Report

On

Drought mitigation strategy for Bundelkhand region of Uttar Pradesh and Madhya Pradesh

2003

2008 Dried up Banda

D

Dried dug

Dried Tank

Degraded grazing

By

Inter - Ministerial Central Team

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

LIST OF APPENDIX

FOREWORD

About 80% of the world and 60% of the Indian Agriculture is rain-dependent, diverse, complex, under-invested, risky, distress prone and vulnerable. Uncertainties and seasonal migrations have been further compounded due to high frequency of the extreme weather events like droughts due to global warming. Historically Bundelkhand region of UP and MP used to have one drought in 16 years in 18th and 19th centuries which increased by three times during the period 1968 to 1992 and the past four years have witnessed continuous drought. Mitigation by devising robust and resilient systems of livelihood and enterprising can provide reasonable solutions to the distress. Mitigation aiming interventions during the normal or above normal rainfall years is entirely different than the calamity relief. A multi-disciplinary inter-ministerial team was constituted to recommend medium and long term measures for mitigating droughts in the Bundelkhand region.

Crop production, livestock rearing and seasonal out-migration provide more than 90% of rural income in the Bundelkhand region. Agriculture production consists of more than

56% of cereals, 32% of pulses, 8% of oil seeds and 4% other crops. About 50% of the indigenous cattle population is unproductive with hardly 0.5% of cross-bred as compared to 15% of the national average. There are some land races of indigenous and drought tolerant fruit trees with the possibility of enhancing their productivity and value addition by top working. Regeneration of the degraded forest (50-64%) and restoring carrying capacity of the grazing land has tremendous possibility to support better livestock production and supply of the minor products.

Analysis of the various data sets revealed occurrence of severe meteorological, hydrological and agricultural droughts which built up cumulatively over the past four years. Participatory integrated watershed management for in-situ conservation of the rainwater, recharging of about 2.8 lakh dug wells, renovation and repairs of Bundela, Chandela and Peshwa tanks, digging of farm ponds and open wells has been recommended as medium term measures. Development of unutilised water resources in MP, improving efficiency of the already developed canal irrigation system and Ken Betwa links are the long term investment portfolio for mitigating droughts.

Intensification of crop diversification, innovative cultivation practices, improving seed replacement rate with high yielding varieties, promoting more sown area in the Kharif season are important interventions. Creation of water, fodder, feed and seed banks for promoting alternative contingency plan will be an important tool of managing risks. Reducing population of the un-productive animals by castrating scrub bulls, improving breeds with Haryanvi, Tharparkar and Murrah bulls will be a long term strategy. Promoting horticulture consisting of Amla, Ber, Bael, Custard Apple, Lemon (Nimbu), Pomegranate, Tamarind and drought tolerant tomatoes will be able to add value and enhance income of the farmers. About 50-63% of the forest is degraded and should be rehabilitated by in-situ conservation of moisture, planting of the locally available land races of the fruit trees, fodder trees, shrubs, grasses and legume forages will be highly complementary to the production of livestock and minor forest products for the local communities.

About 60% of the credit is still non-institutional which need to be institutionalised through enabling policies. Loan for consumption should be encouraged to prevent diversion of

agricultural credit to non-agricultural use. The credit system should be devised for the whole income portfolio rather than crop cultivation alone. Conversion of short-term loan into medium term under specific conditions should be made automatic so as to maintain eligibility for the fresh loans. Alternative weather based insurance derivatives like Barsha Bima will be able to resolve many limitations of the existing safety-net of crop insurance. Some innovative institutions and strengthening of R&D is also suggested.

15th April, 2008
(J.S.Samra)

1. Summary of Comments and Recommendations

The Bundelkhand region comprising of seven districts of Uttar Pradesh State and six districts of Madhya Pradesh State is complex, diverse, rainfed, risky, under invested, vulnerable, socio-economically heterogeneous, ethnically unique, agrarian and backward relative to other regions. It is a hard rock area with limited or inadequate ground water resources, lacks infrastructure, access to improved technologies, markets and inputs with low productivity. Farming system of crops and livestock is the main occupation whereas out sourcing livelihood by seasonal migration minimizes risks and vulnerability. Rainfall in the range of 768 to 1087 mm, black, red, mixed and alluvial soils, sufficient surface run

off, net work of rivers, streams, forests, animals and social capital are the opportunities for a sustained development process. Increased frequency of drought occurrences due to climatic changes, degradation of forest, ground water etc. have been witnessed.

Traditional Chandela, Bundela or Peshwa tanks and Haveli System of cultivation were neglected and could not be integrated with modern technologies, management of resources, livestock production, value addition and market driven economy. Employment opportunities continued to depend on agriculture due to lack of industrialization and communication means. Traditional drought coping mechanisms have under gone transformations due to technological changes with higher risks.

The region has been afflicted with meteorological, hydrological and agricultural drought continuously for the past four years (since 2004–05) and an Inter Ministerial Central Team was constituted by the Agricultural Minister to suggest mitigative measures (Appendix–I). The itenary of visit of the Central Team to the districts is given in Appendix-II.

Grass root level or bottom up participatory approach of Gram-sabhas and road side meetings with villagers, consultations with district and state officials, visit to grain markets for ascertaining arrivals and deliberation with local press and media provided immense information. The recommendations are summarized below:

Comments:

1. Analysis of human development, infrastructure, agriculture related, social and economic indicators ranked Bundelkhand most backward region.

2. Crop production and livestock rearing contribute 90% to the farm income, crop residue provides 67% of the animal fodder and failure of rains caused distress.

3. Climatic variability has increased frequency of extreme weather events, risk and vulnerability.

4. Moderate to severe meteorological drought due to rainfall deficit was analysed.

5. Hydrological drought was evident from 15 to 47% decline in the filling of reservoirs in Madhya Pradesh, 28 to 64% in Uttar Pradesh over three years, 70% dried up tanks, ponds, dug-well and steep fall in ground water table.

6. Out of four years, moderate to severe agricultural drought occurred for 2-4 years in the 13 districts of Bundelkhand. Net sown Area in 2007-08 ranged from 15 to 80% with an average of 60%, and 22% decline in food grain production was observed.

7. Irrigation potentials of less than 45% of net sown area were created, utilization efficiency was about 50% and watershed management is prioritized intervention.

8. Synergies of forest, wasteland, non-arable, arable land, rearing of animals, micro-enterprising, equity and enabling institutions may be optimized in the watershed management programme.

9. Surface water resources are least developed in Madhya Pradesh.

10. Improving water use efficiency by upgrading the system should be high priority for Uttar Pradesh.

11. Out of 37 lift Irrigation schemes of Uttar Pradesh only one at Jalaun was sick and overall utilization was 93%.

12. Out of 31 lift Irrigation schemes of Madhya Pradesh only eight functioned occasionally and overall utilization varied from 5 to 10% only.

13. Only 50% utilization of canal irrigation in Madhya Pradesh is a major concern of improving management.

14. Hybrids of Jowar, Bajra, Bt cotton, input intensive new varieties of pulses, oil seeds, public distribution system, neglect of tanks, dug-wells and installing of tube-wells have altered traditional coping systems and increased risks, distress and vulnerability to droughts.

15. Farmers did not prefer cattle camp for milch and productive animals and argued in favour of fodder and feed banks.

16. Horticulture is another important option to diversify income, employment, risks and vulnerability to rainfall uncertainties.

17. Citrus (Nimbu), phalsa, and jack fruit also have potentials of diversifying risks, distress and vulnerability.

18. Forest and scrub occupy 8.8% of geographical area in Uttar Pradesh and 26.2% of Madhya Pradesh. More than 64% forest in Uttar Pradesh

and more than 50% in Madhya Pradesh are degraded and there are opportunities to improve productivity and other services of land cover.

19. Construction of Water Harvesting structures in forests can improve supplies of water for wild life and downstream agriculture.

20. More than 90% of all category farmers normally take produce to the market, 64% sales being in regulated market.

Recommendations:

A. Medium term

1. Desilting, renovation, repairs of tanks, check dams, deepening and recharging of about 2.8 lakh dug-wells may be taken up.

2. Crop residue provides 67% of fodder and its shortage in drought year is inevitable. Creation of fodder and feed block banks should be immediate priority.

3. Deworming, vaccination and other health measures are being recommended.

4. Mineral mixture should supplement the feed to prevent loss in fertility during droughts.

5. There is a scope to improve efficiency of artificial insemination (AI) services.

6. Naturally growing Traditional drought hardy land races of Ber, Amla, Karounda and custard apple can be top worked with improved varieties detailed in the text to enhance their value.

7. Rainwater conservation in trenches, planting of indigenous fruits, fodder trees, shrubs, grasses, pasture legumes (*Stylosanthes hamata*) and promoting cut and carry system of grasses in place of grazing can improve functions and community services of the forest land.

8. Waving of interest, a part or whole of principal or deferred re-payment should be inbuilt into the loaning process to maintain credit eligibility of the farmers.

9. Integrated participatory management of inputs, natural resources, social capital and innovative institutions is recommended.

10. Digging of farm ponds and new open wells can also yield quick results and provide employment.

11. Completion of ongoing Rajghat canal project and Bariyarpur barrage should be the immediate priority both of Uttar Pradesh and Madhya Pradesh.

12. Extra short duration crops and varieties given in the text can reduce vulnerability to drought and arrangement of their seed bank is suggested.

13. Normal, medium, short and extra short duration crops and varieties are listed to match with the length of growing period and amount of rainfall while preparing crop contingency plans.

14. Regarding the four tehsils of Allahabad district of Uttar Pradesh, the issues in these tehsils are again very unique, do not resemble to that of Bundelkhand region and can be taken up separately

B. Long term

1. Long term strategy consists of professionally designed integrated participatory treatment of watersheds from ridge to valley system. Treatment of forest, non-arable and arable land should be unified into a common plan.

2. About 46% of net sown area of Uttar Pradesh and 45% of Madhya Pradesh Bundelkhand is irrigated with poor and erratic supplies. Ground water over utilization is predominant and open dug-wells provide much needed but non-dependable equity. Recharging of open dug-wells can yield quick results.

3. On an average 31% of replenishable or utilizable ground water have been developed. The remaining major part (69%) has very low yield due to typical hydrogeology of Bundelkhand. Mostly open dug-wells are suitable for future expansion of irrigation under such poor geo-hydrological situations.

4. Left Bank Canal at Bariyarpur of Madhya Pradesh should be expedited and Right Bank Canal taken up on priority basis.

5. Taking up of Ken-Betwa Link Project under National Scheme will be a dependable long term measure of mitigating droughts.

6. The Madhya Pradesh part of Bundelkhand should invest for developing surface water resources by efficient systems right from the beginning and simultaneous development of command area to ensure quick flow of returns.

7. *In situ* conservation of rainwater, contour cultivation, sowing on ridges or raised beds especially in black soils can raise productivity by 15-20% at reduced risks.

8. Seed multiplication and creation of seed banks of traditionally drought resistant crops and varieties of sesame, linseed, lentil, chickpeas and dual purpose Bundela Sorghum is least priority of private sector and public sector should be geared up.

9. Seed replacement rate of pulses, oil seed and cereals with latest improved varieties may be doubled.

10. Long term measures of increasing sown area in *Kharif* Season need systematic and committed efforts. Some of limitation of *Kharif* cultivation in black soils can be tackled by making raised beds and weed control with herbicides.

11. There is 30-40% yield gap and several suggestions on rotation, seed banks, marketing, intensification or diversification are made.

12. Intensification of the existing major four livestock production system has been recommended.

13. Cattle constitute 52% of animal population and only 0.5% is crossbred as compared to 15% of national average. Breed improvement with Tharparkar, Haryana and Murraha bulls is necessary.

14. Goat rearing especially of Jamnapari and Barberi is most economical.

15. Liquidation of animal assets is a normal practice of coping with drought and was observed in Bundelkhand also. Providing consumption credit at reasonable interest can avoid distress sale of animals.

16. Castration of scrub bulls to reduce population of unproductive animals should be a long term measure.

17. Marketing of milk through Private-Producer and Consumer institutions can add to the value, income and employment.

18. Setting up of a modern processing plant for meat, milk and animal related by products can improve benefits tremendously.

19. Productivity of forest resources should be improved through watershed management, planting fodder trees, shrubs and grasses to support animal husbandry.

20. Early bearing grafted Tamarind, pomegranate, fig (Anjir), guava and mango are quite hardy after their initial establishment and may be planted.

21. Drought tolerant tomatoes (Arka Vikas), rainfed onion, coriander, turmeric, ginger, beetle leaves have specific niche or micro region in the Bundelkhand.

22. Minor forest produce of Tendu leaves, Palas leaves, Bamboo, Mahua, Chiraunji, Ber, Bael, Amla, Neem, medicinal plants and honey provide livelihood to local communities and may be promoted.

23. About 58% of credit was raised at high rate of interest from non-institutional sources. Cooperative Banks served only 7% of loans and that

too to the large farmers only. Services of Kisan Credit Card should be enhanced.

24. Credit cycle in rainfed region should automatically switch over to two or three years under specified failures of rains.

25. Livelihood in rainfed region is highly diversified and credit against total income portfolio may be devised.

26. In order to prevent diverting of crop loans for other purposes consumptions loan should also be introduced.

27. Weather based insurance (Barsha Bima) may take away some drawbacks of existing insurance system.

28. Almost 100% of fertilizers, seeds, agro-chemicals, farm implements and animal feeds were purchased from private dealers and 90% of farmers sell some produce. Modern market converging sale of farm produce, purchase of inputs, warehousing, sample testing services, banks, extension and electronic display system etc. should be set up under one roof of a modern market.

29. Bundelkhand region should announce procurement prices at sowing time of pulses, oil seeds and cereals which are unique to this agro-ecology.

30. Special institutional arrangements like that of Sujala Watershed of Karnataka have been advocated to converge different resources and capacities for implementing package.

31. Strengthening of Agriculture College at Tikamgarh (MP) and upgrading IGFRI, Jhansi of ICAR to "Deemed to be University" is recommended.

32. Package components of Rs. 3866 crores for UP and Rs. 4310 crores for MP have been prioritized on definite basis. This recommendation is subject to the demonstration of absorption capacity of the regions and innovative institutional arrangement proposed. Team could not examine absorption capacity due to non-submission of some information by the states.

MEDIUM AND LONG-TERM REHABILITATION PACKAGE FOR BUNDELKHAND (UTTAR PRADESH)

(Rs. In crores)

Sl. No	**Name of the Sector**	**Amount**	**Grand total**
1.	**Institutional Credit**		
	i. Debt Relief	**400**	
	ii. Crop Insurance	**50**	
	Sub-total	**450**	**450**

2.	**Watershed Management** i. Watershed Management in Arable and Wasteland (7 lakh ha out of 18 lakh ha net cultivated area (@ Rs.12,000/ha) ii. Farm ponds (50,000 ponds @ Rs.60,000 per pond) iii. Construction of new dug wells (20,000 dug-wells @ Rs.1 lakh per well) iv. Renovation and recharging of dug-wells, tanks **Sub-total**	700 300 200 300 **1500**	**1500**
3	**Water Resource** i. Modernisation of irrigation system	**644**	**644**
4.	**Agriculture** i. Contingency cropping, seed multiplication/banks, etc. (8 lakh ha) ii. Micro Irrigation (20,000 ha) iii. Warehousing, marketing infrastructure (@ Rs.100 crore per district) and one oil mill for sesame. iv. Capacity building v. Mechanization for zero tillage, broad bed & furrow system, multipurpose planter (custom hiring) (@ Rs.30,000 + tractor 4.5 HP @ Rs.4.8 lakh each – one set for each 100 ha (1250 units) vi. Up-gradation of Indian Grass Land and Fodder Research Institute Jhansi to Deemed to be University **Sub-total**	100 50 700 50 50 100 **1050**	**1050**
5.	Animal Husbandry activities including a meat and milk processing plant	100	**100**
6.	Diversification into Horticulture (10,000 ha)	50	**50**
7	Forest land (60,000 ha @Rs.12,000/ha)	72	**72**
	Grand Total		**3,866**

MEDIUM AND LONG-TERM REHABILITATION PACKAGE FOR BUNDELKHAND (MADHYA PRADESH)

(Rs. In crores)

Sl.No	Name of the Sector	Amount	Grand total
1.	**Institutional Credit**		
	i. Debt Relief	530	
	ii. Weather/Crop Insurance	50	
	Sub-total	**580**	**580**
2.	**Watershed Management**		
	i. Watershed Management in Arable and Wasteland (4 lakh ha @ Rs.12,000/ha)	480	
	ii. Farm Ponds (30,000 ponds @ Rs.60,000 per pond	180	
	iii. Construction of new dug wells (20,000 dug-wells @ Rs.1 lakh per well)	200	
	iv. Renovation of dug-wells, tanks and ponds & recharging (22,000 structures)	440	
	Sub-total	**1300**	**1300**
3.	**Water Resources**		
	i. Development of Water Resources	**1118**	**1118**
	ii. Ken-Betwa River Linkage	National Project	National Project
4.	**Agriculture**		
	i. Contingency cropping, seed multiplication, banks, etc (8 lakh ha)	100	
	ii. Micro Irrigation (20,000 ha)	50	
	iii. Warehousing, marketing infrastructure(@Rs.100 crore per district)	600	
	iv. Mechanization for zero tillage, broad bed & furrow system, multipurpose planter (@Rs.30,000 + tractor 4.5 HP @ Rs.4.8 lakh each – one set for each 100 ha) (2500 units)	100	
	v. Capacity building	50	
	vi. Strengthening of Agricultural College, Tikamgarh	20	
	Sub-total	**920**	**920**
5.	Animal Husbandry and Fisheries including meat and milk processing plant	**100**	**100**
6.	Diversification into Horticulture (10,000 ha)	**50**	**50**
7.	Forest Land (2 lakh ha @ Rs.12,000/ha)	**242**	**242**
	Grand Total		**4,310**

2.0 Background information of Bundelkhand region

Bundelkhand region is located between $23^0$20' and $26^0$20' N latitude and $78^0$20' and $81^0$40'E longitude. Administratively the region comprises of thirteen districts - seven districts of Uttar Pradesh viz., Jhansi, Jalaun, Lalitpur, Hamirpur, Mahoba, Banda and Chitrakut and six districts of Madhya Pradesh viz., Datia, Tikamgarh, Chattarpur, Damoh, Sagar and Panna.

It is predominantly an agrarian economy; over 80% of population is dependent on agriculture, livestock, usufructs from forest and outsourcing income by seasonal migration after *Rabi* sowing. Income (Fig 1) and livelihood analysis (Table 1) of Jhansi district carried out in 2002 is quite representative of the Bundelkhand region.

On an average 96 percent of the farmers' income is being earned from the crop and livestock enterprise alone. The share of crop component increased and that of dairy decreased with increasing land holding size of the farmers. However, landless villagers' livelihood was mainly dependent on labour and dairy.

Table 1: Livelihood analysis of Jhansi district (Uttar Pradesh), 2002

Category of household	**Contribution of sectors**
1. Landless	Labour (mainly), livestock(minor)
2. Marginal farmers	Crops (60%), livestock (35%)
3. Small farmers	Crops (67%), livestock (26%)
4. Medium farmers	Crops (77%), livestock (20%)
5. Large farmers	Crops (84%), livestock (12%)
15-20% seasonal migration even in normal rainfall years	

Mining of stones, sand, gravel and building material, represent very low industrial activity and limited employment potentials for reducing dependence on agriculture. Bundelkhand region of Uttar Pradesh has the lowest density of population (280 persons/ Sq. Km) as compared to the highest of 776 in Eastern Uttar Pradesh and the state average of 690 / Sq. Km. In Bundelkhand region of Madhya Pradesh the population density was still lower (184/ Sq. Km). Lack of investments, assured irrigation, other infrastructure, communication, improved agro-technologies, inputs and marketing make it most backward region of the respective states. All the districts of Bundelkhand portion of Uttar Pradesh except Jhansi and four out of six districts of Madhya Pradesh part are covered under the Backward Region Grant Fund (BRGF) scheme.

2.1 Geography and Topography:

The 7.08 Million hectares (M ha) Bundelkhand region is ravenous, undulating and hillocks are bounded by Vindhyan Plateau in south, river Yamuna in north, river Ken in east and rivers Betwa and Pahuj in west. While the Yamuna flows from west to east, its first order tributaries viz., Betwa, Ken, Pahuj, Baghain, and Paisuni flow from south to north. Second order tributaries of the Yamuna namely, Dhasan, Jamni, Birma, Sonar, Katne, Bewas, Kopra etc., also drain the area. The entire system of drainage and stream flows forms a part of Ganga basin. The region generally slopes from south to north. The elevations in the area ranges from 600 m above mean sea level (amsl) in southern part to 150 m amsl near Yamuna River.

The region covering an area of over 7.08 Million hectares (M ha) in Uttar Pradesh and Madhya Pradesh is characterized by hard rocks, undulating terrain of varied slope. Geologically, entire Bundelkhand comprises of four major systems i.e i) Archaean: comprising of crystalline, impermeable or hard igneous and metamorphic rocks with poor aquifer (water yield 1-5 litres per second (lps)) and high run off producing potentials ii) Vindhyan: comprising of massive sandstone and limestone escarpments and hold relatively more ground water (5-25 lps yield) iii) Transitional: represented by post Aravali and pre Vindhyan period of sedimentary strata of sandstone and limestone and constitute reasonable aquifer (5-25 lps yield) and iv) Recent: comprising of large

scale alluvial deposits with high ground water yield (20-40 lps). Plate-I shows the administrative divisions of the Bundelkhand area in two states. Plate-II shows the physiography and the drainage systems prevailing in the Bundelkhand.

2.2 Soils:

The soils of Bundelkhand are broadly classified into deep and medium black in Southern part (44%), mixed red & black, red & yellow (56%) in middle part and alluvial in north. These major soils are locally known as *Rakar* (17.6%) and *Parwa* (38.5%) in red soil group and *Kabar* (31.4%) and *Mar* (12.4%) in black soil group (Plate-III). Heavy black and light red soils are extensively distributed in the region with unique properties and require very specific and targeted agro-technologies, cropping and farming systems.

2.3 Land Use:

About 8.8 % geographical area of Uttar Pradesh, 26.2 % of Madhya Pradesh and 21.4% of overall Bundelkhand is under forest and scrubs. About 50% of geographical area is cultivated and rest is under various other land uses. Chick peas, wheat, sorghum, paddy, maize, barley, lentil, sesame, mustard, groundnut, soybean, peas, urd, moong bean, vegetables and fruits are important crops. Trends in land use changes after 1985 can be seen in Table 2.

Table 2: Trend of Land use change (%) during 1985-2003 in Bundelkhand region (Uttar Pradesh & Madhya Pradesh)

Major Land use categories	1985	2003	Change
1. Forest cover/open tree cover	18.71	21.41	2.70
2. Land use other than agriculture (LUOTA)	5.16	6.40	1.24
3. Fallow & Rangelands	13.36	5.48	-7.88
4. Wastelands	11.25	8.44	-2.81
5. Cropped land	51.52	58.27	6.75

Area under crops, forest cover, net sown, double cropped and irrigated increased whereas wasteland, fallow and rangeland decreased since 1985. According to 2002 satellite data about 6.5% of the total land was available for grazing. Area under paddy, green gram, black gram and soya bean increased while cultivation of pearlmillet (Bajra), sorghum (Jowar), pigeon peas and maize decreased. In Uttar Pradesh Chickpeas cultivation went down by about 11% and area under peas went up by about 12%. In Panna, Damoh and Sagar Districts of Madhya Pradesh area under wheat decreased in the range of 13-18% whereas it increased in Chickpeas (gram) by around 19%.

2.4 Ground Water Resources:

Water aquifer is inadequate and non-dependable largely due to hard rock hydro-geological conditions. Except a belt along the Yamuna river and a few pockets here and there already having tube-well, water yield in

the remaining part is very low. It can support additional open dug-wells mainly because of high draw down in case of tube-wells.

2.5 Crop production:

Agriculture which is mostly rainfed has been the main livelihood occupation of the farmers in Bundelkhand region. Cereal contribute to the food grain production (54.6%) followed by pulses (32.4%), oilseeds (8.0%), sugarcane (0.2%) and other crops (4.8%) under normal rainfall years. The region is surplus in pulses, deficient in oil seeds and sufficient in cereal production. Unlike other agro-ecologies *rabi* sowing (69%) in Bundelkhand region predominates over *kharif* (31%*)* which is a paradox. As compared to Uttar Pradesh (51%) relatively lesser percentage (43%) of the geographical area of Madhya Pradesh is under cultivation.

2.6 Livestock:

Bovine and small ruminants rearing are an integral part of agricultural production system in Bundelkhand and contribute significantly to the livelihood of the farmers especially women headed, landless and small farmers. Both large ruminant rearing of cattle and buffaloes and small ruminant rearing of goat and sheep are being practised in the region. Although significant proportion of livestock is low productive, the role of animals as a coping mechanism, especially during the drought years is well recognized in the region. Livestock sector in this area is characterized by high population of unproductive cattle, indigenous milch animals with low productivity, ineffective input delivery mechanism,

traditional milk marketing systems and lack of adequate feed resources both quantitatively and qualitatively. The traditional practice of "Annapratha" in Bundelkhand region, where cattle are let loose for free grazing particularly during *kharif* season has been causing considerable problem in *kharif* crop production for meeting emerging challenges of demographic and economic developments.

2.7 Relative Development of Bundelkhand Region:

Quantitative multi-criteria assessment of progress achieved by regions and districts to prioritize investment or allocation of resources is available in the Planning atlas of Uttar Pradesh. The Bundelkhand region is lagging behind in terms of development, human, social, economic and environmental indicators as compared to other agro-ecological zones of the state. Relative ranking of 70 districts of the four regions of the state based on 36 indices covering agriculture, industry, economic and social infrastructure is quite revealing with scores ranging from 78 to 388. The Bundelkhand districts of Chitrakut and Banda were least developed as compared to other region. (Guatam Buddha Nagar, Ghaziabad, Meerut and Lucknow ranked top most, Table 3.

Table 3: Comparative development of Bundelkhand and other districts of Uttar Pradesh based on scoring of 36 indicators.

DEVELOPMENT CATEGORY AND SCORES		DISTRICTS
i) VERY HIGH DEVELOPMENT (125 - 388 scores)	:	GAUTAM BUDDHA NAGAR, GAZIABAD, MEERUT, LUCKNOW (Western Uttar Pradesh)
ii) HIGH DEVELOPMENT (105 – 125 scores)	:	JHANSI (Bundelkhand)
iii) MEDIUM DEVELOPMENT (90 – 105 scores)	:	JALAUN, MAHOBA (Bundelkhand)
iv) LOW DEVELOPMENT (78 – 90 scores)	:	LALITPUR, HAMIRPUR (Bundelkhand)
v) VERY LOW DEVELOPMENT (BELOW 78 scores)	:	BANDA, CHITRAKUT (Bundelkhand)

Source: Planning Atlas, Uttar Pradesh, 2006

Within Bundelkhand region only the district of Jhansi qualified under the category of High development. Out of the remaining six districts two districts i.e Jalaun and Mahoba are ranked in medium development, Lalitpur and Hamirpur in low development and Banda and Chitrakut in very low development category. The development of agriculture sector in Bundelkhand region (based on 10 indices) has also not been promising as all the seven districts of the region ranked beyond 40 in the overall state ranking list on 1 to 70 scale (1 being best). Almost similar is true for Madhya Pradesh part of Bundelkhand.

Table 4: Ranking of agro-ecological regions of Uttar Pradesh based on a few representative agricultural indicators.

	Av. Yield of food grains (q/ha)	**Intensity of cropping (%)**	**Distribution of fertilizers per ha of gross sown area (kg)**	**No. of regulated Mandis / lakh ha of net sown area**
WESTERN	25 (100%)	161 (100%)	154 (100%)	4.2 (100%)
CENTRAL	21 (84%)	153 (95%)	123 (80%)	3.7 (88%)
EASTERN	17 (68%)	155 (96%)	134 (87%)	3.0 (71%)
BUNDELKHAND	***12 (48%)***	***124 (77%)***	***39 (25%)***	***2.7 (64%)***
STATE AVERAGE	20 (80%)	153 (95%)	130 (84%)	3.5 (83%)

Values in brackets is percentage of maximum value of any region

2.8 Rainfall Pattern:

Rainfall is the ultimate source of surface, ground, green and blue water resources for raising biomass and other utilities. The average annual rainfall of Bundelkhand in Uttar Pradesh is 876.1 mm with a range of 786.6 to 945.5 mm. In Madhya Pradesh portion the average rainfall is 990.9 mm with a range of 767.8 to 1086.7 mm and is 13% more than the Uttar Pradesh part. About 90% of the rainfall is received in the monsoon season of July to September in about 30-35 events or spells. Rainfall variation within the season is important for crop production and rain in September is crucial for the maturity of *Kharif* crops and sowing of *Rabi* crops. Delayed on set of rains, early withdrawal or long dry spells in between also lead to drought like situation. The U.P. part of the region experienced rainfall deficit of 25% in 2004-05, 33% in the year 2005-06 which went up to 45% in 2006-07 and 56% in 2007-08 (Table 5). Five out of seven districts had more than 50% rainfall deficit. All the districts experienced meteorological drought.

In Madhya Pradesh part rainfall was almost normal during 2004-05 and 2005-06 except in the districts of Tikamgarh and Datia which experienced meteorological drought (Table 6). In 2006-07 the region experienced overall 37% shortfall in 5 out of 6 districts receiving deficit rainfall ranging from 27 to 47%. The overall shortfall in precipitation went up to 46% during 2007-08 with all the six districts having more than thresh hold deficit of 20% for declaring meteorological drought.

Table 5: Distribution of meteorological drought in Bundelkhand region of Uttar Pradesh.

Districts	Normal Rainfall (mm)	2004-05	2005-06	2006-07	2007-08
		% Deviation	% Deviation	% Deviation	% Deviation
Lalitpur	879	-19	-34	-54	-40
Jhansi	880	-39	-24	-52	-61
Jalaun	787	-23	-24	-47	-55
Hamirpur	851	-30	-37	-51	-50
Banda	851	-30	2	-52	-57
Chitrakoot	945	-14	-8	-22	-60
Mahoba	940	-19	-40	-21	-66
Region Total	**876.1**	**-25**	**-24**	**-43**	**-56**

Table 6: Distribution of meteorological drought in Bundelkhand region of Madhya Pradesh.

Districts	Normal Rainfall (mm)	2004-05	2005-06	2006-07	2007-08
		% Deviation	% Deviation	% Deviation	% Deviation
Chhatarpur	984.8	-10.0	-9.0	-44.0	-54.0
Tikamgarh	971.5	-46.0	-28.0	-43.0	-64.0
Damoh	1065.4	-9.0	53.0	-27.0	-22.0
Sagar	1086.7	-12.0	44.0	-15.0	-35.0
Datia	767.8	-34.0	-29.0	-47.0	-34.0
Panna	1069.6	12.0	33.0	-46.0	-67.0
Region Total	**990.9**	**-16.5**	**10.0**	**-37.0**	**-46.0**

About 16% of the area is irrigated by major/medium schemes and 26% by the ground water sources and 2 % by minor surface water in UP part of Bundelkhand (Table 7). Irrigation with ground water is hardly once or twice in a year and that too is uncertain since dug wells do not hold water throughout the year. Efficiency of major and medium projects is about 50% and it is a poor quality of irrigation services. Accordingly more than 60% of the net sown area is dependent on rainfall and its

distribution. In MP part of the region percent area irrigated by ground water is higher than UP part. Area irrigated by major and medium schemes is very less (Table 8) and over all dependability is poor.

Table 7: Net irrigated area as percent of net sown area in Bundelkhand (Uttar Pradesh)

	Major/Medium Schemes	Ground Water (Wells)	Minor Surface Water	% of net irrigated area to net sown area
JALAUN	13	27	2	42
JHNASI	7	14	4	25
LALITPUR	9	39	1	49
HAMIRPUR	35	28	1	64
CHITRAKOOT	5	18	6	29
BANDA	22	27	1	50
MAHOBA	19	26	2	47
REGION TOTAL	**16**	**26**	**2**	**44**

Source: Minor irrigation census (2001)

Table 8: Net irrigated area as percent of net sown area in Bundelkhand (Madhya Pradesh)

	Major/Medium Schemes	Ground Water (Wells)	Minor Surface Water	% of net irrigated area to net sown area
CHHATARPUR	6	47	12	65
TIKAMGARH	7	64	7	78
DAMOH	1	28	11	40
SAGAR	2	18	8	28
DATIA	10	29	1	40
PANNA	1	10	13	24
REGION TOTAL	**4**	**33**	**9**	**46**

Source: Minor irrigation census (2001)

2.9 History of drought occurrence:

As per historical records there have been only twelve drought years in Bundelkhand during the whole of 19th and 20th century i.e. once in 16 years. Frequency of drought increased from one to three in 16 years during 1968-1992 (Rameshwar Singh *et.al.*, 2002). The past four years since 2004-05 are experiencing drought like conditions in some parts of the region. Climatic changes have increased frequency of extreme weather events during past 15 years and raised the vulnerability and risk. There are several manifestations of drought like late arrival of rains, early withdrawal, long break in between, lack of sufficient water in reservoirs and drying up of wells leading to crop failure and even un-sowing of the crops which ultimately curtail livelihood and may lead to migration.

2003 **2008**

Fig.3: Progressive effect of drought in Banda Pond of Datia District which dried up for the first time (18 ha submergence area)

2.10 Meteorological Drought:

More than 19% deficit in the normal rainfall, late onset of monsoons, early withdrawal of rains, long breaks during growing season and their permutations or combinations are several manifestations of triggering drought. The present drought in UP Bundelkhand was initiated in 2004-05 with 25% shortfall in rains and deficit continued in the next year also (Table 5). The shortfall in rainfall was further aggravated to 43% in 2006-07 and 56% in 2007-08. The rainfall failure exceeded 60% (severe drought) in Mahoba, Jhansi and Chitrakut in 2007-08. In MP the initiation of drought was only from the year 2006 – 07 except in the districts of Tikamgarh and Datia (adjoining UP) which have been experiencing deficit rainfall for the past four consecutive years (Table 6). The cumulative build up of meteorological droughts rippled into hydrological drought with a complex set of highly differentiated adverse impacts and tradeoffs.

2.11 Hydrological Drought:

Reservoirs get inflow from large catchment and give a true average picture of drought in the region**.** Considering the total storage capacity of 2013 MCM in the 28 existing reservoirs

and weirs in UP Bundelkhand, the actual filling during the period of 2004 to 2007 progressively decreased and in 2008 only 17% of the capacity was filled (Fig.4). In MP portion the situation was even more alarming. As against the total storage capacity of 950 MCM of 19 reservoirs of Madhya Pradesh, the actual filling progressively reduced from 52% in 2004 to 10% in 2007. Though the rainfall deficit was comparatively severe in UP part than MP part, the position of filling of reservoirs in UP part was better. This was mainly because of the fact that unutilized water from the Rajghat reservoir was able to sustain other reservoirs in UP Bundelkhand. Drying up of 70% of the tanks, ponds and dug-wells and fall in ground water table (Fig. 6) in the region clearly indicated the hydrological drought situation.

Fig.5:Dried dug-cum bore well in Banda district of UP

Fig.6: Decline in ground water table of Chhatarpur (MP) during continuous drought

Madan Sagar Tank (Mahoba)

During a visit to Mahoba city, District collector, Mahoba informed about great deal of hardships being faced by the people as the drinking water supply to the city dried up for the first time in last 900 years. The city was traditionally getting supplies from a 900-year-old tank called Madan Sagar Tank. This tank has a catchment of about 6 Sq. Km. and the ponding area is about 113 ha. After construction of Urmil dam on river Urmil, the tank has been getting supplies from this project through a feeder canal. Due to deficit rainfall in Urmil catchment in last four years practically no supplies were available from dam. Ten tube wells were bored up to 150 ft. in the tank bed but even the tube wells have gone dry. Further deepening of Tube Wells is not feasible due to rocky bed underneath. Different persons quoted different versions for failure in supplies, but the fact remained that there had been no rainfall in Urmil catchment and thus the storage in the Urmil dam dried after 2003.

2.12 Agricultural drought:

Meteorological and hydrological droughts described at 2.10 and 2.11 ultimately led to loss in the sown area, productivity, failure of already sown crops, non-availability of forages, grass and cultivated fodders.

Fig.7: Cracked soil and withered crop

Reduction in net sown area (Fig 8) as a function of deficiency in rain fall, reduced availability of water in the reservoirs and depletion of ground water was analysed. Overall there was 40% reduction in the net sown area for

the year 2007-08. In Mahoba district of UP 75% of the area could not be sown.

Similarly loss in the food grain production after the normal rainfall year of 2003-04 is given in the Fig.9. The food grain production declined by 6% in 2004-05, by 19% in the 2nd year and by 22% in the 3rd year of the drought. In MP about 42% of the area was unsown and was as high as 78% in the most important agricultural district of Tikamgarh. A temporal lag in the development of meteorological, hydrological and agricultural drought (Fig. 8 & 9) was quite natural. Meteorological drought in the initial years was moderate and farmers made some management adjustments to compensate for shortfall of rain. They also used extra ground water from wells and bore-wells which declined sharply. Ultimately 2007-08 became a full blown drought due to severe rainfall and overall hydrological shortfalls. Shortage of fodder and feed, distress sale of buffalos and letting loose of non–productive animals was reported during the field visits. Normally 15-20% of the labour out migrate from Bundelkhand after wheat sowing to outsource income even in the normal rainfall years and this figure was reported to 40% during the drought of 2007-08. There was a wide spread demand to increase employment days under National Rural Employment

Guarantee Scheme. Significant reduction in the arrival of agricultural commodities into the markets (mandis), distribution of fertilizers, other agro chemicals and seeds was also reported to the visiting team.

Excessive depletion of ground water resources and loss in fertility of the livestock due to non-availability of green fodder and minerals deficiency may recover in 4-5 years presuming normal rainfall subsequently. Loss in the productivity of grasses, shrubs, perennials and trees in the non-arable land was also seen which can be restored back in 2-3 years of normal or excess rainfall only.

The farmers have not repaid their loans to the lending institutions and have become defaulters for raising fresh crop loans. Secondary and tertiary level ripple effects of reduced consumption and market demand due to loss in productivity and income is confounding the complexities of adverse impacts of drought.

Liquidating of assets like mortgaging of gold or land, selling of animals, trees and raising consumption loans are quite common during the droughts. "Savai Pratha" i.e. borrowing grains and returning 25% extra later is common but this amounts to 25% interest. However, these facts could not be verified due to paucity of time and resources.

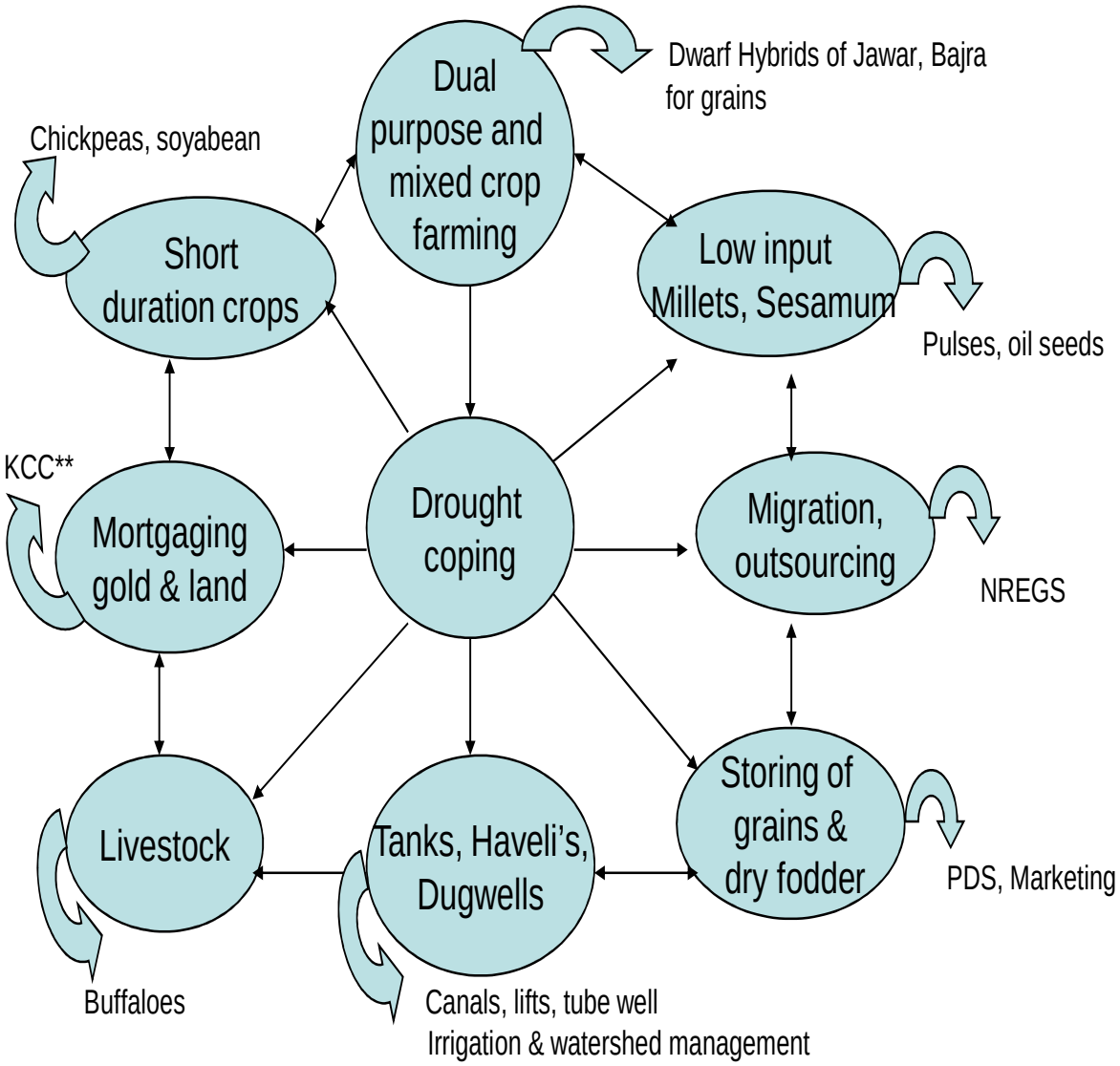
From all above facts and figures it is apparent that all districts of Bundelkhand were afflicted by severe drought cumulatively over two to four years depending upon the districts.

2.13 Prioritization of Mitigation Strategy:

The pro-active mitigating strategy of reducing vulnerability by enhancing coping mechanisms and resilience of the production systems is quite different than the calamity relief. The mitigation is also planned around normal or excessive rainfall years when there is enough precipitation for recharging soil with water, aquifers, surface storage and adequate production to acquire assets. Rainfall is the ultimate source of surface and ground water resources for managing risks and distress associated with spatial and temporal variability in the rainfall and its distribution pattern. Various coping mechanisms of cultivating drought tolerant dual purpose crops, mixed cropping, farming system, drought hardy millets, sesame, livestock rearing, storing of grains and fodder during normal or excessive rainfall years are quite common. Input intensive advanced technologies and ground water exploitation of Indo Gangetic plains was replicated at the neglect of traditional tanks, ponds and dug wells. Low input and low yielding subsistence farming was less risky. In a mixed system some component will give some return without a complete collapsing like Bt. hybrid crops. Mortgaging of gold or land, liquidating assets like selling trees or animals, raising loan, seasonal migration, taking children off the school and out sourcing of income are important for moderating or mitigating adverse effects of drought (Fig.10).

However these traditional mechanisms have been altered (shown by arrows in Fig.10) by technological changes, market forces, socio -

Fig.10:Dynamics of vulnerability, coping mechanisms and drought mitigation*



**KCC: Kissan Credit card

* Arrows indicate shifts in traditional coping mechanisms.

economic shifts, and public policies. Hybrids of Jowar and Bajra have increased productivity of grain at the cost of fodder for animals. Hybrid of sunflower, castor, Bt. Cotton etc. are input intensive and failure of crop or marketing leads to high distress. Drought resistant low input millets have been replaced by oil seed crops especially soyabean and pulses. Employment guarantee schemes, institutionalized credit and insurance system have also impacted the traditional vulnerability and coping mechanism.

Public distribution system encouraged marketing of surplus production during normal or excessive rainfall years instead of storing for contingencies. Public investments into surface, ground water resources and watershed management led to the neglect of Peshwa, Chandela or Bundela tanks, Haveli cultivation, dug wells and other traditional systems. Quarantine enforcement has restricted interstate movement of livestock as drought escaping mechanism or outsourcing of the resources. Ground water exploitation, increased availability of crop residues, fodder and feed led to stall feeding and rearing of buffaloes.

Kissan Credit Cards (KCC), institutionalizing credit raising and recent loan wavers may discourage lending from private money lenders. New varieties of soybean, chickpeas, mustard, sunflower, safflower and oil mills have encouraged diversification in various dimensions. The Bundelkhand does not cultivate some important cash crop except small acreage under oil seeds.

About 90% of the geological area of Bundelkhand is a hard rock with very poor yield of aquifer, fast depletion of water table and inadequate rate of replenishment or recharging. Development of ground water resources is not very dependable or attractive and aquifer water should be prioritized and preserved for drinking purpose. Therefore, watershed management, development of surface water resources, improving water use efficiency, enhancing biomass productivity of forest and livestock sector are the most important options of the new strategies. Watershed management in the upper most forest catchment is the highly prioritized starting point for integrated development of resources from ridge to valley. Therefore, watershed management, development of surface water resources, reviving of traditional dug-wells and tanks, desilting ponds, command area development and efficient micro irrigation systems should get high priority of the investment portfolio. Intensification of diversification, marketing, value addition, processing and ensuring the risks are also essential to consolidate gains of enhancing productivity and other mitigative effects.

3.0 Watershed Development:

Participatory integrated management of inputs and natural resources including social capital, innovative institutions and involvement of community is prioritized for Bundelkhand due to various reasons.

On an average irrigation potential for 45% of the net sown area of Bundelkhand have been developed, there is hardly 50% of its utilization and 60% dependent on rainfall is risky due to uncertainties of rainfall. About 29% of the irrigation with ground water mostly by dug-wells is highly non-dependable. About 90% of the rain is received in 30-40 events in 3 months and lot of runoff can be generated due to undulating topography if conservation measures have not been adopted.

Ground water resources of Bundelkhand region are inadequate with poor water yield due to its typical geological formation of impervious rocks with low porosity. Around 80% of the strata is hard crystalline with 1 to 5 litre per second water yield in Tikamgarh, Sagar, Panna, Datia, Damoh, Chattarpur, Mahoba, Lalitpur and Jalaun and exploiting ground water for irrigation is economically and practically unattractive. Another 10% area having sandstone, shales and limestone in parts of Jhansi, Banda and Hamirpur yield about 15-25 litres per second but occurrence is patchy and boring of wells at exact locations is not an easy task. Success rate of bore-wells tried in 2007 after resistivity survey and hydro-fructuring in Tikamgarh of MP adjoining UP was hardly 40% and it may be a risky preposition for investment. Hardly 10% of alluvium mostly along the Yamuna river, a part of Chitrakut, is unconsolidated with reasonable

yield of 20-40 litre per second but is already utilized especially in the district of Hamirpur. Recharging is also a slow process due to low porosity of the strata and occurrence of clay lens. About 0.8 lakh open dug wells privately constructed by the farmers in UP and 2 lakh in MP part can be used for recharging groundwater. Watershed development is most economical method of recharging rain water into the ground.

Conservation of rain water, soil and vegetation by watershed based interventions will improve perenniality of stream flows to provide value added surface irrigation.

3.1 Medium Term Strategy:

Common property or open access resources like Bundela, Chandela and Peshwa tanks, other water bodies, dug wells and ground water play important role in generating income, employment and livelihood. Renovation, repairs, desilting, raising embankment and crest height to increase storage capacity of check dams, tanks, ponds, deepening and recharging through dug wells, cleaning of irrigation channels etc. can be taken up. These activities may be dovetailed with NREGS, BRGF, Artificial Ground Water Recharging and other such schemes.

Digging trenches, constructing gully plugs, check dams, loose boulder check dams and gabions in non-arable land is the first step to improve biomass productivity. *In situ* conservation of rains by land shaping, contour/field bunding and many other practices consolidate the gains of interventions in the upper catchment. Cultivation of most suitable

crops, high yielding varieties, cultural operation, application of fertilizers are important to optimize benefits of investments into watershed.

3.2 Long Term Strategy:

River flows swell during rainy season, peak flow taper off rapidly and some of the secondary and tertiary level tributaries become dry during post rainy season. Improving seasonality or perenniality through watershed management, constructing reservoirs and other surface storage for irrigation is the logical strategy for mitigating droughts. The planning and implementation process should start from the upper to lower landscape of catchment for full harnessing of rain which falls in 30-40 days or events during monsoon. Sensitizing and organizing communities and other stake-holders into various institutions, participatory planning, complementation and exit protocols may be observed for long lasting solutions.

3.2.1 Farm Ponds:

Digging of farm ponds especially in black soils to store rainwater for providing irrigation at critical stages has been found very successful in similar conditions in many part of the country especially Gujarat and Vidharabha. They also help in recharging ground water and reviving dried up dug-wells. Farm ponds provide better equity and have advantages of private management. Of course large ponds for a Self Help Group of Small landholders on some common lands are also recommended.

3.2.2 Forest Land:

Integrated conservation and management of rainfall, soil, biomass, livestock and social capital in the undulating topography of Bundelkhand should follow the natural sequence of treatments from ridge to valley. Uppermost landscape of the catchments and watersheds become high priority area. Tops of hillocks and upper catchments are generally occupied by forest especially in the districts of Panna (38%), Damoh (36.5%), Sagar (28%), Chhatarpur (19.5%), Chitrakut (18% of area) and Lalitpur (11%). About 50% and 65% of forests of MP and UP part are open, degraded and scrub with less than 40% canopy. *In situ* conservation of rains, eroded soil, nutrients, seeds and vegetative propagules by digging staggered contour trenches on sloping land and loose boulder or gabion check dams in the nallas (streams) should be the foremost intervention. Recharging and water harvesting structures for livestock, wild life, supporting regeneration of vegetation, afforestation and limited irrigation of the adjoining farm land can enlist people's participation.

Planting of fruit, fuel and fodder trees, shrubs, seeding of grasses or pasture legumes to improve forage, transparent sharing of goods and services should be an essential component programme of Joint Forest Management Committees (JFMC). Fodder trees like *Albizzia Lebbek, A. procera, Hardwickia binnata, Leucaenia Leucocephola (K&S24), Sesbania grandifolia/aegyptica, Ficus sps. and Acacia nilotica* should be included in the plantation. Grasses like *Cenchrus ciliaris, Guinea grass and legumes*

like *Stylosanthes hamata, Clitoria ternatea* should be seeded on the soil excavated from trenches and in the barren spots. IGFRI Jhansi of ICAR may be consulted for any clarification regarding seeds or sapling of fodder trees, grasses and forage legumes etc. Sharing of forest produce with the participant community may be negotiated right in the beginning to bring local inhabitants on board for sustained management. In this way protection of forests catchment through incentivized social fencing is possible by making local community as important stakeholders in regeneration process. The package should be implemented only through well designed JFMCs according to the New Common Guidelines on Watershed Development Projects w.e.f. 1st April, 2008 brought out by National Rainfed Area Authority (NRAA). This programme may be integrated with CAMPA or other afforestation schemes wherever possible. About 60,000 ha area of degraded and scrub forest can be treated in UP and 2 lakh ha in MP within 3-4 years.

3.2.3 Wasteland:

This land may belong to revenue, Panchayats, community or private individuals. Self-Help Groups, User Groups, Cooperatives and Producer Companies of landless, small and marginal farmers can be organised for effective treatments to harness full benefits of investment to be made in upstream and downstream area. A long term lease of about 20 years to the community organisations registered under various acts would be essential. The programme may be linked up with ongoing schemes of IWDP, DPAP, Horticulture Mission, Bamboo Mission, NREGS and others.

Contour or field bunding, land shaping, constructing weirs in nallas (streams) to channelize flow, storing water for recharging or irrigation and retention of silt are important interventions. Community based water harvesting, check dams or other structures can be planned for sharing irrigation for critical stages. Agro-forestry, horticulture, animal husbandry, rearing small ruminants, cultivation of improved varieties of pulses, oilseeds and cereals could be important components of the farming system. Fodder tree species as mentioned above can be considered for agro-forestry model.

3.2.4 Private Lands:

Common Guidelines for Watershed Development Projects elaborate institutional and organisational arrangements for integrated management of resources including micro-enterprises may be followed. These guidelines may be observed for ensuring capacity building, community organisation, people's participation, planning and implementation. Activities are supposed to be converged with NWDPRA, National Food Security Mission, RKVY, Horticulture Mission, Bamboo Mission, Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), BRGF and other schemes. Field bunding, land shaping, contour cultivation, gully plugs, farm ponds, recharging through dug wells, deepening of existing dug wells are important for conserving rainwater. Cultivation of latest high yielding varieties of pulses, oilseeds and cereals tolerant to biotic and abiotic stresses elaborated in the chapter on Agriculture will improve productivity and income of the farmers. Enhanced production of crop residues like

karvi, bhusa, non-grain part of pulses and oilseeds can be dovetailed to improve rearing of livestock to augment income and employment throughout the year. Details of improved varieties of cereals, pulses and oil seeds are given in Chapter on Agriculture for improving seed replacement rate, diversification and intensification.

Mulching, weeding, broad beds and furrows, ridge and furrow system of sowing especially in black, heavy clayey soils is useful both during excessive or deficit rainfall with productivity gain of 30-40%. Sowing on raised beds or ridges avoids incidence of diseases in pigeon peas, chick peas, soybeans, maize, mustard etc. and promotes recharging of rainwater for subsequent crop cultivation. Custom hiring of specialized machinery would facilitate this new method of sowing to reduce risks of the cultivators.

3.2.5 Fund requirement:

A seven lakh ha (about 35% of net sown area) in UP and 4 lakh ha (22%) in MP @ Rs. 12,000/- ha is suggested. Construction of new ponds, dug-well, repair and renovation of old structures is also suggested. The total amount comes to be Rs. 1500 crores for UP and 1300 crores for MP. However, states should indicate their absorption capacity of alternative institutional mechanism. According to the new guidelines on Watershed Projects each state would require at least 70 PIAs @ one for 10,000 ha and 280 multidisciplinary professionals for Bundelkhand region of each state.

4.0 Water Resources Management

4.1 Introduction:

Bundelkhand region receives water from a number of perennial rivers most of which originate in Madhya Pradesh and outfall into the Yamuna in Uttar Pradesh. While the Yamuna flows from west to east, its first order tributaries viz., Betwa, Ken, Pahuj, Baghain, Paisuni and Gunta flow from south to north. Second order tributaries of the Yamuna system namely, Dhasan, Jamni, Bearma, Sonar, Patna, Bewas, Kopra etc., also drain the area. The entire drainage forms a part of Ganga basin. The region generally slopes from south to north with elevations ranging from 600 m above mean sea level (amsl) to 300 m amsl in Madhya Pradesh and to 150 m amsl in Uttar Pradesh. Madhya Pradesh part is conspicuous of undulating rocky ravine topography coupled with level plains while Uttar Pradesh part gradually slopes from mild ravines to alluvium level plains near the Yamuna. Plate –II shows the physiograpy and Plate-IV shows drainage system prevailing in the Bundelkhand region. Precipitation is the ultimate source of fresh, green and blue water. Ground water has played a predominant role in irrigation development in both the states and surface water is relatively under developed in MP when compared to UP.

4.2 Irrigation Status:

While geographical area in MP is relatively more than UP, net sown area in both the states is almost equal (about 18 lakh ha). Bundelkhand has different levels of development with ground water more predominant over surface water in both the states. According to third – Minor Irrigation Census (2000-01), about 45.6% of UP and 44.7% of MP net sown area (NSA) is irrigated by canals, dug wells, shallow tube wells, lift irrigation and other flows. Major portion of this, i.e., 26.7% of NSA in UP and 31.7% of NSA in MP is irrigated by ground water. Surface water contribution on the other hand is 18.9% in UP and 12.9% in MP with about 50% utilization. Surface water development from major and medium projects is comparatively under developed in MP. While UP has developed 16.7% from 28 major and medium projects and 2.2% from minor surface flow and lift irrigation schemes, MP on the other hand has developed only 3.9% from 19 major and medium projects and 9.0% from minor surface water flow and lift schemes. List of these schemes in UP and MP is given at appendix – III and V respectively. Overall *Kharif* irrigation in both the states is about 5% and Rabi about 95%.

Most of the surface and ground water resources of UP part of Bundelkhand are developed except a small part of the Rajghat scheme where the canal network is more or less complete and the work on some minors is going to be completed very shortly. Therefore, additional irrigation potential in Uttar Pradesh can be created by lining of the system

to prevent losses due to seepage and efficiency improvement by land leveling, sowing on the ridges, irrigating in furrows and other micro irrigation techniques. There are possibilities of saving of about 30% of surface water by adopting most efficient systems of water conveyance, distribution and application. The other possibilities are to harvest rainwater by constructing check dams, digging farm ponds and more wells and recharging through watershed management programme to improve perenniality of the surface flows and ground water structures. Table 9 shows the irrigated area and percentage of total irrigation from different sources. UP has developed almost its share of surface water except in Rajghat Canal which is going to be completed very soon (Fig. 11). Incremental irrigation is possible by improving efficiency and net working of the system. Proper development of command, renovation of the old system and modernization is emphasized.

Fig.11: Surface Water irrigation as percent of total irrigation in each part of Bundelkhand

Table 9: Irrigable area and area irrigated from different source (thousand ha) in Bundelkhand

District	Geogr-aphical area	Culti-vable area	Net sown area	M&M system canals	Minor irrigation (MI) under different source						Total Irrigation from all source
					Ground water			Surface water		Total MI	
					Dug wells	Shallow tube wells	Deep tube wells	Flow	Lift		
Uttar Pradesh											
Lalitpur	386.5	324.8	299.7	27.45	11.34	45.75	59.66	1.38	2.43	120.54	147.99
Jhansi	313.3	219.3	199.9	13.62	9.61	15.75	1.62	4.68	3.90	35.55	49.16
Jalaun	401.4	324.2	303.9	37.92	10.90	34.52	37.74	2.00	3.46	88.60	126.52
Hamirpur	457.8	371.4	337.1	118.09	7.16	26.71	61.00	1.03	0.51	96.41	214.50
Mahoba	484.0	356.2	306.0	57.24	41.43	30.71	8.76	0.83	5.51	87.25	144.48
Banda	509.9	387.7	213.3	46.74	52.08	2.06	3.80	0.17	2.85	60.97	107.71
Chitrakoot	278.0	203.7	194.1	8.83	31.95	2.22	0.30	10.63	0.87	45.97	54.80
Total	2830.5	2187.3	1854.0	309.89	164.46	157.71	172.88	20.71	19.51	535.27	845.16
Percent of Net Sown Area				*16.7*	*8.9*	*8.5*	*9.3*	*1.1*	*1.1*	*28.9*	*45.6*
Madhya Pradesh											
Sagar	803.0	552.5	498.0	8.74	73.77	15.66	0.94	2.45	38.55	131.37	140.11
Damoh	574.8	334.4	303.4	1.80	69.30	15.02	1.43	9.30	23.01	118.06	119.86
Panna	458.9	265.9	235.5	2.67	12.99	9.00	1.34	8.16	22.37	53.86	56.53
Chhaterpu	876.7	429.3	363.0	21.73	171.06	0.57	0.41	20.42	23.86	216.32	238.05
Tikamgarh	443.9	281.2	240.1	16.85	150.48	2.96	0.31	9.62	7.42	170.79	187.64
Datia	481.0	232.9	212.0	20.72	52.55	9.25	0.53	0.48	1.53	64.34	85.06
Total	3638.3	2069.2	1852.0	72.51	530.15	52.46	4.96	50.43	116.74	754.74	827.25
Percent of Net Sown Area				*3.9*	*28.6*	*2.8*	*0.3*	*2.7*	*6.3*	*40.8*	*44.7*
Bundelkhand											
Total	6468.8	4283.3	3706.0	382.4	694.61	210.17	17784	71.14	136.25	1290.0	1672.41
Percent of Net Sown Area				*10.3*	*18.7*	*5.7*	*4.8*	*1.9*	*3.7*	*34.8*	*45.1*

Source – Third Minor Irrigation Census (2000-01), MI – Minor Irrigation

There are about 2 lakh dug wells created by the private investments of farmers irrigating 28.6% of the net sown area in MP, on the other hand

number of dugwells in UP is 78,476 irrigating only 8.9% of net sown area. In addition to making substantial contributions, dug wells are more equitably distributed in both the states. However there is tremendous scope to extend the water availability in the dug wells by their re-charging. The Central Ground Water Board, after detailed studies has also suggested that additional open wells can be dug. Farm ponds are other possibility which has not been fully exploited in this region.

There are 4,604 deep tube wells and 44,870 shallow tube wells in UP compared to 3,124 tube wells and 16394 shallow wells in MP. Tube well development is more pronounced in alluvium belt in Uttar Pradesh near Yamuna where its average yield is 37.5 ha per structure. The distinct variation in yield rates is primarily due to the hydro-geological characteristics dominant in the two states. Table 10 shows development of ground water in the region.

Table 10: Groundwater Structures in Bundelkhand

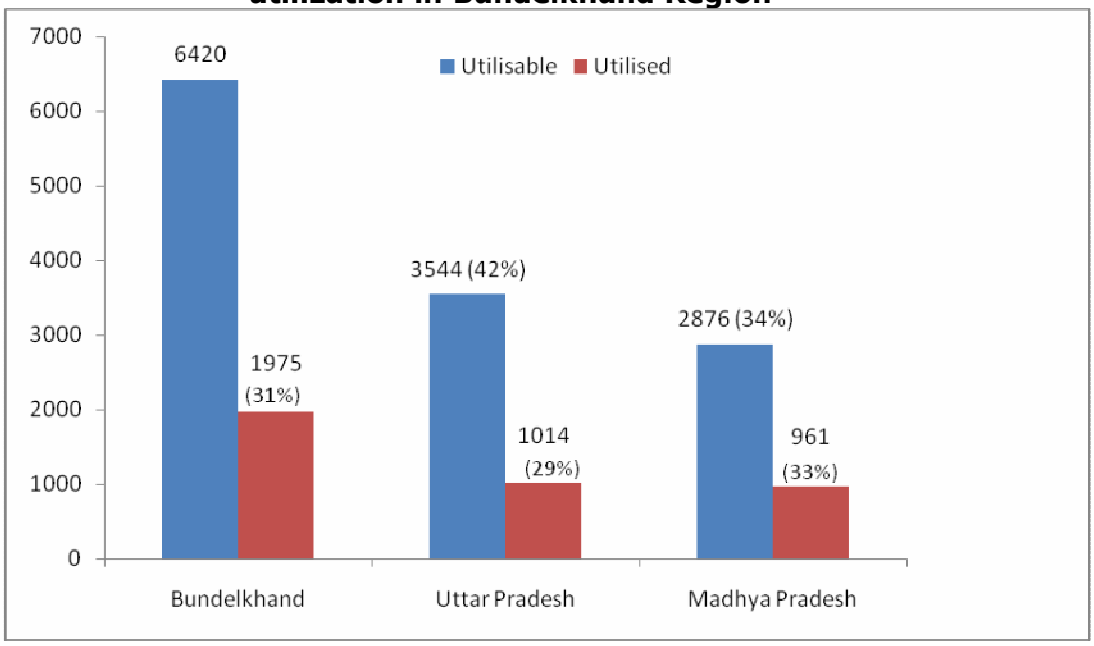
Sub-Region	Deep Tube wells	Shallow Tube wells	Dug wells	All Structures
	Numbers			
Uttar Pradesh	4604	44870	78476	127950
Madhya Pradesh	3124	16394	197507	217025
Bundelkhand	7728	61264	275983	344975
	Average area irrigated (ha) per structure			
Uttar Pradesh	37.5	3.5	2.1	3.9
Madhya Pradesh	1.59	3.2	2.7	2.7
Bundelkhand	23.0	3.4	2.5	3.1

Rajghat portion of main canal in MP is complete while works on distributaries is continuing. About 200 TMC of the surface water is still un-utilized in MP and need prioritization in future water investment portfolios.

4.3 Ground water development:

According to a study done by Central Ground Water Board, the total ground water resources of the Bundelkhand region are 8397 Million Cubic Meter (MCM) out of which 4632 MCM (55.1%) is in Uttar Pradesh and remaining 44.9% in Madhya Pradesh. Utilizable potential for irrigation in Bundelkhand region is around 6419 MCM (76%) out of which 3544 MCM (42%) is in Uttar Pradesh and 2876 MCM (34%) is in MP.

Fig.12: Available ground water Irrigation potential and utilization in Bundelkhand Region



District wise details of ground water resource and irrigation potential is given in table 11.

Table 11: Replenishable ground water resource (MCM) and level of development

District	Total Replenishable ground water recharge	Utilisable GW Resources for irrigation	Net Draft (1998)	Balance GW Resource	Level of Development (%)	Corresponding Utilisable Irrigation Potential (ha)
Uttar Pradesh						
Banda *	1400.89	1071.68	291.66	780.02	24.49	2679.20
Hamirpur**	969.20	741.44	201.69	539.75	24.48	1853.60
Jalaun	1020.18	780.44	149.81	630.63	17.28	1951.10
Jhansi	641.63	490.85	183.68	307.17	33.68	1227.10
Lalitpur	600.45	459.35	191.69	267.66	37.56	1148.30
Total	4632.35	3543.76	1018.53	2525.23	28.70	8859.30
Madhya Pradesh						
Sagar	845.90	647.10	177.60	469.50	24.70	1617.80
Damoh	489.10	374.20	71.10	303.10	17.09	953.40
Panna	389.20	293.10	59.50	233.60	18.27	732.90
Chhaterpur	1014.90	776.40	289.50	486.90	33.55	1941.00
Tikamgarh	766.90	586.70	319.50	267.20	49.01	1466.70
Datia	259.40	198.40	44.10	154.30	20.00	496.10
Total	3765.40	2875.90	961.30	1914.60	33.40	7207.90
Bundelkhand						
Total	8397.75	6419.66	1979.83	4439.83	27.70	16067.2[+]

* includes Chitrakut ** includes Mahoba [+]*0.43% of net sown area*

Present level of ground water utilisation in Uttar Pradesh, is 1019 MCM (29%) and balance ground water available for future development is thus 2525 MCM (71%). On the other hand present level of ground water

development in MP is 961 MCM (33%) and balance ground water available is reported at 19145 MCM (76%). It appears to be a rosy picture but present drought cycle of four years has completely depleted the available resource in the absence of recharge from rainfall and it is likely to take quite a few years to replenish aquifers if the good rainfall is restored. The water yield and re-charging rate are poor and ground water development is economically unsustainable. Table 12 shows expected yield in different districts of the region.

Table 12: Ground water extent and yield in the Bundelkhand region (area in %)

S. No.	Districts	Ground water yield (liters per second(lps))			
		<1	**1-10**	**10-25**	**25-40**
		Uttar Pradesh			
1	Chitrakut	55	-	35	10
2	Banda	-	70	30	-
3	Hamirpur	-	70	30	-
4	Jhansi	-	20	80	-
5	Mahoba	65	35	-	-
6	Jalaun	80	20	-	-
7	Lalitpur	100	-	-	-
		Madhya Pradesh			
1	Datia	55	45	-	-
2	Panna	95	05	-	-
3	Damoh	98	02	-	-
4	Sagar	100	-	-	-
5	Tikamgarh	100	-	-	-

Geo-hydrological formation of Bundelkhand is not very favourable as shown in table 13 given below:

Table 13: Geo-hydrological formation in Bundelkhand Region

S. NO.	Geological Formation	Water Yield (Liters/Sec)	Irrigation Potential ha/day
1	Crystalline rocks (Granite, Gneiss and Quarts)	1-5	0.1-0.2
2	Vindayans (Sand stone, Shale and Lime stone)	5-25	0.2-1
3	Unconsolidated (Clay, Gravel, Silt)	20-40	2-3

About 70 to 80% of aquifer is very poor yielding and remaining 20 to 30% is already exploited.

Overall ground water yield is more in UP as compared to MP part of Bundelkhand. Within UP Lalitpur, Jalaun and Mahoba have very poor yield as compared to Chitrakut, Banda and Hamirpur. In MP the ground water potential is poorest in Tikamgarh, Sagar, Damoh, Panna and slightly better in Datia. Distribution of ground water structure in the past conforms to the above said conclusions.

Central Ground Water Board carried out water pumping tests in 62 cases in UP Bundelkhand in the representative geological strata and results are summarized in Table 14.

Table 14: Summary of 62 Exploratory Drilling Tests by CGWB in UP

District	Water Yield (litres per minute)	Draw Down (m)
(i) Alluvial areas		
Banda	2628	7.7
Hamirpur	1778	5.4
Jalaun	3129	5.1
Average	2512 (3.6 times)	6.1
(ii) Hard Rock Area		
Banda	699	26.3 (4.3 times)

(Risk of investments)

There was lot of variation in the water output and draw down within a given strata and between the two geological formations and chances of ending up into a successful bore-well are very low. In Tikamgarh district success rate of bore-wells was hardly 40% and that too after detailed electro-magnetic surveys. Better aquifers are more or less already utilized and remaining ones are not dependable and investments into tube wells will be risky and distress prone like in Vidharbha, Andhra and other such cases. However, Central Ground Water Board (2002) recommended additional dug wells in Bundelkhand for harnessing low yielding ground water in hard rock area and Central team also endorses the same. Shallow tube wells may be considered in selected area and that too for drinking purpose mainly.

4.4 Surface water development:

With three main perennial rivers viz. Ken, Betwa and Dhasan and a large number of their first and second order tributaries, streams and nallahs, Bundelkhand region has predominant surface water resource potential. The general feature of these rivers is that these swell during monsoon and almost dry up during summer. Canals, including lift canals are the main source of irrigation followed by tubewells, dug wells and surface water ponds/tanks. While Yamuna, Ken, Betwa, are perennial, their tributaries and other small streams are seasonal. The 75% dependability of flows in these three rivers at prominent locations is briefly discussed below:

4.4.1 The Betwa at Rajghat:

As per agreement between the two States, about 3370 MCM (119 TMC) of water is available at 75% dependability, out of which about 250 MCM (9 TMC) or 7.4% is meant for downstream committed use and another 750 MCM (26.5 TMC) or 22.2% each is reserved for down stream use in both Uttar Pradesh and Madhya Pradesh. Remaining 1500 MCM (53 TMC) or 44.4% is reserved for use by Madhya Pradesh upstream of Rajghat dam. Remaining 120 MCM (4 TMC) are planned losses from reservoir. Rajghat is a joint venture of the two States, which is nearly complete and its command is now under development. There are agreements on sharing of use of Betwa system between the two co-

sharing States. Command development should be the immediate highest priority to ensure out comes.

4.4.2 The Dhasan:

Details on flows of this river are not available with the team. It is reported that UP has almost completed irrigation development in the basin while the development in MP is only partial.

4.4.3 The Ken at Daudhan Dam site:

On the basis of information available with the central team, out of the total water availability of 6188 MCM (218.5 thousand million Cubic feet (TMC)) at 75% dependability at proposed Daudhan dam site on the Ken, presently 205 MCM (7.25 TMC, i.e. *3.3%)* is being utilized by MP in Sagar and Panna districts and 1050 MCM (37 TMC, i.e. *17.0 %)* is being utilized by UP in Banda & Chitrakut districts from Bariyarpur barrage mainly during Rabi season. In this way nearly a major portion of waters of Madhya Pradesh is yet to be utilized by Madhya Pradesh. Bariyarpur left bank main canal (AIBP) is presently under construction and only 2650 ha is developed under phase-I so far. Phase-II of the canal covering 10,505 is presently under development while phase-III covering 25,835 ha is yet to be initiated. MP is yet to develop Bariyarpur right bank canal completion of the work at an early date is emphasized.

4.4.4. Other Rivers:

In addition, small rivers like the Paisuni, Gunta and the Baghain originate within Utter Pradesh and have comparatively small contributions for use within Uttar Pradesh which are nearly utilized.

4.5 Performance of Surface Water Schemes during Droughts:

4.5.1 Canal System in Uttar Pradesh:

Barring Rajghat, which is a joint project of the two States, 25 surface water irrigation projects are providing irrigation in Bundelkhand region of Uttar Pradesh and 3 in Madhya Pradesh. A live storage of 2013 MCM (71 TMC) is provided while in a good year actual effective storage is of the order of 70 to 75%. Appendix -III gives a list of existing projects. This table also provides performance of reservoirs through post monsoon storages which indicates that during 2004 and 2005, storages in the reservoir was about 71% to 74 % and was considered as normal in spite of 24% and 28% shortfall in rainfall. On the other hand reservoirs could not be filled up during 2006 and 2007 as post monsoon storages depleted to 28% in 2006 and 17% in 2007 due to 40 and 54% rainfall deficit and canal supplies for irrigation had to be curtailed drastically. It may be seen from this table that performance of many of these schemes during 2004-05 and 2005-06 was good mainly due to 1-2 years of cushioning effect.

In all 23 canal systems are fed from 28 reservoirs. Table 15 given below shows the performance of the canal tails. Out of 1050 tails in 23

canal systems, water could be supplied to only 566 (54%) tails in 2006-07 and which further went down to 37 (3.5%) tails in 2007-08 primarily due to curtailed water supplies.

Table 15: Performance of Canal (no. of tails which could be supplied water)

District	No. of Tails	Tails supplied			No. of Tails	Tails supplied	
		2006-07	2007-08	District		2006-07	2007-08
Jhansi	160	81	19	Mahoba	97	36	-
Jalaun	291	289	16	Hamirpur	100	28	-
Lalitpur	119	95	-	Chitrakoot	88	22	-
Banda	184	9	-	MP Portion	11	6	2
				Total	1050	566 *(53.9%)*	37 *(3.5%)*

Appendix - IV provides canal wise performance of irrigation during recent drought years. It is observed that as against planned *Kharif* irrigation of 126 thousand ha, the same was supported in an area of 71 thousand ha *(56%).* Against recent normal, the effect on *Kharif* is of the order of 11% in 2006-07, which is insignificant. On the other hand, as against planned Rabi of 428 thousand ha, the achievement was 527 thousand ha *(123%)*. It may be seen that despite reduced filling of reservoirs during 2006-07 irrigation could be maintained by ground water recharged from previous years of recharging by the canal. Therefore, assured recharge/return-flow in the system is playing an important role in stabilising the irrigation and mitigation of droughts and should be planned or managed as an important conjunctive use component.

Apart from Rajghat, 2 medium and 3 minor irrigation schemes are ongoing which are reported 55% to 95% complete. While 16 more dams are proposed, there is hardly any immediate urgency of new surface irrigation projects in UP except when some water is exchanged through Ken-Betwa linkage. There is, however, urgency to improve efficiency of the existing system by lining of canals, distributaries, land leveling, sowing on ridges and irrigating in furrows, sprinkler, drips and other micro-irrigation system. In this way 30-40% saved water can be used for expanding command.

4.5.2 Lift irrigation system in UP:

In all 37 lift irrigation schemes (LIS) are in operation in the UP region irrigating 17.79 thousand ha with 93% utilization efficiency. Majority of these are in working condition and have reported about 93% performance even in drought year (2006-07) mainly due to their location on the banks of perennial rivers of Yamuna, Betwa, Dhasan and Ken. Table 16 given below shows the performance of these lift schemes during 2006-07. Only one such scheme in Jalaun district is reported sick requiring rehabilitation.

Table 16: Performance of Lift Irrigation Schemes in 2006-07

Unit: Hectares

District	No. of Minor LIS	Command	Irrigation in a recent normal year (1998-99)	Irrigation in 2006-07
Jhansi	4	8361	3639	3735
Jalaun	6	2494	1068	1027
Lalitpur	-	-	-	-
Banda	8	12229	3036	2745
Hamirpur	10	10660	5794	4984
Chitrakoot	8	10860	4255	4093
Mahoba	1	2832	-	-
Total	37	47436	17792	16584 *(93.2%)*

4.5.3 Command Area Development:

Under the command area development programme of the Ministry of Water Resources, Betwa and Gursarai canal projects and Ken projects have been included for on farm development works in the respective commands. Under the programme earthen field channels are constructed and some portion of the field channels is lined. Field drains, link roads for farms and water control structures are also built as a part of the programme. Osrabandi (Warabandi) is encouraged in the command area. Software activities like field demonstrations, farmers' fairs, exchange programmes, training of personnel, horticulture and animal husbandry programmes and maintenance of OFD works are also taken up. Evaluation studies done on these canal systems have demonstrated over all positive

impacts, though not optimal. While there had been some benefits of the programme, the level of productivities and production are still on lower side. There appears to be an urgent need to improve conveyance efficiencies. Systematic demand side, approach is required for management of all the canal systems in a holistic manner taking full advantage of the 'Restructured Command area Development and Water Management Programme' with participatory efforts. Rajghat and the remaining systems should also be brought under the purview of Command Area Development and Water Management programme. Wherever feasible, gradual shift to highly efficient pressurized systems like drip, sprinklers should be attempted.

4.5.4 Requirement of Funds for Irrigation by Uttar Pradesh:

Discussions with the state officials and information made available to the team suggested that in the sector of Water Management, no new works are proposed in the immediate future as all economically feasible development in the Bundelkhand region in Uttar Pradesh is almost nearing completion. Fund requirement for ongoing development projects are already allocated and the projects are already proposed under respective schemes of various ministries. There is a need to optimize the use and distribute supplies efficiently and equitably including introducing conservation measures to reduce losses, waste and leakages; implementing demand regulations through participatory efforts etc. Deferred maintenance of the vast network of canals over the past many

years have been hampering the operation of canal systems in the state. It is, therefore, an utmost priority to restore all existing works which need immediate attention and large amounts to enhance efficiencies of system operation at all levels. Works of immediate nature have already been started from state funds for which some provision is made in the state budget. However, as the quantum of works is large, they would need sufficient funds and central assistance in this regard would certainly help in restoring the canal network and other storage work to their design capacities.

Due to deficit rainfall in Bundelkhand region, revenue collection has been stayed by the Government of Uttar Pradesh and all seven districts have been declared drought affected. Following immediate measures are under consideration by the Government:

1. As a short term measure silt clearance in all affected ponds/tanks is proposed to be carried out within a span of one year through state funds. Rehabilitation and renovation of ponds/tanks can be taken up under Rehabilitation, Renovation and Repair (RRR) schemes of MoWR and NREGA. There appears to be no potential for further development of ground water for irrigation. Digging of new dug wells, boring of shallow tube-wells for the purpose of drinking water supply should be taken up where ever there is a possibility of storing water by individuals/ communities/WUAs. Repairs and renovation of tube well schemes should be taken up as a priority measure.

2. As a medium to long term measure restoration of canals under ERM is proposed for which it is suggested that specific allocation be made available.

   Roof top rain water harvesting, farm pond, should be encouraged to increase recharge to ground water. Modernisation of Madan Sagar tank including its beautification in Mahoba is strongly recommended to improve supplies to the Mahoba city.

3. As a long term measure of more than years or so, it is suggested to complete all ongoing and proposed irrigation schemes, restore all infrastructures of gravity and lift canals and their appurtenance works. Improving conveyance system, lining of canals where ever necessary, and repairs of other pucca structures, repairs and deepening of dug wells and shallow wells for drinking supply purposes, development of the Rajghat command, are some of the areas where the team recommends investments.

Keeping in view investments already made by the state, likely incremental benefits, length of pendency of the project, resources to be developed, administrative approvals given etc., fund requirements have been prioritized and suggested in Table 17.

Table 17: PRIORITIZATION OF WATER RESOURCE DEVELOPMENT SCHEME RECOMMENDED FOR FUNDING FOR UTTAR PRADESH

Sl. No.	Details of the Scheme
1.	Restoring capacities of canals, lining of canals, repairs to other pucca structures, renovation and remodelling of canals and construction of new canals for the purpose of integration of canals and ponds/tanks etc.
2.	Command Area Development of Rajghat Canal Systems
3.	Repair and renovation of Ponds/Tanks including development of its command areas
4.	Changing pump sets, reconstruction of water distribution network etc.
5.	Completion of ongoing works of dams, canals etc. including restoration of works of dams
6.	Repair of Lift Irrigation Schemes in Jalaun district

4.5.5 Canal system of MP:

Apart from Rajghat system in Datia district, canals from medium and minor irrigation projects are an important source of irrigation in MP. As per records made available to the central team, 19 major and medium projects have been taken up so far totaling development of live storage of 950 MCM and a culturable command area of 322 thousand ha with planned irrigation potential of 148 thousand ha has been developed so

far. Appendix - V shows list of projects taken up so far in Madhya Pradesh. This table also shows performance of storages during recent drought years. Against a live storage of 950 MCM, normally these reservoirs stored up to 750 MCM (79%) but during 2004-05 and 2005-06 these systems were able to store during post monsoon only 521 MCM (54.8% of normal) and 466 MCM (49.0% of normal). The post monsoon storages further depleted to 172 MCM (18.1%) and 105 MCM (11.8% of normal) during 2006-07 and 2007-08 when irrigation supplies during Rabi were curtailed in the interest of water supplies. While projects are reportedly planned for around 79-80% of storage efficiencies under normal years, these operated from 11% to 55% of storage efficiencies.

The actual irrigation practised is, however, less than 50%. Kharif irrigation is roughly around 10% of Rabi irrigation. Discussions during the visit revealed that during the four drought years, the system were not able to deliver even 10% planned Kharif supplies and practically negligible Kharif was supported. However, about 50 thousand ha (37%) of Rabi crops could be irrigated during 2004-05 and 2005-06. Supplies in many canals during 2006-07 and 2007-08 had to be curtailed and Rabi could be supported in only 24.26 thousand (16.4% of planned) and 7.15 thousand (4.8% of planned) respectively during these two years. Appendix - VI shows performance of irrigation of major and medium projects in MP during recent droughts.

4.5.6 Lift irrigation system in MP:

Performance of LIS in MP is unsatisfactory. There are 31 lift irrigation schemes in MP portion, only 8 worked that too occasionally and irrigated 5.4 to 9.5% of planned in the last four years.

Table 18: Performance of lift irrigation schemes in MP

District	No of LIS	Pumping Capacity (HP)	Planned Irrigation (ha)	Actual irrigation (ha)			
				2004-05	2005-06	2006-07	2007-08
Sagar	10	1562	2046	138	58	66	0
Damoh	2	355	1012	518	523	543	520
Panna	5	863	1958	0	0	0	0
Chhaterpur	6	675	2452	527	101	61	0
Tikamgarh	8	2335	4973	0	0	0	506
Datia	-	-	-	-	-	-	-
Total	31	5790	12441	1183	682	670	1026
Percentage of Planned				9.5%	5.5%	5.4%	8.2%

Table 18 shows district wise performance of irrigation from lift irrigation schemes. The major reasons for non-operationaliztion of most of LIS which were put forth by the officials and farmers during field visit were (i) lack of maintenance of the machinery by Water User Associations (WUAs) to whom almost all schemes were handed over to WUAs after enactment of Participatory irrigation Act, (ii) nonpayment of electricity bills to Madhya Pradesh Electricity Corporation by WUAs for various

reasons and (iii) lack of continuous power supply and low voltage problems.

Visit to Londi Lift Irrigation Scheme in Chhatarpur

A visit was made to a Lift irrigation scheme on the Kel river, a tributary of the Ken in Londi Tehsil of Chhatarpur district. This scheme was inaugurated in 1973 and has been lying idle since last 12 years. Three pumps (one standby) of 60HP each had been installed to lift 5.5 cumecs of water by around 60 m. As the source of the scheme is perennial, the scheme provide assured 101 ha of Kharif and an equal amount of Rabi irrigation. When the team visited the site, the river was full of water, the motors were reported to be in order and the transformers working. Even the canal was in very good shape. The villagers reported that the scheme is not working due to non-payment of electricity charges since around 2000. Officers of the Irrigation department informed that the department had earlier handed over the motors to WUAs and has now taken it back and attempts are being made to clear pending bills of the order of Rs. one lakh or so. In this process about 100 ha of CCA has been denied irrigation for almost 10 years and the farmers are left to the mercy of rains. At a rate of net income of Rs. 15000 per ha per season, beneficiaries lost around Rs. 3 Crores. And this happened when water was available in the river even in a severe drought year of 2007-08 and the system was working.

These schemes could be easily made operational through interventions like (i) ensuring dedicated electricity at proper voltage, and (ii) a minor investment cost by the government to the tune of Rs. 10.41 crores, out of which Rs. 6.27 crores is the electricity liability. The team suggests urgent revival of these schemes and recommends central grant of Rs. 10.41 crores for this purpose.

4.5.7 Command Area Development in Madhya Pradesh:

Command Area Development Programme of Ministry of water Resources is not taken up in the Bundelkhand region of MP. Rajghat Canal Command Area and a number of other schemes can be taken up on priority. GoMP has suggested that 14 new schemes can be included costing around Rs. 290 crore, which also includes Rajghat canal command. It is proposed to cover 179.08 thousand ha under the programme spread over next 10 years or so. The programme includes provision of construction of field channels, field drains, and training and capacity building of farmers and functionaries. These projects should be taken up on priority and specific allocation of about 100 crores should be made available for this purpose under CADWM programme of MoWR.

4.5.8 Requirement of Funds by Madhya Pradesh:

i) Ongoing Schemes:

Presently Bariyarpur canal Project is ongoing since 1978. It is reported that progress on this project is slow mainly due to non-clearance from environment angle as the canal passes through Panna Reserve forest. GoMP has desired that a sum of Rs. 236.46 crores be made available for speedy completion of this project in 2 to 5 years. It is recommended that steps be taken for speedy clearance of this scheme by appropriate authorities and additional allocations be made under the

package as this project can quickly provide relief to vast areas in Panna district.

At present 9 minor irrigation schemes are ongoing in various districts to create planned utilisations of 24.64 thousand ha. Against a total cost of Rs. 189.98 crores an expenditure of Rs. 52.18 crores has already been incurred. Balance requirement is around 125 crores. It is recommended that this amount be provided to the State Government for speedy completion of these projects within a span of one to two years.

ii) Proposed projects

GoMP has proposed 18 new major and medium irrigation schemes in 5 districts, of which two medium schemes namely Surajpura tank, Singhpur barrage in Chhatarpur and Samnapur tank have been approved so far to irrigate 5.09 thousand ha at a cost of Rs. 132 crores and the rest are under survey. These two schemes may be considered for construction on priority and funds be provided for the same.

GoMP have proposed another 267 minor irrigation schemes in 6 districts of Bundelkhand out of which 104 have been reported sanctioned and for which administrative approvals have already been issued. These schemes costing around Rs. 285 crores can yield additional potential of 35.84 thousand ha. It is recommended that these schemes be considered for funding. The details of these schemes are in Table 19.

Table 19: MI schemes in Madhya Pradesh for which administrative approval is already issued.

District	No. of Schemes	Estimated cost (Rs. Lakh)	Designed Potential (ha)
Sagar	38	12200.84	16021
Damoh	35	9826.34	11006
Panna	2	112.31	504
Chhaterpur	25	3998.41	6124
Tikamgarh	4	2337.02	2188
Datia	0	0	0
Total	104	28474.92	35843

Large tanks to be used or shared on community basis are quite common. However, small ponds for each individual holding have proved very successful in Gujarat. Tremendous possibilities exist in Bundelkhand especially in heavy textured black, mixed black and red soils. These are dual purpose both for limited irrigation as well as recharging of normal wells. A pond upstream and open well down stream can also optimize the utilization of rainwater.

During the visit the team was informed that about 133 ponds/Tanks needed rehabilitation and restoration including development of its command covering a CCA of about 5502 ha at a cost of Rs. 16.39 Crores. These repairs can be taken up under RRR scheme of Ministry of water Resources or under provision from NREGA funds.

Visit to Ghruna Talab in Londa Tehsil of Chhatarpur district

Another visit to a village in Londa Tehsil of Chhatarpur district revealed that a major tank namely 'Ghruna Talab' having 0.605 MCM of storage in the area had dried up due to deficit rainfall. The Talab has a catchment of 1.25 Sq. Km. and feeds around 40 ha each in 4 villages. While Irrigation officials maintained that the tank had dried up due to practically negligible inflow, villagers on the other hand informed that the system has dried up mainly due to leakage from sluice and the canal intake which are damaged due to ageing. These tank could be repaired at a very small cost of Rs. 3 to 4 lakh, which could be easily done from NREGA funds.

4.5.9 Rehabilitation of Tanks/Ponds:

A large number of ponds/tanks/diversion structures, water conservation structures etc. exist in Madhya Pradesh. MI Census (2000-01) puts their number well above 12 thousand. GoMP has proposed to rehabilitate a large number of these small village level ponds/tanks in 6 districts and tanks on priority. GoMP has also proposed to raise heights of a large number of bundies through Rural Engineering Department and Soil Conservation schemes of MoRD. Repair and renovation of these traditional systems requiring Rs. 80 crore is recommended.

A prioritized list of the scheme is given in table 20. The Government of Madhya Pradesh should indicate its absorption capacity.

Table 20: PRIORITIZATION OF WATER RESOURCE DEVELOPMENT SCHEME RECOMMENDED FOR MADHYA PRADESH

Sl. No.	Details of the Scheme
1.	Incomplete Beriyarpur Project started in 1978
2.	9 ongoing minor irrigation schemes
3.	18 new schemes proposed out of which only 3 having administrative approval are recommended
4.	Another set of 267 minor schemes proposed out of which only 104 having administrative approval are recommended
5.	Command Area Development Programme
6.	Repair of lift irrigation scheme (33) with 5-10% efficiency
7.	Restoring capacities of canals – lining and repair
8.	Repair and renovation of large ponds/tanks

4.6 Joint Ventures:

4.6.1 Rajghat dam – A Joint Project of MP and UP:

Out of 119 TMC of waters available at Rajghat dam site, 53 TMC *(44.5%)* is reserved for use in upstream cathchment by MP. From the 62 TMC of live storage at Rajghat dam site, 9 TMC *(7.5%)* is to be used for committed downstream use in UP and MP, 50% of balance storage i.e., up to 26.5 TMC plus half of the losses from dam to be utilized by UP and

balance and excess over 23.5 TMC is for use in MP in Datia district. To utilize respective shares, the two states are developing their respective commands which should be accorded high priority. State has not demanded any funds.

4.6.2 Ken-Betwa Link project – a Proposal of NWDA:

To utilize the untapped waters of the Ken basin, National Water Development Agency (NWDA) has proposed in its feasibility report, diversion of Ken waters to Betwa basin through a 232 km. long link canal of 72 m^3/sec discharge capacity, which will pass through water deficit areas of Panna, Chhaterpur and Tikamgarh districts. Water is proposed to be diverted after considering Ken basin demands and downstream commitments of both MP and UP as planned earlier under the erstwhile Ken multipurpose project. The link canal will provide irrigation and domestic supplies to enroute water deficit areas of MP and UP and help development of 4 projects in Betwa basin of MP upstream of Rajghat dam by way of adjustment of supplies to Uttar Pradesh. The command envisaged in the earlier proposed Ken Multipurpose project (KMPP) by MP is also to be irrigated from this project for which a dam with revised live capacity of 2753 MCM is proposed on the Ken at Daudhan 2.5 km upstream of existing Gangau weir. The net water availability at dam site after accounting for committed and proposed requirements is 2225 MCM, out of which, 850 MCM is provided to UP and 1375 MCM to MP for use in KMPP command as per inter-state agreement of 1981 on river Ken. Plate

V provides layout map of the Ken – Betwa link project as proposed by NWDA. Pattern of utilisations proposed is as under:

Unit MCM

Existing utilisations upstream of Daudhan dam	42.31
Ongoing projects upstream of Daudhan dam	69.10
Proposed Projects upstream of Daudhan dam	842.70
Direct use in MP	1375.00
Direct use in UP	850.00
Irrigation use enroute Ken-Betwa link Canal for MP	312.00
Drinking purpose in the vicinity of link for both MP and UP	11.75
Transmission/Conveyance losses	37.25
Transfer as adjustment to UP in lieu of use in 4 projects upstream of Rajghat dam in Betwa Basin	659.00
Power Generation	72.00

Annual Irrigation on full development as proposed by NWDA is as under:

Unit: Lakh ha

Irrigation benefit to M.P. in Raisen and Vidisha districts	1.27
Irrigation in M.P. enroute Ken-Betwa-Link canal	0.47
Irrigation in M.P. under Ken Command	3.23
Total	4.97

Ken Betwa link project and the ongoing and proposed projects upstream of the proposed Daudhan dam on full development can transform the entire belt of Sagar, Panna, Chhatarpur and parts of Tikamgarh districts in MP and Banda, parts of Mahoba and Chitrakut districts in UP to water rich areas. Water deficit felt during past four years

due to deficit rainfall in the Panna, Chhatarpur, Tikamgarh, Mahoba, Bandha, can be effectively mitigated through link canals and the two states should give a serious thinking on enroute development. A comprehensive and coordinated development of this project can mitigate the crisis like the present one to a thing of the past.

With Ken-Betwa link project already declared a national project, development of entire Ken basin including Ken-Betwa Link Project may be taken up on priority. Specific fund allocations should be made under respective schemes of various Ministries.

4.7 Improving water use efficiency:

4.7.1 Pressure Irrigation Systems

At present enough water is available in Betwa system and this system is practically running at half of its efficiencies. Wherever feasible, diversification to low water requiring crops, shift to drip/sprinkler should be attempted. Some of the new canals in Rajghat commands, where command areas are yet to be developed, can be designed using pressure systems for shift to sprinkler/drip. Government of Rajasthan has designed canal based micro-irrigation delivery system for their share of Narmada waters right in the beginning and both the states may look into it.

4.7.2 Suggested net-working of rivers and canal systems in UP:

Rivers Betwa, Ken, Baghain, Paisuni, Gunta, and their tributaries Dhasan Chandrawal, Ohen along with a number of other streams/nallahs run mainly from south to north direction out falling into the Yamuna, They flow approximately parallel to each other and can be easily net-worked within Uttar Pradesh. Irrigation through reservoirs built on large rivers with catchments in high rainfall zone in Madhya Pradesh are not seriously affected during droughts as is demonstrated in the first two years of recent deficient rainfalls. In subsequent years conjunctive use has supported irrigation in these canal commands. Reservoirs on small streams originating with in Chhatarpur, Mahoba, Chitrakut and Banda districts of the two states could not withstand droughts during first two years mainly due to non-perennial nature of the streams and relatively small storages on these rivers. Had there been some possibilities of diversion of water from Ken and Dhasan to these areas, drought impact could have been arrested to some extent. Such linkages are desired not only during deficit rainfall/runoff period, but also during normal years in order to share equitable resources in an optimal manner, particularly so when the fertile alluvium soils are limited and should be made use of in the best possible manner for optimizing production/productivity. Proper networking of rivers and canals within UP are also desirable for efficient utilisation of waters during normal times.

4.7.3 Participatory Irrigation Management:

Government of Uttar Pradesh has drafted a Bill on participation of beneficiaries for efficient use and maintenance of its resources by Water Users Associations (WUAs), which are presently formed under 'Societies Registration Act' or any other Act. Draft rules and manuals are in pipeline.

Government of Madhya Pradesh passed an Act in September 1999 called 'Sinchai Prabandhan Me Krishkon Ki Bhagidari Adhiniyam' and since then framed draft rules and prepared manuals and have also conducted two elections. A number of canal system have been handed over to registered WUAs. However, capacity building of farmers/functionaries, bringing reforms in fixation of water charges and its collection is required.

4.7.4 Other means of conservation:

With the completion of ongoing Rajghat Project, UP is going to utilize almost entire of its surface water use. Therefore, improving efficiencies of its water share and system is the only way to expand the command. Following suggestions may be considered:

(i) Completion of the subsidiary systems of the main canal of Rajghat project and command development should be given highest priority to avoid future delay in flow of benefits.

(ii) The canal infrastructure and Warabandi system should be made compatible to sprinkler, drip and other micro irrigation techniques. The

system being developed in Rajasthan for Narmbada canal waters from Sardar Sarovar may be considered to raise water utilization efficiency.

(iii) Possibilities of conjunctive use of surface and ground water may be optimized.

(iv) Land levelling, promoting seeding/planting on the ridges and irrigating furrows can save 30-40% of water. However, proper machinery, tools implements on custom hiring basis have been recommended in the Agriculture section.

(v) Cultivation of water guzzling crops like mentha, sugarcane, rice may be discouraged in the canal commands.

(vi) Management of flows in rivers should also be governed from ecological concerns.

5.0 Agriculture

Crop production and livestock rearing are the major occupation whereas usufruct rights in forest, other common properties or open access resources and migration for income outsourcing are the minor livelihood opportunities in the agrarian economy of the Bundelkhand. Crop cultivation and animal rearing alone contribute more than 90% to the overall livelihood. Crop residues contribute 67% to the animal fodder and coping mechanisms for mitigating vulne*rabi*lity to drought have to be farming system centric. The traditional coping mechanism of cultivating diversified drought resistant coarse cereals, dual purpose varieties for grain and fodder, mixed cropping, staggering sowing over time, short duration varieties, mixed farming, share cropping, agro-forestry and enterprises etc. have been diluted by new technologies to address competitive and emerging economic and social transformations.

Dwarf hybrid varieties of Pearlmillet (Bajra), Shorghum (Jowar), Bt Cotton, improved varieties of soybeans, chickpeas (gram), pigeon peas, lentils and mustard have increased inputs and productivity as well as risks and distress. Hybrids of castor, sunflower, improved varieties of safflowers, mustard, ground nut

Fig.13: Hybrid

etc. require one or two critical irrigation for

harvesting economic yield. Peas have replaced relatively drought tolerant chickpeas especially in UP part. Water guzzling mentha, sugarcane etc. are becoming popular in irrigated areas at the cost of excessive depletion of ground water and inequity in sharing of canal irrigation. Sesamum (til) could survive the current continuous drought of four years almost everywhere but returns are low. Improved varieties of Shekhar and Pragati are better. There is an urgency of at least one oil mill for sesame or til to stabilize its prices and return to the farmers. A lot of churning process is going on and the following medium and long term measures are called upon.

Chickpeas, wheat, sorghum, paddy, maize, barley, seasame, lentils, linseed, mustard, rye, ground nut, soyabean, peas, urd, moong, tomato, onions, other vegetables are important crops combinations with amla, guava, lemon, mango, cows, buffalo, goat and sheep are important risk avoiding strategies.

5.1 Medium-term strategies:

i. Irrigation potential (Fig. 14) of about 40% of net sown area are not very dependable because dug wells being largest source dry up during post rainy season.

Reservoirs and shallow tube-wells also dried during the current drought. About 60% of agriculture and allied activity shall continue to be rainfed or non-dependable even after harnessing all existing water resources. *In situ* conservation of rain water by land shaping or levelling (if soil depth permits), field bunding, contour cultivation, ridge and furrow system of raising crops is quite effective in moderating drought effects. Sowing chickpeas, soybean, pigeon pea, groundnut and mustard on ridges prevents diseases, ensures better conservation of rain water into furrows and mitigate risks. A massive movement of promoting this low-input practice is of very high priority. Farm implements like bed makers, zero till drills and mechanization on custom hiring basis are lacking in the region. About 50 crores for UP and 100 crores for MP are recommended to create custom hiring services by SHG or private entrepreneurship.

ii. Improved varieties of traditionally drought tolerant sesamum, lentil, linseed, chickpeas, dual purpose Bundela Sorghum and pearl millet should be promoted along with rainwater conservation to improve productivity and income. A list of the promising varieties of different crop is given in table 21. Seed multiplication of these minor crops is least priority of private sector and state seed corporation, universities, NGOs and ICAR may step into it.

iii. Seed replacement rate (SRR) in the main crops of pulses is about 12% which may be raised to at least 25% for harnessing gains of improved varieties. About 20% SRR in wheat and oil seeds also needs

improvement to internalize benefits of technologies. A list of promising and latest varieties is given in table No. 21 and 22 along with possible sources at least of breeders or certified seed.

iv. Physiologically oil seed crops are highly tolerant to droughts and should be preferred in drought years. More over these are only cash crop of Bundelkhand.

Table 21: Crop Varieties recommended for Bundelkhand region of UP and MP by different ICAR Institutes and SAUs

Crop	Variety	Release year	Target of breeder seed production (q) (2007-08)	Seed Production Agency
Chickpea	Vijay	1994	435	MPKV, Rahuri, SFCI, New Delhi, JNKVV, Jabalpur. IGKVV, Raipur
	JG 218	1996	133	JNKVV, Jabalpur
	Gujarat Gram 1	1998	44	JAU, Junagadh
	KAK 2	1999	160	PDKV, Akola and SFCI, New Delhi
	Jawahar Gram 16	2001	304	JNKVV, Jabalpur
	Jawahar Gram Kabuli 1	2002	28	JNKVV, Jabalpur
	KGD - 1168	1997	40.0	CSAUA&T, Kanpur
	KWR - 108	1996	10.0	CSAUA&T, Kanpur
	Pragti	1994	12.0	CSAUA&T, Kanpur
Pigeonpea	Asha	1993	54.3	JNKVV, Jabalpur
	MA 3	1999	5.0	BHU, Varanasi
	JKM 7	1996	4.1	JNKVV, Jabalpur
	BSMR 853	2004	22.8	ARS Badnapur
	GT 101	2001	1.0	S.K. Nagar
	BDN 708	2004	1.6	ARS Badnapur
	Vipla	2005	1.25	MPKV, Rahuri
	BDN 2	1978	2.2	ARS Badnapur
	ICPL 87	1986	127.2	JNKVV, Jabalpur
	BSMR 736	1996	17.65	ARS, Badnapur
	JA 4	1991	3.13	JNKVV, Sehore
	Azad	1996	2.00	CSAUA&T, Kanpur
	UPAS - 120	1976	1.00	CSAUA&T, Kanpur

Crop	Variety	Release year	Target of breeder seed production (q) (2007-08)	Seed Production Agency
Mungbean	JM 721	1995	12.00	JNKVV, Jabalpur
	HUM 1	1999	7.5	IGAU, Raipur
			3.5	BHU, Varanasi
			6.0	JNKVV, Jabalpur
	Pusa 9531	2000	9.0	SFCI, New Delhi
			7.0	IARI, RRS, Karnal
	HUM 6	2001	4.5	SFCI
			3.5	BHU, Varanasi
	Samrat	2001	38.0	IIPR, Kapur
			1.0	Berhampur (Orissa)
	Pant Moong 5		2.0	Pantnagar
Urdbean	Barkha	1999	7.0	JNKVV, Banswada
			7.0	JNKVV, Jabalpur
	Uttara	1999	18.0	IIPR, Kanpur
			7.0	NDUAT, Faizabad
	KU 96-3	2003	2.0	CSAUA&T, Kanpur
	Azad – 2 and 3	2006	6.0	CSAUA&T, Kanpur
	Shekhar - 3	2004	4.0	CSAUA&T, Kanpur
Lentil	Narendra Masoor 100	1997	14.0	NDUAT, Faizabad
	Jawahar Lentil 3	1999	40.0	JNKV, Jabalpur
			8.0	JNKVV, Sehore
	Pant L 5	1999	25.0	GBPUA&T, Pantnagar
	Sheri	1997	20.0	IIPR, Kanpur
			15.0	SFCI, Bahraich
	Noori	2000	25.0	SFCI, Bahraich
			10.0	IIPR, Kanpur
Fieldpea	Ambika	2000	77.0	IGAU, Raipur
	KPMR 400	2001	95.0	CSAU, Kanpur
			15.0	SFCI, New Delhi
	Adarsh	2003	14.0	IIPR, Kanpur
			15.0	SFCI, New Delhi
	IPFD 99-13	2005	15.0	IIPR, Kanpur
	IPFD 1-10	2006	20.0	IIPR, Kanpur
Paddy	Pant - 12	1996	20.0	CSAUA&T, Kanpur
Maize	Azad Utam	1991	5	CSAUA&T, Kanpur
Sesame	Shekhar	2001	1.0	CSAUA&T, Kanpur
	Pargati	2003	0.5	CSAUA&T, Kanpur

Crop	Variety	Release year	Target of breeder seed production (q) (2007-08)	Seed Production Agency
Rai/Mustard	Kanti	2003	7.0	CSAUA&T, Kanpur
	Maya	2003	7.0	CSAUA&T, Kanpur
	Urvashi	2001	6.0	CSAUA&T, Kanpur
	Ashirwad	2005	4.0	CSAUA&T, Kanpur
	JM 1	1999		NRCRM, Bharatpur
	JM 2	2004		NRCRM, Bharatpur
	JM 3	2004		NRCRM, Bharatpur
	Vaibhav	1985		NRCRM, Bharatpur
	Vardan	1985		NRCRM, Bharatpur
	Varuna	1975		NRCRM, Bharatpur
Linseed	Parvati	2001	10.0	CSAUA&T, Kanpur
	Sheela	2001	5.0	CSAUA&T, Kanpur
	Shekhar	2001	5.0	CSAUA&T, Kanpur
	Sharda	2006	2.5	CSAUA&T, Kanpur
Safflower Sunflower Castor	Uttar Pradesh: Hybrids: DSH-129, NARI-H-15, NARI-H-1, MKH-11, MRSA-521 Varieties: PBNS-40, Prabhani Kusum Phule Kusum, NARI-6, Type-65, Malaviya Kusum Madhya Pradesh: Hybrids: DSH-129, NARI-H-15, NARI-H-1, MKH-11, MRSA-521 Uttar Pradesh & Madhya Pradesh: Hybrids: KBSH-1, KBSH-44, DRSH-1, MSFH-17, Jwalamukhi, PAC-36, PAC-1091, MLSFH-47, MLSFH-82 Varieties: Morden, DRSF-108, DRSF-113 Uttar Pradesh: Varieties: T-3, T-4, 48-1 (Jwals), Kalpi-6 Madhya Pradesh; Hybrids: GCH-4, DCH-177, DCH-519 Varieties: Jyoti, Jwala			DOR, Hyderabad

Table 22: New Wheat Varieties of Bundelkhand, Madhya Pradesh, Gujarat, South Rajasthan and Chattisgarh (Recommended by Indore Centre of ICAR)

Stage of Cultivation	Time of Cultivation	No. of Irrigations	Varieties		Productivity Qt./ha
			Chandausi/Sharbati *(Aestivum)*	Kathia/Malvi *(Durum)*	
Early	15-30 October	Rainfed (on residual moisture)	HW 2004 (Amar) - Tall HI 1500 (Amrita) - Tall HI 1531 (Harshita) - Dwarf	HD 4672 (Malavratn) HI 8627 (Malavkirti)	15-20
	15 October to 10 November	1	HW 2004 (Amar) dwarf HI 1500 (Amrita) dwarf	HD 4672 (Malavratn) HI 8627 (Malavkirti	30-35
On time	5-25 November	3-4	HI 1418 (Naveen Chandausi) HI 1479 (Swarna) HI 1544 (Poorna)	HI 8381 (Malavshri) HI 8498 (Malavshakti) MPO 1106 (Sudha)	50-55
		4-6	GW 273 GW 322 GW 366	Shrivelled grain if last irrigation is not given	50-55
Late	December	4	HI 1418 (Naveen Chandausi) HI 1454 (Abha) DL 788-2 (Vidisha)	-	40-45
		5	GW 173 MP 4010 HD 2932 (Pusa wheat - 111)		
	January	4-5	Raj – 3777 DL 788-2 (Vidisha) HI 1418 (Naveen Chandausi) HI 1454 (Abha)	-	30-35
On time	Saline/alkaline soil	4-5	Raj 3077 JOB 666 KRL 1-4 KRL 19	-	40-45

v. There are some extra short duration crops and varieties with very deep and extensive root system to mine soil moisture from greater soil mass. They have been found successful even under arid conditions and can reduce risks and vulnerability in Bundelkhand also (Table 23). Seeds of such crops and varieties can be arranged from Director CAZRI, Jodhpur, Rajasthan.

Table 23: Choice of cultivars for contingency planning in Bundelkhand region of Uttar Pradesh and Madhya Pradesh

Sowing period	**Cowpea**	**Moth bean**	**Pearl millet**	**Sorghum**	**Preference of crops**
Upto last week of June	V 585	Jwala CZM 1	Pusa 23 PB 106 GHB 577	SPH 1148 CSH 21 CSH 18 CSV 15	Sorghum
1-15 July	GC 3, V 240	CSM 1	HHB 146 7688 Pusa 415	CSH 21 CSH 18 CSV 15 Bundela	Sorghum Pearl millet
16-31 July	Co CP 7	CZM 2	GHB 538 HHB 68 Pusa 605	CSH 23 CSV 17	Pearl millet Cowpea Moth bean
After 31 July	RC 101	CZM 3 RMO 225 FMM 96	HHB 67 CZP 9802	Sorghum too risky (?)	Moth bean Cowpea

5.1.1 Contingency Plan for Drought Mitigation:

In case of delayed onset of monsoon or around 40% of shortfall in rain, short duration and drought tolerant *Kharif* crops like pearl millet (Bajra) and sorghum (jowar), moth bean, urd bean, green gram, til, pigeon pea and groundnut requiring about 200-350 mm of water should be preferred (Table 21). It will be difficult to raise rainfed rice, maize and even soybean without supplemental irrigation. Long, medium and short duration varieties of pearl millet, wheat, sorghum, cluster bean, pigeon peas, etc. are available to match with the amount of predicted or actual rainfall (Table 21, 22 and 23). Choice of crops and varieties can be staggered with the rainfall onset gradient as given in table 23 and 24

Table 24: Matching of *Kharif* crops with the onset of monsoon in Bundelkhand region

Date of onset of rain	Crops
1-15 July (Normal)	Maize, soybean, rice, long duration hybrids of pearlmillet, sorghum, pigeon pea, groundnut, cowpea, moth bean
15-31 July	Short duration Hybrid Bajra, Hybrid Sorghum, pigeon pea, long duration improved varieties of bajra, sorghum, groundnut, cowpeas, mothbean for fodder
1-15 August	Short duration varieties of sorghum, pearlmillet, cow peas, black gram (urd), green gram (moong), cluster bean (guar), sesamum (til) and pigeon peas for grains, cowpeas, mothbean
16-31 August	The aim should be to raise mostly fodder crops of bajra, cow peas, sorghum and may be urd bean and moth bean for grains

5.1.2 *Rabi* Season:

Wheat is an important crop during normal rainfall and water availability year. A list of varieties for different sowing periods and irrigation facilities is given in table 22.

Other crops for shallow or light soils during normal rainfall situations and deep heavy soil during drought conditions are: Gram, Chickpeas, Masoor (Lentil), Barley, Linseed, Mustard and Sunflower.

5.2 Long Term Strategy:

There are some deep rooted traditional customs and practices which are no more relevant to the high demographic growth, urbanization, industrialization, demand, supply and changes in public preferences. However, they are to be tackled by systematic and substantial efforts.

i. *Kharif* versus *Rabi* Sowing

In Madhya Pradesh portion of Bundelkhand *kharif* season contributes 30% of total production, 24% of food grain production and 38% of net sown area in spite of high probability of rain. Major area is sown in *Rabi* on residual moisture. In Uttar Pradesh also 31% area is sown in *Kharif* and 69% in *Rabi*. This paradox was attributed to letting loose animals during *Kharif* due to the old tradition of Anapratha. If herders can stall feed animals during *Rabi* then why not during *Kharif*? It requires change in mindset which needs massive extension efforts to address increasing demands on the land, rainfall and water resources.

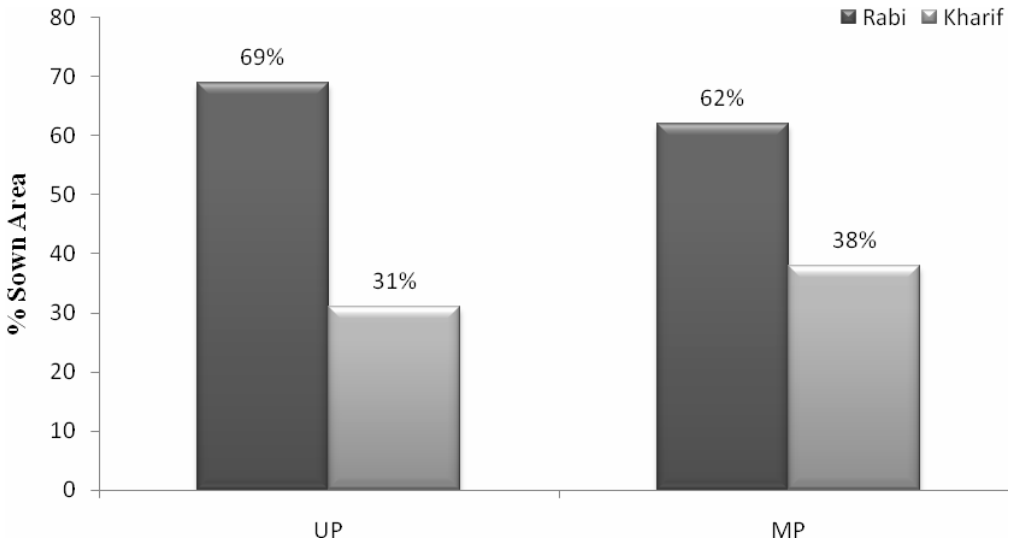


Fig.15: Percent sown area during *kharif* & *rabi* in

Manual weed management of very high infestation could be another reason and farmers are sowing only that much area which they can handled. Use of herbicides and weedicides recommended for different crops can be another alternative to remove this bottleneck.

Many parts of the region have deep black soils which are difficult to work both during rains or if they are dry. It has typical requirements of mechanization and need heavy machinery on custom hiring basis for sowing on ridges and furrow. Sowing on ridge or bed becomes essential to avoid adverse effects of temporary water logging by rains in heavy textured black sails. Establishment of custom hiring of machinery through SHGs or private entrepreneurship is provided in the package.

ii. Bridging Yield Gap

Average productivity of the region (Table 25) is far behind the average of UP and the country as a whole. Except pulses Bundelkhand is lagging behind in all other crops. Similar is the case for Madhya Pradesh. Yield gap of 30 to 40% in Sorghum, Jowar, pulses and oil seeds is quite common in the region.

Table 25: Relative productivity (q/ha) of different crops in Bundelkhand

	Productivity (q/ha)			
Name of Crop	Bundelkhand	India	UP	Highest in U.P.
Rice	8.20 (44%)	21.00	18.76	29.33
Wheat	19.11 (69%)	26.2	27.66	40.27
Pulses	6.57 (90%)	6.00	7.25	14.2
Oilseeds	3.74 (45%)	10	8.36	16.37

(Values in brackets is % of the average UP productivity)

However a large untapped and technologically demonstrated potential exist as analyzed in the table 26.

Table 26: Realizable gaps in the extension of existing technologies (q/ha)

Name of Crop	Potential (q/ha)	Present yield (q/ha)	Gap (q/ha)
Rice	25	08	17
Wheat	41	20	21
Maize	50	07	43
Lentil	20	07	13
Bajra	25	10	15
Gram	23	8	15
Barley	42	9	33

Grass root level extension activities, capacity building, improving seed replacement rate, providing quality inputs at right time, integrated nutrient management, plant protection, credit, marketing etc. will be required. In situ conservation of rainwater, sowing on ridges or raised beds, water harvesting for irrigation at critical stages is very essential in the rainfed areas. Enhancing efficiency of rainwater, irrigation, inputs and mechanizing on custom hiring basis may be given high priority.

iii. Crop rotation

Although rabi sowing on residual moisture is predominant, still raising of two crops will improve cropping intensity: especially with the introduction of proper mechanization. Short duration soybean during Kharief season followed by mustard or chickpeas in Rabi have sufficient potential. Suitable short duration varieties of soyabean are: JS 95-60, NRC 7 (Ahila 3), MAU 47, MAU 61-2, JS 93-05, JS 71-05 and JS 335.

Seeds are available with the National Research Centre for Soyabean, Indore (Madhya Pradesh). Soyabean residues are a good leguminous fodder rich in protein.

iv. Seed Production and Seed Banks

Multiplication of seeds, storage and their availability for various contingencies of normal, deficit or delayed rainfall should be planned meticulously. Some of the seeds of extra short duration varieties meant for drought years may not be used every year, may loose their viability and their regular replacement with viable fresh stock should be built into the scheme.

v. Intensification and diversification

Putting all eggs into one basket is undesirable in the predominantly rainfed region like that of Bundelkhand. Green peas are already replacing chickpeas (gram) and there is scope for tomato and other vegetables. Cultivation of soy bean and sesamum can be intensified by creating better market and establishing oil mills, agro-forestry based planting of Amla, Ber, Tamarind, Lemon, Custard Apple and fodder trees can provide robustness to income and employment. Hybrids of pigeon peas, improved varieties of soybean and other oil seeds can be other choices of spreading out risks. Diversification and integration of dairy production systems and focus on goat production for meat, setting up of a meat and milk processing plant would immensely benefit the farmers through enhanced income generation and improved livelihood. Better enabling cultural

practices like zero tillage, sowing on ridges or beds and irrigation in furrows, use of weedicides, plastic multching, micro-irrigation systems and inter cropping in good rainfall years should be promoted.

Weather based insurance, crop loan for extended period and credit for consumption require specific policy decisions. In situ conservation of rain water, recharging of dug wells, water harvesting for limited irrigation, watershed management in the adjoining forests, if any, should always be an ongoing activity. This region has relatively high population of livestock and organic farming will be able to fetch premium price in the emerging food markets.

vi. Agriculture Markets

At least one modern primary market in each district with facilities for the farmers, cleaning, grading, ware house etc are required. Sale of the inputs like seeds of improved varieties, fertilizes, agro-chemical, farm implement and testing of seed, soil, water etc should also be linked to the market places. In many cases distress may be due to failed marketing and price stabilization mechanisms are required. E-chaupal' experience of ITC in other parts of Madhya Pradesh may be extended to Bundelkhand. More details are elaborated in section 9.1 of this text on marketing.

6.0 Livestock

Livestock in Bundelkhand region of both UP and MP occupies a prominent position contributing significantly to the livelihood, mitigation of risks and distress of the farmers. The livestock sector has been able to provide a good coping mechanism and reduced vulnerability in the region which has been experiencing drought like situation consecutively for the last four years. Four major livestock production systems have been observed in the region i.e Free Range Grazing system, Mixed system, Extensive Stall fed system and Intensive Stall fed system. The choice of the system depends on the species and productivity of the animal, economic status of the farmer, land holding and feed resource availability. In villages which are in the periphery or vicinity of the forests, farmers are mostly adopting uncontrolled free range grazing system especially for rearing goats, sheep and indigenous cattle. Intensive stall fed system of rearing buffaloes is very limited and mostly encountered in irrigated peri-urban areas in and around district head quarters like Jhansi. In Bundelkhand districts of the state Buffalo rearing is preferred over cattle in large ruminants and goat rearing over sheep in small ruminants categories. Poultry rearing is to a very limited extent restricted mostly to backyard poultry.

6.1 Livestock population:

As per the livestock census of 2003 the total population of cattle, buffalo, sheep and goat in the region was 10.18 million heads and poultry

and pig population accounted for another 1.21 million heads (Table 27 & 28). Analysis of composition of livestock population in the region has been quite revealing. Of the total bovine and ovine population in the region, half is cattle. Further analysis of cattle population reveals that crossbred cattle accounts for a negligible 0.5% as against the national average of about 15%, indicative of low priority accorded to cross breeding programme in the region. Only the districts of Mahoba, Jalaun and Lalitpur in UP and Sagar, Panna and Tikamgarh in MP had comparatively higher crossbred cattle. By and large, non-descript indigenous cattle of very low productivity accounts for rest of cattle population. Buffaloes and goats are equally distributed in the region. Goats are sold regularly in local haats after 8-9 months of age and ensure income periodically to cope up with exigencies. Sheep population accounts for hardly 3% of the total population. A modern plant for processing of meat, milk and other by-products should be an urgency to add value to the products.

Table 27: Livestock population in the Districts of Bundelkhand Region of Uttar Pradesh (`000 heads)

District	Cattle	Buffalo	Sheep	Goat	Poultry	Pigs
Banda	378	232	13	151	45	18
Chitrakut	414	138	19	96	20	10
Hamirpur	261	133	26	129	80	25
Jalaun	226	239	30	257	50	26
Jhansi	294	182	56	219	187	14
Lalitpur	425	163	12	154	65	4
Mahoba	536	148	31	242	77	26
TOTAL	**2535**	**1238**	**186**	**1248**	**524**	**123**

Source: Livestock census report, DAH&D, 2003

Table 28: Livestock population in the Districts of Bundelkhand Region of Madhya Pradesh (`000 heads)

District	Cattle	Buffalo	Sheep	Goat	Poultry	Pigs
Chhatarpur	**501**	**251**	**24**	**336**	**104**	**19**
Damoh	**515**	**101**	**7**	**100**	**33**	**8**
Datiya	**139**	**142**	**15**	**113**	**19**	**3**
Panna	**543**	**196**	**7**	**202**	**128**	**24**
Sagar	**595**	**135**	**2**	**107**	**86**	**6**
Tikamgarh	**438**	**182**	**44**	**282**	**128**	**7**
TOTAL	**2731**	**1007**	**99**	**1141**	**499**	**67**

Source: Livestock census report, DAH&D, 2003

6.2 Dairy production:

Dairy production is an important component in the entire region with greater focus on buffalo rearing for milk over cattle rearing. This is also corroborated by the last two livestock census data indicating increase

in buffalo population and decrease in cattle population. Cattle population in the region is characterized by higher number of unproductive animals with only 18 % of cattle in the category of milch animals whereas 33 % of the buffaloes are in milk indicating the preference of farmers for rearing buffaloes for milk production if fodder and feed supply is assured. Dairy entrepreneurship has been able to provide daily income and provide security to farmers. The animal holding is dependent on size of land holding of farmers and their economic status. However, by and large even the landless and small farmers are also maintaining at least one cow/ buffalo as an ensured source of income and asset. However, no concerted effort has been made for development of dairy sector in terms of breed improvement, establishment of a comprehensive milk collection network system, feed and fodder production and providing effective input delivery mechanism. There exists a considerable scope for further development of this subsistence component of dairy sector in whole of Bundelkhand region.

6.3 Feed Resource availability:

Crop residues contribute about 67% of the fodder, and *Kadbi* is an important factor in the choice of varieties for cultivation. Due to deficiency of rainfall there has been a loss/ lower yield of crops in the region as a whole consequently resulting in shortage of crop residues which is the staple livestock feed in the region. The situation has further aggravated since grass have dried up in common lands, field bunds and periphery of

forest areas. Animals are being taken for long distance in search of whatever little grass / shrubs available for grazing/ browsing. Based on crop yield data provided by the district officials, interaction with villagers and visual observation on current availability of grazing resources in the region, the conservative estimated shortage of feed and green forage for livestock feeding could be anywhere in the region of 60 to 70 percent.

The major feed resource available for livestock feeding is coming from the crop residues of wheat, rice and legume straw along with *kadbis* of Jowar and Bajra. Individual concentrate ingredients like wheat bhusa, and oil cakes are given only to the cows and buffaloes which are producing milk and practice of feeding balanced compounded feed is very limited. Interaction with cross-section of livestock owning farmers made during field visit of affected areas, revealed that the present stock of dry fodder (mainly paddy straw/jowar *kadbi*/ bajra *kadbi*) stored by the farmers could last up to middle or at best till the end of February month. Currently, whatever little dry fodder is available is being rationed for productive buffaloes/ cows and non-productive animals are the worst sufferers not receiving any attention. If urgent remedial measures are not initiated for building up of adequate stock of feed and fodder, there is likelihood of the situation worsening further after the month of February and possibility of losing precious livestock wealth appears to be imminent and real.

6.4 Small Ruminant Production:

About 45 % of landless and 40% of marginal farmers in Bundelkhand area are raising goats for meat production and consider this enterprise as low risk activity. Due to its adaptability the local breed of *"Bundelkhandi"* is found in most of the villages. However, over the years farmers have been raising the breeds of *"Jamnapari"* and *"Barberi"* in greater numbers due to their higher growth rate and meat production. By and large, traditional system of raising goats by grazing on community land and forest waste land still continues in the area and stall feeding of goats is very limited. Sheep rearing is not as important in comparison to goat rearing in the region.

Fig.17: Goats being taken for grazing in Panna

6.5 Effect of drought on livestock:

The prevailing drought condition in Bundelkhand for the last four consecutive years has also affected the livestock wealth in the region.

However, the magnitude of the effect has not been to that extent as compared to the crop failure, which could probably be ascribed to greater resilience or robustness of the livestock for withstanding drought conditions. Unlike crops where the effect of drought is seen immediately by way of failure of crop, the impact in case of livestock is realized only after a lag period. Without adequate supply of quality feed and fodder, the primary effect is on the reproductive performance of animals and if the situation prolongs for any considerable duration it would be extremely difficult to restore the reproductive efficiency of animals to normal. In view of this even though livestock species are more resilient to droughts, it would be ill advised to show any sort of neglect in providing adequate nutrition to animals during drought situations.

The major observations made during the field visit of the affected districts are

- Crop residues from paddy straw and *kadbis* of bajra and jowar are the major feed resources available for livestock feeding in the region
- Green fodder is almost not available either in the common or private lands and farmers are taking their animals over long distances for grazing.
- The age old tradition of "Annapratha" where animals are let free for unrestricted grazing is prevailing in the region and is causing immense damage to crops especially in the *Kharif* season. Amongst

other reasons, Annapratha was cited by the farmers as one of the reasons for preference of *Rabi* cultivation over *Kharif* in the region.

- Livestock owners in the region by and large have some stock of dry fodder as was evident from the stacks of paddy straw, bajra and jowar *kadbi* seen at individual households at Chitrakoot, Banda and Mahoba. However, from the interactions of the Team with the farmers, it was evident that the present stock could last up to middle or at best till the end of February month.

- If urgent remedial measures are not initiated for building up of adequate stock of feed and fodder, there is likelihood of the situation worsening further after the month of February and possibility of losing precious livestock wealth appears to be serious.

6.6 Out-migration of livestock:

The media reports appearing in connection with prevailing drought situation in Bundelkhand region and the perception of the common populace is that considerable out-migration of animals is taking place from the affected districts. The Team looked in to this issue critically during the visit and is of the opinion that large scale out migration of animals has not happened by that time. What appears to be the ground situation is that cattle and buffaloes in herds and flock of sheep & goats are seen on the road side going in search of grazing resources and probably this was construed as out-migration. There is a distinct

possibility of out-migration of livestock if suitable remedial measures of providing feed and fodder are not initiated on priority.

6.7 Distress sale of animals:

During the visit of the drought affected Bundelkhand districts of Uttar Pradesh, the Central Team came across few cases where the farmers have resorted to distress sale of their animals primarily due to shortage of feed, fodder and drinking water to animals. A producing buffalo which is valued anywhere between Rs. 15,000-20,000 during normal years depending on the level of production was being sold around Rs.8,000- 9,000. The sale price of cattle was around Rs.400-500 and that of goat was between Rs.600-800.

6.8 Drought relief measures initiated by the government:

The State of Uttar Pradesh has initiated several immediate measures for minimizing the effect of drought on livestock wealth in the affected districts.

i. The State has initiated action for establishment of 95 cattle camps in the seven drought affected districts. Each cattle camp is proposed to handle 580 numbers of animals (400 large and 180 small).

   During the field visit and after interaction with cross section of livestock owners in different villages, it came out clearly that livestock owners were not willing to take their milch buffaloes and

cows to cattle relief camps. They were ready to send only unproductive animals to the camps if the prevailing drought situation worsens further. In view of the existing shortage of feed and fodder which is likely to compound further in the coming months, it would be important for ensuring supply of quality feed and fodder to milch animals at the farmer's door steps. This would ensure that the productivity and reproductive efficiency of the precious livestock asset of the farmer is not affected.

The State should on priority establish feed and fodder banks at Block level and develop a suitable mechanism for effective distribution of feed to the farmers. It would be advisable for preparation and distribution of Total Mixed Ration (TMR) to milch animals as this would ensure supply of adequate and balanced nutrients.

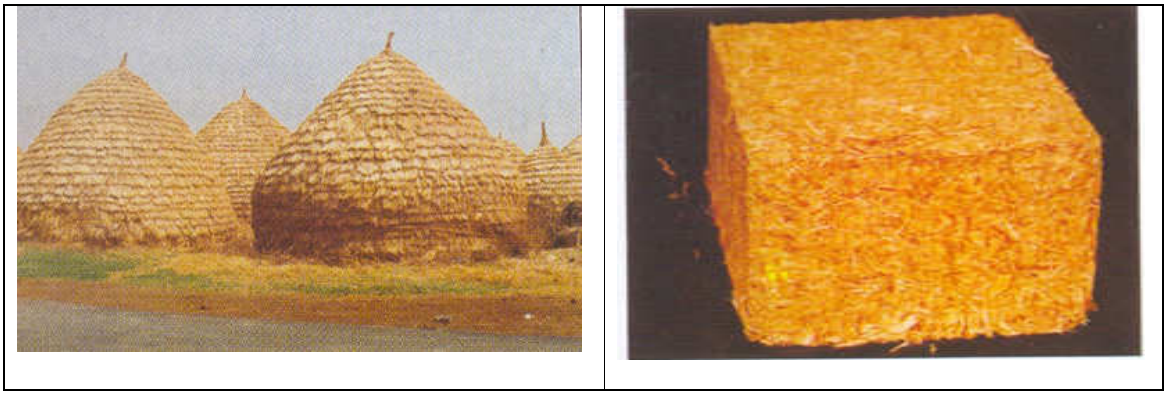


Fig.18: Transportation, storage and densification of dry fodder during drought period

ii. For providing drinking water for animals in the camps, provision for hand pumps (2 per camp) and water troughs (2 per pump) has been made.

iii. Deworming, vaccination and treatment of animals coming to the cattle camp are also proposed to be taken up

iv. For animals not coming to the camp, provision for treatment, deworming and vaccination against Foot and Mouth Disease (FMD) has also been made.

v. Fodder banks have been proposed to be set up at village level.

vi. As long term measures for improving milk production in Bundelkhand area, the State has proposed natural breeding programme of buffaloes and cattle by induction of Murrah and Tharparkar/ Hariyana bulls at village level. For enhancing green fodder production distribution of minikits at Nyayapanchayat level has been proposed.

vii. Promotion of fisheries activity in existing water bodies, renovated ponds and in newly constructed ponds has been proposed.

The Madhya Pradesh state has also initiated relief measures more or less on similar lines.

6.9 Long term strategies for development of Livestock:

Livestock in Bundlkhand region would continue to play a central role in providing livelihood security and coping mechanism to mitigate risks of the resource poor farmers. However the development of this key sector has not progressed to the desired extent in comparison to other regions of the Uttar Pradesh and also across other states of the country. Considerable potential exist for improving the dairy and meat production in the area. The following strategies are suggested for overall improvement of livestock in future.

i. Progressive reduction in population of unproductive indigenous non-descript cattle which is substantially higher in the region. The approach for achieving this objective has to be two pronged. First, the present indiscriminate natural breeding through scrub bulls should be addressed through massive and focused castration programme of indigenous non-descript male cattle population. Secondly, farmers are to be incentivized for rearing of productive

cattle for milk production. However, enough care has to be taken for preserving established native breeds of cattle in the region like *Kenkathia* as sources of rare genes.

ii. Induction of high yielding crossbred cows and buffaloes as adopted in the Vidarbha package may not be the ideal option for Bundelkhand region. Productivity enhancement of livestock in the region has to be a continuous, focused and graduated process. Upgradation of local cattle and buffaloes using improved breeds of Tharparkar and Hariyana cattle and Murrah breed of buffalo has considerable scope in the region. Sustained breeding programme could enhance milk production by 15 to 20 percent and consequently provide higher economic returns to the farmers. The central schemes of Department of Animal Husbandry and Dairying like NPCBB are to be effectively dovetailed in Bundelkhand districts.

iii. Development of commercial goat farming holds considerable promise for enhancing livelihood of assetless, small and marginal farmers and this is another area which needs focused attention. Goat is resistant to diseases and rearing is predominantly for meat production and considered to be less risk production system. Induction of superior breeds of goat i.e. Jamnapari and Barbari goats having higher meat production potential should be given high priority.

iv. Shift from prevailing traditional milk marketing system to modern Private – producer – consumer cooperative entrepreneurship would bring in immense benefit to the farmers of the region.

v. There is urgent need for creating modern and adequate facility for goat and buffalo meat processing, value addition, cold storage chain and marketing including export.

vi. Inadequate availability of quality feed resources has been one of the major constraint in enhancing livestock productivity in the region. Cultivation of dual purpose coarse cereal crops would enhance availability of crop residues, which are the major staple livestock feed resource in the Bundelkhand. Shift from traditional feeding of cattle and buffaloes to feeding of complete feed blocks / total mixed ration would ensure balanced ration economically. Similarly, there is need for encouraging stall feeding of small ruminants over the prevailing free range grazing system.

vii. Forest resources are to be harnessed beneficially through Joint Forest Management System providing adequate feed resource for livestock. Considerable quantity of forest grass is available in the region during the post monsoon months, which could be harvested and conserved for use during the lean season. For discouraging the free range grazing system particularly in the forest area which causes immense damage to the composition of the forest flora, controlled and rotational grazing system has to be encouraged. Further, through the mechanism of joint forest management,

farmers should be encouraged to grow nutritionally superior legume species like *Stylosanthes, clitoria grasses* like cenchrus Ciliaris, Guinea grass etc. and permitted to utilize the produce by cut and carry system. There are some cactus species of fodder. Cactus is highly drought tolerant species and can grown at least on field bunds, wasteland, gravelly and rocky forest land.

viii. Large scale facilities for Feed Processing like mobile baling, compaction and preparing Total Mixed Ration should be created on priority. Bundelkhand region has been prone to frequent droughts and during such situation *in situ* conservation of bulky dry fodder for easy inter district and intra district transport becomes extremely important.

ix. The present input delivery mechanism specifically with regard to Artificial Insemination (AI) and Health Services has not been to the desired level of efficiency. Low success rate of AI has slowed down the progress of breed improvement in the region. Efficient mechanism for effective input delivery is urgently needed. Utilizing the services of trained paravets on a large scale for effective AI and vaccination programmes should be thought as an alternate strategy.

x. Livestock farmers of the region are not conversant with various aspects of efficient and modern methods of livestock rearing. Extension services in livestock sector have been ineffective and as such have not delivered the desired results. Farmers of the region

are to be educated for the need to discontinue the traditional practice of Annapratha, which is causing immense damage to the socio-economic fabric of the region. Capacity building of all the stake holders on a continuous basis needs high priority in the region.

7.0 Horticulture

This sector has potential to diversify income and risks by promoting arid horticulture which is relatively more resilient to droughts as compared to crops. Jhansi is being linked up with five national highways, is well connected by railways, the region has potentials of tourism, market for fresh vegetables and fruits. MP also has historical temples and places and is attracting tourists. Over all connectivity among districts is also being improved and rural electrification under Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) will make it possible to have cooling and refrigeration facilities for the perishable commodities like fruits, vegetables and milk. This region is known for seasonal migration of labour and horticulture can generate employment at all stages from nursery raising, planting, harvesting, packing and retailing. Traditionally *ber, amla, karonda, custard apple, jack fruit, phalsa, bael* and citrus growing on the private and forest lands are very common. These species of land races should be included in the afforestation programme of the forest department and at least 20% of the species should be fruit yielding. However intensification and diversification to other fruit, improved varieties, cultivars and root stock can enhance income. There are many land races and sufficient variability to exploit.

Bundelkhand is also known for the cultivation of chillies, tomatoes, onion, brinjal, potatoes and marigold flowers. There is a scope of enhancing their productivity and marketing.

The Horticulture Mission should aim at top working of the existing *amla* with the budwood of improved cultivars like NA 6, NA 7 and Chaikya (as pollinator). *In situ* grafting and top working of wild ber with the budwood of improved varieties like Seb, Umran and Gola can give immediate returns. Agro-horticulture systems with the improved varieties of ber and amla can also be taken up on the private lands as new initiative. Custard apple is in great demand and existing wild fruits can be top worked with the improved variety of Arka-sahan released by Indian Institute of Horticulture Research, Bangalore. New plantation of the custard apple especially on degraded lands by setting up nurseries of the improved variety Arka-sahan can also be considered to diversify risks, flow of cash and employment generation under Horticulture Mission or NREGS. *Tamarind* which is also very hardy, drought tolerant and early bearing variety is now available and can be considered to mitigate droughts and irregular distribution of rainfall. Pomegranate is another commodity and demonstrations of promising variety like Bhagwa may be organised. Improved varieties of *Bael and Fig (Anjir*) are also drought tolerant to reduce the risks. Allahabad Safeda, L-49 and Chittidar Guava could be another option of expanded opportunities.

Setting up of nurseries, rainwater harvesting by re-configuration or reshaping of land is feasible to improve establishment and productivity of rainfed horticulture. Highest efficiency of the scarce water and other inputs can be realized by promoting drip irrigation, use of plastics and fertigation.

Bundelkhand region also has possibility of cultivating drought tolerant tomatoes like Arka Vikas (selection-22) and rainfed onions provided there is proper marketing and processing facilities. Moringa olifera (*Sahjan*), Mahua (*Madhuca-indica*) and ginger are other possibilities of expanding horticulture. Jhansi Division has one food processing centre which was to be upgraded under UP-DAS project. Cultivation of spices like coriander and further improvement in the production of turmeric and ginger in Baruasagar, beetle leaves in Mahoba, Lalitpur (Pali-gram) and Chattarpur area can also be planned to expand option basket of coping mechanism and drought mitigation.

Research infrastructure of Agriculture University in Bundelkhand of MP is very weak and needs better targeting of this backward and under invested region. Rs. 20 crores is recommended for strengthening Tikamgarh College of Agriculture.

8.0 Forestry

8.1 Status of the Forests:

Forests provide environmental services, regulate water regimes and contribute to the livelihood of local communities in many ways. The role of forests in Bundelkhand region is quite unique in complementing agriculture, livestock production, recharging of ground water and regulating and maintaining the flow of streams and rivers. The forest area of the seven districts in the Bundelkhand region of UP and six districts of MP is given below in table 29 and 30.

Table 29: Area in hectare in UP (as per the State of Forest report 2005 by FSI)

District	Geo Area	Percentage of Forest Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total Forest Area	Scrub	Total (Forest +Scrub)
Banda	453200	2.3	Nil	2700 (26.2%)	7600 (73.7%)	10300	2900	13200
Chitrakut	309200	17.9	Nil	34600 (62.5%)	20800 (37.5%)	55400	1400	56800
Jalaun	456500	5.4	Nil	6800 (27.5%)	17900 (72.5%)	24700	4900	29600
Jhansi	502400	4.0	Nil	3400 (16.8)	16800 (83.2%)	20200	11900	32100
Hamirpur	428200	4.2	Nil	6700 (37.6%)	11100 (62.4%)	17800	3800	21600
Lalitpur	503900	11.4	Nil	14600 (25.3%)	42600 (74.5%)	57200	4200	61400
Mahoba	2884	3.3	Nil	2000 (21.3%)	7400 (78.7%)	9400	9500	18900
Total UP	2656284			70800 (36.3%)	124200 (63.6%)	195,000 (7.34%)	38600 (1.45%)	233600 (8.79%)

Table 30: Area in hectare in MP (as per the State of Forest report 2005 by FSI)

District	Geo Area	Percentage of Forest Area	Very Dense Forest	Moderately Dense Forest	Open Forest	Total Forest Area	Scrub	Total Forest + Scrub
Damoh	730600	36.6	300 (0.01)	86700 (32.4)	180300 (67.5%	267300	500	267800
Datia	269100	5.8	Nil	8100 (51.3)	7700 (48.7)	15800	4400	20200
Panna	713500	38.4	2900 (0.1%)	158600 (57.9%)	112200 (41.0%)	273700	8000	281700
Sagar	1025200	28.4	100 Negligible	170700 (58.5%)	120700 (41.4%)	291500	6600	298100
Tikamgarh	504800	6.0	Nil	9600 (31.6)	20800 (68.4%)	30400	4100	43500
Chhatarpur	868700	19.53	1800 (.01%)	84500 (49.8%)	83400 (49.2%)	169700	7000 (4%)	176700 (100%)
Total	4111900		5100 Negligible	518200 (49.0%)	525100 (50.0%)	1048400 (25.5%)	30600 (0.75%)	1079000 (26.2%)

The forest area including the scrub forests in Bundelkhand region of UP is 8.79% and that of MP is 26.24% of the geographic area. The degradation of 63.6% in UP is relatively higher than in MP (50%. Overall MP has significantly more area under forest (10.79 lakh ha) and better canopy cover than UP which has only 2. 33 lakh ha. Forest generally occupy the upper catchment and watershed treatment will be most effective for enhancing the productivity in the downstream agriculture and allied activities.

8.2 Composition of the Forests:

The forests are mainly Dry Deciduous (5B/C2 of Champion and Seth's classification) and comprise mostly of the following species;

Bamboo (*Dendrocalamus strictus*)	Kardhai (*Anogeissus pendula*)
Arjun (*Terminalia arjuna*)	Shisham (*Dalbergia sissoo*)
Tendu (*Diospyros melanoxylon*)	Reuja (*Acacia leucocephala*)
Amla (*Embelica officinalis*) Salai (Boswellia serrata)	Babul (*Acacia nilotica*) Achar (*Buchnania lanzen*),
Jamun (Syzygium cumini)	Neem (Azadirachta indica)
Bel (Aegle marmelos)	Chilbil (Holoptelia integrifolia)
Goolar (Ficus glomerata)	Seja (Hardwickia binata)
Mahua (Madhuca Indica)	Palash (Butea monosperma)
Dhawda (*Anogeissus latifolia*)	Khair (Acacia catechu)
Grass species found in the region Kans (*Saccharun spontaneum*), Kusha (*Desmostachya bipinnata*), Lampa (*Heteropogon contortus*), Chira (*themede guadrivalis*), Chir (*Imperata cylindrical*), Kail (*Dicanthium annulatum*), Dub (*Cynodon dactylon*), Bhurbhuri (*Eragrostis tenella*), Rusa (*Cymbopogan martini*), Bagai (*Eulaliopsis binnata*),	

Kusal (*Andropogan contortus*), Lahan (*Andropogan annulatus) etc.*	

The major species presently planted in the forest areas under different schemes are:

Bamboo (Dendrocalamus strictus)	Acacia catechu (Khair)
Neem (Azadirachta indica)	Prosopis juliflora
Kanji (Pongamia pinnata)	Babul (Acacia nilotica)
Arjun (Terminalia arjuna)	Chilbil (Holoptelia integrifolia)
shisam (Dalbergia sissoo)	Amla (Emblica officinalis)
Kath-Sagoun (Haplophragma adenophyllum)	Siras (Albizzia procera)
Chilla (Casearia tomentosa)	Mahua (Madhuca Indica)
Jamun (Syzygium cumini)	Bahera (Terminalia belerica)
Teak (Tectona grandis)	Acacia (Acacia auricularformis)

8.3 Contribution of Forest:

The villagers are heavily dependent on forest produce. The forest department creates employment in tendu leave collection, plantation activities, nursery works etc. The livelihood of many people especially in Chitrakoot District depends on Bamboo. They make baskets, fans etc. from the bamboo. Many traditional wooden toys of good quality are exported and provide livelihood to many people. The Villagers also make 'donas' from 'Palas' leaves. Thus, forests play a major role in the

employment generation in the region. The other major forest produce are e.g. Chironji, Mahua, Honey, Ber, Bel, Khatha, Neem, Amla and medicinal plants.

There are rivers which pass through the forest area. These rivers are Mandakini, Ohan and Bardaha, Ken, Betwa and Bagain etc and these river systems are getting affected due to recurrent droughts in the region. The region is under the grip of repeated drought which adversely impacts the livelihood of the rural population. The rural people are heavily dependent on forests and agriculture for sustaining their lives. The drought severely reduces the water in the rivers and rivulets leading to severe shortage of drinking water as also the fodder for the cattle and the wild animals. The people thus living in the fringes of forests are forced to further degrade the forest by indulging in illicit felling of trees and poaching of wild animals, excessive grazing leads to vicious cycle of further degradation of forests, water availability and poverty. The rehabilitation of the forests is considered essential as their canopy above the ground and humus on the ground reduces the surface run off and promotes ground water recharge. The restoration of degraded forests with suitable species meeting the essential livelihood needs of the people like fuelwood and fodder for the cattle and drinking and ground water availability etc will play a critical role in mitigating the impact of recurrent droughts in this part of the country.

8.4 Proposed Activities on Forestlands:

For the better Agriculture productivity, drinking water availability and diversifying the livelihood, it is therefore, necessary that a planned action programme is framed for the treatment of forestlands in a big way. It was stated by the forest department officers during the meeting that for raising successful plantations in the highly refractory lands the cost norms should be realistic especially because of the upward revision of labour rates. They stressed on need for proper measures as the people let loose their cattle in the forest throughout the year under the Anna Pratha. The following items of work are proposed to be taken up under the JFM programme. It is proposed to cover around 26% of the forestlands (60,000ha) for the forestry and watershed activities.

a) **Soil, Water and vegetation Conservation measures:** This will include creation of 300 staggered trenches (3Mx60 cm x 45 cm) per hectare with planting/sowing of seeds of locally available multipurpose and fruit bearing trees and grasses (*Amla, Ber, Bel, Behera, Neem,* Albizia lebbek, *Albizia procera, Acacia nilotica, Hardwickia binata, Leucaenia leucocephala, Sesbania grandiflora, Ficus* species etc. This should also include planting of local grasses like *Cenchrus ciliaris, Guinea grass* and legumes like *Stylosanthes hamata*, C*litoria ternatea* for fodder production. On each trench the seeds of the trees and grasses will be planted so that 600 trees can survive after three years. The estimates for these activities for one

ha would be Rs 14300=00 for a period of three year. The forest department's officers stated that the fencing is essential for the success of the programme as people let loose their cattle in the forest for grazing throughout the year. The activities will be implemented in participatory mode as per common guidelines of watershed projects by ensuring social fencing under the JFM and stall feeding of the cattle. The grasses would start yielding fodder from the first year itself and if the people manage the resources under JFM it would step up productivity of their livestock population as well as agriculture production.

b) **Construction of Water harvesting structures:** This will include construction of soil and moisture retention structures like bunds, gully plugs, check dams, ponds, lakes and water holes for the wild animals. The estimates for Lakes/ Ponds/ Bunds would be based on actual number and would be granted as per the state PWD schedule.

Area to be treated and financial requirement were discussed with state Forest Department and suggestion is quite realistic. There is absorption capacity of Rs. 72 crores in Up and 242 crores in MP. This work should preferably be taken up in forest adjoining to agricultural land and should form a part of the watershed treatment down stream.

9.0 Institutional Credit Extension System

Credit at reasonable rate for the purchase of inputs, tools implements and farm machinery play a significant role for enhancing productivity of Rainfed Agriculture. A sample survey of 40 farmers in two villages of Jhansi revealed that 36% of farmers borrowed from the fellow farmers, 35% from the banks, 22% from money lenders and 7% from Cooperative banks. Loan from cooperative banks were generally availed by influential large farmers. Accordingly non-institutional credit is still important especially for the marginal, small and medium farmers in the Bundelkhand region.

Normally farmers receive their income only at the time of seasonal harvesting and some of the loan is diverted for consumption purposes. The loan is often not available at right time and the applications or proposals are generally entertained by banks with the onset of monsoon. Crop insurance is mandatory for the Institutional Credit and some difficulties in the re-imbursement of the insurance claims were also reported. Weather based insurance or Barsha Bima of farming may take away some drawbacks of the existing scheme.

Credit cycle of the loan should be extended over two to three years. Credit against the total income portfolio should be considered as dry-land agriculture is diversified, income from animal husbandry and other outsourcing is substantial. There should be a provision for the

consumption credit so as to avoid diversion of the crop loan for non productive purposes.

The new technologies based on hybrids and genetically modified crops and animals is capital intensive with high probability of distress. During crop failures the farmer becomes defaulter and become ineligible for fresh loan. Therefore, waver of interest, deferment of repayment or even waving of principal under well defined conditions, situation and calamities should be a part of the loaning process. In the present case waving of interest and loan has already been announced by the Government of India and should be able to take care of farmers' distress. Reforms of the Cooperative banks as per the Vaidyanathan recommendation are under the active consideration of the Government of Uttar Pradesh.

9.1 Marketing:

It is generally believed that Rainfed region do not produce marketable surplus and this important infrastructure remained neglected. However a recent survey of MANAGE revealed that more than 90% of all categories of marginal to large farmers take some produce to the market. About 64% sales are being made in regulated markets, 13% through middle men, 11% through traders, 9% in weekly markets (haat) and 3% in the villages itself. The traditional drought coping system of storing of food grains and fodder for two to three years especially in the normal or

excessive rainfall year has got diluted due to public distribution system (PDS) and attractive support price especially for wheat and paddy.

About 100% of seeds, fertilizers, agro chemicals, animal feed and specialized farm implements are purchased from the input dealers. Therefore each district should have atleast one modern market comprising of covered yards, cleaning facilities, warehouses, shops of inputs dealers, feed suppliers, bank, tools, implements and farm machinery dealers. Sale of the produce, purchase of inputs including animal feed and facilities for testing of soil, plants and quality of agro chemicals should be available at one place or under single roof. Madhya Pradesh has a very good experience of E-Choupal being served by ITC especially in Soyabean growing region of the state. Similar kind of arrangements should be made available at least in one market of each district. Ensuring delivery of the extension services, animal and human health care and other attractions should be an important part of these modern markets. It could be in public-private partnership.

Transparency of the open auction and prompt payment would be able to ensure competitive prices by removing many indigenously designed evil practices. Procurement of rainfed area commodities like pulses, oil seed, seed spices, guar gum and livestock related outputs is generally not as much committed as in case of wheat and rice. There are many niche commodities like cumin, coriander, *mehndi*, spices, and medicinal plants. Each State Government should declare support price and ensure procurement of all these locally important commodities.

Keeping in view the extent of diversity and risks of rainfed agriculture, the Bundelkhand region may identify crops like chickpeas, durum wheat (khatia, malwi and sharbati) and lentils, amla etc. and declare their policies well in advance of sowing. While fixing domestic prices and tariff policies the corresponding International position may be kept in view especially for oil seeds and pulses.

9.2 Institutional Arrangements:

Bundelkhand region being most backward agro-ecology of the state is under invested and lacks infrastructure. Special purpose vehicle of implementation is called upon. A single window system in a project made with officers from line departments deputed with administrative and financial control of project officer like that of Sujala Project in Karnataka would be essential. There is a strong need of convergence and co-ordination of the packages with the already ongoing schemes so as to avoid duplication or gaps and ensure the holistic development process. There should be some ways and means to ensure tenure of at least three years for each posting for specialised delivery. Some incentives in the farm of additional increments or pay can also be considered. A single window delivery system would be able to harness synergies of a development process. The Project Officer may be given a block grant to carry on this package and other ongoing schemes to remove bottleneck of the remittance of a host of schemes. Later on this block grant can be spread over required schemes and items of the package. NRAA can be

considered to build capacity, design the projects, monitor and evaluate the implementation process.

9.3 R & D Infrastructure

Bundelkhand region has unique requirements of Research and Development for mitigating risks and distress

- There is a college of Agriculture (of JNKVV Jabalpur) at Tikamgarh in MP and Rs. 20 crores is recommended.
- There is one Indian Grassland and Fodder Research Institute of ICAR at Jhansi. It has land, buildings, and infrastructure and can be upgraded to "Deemed to be University". However, its mandate, disciplines, laboratories and other infrastructure would need expansion and Rs. 100 crores is recommended for that. This will be the quickest way to build scientific capacity within the region.

10.0 Convergence

There are several inter-sectoral complementaries of different investment portfolios to synergize and optimize for moderation and mitigation of drought risks (Fig.19). The complexion of labour migration and outsourcing is likely to change by the National Rural Employment Guarantee Scheme (NREGS). The labour charges in farm sector have already increased at many places and rate will be the same for men and women. Desilting, renovation, repair and reconstruction of tanks, deepening of privately owned dug wells, construction of farm ponds, new dug wells, afforestation etc. under NREGS are going to create durable assets for generating self-employment and cope with the future droughts.

Introduction of canal irrigation and watershed management will avoid over exploitation of aquifer provided the programmes are implemented concurrently. Diverting sown area to water guzzling crops like mentha in Hamirpur, sugarcane and cultivation of rice elsewhere lowered ground water table, led to inequity and increased risk factors. Efficient method of irrigating in ridge and furrow system and micro-irrigation will save water, expand command area and reduce vulnerability. Traditional water harvesting structures and limited irrigation sources of tanks and dug wells were neglected and their revival for mitigating drought has been emphasised. In canal irrigation tail-enders suffered due to change in cropping pattern at head reach. In this way there is a great justification of coordination, networking, harmonization and rationalisation

to ensure equity in the delivery of canal water. Networking of canals, tanks, completing command development in Rajghat, Ken and Betwa links has been prioritized.

Watershed Development Funds of NWDPRA, IWDP, DPAP, Horticulture Mission, Bamboo Mission, National Food Security Mission, RKVY (Rashtriya Kissan Vikas Yojna), Accelerated Irrigation Benefit Programme, Artificial Ground Water Recharging, CAMPA of Ministry of Environment & Forests and other afforestation programmes may be converged into a coordinated development process. Backward Region Grant Fund (BRGF) is an untied source and can fill up identified gaps and requires decision by the local Panchayat only. Convergence is now possible under the district plan formulation.

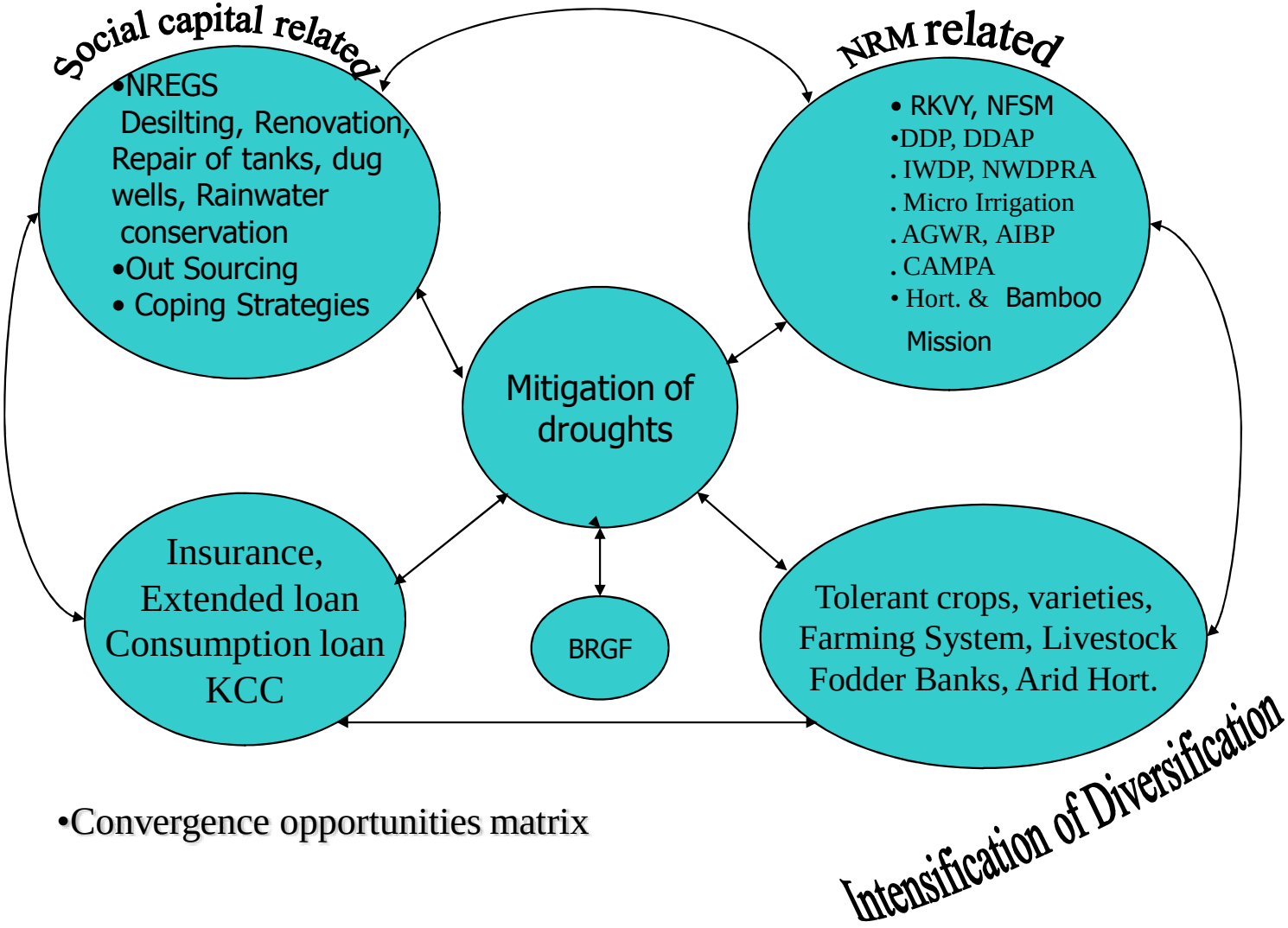
Livestock supported by crop residues (67% of fodder requirements), fodder trees and grazing has always provided resilience and robustness in Bundelkhand. However breeding of dwarf hybrids sorghum (Jowar), pearl millet (Bajra) etc. has altered this interdependence of crops and animals. Soybean replaced traditional crops of sorghum, pearlmillet and pulses and again its area went down due to lack of proper marketing and prices in UP. Some capacity of soyabean oil mills is underutilized or unutilized. Restrictions on interstate migration of livestock, availability of fodder, feed and market forces may lead to more number of economically better buffalos, stall feeding and marketing.

Kissan Credit Card is going to replace mortgaging of gold or land, Savai Pratha, liquidating of assets like animals and trees during droughts.

Public distribution and marketing system is discouraging traditional storage of grains for coping with crop failures. Definite plans and budgetary sources for forestry, livestock, irrigation and other sectors have been suggested to honour highly desirable process of water conservation. There could be many other ways of harmonizing, rationalizing and synergizing the development process. All kinds of innovative ideas ideally suited for local socio-economic conditions need to be tried for realizing full benefits to the society.

Sesame is highly drought tolerant crop but there is no oil mill to avoid glut of seeds in the market and crashing of prices. A part of the distress of cotton growers of Maharashtra was due to failure of the cotton market. Such possibilities should be eliminated in the future by promoting at last one oil mill for til of an appropriate capacity.

Fig.19:Managing Vulnerability by Convergence



•Convergence opportunities matrix

Four Tehsils of Allahabad District

Meja and Karaon Tehsils were visited by the Team, most of the fields were properly levelled, bunded and cultivated under rice. These four Tehsils had three lift irrigation and three gravity canals with properly maintained distribution system. There was loss of production in one year due to excess rain at the harvesting time. In the remaining three years rainfall was deficient by about 20% with a loss in productivity of about 15%. This loss could be attributed to the closure of canal system for the past two years for repair and renovation. The water table in three of the four Tehsils is shallow and should be exploited. Integral development of the canal and ground water is ideal to avoid water logging and meet the exigencies of the closure of the canals or irregular water supply. The issues of these four Tehsils are again very unique, do not resemble to that of Bundelkhand region and can be taken up separately.

Appendix-II

Composition of the Team

Sl. No.	Name	Ministry/Department
LEADER: Dr. J.S. Samra, CEO, NRAA		
1.	Dr. K.S. Ramachandra	National Rainfed Area Authority
2.	Sh. P. Umashankar	NCDC, New Delhi
2.	Sh. Niten Chandra / Sh. Ashok Mehta	Ministry of Rural Development
3.	Sh. V.M. Arora / Sh. R.M. Deshpande	Department of Land Resources,MoRD
4.	Sh. A.S. Dhingra	Ministry of Water Resources
5.	Dr. B.K. Yadav / Dr. A.K. Tiwari	Department of Agriculture and Cooperation
6.	Dr. Surendra Gupta	Department of Animal Husbandry, Dairying & fisheries

Central Team's Visit

For working out the modalities relating to visit of the Team to the affected areas and for getting the preliminary views of the State Officials, a meeting of the Team members along with Senior Officials from the States of Uttar Pradesh and Madhya Pradesh and Subject Matter Specialists invited as Special Invitees was held on 4.1.2008 as a prelude to the visit.

It was considered important that before suggesting any strategy for mitigation of drought like situation prevailing in the districts of Bundelkhand area, the ground situation be looked into, understand the problems of the farmers, examine mitigation strategies drawn out by the

respective States and have an interactive meeting with State Officials. As such, the Team adopted a three stage structure for completion of its task and submission of the Report.

a) Stage – I : Visit to 2-3 affected districts of Bundelkhand region in each of the two States for assessing the ground reality of prevailing drought like situation
b) Stage – II : Meeting with Collectors of the Districts of Bundelkhand of Uttar Pradesh and of Madhya Pradesh for ascertaining scale of implementation of various short-term and long-term drought mitigation programmes / schemes in their respective districts
c) Stage – III : Interactive meeting with the Chief Secretary / Cabinet Secretary of the two States regarding various short-term and long-term drought mitigation strategies required for implementation in their respective State

Appendix - III: List of existing Irrigation Projects and their Peformance of in Bundelkhand region of UP

Unit: Thousand Cubic Meters

S. No.	Name of Reservoir	River name	District	Live storage as on date	Storage as on 1st Oct. 2004		Storage as on 1st Oct. 2005		Storage as on 1st Oct. 2006		Storage as on 1st Oct. 2007		Storage As on 25-1-2008	
					Storage	% of Live	Storage	% of Live	Storage	% of Live	Storage	% of Live	Storage	% of Live
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Matatila dam	Betwa	Lalitpur	648710	648710	*100.0*	648710	*100.0*	648710	*100.0*	319950	*49.3*	238963	*36.8*
2	Dhukwan weir	Betwa	Jhansi	57767	57770	*100.0*	57770	*100.0*	57770	*100.0*	29300	*50.7*	21435	*37.1*
3	Parichha weir	Betwa	Jhansi	30215	30210	*100.0*	30210	*100.0*	30210	*100.0*	14470	*47.9*	11326	*37.5*
4	Dongri dam	Dongri	Jhansi	11893	9880	*83.1*	7980	*67.1*	680	*5.7*	2660	*22.4*	1710	*14.4*
5	Khaprar dam	Pahuj	Jhansi	4810	2490	*51.8*	12400	*257.8*	170	*3.5*	1220	*25.4*	0	*0.0*
6	Pahuj weir	Pahuj	Jhansi	18236	6030	*33.1*	9230	*50.6*	14500	*79.5*	12090	*66.3*	10562	*57.9*
7	Saprar dam	Saprar	Jhansi	70028	8630	*12.3*	18400	*26.3*	3230	*4.6*	2330	*3.3*	0	*0.0*
8	Pahari weir	Dhasan	Jhansi	47742	47740	*100.0*	47740	*100.0*	44940	*94.1*	37350	*78.2*	27300	*57.2*
9	Lachura weir	Dhasan	Jhansi	10562	10560	*100.0*	10560	*100.0*	9590	*90.8*	4610	*43.6*	2120	*20.1*
10	Keolari dam	Keolari	Mahoba	7220	2530	*35.0*	1770	*24.5*	310	*4.3*	260	*3.6*	0	*0.0*
11	Govind Sagar dam	Shazad	Lalitpur	80080	52240	*65.2*	77030	*96.2*	56590	*70.7*	10070	*12.6*	3470	*4.3*
12	Shazad dam	Shazad	Lalitpur	118930	63990	*53.8*	78150	*65.7*	37030	*31.1*	10760	*9.0*	0	*0.0*
13	Jamni dam	Jamni	Lalitpur	84000	81690	*97.3*	84000	*100.0*	71170	*84.7*	14520	*17.3*	3820	*4.5*
14	Sajnam dam	Sajnam	Lalitpur	74650	61550	*82.5*	74650	*100.0*	63950	*85.7*	6340	*8.5*	0	*0.0*
15	Rohini dam	Rohini	Lalitpur	8300	3680	*44.3*	8290	*99.9*	2000	*24.1*	0	*0.0*	0	*0.0*
16	Gangau weir	Ken	Chhaterpur	56472	56472	*100.0*	56472	*100.0*	16080	*28.5*	32560	*57.7*	6600	*11.7*
17	Rangawan dam	Banne	Chhaterpur	155178	155180	*100.0*	153810	*99.1*	24630	*15.9*	16570	*10.7*	9910	*6.4*
18	Bariyarpur weir	Ken	Panna	12599	12599	*100.0*	9400	*74.6*	4630	*36.7*	8970	*71.2*	2640	*21.0*
19	Ohen dam	Ohen	Chitrakoot	37752	6820	*18.1*	10770	*28.5*	7680	*20.3*	3800	*10.1*	360	*1.0*
20	Barwa dam	Barwa	Chitrakoot	23262	3630	*15.6*	5230	*22.5*	1370	*5.9*	690	*3.0*	460	*2.0*
21	Arjun dam	Arjun	Mahoba	58446	26530	*45.4*	20360	*34.8*	28140	*48.1*	4410	*7.5*	1980	*3.4*
22	Chandrawal dam	Chandrawal	Mahoba	30865	8830	*28.6*	16140	*52.3*	11520	*37.3*	2120	*6.9*	80	*0.3*
23	Kabrai dam	Kabrai	Mahoba	11950	2060	*17.2*	5120	*42.8*	1610	*13.5*	610	*5.1*	0	*0.0*
24	Urmil dam	Urmil	Mahoba	113500	54950	*48.4*	38160	*33.6*	33750	*29.7*	0	*0.0*	0	*0.0*
25	Manjgva nala dam	Manjgava	Mahoba	25910	10080	*38.9*	4190	*16.2*	8490	*32.8*	0	*0.0*	0	*0.0*
26	Maudha dam	Chirma	Hamirpur	179000	NA		NA		NA		10000	*5.6*	2000	*1.1*
27	Gunta nala dam	Gunta nala	Chitrakoot	24320	NA		NA		NA		9330	*38.4*	4910	*20.2*
28	Pathrai dam	Pathrai	JHansi	10700	NA		NA		NA		0	*0.0*	0	*0.0*
			Total	**2013097**	**1424851**	*70.8*	**1486542**	*73.8*	**1178750**	*58.6*	**554990**	*27.6*	**349646**	*17.4*
			MCM	**2013.10**	**1424.85**		**1486.54**		**1178.75**		**554.99**		**349.65**	
			TMCft	**71.09**	**50.32**		**52.50**		**41.63**		**19.60**		**12.35**	

Appendix IV: Peformance of Canal Systems in Recent Years in Bundelkhand Region of U.P.

S. No.	Canal System	Length of Canals (Km.)	No. of canals	Comm-and Cov-ered (Tha)	Planned Irrigation (Tha)		Recent Normal Year (Tha)		Maximum Irrigation so far (Tha)		Actual Irrigation (2004-05)		Actual Irrigation (2005-06)		Actual Iirrigation (2006-07)		Actual Iirrigation (2007-08)	
					Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	**Rabi**
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Betwa & Guru Sarai	2619.57	396	428.36	37.02	197.65	6.93	260.05	18.08	271.38	9.28	221.32	9.89	244.88	12.03	277.53	NA	NA
2	Dhasan	628.94	64	97.79	0.00	31.91	0.95	28.14	2.22	47.88	0.71	25.50	0.91	21.47	0.74	14.26	NA	NA
3	Ranipur	114.76	14	28.52	0.00	11.00	0.02	12.85	0.42	15.56	0.06	1.14	0.02	6.05	0.02	0.98	NA	NA
4	Pahuj & Garhmau	42.50	11	15.35	0.00	4.53	0.36	6.37	1.02	6.58	0.20	5.51	0.16	4.60	0.16	4.99	NA	NA
5	Keolari	39.50	6	14.39	0.00	1.46	0.01	3.09	0.05	4.25	0.01	2.37	0.01	0.90	0.01	0.30	NA	NA
6	Dogri & Khaprar	4.40	1	3.12	0.00	1.58	0.06	0.72	0.23	0.96	0.30	1.38	0.05	1.09	0.01	0.32	NA	NA
7	Other Minor (Ponds/ Tanks/ Bandhis) under Jhansi Circle	242.24	47	32.44	0.00	12.34	0.69	22.14	0.89	24.89	2.01	17.39	0.80	9.07	0.41	2.30	NA	NA
8	Ken	1074.13	177	230.38	65.95	45.85	57.69	72.99	65.99	84.90	64.81	78.33	39.48	67.19	54.60	41.58	NA	NA
9	Ohen	135.40	20	18.34	0.57	6.04	0.05	4.77	0.30	5.33	0.04	2.30	0.03	2.97	0.02	2.28	NA	NA
10	Barua	65.47	9	16.58	3.76	1.70	1.22	5.34	1.44	6.63	0.90	2.28	0.19	3.48	0.00	0.71	NA	NA
11	Arjun	143.49	21	40.54	0.00	6.20	0.06	4.09	0.13	18.78	0.11	9.68	0.06	6.25	0.07	9.57	NA	NA
12	Kabrai	85.81	15	30.11	0.00	1.94	0.01	0.34	0.04	3.94	0.02	0.39	0.01	1.71	0.01	0.30	NA	NA
13	Chandrawal	79.30	14	14.32	0.72	3.59	0.02	1.11	0.03	7.29	0.06	3.50	0.03	5.43	0.04	4.17	NA	NA
14	Majgaua	61.82	10	9.32	0.00	2.63	0.08	6.74	0.19	7.72	0.33	5.65	0.06	3.10	0.05	4.27	NA	NA
15	Urmil	48.01	5	6.81	0.00	4.77	0.03	5.54	0.05	6.00	0.11	5.51	0.12	5.16	0.09	5.01	NA	NA
16	Ogasi	65.02	11	14.60	6.01	6.68	0.00	2.68	0.33	3.59	0.00	1.76	0.02	2.37	0.00	2.54	NA	NA
17	Chillimal	51.68	12	8.93	3.47	4.31	0.18	2.04	0.39	2.35	0.38	1.90	0.15	2.18	0.39	2.37	NA	NA
18	Other Minor (Ponds/ Tanks/ Bandhis) under Banda Circle	391.26	98	93.50	4.58	40.06	1.27	22.73	1.93	43.25	1.42	19.04	1.03	15.92	0.83	11.98	NA	NA
19	Gobind sagar	190.09	34	40.33	0.00	10.82	0.25	5.74	0.11	18.06	1.11	19.09	0.08	18.30	0.82	17.40	NA	NA
20	Jamni	245.31	38	55.11	0.00	11.27	0.09	30.08	0.49	32.76	0.44	32.07	0.41	33.09	0.35	29.24	NA	NA
21	Rohini	20.09	5	2.42	0.00	1.78	0.02	2.99	0.17	3.28	0.03	3.07	0.02	3.11	0.04	2.03	NA	NA
22	Sajnam	85.55	17	10.21	0.80	6.35	0.12	13.23	0.48	14.23	0.36	15.37	0.24	15.30	0.53	15.59	NA	NA
23	Shazad	116.60	25	16.00	3.20	11.20	0.27	7.04	1.22	10.57	0.41	10.91	0.52	10.99	0.68	10.81	NA	NA
24	Other Minor (Ponds/ Tanks/ Bandhis) under Lalitpur Circle	85.00	0	12.53	0.00	2.86	0.20	5.88	0.40	9.82	0.31	9.30	0.08	9.51	0.16	7.49	NA	NA
	Total	6635.94	1050.0	1240.00	126.08	428.5	70.58	526.69	96.6	650.0	83.41	494.7	54.37	494.1	72.0	468.0	-	-
	Comparitive performance of Kharif and Rabi (%) Recent Normal year as base				*100*	*100*	*137*	*123*	*118*	*94*	*77*	*94*	*102*	*89*	-	-		

Appendix V: List of existing Irrigation Projects and their Peformance of in Bundelkhand region of MP

S. No.	Project name	Source/ River name	District	Live storage as reported (MCM)	Post monsoon storage (MCM)							
					2004		2005		2006		2007	
					Storage	*% of Live*	Storage	*% of Live*	Storage	*% of Live*	Storage	*% of Live*
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Rangwan	Banne	Chhaterpur	155.08	155.08	*100.00*	155.08	*100.00*	21.50	*13.86*	10.09	*6.51*
2	Urmil	Urmil	Chhaterpur	111.50	111.50	*100.00*	43.26	*38.80*	38.85	*34.84*	0.00	*0.00*
3	Beni Sagar	Khudar	Chhaterpur	26.22	26.22	*100.00*	23.86	*91.00*	3.62	*13.81*	4.38	*16.70*
4	Devendra Nagar	NA	Panna	10.10	10.10	*100.00*	9.80	*97.03*	4.30	*42.57*	4.37	*43.27*
5	Mansor Bari	Padaria	Sagar	97.28	31.03	*31.90*	40.83	*41.97*	11.85	*12.18*	5.65	*5.81*
6	Bila Tank	Billa	Sagar	51.94	0.00	*0.00*	0.00	*0.00*	0.00	*0.00*	0.00	*0.00*
7	Mala Tank	Sun	Damoh	16.86	16.86	*100.00*	12.86	*76.28*	10.11	*59.96*	13.48	*79.95*
8	Jabera Tank	Local	Damoh	3.43	4.14	*120.70*	2.02	*58.89*	2.23	*65.01*	2.26	*65.89*
9	Tejgarh Tank	Local	Damoh	4.60	3.50	*76.09*	5.00	*108.70*	3.79	*82.39*	0.77	*16.74*
10	Daroli Tank	Local	Damoh	5.72	3.96	*69.23*	4.06	*70.98*	5.21	*91.08*	3.96	*69.23*
11	Rajendra Sagar	Local	Tikamgarh	17.00	11.40	*67.06*	12.41	*73.00*	4.49	*26.41*	0.00	*0.00*
12	Jamni Canal	Jamni	Tikamgarh	0.00	0.00	*0.00*	0.00	*0.00*	0.00	*0.00*	0.00	*0.00*
13	Nandanwara Tank	Local	Tikamgarh	23.80	6.48	*27.23*	5.48	*23.03*	0.00	*0.00*	0.00	*0.00*
14	Minor-79	NA	Chhaterpur	97.28	31.03	*31.90*	40.83	*41.97*	11.85	*12.18*	5.65	*5.81*
15	Minor-58	NA	Panna	45.09	29.14	*64.63*	41.29	*91.57*	21.27	*47.17*	14.00	*31.05*
16	Minor -55	NA	Sagar	38.65	0.00	*0.00*	0.00	*0.00*	0.00	*0.00*	10.06	*26.03*
17	Minor-49	NA	Damoh	60.30	42.90	*71.14*	41.06	*68.09*	29.72	*49.29*	28.99	*48.08*
18	Minor-116	NA	Tikamgarh	147.53	37.37	*25.33*	28.10	*19.05*	3.43	*2.32*	1.17	*0.79*
19	Minor-29	NA	Datia	37.83	0.00	*0.00*	0.00	0.00	0.00	*0.00*	0.00	0.00
			Total (MCM)	**950.21**	**520.71**	*54.8%*	**465.94**	49.0%	**172.22**	*18.1%*	**104.83**	11.0%
			Total (TMC)	**29.75**	**16.31**		**14.59**		**5.39**		**3.28**	

Appendix VI: Performance of irrigation projects in Bundelkhand Region of MP

Unit: Ha

S. No.	Project name	CCA	Panned Irrigation	Actual Irrigation (Ha)								Average annual irrigation in 4 drought years
				2004-05		2005-06		2006-07		2007-08		
				Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	Kharif	Rabi	
1	2	8	9	10	11	12	13	14	15	16	17	18
1	Rangwan	19034	17085	0.00	4353	0	4672	0	0	0	0	2256
2	Urmil	10038	7692	0.00	3600	0	3028	0	2665	0	0	2323
3	Beni Sagar	6267	4170	0.00	2995	0	2930	0	24	0	0	1487
4	Devendra Nagar	1987	2400	300	1300	300	1200	300	850	300	0	1138
5	Mansor Bari	3260	1801	0.00	1408	0	1419	0	1400	0	1377	1401
6	Bila Tank	21183	12267	0.00	8500	0	8983	0	3944	0	0	5357
7	Mala Tank	1994	2631	1200	1620	1200	1200	1080	1335	460	1160	2314
8	Jabera Tank	721	910	78	431	110	401	99	438	70	225	463
9	Tejgarh Tank	1085	1619	320.00	560	377	584	389	543	150	430	838
10	Daroli Tank	1429	1295	200.00	550	132	605	232	581	70	155	631
11	Rajendra Sagar	3090	3036	0.00	840	0	1810	0	595	0	0	811
12	Jamni Canal	2927	2429	0.00	1495	0	1552	0	1460	0	0	1127
13	Nandanwara Tank	3095	1819	0.00	635	0	0	0	0	0	0	159
14	Minor-79	32483	17946	0.00	5845	0	6497	602	1661	0	0	3651
15	Minor-58	135493	18561	888.00	4964	791	4398	0	2888	488	0	3604
16	Minor -55	21704	7411	450.00	2710	0	3912	3325	3114	0	605	3529
17	Minor-49	11524	13246	1580.00	4578	1206	2979	0	2766	0	2690	3950
18	Minor-116	38690	27091	0.00	3823	0	4435	0	0	0	506	2191
19	Minor-29	5511	4635	0.00	0	0	0	6041	0	0	0	1510
		321515	148044	5016	50207	4116	50605	12068	24264	1538	7148	Overall Avg. = 2039
			Average	264	2642	217	2663	635	1277	81	376	
Annual irrigation as pecent of Planned+B5				*37.3*		*37.0*		*24.5*		*5.9*		

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