State: Madhya Pradesh

Agriculture Contingency Plan for District: Dhar

1.0 District Agriculture profile

1.1	**Agro-Climatic/Ecological Zone**				
	Agro Ecological Sub Region (ICAR)	Madhya Bharat plateau , western Malwa plateau, eastern Gujarat plain, Vindhyan and Satpura range and Narmada valley			
	Agro-Climatic Zone (Planning Commission)	Subzone :24, Agro climatic zone:9.3, Region : Central plateau			
	Agro Climatic Zone (NARP)	Malawa plateau, Nimar valley, Jhabua Hills			
	List all the districts or part thereof falling under the NARP Zone	Malawa plateau: Dhar,Tirla,Nanchha,Badnawar, Sardarpur Tehsils Nimar valley: Manawar, umarban,Dharmpuri,Nisarpur Tehsils; Jhabua Hills: Kukshi,Bagh, Dahi, Gandhwani Tehsils			
	Geographic coordinates of district headquarters	Latitude	Longitude	Altitude	
		22^0 to 23^0 10'' N	74^0 28'' to 75^0 42''	588 m	
	Name and address of the concerned ZRS/ ZARS/ RARS/ RRS/ RRTTS	Zonal Agricultural Research Station ,College of Agriculture, Indore(RVSKVV)			
	Mention the KVK located in the district	KVK, Post Box. No. 18, Dhar Dist., 454 001 under RVSKVV, Gwalior			

1.2	**Rainfall**	Normal RF(mm)	Normal Rainy days (number)	Normal Onset (specify week and month)	Normal Cessation (specify week and month)
	SW monsoon (June-Sep):	763		2nd week of June	3 rd week of September
	NE Monsoon(Oct-Dec):	52.9			
	Winter (Jan- March)	6.0		-	-
	Summer (Apr-May)	11.2		-	-
	Annual	833		-	-

1.3	**Land use pattern of the district** (latest statistics)	Geographical area	Cultivable area	Forest area	Land under non-agricultural use	Permanent pastures	Cultivable wasteland	Land under Misc. tree crops and groves	Barren and uncultivable land	Current fallows	Other fallows
	Area ('000 ha)	819	504.5	117	52	47	15	3.0	74	2.0	3.0

Source – Directorate of Farmers welfare and Agriculture, Development of Madhya Pradesh, Bhopal, Agriculture Statistics 2009.

1. 4	Major Soils (common names like red sandy loam deep soils (etc.,)*	Area ('000 ha)	Percent (%) of total
	1. Deep soil	352.20	43.29
	2 .Medium deep soil	173.60	21.38
	3. Shallow soil	287.80	35.33

* mention colour, depth and texture (heavy, light, sandy, loamy, clayey etc) and give vernacular name, if any, in brackets

1.5	Agricultural land use	Area ('000 ha)	Cropping intensity %
	Net sown area	504.5	147
	Area sown more than once	239.4	
	Gross cropped area	743.9	

1.6	Irrigation	Area ('000 ha)		
	Net irrigated area	281.9		
	Gross irrigated area	281.9		
	Rainfed area	222.6		
	Sources of Irrigation	Number	Area ('000 ha)	Percentage of total irrigated area
	Canals	74	13.3	4.72
	Tanks	471	12.0	4.25
	Open wells	52034	82.1	29.1
	Bore wells	34185	122.7	43.5
	Lift irrigation schemes	03 Not viable	-	--
	Micro-irrigation		0.142	0.05
	Other sources (please specify):Reservoirs	176	51.8	18.4
	Total Irrigated Area		281.9	
	Pump sets	69103		
	No. of Tractors	7516		
	Groundwater availability and use* (Data source: State/Central Ground water Department /Board)	No. of blocks/ Tehsils	(%) area	Quality of water (specify the problem such as high levels of arsenic, fluoride, saline etc)
	Over exploited			
	Critical		100%	
	Semi- critical			
	Safe			
	Wastewater availability and use			
	Ground water quality			

*over-exploited: groundwater utilization > 100%; critical: 90-100%; semi-critical: 70-90%; safe: <70%
Source: Commissioner land records, M.P. Gwalior.

1.7 Area under major field crops & horticulture (as per latest figures) (2007-08)

1.7	S.No.	Major field crops cultivated	Area ('000 ha)							
			Kharif			*Rabi*				
			Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Summer	Grand total
	1	Soybean		250.3	250.3					250.3
	2	Cotton		116.7	116.7					116.7
	3	Maize		59.0	59.0					59.0
	4	Wheat				216.3		216.3		216.3
	5	Chickpea						40.9		40.9
Others (specify)										
		Horticulture crops - Fruits								
		Mango								0.029
		Guava								0.152
		Orange								0.032
		Banana								0.432
		Horticulture crops - Vegetables								
		Potato								1.900
		Onion								1.332
		Tomato								1.519
		Horticulture crops - Spices								
		Ginger								0.151
		Chilies								8.339
		Garlic								2.971
		Coriander								0.162
		Fenugreek								
		Medicinal and Aromatic crops								
		Medicinal								
		Flower crops								
		Marigold								0.034
		Plantation crops								
	1									
Others (Specify)		Eg., industrial pulpwood crops etc.								
		Fodder crops								
	1									
		Total fodder crop area								
		Grazing land								
		Sericulture etc								
		Others (specify)								

1.8	**Livestock**	**Male ('000)**	**Female ('000)**	**Young Stock (000) Total ('000)**	
	Non descriptive Cattle (local low yielding)	227.3	104.3	141.5	
	Crossbred cattle				
	Non descriptive Buffaloes (local low yielding)	2.3	94.3	83.1	179.7
	Graded Buffaloes				
	Goat				325.1
	Sheep				8.8
	Others (Camel, Pig, Yak etc.)				4.9
	Commercial dairy farms (Number)				

1.9	**Poultry**	**No. of farms**	**Total No. of birds ('000)**
	Commercial		
	Backyard		

1.10	**Fisheries** (Data source: Chief Planning Officer)						
	A. Capture						
	i) Marine (Data Source: Fisheries Department)	**No. of fishermen**	**Boats**		**Nets**		**Storage facilities (Ice plants etc.)**
			Mechanized	Non-mechanized	Mechanized (Trawl nets, Gill nets)	Non-mechanized (Shore Seines, Stake & trap nets)	
	ii) Inland (Data Source: Fisheries Department)	**No. Farmer owned ponds**		**No. of Reservoirs**		**No. of village tanks**	
	B. Culture						

		Water Spread Area (ha)	**Yield (t/ha)**	**Production ('000 tons)**
	i) **Brackish water** (Data Source: MPEDA/ Fisheries Department)			
	ii) **Fresh water** (Data Source: Fisheries Department)			
	Others			

1.11 Production and Productivity of major crops (Average of last 5 years: 05, 06, 07, 08, 09; specify years)

1.11	Name of crop	Kharif		Rabi		Summer		Total		Crop residue as fodder ('000 tons)
		Production ('000 t)	Productivity (kg/ha)	Production ('000 t)	Productivity (kg/ha)	Production ('000 t)	Productivity (kg/ha)	Production ('000 t)	Productivity (kg/ha)	
Major Field crops (Crops to be identified based on total acreage)										
Crop 1	Soybean	327.3	1323.7	-	-			327.3	1323.7	
Crop 2	Cotton	86.3	760.7	-	-			86.3	760.7	
Crop 3	Maize	72.5	1147.2	-	-			72.5	1147.2	
Crop 4	Wheat	-	-	339.7	2209.2			339.7	2209.2	
Crop 5	Chickpea	-	-	50.25	996.5			50.25	996.5	
Others										
Major Horticultural crops (Crops to be identified based on total acreage)										
	Horticulture crops - Fruits									
	Mango								0.435	15000
	Guava								3.800	25000
	Orange								0.672	2100
	Banana								30.240	70000
	Horticulture crops - Vegetables									
	Potato								47.500	25000
	Onion								39.960	30000
	Tomato								33.451	22000
	Horticulture crops - Spices									
	Ginger								0.527	3500
	Chilies								29.452	4000
	Garlic								22.283	7500
	Coriander								0.243	1500
	Medicinal and Aromatic crops									
	Medicinal									
	Flower crops									
	Marigold								0.153	4500
	Plantation crops									
	Eg., industrial pulpwood crops etc.									
	Fodder crops									
	Total fodder crop area									
	Grazing land									
	Sericulture etc									
Others (specify)										

Source – Agriculture Statistics, 2009, Directorate of Farmer welfare and Agriculture Development Madhya Pradesh, Bhopal

1.12	Sowing window for 5 major field crops	Soybean	Maize	Sorghum	Chickpea	wheat
	Kharif- Rainfed	3rd week of June-I st week of July	3rd week of June-I st week of July	3rd week of June-I st week of July	-	-
	Kharif-Irrigated	-	First week of June - Second week of June	-	-	-
	Rabi- Rainfed	-	-	-	Second week of Oct.- Second week of Nov	Second week of Oct.- Second week of Nov.
	Rabi-Irrigated	-	-	-	3rd week Oct -3rd week Nov	3rd week Oct.- Second week of Nov.

1.13	What is the major contingency the district is prone to? (Tick mark)	Regular	Occasional	None
	Drought	-	√	-
	Flood	-	√	-
	Cyclone	-	-	√
	Hail storm	-	√	-
	Heat wave	-	√	-
	Cold wave	-	√	-
	Frost	-	√	-
	Sea water intrusion	-	-	√
	Pests and disease outbreak (specify) Girdle beetel, semi-looper in soybean and gram pod borer in chick pea	-	√	-

1.14	Include Digital maps of the district for		
		Location map of district within State as Annexure I	Enclosed: Yes
		Mean annual rainfall as Annexure 2	Enclosed: Yes
		Soil map as Annexure 3	Enclosed: Yes

Annexure I
Location map

Annexure II
Mean annual rainfall

Annexure III
Soil Map

(Source: NBSS&LUP, Amravati Road, Nagpur)

2.0 Strategies for weather related contingencies

2.1 Drought

2.1.1 Rainfed situation

Condition			Suggested Contingency measures		
Early season drought (delayed onset)	**Major Farming situation**	**Crop/ cropping system**	**Change in crop/cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Delay by 2 weeks (July 1st wk) 27MW	Shallow soils	Cotton	No change	Sowing of short duration Bt varieties Making field free of weeds full utilization of water and nutrients by the crop	Link RKVY for the seed cum fertilizer drills -Supply of certified seeds through seed societies Seeds seed corporation, Agriculture universities
		Sorghum	Sorghum JJ 938, JJ 1041	Select short duration varieties for sowing Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed Rhyzobium culture + PSB 5g./kg. seed each. 1.0 g. Ammonium Molibdate/kg. of seed for soybean and chickpea cropping sequence Cultivate the field on receiving pre monsoon showers	
		Soybean	JS 9305, JS 335, NRC-7		
		Maize	Maize HPQM 1,		
		Pigeonpea	No change	Pigeon pea (medium) JKM 189, TJT 501, RVICPH 2671 (Hy.) + Soybean (early) JS 95-60 (2:4 rows)	
		Groundnut	JGN 3, JGN23, TAG -22	Sowing in ridge and furrow system. Seed treatment with culture & fungicides	
	Deep soils	Cotton	No change	Sowing of short duration Bt varieties Making field free of weeds full utilization of water and nutrients by the crop	
		Soybean	JS 9305, JS 335, NRC-7	-Select short duration varieties for sowing -Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed - Rhyzobium culture + PSB 5g./kg. seed each. 1.0 g. Ammonium Molibdate/kg. of seed for soybean and chickpea cropping sequence -Cultivate the field on receiving pre monsoon showers - Intercropping of pigeonpea with soybean (2:4)	
		Pigeonpea	(medium) JKM 189, TJT 501, RVICPH 2671 (Hy.) + Soybean (early) JS 95-60 (2:4 rows)		
		Maize	Maize HPQM 1, JVM 421, Hybrids	-Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed seed treatment by PSB 5g./kg.	

Condition			Suggested Contingency measures		
Early season drought (delayed onset)	**Major Farming situation**	**Crop/ cropping system**	**Change in crop/ cropping system**	**Agronomic measures**	**Remark on implementation**
Delay by 4 weeks (July IIIrd Week)	Shallow soils	Cotton	No change	Sowing of short duration Bt varieties, Making field free of weeds full utilization of water and nutrients by the crop	Link RKVY for the seed cum fertilizer drills -Supply of certified seeds through seed societies Seeds seed corporation, Agriculture universities
		Sorghum	Maize JVM 421, Early varieties	-Select short duration varieties for sowing -Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed - Rhyzobium culture + PSB 5g./kg. seed each. 1.0 g. Ammonium Molibdate/kg. of seed for soybean and chickpea cropping sequence -Cultivate the field on receiving pre monsoon showers	
		Soybean	JS 9560, NRC-7		
		Maize	Maize HPQM 1,		
		Pigeonpea	No change	Pigeon pea (medium) JKM 189, TJT 501, RVICPH 2671 (Hy.) + Soybean (early) JS 95-60 (2:4 rows)	
		Groundnut	JGN 3, JGN23, TAG -22	Sowing in ridge and furrow system. Seed treatment with culture & fungicides	
	Deep soils	Cotton	No change	Sowing of short duration Bt varieties, Making field free of weeds full utilization of water and nutrients by the crop	
		Soybean	JS 9305, JS 335, NRC-7	-Select short duration varieties for sowing -Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed - Rhyzobium culture + PSB 5g./kg. seed each. 1.0 g. Ammonium Molibdate/kg. of seed for soybean and chickpea cropping sequence -Cultivate the field on receiving pre monsoon showers - Intercropping of pigeonpea with soybean (2:4)	
		Pigeonpea	(medium) JKM 189, TJT 501, RVICPH 2671 (Hy.) + Soybean (early) JS 95-60 (2:4 rows)		
		Maize	Maize HPQM 1, JVM 421, Hybrids	-Seed dressing with Thirum + carbendazim in 2:1 ratio 3g/kg seed seed treatment by PSB 5g./kg.	

Condition			Suggested Contingency measures		
Early season drought (delayed onset)	**Major Farming situation**	**Crop/ cropping system**	**Change in crop/cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Delay by 6 weeks (Aug Ist Week)	Shallow soils	Cotton	Greengram/ Blackgram	Sowing of short duration crops, 20% increase seed rate Making field free of weeds full utilization of water and nutrients by the crop	Link RKVY for the seed cum fertilizer drills -Supply of certified seeds through seed societies Seeds seed corporation, Agriculture universities
		Sorghum			
		Soybean	JS 9560, NRC-7		
		Maize	No change		
		Pigeonpea	No change	Pigeon pea (medium) JKM 189, TJT 501, RVICPH 2671 (Hy.) + Soybean (early) JS 95-60 (2:4 rows)	
		Groundnut	Greengram/ Blackgram	Sowing of short duration crops, 20% increase seed rate	
	Deep soils	Cotton	Greengram/ Blackgram	Sowing of short duration crops, 20% increase seed rate Making field free of weeds full utilization of water and nutrients by the crop	
		Sorghum			
		Soybean Maize Pigeonpea	JS 9560, NRC-7 No change No change	Pigeon pea (medium) JKM 189, TJT 501, RVICPH 2671 (Hy.)	
		Groundnut	Greengram/ Blackgram	Sowing of short duration crops, 20% increase seed rate	

Condition			Suggested Contingency measures		
Early season drought (delayed onset)	**Major Farming situation**	**Crop/ cropping system**	**Change in crop/cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Delay by 8 weeks (Aug 3rd Week)	Shallow soils	Cotton	Fallow/ Plan for rabi crops	Green manuring, Moisture conservation practices	Link RKVY for the seed cum fertilizer drills -Supply of certified seeds through seed societies
		Sorghum			
		Soybean			
		Maize			
		Pigeonpea			
		Groundnut			
	Deep soils	Cotton	Fallow/ Plan for rabi crops	Green manuring, Moisture conservation practices	
		Sorghum			
		Soybean Maize Pigeonpea			
		Groundnut			

***Matrix for specifying condition of early season drought due to delayed onset of monsoon (2, 4, 6 & 8 weeks) compared to normal onset (2.1.1)**

Normal onset (Month and week)	**Month and week for specifying condition of early season drought due to delayed onset of monsoon**			
	Delay in onset of monsoon by			
	2 wks	**4 wks**	**6 wks**	**8 wks**
June 1st wk	June 3rd wk	July 1st wk	July 3rd wk	Aug 1st wk
June 2nd wk	June 4th wk	July 2nd wk	July 4th wk	Aug 2nd wk
June 3rd wk	July 1st wk	July 3rd wk	Aug 1st wk	Aug 3rd wk
June 4th wk	July 2nd wk	July 4th wk	Aug 2nd wk	Aug 4th wk
July 1st wk	July 3rd wk	Aug 1st wk	Aug 3rd wk	Sep 1st wk
July 2nd wk	July 4th wk	Aug 2nd wk	Aug 4th wk	Sep 2nd wk

Condition			**Suggested Contingency measures**		
Early season drought **(Normal onset)**	**Major Farming situation[a]**	**Crop/ cropping system[b]**	**Crop management[c]**	**Soil nutrient & moisture conservation measues[d]**	**Remarks on Implementation[e]**
1	2	3	4	5	6
Normal onset followed by 15-20 days dry spell after sowing leading to poor germination/crop stand etc.	Shallow soil	Cotton	No change	Sowing of short duration Bt varieties, Making field free of weeds full utilization of water and nutrients by the crop	Linkage with NSC, MPSC, RVSKVV, farmers' societies, state seed firms/Agril. University and seed corporations for supply of seed and with RKVY for seed drills
		Soybean	Gap filling with seed , spray 2% solution of DAP water during the dry spell Spraying of PMA@ 3 ppm solution during dry spell	Frequent intercultural operations and mulching with green leaves.	
		Sorghum	-do-		
		Maize	Gap filling with seed of same variety	-do-	
		Pigeonpea	Gap filling with seed of same variety	-do-	
		Groundnut	Gap filling with maize seed	-do-	
	Deep soils	Cotton	No change	Sowing of short duration Bt varieties, Making field free of weeds full utilization of water and nutrients by the crop	
		Soybean	Gap filling with seed , spray 2% solution of DAP water during the dry spell Spraying of PMA@ 3 ppm solution during dry spell		
		Maize	Gap filling with seed of same variety		
		Pigeonpea	Gap filling with seed of same variety		

Condition			Suggested Contingency measures		
Mid season drought (long dry spell, consecutive 2 weeks rainless (>2.5 mm) period)	**Major Farming situation[a]**	**Crop/cropping system[b]**	**Crop management[c]**	**Soil nutrient & moisture conservation measues[d]**	**Remarks on Implementation[e]**
1	2	3	4	5	6
At vegetative stage	Shallow soil	Cotton	Foliar application of 2% DAP solution	Life saving irrigation, Making field free of weeds full utilization of water and nutrients by the crops	Linkage with NSC, MPSC, RVSKVV, farmers' societies, state seed firms/Agril. University and seed corporations for supply of seed and with RKVY for seed drills
		Soybean	Interculture operation Dora , Foliar application of 2% solution of Urea or DAP with water during draught Spray profenophos 40EC@2 ml/l of water to control girdle beetle.		
		Sorghum	Delay the spray of urea till optimum soil moisture availability 20% defoliation of lower leaves and use as mulching		
		Maize	-do-		
		Pigeonpea	-do-		
		Groundnut	Life saving irrigation / water spray		
	Deep soils	Cotton	-do-		
		Soybean	-do-		
		Maize	-do-		
		Pigeonpea	-do-		

Condition			Suggested Contingency measures		
Mid season drought (long dry spell)	**Major Farming situation[a]**	**Crop/cropping system[b]**	**Crop management[c]**	**Soil nutrient & moisture conservation measues[d]**	**Remarks on Implementation[e]**
1	2	3	4	5	6
At reproductive stage	Shallow soil	Cotton	Foliar application of 2% DAP solution	Life saving irrigation Making field free of weeds full utilization of water and nutrients by the crops -Organic mulch/ green leaf mulch	Linkage with NSC, MPSC, RVSKVV, farmers' societies, state seed firms/Agril. University and seed corporations for supply of seed and with RKVY for seed drills
		Soybean	- 20% defoliation in soybean and use as mulching -Spray of 2% solution of MOP/DAP/ water during the dry spell -Spraying of PMA @3 ppm solution during the dry spell		
		Sorghum	Delay the spray of urea till optimum soil moisture availability 20% defoliation of lower leaves and use as mulching		
		Maize	-do-		
		Pigeonpea	-do-		
		Groundnut	Life saving irrigation / water spray		
	Deep soils	Cotton	-do-		
		Soybean	-do-		
		Maize	-do-		
		Pigeonpea	-do-		

Condition			Suggested Contingency measures		
Terminal drought	**Major Farming situation[a]**	**Crop/ cropping system[b]**	**Crop management[c]**	**Rabi Crop planning[d]**	**Remarks on Implementation[e]**
1	2	3	4	5	6
	Shallow soil	Cotton	Wherever water resources are available such as pond, wells etc. protective irrigation can be provided to the crop, Harvest sorghum crop for fodder	Repeated interculture operations to keep the field weed free and use of organic mulches *Glyricidia* leaves,, uprooted weeds keeping roots upwards.	Linkage with NSC, MPSC, RVSKVV, farmers' societies, state seed firms / Agril. University and seed corporations for supply of seed and with RKVY for seed drills
		Soybean			
		Sorghum			
		Maize			
		Pigeonpea			
		Groundnut			
	Deep soils	Cotton			
		Soybean			
		Maize			
		Pigeonpea			

2.1.2 Irrigated situation

Condition			Suggested Contingency measures		
	Major Farming situation	**Crop/ cropping system**	**Change in crop/ cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Delayed release of water in canals due to low rainfall	Shallow soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-
	Deep soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-

Condition			**Suggested Contingency measures**		
	Major Farming situation	**Crop/ cropping system**	**Change in crop/ cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Limited release of water in canals due to low rainfall	Shallow soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-
	Deep soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-

Condition			**Suggested Contingency measures**		
	Major Farming situation	**Crop/ cropping system**	**Change in crop/ cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Non release of water in canals under delayed onset of monsoon in catchment	Shallow soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-
	Deep soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-

Condition			**Suggested Contingency measures**		
	Major Farming situation	**Crop/ cropping system**	**Change in crop/cropping system**	**Agronomic measures**	**Remark on implementation**
1	2	3	4	5	6
Lack of inflows into tank due to insufficient/delayed onset of monsoon	Shallow soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-
	Deep soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	Preferred pre sowing Irrigation (Palewa) Balanced fertilization Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	Dry sowing Application of IPNM techniques Irrigation at critical growth stages, branching and seed filling stage Inter-culture operation	-

Condition	Major Farming situation	Crop/ cropping system	Change in crop/ cropping system	Agronomic measures	Remark on implementation
1	2	3	4	5	6
Insufficient ground water recharge due to low rainfall	Shallow soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	• Preferred pre sowing Irrigation (Palewa) • Balanced fertilization • Irrigation at critical growth stage • Dry sowing Application of IPNM techniques • Irrigation at critical growth stages, branching and seed filling stage • Inter-culture operation	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)		-
	Deep soils	Wheat	Wheat (HW 2004, HI 1554, HI 1500, MP 1203)	• Preferred pre sowing Irrigation (Palewa) • Balanced fertilization • Irrigation at critical growth stage	-
		Chickpea	Chickpea (JG 130, JG 16, JAKI 9218)	• Dry sowing • Application of IPNM techniques • Irrigation at critical growth stages, branching and seed filling stage • Inter-culture operation	-

2.2 Unusual rains (untimely, unseasonal etc) (for both rainfed and irrigated situations)

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
Crop1 (specify) Maize	• Drain excess water with proper drainage system • Crop sowing in FIRB system, Gap filling with improved varieties • Inter culture agter draining excess water to improve the soil aeration • Top dressing of 20-30 kg N/ha toregain lost vigor	• Dain excess water with proper drainage system • Apply 20-30 kg N/ha in the form of urea for good cob formation.	• Drain excess water with proper drainage system • Harvest green cobs for marketing • use sulphur spray for control of fungal infection Harvest the cobs on clear sunny day	• Protect the harvest crop to rains by keeping in safe place • drying of seed in threshing floor before bagging and storage
Crop2 Cotton	• Drain excess water with proper drainage • Sow the cropin FIRB system • Interculture at optimum moisture content to loosen and to aerate the soil and to control weeds • Use 20-30 kg N/ha in the form of,urea for better vegetative growth.	• Drain excess water with proper drainage • Apply 20-30 kg N/ha in the form of urea for good flower formation. • Spray planofix for flower drop control.	• , Drain excess water with proper drainage • Dry wet cotton and market immediately • Spray 1% KNo3 • picking should be done on clear sunny day	• Protect the harvest crop to from rains • Proper storage of picked cotton to avoid wetting and maintaining the quality of lint
Crop3 Soybean	• Drain excess water as early as possible • Sow the crop in ridge and furrow system • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds. • Spray 2% urea or • Top dress 10kgn/ha to the crop to gain losr vigor	• Drain excess water as early as possible • Spray planofix for flower drop control. • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds	• Drain excess water as early as possible • use sulphur spray for control of fungal infection • Allow the crop to dry completely before harvesting	• Protect the harvest crop from rains, • Quick drying followed by threshing • Dry the grain to proper moisture content before bagging and storing.

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
Crop4 Black gram	• Drain excess water with proper drainage • Sow the crop in FIRB system • Interculture at optimum moisture content to loosen and to aerate the soil and to control weeds • Use 20-30 kg N/ha in the form of,urea for better vegetative growth.	• Drain excess water as early as possible • Spray planofix for flower drop control. • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds	- Drain excess water as early as possible • use sulphur spray for control of fungal infection • Allow the crop to dry completely before harvesting	• . Protect the harvest crop from rains, • Quick drying followed by threshing • Dry the grain to proper moisture content before bagging and storing.
Crop5 Paddy	• Drain excess water as early as possible • Take up gap filling either with available nursery or by splitting the tillers from surviving hills • Give nitrogenous fertilizer (20-30 kgN + 10 kg K/ha after drainage of excess water	• Drain excess water as early as possible • Give nitrogenous fertilizer (20-30 kgN + 10 kg K/ha after drainage of excess water	• Drain excess water as early as possible • use sulphur spray for control of fungal infection	• Protect the harvest crop from rains, • Spray common slat of 5% on panicles to prevent germination and spoilage of straw from moulds
Horticulture				
Crop1 (specify) Tomato	• Drain the excess water as soon as possible • Spray Urea 2% solution 2-3 times. • Topdressing of booster dose of 12 kg MOP + 30 kg Urea per acre as soon as possible. • Gap filling may be taken up if the plants are two weeks old and sowing window is still available for the crop. • In case of severe damage (considered as complete economical loss), and the contingency period is between June to August, sowing of best alternative crop must be taken up.	• Drain the excess water as soon as possible • Spray Urea 2% solution 2-3 times. • Topdressing of booster dose of 10 kg MOP + 30 kg Urea per acre as soon as possible.	• Drain the excess water as soon as possible • Harvest the marketable fruits in a clear sunny day'	• Store the harvested fruits in well ventilated place temporarily before it can be marketed. • Market the fruits as soon as possible.
Crop2 Onion	• Drain the excess water as soon as possible	• Drain the excess water as soon as possible	• Drain the excess water as soon as possible	• Dry the rhizomes on concrete floor or use

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
	• Spray Urea 2% or 1% KNO_3 followed by Ferrous Sulphate 0.5% + Citric Acid 0.1 % solution 2-3 times. • Topdressing of booster dose of 40 kg MOP + 50 kg Urea along with 250 kg of Neem Cake per acre as soon as possible. • In case of severe damage (considered as complete economical loss or if inundation is more than for four days), and the contingency period is between June to August, sowing of best alternative crop must be taken up.	• Spray Urea 2% or 1% KNO_3 solution 2-3 times.	• Harvest the rhizomes when field comes to normal	boilers (if available) for processing immediately • Grade and separate the rotten and mould affected rhizomes. • Pack the dried material in gunny bags disinfected with safe insecticides • Store in a well ventilated rooms
Crop3 Chilli	• Drain the excess water as soon as possible • Spray Urea 2% solution 2-3 times. • Topdressing of booster dose of 15 kg MOP + 30 kg Urea per acre as soon as possible. • Gap filling may be taken up if the plants are two weeks old and sowing window is still available for the crop. • In case of severe damage (considered as complete economical loss), and the contingency period is between June to August, sowing of best	• Drain the excess water as soon as possible • Spray Urea 2% solution 2-3 times. • Topdressing of booster dose of 15 kg MOP + 30 kg Urea per acre as soon as possible.	• Drain the excess water as soon as possible • Harvest the matured fruits in a clear sunny day.	• Dry the pods on concrete floor immediately after the appearance of sunlight (or). • Use poly house solar driers for quick drying • Grade the pods and market as soon as possible. • Do not store such produce for long

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
	alternative crop must be taken up.			periods.
Crop4 Cauliflower	• Drain excess water as early as possible • Crop sowing in FIRB system • Apply urea(10-20 kg N/ha) for better vegetative growth. • One spray of mencozeb 75WP 2gm/l for root rot control.	• Drain excess water as early as possible • Spray planofix for flower drop control, • One spray of mencozeb 75WP 2gm/l for root rot	• Drain excess water as early as possible • picking the matured fruits and sell it.	• -
Heavy rainfall with high speed winds in a short span[2]	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
Crop1 Maize	• Drain the excess water as early as possible • Apply 20 kg N + 10 kg K /ha after draining excess water • Take up inter cultivation and at optimum soil moisture condition to loosen and aerate the soil and to control weeds • Earthenup the crop for anchorage • Spray KNO_3 1 % or water soluble fertilizers like 19-19-19, 20-20-20, 21-21-21 at 1% to support nutrition • Take up timely control measures for Pink stem borer, sheath blight and Turcicum leaf blight	• Drain the excess water as early as possible • Apply 20 kg N + 10 kg K /ha after draining excess water • Spray KNO_3 1 % or water soluble fertilizers like 19-19-19, 20-20-20, 21-21-21 at 1% to support nutrition • Take up timely control measures for sheath blight and post flowering stalk rots	• Drain the excess water as early as possible • Allow the crop to dry completely before harvesting	• Harvest the cobs after the they are dried up properly. Dry the grain to optimum moisture condition before storing
Crop2 Cotton	• Drain excess water with proper drainage • Sow the cropin FIRB system • Interculture at optimum moisture	• Drain excess water with proper drainage • Apply 20-30 kg N/ha in the form of urea for good	• Drain excess water with proper drainage • Dry wet cotton and market immediately	• Protect the harvest crop to from rains • Proper storage of picked cotton to

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
	content to loosen and to aerate the soil and to control weeds • Use 20-30 kg N/ha in the form of,urea for better vegetative growth.	flower formation. • Spray planofix for flower drop control.	• Spray 1% KNo3 • picking should be done on clear sunny day	avoid wetting and maintaining the quality of lint
Crop3 Soybean	• Drain excess water as early as possible • Sow the crop in ridge and furrow system • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds. • Spray 2% urea or • Top dress 10kgn/ha to the crop to gain losr vigor	• Drain excess water as early as possible • Spray planofix for flower drop control. • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds	• Drain excess water as early as possible • use sulphur spray for control of fungal infection • Allow the crop to dry completely before harvesting	• Protect the harvest crop from rains, • Quick drying followed by threshing • Dry the grain to proper moisture content before bagging and storing.
Crop4 Black gram	• Drain excess water with proper drainage • Sow the crop in FIRB system • Interculture at optimum moisture content to loosen and to aerate the soil and to control weeds • Use 20-30 kg N/ha in the form of,urea for better vegetative growth.	• Drain excess water as early as possible • Spray planofix for flower drop control. • Take up interculture at optimum moisture condition to loosen and aerate the soil and to control weeds	• Drain excess water as early as possible • use sulphur spray for control of fungal infection • Allow the crop to dry completely before harvesting	• Protect the harvest crop from rains, • Quick drying followed by threshing • Dry the grain to proper moisture content before bagging and storing.
Horticulture				
Crop1 Tomato	• Drain excess water with proper drainage • Crop sowing in FIRB system, Apply 20-30 kg N/ha in the form of	• Drain excess water with proper drainage system • Spray planofix for flower drop control,	• Drain excess water as early as possible • picking the matured fruits and sell them.	• Harvest the produce on clear sunny day

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
	• Urea for better vegetative growth. One spray of mencozeb 75WP 2gm/l for root rot control.	• One spray of mencozeb 75WP 2gm/l for root rot control.		
Crop2 Onion	• Drain excess water with proper drainage • Crop sowing in FIRB system, • Apply 20-30 kg N/ha in the form of urea for better vegetative growth. One spray of mencozeb 75WP 2gm/l for root rot control.	• Drain excess water with proper drainage • One spray of mencozeb 75WP 2gm/l for root rot control.	• Drain excess water with proper drainage • Harvest the crop and shall it as soon as possible.	• Shift the produce in safer place • Harvest the produce on clear sunny day
Crop3 Chilli	• Drain excess water with proper drainage • Crop sowing in FIRB system, • Apply 20-30 kg N/ha in the form of urea for better vegetative growth. • One spray of mencozeb 75WP 2gm/l for root rot control.	• Drain excess water with proper drainage • Spray planofix for flower drop control, and One spray of mencozeb 75WP 2gm/l for root rot	• Drain excess water with proper drainage • picking the matured fruits and sell them	• -
Crop4 Cauliflower	• Drain excess water with proper drainage • Crop sowing in FIRB system, Apply 10-20 kg n?ha in the form ofurea for better vegetative growth. • One spray of mencozeb 75WP 2gm/l for root rot control.	• Drain excess water with proper drainage • Spray planofix for flower drop control, and One spray of mencozeb 75WP 2gm/l for root rot	• Drain excess water with proper drainage • picking the matured fruits and shall it.	• -
Outbreak of pests and diseases due to unseasonal rains	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
Crop1 Maize	• Application of proper insecticides to control of sucking pest , stem borer and bihar hairy caterpillar	• Use of fungicides to control stalk rot	• Use sulphur spray for control of fungal infection	• Proper drying of seed or grains before storage. use EDB ampoules (one ampoule / q)

Condition	Suggested contingency measure			
Continuous high rainfall in a short span leading to water logging	**Vegetative stage[k]**	**Flowering stage[l]**	**Crop maturity stage[m]**	**Post harvest[n]**
1	2	3	4	5
Crop2 Cotton	• Control of sucking pest, stem borer fly, americun caterpillar, control of root rot and collar rot disease	• Control of pink wall worm, sucking pest etc. and control of flower drop.	• Control of pink wall worm, sucking pest etc. and control of flower drop.	• Proper storage of crop harvest and timely marketing.
Crop3 Soybean	• Control of semi looper, blue beetle and girdle beetle	• Control of semi looper, blue beetle, girdle beetle, tobacco caterpillar	• Control of tobacco caterpillar, control of fungal infection use sulphur dust.	• Proper drying of seed or grains before storage.
Crop4 Black gram	• Control of semi looper, blue beetle	• Control of semi looper, blue bitle, tobacco caterpillar	• Pick the mature pods and proper drying it, control the fungal infection use sulphur dust.	• Proper drying of seed or grains before storage. use EDB ampoules (one ampoule / q)
Horticulture				
Crop1 Tomato	• One spray of mencozeb 75WP 2gm/l for root rot control, control of sucking pests and stem borer.	• Control the root rot and early blight, control of sucking pests and stem borer and fruit borer control the flower drop.	• Picking the mature fruits and sold. Control the fruit drop. Control the late blight	
Crop2 Onion	• Control of white grub and fungal disease	• Control of white grub and fungal disease	• Control the rotting of bulbs. Harvest the crop and proper dying it.	• Proper drying the crop and store it proper way.
Crop3 Chilli	• Control the sucking pest, stem borer and root rot and anthracnose disease	• Control the sucking pest, caterpillar and root rot and anthracnose disease and flower drop.	• Control the fungal infection.	• Proper drying of chilli and store it.

2.3 Floods - NA

Condition	**Suggested contingency measure[o]**			
Transient water logging/ partial inundation[1]	**Seedling / nursery stage**	**Vegetative stage**	**Reproductive stage**	**At harvest**
Crop1 (specify)				
Crop2				
Crop3				
Crop4				
Crop5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Continuous submergence for more than 2 days[2]				
Crop1				
Crop2				
Crop3				
Crop4				
Crop5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Sea water intrusion[3]				
Crop1				
Crop2				
Crop3				
Crop4				
Crop5				

2.4 Extreme events: Heat wave / Cold wave/Frost/ Hailstorm /Cyclone - NA

Extreme event type	Suggested contingency measure[r]			
	Seedling / nursery stage	Vegetative stage	Reproductive stage	At harvest
Heat Wave[p]				
Crop1				
Crop2				
Crop3				
Crop4				
Crop 5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Cold wave[q]				
Crop1				
Crop2				
Crop3				
Crop4				
Crop 5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Frost				
Crop1				
Crop2				
Crop3				
Crop4				
Crop 5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Hailstorm				
Crop1				

Extreme event type	Suggested contingency measure[r]			
	Seedling / nursery stage	**Vegetative stage**	**Reproductive stage**	**At harvest**
Crop2				
Crop3				
Crop4				
Crop 5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				
Cyclone				
Crop1				
Crop2				
Crop3				
Crop4				
Crop 5				
Horticulture				
Crop1 (specify)				
Crop2				
Crop3				

2.5 Contingent strategies for Livestock, Poultry & Fisheries

2.5.1 Livestock

	Suggested contingency measures		
	Before the event[s]	**During the event**	**After the event**
Drought			
Feed and fodder availability	Hay and silage making, storage of locally available roughage	Use unconventional feeds as a source of roughage, use urea treated roughage, use urea molasses block as a source of nitrogen and energy. Use low quality processed with mild acid and alkali treatment.	Feeding green feed/ fodder and conventional feed.
Drinking water	Water treated with quick lime	Use sanitized water	Water treated with quick lime
Health and disease management	Vaccination & deworming	Mineral mixture feeding, keep animals in favorable environment	Vaccination & deworming
Floods			
Feed and fodder availability	Hay and silage making,	Use unconventional feeds; avoid spoiled fodder feeding, use roughages processed with mild acid and alkali.	Feeding green feed/ fodder and conventional feed.
Drinking water	Water and quick lime	Use sanitized water	Water and quick lime
Health and disease management	Vaccination & deworming	Vaccination & deworming , avoid food poisoning by spoiled feed, keeping catles in dry and airable place	Vaccination & deworming, use antidote in poisoning case
Cyclone			
Feed and fodder availability	Hay and silage making,	Use unconventional feeds; avoid spoiled fodder feeding, use roughages processed with mild acid and alkali.	Feeding green feed/ fodder and conventional feed.
Drinking water	Water treated with quick lime	Use sanitized water	Water treated with quick lime
Health and disease management	Vaccination & deworming	Vaccination & deworming , avoid food poisoning by spoiled feed, keeping catles in dry and airable place	Vaccination & deworming, use antidote in poisoning case
Heat wave and cold wave			
Shelter/environment management	House of animal should be N-S direction, availability of plenty water, animal house window should have provision of curtain to maintain cold and het wave	Provide favorable environment during heat/ cold wave Heat: availability of plunty of cold water to drink. Keep animal on cool places, two times bathing of animals. Cold: availability of full sun rays in animal shed, keep animal body warm.	Keep environment uniformly to recover animal.
Health and disease management	Availability of antibiotics, B-complex, liver tonic, anti-inflammatory drugs, anti-stress drugs, vaccines etc.	Use suitable drugs depending on condition.	Vaccination & deworming,

[s] based on forewarning wherever available

2.5.2 Poultry

	Suggested contingency measures		
	Before the event[a]	**During the event**	**After the event**
Drought			
Shortage of feed ingredients	Storage of local available food grains/feed ingredients	Mineral mixture feeding, use unconventional feed in feeding of poultry ration, use animal protein source like fish meal, silk worm pupa, blood meal by products of slaughter house etc, ration should be made from locally available feed ingredients.	Feeding high quality balance feed.
Drinking water	Fresh drinking water	Sanitized drinking water	Fresh drinking water
Health and disease management	Vaccination and deworming	Vaccination and deworming	Vaccination and deworming
Floods			
Shortage of feed ingredients	Storage of local available food grains/feed ingredients,	Feed should be protected by fungus, down the curtain of window	Feeding high quality balance feed. Open the curtain for proper aeration and drying of litter.
Drinking water	Fresh drinking water	Sanitized drinking water	Fresh drinking water with quick lime.
Health and disease management	Vaccination and deworming	Vaccination and deworming, use anti fungal and liver tonic during feeding and drinking.	Vaccination and deworming
Cyclone			
Shortage of feed ingredients	Storage of local available food grains/feed ingredients,	Feed should be protected by fungus, down the curtain of window	Feeding high quality balance feed. Open the curtain for proper aeration and drying of litter.
Drinking water	Fresh drinking water	Sanitized drinking water	Fresh drinking water
Health and disease management	Vaccination and deworming	Vaccination and deworming, use anti fungal and liver tonic during feeding and drinking.	Vaccination and deworming
Heat wave and cold wave			
Shelter/environment management	Storage of local available food grains/feed ingredients,	Down the curtain of window, maintain the temperature of shed , lighting in the shed in cold condition	Feeding high quality balance feed.
Health and disease management	Vaccination and deworming	Vaccination and deworming, use anti stress drugs and liver tonic during feeding and drinking.	Vaccination and deworming

2.5.3 Fisheries/ Aquaculture

	Suggested contingency measures		
	Before the event[a]	**During the event**	**After the event**
Drought			
Shallow water in ponds due to insufficient rains/inflows	All the fish should be marketed	Dry ponds should be treated with lime.	After onset of monsoon and ponds fill with water seedling the fish seed.
Impact of heat and salt load build up in ponds / change in water quality	All the fish should be marketed	Dry ponds should be treated with lime.	After onset of monsoon and ponds fill with water seedling the fish seed.
Any other (specify)			
Floods			
Inundation with flood waters	Keeps net in west wear of ponds	Protect the fish to flow with runoff water	-
Water contamination and changes in BOD	Lime treatment should be done.	Lime treatment and $KMnO_4$ treatment 2 ppm	No seedling of new fish seed
Health and disease management	Lime treatment should be done.	Lime treatment and $KMnO_4$ treatment 2 ppm	No seedling of new fish seed
Loss of stock and inputs (feed, chemicals etc.)	Manufactured feed should be given in ponds	Manufactured feed should be given in ponds	Natural feed should be available in ponds
Infrastructure damage	Dust and debris should be clean in west wear.	Continuous Dust and debris cleans in west wear.	-
Cyclone			
Overflow / flooding of ponds	Keeps net in west wear of ponds	Keeps net in west wear of ponds	-
Change in fresh/brackish water ratio	-	-	-
Health and disease management	Lime treatment should be done.	Lime treatment and $KMnO_4$ treatment 2 ppm	No seedling of new fish seed
Loss of stock and inputs (feed, chemicals etc.)	Manufactured feed should be given in ponds	Manufactured feed should be given in ponds	Natural feed should be available in ponds
Infrastructure damage	-	-	-
Heat wave and cold wave			
Management of pond environment	Showering of water by pump for proper availability of oxygen in water	Showering of water by pump for proper availability of oxygen in water	-
Health and disease management	$KMnO_4$ treatment 2 ppm	$KMnO_4$ treatment 2 ppm	-