Post-flood Management Options for Agricultural Sector in Selected Districts of Bihar and Odisha

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Floods are the leading cause of natural disaster that globally affects millions of people each year. Monsoon rains, overland flow, high release from dams, cloudburst, impeded drainage and excessive snow melt are some of the reasons that trigger floods. The devastation is often widespread, from loss of life, property and infrastructure to food insecurity and disease. Floods are particularly disastrous for the world's poor, the majority of whom live in rural areas and rely on agriculture for their food and income. India, Bangladesh and China are among the top 15 nations who account for more than 85% of the total global population exposed to flood incidence. The frequency and extent of flood hazards in general is expected to be higher in the climate change scenario mainly due to extreme weather events.

Flood is identified as one of the major risks to communities, businesses and agriculture in India as about 113 million people which is about 9% of the population are acutely exposed to flood hazard. Out of 40 million ha of flood prone area in India which includes major proportion of flash flood events, Bihar and Odisha accounts for about 12.7% and 4.2% of total flood prone area. Muzaffarpur district in Bihar and Kendrapara district in Odisha are highly suceptible to floods and they experience flood every year due to heavy rainfall and poor drainage. The flood water remains in agricultural fields for 6-10 days causing severe damage to kharif crops, mainly rice. The past experience of flood occurrence in Indian states reveal that the time of incidence, submergence depth and duration are critical factors which vary significantly and hence pose serious challenge to flood management. In several instances, the crop gets fully damaged and there is a strong need to improve the preparedness of the farmers to take up an alternate crop suiting to the land

Flood affected area

situation. This necessitates us to device a strategy for post-flood management.

The government has begun to address these vulnerabilities, introducing a $1.3 billion crop insurance scheme at the start of this year to help farmers cope up with crop failure due to natural disasters. At present only about 19% Indian farmers insure their crops due to lack of awareness about the practice of crop insurance, its cost and lack of availability. The aim of the bulletin is to present type, extent and severity of flooding in Muzzaffarpur and Kendrapara districts and propose management options in the post-flood scenario.

Submerged rice fields during flood incidence

Flood Frequency, Extent and Possible Scenarios

The historical time trend revealed that the flood in Bihar occurred mainly during July to September. The extent of flood damage was extremely high in 2002 and 2004 which affected cropped area of about 9.4 and 13.9 lakh ha in 25 and 20 districts of Bihar respectively. The flood damage was noticed during July-August in 2005 and 2007 in 12 and 14 districts of Bihar affecting 1.35 and 0.87 lakh ha of cropped area respectively. Similarly, in 2013 and 2016, the flood occurred during July to September in 20 and 12 districts affecting 5.9 million and 3 million people respectively.

Odisha experienced the flood disaster mainly during July to October as per the historical time trend. In 2001 and 2006, the period of flood occurrence was July-August resulting in damage of 7.99 lakh ha and 3.1 lakh ha of crop cultivated area in 24 districts and 27 districts respectively. In 2003, the flood occurred during July to October in 26 districts of Odisha affecting 5.03 lakh ha of cultivated land. Similarly, in 2008, the flood occurred during June and September in 21 districts of Odisha affecting 4.45 lakh ha of cropped land. Flood occurrence is highly correlated with the extreme rainfall events and based on the long term rainfall analysis, we can identify the frequency and time of flood.

Blocks critically affected by frequent floods

State	District	Blocks
Bihar	Muzaffarpur	Aurai, Bandra, Bochaha, Gaighat, Katra, Kurhani, Marwan, Paroo, Sakra
	Sitamarhi	Bokhra, Pupri, Charaut,
	Madhubani	Bisfi, Madhepur, Benipatti, Lakhanpur
	Darbhanga	Ghanshyampur, Hanumannagar, Khusheshwar Asthan, Jale
	East Champaran	Banjaria, Bankatwa, Chiraiya, Dhaka, Ghorasaran, Motihari, Narkatiganj, Ramgarhwa, Sugauli
Odisha	Kendrapara	Mahakalapada, Garadpur, Ali, Kendrapada, Marshaghai, Pattamundai, Rajkanika and Rajnagar
	Jagatsinghpur	Balikuda, Tirtol and Nuagaon
	Puri	Nimapara and Gop
	Bhadrak	Basudevpur, Bhadrak, Chandabali and Dhamnagar

Based on the historical time, trend of flood events, the major scenarios which is required for providing post-flood management options are as given below:

A. Time of occurrence of flood event

a. If flood occurs in early phase (July 1st week to August 1st week)

b. If flood occurs in mid phase (August 2nd week to September 2nd week)

c. If flood occurs in late phase (September 3rd week onwards)

B. Duration and depth of flood water submergence

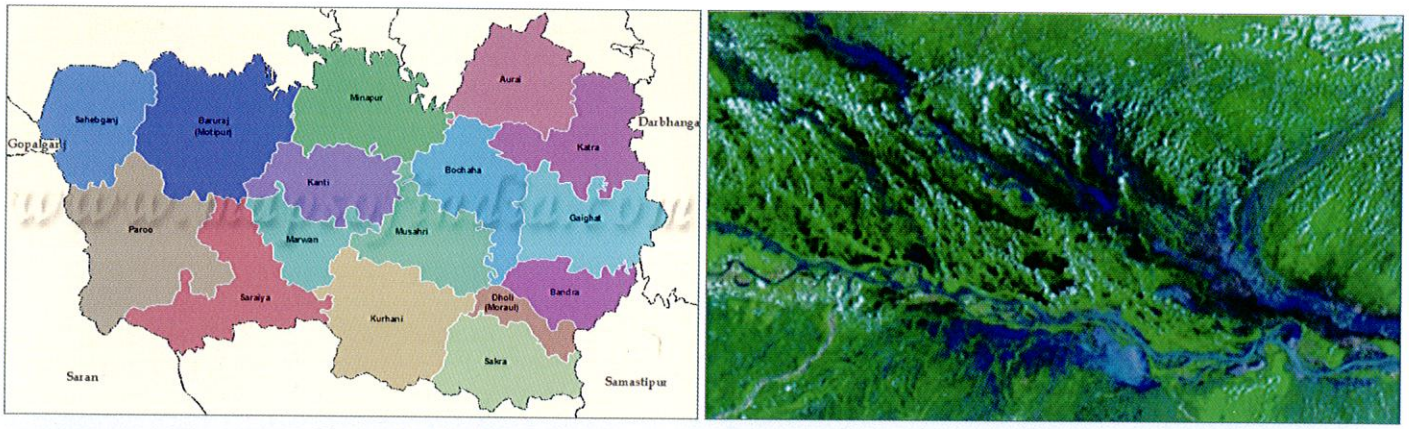
1. Duration of 7 days or less and depth of 0.25-0.5 m
2. Duration of 7 days or less and depth of 0.5-1 m
3. Duration of 8-14 days and depth of 0.25-0.5 m
4. Duration of 8-14 days and depth of 0.5-1 m

Post-flood Management

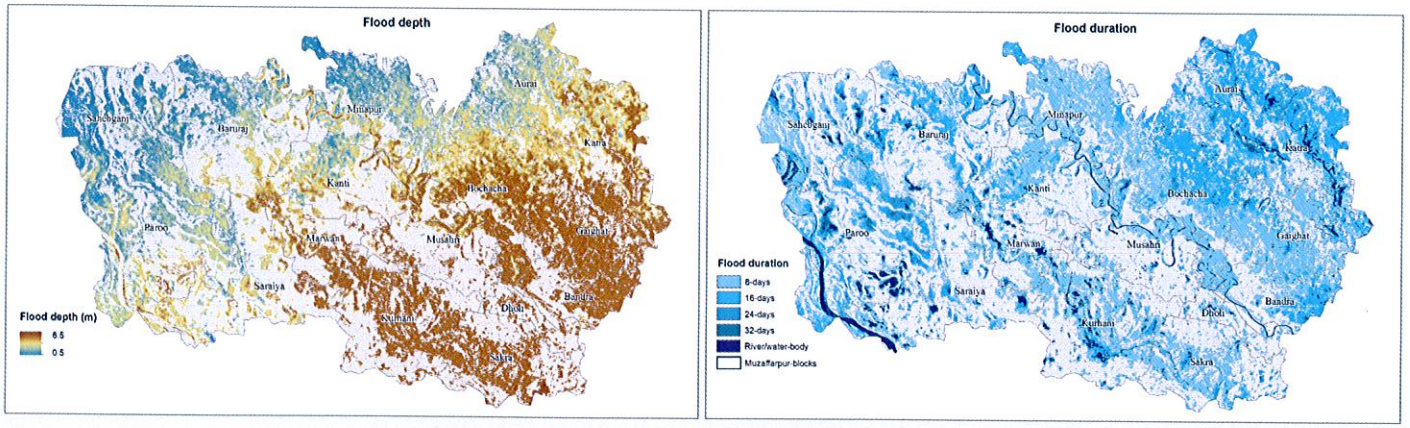
Post-flood management is a set of practices followed to make the flood affected land ready for cultivation with the best alternate crops suiting the land ecology. Once the flood water recedes from the field, early cultivation of new alternate crop is encouraged for availing the resources like water and nutrients in an efficient manner. The inputs like seed have to be made ready for timely implementation of post-flood management. It is difficult and not feasible to keep huge volume of seed for total cultivated area. However, identification of most seriously affected areas to flood occurrence will enable us to concentrate on site specific input management. The main advantages of post-flood management are (i) the farmers will recover from the loss caused by flood event (ii) Efficient utilization of available natural resources for raising alternate crops (iii) compliment the flood insurance policies by enhancing the resilience of the agricultural system as a whole.

Post-flood management options for Muzaffarpur district:

Muzaffarpur district of Bihar comes under Agro-climatic zone no. IV of Middle Gangetic Plain Region. It has about 3,15,000 ha of geographical area and 2,19,000 ha of net sown area with a cropping intensity of 130%. It comprises of 16 blocks namely Musahri, Kurhani, Baruraj (Motipur), Paroo, Minapur, Saraiya, Sakraa, Aurai, Kanti, Gaighat, Bochaha, Katra, Sahebganj, Marwan, Bandra and Dholi (Moraul). It receives an annual rainfall of 1196 mm in 57 rainy days mainly during June-October. Owing to extreme climatic rainfall events, this district is extremely susceptible to floods. The combination of depth (0.4 -1.5 m) and duration of flood occurrence (8-32 days) poses severe challenge to agricultural sector in this district. Rice and maize are major crops grown during Kharif season. Scenario wise post-flood management plan has been prepared for this district.



Blocks of Muzaffarpur district and MODIS satellite data showing flood extent



Flood depth and duration using time series satellite data and DEM

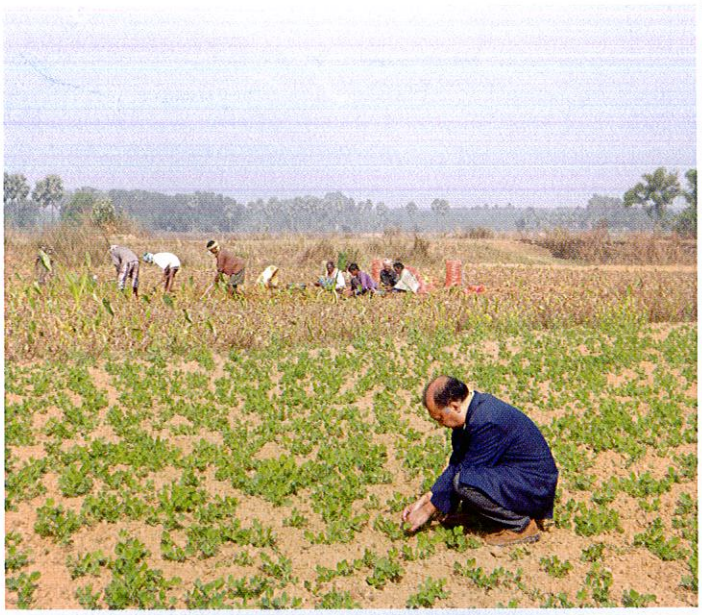
Crop specific post-flood management options for Muzaffarpur district

Crop along with its cultivated area (000' ha)	Scenario	Suggested post-flood management options
Rice (119.3)	a^2 & a^4	Double transplanting method (Kharuhan)
		Deep Waterlogging tolerant varieties like Varshadhan
	a^3	Replanting with dapog nursery seedlings
		Over aged rice seedlings of 60 days duration
	b^3 & b^4	Short duration rice varieties like Prabhat (90 days)
		Advancing Rabi maize and potato cultivation in case of complete crop damage
	#	Water chestnut integrated with aquaculture
		Use copper fungicides against Bacterial leaf blight
		Lentil may be taken as paira crop
		Establishment of horticultural tree saplings in rice fields
Maize (13.1)	a^1 & a^2	Earthing up
		Resowing and gap filling
	b^1 & c^1	Provision of drainage
	c^3 & c^4	Toria / Wheat / Groundnut if crop is completely damaged
	#	Spray with Imidacloprid @3ml/10 litre to control stem borer
		Foliar blight control by Mancozeb @2.5 g/l or Zineb/Maneb @2.5-4 g/lit of water (2-4 applications at 8-10 days interval)
Potato (10.0) & other vegetables	a^1 & a^2	Earthing up
		Replanting and gap filling
	b^1 & c^1	Provision of drainage
	b^2 & b^4	Toria / Wheat if crop is completely damaged
	#	Grow nursery on raised bed

[a] If flood occurs in early phase (July 1st week to August 1st week); [b] If flood occurs in mid phase (August 2nd week to September 2nd week); [c] If flood occurs in late phase (Sept 3rd week onwards) [1] Duration of 7 day or less and depth of 0.25-0.5 m; [2] Duration of 7 day or less and depth of 0.5-1m; [3] Duration of 8-14 days and depth of 0.25-0.5 m; [4] Duration of 8-14 days and depth of 0.5-1 m; [#] Applicable for all scenario

Kharuhan method in rice

Establishing horticultural tree species in agricultural fields

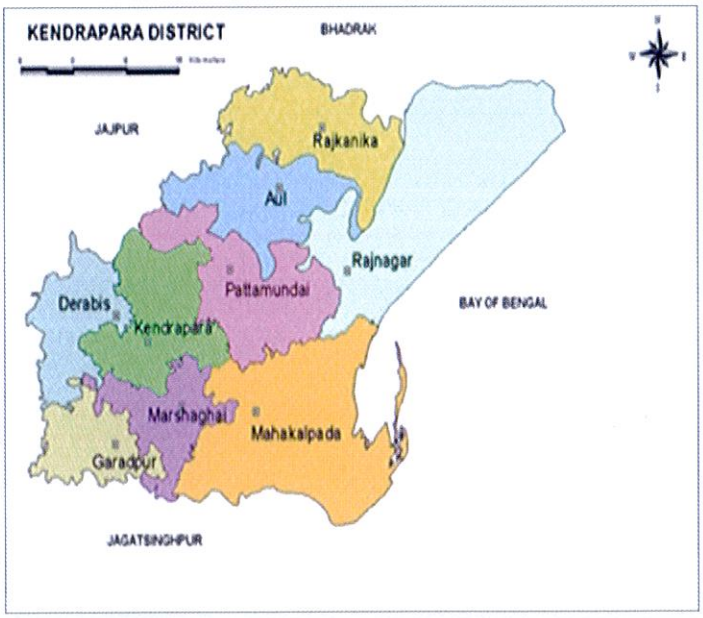


Groundnut and swamp taro cultivation

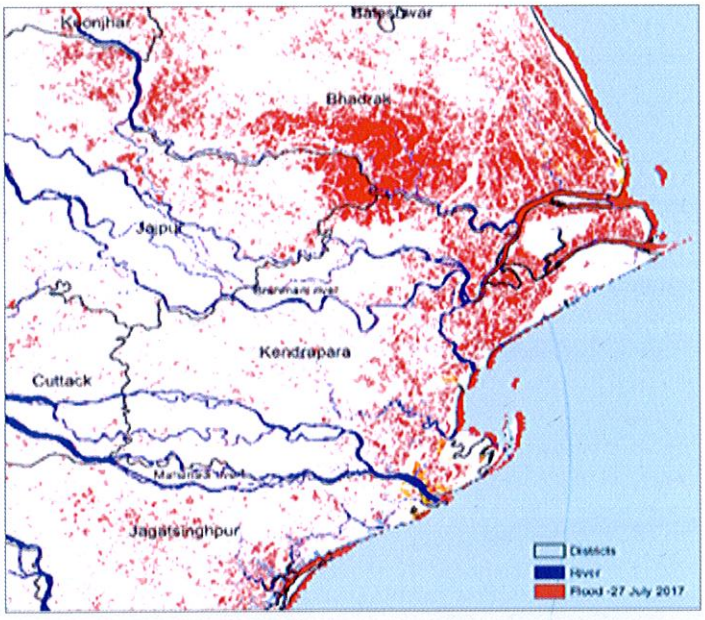
Water chestnut cultivation

Post-flood management options for Kendrapara district:

Kendrapara district of Odisha comes under Agro-climatic zone no. XI of East Coast Plains and Hills Region. It has about 2,64,000 ha of geographical area and 1,44,000 ha of net sown area with a cropping intensity of 186%. It comprises of 9 blocks namely Aul, Derabis, Pattamundai, Garadpur, Mahakalpada, Kendrapara, Marshaghai, Rajnagar and Rajkanika.



Block map of Kendrapara district



ESA's Sentinel-1 SAR image (27 Jul 2017) showing flood affected blocks of Rajkanika, Rajnagar & Mahakalpada

Kendrapara district receives an annual rainfall of 1582 mm with 76 rainy days mainly during June-October. Rice and jute are major crops grown during Kharif season. Flat coastal belts with poor drainage, high degree of siltation in the rivers, soil erosion, breaching of the embankments and spilling of flood waters over them were identified as main problems causing severe floods in the river basins of this district. Scenario wise post-flood management plan has been prepared for this district.

Crop specific post-flood management options for Kendrapara district

Crop along with its cultivated area (000' ha)	Scenario	Suggested post-flood management options
Rice (138)	a^2 & a^4	Deep/Intermediate waterlogging tolerant rice like Hanseswari, Durga
	a^1 & b^1	Drainage at tillering stage for 8-10 days
	a^3	Over aged rice seedlings of 60 days duration
	b^2 & c^2	Swamp taro cultivation
	b^3 & b^4	Short duration rice (60 days - Heera; 90 days - Kalinga-III),
		Medium duration rice (100-120 days - Lalat, Parijat)
	c^3 & c^4	Plan for early rabi crop under zero tillage
		Maize / Potato / Cauliflower in case of complete crop damage
	#	Blackgram / greengram may be taken as paira crops
		Bio-drainage with Casuarina in coastal blocks
		Establishment of horticultural tree saplings in rice fields
Jute (3.31)	b^1 & c^1	Provision of drainage
	#	Spray the basal portion of the plant with Carbendazim@ 0.15%
Brinjal (6.1) & other vegetables	a^1 & a^2	Earthing up
		Replanting and gap filling
	b^1 & c^1	Provision of drainage
	#	Spray the base of the plant with Streptocycline@ 0.015%+ Copper oxychloride @ 0.2% in1lit. of water

[a]If flood occurs in early phase (1st week Jul to 1st week Aug); [b]If flood occurs in mid phase (2nd week Aug to 2nd week Sep); [c]If flood occurs in late phase (3rd week Sep onwards) [1]Duration of 7 days or less and depth of 0.25-0.5 m; [2]Duration of 7 days or less and depth of 0.5-1 m; [3]Duration of 8-14 days and depth of 0.25-0.5 m; [4]Duration of 8-14 days and depth of 0.5-1 m [#]Applicable for all scenario.

Vegetable cultivation in flood affected areas

Waterlogging tolerant rice varieties

Overaged (60 days) rice seedlings

Swamp taro cultivation

Bio-drainage with *Casuarina*

Bibliography

Amarnath, G. (2014). An algorithm for rapid flood inundation mapping from optical data using a reflectance differencing technique. Journal of Flood Risk Management, 7, 3: 239-250.

Brahmanand, P.S., Ghosh, S., Dinesh Chandra, Singandhupe, R.B., Roy Chowdhury, S., Sahoo, N., Reddy, G.P. and Khan, A.R. 2009. Studies on performance of rice as influenced by drainage in Eastern India. Archives of Agronomy and Soil Science. 55:295-300.

Brahmanand, P.S., Kumar, A., Ghosh, S., Roy Chowdhury, S., Singandhupe, R.B., Singh, R., Nanda, P., Chakraborty, H.C., Srivastava, S.K. and Behera, M.S. 2013. Challenges to Food Security in India. Current Science. 104:841-846.

Brahmanand, P.S., Sahoo, N., Roy Chowdhury, S., Ghosh, S., Mohanty, R.K., Mandal, K.G., Nayak, A.K. and Kumar, A. 2015. Performance evaluation of water chestnut based farming system in seasonal waterlogged areas. Journal of Interacadamicia: 19:46-50.

Doocy S, Daniels A, Murray S and Kirsch TD. 2013. The Human Impact of Floods: a Historical Review of Events 1980-2009 and Systematic Literature Review. PLOS Currents Disasters. 2013 Apr. 16. Edition 1. doi: 10.1371/currents.dis.f4deb 457904936 b07c09daa98ee8171a.

DWM. 2012. Annual report, 2011-12. Directorate of Water Management, (ICAR), Bhubaneswar, India. Crop Management Interventions and Contingency Crop Planning for Post-flood Management in Odisha. P:49-50.

DWM. 2013. Annual report, 2012-13. Directorate of Water Management, (ICAR), Bhubaneswar, India. Crop Management Interventions and Contingency Crop Planning for Post- flood Management in Odisha. P:52-55.

ICAR-CRIDA. 2012. Agriculture contingency plan of district: Kendrapara, State: Odisha. (http://www.crida.in/CP-2012/statewiseplans/Orissa%20(Pdf)/OUAT,%20Bhubaneswar/Orissa%2028-%20Kendrapara%2004.10.2011.pdf)

ICAR-CRIDA. 2013. Agriculture contingency plan of district: Muzaffarpur, State: Bihar (http://www.crida.in/CP-2012/statewiseplans/Bihar%20(Pdf)/BR26_Muzaffarpur_28.12.2013.pdf)

IPCC. 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (eds Field, C. B. et al.), Cambridge Univ. Press.

List of past flood and area damaged by flood in Orissa. (http://www.dowrorissa.gov.in/HistoryofFLOOD/HistoryofFLOOD.pdf), accessed on 15.08.2017.

List of Flood-prone blocks in different districts of Eastern India. (http://nfsm.gov.in/ Circulars_Notifications/FloodedBlocks.pdf), accessed on 11.8.2017

Milly, P., Wetherald, R., Dunne, K. and Delworth, T. 2002. Increasing risk of great floods in a changing climate. Nature 415:514–517.

Roy Chowdhury, S., Brahmanand, P.S., Kundu, D.K., Thakur, A.K. and Kumar, A. 2014. Influence of seedling age and nitrogen application on photosynthesis and yield of rice (Oryza sativa) grown under waterlogged condition. Indian Journal of Plant Physiology 19:83-86.

Roy Chowdhury, S., Brahmanand, P.S., Ghosh, S., Jena, S.K., Mohanty, R.K. and Kumar, A. 2012. Photosynthetic performance and yield of watermelon grown under bio-drainage. Journal of Indian Society of Coastal Agricultural Research. 30:34-40.

Roy Chowdhury, S., Brahmanand, P.S., Kumar, A., Kundu, D.K. and Behera, M.S. 2011. Growth and yield of over-aged rice (Oryza sativa) seedlings under different nitrogen levels in waterlogged situations. Indian Journal of Agricultural Sciences. 81:1149-1152.

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