Theme 1 : Resource appraisal and inventorization

1.1 Inventorization of resources including use of modern tools for planning and monitoring

1.1.1 Soils, land capability classes and various land forms in eastern region

(A.K. Sikka, B.Saha and L.K.Prasad)

Soil classification: Seven taxonomic soil orders namely Entisol, Aridisol, Inceptisol, Alfisol, Vertisol (or) Vertic at sub-group levels, Mollisol and Histosol are prevalent in eastern region (Fig. 2).

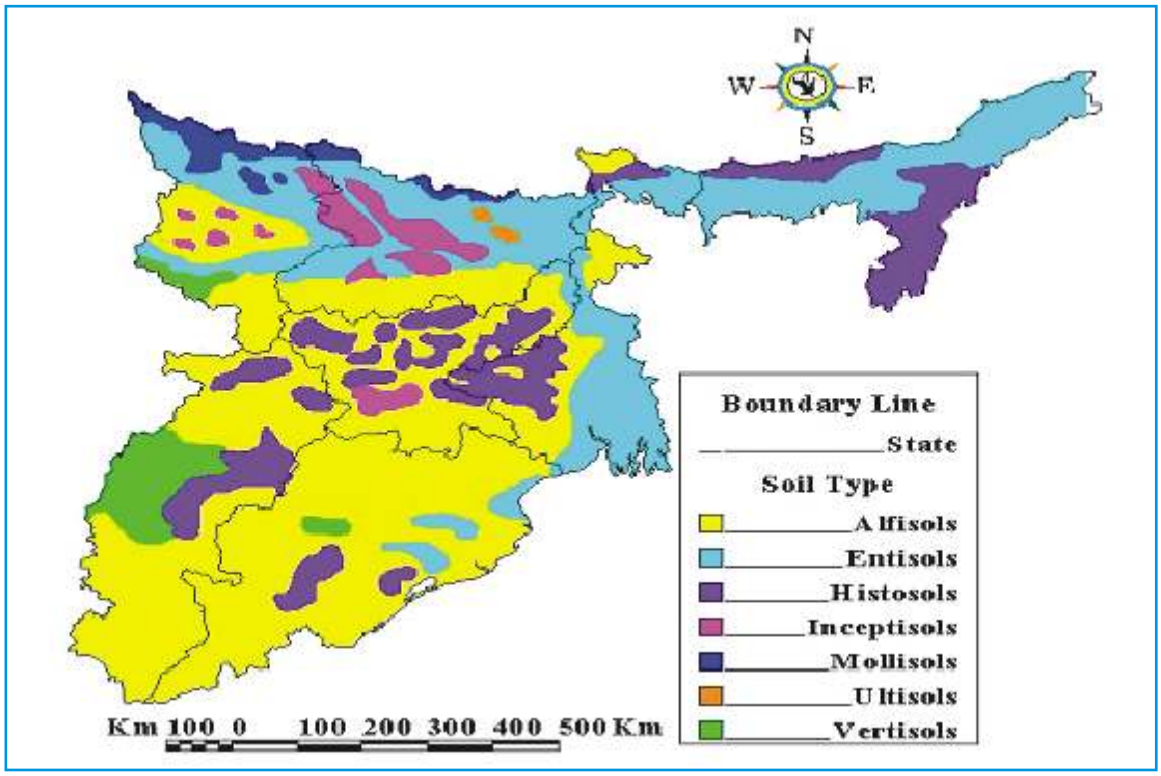

Fig. 2. Soil types of eastern region

Deep and light textured flood plain alluvial soils have been classified under Entisols. These soils were further classified as Fluvaquents, Haplaquents and Ustifluvents, Ustorthents based on aquic moisture regime, high clay content with decreasing organic carbon with depth and Ustic moisture regime respectively.

The soils of *Diara* land occurring in alluvial fans and flood plains were young and stratified with AC profiles and had very faint and poor pedogenic manifestations, which were classified as Typic Ustifluvents. The red and laterite soils of Machkund catchment in Orissa have been classified as Udic haplustalfs, Ultic paleustalfs and Ultic rhodustlafs. The red, black and yellow coloured soils of Rajmahal

traps of Bihar have been classified under red soils as Alfisols, black soils as Inceptisols, Vertisols, Entisols and Alfisols and yellow soils as Inceptisols.

Land capability classes: Most of alluvial plains present in Bihar, eastern U.P, West Bengal and Assam fall under very good good lands. Most of the region in Jharkhand and Chattisgarh and parts of West Bengal are moderately good lands. Land with severe limitations for crop growth is seen in western parts of Jharkhand and eastern parts of Chattisgarh and southern parts of Orissa. Arid lands water limitation is spread in southern tip of Orissa and parts of Jharkhand (Fig.3).

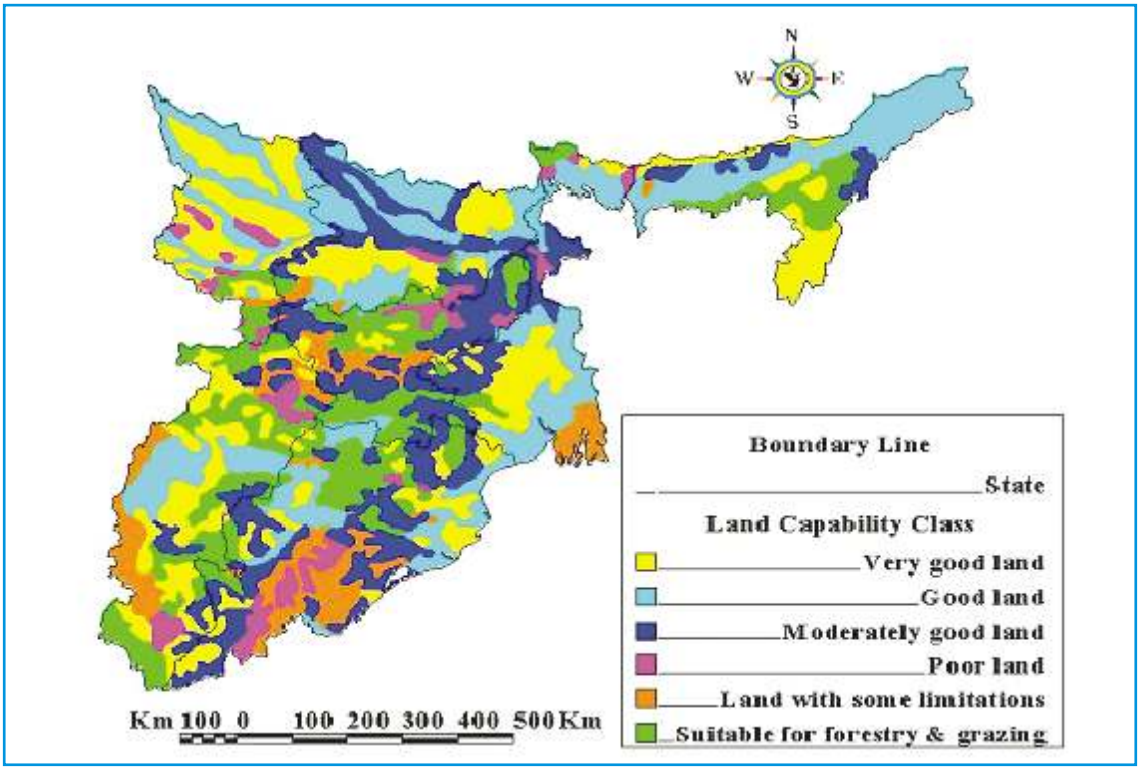

Fig. 3. Land capability classification of eastern region

Different landforms and natural depressions of eastern region

Topographically, the cultivated lands are divided into three broad categories, viz., upland, medium land and low lands. These classifications are based on the relative elevations of fields, which in turn determine the depth, and duration of submergence of these lands during a year. Upland soils are located at the higher elevation in a tract. Due to continuous fluvial processes of erosion and sedimentation, these soils are primarily light textured and highly permeable with rapid rates of infiltration and internal drainage. Medium lands are normally mildly sloping highly productive flat lands. The medium lands with irrigation facilities possess higher yield potentials.

The saucer shaped land in a tract is low land where runoff and seepage water of the tract accumulates. The rising surface water of many isolated lowlands join along a shallow natural depression and form a seasonal stream called "*tal*." The water from such a stream ultimately falls into a river system. In case, where the lowlands and depressions are connected to nearby rivers, the floodwater from the river enters and stands as backwater for a long period in such depressions. Large part of the land measuring more than 1000 km^2 adjoining the Ganga between Patna and Kiul is saucer shaped low lying area known as Mokama group of *tals*- remains submerged for a considerable period of time during monsoon (Fig 4).

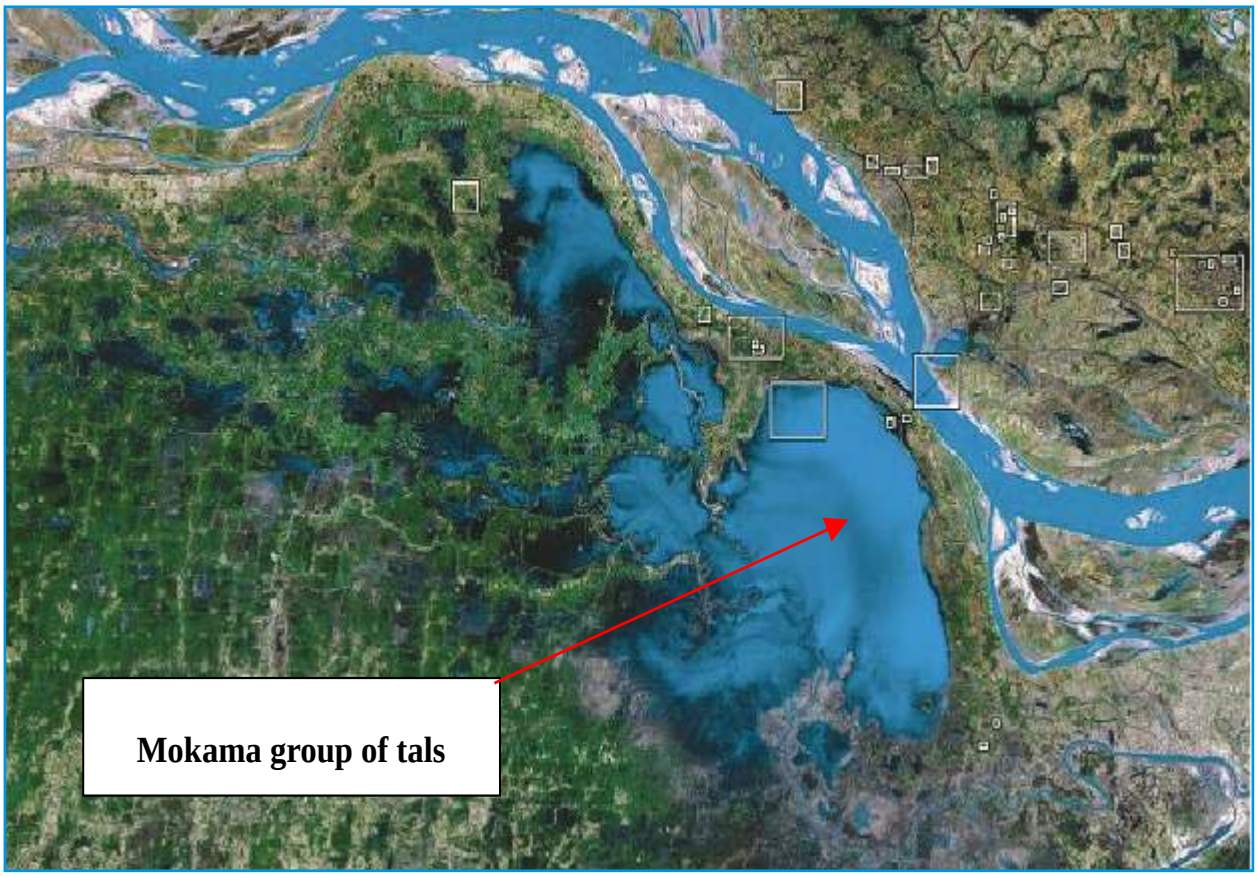

Fig. 4. Mokama group of tals in Bihar

In soft and flat lands the width of river gets widened to facilitate large flows. The receding flow deposits its sediment load in a portion of riverbed thereby raising its elevation. The raised portion of the riverbed is suitable for cultivation after the fall in the water table. This land is known as "*deeyar*" or "*diara*" in eastern U.P and Bihar. Due to frequent (almost annual) erosion and sedimentation of *diaralands*, the texture of the soil is likely to change unless it has been stabilized after further widening of the river. In the Ganga, the *diaraland* can extend up to 12 km in width. *Diaralands* are estimated to cover about 2.3 Mha area in the Ganga and Bramhaputra basins (Fig. 5).

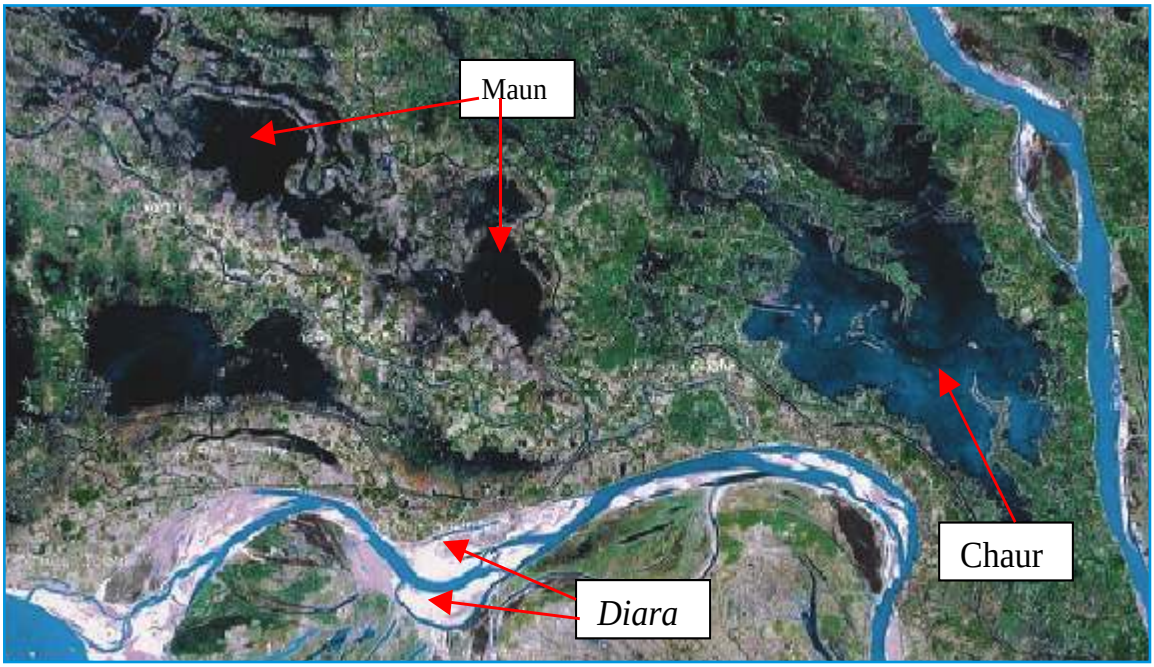

Fig. 5: Diara, Chaur *and* Maun *in the eastern region*

The meandering and braiding tendency of the river due to various topographic and hydrologic processes leads to shifting of the river course. Such changes in the river course and avulsions and cut offs of the meander loops formed local depressions called as "maun". "*Chaurs*" on the other hand are remnants of the river course, which are generally shallower than the "maun" (Fig. 5).

Major deltaic areas in eastern region fall in West Bengal where river Ganga meets with the Bay of Bengal. The area is famous as Sunderbans comprising combination of acid sulfate soils and alluviums. Lower portion of the delta is under mangrove forests.

1.1.2 Status of livestock in eastern region

(A.Dey, B. Saha and B. P. S. Yadav)

Distribution pattern of livestock population in the states of eastern region comprising of Assam, Bihar, Chhattisgarh, Eastern UP, Jharkhand, Orissa and West Bengal was analyzed. The analysis is based on the districtwise livestock population data, 2003, collected from Dept. of Animal Husbandry and Fisheries, Govt. of India. Further, livestock population density was also determined according to the agro-climatic condition of the region as depicted in Fig. 6. It is observed that in most of the districts of the region, crossbred cattle population is meager. About 89 per cent of the districts only have crossbred cattle population below 20/ sq. km. The crossbred cattle population is unevenly distributed with highest density found in some pockets along the Ganges in the states of Bihar, West Bengal and eastern UP. However, apart from West Bengal, the indigenous cattle are mostly concentrated in hilly and plateau region. The high concentration of indigenous cattle in plains of West Bengal may be attributed to inclusion of the draught animals. In case of buffalo, it is mostly concentrated in the districts of Bihar and eastern UP (Figs. 6a, b & c).

Among the agro-climatic regions, poultry and duck are mainly concentrated in the Lower Gangetic Plains followed by the eastern Himalayan region (Assam). In general, crossbred sheep has very low population in the eastern region, while indigenous sheep and goat is evenly distributed with highest concentration in the Lower Gangetic Plains. Swine population is larger in eastern Himalaya and Lower Gangetic Plains (Fig. 6d).

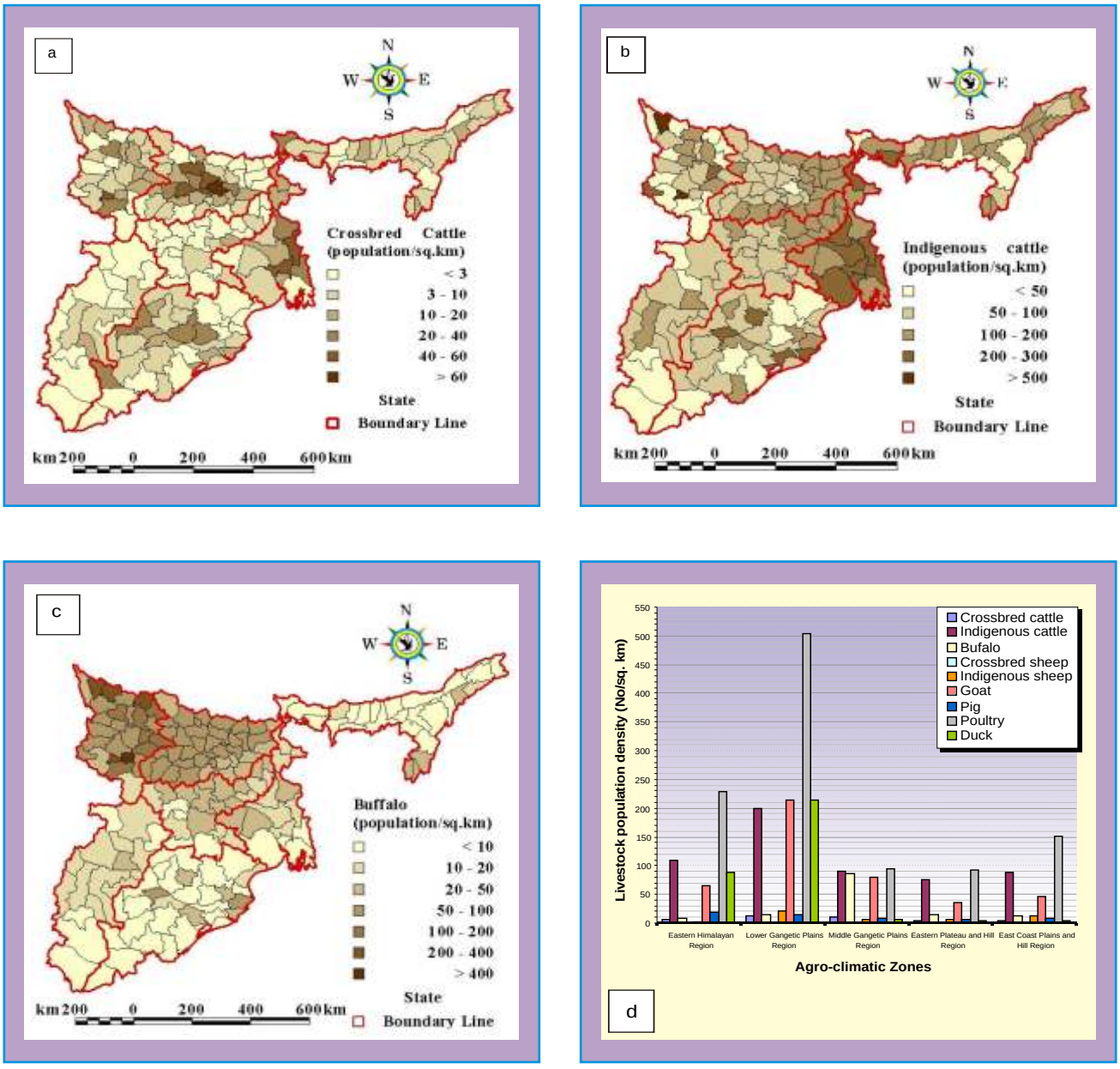

Fig. 6. District wise livestock population density in the eastern region, a) Crossbred cattle; b) Indigenous Cattle; c) Buffalo, d) Agro-climatic Zone wise livestock population density

1.1.3 Development of web enabled multimedia based crop information system.

(Manibhushan and Sanjeev Kumar)

Different Graphic User Interfaces have been created for data entry and to make it user interactive using Visual Basic 6.0. A database has also been designed for the storage of data regarding package of practices of selected crops using MS-ACCESS and MySQL software packages. A user interactive website is being designed for the package of practices of selected crops using PHP, HTML, JAVA SCRIPT, ASP and VB SCRIPT. Rice, wheat, maize, sorghum, pulses, oilseed, commercial and fodder crops are mainly taken into consideration. A graphic user interface is shown in Fig.7 .

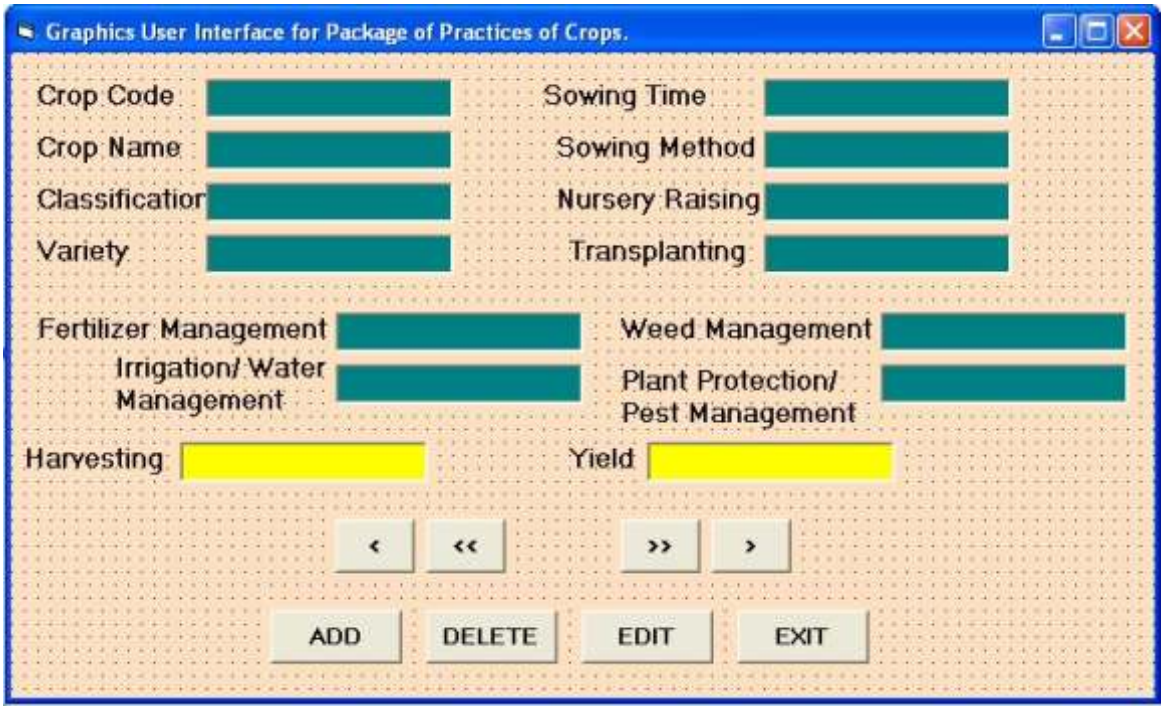

Fig. 7. Graphics user interface for package of practices of crops.

1.2 Constraints analysis and prioritization

1.2.1 Prioritization of researchable issues of eastern region of India

(A.K.Sikka, B. Saha, P.K.Thakur, L.K.Prasad, Abhay kumar, A.R.Reddy, A. Dey and Bikash Das)

The researchable issues for five different agro-climatic zones of the region have been prioritized in view of the identified constraints and the limited natural resources. The prioritization exercise has been accomplished by ranking of production constraints following identification of socio-economic and environmental criteria and through measurable indicators as per the guidelines of NCAP, New Delhi. Composite index values were developed using regional and efficiency index. The researchable issues were ranked on the basis of the composite index values. The prioritized researchable issues of the respective agro-climatic zones of eastern region are presented in Table 1.

Table 1: The agro-climatic zone wise prioritized researchable issues for the eastern region

Thematic Issues/ areas	Zonal priorities				
	Eastern Himalayan Region	Lower Gangetic Plain	Middle Gangetic & Hills	Eastern Plateau plains	East coast Plain and Hill Region
Development of quality cultivars of agricultural, horticultural and aquatic crops	High	High	High	High	High
Integrated location specific, multicommodity farming system involving field crops, horticulture, fisheries, crops and other enterprises	High	High	High	High	High
Production techniques for field, horticultural, agro-forestry and aquatic crops like makhana	Medium	High	Medium	High	Medium
Integrated water management	Medium	Medium	High	Medium	Medium
Multiple uses of water	Medium	High	High	Medium	High
Rain water harvesting and watershed management	High	Low	Low	High	Medium
Development, testing and popularization of resource conservation technologies	Medium	High	Medium	Medium	Medium
Management of flooded & flood prone and water congested areas	High	Medium	High	Low	Medium
Risk analysis and management	Medium	Medium	Medium	Medium	High
Animal husbandry and fisheries practices and potentials	Medium	Medium	High	High	Medium
Feeds and feeding of livestock and fisheries	Low	High	High	Medium	Low
Livestock and fish production	Medium	High	High	Medium	Medium
Animal and fish health management	Medium	High	High	Medium	Medium
Post-harvest technology and value addition of agricultural, horticultural and aquatic produce	High	High	High	High	High
Plant & seed material production	High	High	High	High	High
Technology assessment, refinement and dissemination.	High	High	High	High	High
Socio-economic and policy research	High	Medium	High	High	High

1.3 Meteorological information

1.3.1 Weather data of ICAR RCER, Patna

Mean maximum monthly temperature varied from 23.3°C in the month of December to 37.0°C in May. Mean minimum monthly temperature varied from 8.5°C in January to 27.3°C in July (Table 2). Maximum daily pan evaporation of 7.5 mm/day was recorded in the month of April and minimum of 0.7mm /day during December.

Table 2: Monthly meteorological data recorded at ICAR RCER, Patna during 2006

Month	Rainfall (mm)	Temperature (°C)		Relative humidity (%)		Pan Evaporation	
		Max.	Min	7.00hr	14.00hr	Total (mm)	mm/day
January	0.0	23.3	8.5	83.2	55.5	30.8	1.0
February	0.0	30.1	18.4	79.8	49.5	68.1	2.4
March	0.0	32.8	17.0	58.0	35.2	141.6	4.6
April	14.1 (1)	36.9	22.3	56.6	33.6	213.2	7.1
May	27.1 (2)	37.0	25.7	66.9	50.4	184.1	5.9
June	253.5 (5)	36.1	26.9	74.9	61.9	144.9	4.7
July	325.5 (7)	33.5	27.3	81.7	72.4	129.3	4.3
August	161.7 (9)	33.8	26.9	78.6	70.6	100.7	3.3
September	229.2 (9)	32.6	25.8	82.1	74.7	90.9	3.0
October	2.4 (1)	33.0	22.8	77.6	60.5	101.1	3.3
November	0.0	28.7	16.4	77.5	63.5	69.9	2.3
December	0.0	23.4	9.0	83.6	60.4	35.1	1.1
Annual mean/Total	**1013.5**	**31.8**	**20.6**	**75.0**	**57.3**	**1309.6**	**3.6**

The number in parentheses indicate the number of rainy days

The total annual rainfall received was 1013.5 mm, out of which 95.7 per cent was received during the southwest monsoon season. The total rainfall received during the monsoon season was 969.9 mm with a surplus of 2.5 per cent from the normal rainfall of 946.5 mm, and the distribution during monsoon months also varied from 86.9 per cent surplus during June, 2006 and 37.9 per cent deficit during August, 2006 (Table 3).

Table 3:Distribution of monsoon rainfall in Patna district

Month	Normal	2006	Per cent departure from normal
June	135.6(6)	253.5(5)	86.9
July	339.6(14)	325.5(7)	-4.2
August	260.4(13)	161.7(9)	-37.9
September	210.9(10)	229.2(8)	8.7
Total	**946.5(43)**	**969.9(29)**	**2.5**

1.3.2 Weather data of CRP, Pusa

Observations of different meteorological parameters were taken from the meteorological observatory located at Research Farm of this centre (Table 4). The total annual precipitation was 1109.0 mm in 51 rainy days. Maximum rainfall (368.5 mm) and minimum rainfall (352.0 mm) were received in the month of July 2006 and September 2006, respectively. The monthly mean maximum temperature was recorded 36.2^{0}C during May and minimum temperature was recorded 7.8^{0}C during January. Relative humidity varied from 66 per cent in April to 90 per cent in January and December during the morning hours and 33 per cent in March to 71 per cent in July during the afternoon period. Evaporation was maximum (6.8 mm/day) in April and minimum (1.5mm/day) in January.

Table 4: Meteorological observations recorded at CRP, Pusa during 2006

Month	Temperature (^{0}C)		Humidity (%)		Rainfall (mm)	No. of rainy days	Evaporation (mm/day)
	Max.	Min.	7:00 hrs	14:00 hrs			
January	21.9	7.8	90	55	-	-	1.5
February	28.6	14.0	88	52	-	-	2.3
March	25.4	14.8	69	33	2.5	-	5.0
April	35.3	21.4	66	34	19.0	1	6.8
May	36.2	25.6	74	54	97.5	6	5.9
June	35.3	26.8	83	62	158.0	9	4.9
July	33.0	27.4	85	71	368.5	13	3.8
August	34.3	27.3	86	64	88.5	8	6.2
September	32.1	25.8	88	68	352.0	11	3.8
October	32.4	23.0	86	55	220.0	3	3.2
November	28.0	15.1	89	55	1.0	-	2.1
December	24.5	10.6	90	50	0.0	-	1.6
Annual mean/Total	**30.6**	**20.0**	**83**	**54**	**1109.0**	**51**	**3.9**

1.3.3 Weather data of HARP, Ranchi

Monthly meteorological data recorded at HARP, Ranchi centre reveals that maximum temperature varied from 22.8^{0}C in December to 34.1^{0}C in April 2006. Minimum temperature varied from 9.5 ^{0}C in January to 24.1^{0}C in June 2006. Mean annual temperature was 22.8^{0}C. Humidity varied from 62.2 per cent in February 2006 to 90.6 per cent in July 2006. Total annual rainfall was 1576.2 mm, which occurred mainly during five months in May to September 2006. Highest rainfall (369.8 mm) occurred in the month of September 2006. Rainfall was negligible during winter months (Table 5).

Table 5 : Monthly meteorological data recorded at HARP, Ranchi during 2006

Months	Temperature (^{o}C)			Humidity (%)	Rainfall (mm)
	Max.	Min.	Mean		
January	23.6	9.5	16.2	63.7	0.0
February	29.0	14.0	21.2	62.2	4.2
March	28.9	16.6	22.5	65.4	64.0
April	34.1	20.3	26.9	63.5	0.0
May	33.5	23.0	28.0	75.4	116.0
June	30.3	24.1	27.0	84.8	264.8
July	27.5	23.5	25.4	90.6	358.0
August	26.0	22.6	24.2	88.7	352.0
September	27.5	22.5	24.8	88.0	369.8
October	28.1	18.7	23.1	80.4	45.4
November	23.3	13.6	18.2	76.6	2.0
December	22.8	10.3	16.2	78.8	0.0
Annual Mean/Total	**27.9**	**18.2**	**22.8**	**76.5**	**1576.2**