bad condition. Most of the ponds and open wells in the villages are not in use. Because of that no body is taking care for maintenance of these structures. But the condition of hand pumps situated in the village is far better then the hand pump situated far from village area. Most of the hand pumps situated in the village area are used for more then eight hour a day. In case of any brakeage in these hand pumps villagers takes the responsibility for maintenance of these hand pumps. But it will be better if some village peoples should bear this responsibility.

Most of the tube wells are situated on agriculture fields and the condition of these tube wells are quite good. But the condition of government tube wells is not that good.

9.4.5 Other Reasons

In sixties and seventies most of the rural houses of the region were made up of mud. The roof of these houses was made of earthen tiles. The mud for construction of these hoses are mostly collected from the near by ponds. Not only the construction of mud houses were done by taking mud from ponds, maintenance of these houses were also done by taking mud from ponds. The process of taking mud from ponds every year performed desilting of these ponds and maintained initial depth of ponds. But, with the mechanization, these mud houses are converted in to pukka (brick) houses and it has stopped the process of desilting of ponds. Gradually the depth of these ponds was reduced and some of these ponds have even disappeared.

In some survey villages it was found that the farmers got their Patta on the pond land area. They have started cultivation on the pond land and even they have destroyed outer boundaries of the pond.

In some of the survey villages ponds situated near house hold are encroached by the people living near the pond. Gradual encroachment of ponds situated near house holds leads to the reduction of size of pond and finally most of these ponds were either converted in to house hold or utilized for their domestic purposes.

In some cases the catchment area of ponds is so small that it remains dry during rainy season. This happens because of wrong selection of area and location of ponds.

10.0 Recommendations

The deteriorating condition of traditional water resources and non judicial use of natural resources has started showing its negative impact on traditional water resources. These negative impacts on traditional water resources can be reduced by adopting following recommendations:

- Rain water harvesting can be improved by adopting agronomic practices like ridging and furrowing, contour farming, strip cropping, judicial use of improved and traditional varieties and promotion of organic fertilizer;
- Rain water harvesting can also be improved adopting soil conservation measures like contour bunding, field bunding, peripheral bunding, check dam etc.

- Maintenance of existing traditional water resources of the district through community participation and active involvement of Panchayat representatives;
- Formation of water users association mainly responsible for the maintenance of traditional water resources;
- Conversion of damaged water resources in to water harvesting structures;
- Awareness generation among local people, Government and Panchayat representative for the conservation of natural resources like water and land trough small and big campaign;
- Organizing demonstrations on rain water harvesting and construction of rain water harvesting models;
- Develop a rain water harvesting model village in every developmental block;
- Develop master trainers for rain water harvesting practices in every developmental block of the district;
- Judicial installation of new water resources like tube wells. Water harvesting should be made necessary for person who want to install new tube well or hand pump;
- Policy makers should review for subsidies on installation of new tube wells and incorporation of water harvesting in new irrigation projects;

Annexure 1: Format for primary data collection

WATER RESOURCE STUDY
PROFORMA FOR PRIMARY DATA COLLECTION

1-1-0 GENERAL INFORMATION ABOUT VILLAGE

1-1-1 Village Name _____

1-1-2 Block _____

1-2-0 DEMOGRAPHIC DATA

1-2-1 No. of Families _____

1-2-2 Total Population _____

1-2-3 Cattle Population (Approx.) _____

1-3-0 EXISTING WATER RESOURCES

1-3-1 Depth of Water Table Below Ground Level (in mts.) During Summer_____
After Rains _____

1-3-2 **All of the Existing Open Wells (within village habitation and in field)**:

Total Number_____ Permanent Water Available (No.) _____ Permanent Dry Wells (No)_____

Water Available during few months (No.)_____

Availability of Water in those Open Wells where water is available for few Months (in months)___

Location of well:

Residential Area (No.)_____ Agriculture Fields (No.)_____ Forest (No.)_____

Other (No.)_____

Construction Details:

Year of Construction(For each Well)_____

Construction Agency :-

Project Gov. (No)_____/CSO Project (No.)_____ Private(No.)_____ Other (No.)_____

Approx Cost of Construction_____ Type (Pakka(No)_____/Kachha(No_____)

Use of Open Wells (in no.) Drinking (No)_____Drinking/ Irrigation(No)_____For Animals(No)_____

Washing/ Bathing(No) _____ Only Irrigation(No) _____ Personal Benefited(No) _____

Depth of Open Wells (mts.) Minimum_____ Maximum _____

If used for irrigation then give the total area irrigating (Ha.) Full Irrigation ____ Partial Irrigation __

Present Status: (Very Good(No)_____/ Good(No)_____ Average(No)_____ Bad(No)_____

Remarks (Pl. give changes in the open wells during last 30 years):

_____

_____

_____

_____

1-3-3 All of the Existing Tube Wells: Total Number_____ Government _____ Private _____

Water Available Round the year (No.) _____ Permanently Out of Use (No)_____

Water Available during few months (No.)_____

Availability of Water in those Tube Wells where water is available for few Months (in months)____

Location of Tube Well:

Residential Area(No)_____ Agriculture Fields(No)_____ Forest(No)_____

Other(No)_____

Construction Details:

Year of Installation (For Every Well)_____

Installation agency-- Gov. Project (No)_____/CSO Project (No.)_____

Private(No.)_____ Other (No.)_____

Approx Cost of Construction_____ Type (Pakka(No)_____/Kachha(No_____)

Use of Tube Wells (in no.) Irrigation_____ Irrigation/ Domestic Use _____ Other_____

If used for irrigation then give the total area irrigating (Ha.) Full Irrigation _____ Partial Irrigation _

Depth of Tube Wells (mts.) Minimum_____ Maximum _____

Diameter of Tube Wells (in inches) Minimum_____ Maximum _____

Type of Pumps (Nos.) Electric_____ Diesel_____ Others_____

Daily average running hours of pumps (average hours) Rabi Season _____Kharif Season____

Effect of running of pumps on Ground Water in the surrounding open wells

_____

_____

_____

_____

Remarks (Pl. give changes in the tube wells conditions during last 30 years, such as increase in the number, running, etc.):

_____

_____

_____

_____

1-3-4 **All of the Existing Ponds**: Total Number_____ Gram Sabha owned____ Private _____

Location of Ponds:

Residential Area(No)_____ Agriculture Fields(No)_____ Forest(No)_____

Other(No)_____

Construction Details:

Year of Construction (For Every Pond)_____

Constructed Under -- Gov. Project (No)_____/CSO Project (No.)_____

Private(No.)_____ Other (No.)_____

Total area covered by pond lands, in the village (Ha.) At present_____ 30 years before_____

Total area which remain submerged under ponds (Ha.) Before rains _____ After rains_____

Total catchments area of ponds (Ha.)_____ Catchments area encroached (Ha.)_____

Water column depth of ponds (in mts.) Before rains: Minimum_____ Maximum _____

After rains: Minimum_____ Maximum _____

No. of ponds which dries up in summers_____ Submergence area of these ponds (Ha.)_____

Use of Ponds (in no.) Irrigation_____ Irrigation/ Domestic Use _____ None_____

If used for irrigation then give the total area irrigating (Ha.) Full Irrigation _____ Partial Irrigation _

Any other comments

_____

_____

_____

_____

1-3-5 **All of the Existing Hand Pump**:

Total Number_____ Government _____ Private _____

Water Available Round the year (No.) _____ Permanently Out of Use (No)_____

Water Available during few months (No.) _____

Availability of Water in those Hand Pumps where water is available for few Months (in months) __

Location of Hand Pump:

Residential Area(No)_____ Agriculture Fields(No)_____ Forest (No)_____

Other (No)_____

Construction Details:

Year and agency of Installation (For Every Hand Pump)_____

Project Gov. (No)_____/CSO Project (No.)_____ Private(No.)_____

Other (No.)_____

Approx Cost of Construction _____Type (India Marka (No)_____/Local HP (No) _____)

Use of Hand Pump (in no.) Domestic Use _____ Other_____

Depth of Hand Pump (mts.) Minimum_____ Maximum _____

Diameter of Hand Pump (in inches) Minimum_____ Maximum _____

Daily average running hours of Hand Pumps (average hours) _____

Remarks (Pl. give changes in the Hand Pump conditions during last 30 years, such as increase in the number, running, etc. Monition about platform of pump and drainage system):

_____

_____

_____

_____

1-3-6 **Canal**: Yes_____ No_____

Duration of availability of water in months_____ in days _____

Total area irrigating (Ha.) Full Irrigation _____ Partial Irrigation _____

Any other comments (changes over last 30 years)

_____

_____

_____

_____

1-3-7 **Other Water Resources (Such as Artisan Wells/ Lift Irrigation Schemes/ Others)**

Comments: (Pl. comment on the type of scheme, its present condition, its past conditions, irrigation potential etc.)

_____

_____

_____

_____

_____

_____

1-3-8 Whether farmers are doing Water Harvesting in the village : Yes No (If yes than What type of practices)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Annexure 2: Format for Focus Group Discussion

FGD FORMAT FOR ANALYSIS OF CAUSES FOR DETERIORATION OF TRADITIONAL WATER RESOURCES

1. What are the present kharif and rabi crops of the village.
   a) Arhar b) Bajr c) Jwar d) Wheat e) Gram f) Pea
2. What was the Kharif/Rabi crops of the village before 20 years
   a) Arhar b) Bajr c) Jwar d) Wheat e) Gram f) Pea g) Sanwa h) Kodo/Kutki/Ragi
3. Whether there is any change in cropped area of major crops of the villages in last 20 years.
   a) Yes b) No change
4. If yes
   a) Wheat area increased/decreased c) Arhar area increased/decreased
   d) Gram area increased/decreased e) Jwar/bajra area increased/decreased
   f) Millets area increased/decreased
5. Is there any change in crop varieties of different crops used by farmers in last 20 years.
   a) Yea b) No change
6. If yes
   a) Use of improved variety of wheat/Jwar/Bajra b) Use of improved variety of Arhar/Gram
7. Is there any change in cropping season in last 20 years (yes/No change) If yes
   a) Cropped area increased in Kharif/Rabi b) Copped area decreased in Kharif/Rabi
8. is there any change in irrigated area of the village in last 20 yeas (yeas/ No change)
   if yes a) Increased b) Decreased
9. What are the sources of irrigation in the village
   a) Tube well b) Open well c) Pond d) Artisan well e) Canal
10. What was the source of irrigation before 20 years
    a) Open well b) Pond c) Artisan well d) Canal
11. How many tub wells were installed in last 20 years (number)
12. How many ponds/open well were dogged in last 20 years
    a) Ponds b) Open wells
13. What was the major use of open wells before 20 years
    a) Drinking b) Irrigation c) Domestic purposes
14. What was the major use of Ponds before 20 years
    a) Drinking b) Irrigation c) Domestic purposes
15. What is the present use of open wells
    a) Drinking b) Irrigation c) Domestic purposes

16. What is the present use of Ponds

    a) Drinking b) Irrigation c) Domestic purposes

17. What was the source of drinking water before 20 years

    a) Open well b) Ponds c) Rivers d) Hand pump e) Tube well

18. What are the present sources of drinking water

    a) Hand Pump b) Tube Well c) Tap (Government) d) Open Well

19. Is there any change in crop management practices in last 20 years (Yes/No change)

    If yes a) Irrigation b) Weed Management d) Fertilizer Management e) Sowing

20. What was the change in fertilizer management practices in last 20 years

    a) Use of FYM increased/Decreasedb) Use of chemical Fertilizer increased/decreased

21. What is the change in ravine affected area of the village in last 20 year

    a) Increased b) Decreased d) No change

22. What is the change in animal population in last 20 years

    a) Increased b) Decreased d) No change

23. What was the source of drinking/other water for animal before 20 years

    a) Pond b) Rivers c) Open well d) Tube well e) Hand pump

24. What is the present source of drinking/other water for animal

    a) Hand Pump b) Tube Well c) Open well d) Pond e) River

25. What is the change in economic value of the agriculture produce in last 20 year

    a) Big increase b) Big decrease c) Little increase c) Little decrease d) No change

Annexure 3: Water Demand and Gap Analysis

Table 6: Status of water demand, loss, harvesting potential and gap between water requirement and availability in project village

Name of project villages	Area In ha	Population	Area In ,000 M^2	Amount of water received in ,00 M^3	Amount of water received in ,000 liters	Amount of water lost in ,000 liters	Available water in ,000 liters	Water Demand in liters				Gap Between demand and water availability	Water Harvesting Potential in ,000 liters	% of total WHP
								Human	Animal	Agriculture in ,000 liters	Total			
Himatpur	247.00	359	2470	14820	1482000	1185600	296400	14413850	8648310	494000	517062160	220662160	889200	24.8
Machkacha	260.00	228	2600	18200	1820000	1274000	546000	21637200	12982320	520000	554619520	8619520	936000	0.92
Asahna	455.50	301	4555	31885	3188500	2231950	956550	28564900	17138940	911000	956703840	153840	1639800	0.01
Kadampur	764.50	774	7645	53515	5351500	3746050	1605450	73452600	44071560	1529000	1646524160	41074160	2752200	1.49
Laxmanpura	287.50	320	2875	20125	2012500	1408750	603750	30368000	18220800	575000	623588800	19838800	1035000	1.92
Choti Bedh	327.00	316	3270	22890	2289000	1602300	686700	29988400	17993040	654000	701981440	15281440	1177200	1.30
Mirza Pura	387.00	586	3870	27090	2709000	1896300	812700	55611400	33366840	774000	862978240	50278240	1393200	3.61
Kapur kas Pura	134.50	224	1345	9415	941500	659050	282450	21257600	12754560	269000	303012160	20562160	484200	4.25
Tiliya	221.00	176	2210	15470	1547000	1082900	464100	16702400	10021440	442000	468723840	4623840	795600	0.58
Karmara	423.00	313	4230	29610	2961000	2072700	888300	29703700	17822220	846000	893525920	5225920	1522800	0.34
Tajpura	210.50	293	2105	14735	1473500	1031450	442050	27805700	16683420	421000	465489120	23439120	757800	3.09
Chandan Ka Pura	489.70	389	4897	34279	3427900	2399530	1028370	36916100	22149660	979400	1038465760	10095760	1762920	0.57
Hailauli	861.50	473	8615	60305	6030500	4221350	1809150	44887700	26932620	1723000	1794820320	14329680	3101400	0.46
Rithaura	290.00	335	2900	20300	2030000	1421000	609000	31791500	19074900	580000	630866400	21866400	1044000	2.09
Gidhan Ki Khor	623.00	461	6230	43610	4361000	3052700	1308300	43748900	26249340	1246000	1315998240	7698240	2242800	0.34
Naraul	1400.00	1425	14000	98000	9800000	6860000	2940000	135232500	81139500	2800000	3016372000	76372000	5040000	1.52
Jahraila	318.00	432	3180	22260	2226000	1558200	667800	40996800	24598080	636000	701594880	33794880	1144800	2.95
Bhimnagar	649.00	793	6490	45430	4543000	3180100	1362900	75255700	45153420	1298000	1418409120	55509120	2336400	2.38
Sundarpura	287.50	299	2875	20125	2012500	1408750	603750	28375100	17025060	575000	620400160	16650160	1035000	1.61
Kusepura	623.50	663	6235	43645	4364500	3055150	1309350	62918700	37751220	1247000	1347669920	38319920	2244600	1.71
Mahoba	399.00	247	3990	27930	2793000	1955100	837900	23440300	14064180	798000	835504480	2395520	1436400	0.17
Shidhpura	1223.60	689	12236	85652	8565200	5995640	2569560	65386100	39231660	2447200	2551817760	17742240	4404960	0.40
Mingnee	784.50	815	7845	54915	5491500	3844050	1647450	77343500	46406100	1569000	1692749600	45299600	2824200	1.60
Rathauran Ka pura	1123.00	1378	11230	78610	7861000	5502700	2358300	130772200	78463320	2246000	2455235520	96935520	4042800	2.40
Madha Bhagwanpur	1077.50	928	10775	75425	7542500	5279750	2262750	88067200	52840320	2155000	2295907520	33157520	3879000	0.85
Ninalwali Jageer	3203.80	2977	32038	224266	2242660	15698620	6727980	282517300	169510380	6407600	6859627680	131647680	11533680	1.14
Total	17071	16194	170711	1192507	119250700	83623690	35627010	1517155350	910293210	34142200	36569648560	655736000	61455960	2.33