Technical Bulletin-3/2018

भाकृअनुप
ICAR

Contingency Plan during Abnormal Weather for Bundelkhand Region

केकृवाअनुसं
CAFRI

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भाकृअनुप–केन्द्रीय कृषिवानिकी अनुसंधान संस्थान
झाँसी-284 003 (उ.प्र.)
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Introduction and Objectives

The primary objective of this bulletin is to provide a tool to planners/ administrators to enable them to handle the situation arising due to bad weather and plan relief operations accordingly besides helping farmer in earning minimum economic support from farming. Crop diversification and integrated farming system approach are major tools in this regard. This is a long term planning and requires awareness amongst farming masses. The planners through interventions of quality seed material supply during crisis, arrangement of necessary inputs can ensure relief. The Government machinery can build capacity of farmers to integrate various components e.g. agroforestry, mixed farming, agroforestry based small enterprises like lac, gum/resin, silk worm, mushroom cultivation, fish farming, fruit, vegetable, spices, ornamental crop, medicinal and aromatic crops in their farming approach for risk partitioning. The process of climate change is not in hands of mankind and it is unpredictable, therefore, multi prong approach to ensure livelihood during odds is only viable solution. This bulletin is first step in this direction.

Agroforestry in the service of mankind :

Agroforestry opens up avenues for many small scale livelihood support options. Trees provide shelter to birds and thus contribute in integrated pest management. Trees have different flowering season and thus ensure pollen to honey bees which are crucial for honey production and pollination in several cross pollinated crops. Many trees have medicinal and aromatic value and yield revenue to the owner. Wood based livelihood support options include, basket making, lac cultivation, gum and resin cultivation. Especially bamboo alone can give employment to many families through artifact making and utility items. Presence of timber trees can serve as long term investment by farmer for future generations. Fuel trees under agroforestry system can potentially reduce burden on forest land for fuelwood collection. Various systems of agroforestry such as homestead, fish pond cultivation do not require additional land. It is a well known fact that 66% area on hills and 33% on plains should be under forest for healthy environment and conservation of natural resources particularly soil and water. Since population pressure is on the rise and holding sizes are already small (below economical level of sustenance) it is not possible to increase area under forest, therefore, only alternative left is to adopt agroforestry for increasing tree cover to save life on earth. Agroforestry can make best use of unutilized lands like bunds, boundaries and homestead for production and protection of environment.

Studies on water resource development through integrated watershed interventions in Tikamgarh (M.P.) revealed that consequent upon construction of check dams (8 nos.) use of gabions (150 nos.), khadins (6 nos.), marginal bunding (50 ha) and scattered plantation in 850 ha catchment area increased evapo-transpiration from 58% to 64%, reduced surface runoff from 35% to 25%, enhanced ground water recharge from 7% to 11% and base flow from 1.2% to 7.2% of rainfall received during monsoon season. Soil loss from the catchment reduced by 45-70% in different storms. In this watershed, a total capacity of 3743m^3 rain water storage was created through check dams but they harvested more than 8 times of their storage capacity due to infiltration, percolation and retention of water in soil profile, thus saturated wells and ensured base flow for longer duration. Prior to project, surface water in watershed was visible upto 4 months only but afterwards year round surface water availability in drainage course was able to quench the thrust of stray cattle. Availability of water in catchment led to increase in cropping intensity from 69% to 207%. Crop productivity across the crops increased by about 20-60%. During 2008 summer (preceding 4 years faced acute drought), 95% wells were dry but in 2015 only 26% wells were dry despite 32% deficit rainfall in 2014 and extensive wheat cultivation in the catchment area. This clearly indicated that watershed interventions can cope up water deficit atleast for one severe drought year. The study revealed that upto 400 mm rainfalls there is no impact of integrated watershed interventions. Upto 600 mm rainfall 86% weathered zone was well saturated in treated catchment. The probability of 600 mm plus rainfall in the region is 85%. This level of ground situation was achieved at 1100 mm rainfall which was only 26% probability. These hydrological features of red soils of Bundelkhand region clearly indicated that drought can be managed through integrated watershed interventions. Thus, impact of drought on irrigation water and drinking water hardship can be minimized through rain water harvesting and judicious use of available water for crop cultivation.

Anna Pratha is an age old tradition of rearing cattle in the region. Farmers own large herds of non-descript cattle which are low milk yielding. These cattle are tied from October to April i.e. *rabi* season. After *rabi* harvest they are let loose for open grazing till next *rabi* sowing. During this period, if any farmer wishes to sow summer or *kharif* crops, he will have to arrange watch and ward for his crop. Due to mechanization in agriculture need of bullock paver has greatly reduced. Because of this male calves are let loose and add to population build-up. These loose cattle browse all green vegetation in summer, thus, hamper tree growth and agroforestry.

Relevance of contingency planning :

Contingency planning is required to make-up losses due to bad weather. Weather

is always unpredictable and sporadic. Farmers prepare their agriculture plan well in advance and accordingly gather input like seed, fertilizer, weedicide, etc. Any deviation from normal hampers agricultural operation. In black soil, due to narrow time availability for soil working, farmers plow their field after first shower in monsoon and immediately sow crop. Subsequent drought or monsoon failure affects crop germination. Similarly in red soil also, farmers attempt to sow crops after one or two heavy shower. Subsequent drought, if any, damages crop even after germination. Different crops respond to sowing time as such, late sowing affect crop yield. Many times farmer needs re-sowing of same crop or other crop in the same field but unpreparedness of farmer in terms of quality seed availability prohibits him. In such circumstances, if he has a contingency plan well in advance, this plan can rescue him from total failure. In fact, the uncertainty in weather parameters leads to mix cropping and diversification of crops. This diversification and mixed cropping rescues farmers from total loss. This risk is more in *Kharif* than *Rabi* or *Zayad* season. During *rabi* season, high temperatures in October restrict sowing of oilseeds and pulses, in particular. Rain storm during crop maturity is another risk with *rabi* crops. This can be handled through diversification of crops. Agroforestry is likely to play vital role in mitigating such risks as due to woody nature, they are less affected by late winter rains, wind and moisture stress. They ensure some return in terms of leaf fodder, fuelwood, fruit and other produces. Trees also mediate micro-climate and buffer the ill effects of high velocity wind in particular. A contingency plan is not only required at farmers level but also at administration level to provide relief to farmers in need. With this in back of mind, this contingency plan is prepared to assist farmers, planners and administrators engaged in agriculture development.

Bundelkhand Region

Climate is an ever changing phenomenon, however frequent and intense changes in weather parameters are of great concern. In recent past, the frequency and intensity of climate change events or weather aberrations have increased. This has been amply revealed by meteorological observations worldwide. The accelerated climate change is attributed to increase in CO_2 level in atmosphere due to increased emissions and reduced permanent vegetation cover. It has been amply proved that vegetation is major sink for CO_2. Therefore, to offset pace of climate change, the first priority is being given on plantation followed by judicious use of resources for controlled emission.

According to the India State of Forest Report (ISFR) 2015, the total forest and tree cover is 24.16% of the total geographical area of the country. However, NFP-1952 advocated 33% tree/forest cover of geographical area of India. Increasing population pressure on the globe is pressing hard to increase area under crops to feed them and thus, leaves no scope to increase area under orchards and forests. The first priority is being met with by crop intensification, however the second can be met through agroforestry only. Thus, agroforestry is indispensable for healthy environment and climate change process. Sustainability of production due to climate change is a challenge. This warrants preparedness for ill events. Fortunately, vast network of meteorological observatories throughout the country provide enough data on prevailing weather conditions. Based on past trends and correlations, scientists have developed efficient models to predict weather well in advance. Long term, medium and short term weather forecasts are being made with fairly good accuracy. This has given an opportunity to develop contingent plans to rescue farmers who are directly affected and of course whole population which is indirectly affected in terms of economics and belly filling.

Bundelkhand region of India experiences semi-arid, sub-tropical climate with rainfall ranging from 848-1197 mm. There are 13 districts in the region, seven in U.P. and six in M.P. The region, geologically, is situated on hard granite rock. East southern part of Bundelkhand receives higher rainfall than West-

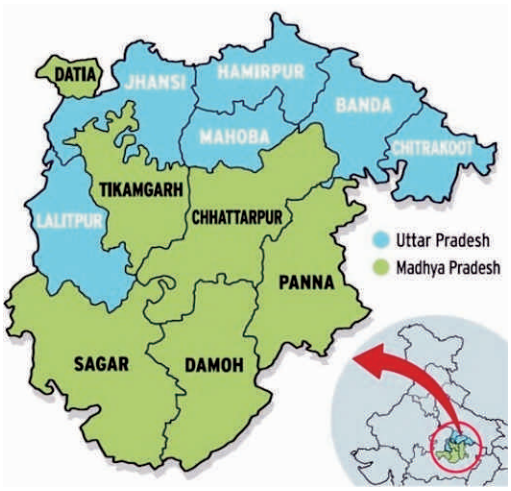


Figure 1. Bundelkhand region

northern part. By and large, terrain is undulating with exposed rocks at places. About 56% soil of the region is coarse textured red, while 44%, is light black. Area along river Yamuna, which constitutes northern boundary is ravenous as well. The region suffers from water scarcity. Main source of irrigation in the region are shallow dug wells and dugout ponds or lakes. Perched water is tapped for irrigation and drinking. Agriculture is main stay of region's economy and well supported by dairying. Crop productivity due to various edapho-climatic conditions is low. Forests in the region are dry deciduous thorn forests which are rapidly degrading due to enormous pressure of extraction and slow regeneration. Detailed information about Bundelkhand region is given in Table 1.

Long term contingency plans envisage plantations of permanent vegetation on field bunds under agroforestry systems to create sink for increasing CO_2 in atmosphere and assured sources of direct income besides microclimate mediation. Further, water is most critical input in agriculture. As the region depends upon perched water for irrigation and drinking, it is utmost important to harvest rain water in-situ and facilitate ground water recharge for uninterrupted water availability in wells. This requires intensive soil and water conservation measures. In red soil, emphasis should be placed on in-situ water harvesting through bunding and trenching besides nallah training, while in black soil, safe disposal of excess water from crop lands and harvesting ex-situ at designated site needs to be done on priority. Agroforestry will achieve goal of risk proofing/sustainability, while water conservation will help in enhancing productivity. Bundelkhand region, though, largely rainfed but *rabi* is the major cropping season. In this region, double cropped area is hardly 5-7%. *Kharif* crops are grown in about 28% area which was earlier below 10%. Zaid crops are grown in very small area near wells. Mostly vegetables and fodder crop (MP Chari) are grown for home consumption/cash and fodder purpose. Simultaneously, catch crops should be introduced to combat ill effects of climate change. Crop planning is key to success in rain fed areas. Crop diversification and mixed cropping may be regarded as panacea to combat climate change. Due emphasis should be given on accurate forecasting of mid season dry spells, early rise of temperature in February-March and late onset of winter that too at least one month in advance so that necessary arrangements to equip or educate the farmers should be made.

In this region weather in *rabi* season is often homogenous while that in *kharif* season is highly localized. This needs to be taken care of while preparing contingent plan. This also necessitates crop planning in a given season.

As regards to medium term strategy, government policies should be amended to

make necessary provision for government procurement of produce like barley, grain, sesame, lentil, taramira, mustard, etc. which are drought hardy and can escape drought or prolonged rains in *rabi* season. Minimum support price (MSP) alone for many crops is not sufficient to assist the farmers in combating climate change.

With this background contingent plan for Bundelkhand region is prepared keeping in view the soil type, season, prevailing agriculture practices and frequently experienced weather aberrations. This plan is meant for areas either rainfed or receiving life saving irrigation from shallow dug wells which have poor water recharge and water yield. Canal irrigated areas are not included in this plan because they need crop intensification through introduction of catch crops to cover up failure of main crop. Ten major weather aberrations have been presumed and accordingly suggestions to combat the aberrations have been proposed.

Following weather abnormalities have been presumed and contingency plan for 13 districts of Bundelkhand region is given below:

Aberrations:

***Kharif* season**

1. Delayed monsoon by 15 days
2. Delayed monsoon by 1 month
3. Timely monsoon followed by long dry spell
4. Early cessation of monsoon
5. Drought like situation (rainfall <81%)
6. Excessive rainfall

Winter season

7. No winter rains
8. Excessive winter rains
9. High temperature in October-November
10. Early temperature rise in February-March

Strategies to combat above situations in Bundelkhand region are given below. Agroforestry (bund/boundary/field plantation etc.) and forage grass planting on bunds is mandatory to combat the ill effects of weather aberrations. Crop diversification, crop planning and mixed cropping are major strategies. Increased seed rate of crops during late sowing is generally recommended as precautionary measure, but in Bundelkhand region the seed rate of crops in common practice is very high.

General information about Bundelkhand

Demography

- Total population 18,311,896 (53% male 47% female).
- Population density (280 persons/ Sq. Km UPBR), (184/ Sq. Km MPBR).

Topography

- The region covering an area of over 7.08 Million hectares (M ha), more than 54% characterized by hard rocks, undulating terrain of varied slope.

  i) Archaean:- (water yield 1-5 lps)

  ii) Vindhyan:- (5-25 lps)

  iii) Transitional:- (5-25 lps)

  iv) Recent:- (20-40 lps).

Soils

- Deep and medium black in Southern part (44%),

  1 Kabar (31.4%)

  2 Mar (12.4%)

- Mixed red & black, red & yellow (56%) in middle, north.

  1 Rankar (17.6%)

  2 Padua (38.5%)

Rainfall Pattern

- 865 mm with a range of 848 to 902 mm (UPBR).
- 1094 mm with a range of 852 to 1197 mm (MPBR) and is 26% more than the UP part.
- About 90% rainfall is received from July to September in 30-35 events or spells.
- Land Use: 21.4% area under forest and scrubs, 50% of geographical area is cultivated

Crop production

- Agriculture which is mostly rainfed.
- Cereals contribute 54.6%, pulses 32.4%, oilseeds 8.0%, sugarcane 0.2% and other crops 4.8%.
- The region is surplus in pulses, deficient in oil seeds and sufficient in cereal production.

***Annapratha* in Bundelkhand region**

- Unlike other agro-ecologies *rabi* sowing (69%) in Bundelkhand region predominates over *kharif* (31%) which is a paradox.
- The traditional practice of "Annapratha" in Bundelkhand region causing considerable problem in *kharif* crop production.

Livestock

- High population of unproductive cattle, indigenous milch animals with low productivity.
- Ineffective input delivery mechanism, traditional milk marketing systems.
- Lack of adequate feed resources both quantitatively and qualitatively.

District wise information on latitude, longitude, soils, physiography and crops

S. No.	District	Latitude	Longitude	Altitude (m)	General physiography	Soil types	Area (ha)	Av. rainfall (mm)	*Kharif* crops	*Rabi* crops
1.	Mahoba (U.P.)	25° 17' 33.03" N	79° 52' 21.59" E	208	Northern part having relatively low relief with low hillocks, Southern part having high relief with hillocks	Kabar, Mar, Padua, Rankar	2,88,400	864	Sorghum, pigeonpea, sesame, mung, urd	Wheat, mustard, barley
2.	Hamirpur (U.P.)	25° 58' N	80° 12' E	80	The terrain of the district is mostly hilly and undulating. Ravines along Yamuna river	Kabar, Mar, Padua, Rankar	4,12,200	851	Paddy, pearlmillet, sorghum, urd, mung, sesame, pigeonpea	Chickpea, wheat, barley, pea, lentil
3.	Banda (U.P.)	25° 20' N	80° 22' E	123	Irregular uplands with outcrops of rocks intermingling with mostly lowlands	Kabar, Mar, Padua, Rankar	4,14,400	902	Paddy, sorghum, pearlmillet, til, mung, urd, pigeonpea and sanhemp	Wheat, barley, gram, linseed, mustard, lentil and peas
4.	Chitrakoot (U.P.)	24° 48 ' to 25° 12 ' N	80° 58 ' to 81° 34 ' E.	209	General topography is hilly and undulating cut off by numerous rivers and rivulets. A large part of the district is rocky and denuded, forested upland called the Patha.	Balui, Kabar, Kankirili, Padua, Rankar	3,14,700	850	Paddy, urd, maize, sorghum, pearlmillet, sesame, mung and minor millets	Wheat, chickpea, barley, pea, mustard

5.	Lalitpur (U.P.)	24° 22' N	78° 28' E	428	Undulated plains of black soil. Most area drained by rivers. In some area red soil tract are present.	Kabar, Mar, Padua, Rankar	5,09,400	881	Maize, urd, mung, sorghum, paddy, soybean and groundnut	Wheat, barley, pea, lentil, mustard and linseed
6.	Jhansi (U.P.)	25° 44' N	79° 25' E	280	North eastern plains and South West Hilly Terrains	Kabar, Mar, Padua, Rankar	5,02,400	848	Urd, mung, groundnut, sesame, sorghum	Wheat, barley, chickpea, potato, mustard and lentil
7.	Jalaun (U.P.)	26° 08' N	79° 23' E	164	Ravinous, upland and center plain soils	Kabar, Mar, Parwa, Rankar	4,54,400	862	Urd, mung, sesame, sorghum, pearlmillet, paddy	Wheat, pea, mustard, chickpea, barley, lentil
8.	Datia (M.P.)	25.20°N	78.47°E	302	Uniformly sloping towards the north-east and the presence of mounds and hillocks formed mostly of the river alluvium	Kabar, Padua, Rankar	2,95,700	852	Urd, mung, sesame, groundnut	Wheat, barley, mustard, pea, chickpea
9.	Tikamgarh (M.P.)	24°26'10" to 25°33'15" N	78°25'10" to 79°25'16" E	260	Rocky with gentle slope	Kabar, Padua, Rankar	5,04,800	1070	Urd, sesame, groundnut, mung, sorghum, soybean	Wheat, mustard, barley, chickpea and vegetables

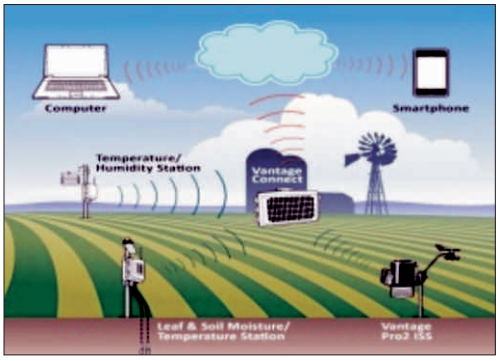
10. Chhatarpur (M.P.)	24° 06' to 25° 20' N	78° 59' to 80° 26' E	305	Undulated, multidirectional complex stage, varying thickness of alluvium	Kabar, Padua, Rankar	8,68,700	1095	Paddy, sorghum, maize, pigeonpea, urd, sesame, groundnut soybean and sugarcane	Wheat, chickpea, linseed, Mustard and vegetable
11. Panna (M.P.)	23° 45' to 25° 10' N	79° 45' to 80° 40' E	416	Area consists of granite rocks of the Arabian era. Generally, the plateau is flat with marginal slopes and the topography is smooth and undulating.	Kabar, Padua, Rankar	7,13,500	1182	Paddy, sorghum, urd, pigeonpea, sesame and soybean	Wheat, lentil, mustard, pea, chickpea
12. Damoh (M.P.)	23° 09' to 24° 27' N	79° 03' to 79° 57' E	351	District divided into three physiographic sub-divisions, namely Vindhyan range, Vindhyan Scraps and Bundelkhand uplands	Kabar, Mar, Padua, Rankar	7,30,600	1170	Soybean, rice, blackgram, sorghum, pigeonpea, sesame	Chickpea, wheat, lentil, pea, linseed
13. Sagar (M.P.)	23° 10' to 24° 27' N	78° 40' to 79° 21' E	427	Vindhayan and Daccan trap land system. Hill ranges are prominent in the southwest.	Kabar, Mar, Padua, Rankar	10,25,200	1197	Soybean, rice, maize, blackgram, sorghum, pigeonpea, sesame	Chickpea, wheat, lentil, pea, linseed

Checkdam

Grassed waterways

Mulching

Catch crop



Weather Forecasting

Deep Summer Ploughing

Change in Crop Plan

Sprinkler Irrigation

Crop Diversification

Farm bunding

Inter cropping

Integrated Farming System

Silage making

Agroforestry system

Agroforestry system

Agroforestry system

District wise crop contingency plan according to type of weather aberrant for Bundelkhand region

1. Mahoba

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, urd, mung with pre-sowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize, chari	Mung
2.	Bunding for moisture conservation, summer ploughing	Mixed crop of jowar + arhar+urd, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Mung, maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red soil and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hey making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/ hey making	Normal *rabi* crop+potato, toria as catch crop	Normal *rabi* catch crop	Normal crop crop+toria as	Normal crop
4.	Irrigate the crop using pressurized irrigation tools	Save part of crop by irrigation, use remaining for silage/hey	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hey making	Grow toria, potato as catch crop + normal *rabi* crop	Grow toria as catch crop + normal *rabi* crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Sow mixed crop of jowar+arhar+urd+ mung, sole crop of soybean, urd, mung	Sow tall Indian wheat, barley, Mix crop of kathia+, mustard+gram+ linseed, taramira	Tall Indian wheat, barley, kathia, gram, pea, mustard, lentil. Mix crops	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, jowar/bajra+ pegion pea	Soybean, jowar+ pegion pea+urd	Wheat, mustard, pea, gram	Wheat, lentil, gram, pea	Mung, maize, vegetable	Mung, vegetable
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian, kathia	Gram, pea, mustard, barley, kathia, safflower	Maize	Mung
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, barley, mustard, pea	Gram, pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea, wheat, barley	Maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part of crop by watering.	Wheat, barley	Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

2. Hamirpur

(Ravinous, Undulating, Light soils need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, urd, mung , jowar + arhar	Jowar + arhar, maize, soybean	Normal *rabi* crop, wheat, barley, pea, gram	Normal crop of wheat, barley, pea, gram, lentil	Maize, vegetable, flowers	Mung, vegetables, flowers
2.	Bunding for moisture conservation, summer ploughing	Mixed crop of jowar + arhar + urd/mung, til	Mixed crop of jowar + arhar, soybean	Normal *rabi* crop, wheat, barley, pea, gram	Normal *rabi* crop, gram, lentil, wheat,	Mung, vegetable, flowers	Vegetables, flowers
3.	Mulching with tree leaves after 10 days drought in black and 7 days in red soil	Groundnut, urd, mung, maize, soil mulching or green weed/tree leave mulching	Paddy, soybean, urd, mung, jower, mulching	Normal *rabi* crops	Normal *rabi* crops	Normal zaid	Normal zaid
4.	Irrigate crop using pressurized tools	Save part of crop by watering, use rest for hay/silage	Save part of crop by watering, use rest for hay/silage	CA for moisture conservation, grow wheat, barley, gram, pea	CA for moisture conservation, grow wheat, barley, lentil, gram, pea	Normal	Normal
5.	Bunding for moisture conservation and summer ploughing, reduce field size to max. 0.4 ha	Mixed crop of jowar + arhar + urd/mung, til	Mixed crop of jowar + arhar, soybean	Tall Indian wheat, barley, gram, pea, kathia+gram+ mustard+linseed	Kathia+gram + linseed, tall Indian wheat, barley + gram, lentil, pea	-	-

6.	Arrange drainage on every field, grassed water ways, reduce field size to max. 0.4 ha	Jowar, groundnut, urd, mungJowar, urd, jowar + arhar	Toria as catch crop, wheat, pea, gram normal crop	Wheat, pea, gram, lentil, toria as catch crop	Maize, mung, vegetables, flowers	Vegetables, flowers	
7.	-	Normal *kharif*	Normal *kharif*	Tall Indian wheat, barley, pea, gram, taramira	Kathia, barley, lentil, taramira	-	-
8.	Arrange drainage + grassed water ways	Normal *kharif*	Normal *rabi*	Wheat, barley, pea, gram	Wheat, barley, pea, gram, lentil	Maize, mung, vegetables, flowers	Mung, vegetables, flowers
9.	-	Normal *kharif*	Normal *rabi*	Late sown wheat, barley	Late sown wheat, barley	Maize, mung, vegetables, flowers `	Mung, vegetables, flowers
10.	-	Normal *kharif*	Normal *kharif*	Save part of wheat, barley by life saving irrigation	Save part of crop by watering	-	-

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

3. Banda

(Part Ravinous, Part Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Dry sowing of jowar/bajra, paddy upland, rest normal kharif crop late nursery (paddy)	Dry sowing of jowar/bajra, rest normal crop, upland paddy, late nursery (paddy)	Normal *rabi* crops	Normal rabi crops	-	-
2.	Bunding for moisture conservation, summer ploughing	Sowing of urd, mung, til jowar/ bajra	Sowing of jowar/bajra urd barley, gram	Normal *rabi* crop emphasis on barley, gram, mustard, pea	Normal rabi crop, emphasis on pea, mustard, lentil	Maize	Mung
3.	-	Mulching after 1 week drought normal kharif	Mulching after 10 days drought normal kharif	Normal *rabi*	Normal rabi	Maize	Mung
4.	-	Save part crop by irrigation, rest use for hay/silage	Save part crop by irrigation, rest use for hay/silage	Timely/early sowing of gram, pea, wheat, barley	Timely sowing of lentil, gram, pea, barley, wheat	Maize,	Mung
5.	Bunding for moisture conservation, summer ploughing, reduce field size to a max. 0.4 ha	Mix crop of jowar/bajra + pigeonpea, sole crop of til, arhar, upland paddy	Mix crop of jowar/ bajra+urd+ mung+ pigeonpea, sole crop of til, arhar, upland paddy	Barley, gram, pea, mustard + linseed under mix cropping, sole cropping of Kathia wheat and above crops	Mixed crop of Kathia + gram + linseed, sole crop of lentil, Gram	-	-

6.	Arrange drainage in field. Reduce field size to a max. of 0.4 ha	Paddy in field, pigeonpea on bunds, jowar/ bajra, urd, mung	Paddy in field and pigeonpea on bund jowar/ bajra, urd	Normal *rabi* crops	Normal *rabi* crops	Maize, mung, vegetables, flowers	Mung, vegetables, flowers
7.	-	Normal *kharif* paddy	Normal *kharif* paddy	Tall Indian wheat, barley, Kathia wheat, gram, pea, terameera, mustard, safflower	Tall India wheat, Kathia wheat, barley, gram, lentil, Terameera, Mustard, Safflower	-	-
8.	Arrange drainage and grassed waterways	Normal	Normal	Wheat, gram, pea	Wheat, gram, massor	Maize	Mung
9.	-	Normal	Normal	Late sowing, increased seed rate of wheat, barley, under rainfed condition, Taramira	Late sowing with increased seed rate of wheat, barley, Taramira, Safflower	Maize	Mung
10.	-	Normal	Normal	Water crop to save shriveling of grain	Water crop to save grain shriveling	Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

4. Chitrakoot

(Rocky, Undulating terrain need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	No panic	Jowar, bajra, groundnut, urd, til	Jowar, bajra, urd, pigeonpea	Normal *rabi* crop	Normal rabi crop	Maize	Mung
2.	Bunding for conservation and summer ploughing	Jowar/bajra, urd, til, pigeonpea, groundnut	Jowar/bajra, urd, pigeonpea	Normal *rabi* crop	Normal rabi crops	Mung, maize, fodder	Mung, fodder
3.	Bunding for moister conservation	Jowar/bajra, groundnut, pigeonpea, mulching by tree leaves/weeds after one week or soil working	Jowar, bajra, urd, pigeonpea, mulching by weed or tree leaves after 10 days dry spell	Normal *rabi* crops	Normal rabi crops	Mung, maize, chari	Mung, chari
4.	-	Save part crop by irrigation, rest may be used for hay or silage making while green crops : groundnut, jowar/ bajra, urd	Jowar, bajra, urd, save part crop of jowar, bajra by irrigation, rest use for hay/silage while green	Toria, gram, pea, barley, wheat	Toria, gram, pea, barley, wheat	Maize, mung, chari	Mung, chari
5.	Bunding for moisture conservation reduce field size to a max. of 0.4 ha	Mixed crop of jowar/bajra + pigeonpea+urd, mulching	Mixed crop of jowar/bajra + pigeonpea+urd, mulching	Mixed crop of Kathia+gram + linseed+Mustard, barley, Taramira, Tall Indian wheat	Mixed crop of gram+Linseed +Mustard, barley tarameera, tall Indian wheat, lentil	-	-

6.	Drainage arrangement, grassed waterways, reduce field size to a max. 0.4 ha	Groundnut, urd, paddy	Paddy, urd	Wheat, gram, mustard, pea	Normal crop	Maize, vegetable, flowers	Mung chari, vegetable, flowers
7.	-	Normal *kharif*	Normal *kharif*	Tall Indian wheat, gram, pea, mustard, barley	Tall Indian wheat, barley, gram, lentil	-	-
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, pea, barley, mustard	Wheat , pea, barley, mustard	Maize, mung, chain	Mung chari
9.	-	Normal	Normal	Late sown wheat, barley with increased seed rate	Late sown barley with increased seed rate	Maize mung chari	Mung, chari
10.	-	Normal	Normal	Water crop to escape grain shriveling, save part crop	Water crop to escape grain shriveling, save part crop	Maize, mung	Mung, chari

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

5. Lalitpur

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize	Mung,
2.	Bunding for moist., conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal rabi crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Grow toria, potato as catch crop + normal rabi crop	Grow toria as catch crop + normal rabi crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, barley, mix crop of Kathia wheat, mustard, Gram, taramira	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram	Lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian) taramira	Gram, Pea, mustard, barley, Kathia, Safflower	Maize	Mung
8.	Arrange drainage	Normal *Kharif*	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, pea	Mung, maize, vegetable, flowers	Mung, Vegetable, Flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Mung, maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley		Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

6. Jhansi

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal crop	Mung, Normal crop	Mung, Normal crop
2.	Bunding for moist., conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Mung, maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Grow toria, potato as catch crop + normal *rabi* crop	Grow toria as catch crop + normal rabi crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, Barley, Kathia wheat, mustard, Gram, lentil	Tall Indian wheat, Kathia wheat, barley, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram,	Lentil, gram, pea, mustard	Maize, vegetable	Mung, vegetable
7.	-	Normal kharif	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian), Kathia	Gram, Pea, mustard, Barley, Kathia, Safflower	Mung	Mung
8.	Arrange drainage	Normal Kharif	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, Pea	Mung, Maize, Vegetable, Flowers	Mung, Vegetable, Flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Mung, Maize, Vegetable, Flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley, Use remaining for silage/hay		Mung, Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

7. Jalaun

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal crop	Mung, Normal crop	Mung, Normal crop
2.	Bunding for moisture, conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal *rabi* crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Grow toria, potato as catch crop + normal *rabi* crop	Grow toria as catch crop + normal *rabi* crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, Barley, mix crop of Kathia wheat, mustard, gram, lentil	Tall Indian wheat, barley mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Sow groundnut, urd, soybean	Sow soybean, jowar	Wheat, mustard, pea, gram	Sow lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian), taramira	Gram, pea, mustard, barley, Kathia, Safflower	Maize	Mung
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, pea, lentil	Maize, Maize, Vegetable, Flowers	Mung, Vegetable, Flowers
9.	-	Normal	Normal	Late sowing of wheat, barley with increased seed rate	Late sowing of lentil, pea	Maize, Maize, Vegetable, Flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley		Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

Kharif crops for Bundelkhand Region

Blackgram

Greengram

Groundnut

Sesame

Pigeonpea

Sorghum

Rabi crops for Bundelkhand Region

Wheat

Chickpea

Barley

Mustard

Lentil

Linseed

8. Datia

(Rocky, Undulating part ravinous need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize, Normal Crop	Mung, Normal Crop
2.	Bunding for moisture, conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Toria, potato as catch crop + normal *rabi* crop	Toria as catch crop + normal rabi crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, Barley, mix crop of Kathia wheat, mustard, Gram, lentil	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram	Lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian)	Gram, pea, mustard, barley, Kathia wheat	Maize	Mung
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, barley, mustard, pea	Gram, pea, lentil	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley with increased seed rate	Late sowing of lentil, pea	Maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley		Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

9. Tikamgarh

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize, Normal Crop	Mung, Normal Crop
2.	Bunding for moisture, conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Grow toria, potato as catch crop + normal *rabi* crop	Grow toria as catch crop + normal rabi crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, barley, mix crop of Kathia wheat, mustard, gram, lentil	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram	Lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal kharif	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian, Kathia	Gram, pea, mustard, barley, Kathia, Safflower	Maize	Mung
8.	Arrange drainage	Normal Kharif	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Mung, maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley		Mung, Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

10. Chhatarpur

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, urd, mung with presowing soybean irrigation or dry sowing of jowar	Dry sowing of jowar + arhar,	Normal crop	Normal Crop	Maize, Normal Crop	Mung, Normal Crop
2.	Bunding for moisture, conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop (Mung, Vegetables)	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Toria, potato as catch crop + normal *rabi* crop	Toria as catch crop + normal rabi crop on time	Normal crop (Mung, Vegetables)	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Sow mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Sow tall Indian wheat, barley, mix crop of Kathia wheat, mustard, gram, lentil	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grased waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram,	Lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *Kharif*	Normal *Kharif*	Barley, gram, mustard, pea, wheat/tall Indian), Kathia wheat	Gram, pea, mustard, barley, Kathia, safflower	Mung	Mung
8.	Arrange drainage	Normal *Kharif*	Normal *Kharif*	Wheat, Barley, Mustard, Pea	Gram, pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Gram, pea mustard Save part crop by watering wheat, barley	Gram, pea, mustard, safflower	Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

11. Panna

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif* Red Soil	*Kharif* Black Soil	*Rabi* Red Soil	*Rabi* Black Soil	*Zaid* Red Soil	*Zaid* Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal crop	Maize, Normal crop	Mung, Normal Crop
2.	Bunding for moisture, conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal *rabi* crop + toria as catch crop	Normal crop	Normal crop (Mung, Vegetables)
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Toria, potato as catch crop + normal *rabi* crop	Toria as catch crop + normal *rabi* crop on time	Normal crop (Mung, Vegetables)	Normal crop (Mung, Vegetables)

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, barley, mix crop of Kathia wheat, mustard, gram, lentil, taramira	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil, safflower	-	-
6.	Arrange drainage in field, waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, soybean	Soybean, jowar	Wheat, mustard, pea, gram	Sow lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tallIndian), Kathia wheat	Gram, pea, mustard, barley, Kathia, safflower	Maize	Mung
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, Pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley with increased seed rate	Late sowing of lentil, pea	Maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part of crop by watering wheat, barley		Mung, Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

12. Damoh

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, Urd, Mung with presowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize Normal Crop	Mung, Normal Crop
2.	Bunding for moist., conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal rabi crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Toria, potato as catch crop + normal *rabi* crop	Toria as catch crop + normal rabi crop on time	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, barley, mix crop of Kathia wheat, mustard, gram, lentil	Tall Indian wheat, barley, mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, mung	Soybean, jowar	Wheat, mustard, pea, gram	Lentil, gram, pea	Maize, vegetables	Mung, vegetables
7.	-	Normal *kharif*	Normal *kharif*	Barley, gram, mustard, pea, wheat/tall Indian), Kathia	Gram, Pea, mustard, barley, Kathia, safflower	Maize	Mung
8.	Arrange drainage	Normal *kharif*	Normal *kharif*	Wheat, Barley, Mustard, Pea	Gram, Pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part of crop by watering wheat, barley		Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

13. Sagar

(Rocky, Undulating need to increase area under *Kharif*)

Abb. Type*	Gen. Precaution	*Kharif*		*Rabi*		*Zaid*	
		Red Soil	Black Soil	Red Soil	Black Soil	Red Soil	Black Soil
1.	-	Groundnut, urd, mung with pre-sowing irrigation or dry sowing of jowar	Dry sowing of jowar + arhar, soybean	Normal crop	Normal Crop	Maize, Normal crop	Mung, Normal crop
2.	Bunding for moist., conservation, summer ploughing	Mixed crop of jowar + arhar, mung, til	Mixed crop of jowar + arhar + urd/mung, soybean	Normal crop	Normal crop	Mung, maize, vegetables	Mung, vegetables
3.	Mulching with tree leaves after one week drought in red and 10 days in black soil	Save part of crop by supplemental irrigation. Use remaining for silage/hay making	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Normal *rabi* crop + potato, toria as catch crop	Normal *rabi* crop + toria as catch crop	Normal crop	Normal crop
4.		Save part of crop by irrigation, use remaining for silage/hay	Save part of crop by supplemental irrigation through sprinkler, use remaining for silage/hay making	Toria, potato as catch crop + normal *rabi* crop (gram, pea, mustard, taramira)	Toria as catch crop + normal *rabi* crop on time (gram, pea lentil, safflower)	Normal crop	Normal crop

5.	Bunding of field and summer ploughing for moisture conservation, reduce field size to 0.4 ha max.	Mixed crop of jowar + arhar + urd, sole crop of til, urd, mung	Mixed crop of jowar + arhar + urd + mung, sole crop of soybean, urd, mung	Tall Indian wheat, barley, mix crop of Kathia wheat, mustard, Gram, lentil	Tall Indian wheat, barley mix crop of Kathia wheat, gram, pea, mustard, lentil	-	-
6.	Arrange drainage in field, grassed waterways, reduce field size to max. 0.4 ha.	Groundnut, urd, mung	Soybean, jowar	Wheat, mustard, pea, gram	Lentil, gram, pea	Maize, vegetable	Mung, vegetable
7.	-	Normal *Kharif*	Normal *Kharif*	Barley, gram, mustard, pea, wheat/tall Indian), Kathia	Gram, pea, mustard, barley, Kathia, safflower	Maize	Mung
8.	Arrange drainage	Normal *Kharif*	Normal *Kharif*	Wheat, Barley, Mustard, Pea	Gram, pea	Maize, vegetable, flowers	Mung, vegetable, flowers
9.	-	Normal	Normal	Late sowing of wheat, barley	Late sowing of lentil, pea	Mung, maize, vegetable, flowers	Mung
10.	-	Normal	Normal	Save part crop by watering wheat, barley		Mung, Maize	Mung

*Aberration type-1. Delayed monsoon by 15 days; 2. Delayed monsoon by 1 month; 3. Timely monsoon followed by long dry spell; 4. Early cessation of monsoon; 5. Drought like situation (rainfall <81%); 6. Excessive rainfall; 7. No winter rains; 8. Excessive winter rains; 9. High temperature in October-November; 10. Early temperature rise in February-March.

Agroforestry can play a vital role in meeting the diverse needs of people through trees, crops and livestock in addition to the multiple produce *viz.* food, fruit, fodder, fuel, fertilizer and fibre from limited land resources. Trees are integral to our traditional farming systems, for the innumerable benefits that they provide. Trees complement farming in terms of manure, fodder and fuel needs of the farmer. They form the backbone for practicing integrated farming systems which is necessary for self-reliant and sustainable agriculture. Agroforestry systems due to diverse options and products provide opportunities for employment generation in rural areas. Agroforestry has the potential to mitigate the climate change effects through microclimate moderation and conservation of natural resources in the short run and through sequestration of carbon in the long run, which is far greater than the crop and grass systems. The role of agroforestry in stabilizing the CO_2 levels and increasing the C sink potential has attracted considerable attention, especially after the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). Agroforestry has an important role in reducing vulnerability, enhancing resilience of farming systems and buffering households against climate related risks. Agroforestry, as a strategy to combat changing climate should include live fencing with karonda (*Carissa carandas*), mehadi, (*Lawsonia inermis*), kumat (*Acacia senegal*) and boundary plantation of teak (*Tectona grandis*), siris (*Albizia procera*), mahua (*Madhuca indica*), neem (*Azadirachta indica*), babul (*Acacia nilotica*), ardu (*Ailanthus excelsa*). Bamboo plantation along boundary can serve both the purposes together. Amongst fruit plants, aonla (*Emblica officinalis*), ber (*Zizyphus mauritiana*) bael (*Aegle mermelos*), citrus spp., guava (*Psidium guajava*), chironji (*Buchanania lanzan*) can be planted on field bunds or inside the field. Homestead plantations of fruit plants have shown great promise. Since, trees are spaced far apart, bund space can be further utilized for raising forage grasses to feed animals. Needless to emphasize that dairying is most dependable source of rural economy during aberrant weather conditions. Trees on field bunds serve the purpose of top feed during scarcity which plays crucial role in dairying in drought prone regions. Even tree management practices like pruning or lopping can be altered in accordance with weather aberration. Thus agroforestry can help in combating ill effects of drought. In fact, agroforestry need to be strengthened in areas prone to drought for greater resilience.

In Bundelkhand region as much every field should have trees either on bunds or inside field for risk partitioning, sustainability and income. Therefore to counter ill effects of frequent weather aberrations and looming climate change, agroforestry must be treated as potent tool and should be included in contingent plan as long term strategy.

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