



PAKISTAN: FLOODS/RAINS 2010

Series No. 2

RAPID CROP DAMAGE ASSESSMENT

December 20, 2010



SUPARCO

Pakistan Space &
Upper Atmosphere
Research Commission



Food and Agriculture
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&
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SPARCENT, Islamabad, Main Islamabad Highway 44000, Islamabad, Pakistan

Tel.: (+92) 51 4611792 Fax: (+92) 51 4611796

E-mail: sgs@suparco.net.pk <http://www.suparco.gov.pk>

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ACRONYM	DESCRIPTION
AJK	Azad Jammu and Kashmir
CLCV	Cotton Leaf Curl Virus
CRS	Crop Reporting Services
CUSEC	Cubic Feet Per Second
FAO	Food and Agriculture Organization
FCA	Federal Committee on Agriculture
GB	Gilgit Baltistan
Ha	Hectare
KP	Khyber Pakhtunkhwa
MAF	Million Acre Feet
MINFA	Ministry of Food & Agriculture
NDVI	Normalized Difference Vegetation Index
PMD	Pakistan Meteorology Department
RIM	Regulated Irrigation Measurement
SPARCENT	Space Application & Research Center
SUPARCO	Pakistan Space & Upper Atmosphere Research Commission

1. Pakistan Agriculture and Demography

Agriculture in Pakistan, is a major sector of economy. It contributes 21 percent to GDP, employs 45 percent of labor force and contributes 70 percent of the foreign exchange earnings through export of raw materials, semi processed and processed products. The average annual growth rate of the sector has been 3.2 percent over last one decade. The target of growth for the year 2010-11 has been fixed at 3.8 percent. In view of damage to agriculture by floods and rains, this growth target is not likely to be achieved.

The geographic area of the country is 79.6 million ha. The cultivated area is 21.2 million ha and cropped area is 23.7 million ha. The cropping intensity is 112 percent.

The population of the country is about 174 million. The annual growth rate in population is about 2.0 percent. At this rate, the annual increase in population is 3.7 million which is a huge size for a developing economy like Pakistan. This disrupts all development planning of the country for various socio economic and demographic parameters. As per World Bank report, the population below poverty line was 17.2 percent during the year 2008.

2. Cropping Seasons

There are two main cropping seasons in Pakistan viz. kharif meaning autumn and Rabi meaning spring. The cropping seasons relate to crop maturity time. Kharif means maturity of crops in autumn and the term Rabi is likewise. The main kharif crops include cotton, rice, sugarcane, maize, fodders, sorghum, millet, fruits, vegetables and spices. The main Rabi crops include wheat, rapeseed and mustard, canola, chickpeas, lentil, potato, fodders, vegetables, fruits and others. Some crops are grown around the year in various ecological regions of Pakistan. These include onion, tomato, chillies, root crops and others.

There is a wide variability of sowing period among kharif crops. The sowing period for kharif ranges from February for sugarcane to August for maize crop. In Sindh, sugarcane is sown in September. The cotton and rice are medium season kharif crops. Cotton is sown from March to May and rice is sown from mid May to July.

The sowing period of Rabi crops is comparatively contained. The sowing of rapeseed, mustard and vegetables starts from mid September. Potatoes are sown at the end of October. The chickpeas are generally sown from first decadal of October to mid November. Wheat is sown from second decadal of October to end December.

3. Crop Calendar by Regions

The crop calendar for various regions of the country is as follows:

CROP CALENDAR				
Wheat Crop: Sowing and harvesting times				
Province	Region	Sowing time	Picking time	
Punjab	Rainfed : Potohar and others	20 th Oct - 15 th Nov	Apr	
	Irrigated :fallow lands	1 st Nov - 25 th Nov	Apr	
	Irrigated-after Kharif crops	Mid-Nov - end Dec	Apr	
Sindh	Lower Sindh	1 st Nov - 15 th Dec	Mar	
	Upper Sindh	1 st Nov - end Dec	Mid Mar-Mid Apr	
KP	Plains	1 st Nov - 15 th Dec	Apr	
	Hilly areas	25 th Oct - 15 th Dec	Apr	
Balochistan	Plains	1 st Nov - 15 th Dec	Apr	
Cotton: Sowing and Picking times				
Province	Region	Sowing time	Picking time	
Punjab	Southern and Central Punjab	1 st May - 15 th Jun	Aug - Nov	
Sindh	Mirpur Khas	1 st Mar - 15 th Apr	July - Oct	
	Hyderabad, Badin	10 th Apr - 10 th May	Aug - Oct	
	Upper Sindh	1 st Mar - 10 th Jun	Aug - Nov	
KP	D.I.Khan	1 st May - 31 st May	Aug - Nov	
Province	Planting time			
	Spring (Mid Feb-March)	Autumn (Sep)		
Punjab	1 st Feb -3 rd week of Mar (main crop)	Sep	Nov - Mar	
Sindh	1 st Feb- 15 th Mar	Sep (main crop)	Nov - Mar	
KP	1 st Feb -3 rd week of Mar (main crop)	Sep	Nov - Mar	
RiceSowing and harvesting times				
Province	Variety	Nursery	Transplanting/seeding	Harvesting
Punjab	Basmati (main crop)	1 st Jun - 30 th Jun	1 st Jul - 31 st Jul	Oct-Nov
	Irri	20 th May - 31 st May	10 th Jul - 7 th Jul	Mid Sep-Oct
Sindh/Barrage				
Kotri	Irri	25 th Apr - 10 th Jun	15 th Jun - 15 th Jul	Sep - mid Oct
Sukkur	Irri	10 th May - 15 th Jun	1 st Jun - 20 th Jul	Sep-Nov
Guddu	Irri	20 th May -30 th Jun	15 th Jun - 30 th Jul	Sep-Nov
KP				
Plains	Irri	1 st May - 31 st May	1 st Jun - mid Jul	Sep-Oct
Hilly areas	Japonica	1 st May - 20 th May	20 th May - 30 th Jun	Sep-Oct
Balochistan	Irri	20 th May - 30 th Jun	15 th Jun - 31 st Jul	Sep-Oct
Onion:Planting and harvesting times				
Province	Region	Nursery	Transplanting/seeding	Harvesting
Punjab	Central and Southern	Nov	Dec - Jan	Jan - Mar
Sindh	Lower	Jun-Aug	Jul - Sep	Jan - Mar
	Upper	Sep	Aug - Sep (Direct from bulbs)	Nov - Dec
KP	Plains	Sep-Oct	Dec - Jan	May - Jun
	Hilly areas	Aug-Sep	Feb - Mar	Jun - Jul
Balochistan	Uplands	Direct seeding	Feb - Mar	Aug - Nov
	Plains	Aug	Oct	Apr - May
Potato: Planting & Harvacting times				
Province	Season	Planting	Harvest	
Punjab	Autumn	End Oct-Early Nov	Dec - Jan	
	Spring	Jan - Feb	Apr - May	
KP	Autumn	End Oct - Early Nov	Dec - Jan	
Balochistan	Hill/summer	Mar - May	Aug - Oct	

4. Floods 2010

Pakistan usually receives 65 percent of the annual rainfall during July to mid September through monsoon system originating from Bay of Bengal. During winter months, Pakistan receives rainfall through westerly disturbances starting off from Mediterranean and other oceans. It is rare that these systems combine together in a given time frame. This year the monsoon and mid-latitude westerlies combined in July and August and resulted in an unprecedented rainfall. Two severe systems were observed during July 28-29 and August 5-9, 2010. The floods started during the last week of July and continued till mid September, 2010. The receding water in Sindh and Balochistan continued flowing upto the end of November. The flood water is now ponding in a few districts of Sindh from Shikarpur to Dadu.

The rains generated a discharge of more than 300 thousand cusecs in Chenab river at Trimmu RIM station and about 600 thousand cusecs at Kalabagh RIM station in Indus river. Downstream Mithan Kot which is a juncture of both the above rivers, the discharge crossed over one million cusecs. The Indus river system breached upstream Taunsa Barrage in Punjab and at Tori/ Ghauspur upstream Sukkur Barrage. Large areas were subjected to flooding by the breaches of the river embankments and by flash floods of Rodh Kohis in Suleman Piedmont and by torrential rains in the catchments of rivers and creeks. In all, 6 million ha of geographic area came under inundation in Pakistan. The affected cultivated area was 3.3 million ha and the crops were destroyed at an area of 2.3 million ha.

The floods during July to September 2010 caused colossal loss to the economy in Pakistan. The damage assessment for kharif crops was made in the report titled "Pakistan: Floods /Rains 2010 Series No. 01". The present report is designed to update the situation for Rabi season 2010-11. The damage to standing crops on 22nd September was as under:

Area under Flash Floods: 22 nd September 2010					
Province	Cotton	Sugarcane	Rice	Other crops	Total
000 ha					
Punjab	405.3	102.8	235.8	495.8	1239.7
Sindh	190.6	76.4	507.3	137.3	915.2
KP	0.0	15.4	5.5	41.1	62.1
Balochistan	2.5	0.0	124.3	20.3	147.0
Total	598.4	194.6	872.9	694.5	2364.0

5. Situation of on-going Floods during Rabi Season 2010-11

The situation during Rabi season was as follows:

a. Inundation Statistics

1. Pakistan: Floods/Rains 2010: Rapid Crop Damage Assessment: Series No.1, Joint Publication of FAO and SUPARCO issued on 30th September 2010.

The inundation statistics is as given below:

i) Geographic Area

The temporal information on inundation extent was gathered using MODIS 250 m data. The statistics are as under:

Temporal Inundation Statistics of Geographic Area-000 ha								
Province	District	10-Oct	20-Oct	31-Oct	10-Nov	20-Nov	30-Nov	10-Dec
Sindh	Dadu	167.0	153.7	132.3	127.4	113.4	104.0	93.5
	Jacobabad	126.5	122.1	80.0	77.9	59.4	54.5	52.9
	Larkana	164.1	136.7	105.2	100.7	77.3	66.9	58.8
	Shikarpur	50.1	44.1	29.2	28.7	20.2	16.9	16.5
	Thatta	95.3	82.8	72.6	61.1	49.2	40.2	35.3
	Total	603.0	539.4	419.3	395.8	319.5	282.5	257.0
Balochistan	Jafarabad	70.9	46.9	32.8	30.5	22.0	16.2	14.5

The area under flood water has been estimated using MODIS sensor on Aqua-Terra satellite with a resolution of 250 m. This information was further substantiated through use of SPOT satellites constellation; with resolution from 2.5 m to 20 m. It was noted that in Sindh, 0.6 million ha area was still inundated on 10th October 2010. Water continued draining during next two months, by 10th December 2010, the inundated area decreased to 0.26 million ha. In Balochistan, about 71 thousand ha was under water in Jafarabad district.

ii) Agricultural Area

The temporal inundation statistics of agricultural area was as under:

Temporal Inundation Statistics of Agricultural Area-000 ha								
Province	District	10-Oct	20-Oct	31-Oct	10-Nov	20-Nov	30-Nov	10-Dec
Sindh	Dadu	108.2	99.4	83.4	78.7	64.1	55.8	44.7
	Jacobabad	59.8	51.9	35.9	35.0	27.4	24.8	23.4
	Kamber Shahdad Kot	66.7	53.6	34.9	32.6	21.8	17.3	15.7
	Shikarpur	18.3	15.0	9.9	9.8	6.4	5.4	5.0
	Thatta	23.3	22.2	18.8	14.2	10.7	7.5	6.0
	Total	276.3	242.1	182.9	170.3	130.4	110.8	94.8
Balochistan	Jafarabad	63.8	41.5	28.3	26.1	18.8	13.9	12.4

The inundation duration chart is given on the next page.

INUNDATION DURATION CHART (Oct-Dec)												
Sr. No.	Province	District	Total District Area (sq. km)	Total Affected Area (sq. km)	31-Oct	10-Nov	20-Nov	30-Nov	10-Dec	Inundation Duration	Status as on 25 September	
1	AJK	1 MIRPUR	765	167						05 Days	100 % Receded	
2		2 BHIMBER	1652	105						10 Days	100 % Receded	
3	BALUCHISTAN	1 BOLAN	8546	3034						45 Days	100 % Receded	
4		2 JAFARABAD	2487	1926	14 %	2 %	8 %	6 %	2 %	116 Days	13 % Still Inundated	
5		3 NASIRABAD	3222	1264						65 Days	100 % Receded	
6		4 JHAL MAGSI	3859	929						70 Days	100 % Receded	
7	BALUCHISTAN	5 LORALAI	9955	286						05 Days	100 % Receded	
8		6 SIBI	4963	250						05 Days	100 % Receded	
9		7 DERA BUGTI	10286	229						20 Days	100 % Receded	
10		8 QILLA SAIFULLAH	12446	229						05 Days	100 % Receded	
11		FATA	1 SOUTH WAZIRISTAN AGENCY	5034	84						05 Days	100 % Receded
12			2 MOHAMAD AGENCY	2280	47						05 Days	100 % Receded
13			3 BAJAUR AGENCY	1502	31						05 Days	100 % Receded
14			4 KURRAM AGENCY	3469	20						05 Days	100 % Receded
15	KHYBER PAKHTOON KHWA	1 D. I. KHAN	9466	6014						75 Days	100 % Receded	
16		2 TANK	3167	1108						50 Days	100 % Receded	
17		3 LAKKI MARWAT	3126	316						05 Days	100 % Receded	
18		4 NOWSHERA	1806	287						30 Days	100 % Receded	
19		5 SWABI	1474	241						30 Days	100 % Receded	
20		6 HARIPUR	2113	220						10 Days	100 % Receded	
21		7 CHARSADDA	1091	215						10 Days	100 % Receded	
22		8 LOWER DIR	1697	149						05 Days	100 % Receded	
23		9 KOHAT	3495	147						30 Days	100 % Receded	
24		10 BANNU	2299	138						05 Days	100 % Receded	
25		11 SWAT	5087	130						05 Days	100 % Receded	
26		12 MANSEHRA	4310	62						05 Days	100 % Receded	
27		13 MARDAN	1617	59						05 Days	100 % Receded	
28		14 KOHISTAN	7628	43						05 Days	100 % Receded	
29		15 PESHAWAR	1410	29						10 Days	100 % Receded	
30		16 SHANGLA	1278	11						05 Days	100 % Receded	
31	PUNJAB	1 MUZAFFARGARH	8412	4783						80 Days	100 % Receded	
32		2 RAJANPUR	12372	3772						80 Days	100 % Receded	
33		3 JHANG	6189	3003						65 Days	100 % Receded	
34		4 DERA GHAZI KHAN	11763	2840						70 Days	100 % Receded	
35		5 KHUSHAB	6634	1460						50 Days	100 % Receded	
36		6 MIANWALI	5875	1443						55 Days	100 % Receded	
37		7 MANDI BAHUDDIN	2832	1374						45 Days	100 % Receded	
38		8 SARGODH	6082	1255						50 Days	100 % Receded	
39		9 JHELUM	3751	1194						50 Days	100 % Receded	
40		10 RAHIM YAR KHAN	12510	1111						55 Days	100 % Receded	
41		11 GUJRAT	2925	1057						25 Days	100 % Receded	
42		12 LEIAH	6238	959						70 Days	100 % Receded	
43		13 CHINIOT	2801	672						65 Days	100 % Receded	
44		14 MULTAN	3767	554						65 Days	100 % Receded	
45		15 BAHAWALPUR	25692	538						50 Days	100 % Receded	
46		16 KHANEWAL	4418	517						35 Days	100 % Receded	
47		17	2455	492						25 Days	100 % Receded	
48		18 TOBA TEK SINGH	3027	476						05 Days	100 % Receded	
49		19 SHEI KHUPURA	3348	373						05 Days	100 % Receded	
50		20 SIALKOT	2593	326						25 Days	100 % Receded	
51		21 CHAKWAL	6819	208						10 Days	100 % Receded	
52		22 BHAKKAR	8046	194						65 Days	100 % Receded	
53		23 GUJRANWALA	3455	179						05 Days	100 % Receded	
54		24 NANKANA SAHIB	2755	172						05 Days	100 % Receded	
55	25 OKARA	4225	129						05 Days	100 % Receded		
56	26 KASUR	3937	101						05 Days	100 % Receded		
57	27 FAISALABAD	5876	88						05 Days	100 % Receded		
58	28 NAROWAL	1995	67						05 Days	100 % Receded		
59	29 ATTOCK	6976	52						30 Days	100 % Receded		
60	30 RAWALPINDI	5527	45						15 Days	100 % Receded		
61	31 BAHWALNAGAR	9331	17						05 Days?	100 % Receded		
62	32 SAHIWAL	3167	12						05 Days	100 % Receded		
63	SINDH	1 THATTA	17390	5332	7 %	7 %	8 %	6 %	3 %	111 Days	8 % Still Inundated	
64		2 KAMBER SHAHDA DKOT	5607	3401	17 %	2 %	13 %	6 %	4 %	116 Days	14 % Still Inun dated	
65		3 JACOBABAD	2751	2678	21 %	1 %	9 %	2 %	1 %	116 Days	20 % Still Inun dated	
66		4 DADU	8016	2288	13 %	3 %	8 %	6 %	6 %	116 Days	36 % Still Inun dated	
67		5	6440	2165						70 Days	100 % Receded	
68		6 GHOTKI	6440	2165						70 Days	100 % Receded	
69		7 SHIKARPUR	2563	2124	10 %	1 %	7 %	4 %	1 %	116 Days	15 % Still Inun dated	
70		8 SUKKUR	5203	1236						55 Days	10 % Receded	
71		9 LAR KANA	1907	1217						55 Days	100 % Receded	
72		10	15804	901						55 Days	100 % Receded	
73		11 KHAIRPUR	15804	901						55 Days	100 % Receded	
74		12 NAWAB SHAH	4493	849						55 Days	100 % Receded	
75		13 NAUSHAH RO FEROZE	3037	843						65 Days	100 % Receded	
76	14 MATIARI	1453	492						70 Days	100 % Receded		
77	15 TANDO MUHAMMAD KHAN	1545	353						70 Days	100 % Receded		
78	16 SANGHAR	10676	217						05 Days	100 % Receded		
79	17 HYDERABAD	1018	165						65 Days	100 % Receded		
80	18 BADIN	6690	73						05 Days	100 % Receded		
81	GILGIT BALTISTAN	1 DIAMIR	7548	109						05 Days	100 % Receded	
82		2 SKARDU	19004	102						05 Days	100 % Receded	
83		3 GILGIT	18296	84						05 Days	100 % Receded	
84		4 GHANCHE	8266	30						05 Days	100 % Receded	
85		5 GHIZER	12002	29						05 Days	100 % Receded	
86		6 ASTOR	5226	10						05 Days	100 % Receded	

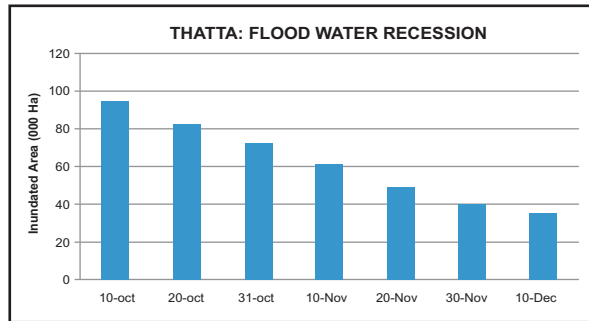
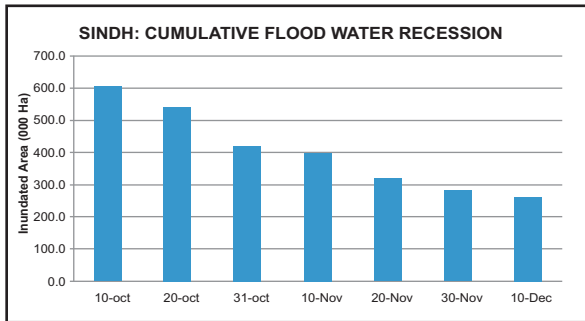
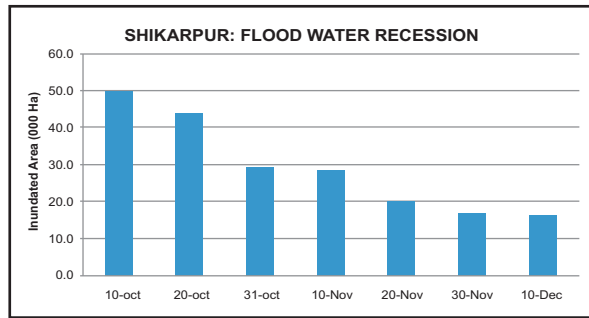
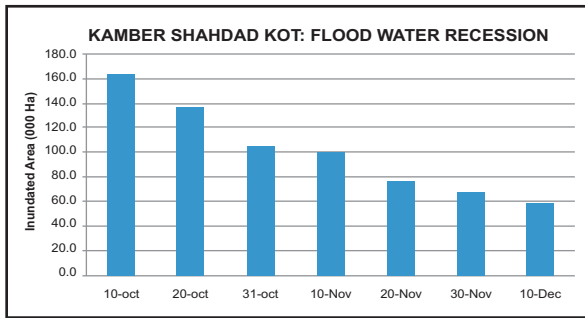
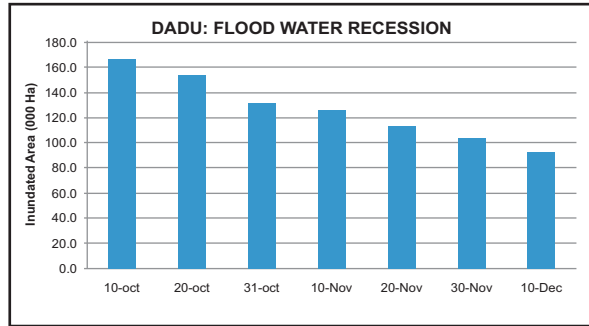
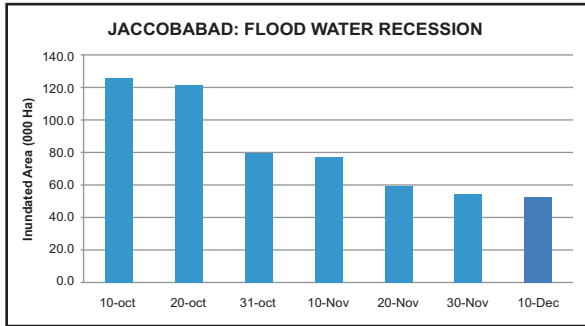
% Recession of flood water **% Increase in flood area**

Note : Blanks represent area cleared of flood water by 100 %

c. Situation of Temporal Recession of Flood Water

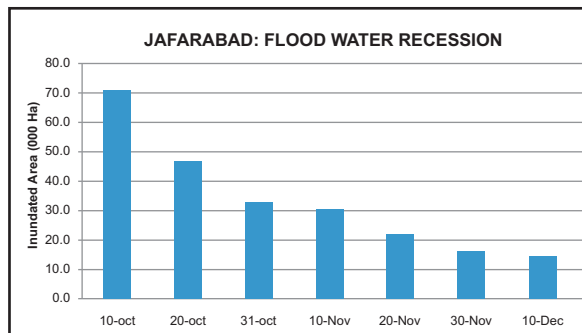
i) Sindh

The bar diagrams for temporal recession of flood water is as follows:



ii) Balochistan

Jafarabad was the only district under flood water at this point of time. The bar diagram for the temporal recession of flood water is as follow:



6. Floods/Rains

The floods 2010 devastated crops, infrastructure and households.

a. Khyber Pakhtunkhwa and Punjab

Short of a few low lying pockets, the flood water generally cleared off by mid September from major parts of KP and Punjab provinces. The soils usually attained the moisture level to field capacity making these areas available for cropping by mid October. The time space available, made it possible to carry out tillage / other farm operations facilitating sowing of crops. In Punjab, by 10th December the standing ponded water in low lying pockets from the flood water occupied a cumulative area of 1200 ha. This is infinitesimal small area. The ponded area on this date in KP was negligible.

b. Balochistan

In Balochistan, Jafarabad was the main district affected by floods. The agricultural area under flood water in this district on 10th October was 63.8 thousand ha. The flood water continued standing in some parts of the province. It is opined that areas under water beyond 10th November will not be available for sowing of Rabi crops. This also includes short duration cultivars. The main reason for this imbroglio is that field moisture level has to moderate field capacity before any sowing farm operation can be initiated.

By 10th November, the agricultural area under flood water was 26.1 thousand ha. All other areas were cleared off standing water by this threshold date. The agricultural area under flood water on 10th December in the district was 12.4 thousand ha, showing a slow rate of water recession.

c. Sindh

The major flooded areas were on the right bank of Indus. These include Shikarpur, Jacobabad .Kamber Shahdad Kot and Dadu. On left bank of Indus, Thatta was the main affected district. The agricultural area under flood water was 276.3 thousand ha. By the threshold date of 10th November, the area under flood water was 170.3 thousand ha. By 10th December, the agricultural area was 95 thousand ha.

d. Photographs of Flood Affected Areas

The photographs of flooded areas are given on the next page.

Photographs : October 2010



Fig 1. Sehwan: PARCO Refinery



Fig 2. Sehwan: PARCO Refinery



Fig 3. Sehwan: Field Work on Flooding



Fig 4. Sehwan: Airport under water



Fig 5. Substitute link to Johi Town in Dadu



Fig 6. Johi: Late rice sowing

Photographs : October 2010



Fig 7. Khairpur Nathan Shah



Fig 8. Khairpur Nathan Shah
Trees as RIM Station



Fig 9. Road to Khairpur Nathan Shah



Fig 10. Khairpur Nathan Shah-Dadu:
Damage to Installations



Fig 11. Khairpur Nathan Shah :
Fishing in places that were fields



Fig 12. Katcho Area Naushero Feroze

e. Inundation Images

The inundation charts, graphs and images are as follows:

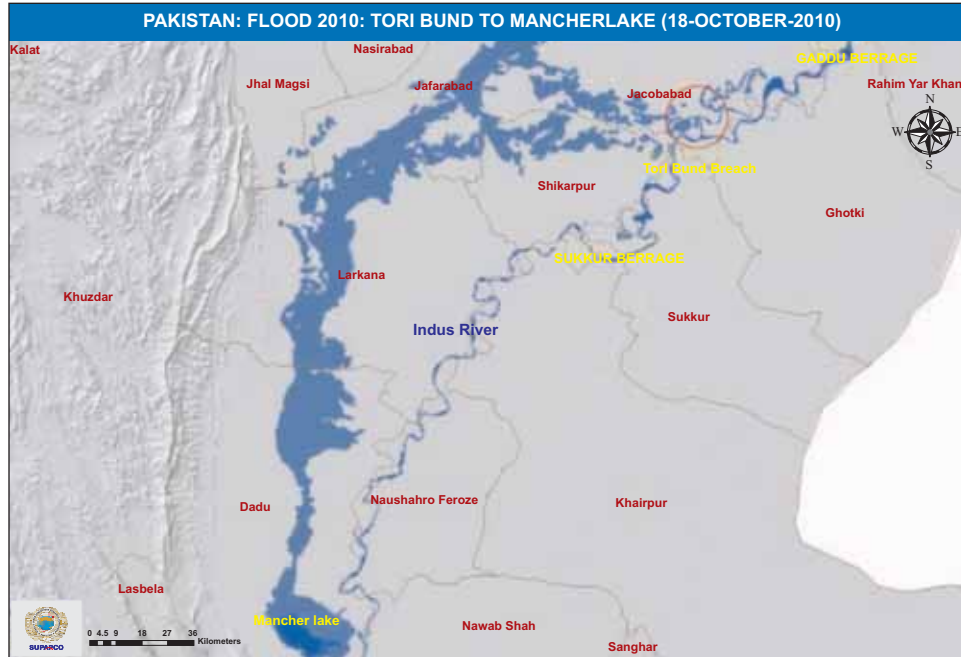


Fig 13. Sindh: Receding Flood Water on 18th October, 2010

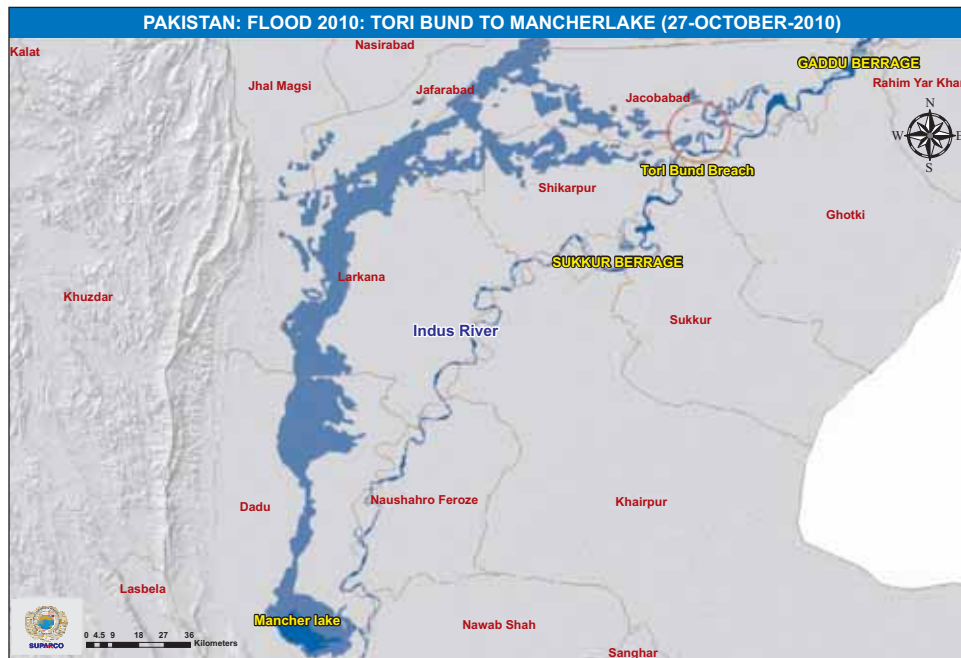


Fig 14. Sindh: Receding Flood Water on 27th October, 2010

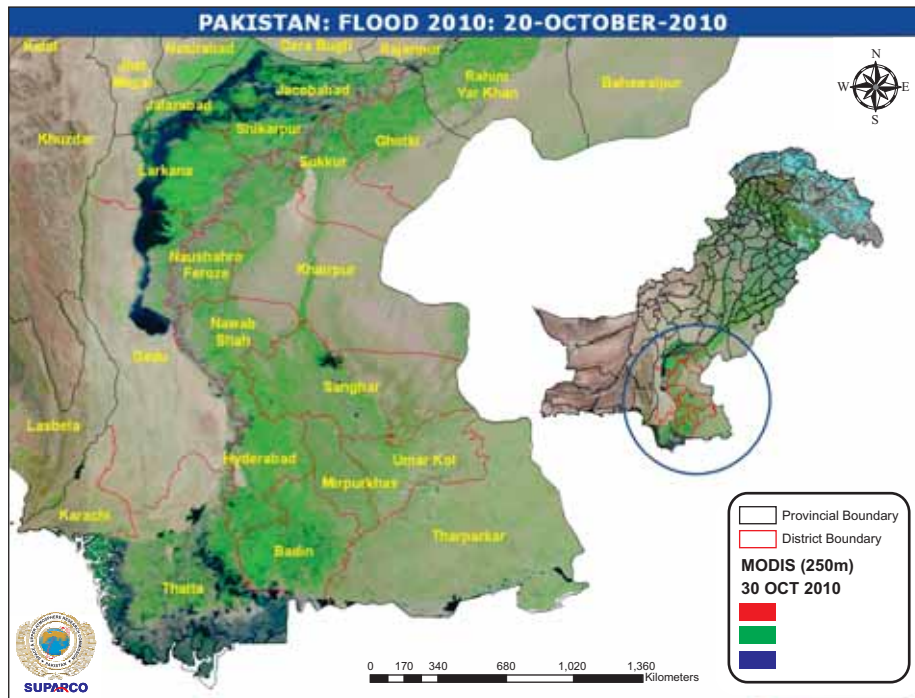


Fig 15. Poned Flood Water in Sindh on 20th October, 2010

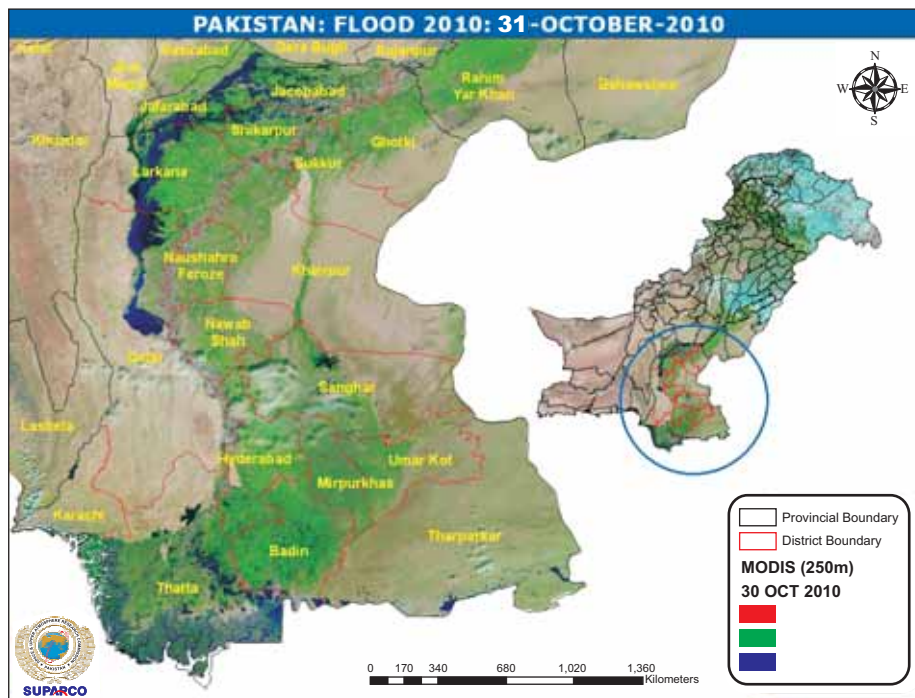


Fig 16. Poned Flood Water in Sindh on 31st October, 2010

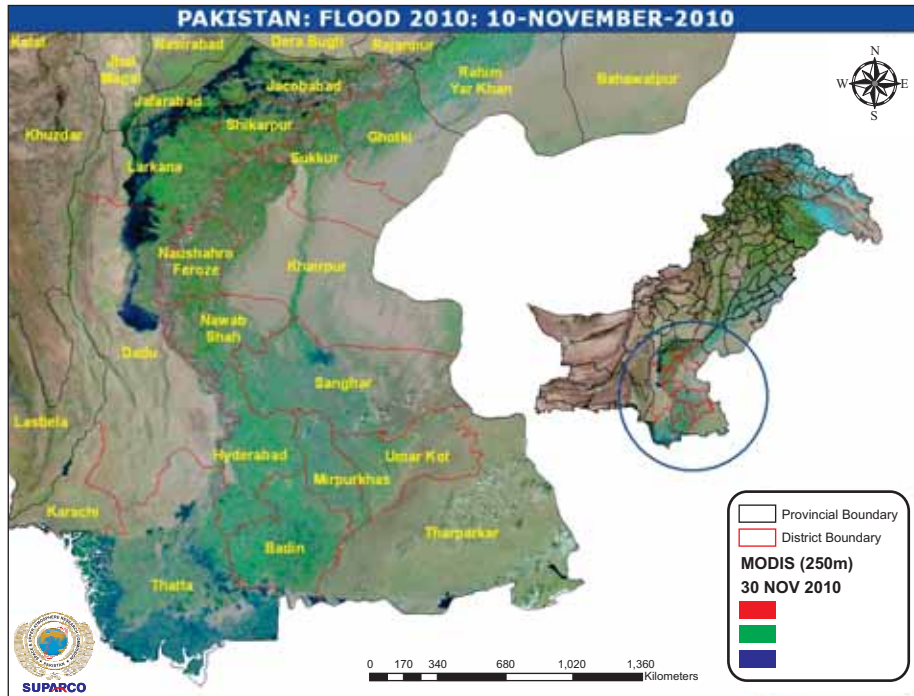


Fig 17. Poned Flood Water in Sindh on 10th November, 2010

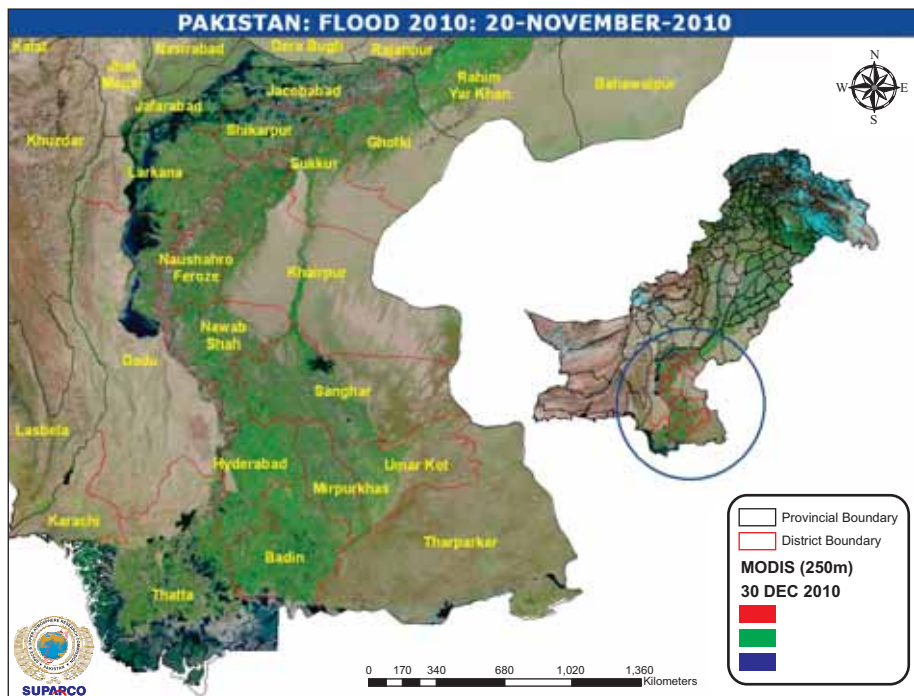


Fig 18. Poned Flood Water in Sindh on 20th November, 2010

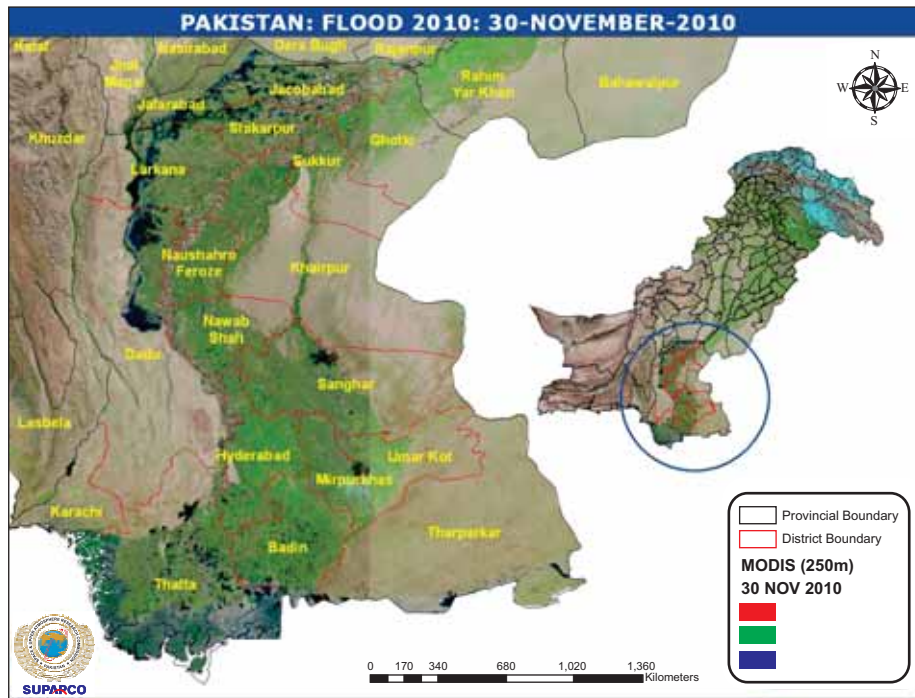


Fig 19. Poned Flood Water in Sindh on 30th November, 2010

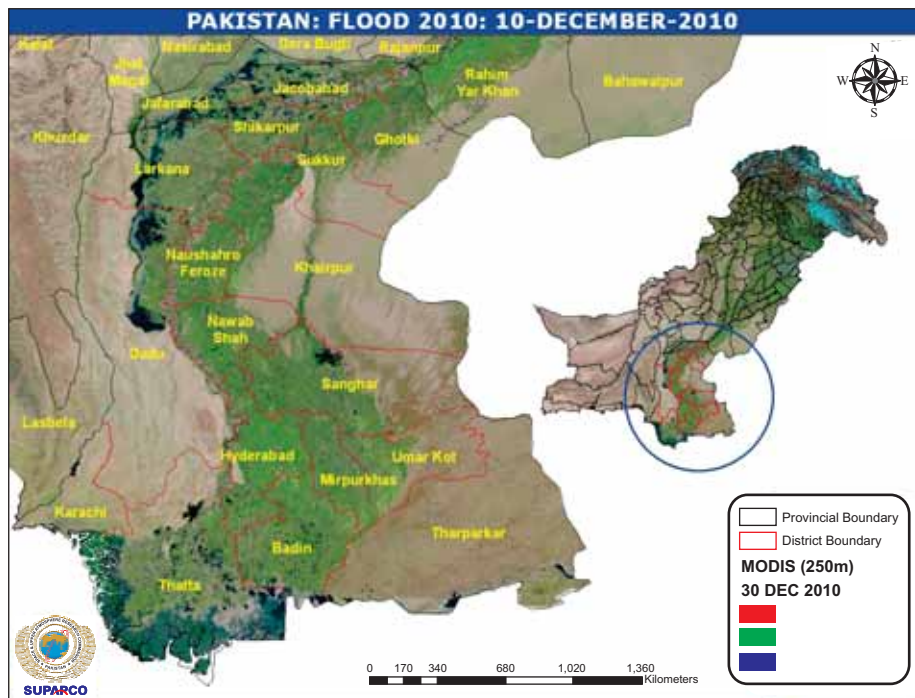


Fig 20. Poned Flood Water in Sindh on 10th December, 2010

7. Categorization of Inundated Areas

The 10 daily categorization of flood water for the period from October to first decadal of December is given below:

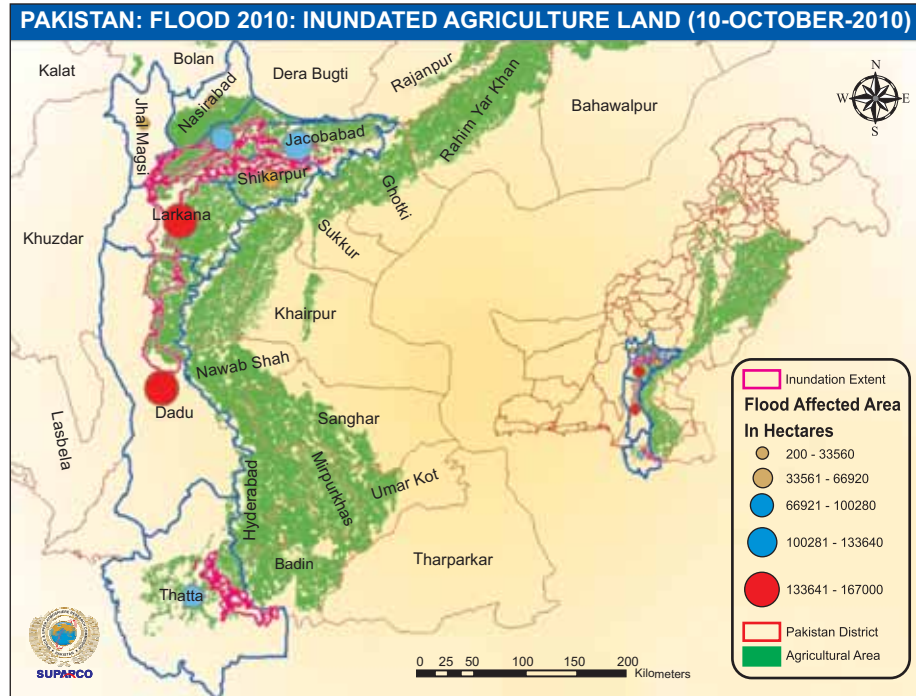


Fig 21. Flood Affected Agriculture Area on 10th October, 2010 in Sindh

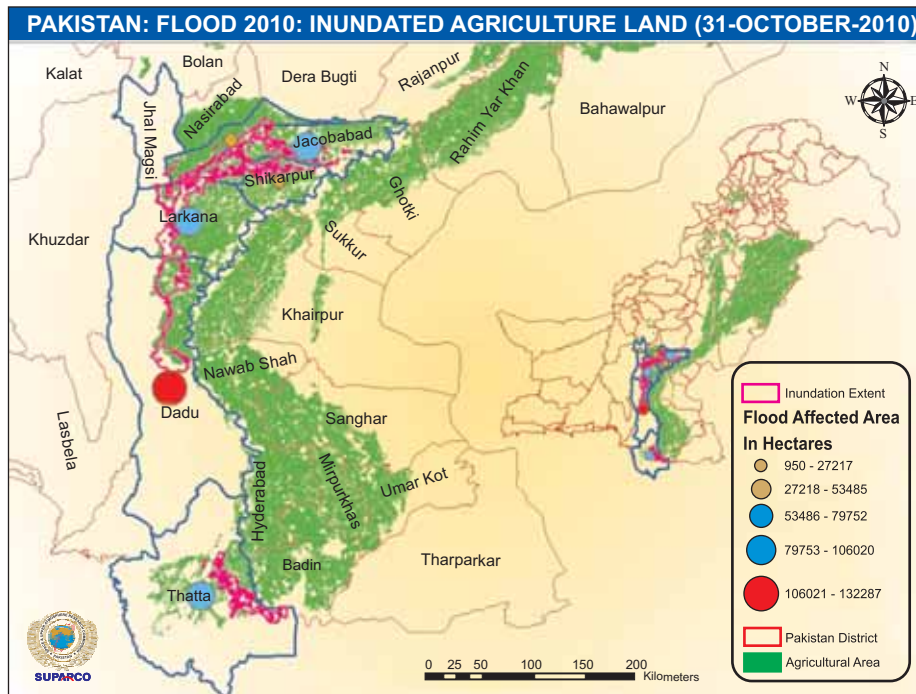


Fig 22. Flood Affected Agriculture Area on 31th October, 2010 in Sindh

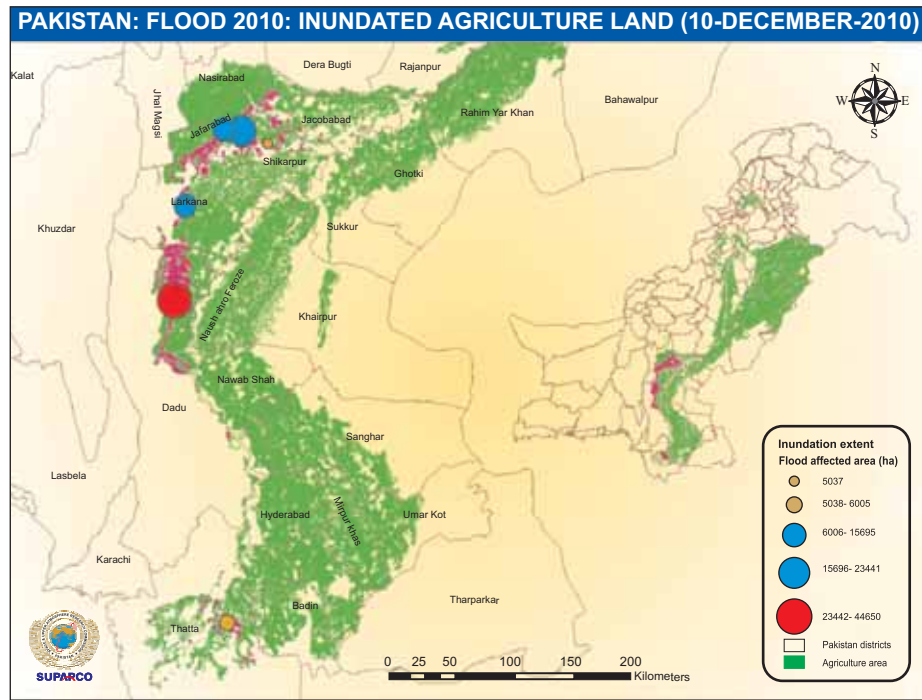


Fig 23. Flood Affected Agriculture Area on 10th December, 2010 in Sindh

8. Thematic Maps of Flood Affected Areas

The thematic maps of flooded areas by categories are given below:

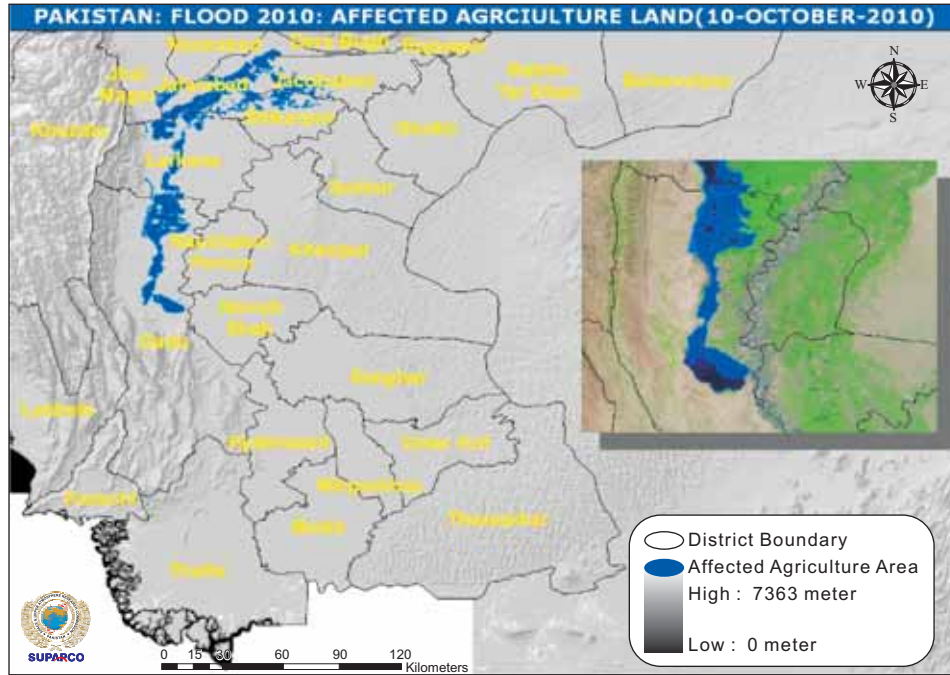


Fig 24. Thematic Map of Sindh Flood Affected Agriculture Area on 10th October, 2010

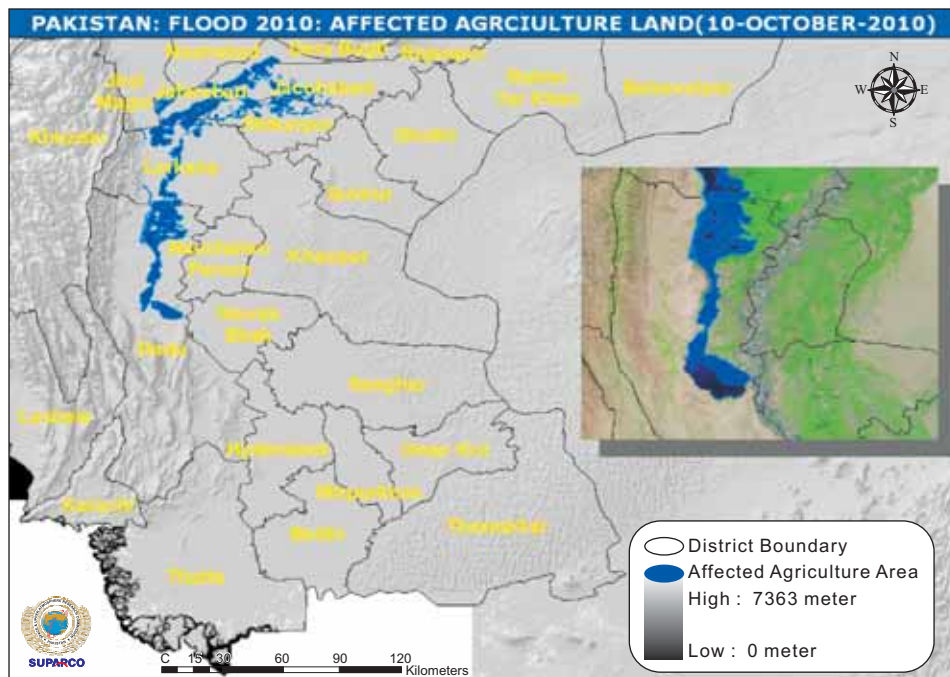


Fig 25. Thematic Map of Sindh Flood Affected Agriculture Area on 10th November, 2010

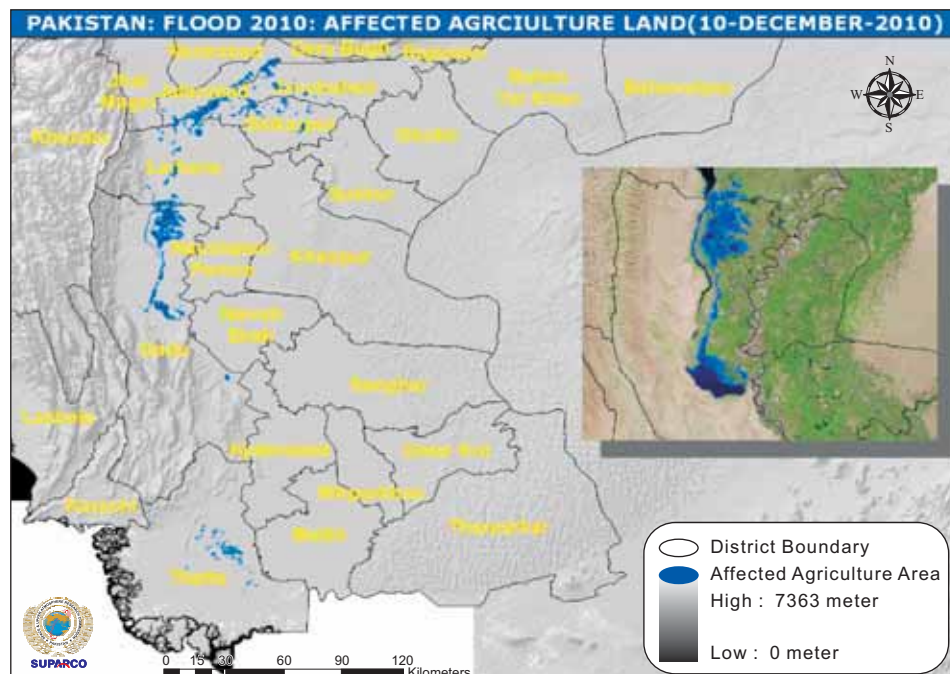


Fig 26. Thematic Map of Sindh Flood Affected Agriculture Area on 10th December, 2010

9. Water Flowing Downstream Kotri Barrage

Kotri Barrage is the terminal point of irrigation water diversion for canals on river Indus at the mouth of deltaic region. This barrage has 4 canals. The Kalri canal is on the right bank and is connected through Kenjhar Lake and irrigates parts of Thatta and Jamshoro districts. This canal eventually supplies water to Karachi city to meet urban needs. The barrage has also three canals on the left bank namely Akram Wah , Phuleli and Pinayari, irrigating parts of Hyderabad, T.M.Khan, Badin and Thatta districts.

Most of the irrigation water available at kotri is diverted at this barrage for irrigation purpose. However, some water allowance is made for the deltaic region to preserve mangroves/ wild life and keep the intruding sea water out. Experts have suggested allowing 10 million acre feet of water per annum to pass through the deltaic region to serve this purpose.

There are two dimensions of the flood water: (a) water spread over surface of geographic area (b) Water passing downstream Kotri Barrage .The description is as follows:

a. Flood Water Spread over the Geographic area

SUPARCO used MODIS data with 250 m medium level resolution to estimate area covered under flood water. This information was further verified by using 2.5 m resolution data from SPOT satellite. The estimated geographic area covered under floods in the country was 6.0 million ha or 14.8 million acres. There was a flood wave of more than 4 meter height in Punjab, Sindh, Balochistan and other affected areas. Assuming an average depth of flood water at 1 m (3.28) feet, the flood water spread over geographic area is work out at 48 million acre feet (59.207 BCM).

b. Water passing down Stream Kotri Barrage

The volume of water arriving at the RIM station of Kotri Barrage and reported by Pakistan Meteorology Department during the period of 17th August to 12th September, the peak flood period in this section of the river Indus is as follows:

Floods 2010: Water Passing down Stream of Kotri Barrage

Date	Discharge at Kotri	Vol of water-70 % basis			Vol of water-100% basis	
Unit	Million Cusecs	Million Cusecs entering sea	Million Acre Feet	Billion Cubic Meter	Million Acre feet entering sea	Billion Cubic Meter
17-Aug	0.250	0.175	0.347	0.428	0.496	0.612
18-Aug	0.320	0.224	0.444	0.548	0.635	0.783
19-Aug	0.420	0.294	0.583	0.719	0.833	1.028
20-Aug	0.600	0.42	0.833	1.028	1.190	1.468
21-Aug	0.750	0.525	1.041	1.284	1.488	1.835
22-Aug	0.810	0.567	1.125	1.387	1.607	1.982
23-Aug	0.830	0.581	1.152	1.421	1.646	2.031
24-Aug	0.930	0.651	1.291	1.593	1.845	2.275
25-Aug	0.938	0.6566	1.302	1.606	1.861	2.295
26-Aug	0.938	0.6566	1.302	1.606	1.861	2.295
27-Aug	0.965	0.6755	1.340	1.653	1.914	2.361
28-Aug	0.951	0.6657	1.320	1.629	1.886	2.327
29-Aug	0.910	0.637	1.263	1.558	1.805	2.226
30-Aug	0.866	0.6062	1.202	1.483	1.718	2.119
31-Aug	0.833	0.5831	1.157	1.427	1.652	2.038
1-Sep	0.800	0.56	1.111	1.370	1.587	1.957
2-Sep	0.777	0.5439	1.079	1.331	1.541	1.901
3-Sep	0.744	0.5208	1.033	1.274	1.476	1.820
4-Sep	0.718	0.5026	0.997	1.230	1.424	1.757
5-Sep	0.706	0.4942	0.980	1.209	1.400	1.727
6-Sep	0.679	0.4753	0.943	1.163	1.347	1.661
7-Sep	0.647	0.4529	0.898	1.108	1.283	1.583
8-Sep	0.611	0.4277	0.848	1.046	1.212	1.495
9-Sep	0.586	0.4102	0.814	1.004	1.162	1.434
10-Sep	0.535	0.3745	0.743	0.916	1.061	1.309
11-Sep	0.497	0.3479	0.690	0.851	0.986	1.216
12-Sep	0.445	0.3115	0.618	0.762	0.883	1.089
Total	19.056	13.339	26.458	32.636	37.798	46.623

The total water arrival at Kotri during the period 17-Aug to 12-Sep 2010 was 37.798 MAF (46.623 BCM). It is assumed that during the flood, 70% of the water entered sea and 30 % water inundated the land areas beyond Kotri barrage. On this assumption the combined size of flood water is estimated as follows.

1 Conversion factor from Cusecs to Acre feet has been taken as 1.9835

2 @ 70% water during flood is assumed to be moving to sea and 30 % is assumed to be spread over the land surface

3 1 MAF =1.233482 BCM

4 BCM=Billion Cubic Meter

5 Source of water discharge data. Pak Met Department

S.No	Category	Size of flood water	
		Million Acre feet	Billion Cubic Meter
1.	Water spread out on land area	48.000	59.207
2.	Water entering into sea @ 70%	26.458	32.636
Total		74.458	91.843

Pakistan has built up a total annual reservoir capacity of about 18 million acre feet. More than 2 million acre feet capacity has been choked by incoming sediments. The volume of flood water was more than 4 times of Pakistan's annual reservoir capacity. It suggests for better water resources development and management.

10. Impact of On-going Floods on Rabi Crops 2010-11

The losses to Rabi crops were estimated, on the basis of following two assumptions:

a. Areas under inundation on 10th November

Areas in Sindh and Balochistan still under water on 10th of November will not be available for sowing of Rabi crops.

The total agricultural area estimated from the agricultural crop mask on 10th of November 2010 under floods was 170.3 thousand ha in Sindh and 26.1 thousand ha in Balochistan. The district wise crop area in annexure 4 for the year 2009-10 was used to delineate these areas on district/crop wise basis on in the light of relative proportion.

Farmers in such areas will lose Rabi season of cropping in addition to kharif season already lost. The major food crops lost are rice during kharif and wheat during Rabi, although losses also accrued to other crops such as cotton, sugarcane, maize, fodders, vegetables and others. Both of these being high profile food security crops, the affected farmers would lose the resilience to cope with the impasse of food security. Food security programme would have to be orchestrated for these areas.

b. Areas drained off up to 10th of November 2010

In areas that were subjected to heavy flooding, the farmers lost their households, cattle, farm machinery, and other valuables. In such areas, the failure of farming community to make investment in high return technologies as good quality seeds, fertilizers, herbicides and others may emerge as a serious limitation on raising good productivity of crops. Such losses in these affected districts have been estimated at 10 percent.

Based on above two assumptions, the crop losses have been calculated for wheat, chickpeas, rapeseed & mustard, onion, potato, fodders and vegetables. The production loss of wheat is estimated at a little more than half a million tons. A similar quantity of valuable fodders for already malnourished livestock is predicted to be lost during Rabi season. Losses to other Rabi crops have been estimated and are given in the annexure.

Annexure 1: Summary of Losses to Rabi crops in Inundated Areas

Wheat: Loss of Crop in the Flooded Areas			
Wheat	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	133.5	133.5
Sindh	250.3	98.6	348.9
K P	0.0	5.5	5.5
Balochistan	24.6	17.9	42.5
Total	274.9	255.5	530.4

Fodders Crop: Loss of Crop in the Flooded Areas			
Fodders	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	24.8	24.8
Sindh	363	156.7	519.7
K P	0.0	12.1	12.1
Balochistan	5.2	3.3	8.5
Total	368.2	196.9	565.1

Chickpeas Crop: Loss of Crop in the Flooded Areas			
Chickpeas	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	0.0	0.0
Sindh	5.7	0.0	5.7
K P	0.0	0.0	0.0
Balochistan	0.2	0.0	0.2
Total	5.9	0.0	5.9

Rapeseed & Mustard Crop: Loss of Crop in the Flooded Areas			
Rapeseed & Mustard	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	1.4	1.4
Sindh	4.2	3.6	7.8
K P	0.0	0.0	0.0
Balochistan	6.1	0.0	6.1
Total	10.3	5	15.3

Onion Crop: Loss of Crop in the Flooded Areas			
Onion	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	1.7	1.7
Sindh	0.0	16.4	16.4
K P	0.0	0.0	0.0
Balochistan	0.0	0.0	0.0
Total	0.0	18.1	18.1

Mattar/Fabacea Crop: Loss of Crop in the Flooded Areas			
Mattar/Fabacea	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	(000 tons)	(000 tons)
Punjab	0.0	0.0	0.0
Sindh	8.2	0.0	8.2
K P	0.0	0.0	0.0
Balochistan	0.0	0.0	0.0
Total	8.2	0.0	8.2

Lentil Crop: Loss of Crop in the Flooded Areas			
Lentil	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	('000' tons)	(000 tons)
Punjab	0.0	0.0	0.0
Sindh	1.5	0.0	1.5
K P	0.0	0.0	0.0
Balochistan	0.0	0.0	0.0
Total	1.5	0.0	1.5

Vegetables Crop: Loss of Crop in the Flooded Areas			
Vegetables	Sowing Failures	Investment Failures	Total
Provinces	(000 tons)	('000' tons)	(000 tons)
Punjab	0.0	7.2	7.2
Sindh	14.9	14.2	29.1
K P	0.0	1.1	1.1
Balochistan	6.1	4.7	10.8
Total	21.0	27.2	48.2

Annexure 2: Areas not available for sowing of Rabi crops.

Province	District	Wheat		
		Area	Yield	Production
		000 ha	kg/ha	000 tons
Sindh	Jacobabad	10.3	2670	27.5
	Shikarpur	4.5	2817	12.7
	Kamber Shahdad Kot	19.9	2788	55.6
	Dadu	51.4	2896	148.7
	Thatta	1.8	3093	5.7
	Total	88.0	2845	250.3
Balochistan	Jafarabad	9.7	2537	24.6
Total		97.7	2814	274.9

Province	District	Fodder		
		Area	Yield	Production
		000 ha	tons /ha	000 tons
Sindh	Jacobabad	0.8	36.5	28.2
	Shikarpur	0.2	36.1	6.3
	Kamber Shahdad Kot	2.8	36.5	103.3
	Dadu	4.1	41.7	171.0
	Thatta	1.3	41.5	54.2
	Total	9.2	39.5	363.0
Balochistan	Jafarabad	0.2	25.8	5.2
Total		9.4	40.2	368.2

Province	District	Chickpeas		
		Area	Yield	Production
		000 ha	kg /ha	000 tons
Sindh	Jacobabad	4.1	1032	4.2
	Shikarpur	1.3	979	1.2
	Kamber Shahdad Kot	0.2	1000	0.2
	Dadu	0.1	1000	0.1
	Total	5.6	1018	5.7
Balochistan	Jafarabad	0.2	1000	0.2
Total		11.5	1013	5.9

Mattar/ Fabacea				
Province	District	Area	Yield	Production
		00 ha	kg /ha	000 tons
Sindh	Jacobabad	9.0	571	5.1
	Shikarpur	1.5	582	0.9
	Kamber Shahdad Kot	1.5	600	0.9
	Dadu	2.3	563	1.3
	Total	14.3	574	8.2
Balochistan	Jafarabad	1.6	558	0.9
Total		15.9	572	9.1

Lentil				
Province	District	Area	Yield	Production
		000 ha	kg /ha	000 tons
Sindh	Jacobabad	2.7	524	1.4
	Shikarpur	0.1	600	0.0
	Kamber Shahdad Kot	0.0	400	0.0
	Dadu	0.0	0	0.0
	Thatta	0.0	0	0.0
	Total	2.8	526	1.5
Total		2.8	526	1.5

Rapeseed & Mustard				
Province	District	Area	Yield	Production
		000 ha	kg /ha	000 tons
Sindh	Jacobabad	0.9	857	0.8
	Shikarpur	0.2	1167	0.3
	Kamber Shahdad Kot	1.0	938	0.9
	Dadu	1.5	1000	1.5
	Thatta	0.9	875	0.8
	Total	4.5	941	4.2
Balochistan	Jafarabad	3.7	1657	6.1
Total		8.2	1265	10.4

Vegetables	Area	Yield	Production
Balochistan	000 ha	kg/ha	000 tons
Jafarabad	0.4	15191	6.1

Vegetables	Area	Yield	Production
Sindh	000 ha	kg/ha	000 tons
Jacobabad	0.3	6259.4	1.9
Shikarpur	0.1	7775.0	0.8
Kamber Shahdad Kot	0.6	4390.2	2.6
Dadu	0.6	7162.2	4.3
Thatta	2.0	7457.2	14.9

Annexure 3: Losses of Rabi crops owing to investment failures**Wheat Crop**

Wheat Punjab	Area	Yield	Loss	Production Loss
District	(000 ha)	(tons/ha)	%	(000 tons)
Mianwali	20.8	1894.6	10	3.9
Bhakkar	4.7	2272.8	10	1.1
Jhang	109.7	2799.9	10	30.7
Muzaffar Garh	173.2	2707.7	10	46.9
Layyah	25.0	2535.8	10	6.3
Dera Ghazi Khan	41.3	2323.7	10	9.6
Rajanpur	106.7	2561.3	10	27.3
Rahimyar Khan	28.1	2715.2	10	7.6
Total	509.6	2621	10	133.5

Wheat Sindh	Area	Yield	Loss	Production Loss
District	(000 ha)	(tons/ha)	%	(000 tons)
Ghotki	82.9	3707	10	30.7
Shikarpur	63.3	2725	10	17.2
Kamber Shahdad Kot	80.2	2806	10	22.5
Jacobabad	17.6	2441	10	4.3
Thatta	40.9	2789	10	11.4
Dadu	32.9	2798	10	9.2
Hyderabad	8.4	3808	10	3.2
Total	326.2	3022	10	98.6

Wheat KP	Area	Yield	Loss	Production Loss
District	(000 ha)	(kg/ha)	%	(000 tons)
Charsadda	4.3	2620	10	1.1
Nowshera	5.8	2430	10	1.4
Dera Ismail Khan	16.0	1862	10	3.0
Total	26.0	2113	10	5.5

Rapeseed and Mustard

Rapeseed	Area	Yield	Loss	Production Loss
Punjab				
District	(000 ha)	(kg/ha)	%	(000 tons)
Mianwali	0.6	588	10	0.0
Bhakkar	0.1	810	10	0.0
Jhang	0.5	1000	10	0.0
Muzzaffar Garh	2.2	700	10	0.2
Layyah	0.3	885	10	0.0
Dera Ghazi Khan	0.6	1080	10	0.1
Rajanpur	10.5	923	10	1.0
Rahimyar Khan	1.0	920	10	0.1
Total	15.8	886	10	1.4

Rapeseed	Area	Yield	Loss	Production Loss
Sindh				
District	(000 ha)	(tons/ha)	%	(000 tons)
Ghotki	0.5	1000	10	0.1
Shikarpur	3.4	1167	10	0.4
Kamber Shahdad Kot	18.7	1188	10	2.2
Jacobabad	1.5	857	10	0.1
Thatta	8.6	875	10	0.8
Dadu	0.9	1000	10	0.1
Hyderabad	0.1	0.0	10	0.0
Total	33.8	1081	10	3.6

Rapeseed	Area	Yield	Loss	Production Loss
Balochistan				
District	(000 ha)	(kg/ha)	%	(000 tons)
Nasir Abad	39.4	613	10	2.4
Jafarabad	58.2	604	10	3.5
Total	97.7	607	10	5.9

Onion

Onion	Area	Yield	Loss	Production Loss
Punjab				
District	(000 ha)	(kg/ha)	%	(000 tons)
Mianwali	0.1	13889	10	0.1
Bhakkar	0.0	7375	10	0.0
Jhang	0.4	8538	10	0.3
Muzaffar Garh	0.4	5000	10	0.2
Layyah	0.0	7333	10	0.0
Dera Ghazi Khan	0.2	7100	10	0.2
Rajanpur	0.4	16833	10	0.7
Rahimyar Khan	0.2	6773	10	0.1
Total	1.8	9398	10	1.7

Onion	Area	Yield	Loss	Production Loss
Sindh				
District	(000 ha)	(tons/ha)	%	(000 tons)
Ghotki	2.4	14135	10	3.4
Kamber Shahdad Kot	2.7	13937	10	3.8
Jacobabad	0.3	13738	10	0.5
Thatta	5.9	10872	10	6.4
Dadu	1.5	13344	10	2.0
Hyderabad	0.2	14532	10	0.3
Total	13.1	12527	10	16.4

Fodders

Fodders	Area	Yield	Loss	Production Loss
Punjab				
District	(000 ha)	(tons/ha)	%	(000 tons)
Mianwali	0.3	7509	10	0.2
Bhakkar	0.3	9704	10	0.3
Jhang	6.1	12447	10	7.6
Muzaffar Garh	7.7	11804	10	9.1
Layyah	1.1	12000	10	1.3
Dera Ghazi Khan	1.5	11517	10	1.7
Rajanpur	3.5	10590	10	3.7
Rahimyar Khan	0.8	11503	10	0.9
Total	21.2	11675	10	24.8

Fodders	Area	Yield	Loss	Production Loss
Sindh				
District	(000 ha)	(kg/ha)	%	(000 tons)
Ghotki	5.2	40226	10	21.0
Kamber Shahdad Kot	14.7	34810	10	51.0
Jacobabad	1.4	36462	10	5.2
Thatta	15.9	41508	10	66.0
Dadu	2.6	41745	10	10.7
Hyderabad	0.7	38462	10	2.8
Total	40.5	38702	10	156.7

Fodder	Area	Yield	Loss	Production Loss
Balochistan				
District	(000 ha)	(kg/ha)	%	(000 tons)
Nasir Abad	0.5	25700	10	1.285
Jafarabad	0.8	25800	10	2.064
Total	1.3	25762	10	3.349

Fodders	Area	Yield	Loss	Production Loss
KP				
District	(000 ha)	(kg/ha)	%	(000 tons)
Charsadda	0.5	30629	10	1.4
Nowshera	0.4	29444	10	1.3
Dera Ismail Khan	2.5	37620	10	9.4
Total	29.5	4114	10	12.1

Vegetables

Vegetables	Area	Yield	Loss	Production Loss
Punjab				
District	(000 ha)	(kg/ha)	%	(000 tons)
Mianwali	0.1	10400	10	0.1
Bhakkar	0.0	12750	10	0.1
Jhang	1.3	16638	10	2.1
Muzaffargarh	1.6	13367	10	2.2
Layyah	0.3	11792	10	0.4
Dera Ghazi Khan	0.6	15600	10	1.0
Rajapur	0.1	117000	10	0.8
Rahimyar Khan	0.5	12571	10	0.6
Total	4.6	15841	10	7.2

Vegetables	Area	Yield	Loss	Production Loss
Sindh				
District	(000 ha)	(kg/ha)	%	(000 tons)
Ghotki	0.4	6479	10	0.3
Kamber Shahdad Kot	2.8	5129	10	1.4
Jacobabad	0.3	6259	10	0.2
Thatta	15.6	7457	10	11.6
Dadu	0.3	7162	10	0.3
Hyderabad	0.6	7321	10	0.4
Total	20.0	7085	10	14.2

Vegetables	Area	Yield	Loss	Production Loss
Balochistan				
District	(000 ha)	(kg/ha)	%	(000 tons)
Nasir Abad	1.7	16602	10	2.822
Jafarabad	1.3	15191	10	1.975
Total	2.9	16542	10	4.797

Vegetables	Area	Yield	Loss	Production Loss
KP				
District	(000 ha)	(kg/ha)	%	(000 tons)
Charsadda	0.4	9111	10	0.364
Nowshera	0.3	8769	10	0.263
Dera Ismail Khan	0.5	11462	10	0.573
Total	1.2	10005	10	1.201

Annexure 4: Crop area Statistics for Flood affected districts 2009-10

Sindh	Wheat	Chilies	Fodder	Sunflower	Onion	Lentil	R&M	Tomato	Gram	Matter	Total
District (000 ha)											
Jacobabad	16.1	0.0	1.2	0.2	0.3	4.2	1.4	0.0	6.3	14.0	43.7
Shikarpur	33.8	0.0	1.3	0.4	0.3	0.5	1.8	0.0	9.4	11.2	58.7
K. Shadakot	33.7	0.0	4.8	0.3	0.7	0.0	1.6	0.2	0.3	2.5	44.1
Dadu	70.3	1.5	5.6	0.2	3.2	0.0	2.0	0.3	0.2	3.2	86.5
Thatta	15.2	9.3	4.5	54.7	2.2	0.0	3.2	4.7	0.1	0.0	93.9
Total	169.1	10.8	17.4	55.8	6.7	4.7	10.0	5.2	16.3	30.9	326.9
Balochistan/District											
Jafarabad	44.7	0.0	1.1	0.0	1.7	0.0	16.9	0.8	23.4	7.4	96.0

