

CONTINGENT CROP PLAN FOR KHARIF ,2008

The occurrence of drought and flood is common in Orissa. It is irony that our state receives nearly 1500 mm of rainfall annually of which 80% is received in a span of 4 months (June-September) which is quantitatively enough for most of the crop needs. However, the aberration in temporal and spatial distribution makes the crop vulnerable to drought as well as flood. Such adverse effects on crops can be combated in two ways: (I) Preventive measures and (II) contingent measures.

I. Drought Preventive Measures

Among the different *kharif* crops the upland rice is most affected by drought. Therefore, diversified land use with low duty non-paddy crops is the best option in these lands. In real sense the technology available to mitigate drought are mostly preventive in nature and requires early planning. The age-old adage "Prevention is better than cure" thus holds good in drought management. Therefore it is imperative to have a long term policy and planning at the beginning of the season for judicious use of water, land and crops in a particular locality for best results. The major thrust in drought mitigation in rainfed areas should be on rain water management through *in-situ* conservation and water harvesting through on-farm reservoirs/ capturing runoff from local catchments/ flash flood water from local streams to recycle at the time of need. Some of the important preventive measures that can be adopted early in the season to mitigate the impact of drought and augment sustainable crop production are elaborated below.

A. Upland

1. Select efficient crops and cropping systems matching the length of growing season. Some of the promising non-rice crops for rainfed uplands are maize, cowpea, arhar, blackgram, rice bean, ragi, groundnut, sesame, castor, pumpkin and sweet potato.
2. Choose short duration varieties which possess faster rate of growth, deep and penetrating root system and ability to escape drought.
3. Store rain water to use as life saving irrigation. On-farm water harvesting structures lined with 6:1 soil :cement mortar of 6 cm thickness in 10% land area helps to harvest the rainwater for providing protective irrigation.
4. Perform off season ploughing to conserve moisture, reduce pest and weed problem and to facilitate early sowing.

5. Plough and sow the crops across the slope to develop a ridge and furrow type of land configuration for effective soil moisture conservation to overcome drought for longer period.
6. Follow partial mechanization to ensure timeliness and precise of operations (desired depth and tilth) to utilize land, rainfall and other natural resources effectively.
7. Apply lime @ 0.15 to 0.25 LR (500 kg lime) mixed with FYM @ 5.0 t/ha in furrows at the time of sowing in acid soils.
8. Adopt intercropping/mixed cropping system in recurrent drought prone areas as mentioned below:

Sl. No.	Intercropping	Row ratio	Set specification (cm)	Row distance of intercrop (cm)
ARHAR BASED				
1.	Arhar + groundnut	2:6	30-210-30	30
2.	Arhar + sesame/niger	2:4	30-150-30	30
3.	Arhar + greengram/blackgram	2:3	30-120-30	30
4.	Arhar + ragi	2:4	30-100-30	20
5.	Arhar + rice	2:5	30-90-30	15
6.	Arhar + rice (mixed broadcast)	40:60	Seed rate ratio of individual crop for broadcasting	
7.	Arhar + radish*	2:2	30-90-30	30
8.	Arhar + okra	2:2	30-90-30	30
MAIZE BASED				
9.	Maize + arhar	2:2	30-90-30	30
10.	Maize + cowpea	2:2	30-90-30	30
11.	Maize + cowpea (fodder)	2:1	30 cm uniform row	30
12.	Maize + runner bean*	2:2	30-120-30	40
13.	Maize + yam*	Two rows of maize grown at 30 cm distance in both sides of yam planted in mounds at 90 cm x 90 cm to act as live staking		
RICE BASED				
14.	Groundnut + rice	1:4	Uniform row	15
15.	Greengram/blackgram + rice	1:4	Uniform row	15
16.	Greengram/blackgram+rice	1:2	In drought year, if rice fails, pulse crop is maintained and in a normal year pulse is cut for fodder and rice is maintained	
17.	Okra + rice	2:4	30-75-30	15
18.	Radish* + rice	2:4	30-75-30	15

* Suitable for inland hilly districts

9. Adopt integrated farming system. Apart from crop component, inclusion of animal components and some ancillary enterprises like bee keeping, mushroom cultivation, goatery, poultry, planting fruit trees, timber species will diversify production and impart stability to production system.
10. Practice tree based farming systems and grow different field crops in the alleys.

Sl. No.	System	Tree species	Campanion crops
1.	Agri-silvi	<i>Acacia mangium</i> <i>Dalbergia sissoo</i> <i>Tectona grandis</i> <i>Casuarina equisetifolia</i> <i>Gmelina arborea</i>	Maize/cowpea/ greengram/ blackgram/ sesame
2.	Silvi-pastoral	<i>Leucaena leucocephala</i> <i>Dalbergia sissoo</i> <i>Acacia auriculiformis</i> <i>Albizia lebeck</i>	Hybrid napier/ guinea/ stylo/ dinanath
3.	Agri-horti	Guava/ custard apple/ mango/pomegranate	Arhar/cowpea/ niger/okra

11. Follow principles of watershed management as follows:
 - *In situ* soil and water conservation measures like contour farming, cover cropping, bunding, trenching, terracing, ridge and furrow method of planting.
 - Manage water ways through check dams, stone structures, brushwood structures on natural streams/ nallahs to store water.
 - Water harvesting (digging ponds and lining) in 10-12% area.
 - Utilize harvested water through micro-irrigation methods (drip/sprinkler).
 - Moisture conservation through mulching.
 - Gully plugging through stacking of locally available pebbles filled in empty cement bags across water ways. Growing of grasses in water ways is also helpful in reducing soil erosion.
 - Construct a series of percolation tanks in light textured soils to recharge the profile and for supplemental irrigation.
 - Strengthen village institutions to enable people's participation.
12. Follow suitable agronomic practices as follows :
 - Apply a portion of FYM in the seed furrows at the time of sowing to conserve moisture to prevent seedling mortality from early drought.
 - Grow short duration rice varieties such as Annanda, Pathara, ZHU XI-26, Shankar, Jogesh, Sidhanta, Khandagiri, Kalinga-III, Heera, Vandana, Anjali and RR 166-645 or tall varieties like Brown Gora, Surajmukhi, Saria.

- Sow non-paddy crops like ragi, maize, arhar, greengram, blackgram, cowpea, guar, sesame, groundnut, castor in place of upland rice.
- Vegetables come up well in drought/low rainfall years. Utilize the ponds, reservoirs and water bodies for growing tomato, cauliflower, radish, brinjal, runner bean in the inland hilly districts and cowpea, guar, lady's finger and chilli in coastal plains.

B. Medium / low land

Rainwater management in medium and low lands is crucial for mitigation of drought and improvement in production. A technology for storing excess rain water in refuges in medium/low land has been standardized by devoting 10% of the cultivable area. The objective is to minimize runoff by encouraging its entry into the soil (*in-situ* water conservation) and capturing that which can not get into the soil. In the first step, the field bund is strengthened by raising the dyke height to 45 cm with provision of weir at 20 cm height for spilling over excess water to runoff collection tank (refuge). The refuge is constructed at the lower reach of the plot with top width 3.0m, bottom width 2.0m and depth 1.8m. The length of the refuge is equal to the width of the plot. This technology is based on the principle that out of total annual rainfall (1500 mm) nearly 50% of the rainfall comes from a few intense showers resulting in higher runoff. On the other hand, in certain years there is a break in rainfall at a stretch for 10-12 days during crop growth period. This long stretch of dry period affects the rice crop adversely. The excess runoff discharged over the weir height during intense showers in the early season if collected in the refuge can provide protective irrigation to mitigate the intermittent drought in rice crop.

II. Drought Ameliorative Measures

It is difficult to define the exact crop and weather scenario during an anticipated drought or dry spell. Hence, it is really a difficult task to delineate rigid contingent measures well in advance of the cropping season applicable to all situations. However, there are three distinct periods of *kharif* season relating to crop growth stage and associated farm practices. Depending on the rainfall onset and pattern of distribution, seven types of scenarios have been projected and required contingent measures have been suggested below.

A. Early season drought (June 10 to July 31)

- Scenario 1: Early onset and sudden stoppage of monsoon
- Scenario 2: Late onset, uplands not covered till mid-July

- B. Mid season drought (August 1 to September 15)
 Scenario 3: Non-paddy crops in uplands affected
 Scenario 4: *Beushaning* of rice delayed
 Scenario 5: Transplanting of rice delayed / seedlings over aged
 Scenario 6: *Beushaned*/transplanted rice affected at early vegetative stage.
- C. Late season drought (September 16 to October 31)
 Scenario 7: Medium and low land rice affected at vegetative / reproductive stage.

A. EARLY SEASON DROUGHT (June 10 to July 31)

Scenario 1: Early onset and sudden stoppage of monsoon

Under such a situation there is more likelihood of mortality of sprouts and seedlings and difficulties in sowing.

(a) Upland

- ❖ When there is more than 50% mortality, resow the crop up to July after receipt of sufficient rain water. It is always wise to raise low water requiring non-paddy crops like ragi (Suvra, Bhairabi, Dibyasinha, Godavari), greengram (K-851, Sujata, Durga, Kamdev, PDM-54), blackgram (T-9, Pant-U-19, Pant-U-30, Ujala and Sarala), cowpea (SEB-2, Pusa Barsati, Utkal Manik), sesame (Uma, Usha, Nirmala, Prachi), ricebean (RBL-6, BRB-1), castor (Jyoti, Kranti, Harita). If mortality is less than 50%, the crops may be gap filled.
- ❖ Cultivate vegetables-cowpea, guar, radish, runner bean, okra, cauliflower, brinjal, tomato wherever possible.
- ❖ Niger (Deomali, Alasi-1) and horsegram (Urmi) to be sown in August.
- ❖ In wide as well as close spaced line sown crops complete hoeing, weeding followed by ridging to the base of the crop rows at 20 days after sowing for *in-situ* moisture conservation. .

(b) Medium and low land

- ❖ If rice population is less than 50%, resow the crop. Select medium duration varieties (125 days) for coastal districts. Sprouted seeds may be direct seeded or fresh seedlings of early varieties may be raised for transplanting. The sprouted seeds can be sown in the lines by seed drill.

- ❖ If the rice population is more than 50% carry out weeding and adjust the plant population by *Khelua* (removing and redistributing the hills) and clonal propagation.
- ❖ Raise community nursery of rice for transplanting at a reliable water source to save time for further delay.
- ❖ Sow the seeds at 5-6 cm depth by *punji* method (6 - 8 seeds at one point) at a spacing of 20 cm x 10 cm and cover it with a mixture of FYM:SSP (10:1) to avoid seedling mortality due to moisture stress in lowland. Use a seed rate of 100 to 120 kg per ha to maintain 400 - 600 plants/m².
- ❖ In saline soil use FYM/green leaf manure, sow sprouted seeds, gap fill the crop by clonal propagation.

Scenario 2 :Late onset, uplands not covered till mid-July

- ❖ Sow drought tolerant non-paddy crops like ragi, greengram, blackgram, cowpea, guar, sesame, castor in place of upland rice.
- ❖ Maize, cowpea maybe grown in the first week of August to meet the fodder crisis.
- ❖ Niger (Deomali, Alasi-1) and horsegram (Urmi) are to be sown in August.
- ❖ Grow sweet potato varieties like Gouri, Shankar, Samrat, Shree Nandini, Shree Bhadra, Shree Ratna in the ridges and allow the furrows to conserve rain water.
- ❖ Grow vegetables like tomato, cauliflower, radish, brinjal, runner bean in the inland hilly districts and cowpea, guar, lady's finger and chilli in the coastal plains
- ❖ Apply full P,K and 20% N of the recommended dose as basal along with well decomposed organic manure for early seedling vigour.
- ❖ Major emphasis should be given on *in-situ* rain water conservation, harvesting excess run-off for its recycling to make provision for life saving irrigation.

B. MID SEASON DROUGHT (August 1 to September 15)

Scenario 3: Non-paddy crops in uplands affected

- ❖ Complete hoeing and weeding in non paddy crop fields to provide dust mulch.
- ❖ Weeding groundnut after 45 days of sowing disturbs the pegging process. Under such a situation prune the weeds with the help of sickle
- ❖ Apply post emergence spray of quizalofop ethyl 5% EC @ 0.05 kg/ha in 500 litre of water (2ml/litre of water) at 20-25 day after sowing to control grassy weeds in groundnut/jute.

- ❖ Spray 2% KCl + 0.1 ppm boron to blackgram to overcome drought situations.
- ❖ Foliar application of 2% urea at pre-flowering and flowering stage of greengram is helpful to mitigate drought.
- ❖ Spray 1% urea in brinjal. Take up spraying measures against mealy bug and mite which are more prevalent in dry weather.
- ❖ Top dress the crops after receipt of rain .
- ❖ Remove the borer affected tillers/late formed tillers/dried leaves in sugarcane and follow wrapping and propping in chains. Stripe out the lower 4-5 leaves.
- ❖ Spray planofix or celmone 10 ppm (2 ml in 9 litre of water) at 45 days and 20 ppm (4 ml in 9 litre of water) 10 days later to prevent boll shedding in cotton.
- ❖ Spray 2% urea in late planted jute to encourage growth.
- ❖ Top dress nitrogen to ginger and turmeric @ 60 and 30 kg/ha, respectively after receipt of rainfall followed by mulching.
- ❖ Practice mulching with organics to extend the period of moisture availability.
- ❖ Thin out to the extent of 25% and use the removed plants as feed/mulch.
- ❖ Close the drainage holes and check the seepage loss in direct sown medium land rice regularly.

Scenario 4: *Beushaning* of rice delayed

- ❖ Do not practice *beushaning* (blind cultivation) in rice, if the crop is more than 45 days old.
- ❖ Weed out the field without waiting for rainfall.
- ❖ Go for gap filling using seedling of same age or clonal tillers to have a uniform distribution of plant.
- ❖ Strengthen the field bunds and close the holes to check seepage loss.
- ❖ Withhold N fertilizer application up to receipt of rainfall.

Scenario 5: Transplanting of rice delayed

- ❖ Generally in this case rice seedlings are over aged.
- ❖ Seedlings up to 45 and 60-70 days old can be transplanted in case of medium and late duration rice varieties, respectively without much reduction in yield.
- ❖ Remove the weeds and follow plant protection measures against blast in the nursery.
- ❖ Pulverize the main rice field in dry conditions, if it is not ploughed earlier to save time in final puddling.
- ❖ Use tractor/power tiller/tractor mounted rotavator for speedy land preparation/puddling to cover more area with less time.

- ❖ Follow close transplanting using 5-7 seedlings/hill
- ❖ Apply 50% recommended nitrogen at the time of transplanting.
- ❖ Apply life saving irrigation to maintain the nursery seedlings in good health.
- ❖ Do not top dress nitrogen in nursery.

Scenario 6: *Beushaned*/transplanted rice affected at early vegetative stage

- ❖ Provide protective irrigation through recycling of harvested rain water.
- ❖ Remove the weeds and follow plant protection measures against blast in the nursery if existing.
- ❖ Withhold N fertilizer application up to receipt of rainfall.
- ❖ Apply Potassic fertilizers wherever soil moisture allows or wait up to receipt of rainfall.
- ❖ Strengthen the field bunds and close the holes to check seepage loss.

C. LATE SEASON DROUGHT (September 16 to October 31)

Scenario 7: Medium and low land rice affected at vegetative/reproductive stage

It occurs as a result of early cessation of monsoon rains. The management practices are as follows.

- ❖ Provide protective irrigation through recycling of harvested rain water.
- ❖ Provide irrigation at critical stages such as flowering, grain filling, etc. in alternate furrows in wide spaced crops.
- ❖ Crops like cowpea, maize, greengram may be harvested for fodder purpose to avoid their failure as grain crops.
- ❖ When the soil becomes hard it is difficult to uproot groundnut from the field, sprinkle water from water harvesting structures/nallahs to soften the soil.
- ❖ Under situation of complete failure of *kharif* crop dismantle it. In such situation or where land is remaining fallow, sow (dibble) the pre-*rabi* crops.
- ❖ The ideal pre-*rabi* crops with residual moisture condition are horsegram, castor, niger, blackgram and sesame in uplands and well drained medium lands.
- ❖ Pre-position inputs, particularly seeds for the *rabi* crop.

Insects pest management

The following insect/pests and diseases appear more frequently under drought situation for which it requires constant vigilance to take up timely control measures.

Rice

- ❖ In rice the mealy bug attack will be more. Thus the plants will look yellow, stunted and whitish. Mealy bugs are seen when the leaf sheath is detached. The pest can be controlled by spraying with phosphamidon 40 SC @ 500 ml or monocrotophos 36 SL @ 1000 ml/ha.
- ❖ The problem of termites will be seen in rice, maize and other standing cereal crops which can be tackled by soil dressing with chlorpyrifos 20 EC @ 4-5 ml/litre of water or by adding chlorpyrifos 1.5% dust @ 20 – 25 kg/ha before final land preparation.
- ❖ Grasshopper menace is also seen in rice. The pest can be tackled by dusting the field and field bunds with carbaryl 4% or malathion 5% @ 25 – 30 kg/ha..

Pulses

- ❖ In arhar termite attack will be noticed. The pest attack can be reduced as suggested in case of rice.
- ❖ In greengram, blackgram, cowpea, country bean, the spread of YMV by insect vector may increase. Therefore, regular surveillance in the fields is essential. Manage the crop from insect vectors by spraying of dimethoate 1000 ml/ha or imidacloprid 125 ml/ha at 10-15 days interval.

Oilseeds

- ❖ In groundnut crop termites and white grub incidence is expected to be more. Methods suggested in rice may be followed to reduce the pest infestation.
- ❖ Incidence of leaf miner in groundnut may increase which can be managed by spraying with monocrotophos 36 SL or Triazophos 40 EC @ 1 litre/ha at fortnight intervals.

Vegetables

- ❖ In vegetable crops the incidence of mites is expected to increase under drought situation. The pest menace can be brought down by spraying of dicofol @ 2.5 lit/ha or propargite @ 2.5 lit/ha.

Cotton

- ❖ In cotton the incidence of sucking pests like Jassids, thrips and mites may increase. Spraying the crop with imidacloprid / acetamiprid @ 125 ml or 125 g/ha will decrease the pest attack.
- ❖ The problem of termite attack in the crop can be managed in the same manner as suggested in case of rice.

Disease management

- ❖ Early and mid season drought favour out break of disease like brown spot of rice, bacterial wilt of brinjal and other vegetables, red rot of sugarcane, Macrophomina stem rot of jute etc.
- ❖ Late season drought result in outbreak of foliar, node and neck blast of rice depending on the stage of crop. Other important diseases are Phomopsis blight of brinjal, Cercospora and Alternaria leaf blight of oilseed, vegetable, pulse and plantation crops; bacterial wilt of vegetable crops and downy mildew of cucurbits and cruciferous crops
- ❖ Drought condition during the month of August-September onwards shall result in severe incidence of foliar blast and brown spot diseases in rice. It is advised to spray the crop with tricyclazole @ 0.06 to 0.1% or Hinosan @ 0.25% or Casugamycin (0.2%) at 10-12 days intervals during drought period.
- ❖ Early drought result in late transplanting of rice which makes the crop vulnerable to sheath rot and sheath blight diseases. Maintenance of field sanitation followed by two spray at 10 days interval with validamycin (0.3%) or Tilt (0.15%) or carbendazim (0.2%) are advised.
- ❖ Bacterial wilt in most of the vegetables and other crops may occur in severe form during drought and period following drought. Basal soil drenching with streptomycin (0.015%) or plantomycin (0.15%) or Basto 805 (0.05%), bacterinol (0.1%) at 5 - 7 days interval during dry period is advised.
- ❖ There is every chance of occurrence of *Alternaria* and/or *Cercospora* blight in oilseeds, vegetables and cucurbits. Protective spray with mancozeb @ 0.3 to 0.4% may be done.
- ❖ Downy mildew in cucurbits can be controlled by spraying the crops twice with metalaxyl + mancozeb (Ridomil MZ Dhanuxyl) @ 0.15% at 10 days interval.
- ❖ Late transplanted rice due to mid season drought resulting in the occurrence of sheath rot and grain discoloration diseases.

FLOOD

Early Flood (upto mid-August)

Medium/low land

- ❖ Select rice varieties like Kanchan, Ramachandi, Durga,Uphar, Sarala, Varshadhan for semi-deep low lands.
- ❖ If damage is more than 50% re-transplant rice crop of medium duration group..
- ❖ In partially damaged fields, allow the rice plants to stand upright. Do not go for beushaning as it may further reduce the plant population.
- ❖ Weed out the rice field, make gap filling and top dress N and K to boost the growth if situation permits.

Late flood (September)

If flood occurs during mid August to early September.

- ❖ Transplant 40-65 days old seedlings after flood water recedes.
- ❖ Make up plant population by transplanting clonal tillers detaching from the old clumps, wherever possible.
- ❖ Broadcasting/line sowing of sprouted seeds of relatively short duration rice varieties in soft puddle after flood water recedes.
- ❖ Apply moderate dose of fertilizer (40:20:20 N:P₂O₅:K₂O kg/ha).
- ❖ Particularly in up-medium land, where there is no scope for revival of rice, go for pulses like blackgram, greengram, horsegram.

Plant population

- ❖ Raise nursery by Dapog method to transplant wherever possible.
- ❖ Maintain a buffer nursery in the backyard/highland area to ensure adequate plant population in the field after flood damage.

Fertilizer application

- ❖ Reduce nitrogen application and apply recommended dose of P and K as basal to increase flood resistance. .
- ❖ Apply moderate dose of NPK at beushaning, if not applied earlier.

- ❖ Top dress N and K in flood affected areas if situation permits.

Insect pest management

Rice

- ❖ After the flood recedes there is probability of attack of swarming caterpillar in rice. To manage the pest.
 - Regular surveillance in the rice fields where flood water recedes should be done to locate appearance of swarming caterpillars.
 - When they cross the ETL i.e., one larva / hill then spray the crop with chlorpyrifos / triazophos / profenophos @ 1 lit/ha or dust the crop with quinalphos @ 1.5% D @ 25 kg/ha.
 - To prevent migration of larvae from one field to other, bunds should be heavily dusted with the dust formulation mentioned above.
 - Application of insecticides in the afternoon hours is preferred.
- ❖ In partially inundated areas, rice caseworm and in general leaf folder attack is expected. If 1-2 cases or folded leaves / hill is seen spray the crop with monocrotophos / chlorpyrifos @ 1 lit/ha or with cartap hydrochloride 50 SP / fipronil 5 SP @ 500 g/ha.

Pulses, Oilseeds, Vegetables, Cotton

- ❖ In these crops due to high humidity black aphid and cotton aphid population may increase. The pest severity can be managed by spraying of neem formulations (1500 ppm Azadirachtin) @ 2.5 lit/ha when the population is low or spraying with dimethoate @ 1 lit/ha or imidacloprid @ 125 ml/ha if population is high.
- ❖ In general regular surveillance work should be taken up in all crops. Resistant/tolerant varieties should be grown in all crops as far as possible.

Disease management

- ❖ Rain storms during *kharif* may result in severe occurrence of bacterial leaf streak and bacterial blight in rice. It is advised to spray the crop immediately after each rain storm with streptocycline (0.01%) or plantomycin (0.1%) or bacterinol (0.2%).
- ❖ Post flood affected areas where vegetable is grown are likely to be affected by bacterial wilt disease. Therefore, total package of practices starting from planting need to be followed as given below.
 - Seedling root dip for 15 minutes in 0.015% streptocycline or 0.15% plantomycin.
 - Perform soil drenching to the base of the plants with a solution of carbendazim (0.15%) and streptocyclin (0.015%) at 10 DAP, 25 DAP and 40 DAP coinciding with intercultural operations.
- ❖ Spray Ridomil MZ @ 0.15% against downy mildew diseases of cucurbit crops.
- ❖ A protective spray with mancozeb @ 0.3% may be given to pulse crops (greengram and blackgram) against *Cercospora* blight disease.