KNOWLEDGE PARTNERSHIP PROGRAMME

Scoping Study:

India's Global Resource Footprint in Food, Energy and Water (FEW)

By

Shiv Kumar

Indira Khurana

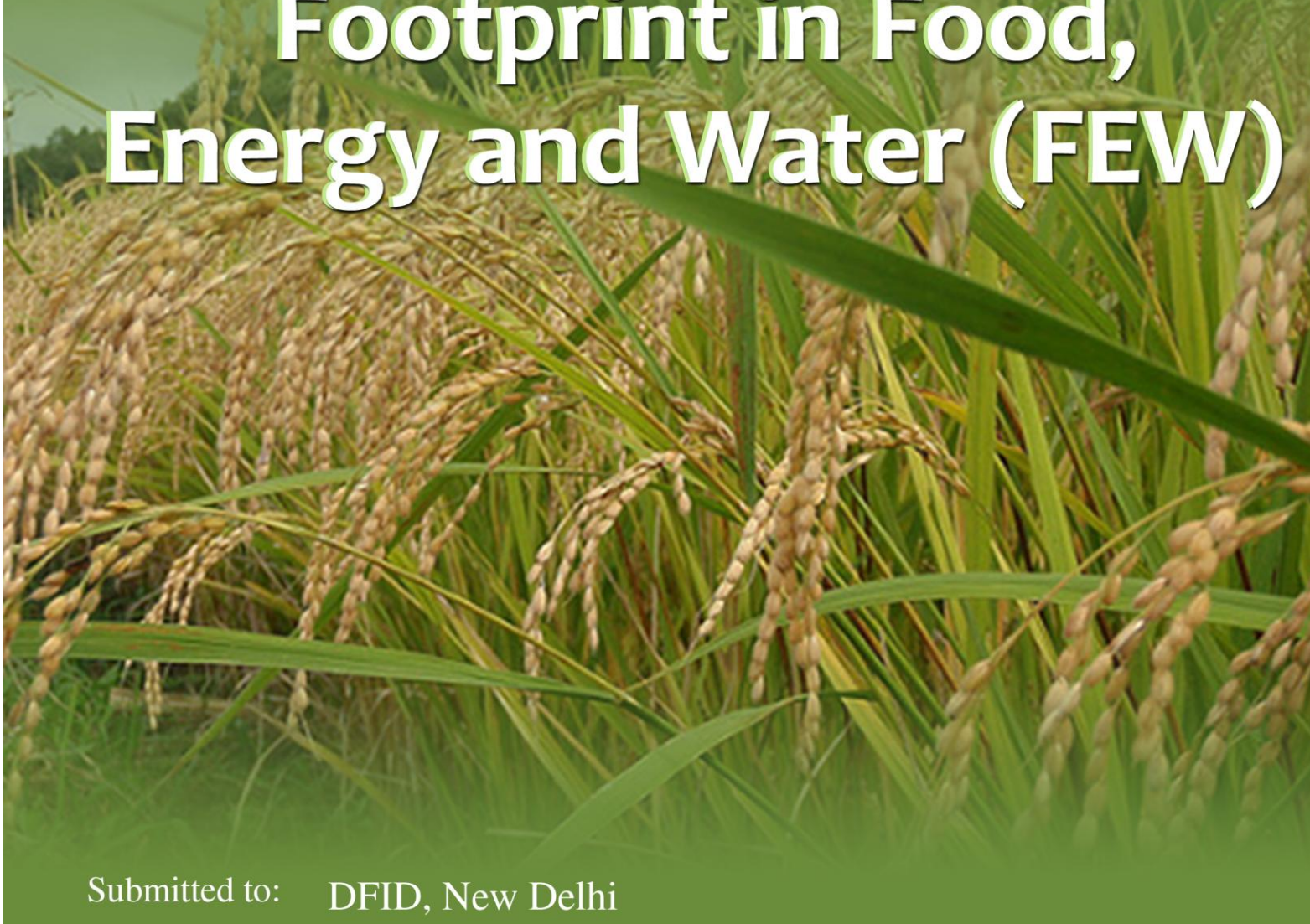
Sobhanbabu PRK

March, 2014

VOLUME II
(Annexures)


March 2014

India's Global Resource Footprint in Food, Energy and Water (FEW)



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(Annexures)

India's Global Resource Footprint in Food, Energy and Water (FEW)

List of Annexures

Annexures

I. FOOD

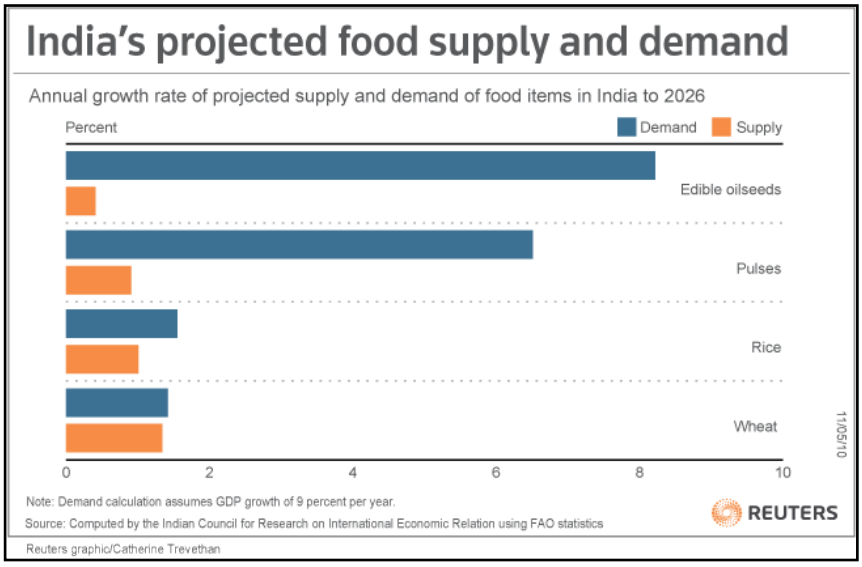
II. ENERGY

III. WATER

I. FOOD

Annexure 1

India's Projected Food Supply and Demand



Annexure 2

Yield Per Hectare – (Kg/Hectare)

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
1950-51	668	663	408	542	441	522
1951-52	714	653	414	557	448	536
1952-53	764	763	462	608	463	580
1953-54	902	750	506	678	489	640
1954-55	820	803	520	664	500	631
1955-56	874	708	449	639	476	605
1956-57	900	695	473	664	495	629
1957-58	790	682	495	630	424	587
1958-59	930	789	519	707	541	672
1959-60	937	772	522	713	475	662
1960-61	1013	851	528	753	539	710
1961-62	1028	890	519	763	485	706
1962-63	931	793	556	733	475	680
1963-64	1033	730	540	757	416	687
1964-65	1078	913	514	817	520	757
1965-66	862	827	483	676	438	629
1966-67	863	887	533	707	377	644
1967-68	1032	1103	608	840	534	783
1968-69	1076	1169	545	843	490	781
1969-70	1073	1208	578	865	531	805
1970-71	1123	1307	665	949	524	872
1971-72	1141	1380	564	936	501	858
1972-73	1070	1271	548	886	474	813
1973-74	1151	1172	623	918	427	827
1974-75	1045	1338	606	907	455	824
1975-76	1235	1410	694	1041	533	944
1976-77	1089	1387	689	985	494	894
1977-78	1308	1480	710	1100	510	991
1978-79	1328	1568	721	1136	515	1022
1979-80	1074	1436	652	982	385	876
1980-81	1336	1630	695	1142	473	1023
1981-82	1308	1691	733	1157	483	1032
1982-83	1231	1816	685	1151	519	1035
1983-84	1457	1843	813	1296	548	1162
1984-85	1417	1870	795	1285	526	1149
1985-86	1552	2046	664	1323	547	1175

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
1986-87	1471	1916	675	1266	506	1128
1987-88	1465	2002	721	1315	515	1173
1988-89	1689	2244	814	1493	598	1331
1989-90	1745	2121	922	1530	549	1349
1990-91	1740	2281	900	1571	578	1380
1991-92	1751	2394	778	1574	533	1382
1992-93	1744	2327	1063	1654	573	1457
1993-94	1888	2380	939	1701	598	1501
1994-95	1911	2559	929	1763	610	1546
1995-96	1797	2483	940	1703	552	1491
1996-97	1882	2679	1072	1831	635	1614
1997-98	1900	2485	986	1775	567	1552
1998-99	1921	2590	1068	1856	634	1627
1999-00	1986	2778	1034	1925	635	1704
2000-01	1901	2708	1027	1844	544	1626
2001-02	2079	2762	1131	1980	607	1734
2002-03	1744	2610	966	1753	543	1535
2003-04	2077	2713	1221	1983	635	1727
2004-05	1984	2602	1153	1903	577	1652
2005-06	2102	2619	1172	1968	598	1715
2006-07	2131	2708	1182	2020	612	1756
2007-08	2202	2802	1431	2151	625	1860
2008-09	2178	2857	1459	2183	659	1909
2009-10	2130	2830	1222	2082	225	1798
2010-11	2240	2938	1528	2247	689	1921
2011-12	2372	3140	1593	2396	694	2059
2012-13	2462	3119	1626	2450	786	2125

Annexure 3

Three Year Export Statement of APEDA Products

(Value in Rs. Lacs/ Qty in MT)

PRODUCT	2010-11		2011-12		2012-13	
	Qty	Value	Qty	Value	Qty	Value
FLORICULTURE						
Floriculture	28906.79	29604.04	30926.02	36532.15	27121.86	42344.6
Fruits & Vegetables Seeds	11622.33	18491.77	15205.81	28776.35	17168	34772.39
Total	40529.12	48095.81	46131.83	65308.5	44289.86	77116.99
FRESH FRUITS & VEGETABLES						
Fresh Onions	1182324.2	177928.62	1309924.82	172299.8	1666872.6	196662.66
Other Fresh Vegetables	499320.05	92138.76	734178.83	131048.2	768627.2	151633.56
Walnuts	5762.34	16629.25	5841.56	23108.4	5295.47	19983.57
Fresh Mangoes	58863.41	16483.6	63441.29	20974.3	55584.99	26471.78
Fresh Grapes	98005.12	42830.28	108584.57	60288.15	172744.42	125942.78
Other Fresh Fruits	255024.83	51175.27	270437.2	75541.11	263970.29	77975.78
Total	2099299.95	397185.78	2492408.27	483259.96	2933094.97	598670.13
PROCESSED FRUITS AND VEGETABLES						
Cucumber and Gherkins (Prepd. & Presvd)	209231.83	51525.79	258603	74503.45	238624.89	85659.18
Dried & Preserved Vegetables	49009.12	37333.5	64794.09	52678.47	68520.25	63795.76
Mango Pulp	170219.72	81893.27	150499.06	62082.91	147815.69	60855.73
Other Processed Fruits & Vegetables	199868.41	99704.05	274807.05	157759.82	269217.26	173305.54
Pulses	209010.49	87004.28	174625.18	106793.13	202751.36	128500.32
Total	837339.57	357460.89	923328.38	453817.78	926929.45	512116.53
ANIMAL PRODUCTS						
Buffalo Meat	726670.22	861324.17	986618.46	1374573.96	1107506.27	1741289.3
Sheep/Goat Meat	12298.38	25879.45	11181.04	25522.07	16046.91	42565.86
Other Meat	1021.79	967.42	318.33	364.34	194.13	233.33
Processed Meat	922.2	1395.53	575.94	949.53	796.92	937.41
Animal Casings	1804.72	3323.61	923.56	2705.01	602.53	1837.08
Poultry Products	516754.71	31433.28	624181.11	45805.29	577864.27	49493.41
Dairy Products	37435.87	54797.37	25639.51	28935.68	87824.21	141209.83
Casein	10583.01	36791.77	838.66	3719.76	13650.78	55625.72
Natural Honey	25979.21	30086.76	26089.03	32123.96	25780.7	35632.05
Albumin(Eggs & Milk)	1235	3954.66	1454.31	5302.71	1663.83	9016.14
Total	1334705.11	1049954.02	1677819.95	1520002.31	1831930.55	2077840.13
OTHER PROCESSED FOODS						
Groundnuts	433753.23	217840.59	832616.93	524644.77	535637.36	406536.09

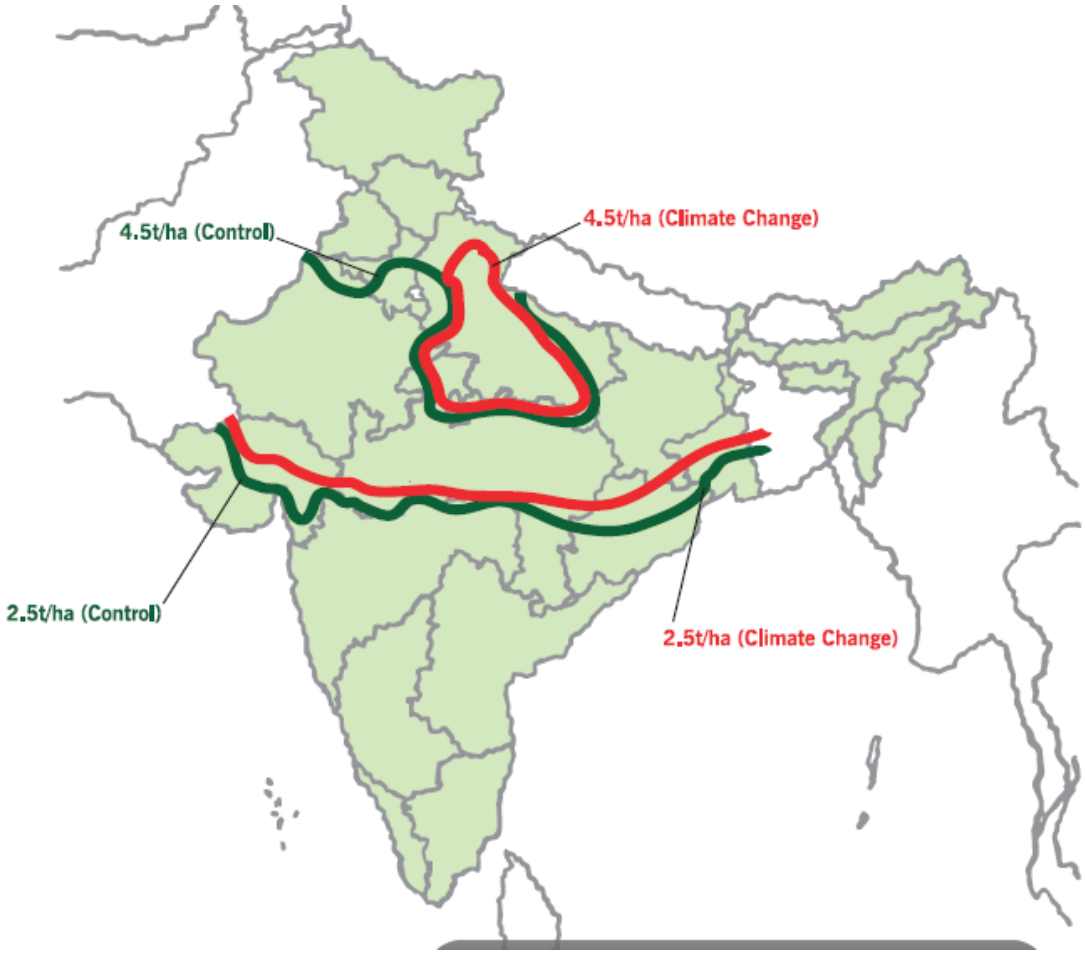
PRODUCT	2010-11		2011-12		2012-13	
	Qty	Value	Qty	Value	Qty	Value
Guargum	441607.7	293869.89	707326.43	1652386.71	406311.81	2128701.08
Jaggery & Confectionery	72361.48	32299.57	207694.35	76421.98	246566.93	91759.98
Cocoa Products	9077.54	12696.83	16678.58	17597.61	19083.34	29392.13
Cereal Preparations	226485.28	126179.36	301289.71	188859.7	293124.3	224076.04
Milled Products	99101.24	19706.3	171158.13	35890.14	273584.39	60360.8
Alcoholic Beverages	122295.16	81683.52	214110.69	145944.99	264466.08	190937
Miscellaneous Preparations	159209.15	83281.49	229341.93	121916.02	293958.19	171205.7
Total	1563890.78	867557.55	2680216.75	2763661.92	2332732.4	3302968.82
CEREALS						
Basmati Rice	2370658.39	1135463.37	3178174.43	1544959.62	3459898.93	1940939.06
Non Basmati Rice	100685.78	23128.82	3997719.57	865912.61	6687990.85	1444880.75
Wheat	394.47	69.96	740746.76	102326.85	6514810.6	1052900.15
Maize	3010423.39	335946.44	3855721.2	515751.49	4788328.25	709634.06
Other Cereals	209647.62	28902.06	217962.03	33540.86	652975.53	108427.36
Total	**5691809.65**	**1523510.65**	**11990323.99**	**3062491.43**	**22104004.16**	**5256781.38**
Grand Total	**11567574.18**	**4243764.7**	**19810229.17**	**8348541.9**	**30172981.39**	**11825493.98**

Source: DGCIS Annual Data

Annexure 4

Boundary Changes for Productivity of Irrigated Wheat

- Impact under 425ppm CO_2 concentration and 2°C temperature rise



Annexure 5

India's Food Grain Production

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
2012-13	104.40	92.46	40.06	236.92	18.45	255.36
2011-12	105.30	94.88	42.01	242.20	17.09	259.29
2010-11	95.98	86.87	43.40	226.25	18.24	244.49
2009-10	89.09	80.80	33.55	203.45	14.66	218.11
2008-09	99.18	80.68	40.03	219.90	14.57	234.47
2007-08	96.69	78.57	40.76	216.02	14.76	230.78
2006-07	93.35	75.81	33.92	203.08	14.20	217.28
2005-06	91.79	69.35	34.06	195.20	13.39	208.59
2004-05	83.13	68.64	33.46	185.23	13.13	198.36
2003-04	88.53	72.15	37.60	198.28	14.91	213.19
2002-03	71.82	65.76	26.07	163.65	11.13	174.78
2001-02	93.34	72.77	33.37	199.48	13.37	212.85
2000-01	84.98	69.68	31.08	185.74	11.07	196.81
1999-00	89.68	76.37	30.34	196.39	13.41	209.80
1998-99	86.08	71.29	31.33	188.70	14.91	203.61
1997-98	82.54	66.35	30.40	179.29	13.83	193.12
1996-97	81.73	69.35	34.11	185.19	14.24	199.43
1995-96	76.98	62.10	29.03	168.11	12.31	180.42
1994-95	81.81	65.77	29.88	177.46	14.04	191.50
1993-94	80.30	59.84	30.82	170.96	13.30	184.26
1992-93	72.86	57.21	36.59	166.66	12.82	179.48
1991-92	74.68	55.69	25.99	156.36	12.02	168.38
1990-91	74.29	55.14	32.70	162.13	14.26	176.39
1989-90	73.57	49.85	34.76	158.18	12.86	171.04
1988-89	70.49	54.11	31.47	156.07	13.85	169.92
1987-88	56.86	46.17	26.36	129.39	10.96	140.35
1986-87	60.56	44.32	26.83	131.71	11.71	143.42
1985-86	63.83	47.05	26.20	137.08	13.36	150.44
1984-85	58.34	44.07	31.17	133.58	11.96	145.54
1983-84	60.10	45.48	33.90	139.48	12.89	152.37
1982-83	47.12	42.79	27.75	117.66	11.86	129.52
1981-82	53.25	37.45	31.09	121.79	11.51	133.30
1980-81	53.63	36.31	29.02	118.96	10.63	129.59
1979-80	42.33	31.83	26.97	101.13	8.57	109.70
1978-79	53.77	35.51	30.44	119.72	12.18	131.90
1977-78	52.67	31.75	30.02	114.44	11.97	126.41
1976-77	41.92	29.01	28.88	99.81	11.36	111.17

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
1975-76	48.74	28.84	30.41	107.99	13.04	121.03
1974-75	39.58	24.10	26.13	89.81	10.02	99.83
1973-74	44.05	21.78	28.83	94.66	10.01	104.67
1972-73	39.24	24.74	23.14	87.12	9.91	97.03
1971-72	43.07	26.41	24.60	94.08	11.09	105.17
1970-71	42.22	23.83	30.55	96.60	11.82	108.42

Annexure 6

Absolute and percentage break-up of MPCEMMRP by item group, all-India 2011 -12

Item group	Monthly per capita exp. (Rs.)		Percentage to total MPCE	
Rural	**Urban**	**Rural**	**Urban**	
(1)	*(2)*	*(3)*	*(4)*	*(5)*
cereals & cereal substitutes	154	175	10.8	6.7
pulses & their products*	42	54	2.9	2.0
milk & milk products	115	184	8.0	7.0
edible oil	53	70	3.7	2.7
egg, fish & meat	68	96	4.8	3.7
vegetables	95	122	6.6	4.6
fruits	41	90	2.8	3.4
sugar, salt and spices	76	94	5.3	3.6
beverages, refreshments, processed food#	113	236	7.9	9.0
food total	**756**	**1121**	**52.9**	**42.6**
pan, tobacco & intoxicants	46	42	3.2	1.6
fuel and light	114	176	8.0	6.7
clothing & footwear$	100	167	7.0	6.4
education	50	182	3.5	6.9
medical	95	146	6.7	5.5
conveyance	60	171	4.2	6.5
consumer services excl. conveyance	57	147	4.0	5.6
misc. goods, entertainment	76	152	5.3	5.8
rent	7	164	0.5	6.2
taxes and cesses	4	22	0.2	0.8
durable goods	65	139	4.5	5.3
non-food total	**673**	**1509**	**47.1**	**57.4**
all items	**1430**	**2630**	**100.0**	**100.0**
*includes gram #includes purchased cooked meals $excludes tailoring charges				

Source:

- Government of India
- Ministry of Statistics and Programme Implementation
- National Sample Survey Office

Annexure 7

Area Under Cultivation – Food grains

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
2012-13	42.41	29.65	24.64	96.69	23.47	120.16
2011-12	43.97	29.90	26.37	100.52	26.22	125.03
2010-11	42.56	29.25	27.64	99.45	26.28	125.73
2009-10	41.87	28.34	27.52	97.73	23.39	121.12
2008-09	45.54	27.75	27.45	100.74	22.09	122.83
2007-08	43.91	28.04	28.48	100.43	23.63	124.06
2006-07	43.81	27.99	28.71	100.51	23.19	123.70
2005-06	43.66	26.48	29.04	99.18	22.39	121.57
2004-05	41.91	26.38	29.03	97.32	22.76	120.08
2003-04	42.59	26.60	30.80	99.99	23.46	123.45
2002-03	41.18	25.20	26.99	93.37	20.50	113.87
2001-02	44.90	26.34	29.52	100.76	22.01	122.77
2000-01	44.71	25.73	30.26	100.70	20.35	121.05
1999-00	45.16	27.49	29.34	101.99	21.12	123.11
1998-99	44.80	27.52	29.34	101.66	23.50	125.16
1997-98	43.45	26.70	30.83	100.98	22.87	123.85
1996-97	43.43	25.89	31.81	101.13	22.45	123.58
1995-96	42.84	25.01	30.88	98.73	22.28	121.01
1994-95	42.81	25.70	32.17	100.68	23.03	123.71
1993-94	42.54	25.15	32.82	100.51	22.25	122.76
1992-93	41.78	24.59	34.42	100.79	22.36	123.15
1991-92	42.65	23.26	33.42	99.33	22.54	121.87
1990-91	42.69	24.17	36.32	103.18	24.66	127.84
1989-90	42.17	23.50	37.69	103.36	23.41	126.77
1988-89	41.73	24.11	38.68	104.52	23.15	127.67
1987-88	38.81	23.06	36.55	98.42	21.27	119.69
1986-87	41.17	23.13	39.74	104.04	23.16	127.20
1985-86	41.14	23.00	39.47	103.61	24.42	128.03
1984-85	41.16	23.56	39.21	103.93	22.74	126.67
1983-84	41.24	24.67	41.71	107.62	23.54	131.16
1982-83	38.26	23.57	40.43	102.26	22.83	125.09
1981-82	40.71	22.14	42.45	105.30	23.84	129.14
1980-81	40.15	22.28	41.78	104.21	22.46	126.67
1979-80	39.42	22.17	41.36	102.95	22.26	125.21
1978-79	40.48	22.64	42.23	105.35	23.66	129.01
1977-78	40.28	21.46	42.28	104.02	23.50	127.52
1976-77	38.51	20.92	41.94	101.37	22.98	124.35
1975-76	39.48	20.45	43.80	103.73	24.45	128.18

Year	Cereals					
	Rice	Wheat	Coarse Cereals	Total Cereals	Pulses	Total Foodgrains
1974-75	37.89	18.01	43.15	99.05	22.03	121.08
1973-74	38.29	18.58	46.24	103.11	23.43	126.54
1972-73	36.69	19.46	42.21	98.36	20.92	119.28
1971-72	37.76	19.14	43.57	100.47	22.15	122.62
1970-71	37.59	18.24	45.95	101.78	22.54	124.32
1969-70	37.68	16.63	47.24	101.55	22.02	123.57
1968-69	36.97	15.96	46.24	99.17	21.26	120.43
1967-68	36.44	14.99	47.34	98.77	22.65	121.42
1966-67	35.25	12.84	45.09	93.18	22.12	115.30
1965-66	35.47	12.57	44.34	92.38	22.72	115.10
1964-65	36.46	13.42	44.35	94.23	23.88	118.11
1963-64	35.81	13.50	43.93	93.24	24.18	117.42
1962-63	35.69	13.59	44.29	93.57	24.27	117.84
1961-62	34.69	13.57	44.73	92.99	24.24	117.23
1960-61	34.13	12.93	44.96	92.02	23.56	115.58
1959-60	33.82	13.38	43.79	90.99	24.83	115.82
1958-59	33.17	12.62	44.66	90.45	24.31	114.76
1957-58	32.30	11.73	42.91	86.94	22.54	109.48
1956-57	32.28	13.52	42.02	87.82	23.32	111.14
1955-56	31.52	12.37	43.45	87.34	23.22	110.56
1954-55	30.77	11.26	43.92	85.95	21.91	107.86
1953-54	31.29	10.68	45.37	87.34	21.73	109.07
1952-53	29.97	9.83	42.45	82.25	19.84	102.09
1951-52	29.83	9.47	38.88	78.18	18.78	96.96
1950-51	30.81	9.75	37.67	78.23	19.09	97.32

Note: Data for 2011-12 are based on Advance Estimates

Source: Ministry of Agriculture, Government of India

Annexure 8

India's Import in Rs. Billion

Year/ Commodity	1. Cereals and Cereal Preparations	2. Edible Oils	3. Pulses	4. Sugar
2012-13	4.53	611.06	127.39	30.72
2011-12	3.52	462.55	89.31	3.14
2010-11	5.45	298.60	71.50	27.90
2009-10	4.97	264.83	98.13	59.66
2008-09	2.16	158.38	62.46	5.83
2007-08	28.39	103.01	53.75	0.06
2006-07	59.96	95.40	38.92	0.04
2005-06	1.60	89.61	24.76	6.52
2004-05	1.19	110.77	17.78	9.76
2003-04	0.89	116.83	22.85	0.63
2002-03	1.19	87.80	27.37	0.33
2001-02	0.87	64.65	31.60	0.33
2000-01	0.87	59.77	4.99	0.31
1999-00	9.62	80.46	3.55	11.11
1998-99	12.11	75.89	7.09	11.11
1997-98	10.83	27.65	11.95	4.70
1996-97	4.87	29.29	8.90	0.03
1995-96	0.80	22.62	6.86	2.16
1994-95	0.92	6.24	5.93	22.83
1993-94	2.91	1.67	5.67	0.01
1992-93	9.66	1.67	3.34	0.00
1991-92	1.73	2.48	2.55	0.01
1990-91	1.82	3.26	4.81	0.09
1989-90	3.90	2.09	2.30	0.97
1988-89	7.74	7.30	3.85	0.00
1987-88	0.66	9.69	2.51	1.93

Annexure 9

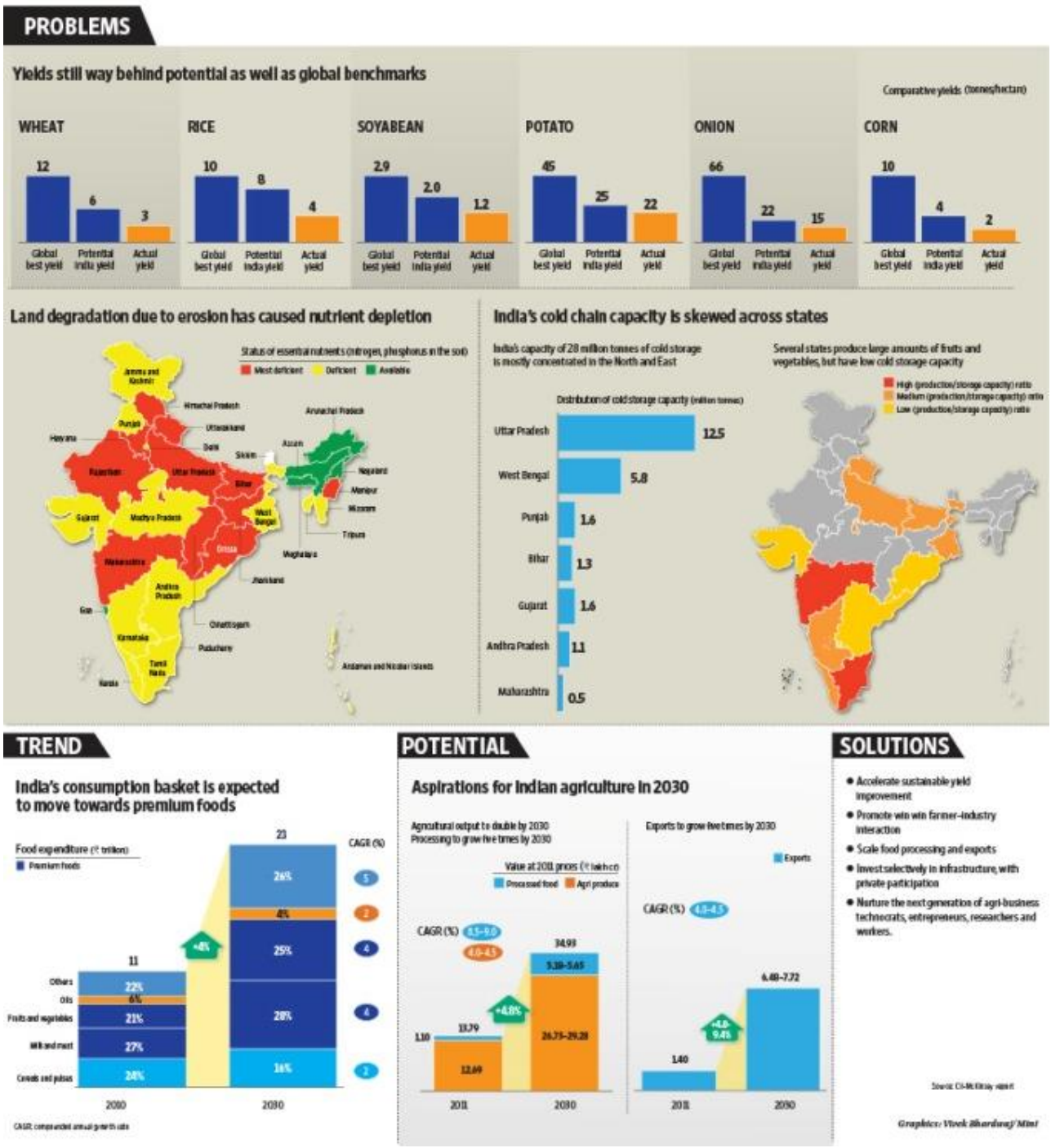
India's Land acquisitions

	Indian Company	Country	Details
1.	Karuturi Agro Products Plc	Ethiopia	Acquired 100,000 ha in the Jikao and Itang Districts of the Gambela Region for growing palm, cereal and pulses, with conditional option to acquire another 200,000 ha. Karuturi Agro Products is a subsidiary of Karuturi Global Ltd.
2.	Ruchi Soya Industries	Ethiopia	Acquired 25-years lease for soyabean and processing unit on 152,649 ha in Gambela and Benishangul Gumaz States
3.	KS Oils	Indonesia	Acquired 130,965 ha at Kalimantan for palm plantation; This is the third tranche of land acquired by the company after it previously acquired 210,039 ha in two deals in 2008 and 2009
4.	Verdanta Harvests Plc	Ethiopia	Acquired a 50-years lease for 5,000 ha in the Gambela region for a tea and spice plantation
5.	Chadha Agro Plc	Ethiopia	Acquired up to 100,000 ha in Guji Zone in Oromia Regional State for a sugar development project
6	Sterling Group	Argentina	Purchased a 2,000-hectare olive farm and another 17,000 ha for growing peanuts
7.	Olam International	Argentina, Gabon, Uruguay	Acquired 17,000 ha in Argentina to grow peanuts, 300,00 ha in Gabon for palm oil and 16,000 ha in Uruguay for dairy farming. Olam is a Non-Resident Indian firm based in Singapore
8.	Varun International	Madagascar	Subsidiary Varun Agriculture Sarl leased or purchased 232,000 ha to grow rice, corn and pulses
9.	Solvent Extractors Associations of India	Latin America (Uruguay, Paraguay)	A consortium of 18 vegetable oil companies was set up to acquire lands in Latin America to grow soyabean and sunflower
10.	Uttam Sucrotech	Ethiopia	Won a $100-million contract to expand the Wonji-Shoa sugar factory
11	Shree Renuka Sugars	Brazil	Purchased sugar and ethanol producer Vale Do Ivai S.A. Acucar E Alcool in November 2009 for $240 million, including its 18,000 ha of land for sugarcane; and acquired a 51-percent stake in Equipav SA Acucar e Alcool fr $329 million that owns two sugar mills and has 115,000 ha of cane growing land in south-eastern Brazil
12.	McLeod Russel India	Uganda	Purchased tea plantations worth $25 million, including Uganda's Rwenzori Tea Investments; McLeod Russel India is owned by BM Khaitan
13.	ACIL Cotton Industries	Brazil, Congo and Ethiopia	Plans to invest nearly $15 million (Rs 68 crore) for land leases to start contract farming pulses and coffee in Brazil, Congo and Ethiopia
14.	MMTC Ltd (state-owned)	Kenya and Tanzania	Plans to (as of Oct 2010) grow pulses
15	Adani Group	Africa, Brazil, Argentina, Indonesia and Malaysia	Plans to (as of Oct 2010) set up farms to cultivate edible oil and pulses
16	Neha International	Ethiopia	Leased land in the Oromia region — in Holetta for floriculture and near Bako for rice, maize, oilseeds and pulses
17	Sanmati Agro Farm Enterprise Pvt. Ltd.	Ethiopia	Acquired a 25-years lease on 10,000 ha in Dimi District, Gambela Region, for the cultivation of rice, pulses, and cereals
18	Jay Shree Tea & Industries	Rwanda, Uganda	Acquired two tea plantations in Rwanda and one in Uganda; Jay Shree Tea & Industries is controlled by BK Birla
19	BHO Bio Products Plc	Ethiopia	Acquired 27,000 ha to grow cereal, pulses and edible oil crops
20	ACIL Cotton Industries	Brazil, Congo and Ethiopia	Announced plans in January 2011 to invest nearly $15 million (Rs 68 crore) to start contract farming of crops like pulses and coffee in Brazil, Congo and Ethiopia

Annexure 10

India's Agricultural Map for Commercial Crop

Source: Mapsofindia.com



QUICK-Synoptic of several interconnected factors in India-NOT REFERRED TO SPECIFICALLY IN TEXT OF DISSERTATION, HENCE NOT NUMBERED.

Annexure 11

India's import and export of commodities- National comparison

The additional annexures are details from which analysis is made and presented.

India's Imports and Exports of Agricultural Commodities *(Value in ₹ Crore)*

Year	Agriculture Imports	Total National Imports	%age Agriculture Imports to Total National Imports	Agriculture Exports	Total National Exports	%age Agriculture Exports to Total National Exports
1	2	3	4	5	6	7
1990-91	1205.86	43170.82	2.79	6012.76	32527.28	18.49
1991-92	1478.27	47850.84	3.09	7838.04	44041.81	17.80
1992-93	2876,25	63374,52	4,54	9040,30	53688,26	16,84
1993-94	2327.33	73101.01	3.18	12586.55	69748.85	18.05
1994-95	5937.21	89970.70	6.60	13222.76	82673.40	15.99
1995-96	5890.10	122678.14	4.80	20397.74	106353.35	19.18
1996-97	6612.60	138919.88	4.76	24161.29	118817.32	20.33
1997-98	8784.19	154176.29	5.70	24832.45	130100.64	19.09
1998-99	14566.48	178331.69	8.17	25510.64	139751.77	18.25
1999-00	16066,73	215528,53	7,45	25313,66	159095,20	15,91
2000-01	12086.23	228306.64	5.29	28657.37	201356.45	14.23
2001-02	16256.61	245199.72	6.63	29728.61	209017.97	14.22
2002-03	17608,83	297205,87	5,92	34653,94	255137,28	13,58
2003-04	21972.68	359107.66	6.12	37266.52	293366.75	12.70
2004-05	22811.84	501064.54	4.55	41602.65	375339.53	11.08
2005-06	21499.22	660408.90	3,26	49216.96	456417.86	10,78
2006-07	29637.86	840506.31	3.53	62411.42	571779.28	10.92
2007-08	29906.23	1012311.70	2.95	79039.52	655863.52	12.05
2008-09	37183,04	1374435,55	2,71	85551,67	840755,06	10,18
2009-10	59528,37	1363735,55	4,37	89341,5	845533,64	10,57
2010-11	57334.32	1683466.96	3.41	117483.61	1142921.92	10.28
2011-12 (P)	77061.73	2345972.70	3.28	187475.89	1459280.51	12.85

P-Provisional

Source:- Director General of Commercial Intelligence & Statistics, Ministry of Commerce,Kolkata,

Annexure 12

India's Import of Agricultural Product

Commodity	2002-03		2003-04		2004-05		2005-06		2006-07	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	2	3	4	5	6	7	8	9	10	11
Pulses	1992.29	2737.05	1723.33	2284.87	1339.45	1777.58	1695.95	2476.25	2270.97	3891.91
Wheat			0.46	0.25					6079.56	5850.49
Rice	0.87	1.09	0.54	0.27			0.26	0.34	0.16	0.41
Other Cereals	1.12	0.67	1.53	1.87	6.62	6.56	27.88	30.09	7.96	11.73
Cereal Preparation	51.74	116.79	32.51	86.85	45.46	112.16	42.40	129.23	38.22	132.92
Milk & Cream	1.14	9.55	11.55	89.56	2.21	12.87	1.63	14.20	3.09	28.90
Cashew Nuts Cashew shelled	402.98	1236.24	442.59	1371.80	479.71	1804.96	543.94	2089.46	586.49	1820.75
Fruits & Nuts Excluding Cashew Nuts	-	641.76		802.27	-	1100.83		1390.32		1913.11
Spices	121.28	586.44	124.17	564.42	107.22	593.83	108.93	687.81	118.51	738.90
Sugar	41.43	32.83	74.40	62.70	932.74	976.18	558.77	651.59	1.05	3.48
Oil Seeds		11.49		13.89		28.41		47.03		104.47
Vegetable Oils Fixed (Edible)	4365.03	8779.64	5290.30	11683.24	4751.19	11076.89	4288.10	8960.99	4269.38	9539.90
Vegetable & Animal fats	1.45	11.61	1.76	12.68	1.42	12.78	1.47	14.24	1.11	11.19
Cotton (Raw & Waste)	233.85	1237.61	252.90	1570.03	192.18	1135.56	98.75	703.66	81.48	663.07
Jute (Raw)	143.23	134.77	111.97	93.92	20.74	31.79	61.34	93.16	83.05	115.21
Tea	23,64	125,30	10,77	64,60	31,76	146,92	18,75	108,14	23,29	127,06
Wood & Wood Products		1945,99		3269,46		3994,52		4102,71		4684,35
Total Agricultural Imports		17608,83		21972,68		22811,84		21499,22		29637,86
Total National Imports		297205,87		359107,66		501064,54		660408,90		840506,31
% Share of Agricultural Import in National Imports		5,92		6,12		4,55		3,26		3,53

2007-08		2008-09		2009-10		2010-11		2011-12 (P)	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
2	3	4	5	6	7	8	9	10	11
2835,05	5374,94	2474,11	6246,40	3509,58	9813,37	2698,66	7149,62	3307,87	8767,42
1793,21	2657,51	0,01	0,01	164,38	231,90	185,28	255,85	0,02	0,08
0,16	0,42	0,09	0,06	0,07	0,37	0,22	1,12	1,08	5,73
10,42	19,34	20,60	45,46	33,69	76,33	30,68	59,53	15,36	30,04
43,96	161,83	29,78	170,17	40,85	188,22	37,09	228,84	46,26	300,23
1,98	28,96	3,23	38,21	8,27	77,56	37,17	491,98	63,10	1037,73
591,88	1714,75	614,46	2672,43	755,96	3047,50	529,73	2649,56		
								2,07	41,86
1858,39	-	2372,89	-	2873,15		3636,63		4518,62	
-									
144,627331	973,64	122,85	1076,07	153,40	1432,31	113,33	1556,11	124,33	2102,17
0,733	5,87	386,10	583,16	2551,42	5965,80	1198,39	2789,55	99,71	313,84
-	149,32	-	129,58	-	186,61		115,48		99,41
4903,388	10301,09	6719,35	15837,46	8033,92	26483,32	6905,43	29860,40	8429,08	46242,22
1,095	12,48	0,81	12,20	1,36	23,31	0,78	16,01	0,86	20,02
136,487	912,14	211,69	1690,22	171,42	1241,37	58,41	623,54	78,32	1059,12
135,75	148,01	52,24	71,21	62,66	149,49	83,31	302,49	181,18	449,17
19,725721	130,95	25,16	197,00	34,46	276,54	20,82	202,00	22,06	213,82
-	5456,60	-	6040,51	-	7461,20		7395,61		11860,25
	29906,23	-	37183,04		59528,37		57334,32		77061,73
-	1012311,70	-	1374435,55		-1363735,55		1683466,96		2345972,70
-	2,95	-	2,71	-	4,37		3,41		3,28

:- Director General of Commercial Intelligence & Statistics, Ministry of Commerce,Kolkata.

Annexure 13

India's Exports of Agricultural Products (In Rs. Crore)

Commodity	2002-03		2003-04		2004-05		2005-06		2006-07	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1	2	3	4	5	6	7	8	9	10	11
Pulses	148.08	345.02	153.88	328.6	271.18	602.57	447.44	1115.21	250.70	773.34
Rice Basmati	708,79	2058,47	771,49	1993,05	1163	2823,90	1166,57	3043,10	1045,73	2792,81
Rice(Other than Basmati)	4259.08	3772.77	2640.57	2174.94	3615,1	3945.02	2921.60	3178.17	3702.22	4243.10
Wheat	3671,25	1759,87	4093,08	2391,15	2009,35	1459,82	746,18	557,53	46,64	35,35
Other Cereals	106.08	91.06	604.23	397.55	1178.03	793.82	567.22	453.82	730.38	599.25
Tea	182.86	1652.07	177.77	1637.35	183.4	1840.30	162.86	1730.73	185.63	1969.51
Coffee	184,87	993,98	188,44	1085,92	167,55	1069,08	177,68	1588,69	213,65	1969,00
Tobacco Unmanufactured	100.47	733.52	120.64	801.41	135.74	940.07	142.70	1021.32	158.25	1251.28
Tobacco Manufactured		289.37		295.06		314.54		309.34		433.89
Dairy Products		176,45		161,56		458,79		794,61		497,09
Floriculture Products		180.77		250.47		222.92		301.45		652.70
Spices	277.02	1655.49	267.47	1544.18	364.53	1883.18	400.24	2115.98	482.80	3157.90
Cashewnut Shell Liquid	6.14	8.56	4.33	5.02	5.33	11.94	5.94	8.67	8.09	15.34
Cashew	129.43	2052.94	99.68	1699.82	118.11	2477.18	125.10	2584.70	122.78	2291.18
Sesamum Seed	118,31	372,89	189,11	708,9	168,28	708,95	199,81	746,60	233,34	939,58
Nigerseed	36.13	77.99	17.89	45.41	26.14	64.74	28.42	60.25	30.02	66.87
Groundnut	67.89	178.3	176.93	179.11	177.15	547.02	190.06	513.69	251.43	798.46
Guargum Meal	111.94	486.64	119.33	120.56	131.31	689.48	186.73	1094.23	189.33	1125.79
Oil Meals	1776.13	1487.35	3172.31	3249.89	3603.38	3177.60	5976.00	4875.01	6437.43	5504.32
Castor Oil	177.69	609.81	152.36	656.06	271.69	1077.98	254.72	939.74	294.87	1090.11
Shellac	5.72	89.85	10.5	179.74	8.54	164.87	9.30	159.98	7.51	147.20
Sugar	1662.37	1769.49	1200.6	1216.59	108.69	149.53	321.20	569.10	1643.40	3127.47
Molasses	207.86	45.05	98.62	19.38	8.16	5.52	72.94	28.81	326.87	133.37
Fruits/Vegetable Seeds	8.92	97.96	5.18	53.61	6.74	66.04	7.52	92.96	8.10	121.59
Fresh Fruits		447,32		784,03		862,26		1120,69		1413,98
Fresh Vegetables		642.78		953.93		862.99		919.81		1546.53
Processed Vegetables		256,73		291,15		362,46		494,48		650,23
Processed Fruit Juices		574,13		343,66		369,16		599,91		711,40
Miscellaneous Processed Items		910.08		1058.69		908.03		989.53		1125.05
Meat & Preparations		1377,19		1714,41		1905,27		2750,17		3314,03
Marine Products	527.87	6928.05	409.49	6105.63	483.52	6469.22	554.20	7035.91	611.55	8001.04
Cotton Raw including Waste	11.75	50.28	179.61	942.37	86.64	422.58	614.80	2904.35	1162.22	6107.81
Jute Hessian		349,31		410,11		427,20		490,90		375,81
Poultry Products		182.07		253.59		281.96		313.37		313.82
Paper/Wood products		1950,33		2362,58		3236,66		3759,15		4915,22
Total Agricultural Exports		34653.94		37266.52		41602.65		49216.96		62411.42
Total National Exports		255137,28		293366,75		375339,53		456417,86		571779,28
% Share of Agricultural Exports in National Exports		13,58		12,70		11,08		10,78		10,92

2007-08		2008-09		2009-10		2010-11		2011-12 (P)	
Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
12	13	14	15	16	17	18	19	20	21
164,20	526,41	136,27	540,22	99,92	407,35	208,02	865,74	174,20	1065,84
1183,36	4344,58	1556,41	9477,03	2016,87	10889,60	2370,68	11354,77	3211,80	15450,45
5286,08	7410,03	931,89	1687,37	139,54	365,30	100,68	231,29	4099,00	8668,19
0.24	0.24	1.12	1.46	0.03	0.06	0.40	0.70	741.19	1023.80
3228.05	3002,33	3999.65	3920,58	2892,42	2973,19	3220.07	3648,49	4072.37	5479,21
197,39	2034,17	207,46	2688,87	207,53	2943,53	238,34	3354,31	324,80	4139,19
178.30	1872,27	174.08	2255.76	157,41	2032.06	232,63	3009,91	278.94	4533.31
173,34	1432,80	208,31	2766,27	230,80	3621,44	215,88	3151,65	197.12	2898,56
	499.09		294.78		722.96		833.74		1107.56
	960,24		1130,08		549,37		850,17		608,06
	340,30		368,81		294,46		296,05		365,24
614.86	4314.86	673.87	6338.42	663.21	6157.33	762.71	8043.47	931.26	13175.52
14,78	25,17	10,82	29,69	11,23	27,62	12,05	33,77	14,68	59,46
111.26	2209.60	126.15	2900.97	117.99	2801.58	105.76	2819.39	131.76	4390.68
317,01	1642,29	196,98	1494,26	215,73	1494,10	398,44	2307,52	399,41	2641,85
21,68	90,03	13,72	64,23	6,00	24,23	12,86	44,51	28,23	117,27
269.59	1054.08	297.89	1239.01	340.24	1425.93	433.75	2178.41	853.08	5249.59
211,17	1125,75	258,57	1338,99	218,47	1133,31	441,61	2938,70	706,97	16356,74
6908.50	8140.55	6742.94	10269.24	4671.13	7831.79	6936.93	11069.58	7436.22	11762.27
282,18	1275,72	357,26	2128,72	398,00	2179,28	424,49	2982,92	492,60	4571,18
8,08	123,99	6,03	103,89	4,05	71,30	4,39	140,07	4,71	259,34
4684.55	5412.16	3332.08	4448.74	44.74	110.21	1714.37	5419.16	2747.35	8779.07
897.52	250.62	172.20	82.70	31.10	19.78	371.92	214.09	384.93	204.49
10.08	141.96	8.54	119.99	8.88	145.08	11.62	184.96	17.66	284.83
	1446.59		1945.24		2269.08		2174.13		2530.52
	1477,89		2454,15		2941,73		2545,88		2890,52
	602.18		711.22		752.30		764.00		1056.40
	773,40		1099,15		1159,32		1041,12		1658,80
ns	1362.39		2077.44		2095.29		2628.26		3804.98
	3749,47		5371,42		6286,10		8960,07		14111,02
490,06	6926,67	464,90	7066,37	709,88	9899,98	825,31	11917,11	1031,53	16588,18
1557.59	8865.39	457.56	2865.85	1357.99	9537.08	1885.77	13160.47	2013.33	21623.06
	464,44		415,59		307,63		722,87		920,52
	429,53		413,53		366,10		283,67		388,37
	4712.33		5441.63		5506.04		7312.67		8711.80
	79039,52		85551,67		89341,50		117483,61		187475,89
	655863.52		840755.06		845533.64		1142921.92		1459280.51
ts in	12,05		10,18		10,57		10,28		12,85

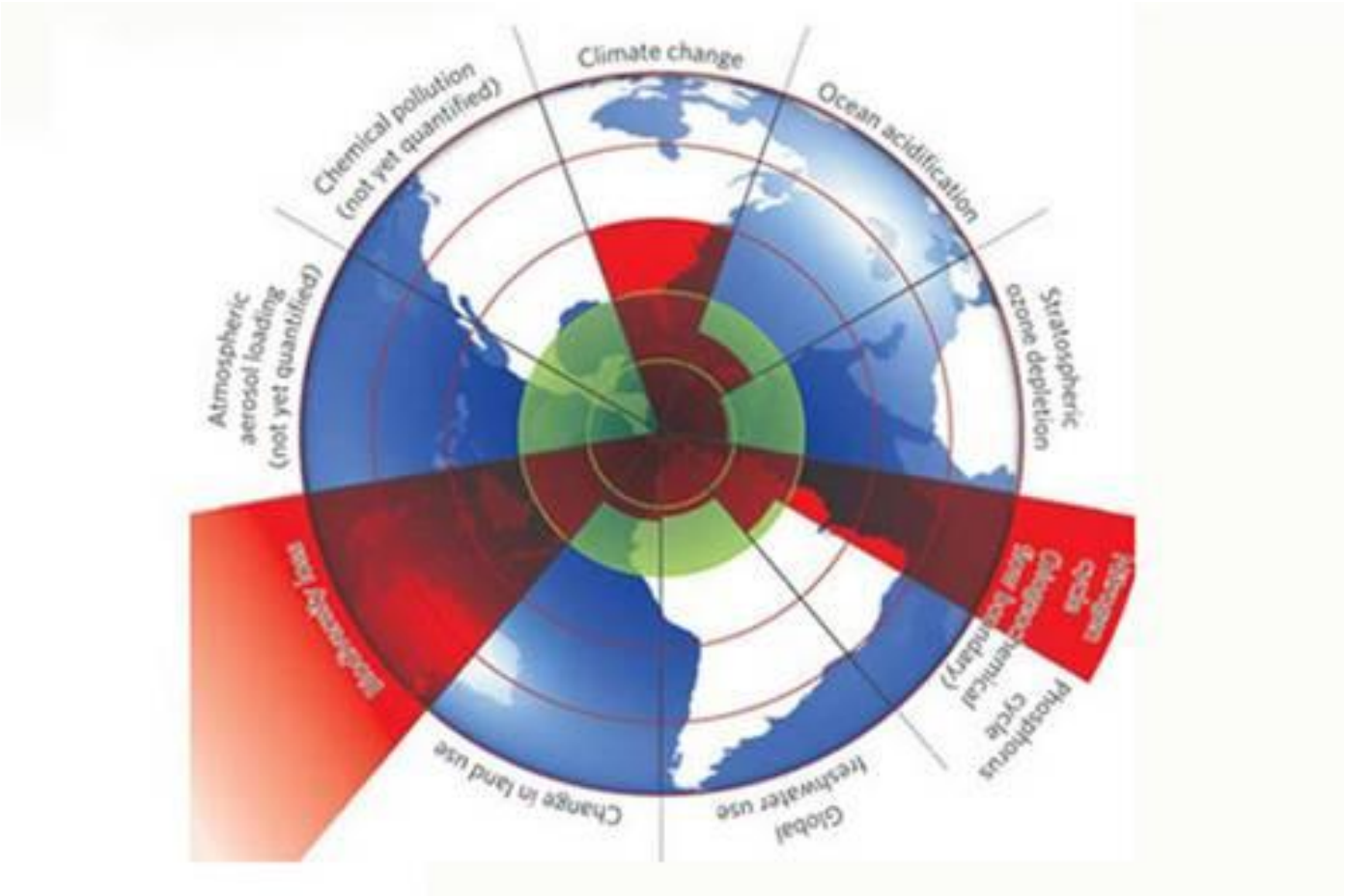
Annexure 14

Production & Use of Agricultural Inputs in India

Programme	Unit	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. Seeds																						
(i) Production of Breeder Seeds	Thousand Qtls.	34.90	36.00	37.00	40.11	43.36	46.03	46.13	38.99	51.13	42.69	45,54	48,42	61,82	66,46	68,64	73,83	91,96	94,41	105,00	119,21	119,21
(ii) Production of Foundation Seeds	Lakh Qtls.	3.75	3.93	4.06	4.73	4.76	5.76	6.84	6.75	4.66	5.91	5,44	6,14	6,50	6,90	7,40	7,96	8,22	9,69	10,50	17,53	21,86
(iii)Distribution of Certified/Quality Seeds	Lakh Qtls.	57,50	60,33	62,20	65,86	69,90	73,27	78,79	84,97	87,98	86,27	91,80	98,03	108,59	120,26	126,75	155,01	179,05	215,81	257,11	277,34	283,85
2. Consumption of Chemical Fertilisers																						
Nitrogenous (N)	Lakh Tonnes	80.46	84.26	87.88	95.07	98.23	103.02	109.02	113.54	115.92	109.20	113,10	104,74	110,77	117,13	127,23	137,73	144,19	150,91	155,80	165,58	173,00
Phosphatic(P)	Lakh Tonnes	33.21	28.43	26.69	29.32	28.98	29.77	39.14	41.12	47.99	42.15	43,82	40,19	41,24	46,24	52,04	55,43	55,15	65,06	72,74	80,50	79,14
Potassic(K)	Lakh Tonnes	13.61	8.84	9.09	11.25	11.56	10.29	13.72	13.32	16.78	15.67	16,67	16,01	15,98	20,60	24,13	23,35	26,36	33,13	36,32	35,14	25,26
Total (N+P+K)	Lakh Tonnes	127.28	121.53	123.66	135.64	138.77	143.08	161.88	167.68	180.69	167.02	173,59	160,94	167,99	183,97	203,40	216,51	225,70	249,1	264,86	281,22	277,40
Per Hectare **	Kg.	69.84	65.48	66.27	72.13	74.02	75.47	84.94	87.02	94.94	89.63	91,13	91,45	88,05	94,52	105,50	111,76	115,27	127,67	137,81	146,32	144,33
3. Consumption of Pesticides (Technical Grade Material)	Thousand Tonnes	72.13	70.79	63.65	61.36	61.26	56.11	52.24	49.16	46.20	43.58	47,02	48,30	41,00	40,67	39,77	41,51	43,63	43,86	41,82	55,54	50,58
4. Area Covered Under Soil Conservation (Cumulative)	Lakh Hactares	-	-	-	-	-	-	-	-	-	4.36	4.70	4.30	5.55	7.37	8.67	11.41	7.34	6.90	5.32	7.49	4.72

ANNEXURE 15

Planetary Boundaries of Extraction

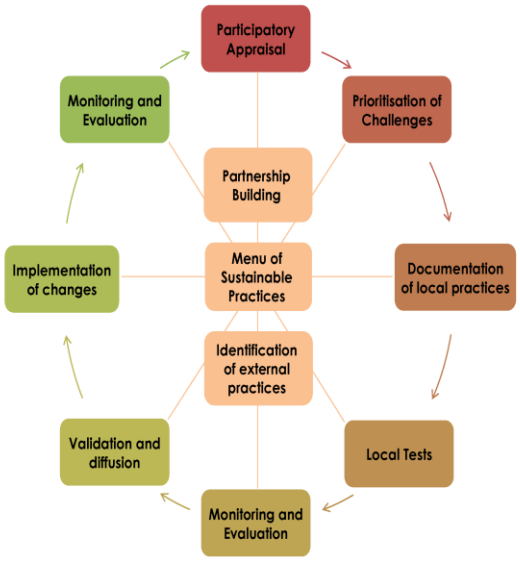


To avoid catastrophic environmental change humanity must stay within defined 'planetary boundaries' for a range of essential Earth-system processes, argue Johan Rockström and his co-authors in a Nature Feature. If one boundary is transgressed, then safe levels for other processes could also be under serious risk, they caution".

Annexure 16

Climate Resilient Sustainable Agriculture

Climate resilient sustainable agriculture is a way of life, based on self-reliance and agro ecological systems which encompass all forms of livelihoods for all classes of farmers relying on ecological process, bio diversity, and cycles adapted to local conditions combining tradition, innovation and modern science to benefit the shared environment globally. The main approaches focus on participatory approaches, local potential, innovations, identifying and documenting and disseminating, common sense local knowledge and practice, thus reducing dependence on external inputs, and adapting to climate change. They are based on the seven pillars being currently focused globally: Soil conservation; Livelihood diversification sustainable water and agronomy practices; Supporting farmers organization; Sustainable water management; Gender equality and women's rights; Agro bio diversity & processing and access markets for all.



Climate resilient sustainable agriculture

Brilliant examples of these are available globally, mostly of local farmer's that have been scaled up nationally. Smart agriculture of ensuring humidity levels in cardamom plantations, deep planting of sugarcane, organic farming successes, trellis method for vegetables, multipurpose farms through association in Cambodia, ground nut replication in Senegal, banks for neglected species in Nepal.

- **Consultants Further Recommendations**

The way forward, transfers and "bountiful take aways' to LICs" the great Indian tradition

In the new Indian scenario, efficient resource use, land agglomeration, food and operational waste management, new cooperative models,, subsidising farmer's education training, tools, technology adaption, improved genetic base, women empowerment, innovative finance and insurance, better ICT methods is the real answer. Examples of project transfers to LICs outline India's intent and progress to achieving, these sustainable goals. Suggestions have been made as best "Indian" examples, however, transferability, scalability, sustainability, and relevance will vary from the explicit need of each country and their food habit sovereignty. The submissions, on food and agriculture development, below should be considered as "living, dynamic, and importantly synergistically intertwined, for optimum effects on a spectrum of LICs. The multi-dimensional table, while highlighting top innovation shows the relationship of transfer factors and impacts. For example soil testing primarily benefits productivity, it is a simple tool, highly effective and also sustainable over time, and can be scaled nationally. Farmers' credit cards, helps to buy inputs primarily, and due to this there is a direct, influence on productivity. By using micro nutrients the relevance to human physiological benefit and to production is very high, a proven technology easily transferable and nationally scalable. The Indian food sector encompasses diverse zones and constraints and many innovations are available at institutional, and community level, for a broad range

of targeted disbursals to LICs. The extension service system is fully mature with outstanding transferability schemes, built over four decades.

- **Consultants view and innovative suggestions.- "Small and simple is beautiful – Green Initiatives"**

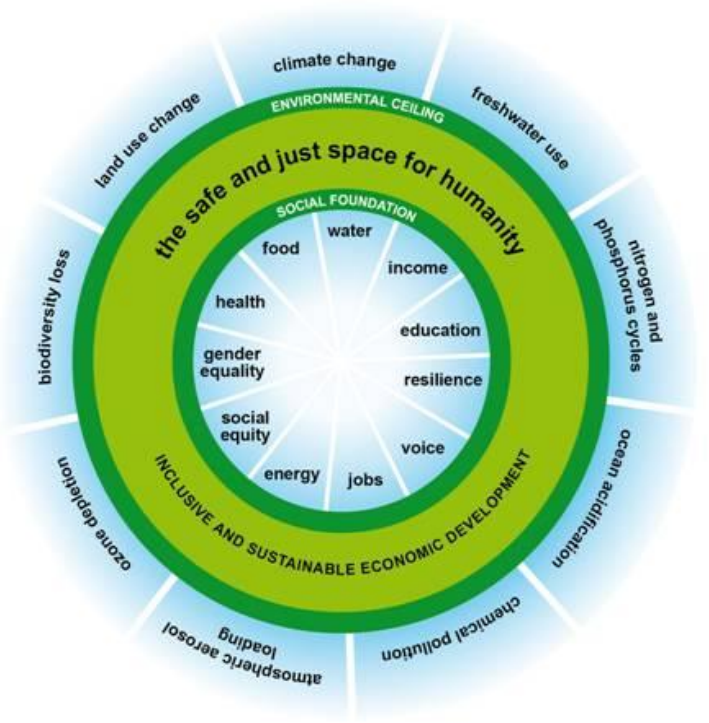
Self-reliant communities are the order of the day. Scaled up and interconnected they would form the backbone of national food security, rural prosperity and employment by applying simple but holistic techniques in the nexus of food energy and water. The key is the right, low cost practical and locally adaptable practises to mitigate constraints. Cooperative use of land assets, the right mix of crops, pasture land, cattle and water management will result in a complete food basket. Salient aspects of WASH and education are the drivers.

	IR-1	IR-2	IR-3	IR-4	IR-5
Best Practice	Effectiveness	Scalability	Transferability	Relevance	Sustainability
IR1 - Increased Agricultural Productivity and Output to Increase Farmers' Incomes					
Improving Fertilizer Use Efficiency Using Soil Testing and ICT	PRIMARY	SECONDARY			SECONDARY
Urea Deep Placement	PRIMARY				SECONDARY
Artificial Insemination	PRIMARY				
Integrated Pest Management	PRIMARY				SECONDARY
Small Ruminant Introduction Program	PRIMARY			SECONDARY	
Tools for Women	PRIMARY			SECONDARY	
India's Potato Production System	PRIMARY				
IR 2 - Expanded Use of Knowledge, Innovations and Research by Farmers and Agribusinesses					
Digital Green		PRIMARY			
ICT in Agriculture	N/A	N/A	N/A	N/A	N/A
IR 3 - Farmers Linked to Markets and Expanded Trade and Investment					
Kisan Credit Card	SECONDARY		PRIMARY		
Rural Business Hubs		SECONDARY	PRIMARY		
Linking Smallholder Farmers To Commercial Value Chains			PRIMARY		
CoolBot and Other Low-Cost Post-Harvest Handling Methods	SECONDARY		PRIMARY		SECONDARY
Producer Companies					
IR 4 - Improved Household Nutritional Status, Particularly of Women and Adolescent Girls					
Home Gardens				PRIMARY	
Multi-Sectoral Nutrition Education		SECONDARY		PRIMARY	
Micronutrient Fortification in Staples		SECONDARY		PRIMARY	
IR 5 - Improved Natural Resource Management Practices & Agricultural Systems Adapted to Projected Climate Changes					
Conservation Agriculture	SECONDARY				PRIMARY
Laser Land Leveling	SECONDARY				PRIMARY
Climate Analogues					PRIMARY
Climate Finance for Adaptation					PRIMARY
National Initiative on Climate Resilient Agriculture (NICRA)					PRIMARY
Stress-Tolerant Varieties of Cereals for Climate-Resilient Agriculture	SECONDARY				PRIMARY
System of Rice Intensification (SRI)	SECONDARY				PRIMARY
Insurance	SECONDARY				PRIMARY
Ridge to Valley Integrated Watershed Management	SECONDARY				PRIMARY
Livestock Insurance	SECONDARY	SECONDARY			PRIMARY
Scores on the five criteria were assigned to each best practice as follows:					
NA = Not applicable.					
Green Meets criterion fully					
Yellow Meets criterion partially					
Red Meets criterion very little					

- Square trenches for cash crop planting (with organically enriched soils and micro irrigation with embedded bamboo sleeves, has produced dramatic results in semi-arid zones. The inter rows are planted with leguminous crop for increasing soil fertility and lentil/ beans production. This has ensured stable yields and acts as a hedge against crop failures, even in rock dispersed lands.
- The tree-land –crop-nexus needs to be exploited. Eucalyptus groves grown for fuel in marginal soils were planted with high value cardamom, using trenches again and further intercropped with African marigold flowers, as a cash crop, and to combat eel worm. Thus, a twelve year cycle of cardamom, and fuel income was assured. Swamps were drained with an innovative "lock and spill" method ensuring perennial water supplies and planted with tree spices, along with Luecana.l sp, which binds nitrogen, and increases milk yield dramatically and Shade loving "bird's eye" chilly acts as the cash crop.
- High yielding seeds must give way to climate and water stress resistant cultivars. Developing seed stock from diverse, eco sources has produced dramatic and hardy maize varieties.
- Fertilizers are expensive and wasted by broadcasting. Experiments have shown that a 50% reduction in use is possible with wrapping in coarse thin *Khadi* degradable cloth, and placing it. The production of these pouches and cloth spinning offers secondary employment "*Gandhiji's chakra*" especially to the aged and women.
- Hand powered micro sprayers with controlled droplet application; have been developed at low costs. This coupled with "target delivery chemicals" will see reduction in spray volumes by 75% and a saving in pest and disease control chemicals, by 60%, along with ecological safety.

- Captive farming, hydroponics, and low cost green houses, are very practical methods, in the sub tropics. Here the bottle neck is the transfer of technology and extensions. This can be overcome by demonstration and training units and farmer schools.
- Value addition and waste prevention are key issues at community level. Supporting and enhancing sun dried, puffed rice and flake production, sago production, wheat –rice-corn chips, nutritious mix "*sattu*", at local levels should be prioritised.
- All, inland water waste both domestic and other run offs should be garnered for aqua culture .Classic example is "cat fish" production in India for export.
- Reduce mystical hi-tech, to shack tech. The classical example (plant tissue culture) of Thailand's orchid production is a case in point.
- Encourage all forms of ruminant and other small species production in line with community "food sanctity (rabbit, deer, dog, bird species, reptiles, & other entomological beings) as protein replacements.
- Conversion of all human, animal and other bio degradable inputs (including human faeces, for power production, and fertilizer briquettes, after due digestion (The Salem, India method that produces 100 MW power and thousands of tonnes of pilled urea enriched bio mass for placement, from poultry refuse). Ingenuity in face of adversity is a basic "Homo Sapiens trait".
- Value chains and microfinance have an integrated, synergistic effect on small farm holders. The "hot spots" can occur in all aspects of production, harvest, retention and disposal. The criticality lies in the ability, to provide succour when most needed at short notice and efficiently. The informal system of emergency finance is very usurious. The suggestion is to create a community level "trained assayer and disburser" with macro institutional support, to meet exigencies.

Ingenuity in face of adversity is a basic trait of mankind. If man can go to the moon, LICs can be adequate, and all it needs is empathy, sharing, and knowledge transfer



II. ENERGY

Annexure 1

Total installations of renewable energy in India as on March 2013

SN	Power from renewables		Unit	Total Installation as on 31.03.2012
1	**Grid Interactive power**			
2	Biomass Power		MW	3,135.33
3	Waste to Energy		MW	89.68
4	Wind Power		MW	17,352.66
5	Small Hydro Power		MW	3,395.33
6	Solar Power		MW	941.24
	Total			24,914.24
7	**Off-Grid Power**			
8	Biogas Plants		Nos.	45,45,182
9	Water pumping wind Mills		Nos.	1,352
10	SPV Pumps		Nos.	8,792
11	Solar Photovoltaic	Street Lighting System	Nos.	226,506
		Home Lighting System	Nos.	8,92,974
		Solar Lantern	Nos.	930,813
		Power Plants	kWp	23,431
12	Aerogenerator Hybrid system		kW	1,647.5
13	Solar Cooker		MW	1,221.26
14	Biomass Gasifier		MW	150.21
15	Waste to Energy		MW	70.54
16	Remote Village Electrification	Villages	Nos.	7,286
		Hamlets	Nos.	1,874

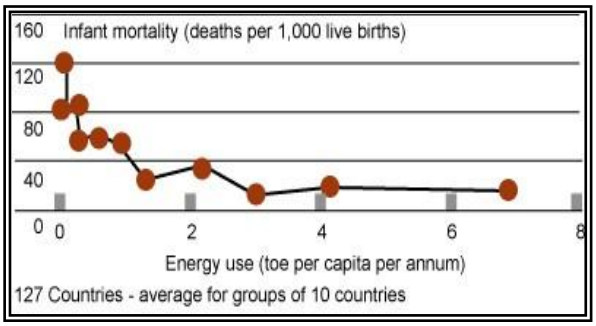
Source: *MNRE Annual Report 2012*

Annexure 2

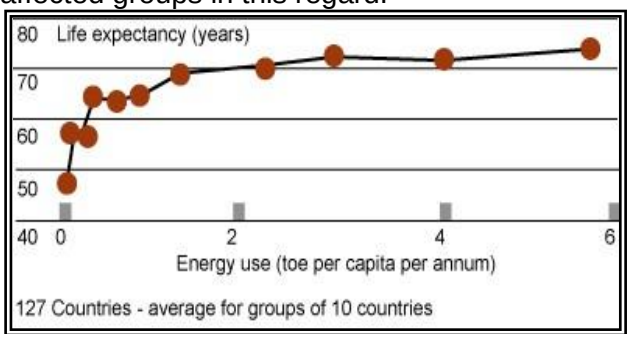
Impact of energy consumption on growth, human development and poverty reduction

Human development index and poverty reduction

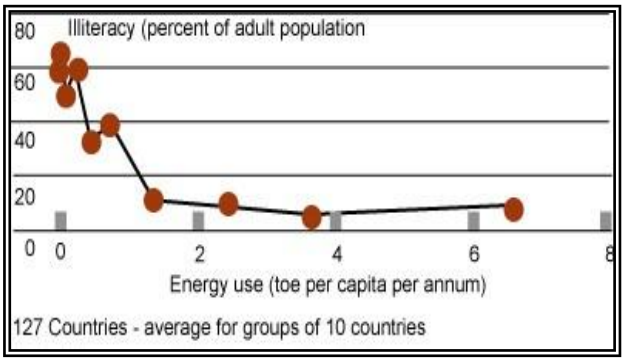
In the majority of the developing countries where commercial energy consumption is low, illiteracy and infant mortality are high, while life expectancy is low. Low energy consumption is not the cause of poverty; however, it is an indicator for many of its elements, such as poor education, bad health care, and the hardship imposed on women and children[1].



The lack of access to energy is one of the key factors contributing to the relatively poor quality of life in the rural areas. Traditional biomass still remains the primary energy source for cooking, accounting for 75% of the total rural energy demand. Use of kerosene for lighting and of traditional biomass for cooking leads to high indoor air pollution. Women and children are the most affected groups in this regard.



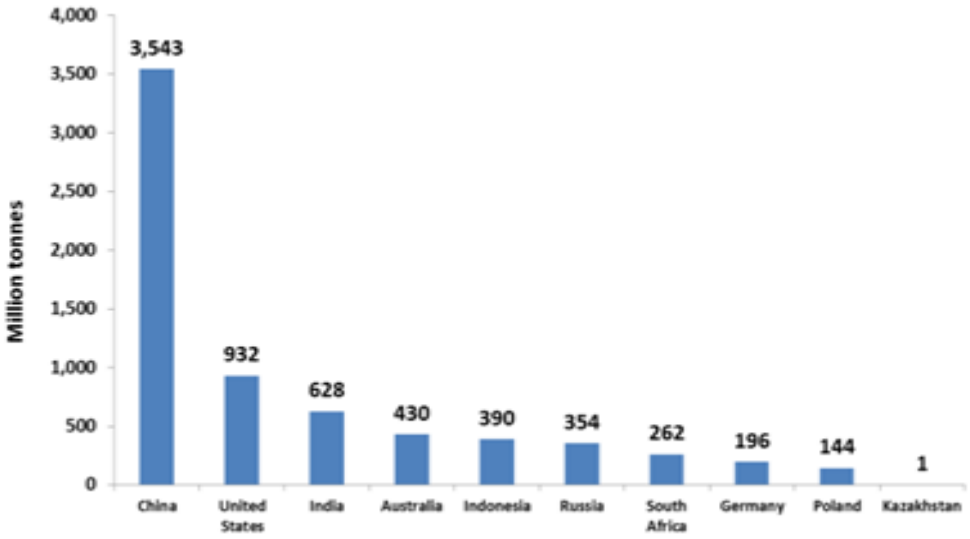
The lack of access to modern energy services also limits the livelihood opportunities be it in the form of employment in the cottage or rural industry, or by way of imposing a limit on farm productivity.



[1] Grant making strategy for TPW: Energy Collaborative in India, 2009

Annexure 3

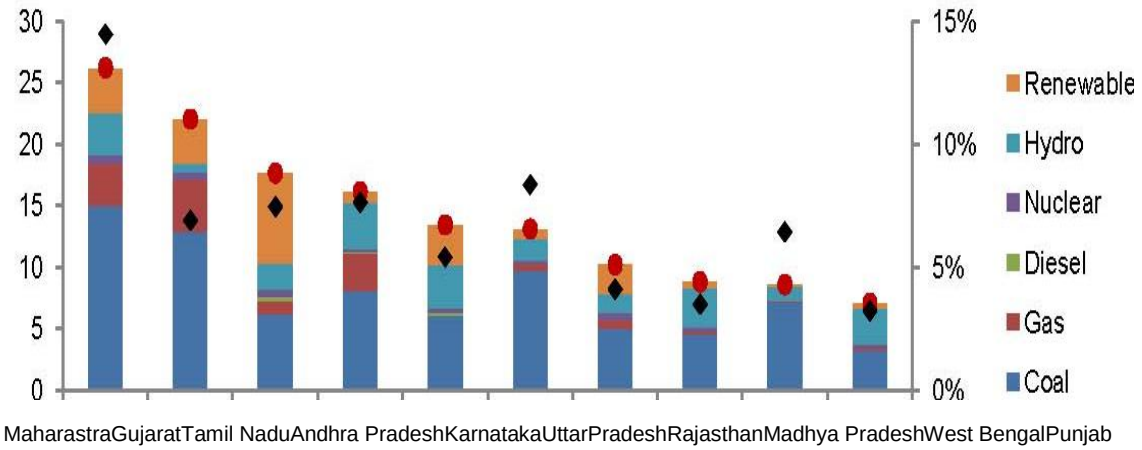
World's 10 largest coal producing countries (2012)



Source: *IEA: Understanding Energy Challenges in India*

Annexure 4

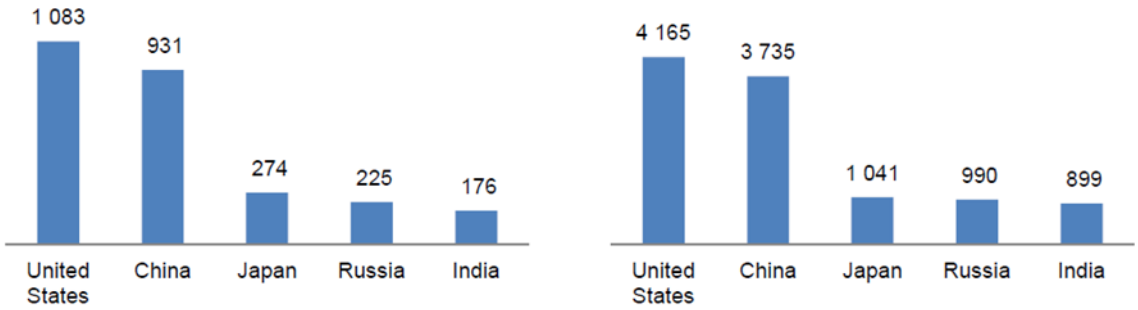
India's top ten states by installed power generation capacity (2012)



Source: *IEA: Understanding Energy Challenges in India*

Annexure 5

Top five countries in installed capacity and electricity generated (2012)

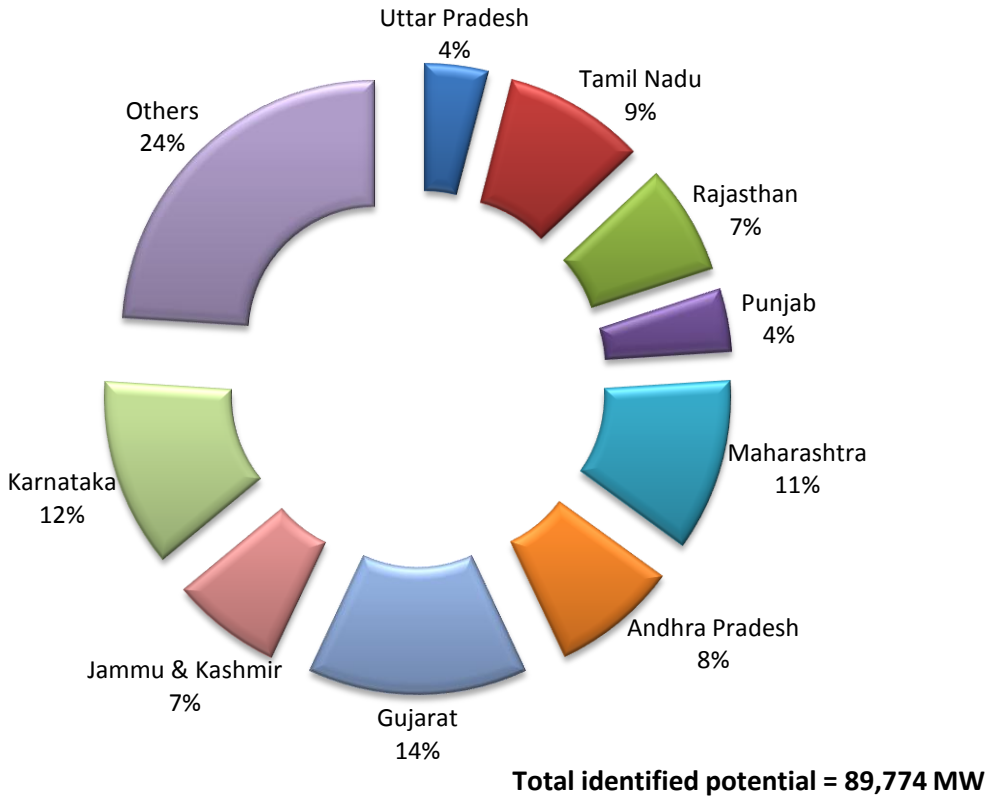


Installed capacity (GW) ***Generated electricity (TWh)***

Source: *IEA: Understanding Energy Challenges in India*

Annexure 6

Spatial distribution of renewable energy potential in India (2012)

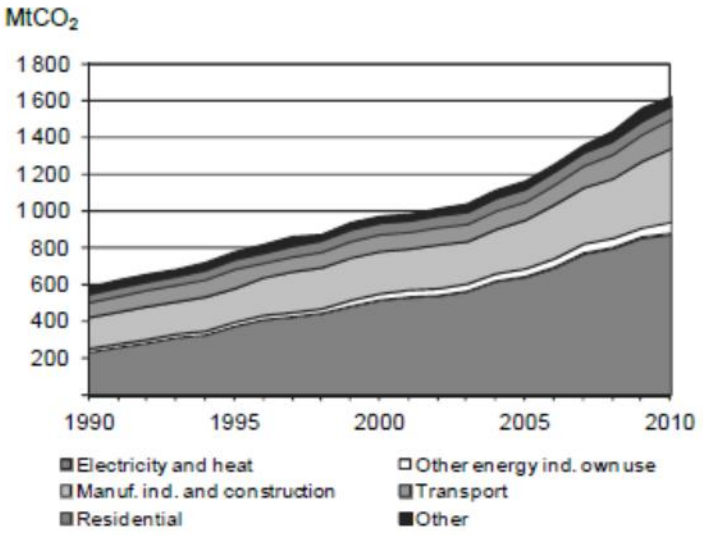


Source: *Energy Statistics 2013, Central Statistical Office, National Statistical Organization, Ministry of Statistics and Programme Implementation (www.mospi.gov.in)*

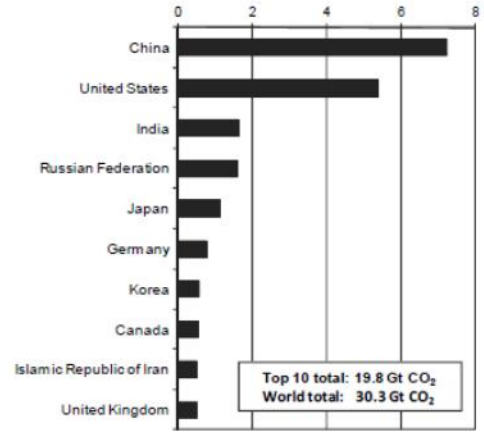
Annexure 7

Sectoral distribution of India's CO_2 emissions and world's top ten CO_2 emission countries

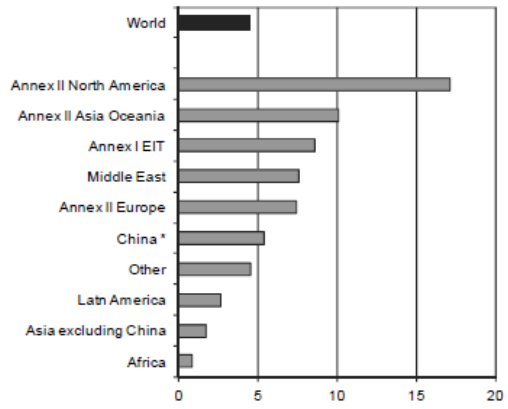
The CO_2 emissions in India have almost tripled between 1990 and 2010 and account for more than 5% of global CO_2 emissions. A large share of these emissions is produced by the electricity and heat sector, which represented 54% of CO_2 in 2010, up from 40% in 1990.



Key point: The bulk of CO_2 emissions in India comes from the electricity and heat generation sector, the share of which continues to grow.



Key point: The top 10 emitting countries account for nearly two-thirds of the world CO_2 emissions.



* China includes Hong Kong.

Key point: Emissions per capita vary even more widely across world regions than GDP per capita.

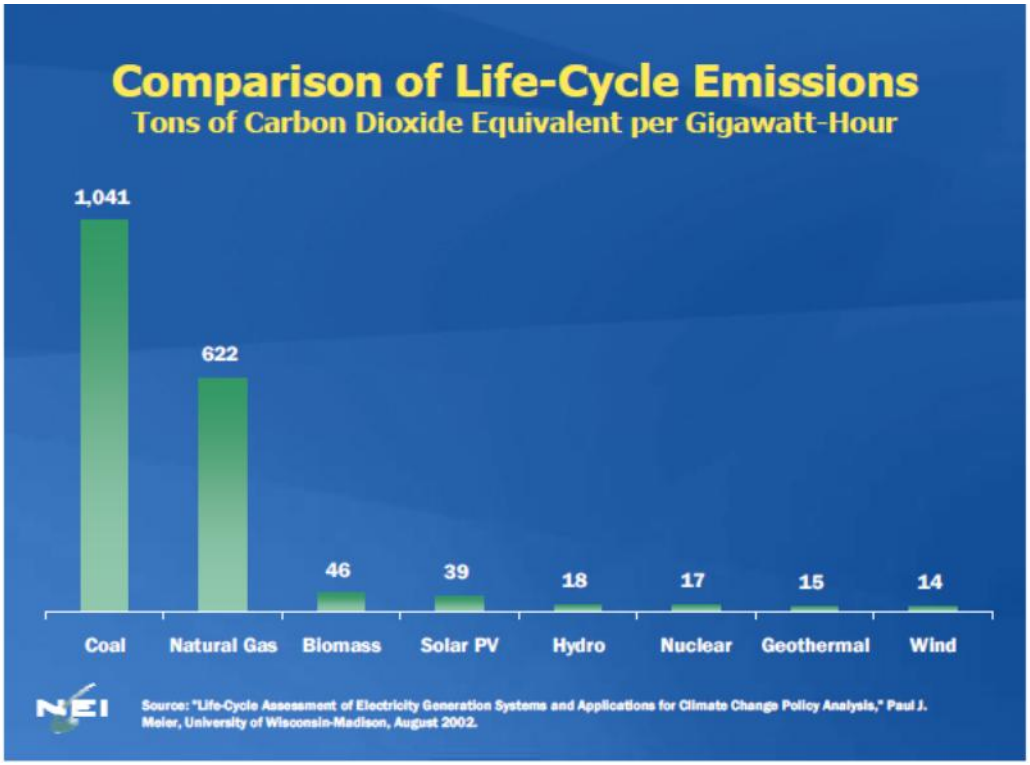
Top 10 Emitting Countries in 2010 (GtCo2)[2]

Per capita CO2 emission by major world regions

[2] CO_2 emission from fossil fuel combustion

Annexure 8

Comparison of life-cycle emissions of electricity generation



Source: *Energy Scenario and Vision 2020 in India*

Annexure 9

Energy demand forecasts for 2020 and 2050

- **Power sector**

The current and projected installed capacity and the electricity generation mix by power generation technology for three scenarios (reference case; low carbon scenario-1; low carbon scenario-2) are shown in Figure 1 below:

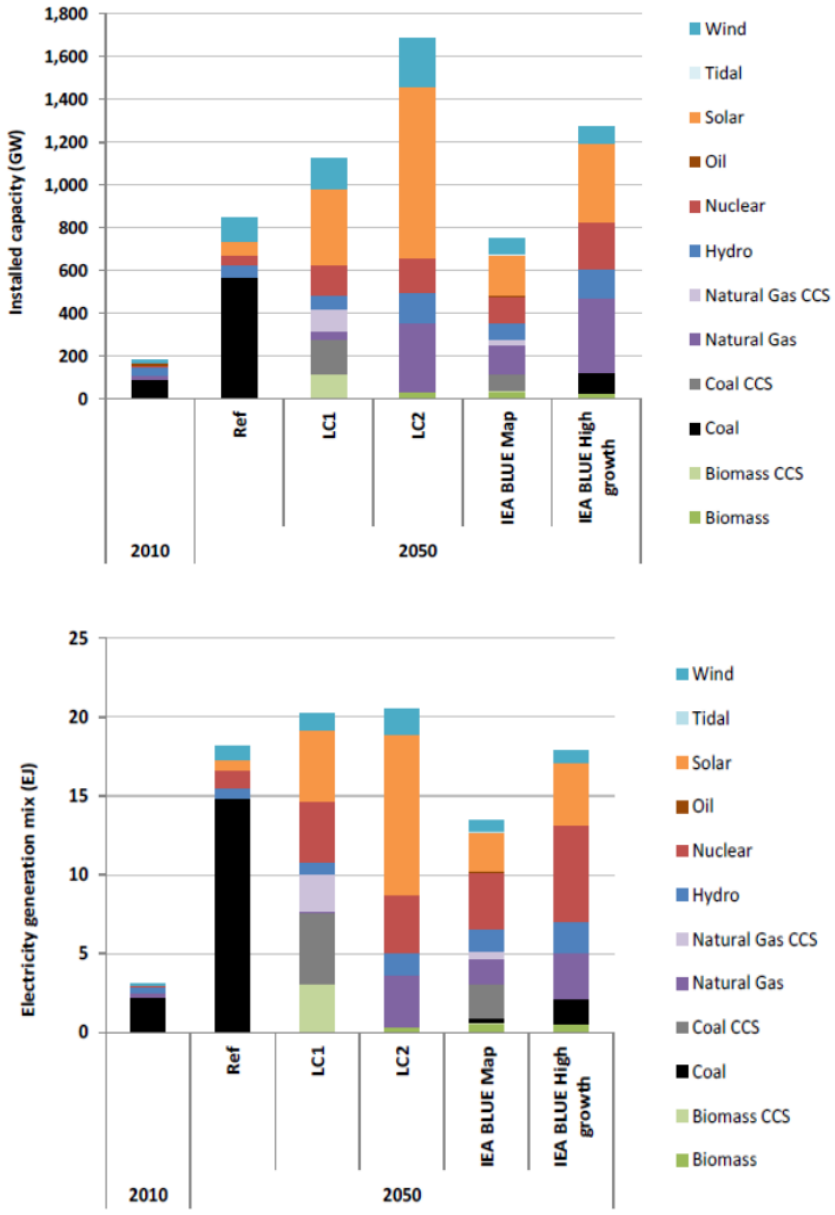


Figure 1: ***A) Installed power generation capacity showing mix of different power generation technologies (top). B) Power generation mix of the different scenarios (bottom)***

- **Industrial Sector**

India is the world's fourth largest consumer of energy for industrial activities. The share of sectoral energy demand is not projected to change significantly by 2050. Currently, around 28% of industrial energy demand in India is supplied by coal. Unlike developed countries, biomass supplies the next largest share of energy (22%). This is largely for combustion in small boilers. Gas and oil each supply 19% and electricity makes up the remaining 12%.

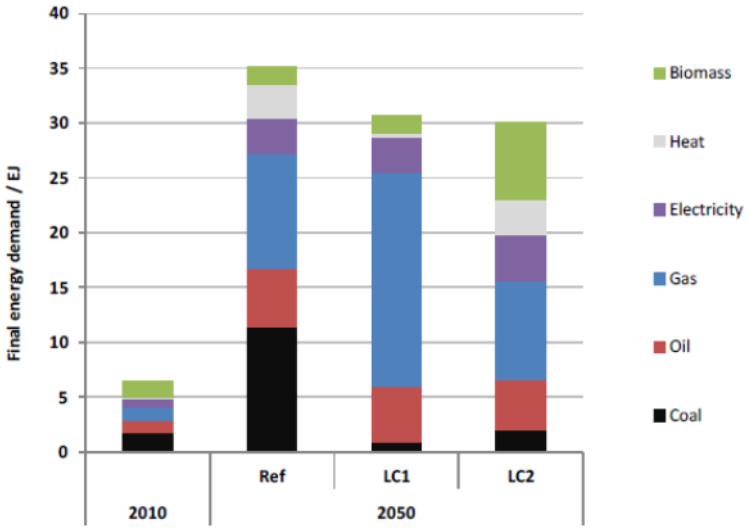


Figure 2: ***Industrial final energy demand and fuel mix for the three different scenarios***

- **Transport sector**

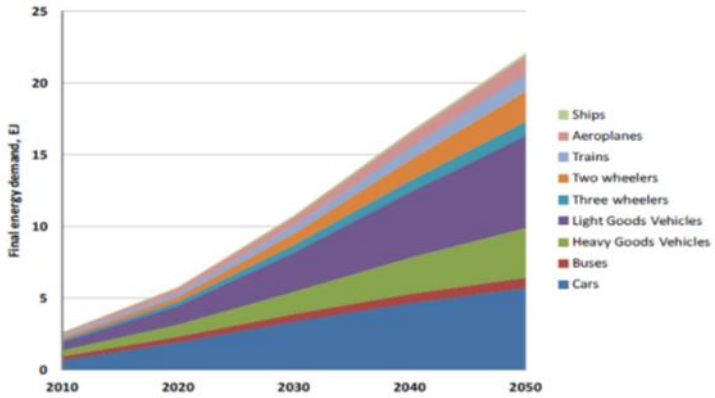


Figure 3: ***Final energy demand by transport mode between 2010 and 2050 in reference scenario***

The nature of the vehicle mix in 2050 will be influenced by the degree of continuing uptake of motor-scooters and other two wheelers, as opposed to a shift to cars as incomes increase, as well as the provision of efficient public transport as urbanisation continues. Perhaps most significantly for India's future CO_2 emissions, car transport is taken to grow about 10-fold over the next four decades, driven by increasing uptake as incomes rise. Other studies show similarly strong growth trends, with TERI (2006) projecting an almost 10 to 15-fold increase in passenger-km levels for cars and taxis by

2030 compared to current levels. In terms of future energy demand, road transport (especially cars and light good vehicles) is projected to demand the majority of final energy, as shown in Figure 4.

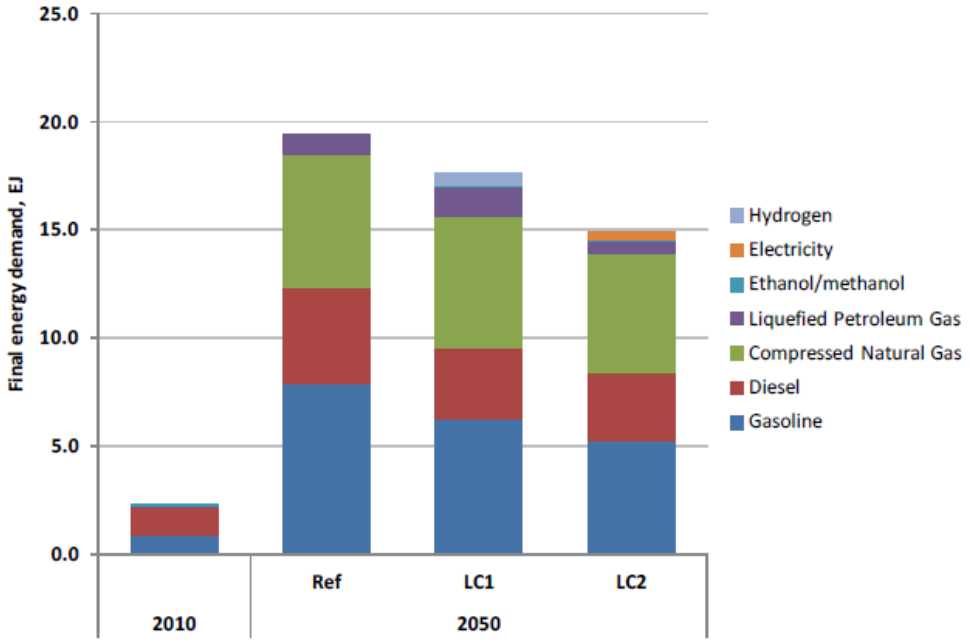


Figure 4: ***Energy demand (split by fuel type) in the road transport sector in 2010 and 2050***

- **Buildings**

In 2009, biofuels and waste made up almost 80% of total final energy demand (about 7 EJ) in the residential buildings sector, and over 40% of total final energy demand (about 0.6 EJ) in the commercial buildings sector.

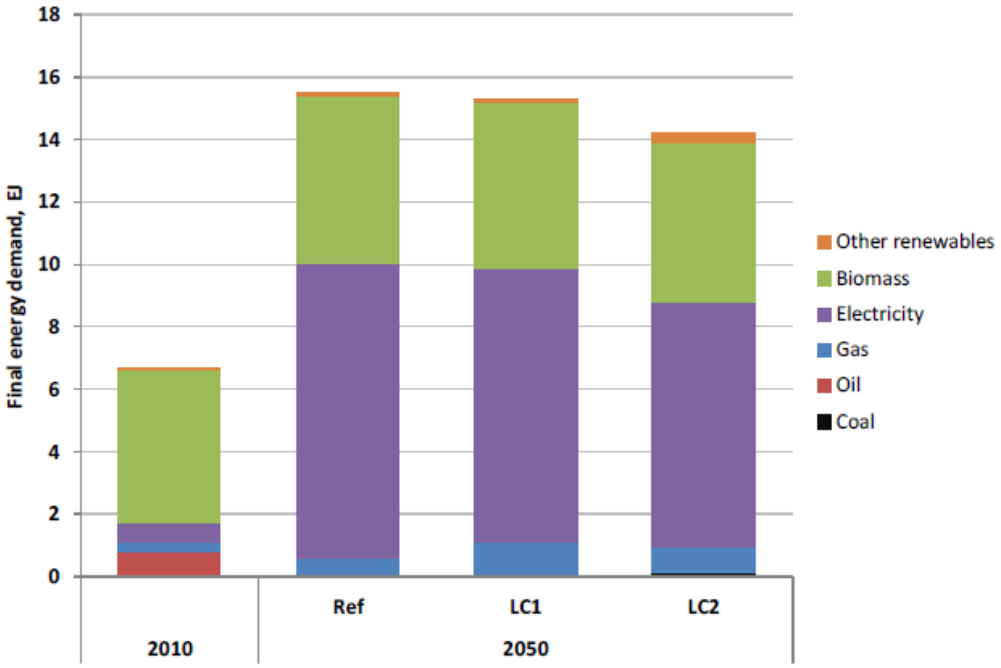


Figure 5: ***Final energy demand (split by fuel type) in residential buildings in 2010 and 2050***

Note: Other Renewables consists mainly of solar thermal heating

In residential buildings, cooking dominates today's energy demand and this could increase by around 30% by 2036. Much more dramatic energy demand increases will come from refrigeration (a five-fold increase to 2036), lighting (a doubling to 2036) and above all air conditioning (a twenty-fold increase to 2036). For commercial buildings, the modelling projects increased use of gas in the reference scenario principally in commercial cooking which dominates current and projected energy demand (Figure 6).

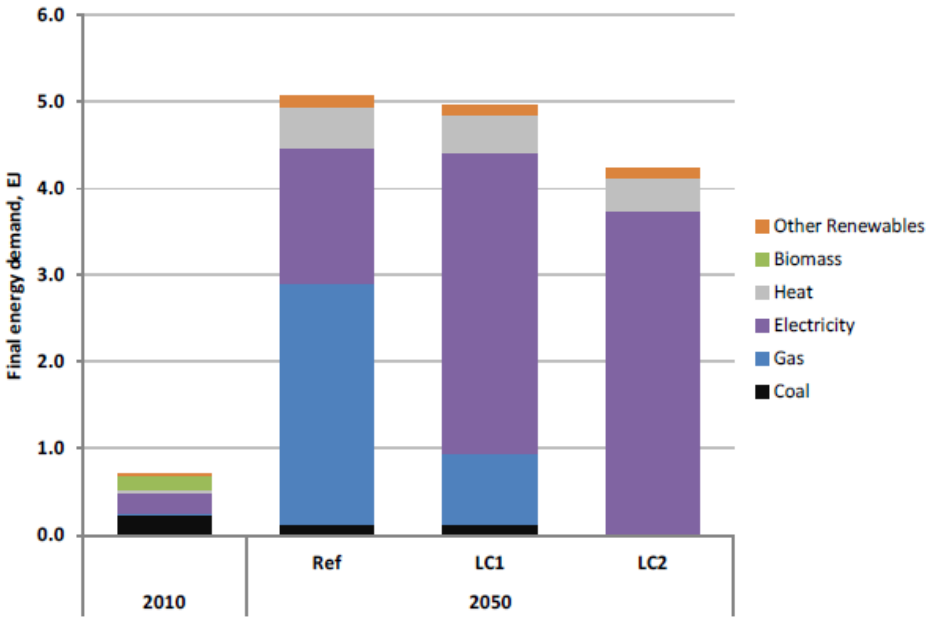


Figure 6: ***Final energy demand (split by fuel type) in commercial buildings in 2010 and 2050***

Note: Heat denotes combined heat and power, with emissions allocated to electricity generation

Other Renewables consists mainly of solar thermal heating

III. WATER

Annexure 1

Land Acquisition by India: 'Push' or 'Pull'?

The growing presence in the African continent by the two rising Asian giants, China and India, has implications for the continent's development. While these two countries reflect a shift away from dependence on the 'West' they are being accused of being a part of the global land acquisition club.

Although getting official figures is difficult, according to statistics provided by governments of various countries in East Africa, in 2010, more than 80 Indian companies hade invested about $US 2. 4 billion in buying or leasing huge plantations in countries in Africa such as Ethiopia, Kenya, Madagascar, Senegal and Mozambique to grow food grains and other cash crops for the Indian market. *(See Annexure 2).*

Why this push by India?

There are several reason behind ventures of buying land for farming in other countries:

- *Food Security Concerns*: India's current annual food grain production of 230 million tones is just about sufficient for the country right now. But, the Planning Commission estimates that this demand will go to 240 million tonnes (may be even 250 million tonnes by 2020! With an ever-increasing population and reduction of poverty on one hand and nearly stagnant food grain production in the last decade on the other, there is a greater likelihood of higher demand for food grains. Factors such as climate change, water scarcity, erratic rainfall and expansion of livestock production further add to the woes.
- Most of the Indian or Indian owned companies have bought hectares of land in Africa, South America and South East Asia to grow food grain, pulses and edible oils. Most of these are expected to be shipped back to India – a move being claimed to be backed by the Indian government. However, refuting this claim the Indian Ambassador Gurjit Singh addressing an Ethiopian Parliament Panel stated, "We are encouraging more Indian companies to come into mainstream agriculture so that they can contribute to local demand and food security."
- *Increasing water scarcity:* A 2009 study by NASA on northern India revealed that India is losing about one foot of its groundwater each year and in a state like Punjab it may go down to below 100 feet by 2020 where existing pumps and irrigation will stop working. As a result, Indian companies are being urged to do more land investing in water-rich South American countries for increased agribusiness opportunities.
- *The profit motive:* Not just food security but the low cost of farming is another added attraction for Indian companies to look at Africa. "The cost of agricultural production in Africa is almost half of India. There is less need for fertilizer and pesticides, labor is cheap and output is higher," according to S.N. Pandey, Director of Agro technology Division at Lucky Group.
  Besides, land prices in Africa are much lower than India so farmers can even think of doing a large-scale agricultural production at a lower cost: The land lease rate in Punjab's Doaba region is a minimum of Rs 40,000 per acre as compared to most African nations Rs 700 per acre (after INR conversion)
- *The government support:* Government support has come in various forms
  - Participation of many farmer trade missions at major regional and business summits to facilitate of entry of Indian foreign agricultural investors;

- Giving Concessional Lines of Credit (LoCs) to various developing country governments, banks, financial institutions, as well to regional financial institutions through the Indian Export Import Bank (Exim Bank);
- Support for new greenfield foreign direct investments, Merger and Acquisition (M & A), Public Private Partnerships (PPPs), negotiation of regional Bilateral Trade and Investment Treaties (and Double Taxation (Avoidance) Agreements; and,
- Liberalisation of rules by India on allowing outward foreign direct investment by Indian companies.

➥ *The support of Indian Business Associations*
- Several buyer-seller meets between African delegates and Indian businesses for discussion on agricultural investments organized by trade and industry organisations like Confederation of Indian Industries (CIIs) and Federation of Indian Chambers of Commerce (FICCI);
- Many Indian business associations are also directly pursuing overseas farming investments on behalf of their members. The Solvent Extractors Association (SEA), a body of over 800-edible oil producing companies, is advocating for greater Indian government support for helping Indian companies set up farming operations in Southern Cone of Latin America.

Is it just Push?

Besides the Indian interest in land investments abroad, there are many governments in Africa like those of Ethiopia, Trinidad, Tobago, Sudan, Mongolia, Egypt, Senegal and developing nations, which often invite Indian companies for land investments. The objective of the offer is to increase agriculture production in the respective countries to reduce their dependence on import of food grains and export surplus food grains to third world countries.

In 2011 it was reported that Ethiopia had offered 1.8 million hectares of its farmlands to Indian investors. India is, the largest foreign investor in Ethiopia with approves investments of $4.4 billion, of which 40 percent is for commercial agriculture. Already more than 80 Indian companies have bought or leased land in Ethiopia.

Concerns

➥ **Increased local population displacement** due to creation of huge new corporate agricultural plantations. The government claim that foreign investments in land will create job for locals and improve living conditions, has not been brought by all. For example, in Ethiopia, where over 600,000 hectares have been leased out to investors, the average landholding size is about 2 hectares. Thus over 300,000 families have been potentially displaced whereas only about 20,000 people are expected to get jobs on the highly mechanized farms.
➥ **More exploitation of the country's resources** terming it as a new form of 'neo-colonialism' thus leading to serious environmental concerns.
➥ **Increased labor issues** and poor working conditions of the local employees in foreign investment projects.
➥ **Increased skepticism** wherein companies are being looked at merely interested in buying agricultural land and selling it either back home or in international markets.
➥ Weak Governance
➥ Profit as the only motive.

Source: *Inputs from "India's Role in New Global Farmland Grab" by Rick Rowden; August 2011, printed in collaboration with GRAIN and the Economic Research Foundation*

References

1. Mihretie, K. (2010) “Ethiopia on the Verge of Colony of Many,” Anyuak Media, 31 January.
2. Hazra 2009, Hazra, A. (2009) “India joins race for land in Africa, China way ahead,” Hindustan Times, 4 May.
3. Sharma, D. (2011) “With farmlands being grabbed, Africa too awaits march of the millions,” Ground Reality, 4 February.
4. Conclave by Confederation of Indian Industries (CII), April 29, 2010
5. Vashisht, D. (2010) “Punjab’s African plot,” Indian Express, 11 July.Goswami, R. (2010) “African landrush,” Infochange News & Features, 5 April.
6. Sharma 2011
7. Bagchi, I. (2009) “The new landlords,” Times of India, 26 September. *(Inputs from “India’s Role in New Global Farmland Grab” by Rick Rowden; August 2011)*

Annexure 2

A sample of Indian companies investing in agricultural land overseas

	Indian Company	Country	Details
1.	Karuturi Agro Products Plc	Ethiopia	Acquired 100,000 ha in the Jikao and Itang Districts of the Gambela Region for growing palm, cereal and pulses, with conditional option to acquire another 200,000 ha. Karuturi Agro Products is a subsidiary of Karuturi Global Ltd.
2.	Ruchi Soya Industries	Ethiopia	Acquired 25-years lease for soyabean and processing unit on 152,649 ha in Gambela and Benishangul Gumaz States
3.	KS Oils	Indonesia	Acquired 130,965 ha at Kalimantan for palm plantation; This is the third tranche of land acquired by the company after it previously acquired 210,039 ha in two deals in 2008 and 2009
4.	Verdanta Harvests Plc	Ethiopia	Acquired a 50-years lease for 5,000 ha in the Gambela region for a tea and spice plantation
5.	Chadha Agro Plc	Ethiopia	Acquired up to 100,000 ha in Guji Zone in Oromia Regional State for a sugar development project
6	Sterling Group	Argentina	Purchased a 2,000-hectare olive farm and another 17,000 ha for growing peanuts
7.	Olam International	Argentina, Gabon, Uruguay	Acquired 17,000 ha in Argentina to grow peanuts, 300,00 ha in Gabon for palm oil and 16,000 ha in Uruguay for dairy farming. Olam is a Non-Resident Indian firm based in Singapore
8.	Varun International	Madagascar	Subsidiary Varun Agriculture Sarl leased or purchased 232,000 ha to grow rice, corn and pulses
9.	Solvent Extractors Associations of India	Latin America (Uruguay, Paraguay)	A consortium of 18 vegetable oil companies was set up to acquire lands in Latin America to grow soyabean and sunflower
10.	Uttam Sucrotech	Ethiopia	Won a $100-million contract to expand the Wonji-Shoa sugar factory
11	Shree Renuka Sugars	Brazil	Purchased sugar and ethanol producer Vale Do Ivai S.A. Acucar E Alcool in November 2009 for $240 million, including its 18,000 ha of land for sugarcane; and acquired a 51-percent stake in Equipav SA Acucar e Alcool fr $329 million that owns two sugar mills and has 115,000 ha of cane growing land in south-eastern Brazil
12.	McLeod Russel India	Uganda	Purchased tea plantations worth $25 million, including Uganda's Rwenzori Tea Investments; McLeod Russel India is owned by BM Khaitan
13.	ACIL Cotton Industries	Brazil, Congo and Ethiopia	Plans to invest nearly $15 million (Rs 68 crore) for land leases to start contract farming pulses and coffee in Brazil, Congo and Ethiopia
14.	MMTC Ltd (state-owned)	Kenya and Tanzania	Plans to (as of Oct 2010) grow pulses
15	Adani Group	Africa, Brazil, Argentina, Indonesia and Malaysia	Plans to (as of Oct 2010) set up farms to cultivate edible oil and pulses
16	Neha International	Ethiopia	Leased land in the Oromia region — in Holetta for floriculture and near Bako for rice, maize, oilseeds and pulses
17	Saunari Agro Farm Enterprise Pvt. Ltd.	Ethiopia	Acquired a 25-years lease on 10,000 ha in Dimi District, Gambela Region, for the cultivation of rice, pulses, and cereals
18	Jay Shree Tea & Industries	Rwanda, Uganda	Acquired two tea plantations in Rwanda and one in Uganda; Jay Shree Tea & Industries is controlled by BK Birla
19	BHO Bio Products Plc	Ethiopia	Acquired 27,000 ha to grow cereal, pulses and edible oil crops
20	ACIL Cotton Industries	Brazil, Congo and Ethiopia	Announced plans in January 2011 to invest nearly $15 million (Rs 68 crore) to start contract farming of crops like pulses and coffee in Brazil, Congo and Ethiopia

Annexure 3

Water conservation works implemented under MGNREGA between 2006-12

SN	Type of Works	Total number of works completed from FY2006-2007 to 2011-2012 (in million)	On-going works (in million)	% of total works taken up from FY 2006-2007 to FY 2011-2012
1	Water conservation and water harvesting (eg farm pond, percolation tanks etc)	1.95	3.64	25
2	Flood control and protection (e.g. check dams, culverts, etc.)	0.39	0.59	4
3	Drought proofing (e.g. afforestation/tree plantation, agro-forestry, etc.)	0.52	1.3	9
4	Irrigation canals (macro and micro-irrigation works, etc.)	0.57	0.95	7
5	Renovation of traditional waterbodies (e.g. desilting of tanks, etc)	0.66	0.98	7
	Total water conservation and water related works	4.09	7.46	52

Source: Ministry of Rural Development, Government of India, *MGNREGA Sameeksha, An Anthology of Research Studies on the Mahatma Gandhi National Rural Employment Guarantee Act, 2005, 2006–2012*. Edited and compiled by Shah, M., Mann N. and Pande, V. 2012, Orient BlackSwan, New Delhi, India.

Annexure 4

List of MNREGA activities and its expected environmental services

MGNREGA Activities	Local Environmental Services	Regional and Global Environmental Services
Water conservation and harvesting	Groundwater recharge, soil moisture retention, and protection (erosion control), flood control (reduced risk), providing irrigation and drinking water and improving soil quality (nutrient recycling)	Water conservation
Irrigation provisioning and improvement	Providing irrigation, improved agriculture and livelihoods, increased crop production	Reduce the need for methane producing large farms
Renovation of traditional water bodies	Improved storage capacity, irrigation availability, groundwater recharge, soil quality (nutrient recycling), biomass production and crop production	Water conservation
Land development	Land reclaimed for agriculture, improved irrigation availability, hance agriculture and livelihood improvement	
Drought proofing	Soil moisture retention, protection (erosion control) and soil quality (nutrient cycling), flood control (reduced risk), biomass production (fuel wood) and local climate regulation	Water conservation, carbon sequestration, biodiversity conservation
Flood control	Better drainage, higher land productivity (erosion control) and flood control (reduced risk)	Water conservation

Source: Ministry of Rural Development, Government of India, *MGNREGA Sameeksha, An Anthology of Research Studies on the Mahatma Gandhi National Rural Employment Guarantee Act, 2005, 2006–2012*. Edited and compiled by Shah, M., Mann N. and Pande, V. 2012. Orient Black Swan, New Delhi, India.

Annexure 5

Standard Operation Procedures for Drinking Water and Sanitation

All Central Ministries/ State Governments are mandated to prepare detailed Standard Operating Procedures (SOP) in consonance with the national SOP, national policy and various guidelines issued by National Disaster Management Authority (NDMA) for their sectors.

The Ministry of Drinking Water and Sanitation (MDWS) keeps aside 2 per cent of its funding under the National Rural Drinking Water Programme (NRDWP) for assisting the States to mitigate drinking water problems in rural areas in the wake of natural calamities. It has also prepared an SOP.

The SOP lays down the institutional mechanisms at national, state, district, block and village level. It lays down the specific actions required at these levels in responding to natural disasters of any magnitude and dimension and brings out the roles and responsibilities of various stakeholders in providing water, sanitation and hygiene services during different phases of disasters. It is meant to guide the administration at various levels to respond better in maintaining the basic services of drinking water and sanitation during natural disasters. In case of drought, this specific action could include development of a detailed contingency plan for drinking water supply, identification of habitations in need of emergency drinking water supply, identification of water sources which can be tapped, rejuvenation of ponds and other water bodies, deepening of tube wells, arranging for tanker water supply and repair of hand pumps.

It lists the actions to be undertaken by the individual officers (for example Executive Engineer, Assistant Executive Engineer, Assistant Engineer and Junior Engineer) before, during and after disasters. This will enable the officers at all levels to be better informed and equipped to prepare for, respond to and recover from the impact of disasters.
State governments are also encouraged to prepare their own State SOP for Rural Drinking Water and Sanitation.

In case of drought, the key responsibilities of the engineer include (a) prepare a detailed contingency plan for supply of drinking water in rural areas with technical help from the Central Ground Water Board (CGWB) and utilising, if need be the rigs and other capital equipment from the CGWB (b) Identify habitations / villages indicating the month from which they are likely to face water scarcity(c) promote rainwater harvesting (d) work closely with NGOs (e) set up a toll free helpline.

(For details of the SOP refer to Standard operating procedures for responding to natural disasters: Rural Drinking Water Supply and Sanitation, Ministry of Drinking Water Supply and Sanitation, 2011).

Annexure 6

Area under micro irrigation

State	Area under drip irrigation in '000 ha	Area under sprinkler irrigation in '000 ha	Total area under MI IN '000 ha
Andhra Pradesh	363.07	200.95	564.02
Bihar	0.16	0.21	0.37
Chhattisgarh	3.65	59.27	62.92
Goa	0.76	0.33	1.09
Gujarat	169.69	136.28	305.97
Haryana	7.14	518.37	525.50
Himachal Pradesh	0.12	0.58	0.70
Jharkhand	0.13	0.37	0.50
Karnataka	177.33	228.62	405.95
Kerala	14.12	2.52	16.64
Madhya Pradesh	20.43	117.69	138.12
Maharashtra	482.34	214.67	697.02
Nagaland	0.00	3.96	3.96
Orissa	3.63	23.47	27.10
Punjab	11.73	10.51	22.24
Rajasthan	17.00	706.81	723.81
Tamil Nadu	131.34	27.19	158.52
Uttar Pradesh	10.68	10.59	21.26
West Bengal	0.15	150.03	150.18
Other States	15.00	30.00	45.00
Total	**1428.46**	**2442.41**	**3870.86**

Data Source: *Spread and Economics of Micro-irrigation in India: Evidence from Nine States: K Palanisami, Kadiri Mohan, K R Kakumanu, S Raman, Economic and Political Weekly, June 25, 2011 VOL XLVI NOS 26 & 27*

Annexure 7

State-wise subsidy scheme for micro-irrigation

State	Subsidy % for drip irrigation	Subsidy % for sprinkler irrigation	Major crops under MI
Andhra Pradesh	70	70	Chilies, Mango, Orange, Groundnut
Bihar	90	90	Sugarcane, Banana, Coconut, Maize
Chhattisgarh	70	70	Sweet Orange, Vegetables
Goa	50	50	Vegetables
Gujarat	50	50	Cotton, Vegetables, Groundnut
Haryana	90	50	Orchard crops
Himachal Pradesh	80	80	Orchard crops
Jharkhand	50	50	Vegetables
Karnataka	75	75	Grapes, Vegetables, Groundnut
Kerala	50	50	Coconut, Areca Nut, Pepper
Madhya Pradesh	70	70	Sweet Orange, Banana, Vegetables
Maharashtra	50	50	Grapes, Banana, Sugarcane, Cotton
Orissa	70	70	Vegetables, Cashew, Mango, Banana
Punjab	75	75	Vegetables, Orchard crops
Rajasthan	70	60	Groundnut, Maize
Tamil Nadu	65	50	Sugarcane, Banana, Coconut, Maize, Groundnut
Uttar Pradesh	50	100	Vegetables, Mango, Sugarcane
Uttarakhand	50	50	Potato, Groundnut, Orchard crops
West Bengal	50	50	Banana, Maize, Mango

Data Source: *Spread and Economics of Micro-irrigation in India: Evidence from Nine States: K Palanisami, Kadiri Mohan, K R Kakumanu, S Raman, Economic and Political Weekly, June 25, 2011 VOL XLVI NOS 26 & 27*

Annexure 8

Terrain-specific traditional water harvesting systems for agriculture and drinking water

Ecological region	Systems for agriculture	Systems for drinking water
Hill and mountain regions	• Diversion channels leading directly to agricultural fields (example, guhls and kuhls of western Himalaya) or to a storage structure so that water can be used in the subsequent dry period (eg. zings of Ladakh).	• Harvesting of natural springs. • Rooftop rainwater harvesting. • Carrying spring water over long distances through bamboo pipes.
Arid and semi-arid regions	• Rainfed storage structures, which provide water for a command area downstream (eg. tanks). • Stream or river fed storage structures, sometimes built in series wit overflow from one becoming the runoff for the subsequent one (eg. system tanks of Tamil Nadu, bandharas of Maharashtra, keres of Karnataka. • Rainfed storage structures, which allow runoff to stand over and moisten the fertile soil-bed of the storage structure itself, which is later, used for growing crops (eg. khadins in Jaisalmer and johads in Alwar district, Rajasthan.	• Groundwater harvesting structures like wells and stepwells to tap groundwater (eg. bavadis of Rajasthan and Gujarat). • Groundwater harvesting structures like wells and stepwells, especially below storage structures like tanks to collect clean seepage for use as drinking water (eg. structures in the forts of Chittor and Ranthambore).
Plains and flood plains	• In the floodplains of major rivers, people built inundation channels which allowed floodwater to be diverted to agricultural lands (eg. flood irrigation system of West Bengal) • In the specific types of soil and cropping regions, storage of rainwater in the agricultural fields by bunding these (eg. Haveli system of Madhya Pradesh).	• Dugwells
Coastal areas	• Regulatory systems to control ingress of saline river waters, especially during coastal tides, and thus maintain crop productivity in the coastal plains (eg. Khazana lands of Goa).	• Dugwells

Source: Agarwal A and S Narain (1997), Dying Wisdom, Rise, Fall and Potential of India's Traditional Water Harvesting Systems, p 27

Annexure 9

Involving the people in groundwater management in drought-prone regions, AP

The Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) project was implemented in seven drought-prone districts of AP state. The goal of the project was to enable farmers to manage their groundwater systems and adopt suitable agricultural options.

Over 9,000 farmers residing in 638 habitations voluntarily took several steps to reduce groundwater pumping for tiding over the problem of groundwater depletion. The project was funded by the Royal Netherlands Embassy, New Delhi, and the implementation guided by Food and Agricultural Organization (FAO). The NGO Bharatiya Integrated Rural Development Society (BIRDS) implemented the project through a federation of nine NGOs.

APFAMGS was designed to stimulate farmers' innovation in the assessment and analysis of groundwater, and fine tune initiatives to optimize water-based livelihoods. The knowledge was used to help the farmers and other vulnerable communities deal with the depleting groundwater and its effect on agriculture. Community institutions took responsibility for assessing groundwater availability for a micro unit, and used the understanding to plan groundwater resources sustainably for their agriculture and livelihood pattern. Overall, the effort was also to ensure that there is no attempt to dilute the science just because the community handles it.

The project (i) Offered local solutions in managing groundwater distress; (ii) Reduced groundwater pumping along with an increase in wealth creation; (iii) Enhanced recharge initiatives and consequent rise in water level; and (iv) Diversified the cropping system matching with availability of water.

For the first time, the issue of water was not compartmentalized on the basis of individual farmers, habitations and villages. Water was looked at comprehensively at the micro-basin level with all competing interests brought to a common platform and the needs prioritized scientifically and equitably.

The farmers also worked out ways to reduce ground water pumping through changes in cropping, crop diversification, improved water use efficiency, improved pump efficiency, regulating new well construction and reviving abandoned wells as recharge structures.

Outcomes included: (a) A significant change in the cropping system; (b) Increase in crop diversity from 14 to 32, largely in favour of low water consuming and low risk crops; and, (c) Substantially reduced irrigation (ranging from 20-60 per cent) in the cultivation of high water consuming crops like paddy, sugarcane, banana, turmeric, and mulberry. Food security and improved nutrition were never compromised while changing the cropping systems.

The core message of the project, that groundwater abstraction over the long term needs to be aligned with water availability, is taking hold. This is suggested by the emerging positive correlation between water availability and water use in 48 out of the 58 project hydrological units. The project also indicated how enabling communities to generate and handle scientific input can result in solutions that are acceptable to all.

(http://www.mdws.gov.in/sites/upload_files/ddws/files/pdfs/Towards%20Drinking%20Water%20Security.pdf).

Annexure 10

Raj Samadhiyala, Gujarat

In 2002 Raj Samadhiyala village in Gujarat state got around 80 mm of rainfall. It was the severest drought year for the state. Despite this, the wells in the village had water and the water supply scheme was supplying water for close to eight hours a day. This was probably the only village that did not report out-migration.

Raj Samadhiyala is an example of integrated water resource management backed by good water governance that resulted in water security. For the last 30 plus years, since 1978, the village has been harvesting rainwater. It is more than 20 years that the village last received drinking water through tankers, which is in stark contrast to surrounding villages. Irrespective of drought, villagers here have been taking up three crops a year using the harvested rainwater. In 2002, while the state reported a crop loss of 60 per cent, the annual estimated earnings from agriculture in this village were around Rs 3 million (USD 45,984).

Raj Samadhiyala was a severely water scarce village in 1970s. Village women used to walk five to seven kilometers for fetching drinking water. Irrespective of rainfall, water scarcity remained the biggest problem. An irregular water tanker was the only hope for getting water at the village. The groundwater level dipped to 250 metres.

In 1978 the villagers took up extensive rainwater harvesting measures and established a village development committee that took over water management and laid strict rules for water use. To start with, the village development committee planned out in detail how to harvest the 500 mm average rainfall it gets, for optimal uses.

Between 1978-2003, Rs. 25 million (USD 383,200) from the available District Rural Development Agency (DRDA) government funds was spent on water harvesting, through the construction of 45 check dams, percolation tanks and farm ponds over an area of 1,090 hectares. Run off rainwater was directed into sub-surface percolation structures using satellite maps that indicated old dried water channels. To treat the catchments, 60,000 trees were planted to help regulate water runoff and enhance water conservation.

In 1992 the village stopped getting water through tankers. All the water conservation works resulted in recharging of groundwater: The water level went up, from 250 metres in 1985 to 15 metres in 2004. A 70 feet deep well, earlier completely dry, is now exclusively used for supplying drinking water to 300 households. The well has 60 feet of water, even when monsoon fails. Water is pumped to a surface tank and from there supplied to households through taps. It appears that the village has reached a sustainable level where groundwater recharge and surface water use are balanced.

Annexure 11

Hiware Bazar, Maharashtra

Hiware Bazar village in semi-arid Ahmednagar district of Maharashtra state is one of the few villages in the country that undertakes an annual water budgeting exercise, which it has been doing since 2004. The district's groundwater department is a key partner in the village's tryst with water security. It has been more than a decade that the village stopped having a seasonal drinking water problem.

Once a prosperous village, the scenario changed after the 1972 drought, one of the worst of the 20th century. First forests vanished, triggering soil erosion and groundwater depletion. Traditional water harvesting structures collapsed. This affected water availability, both for drinking and irrigation. There was virtually no water after the monsoon. The impacts of droughts were also becoming severe, compounded by ecological degradation.

In 1989 the village took the first step towards water security by adopting an integrated model of water management. The village used all available government funding resources, while retaining decision-making power with the village institution that had representation from all constituencies in the village. Voluntary labour participation by residents became mandatory. To begin with the village regenerated the 70 ha of village forests, the catchment for the wells. With government money and voluntary labour participation 40,000 contour trenches around the hill to conserve rainwater and recharge groundwater were built. Between 1995-2005, the entire development money was spent on water conservation. The 70 ha of afforestation helped in treating the catchments for most of the wells, the contour bunding stopped run off and saved farms from silting, and around 660 water harvesting structures of various types captured rainwater.

In early 1990s, the wells had water for more than eight months. By 1995-96, the village got drinking water throughout the year from local sources. The water table has gone up in village wells. With rising water level, the number of wells has also gone up – from 97 in 1990 to 217 in 2007. The village also reaped a rich harvest, providing an increase in agriculture income: In 2006 the agricultural income was Rs 24.70 million (USD 378,601; *Mahapatra et al, 2010*).

Every year, the village measures the total amount of water available in the village, estimates its uses and then prescribes the agricultural cropping pattern to be taken up. The idea is to strike a balance among all water uses. The villagers decide on the crops to be grown consensually. Borewells have been banned to safeguard aquifers.

The audit begins with monitoring the groundwater level of the six observation wells in the village, along with the amount of total rainfall received measured by the rain gauges installed in the village. The sum of rainfall and groundwater is the water available. The villagers then budget water for the village, awarding priority for drinking (for humans and animals) and other daily uses. Seventy per cent of the remaining water is used for irrigation and the rest for groundwater recharge.

The water audit has been very useful in ensuring sustainability of both agriculture and water availability for drinking purposes for humans and livestock in the village. During 2003-04, there was a drought in the district and there was a drinking water scarcity, Hiware Bazar did not need tankers. That year, the villagers did not cultivate any major crop and switched to drip irrigation for crops like tomatoes and onions.

Annexure 12

Laporiya, Rajasthan

Nine droughts between 1997-2007 and still Laporiya in Rajasthan state did not need a water tanker. Its wells had enough water for drinking purposes, its soil had enough moisture to support a good harvest of fodder to sustain a livestock population that yielded Rs 3.7 million (USD 56,713)a year from milk sale.

The village got a good monsoon of 700 mm in 1997 and since then, till 2007, the rainfall ranged from 100 to 238 mm. Yet this village did not require aid in the form of water tankers for drinking purpose when all the nearby villages suffered from lack of water. Over 189 families here traveled the journey from drought and thirst to self-sufficiency, by reviving traditional rainwater harvesting systems. And on the way, it has inspired 250 more villages to take the same path for a water secured future.

The village, once well networked with traditional water harvesting structures, slipped into an abyss of ecological degradation. After Independence in 1947, embankments of its most reliable water source, the Ann Sagar breached. Nobody cared to repair it for the next 20 years. Being the main recharge point for numerous dug wells used for drinking purposes, it impacted the overall groundwater level. Gradually the village became water scarce. In spite of there being rain, the land was completely dry. There was no moisture in the soil. All rainwater ran off into the river. By the 1970s, the government described the village as 'barren with highly saline landscapes and denuded pasturelands, capable of producing only one low-value monsoon crop'. During summer months, 40 per cent of the population migrated to the cities in search of jobs and, due to lack of fodder, some 75 per cent of livestock moved to nearby states.

In 1991, the village began digging 50 new wells, three large natural tanks, and a unique dyke system called the 'chauka' to capture rainwater in pasturelands. The number of tanks excavated in the village and surrounding areas in 1991 alone was worth Rs. 2.5 million. The first impact was felt in availability of drinking water. The village for the first time got drinking water round the year. Water table levels in the village rose to just 15 feet below the surface, from a depth of 60 feet in 1991. Its 100-odd wells got back life – the major sources of drinking water. Availability of water ensured a bumper harvest. Villagers grew wheat in Laporiya for the first time in 20 years. The amount of irrigated land area increased to 741 acres (300 ha) and the village's agricultural production increased more than 12 times. Laporiya's efforts to conserve land and water are an integrated and multi-pronged approach that requires villagers to make interventions and changes at every step.

Laporiya model is now being adopted in 250 neighbouring villages in Rajasthan ensuring drinking water security to some 42,000 families. As a result, at least 40 villages have moved out of the government status of 'drought-prone'. If rainwater harvesting measures would not have been adopted, the villagers would have been searching for drinking water for themselves and their livestock, living a life in penury.