

# Diversity of Cropping Pattern in Bogra

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## ABSTRACT

With a view to document the existing cropping patterns, cropping intensity and crop diversity, a study was carried out over all the upazilas of Bogra agricultural region during 2015-16. A pre-tested semi-structured questionnaire was properly used for this purpose. In the findings it was recorded that 21.88% of net cropped area (NCA) of the region was occupied by the cropping pattern Boro-Fallow-T. Aman. This pattern was found to be distributed over 27 upazilas out of 35. The second largest area, 13.26% of NCA, was covered by Potato-Boro-T. Aman, which was spread over 17 upazilas. A total of 177 cropping patterns were identified in the whole region in this investigation. The highest number of cropping patterns was identified 36 in Nandigram upazila and the lowest was six in Dupchachia and Kahalu upazila of Bogra district. The lowest crop diversity index (CDI) was reported 0.718 in Raiganj upazila of Sirajganj district followed by 0.734 in Kalai of Joypurhat. The highest value of CDI was observed 0.978 in Pabna sadar followed by 0.972 in Bera upazila. The range of cropping intensity values was recorded 183-291%. The maximum value was for Khetlal upazila of Joypurhat district and minimum for Bera of Pabna. As a whole the CDI of Bogra region was calculated 0.966 and the average cropping intensity at regional level was 234%.

**Key words:** Diversity index, land use, cropping system and flash flood

## INTRODUCTION

A total of 35 upazilas of four districts formed the Bogra agricultural region. It has a wide diversity in land topography and soil characters ranging from river-eroded area to Barind Tract. This region belongs to Tista Meander Floodplain (AEZ-3), Karatoa-Bangali Floodplain (AEZ-4), Lower Atrai Basin (AEZ-5), Active Brahmaputra-Jamuna Floodplain (AEZ-7), Active Ganges Floodplain (AEZ-10), High Ganges River Floodplain (AEZ-11), Low Ganges River Floodplain (AEZ-12), Level Barind Tract (AEZ-25) and North-eastern Barind Tract (AEZ-27) (FAO, 1988).

Majority area of this region is very suitable for agricultural crop production especially in cereals and vegetables. The cropping intensity is much higher than the other region of the country. Shortage of surface water, serious flooding and river erosion are location-specific critical problems. Low moisture-holding capacity, low organic matter content and low

natural fertility are special characters of the Barind Tract.

Cropping system is the crop production activity of a farm which includes all cropping patterns grown on the farm resources, other household enterprises and the physical, biological, technological and socioeconomic factors or environments. A cropping pattern is the yearly sequence, temporal and partial arrangement of crops in a given land area. It is dependent on physical, historical, social, institutional and economic factors as well as government policies (Agrawal and Kassam, 1976). The cropping pattern and the changes therein depend on a large number of factors like climate, soil type, rainfall, agricultural technology, availability of irrigation facilities and other inputs, marketing and transport facilities and growth of agro-industries (Neena, 1998; Gadge, 2003; Rashid *et al.*, 2005).

The yields of cereal crops are tending to stagnation, even in favourable environments. Moreover, cultivable land area is decreasing

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day by day in the country. To increase the system productivity of the total environment it needs to bring diversity in enterprises for better utilization of limited resources. Detailed information on land situation and cropping systems is a prerequisite for a fruitful development programme. Diversified cropping pattern may be an option for the farmers as a coping strategy against risks (Mandal and Bezbaruah, 2013). Typology of different cropping systems is the base for the managers of these systems to intensify production (Shriar, 2000). There is a strong need for judicious and appropriate use of limited resources in case of intervention selection that does not lead to increased mal adaptation or inequity in the society over long term. Existing trends of available agricultural lands is most essential requirement for any land use planning related to farming and food security in a sustainable manner. Therefore, an increased understanding of arable land use based on the cropping system is essential for the appropriate intervention in sustainable way. In these contexts, existing cropping patterns along with their diversity of such complex agricultural region are very crucial for risk minimization and overall productivity improvement. The specific objectives of the present study were to:

- Understand the existing cropping patterns scenario in Bogra region
- Visualize the existing land use pattern at upazila and regional level
- Determine the crop diversity and cropping intensity at local and regional level.

## METHODOLOGY

Thirty-five upazilas of Bogra, Joypurhat, Pabna, and Sirajganj districts under Bogra agricultural region were the locale of this study. Data were collected using double stage procedure. At initial stage, data were collected through pre-tested semi-structured questionnaire from 35 pre-assigned Sub-Assistant Agriculture Officers (SAAO) of each upazila during October 2015 at upazila level. SAAOs were purposively pre-

selected by Agriculture Extension Officers (AEO), Additional Agriculture Officer (AAO) and Upazila Agriculture Officer (UAO) or altogether. Prior to data collection, the pre-tested questionnaire was explained along with proper guidelines to the AEOs or UAOs or both and handed over to them at each Deputy Director's office of Department of Agricultural Extension (DAE) during monthly meeting for the sake of accurate data collection. The filled questionnaires were collected by the scientists of RFS Division, checked and analyzed to find the inconsistencies of the supplied data before validation workshop. All the inconsistencies among the information were documented. The collected data along with documented inconsistencies were discussed in district level workshop for necessary correction and validation. Second stage of data collection was a day-long data validation workshop at district level. The workshop dates were 26 November 2015 for Sirajganj; 14 January 2016 for Bogra; 2 February 2016 for Pabna; and 20 September 2016 for Joypurhat. Four field-workers i.e. one SAPPO and three SAAOs experienced and engaged in crop-based data documentation, all officers from all upazilas viz UAOs, AEOs, AAEOs, DD (DAE), DD (Horticulture), DD of Seed Certification Agency, DTO and ADDs, one representative from Agricultural Training Institute (ATI) and scientists of BRRI regional station, Kushtia, and Rangpur, participated in the data validation workshop. The number of participants of validation workshop ranged from 50 to 92 in each district. All the participants were divided into three to four groups for data validation. Each group was facilitated by two RFS scientists to finalize and validate the data and authenticated data were captured. Crop diversity index was calculated by using the following equation described by Kshirsagar *et al.* (1997).

$$CDI_i = 1 - \sum_{j=0}^n \left( \frac{a_{ij}}{A_i} \right)^2$$

Where,  $CDI_i$  = Crop Diversity Index  
 $a_{ij}$  = Area planted to the  $j^{th}$  crop in the  $i^{th}$  location  
 $A_i$  = Total area planted under all crops

The index is zero for a land area growing only one crop. It approaches unity as the level of diversity increases. Compilation and processing of collected data were done using Micro Soft Excel programme. Descriptive statistics were used to facilitate the presentation of the findings.

## RESULTS AND DISCUSSION

### Land use

Table 1 presents the status of agricultural land utilization. The net cropped area of the Bogra region is 668,440 ha. Crops occupied the particular land for round the year were considered under annual crops. The major annual crops reported in the region were banana, papaya, sugarcane, betel leaf, ginger and turmeric. The annual crops area in different upazilas ranged from 10 to 3,500 ha. The annual crops area accounted only 1.70 % of the net cropped area (NCA) in the region. At a glance the region possesses 7.58% single cropped area (SCA), 48.09% double cropped area (DCA), 41.15% triple cropped area (TCA). The quadruple cropped area also exists as a very negligible portion (0.76%) and was limited in only six upazilas viz Bogra, Dhunat, Nandigram, Sherpur, Sonatola and Atghoria. Most of the upazilas of Bogra and Joypurhat district cropping intensity was very high (246%-291%) which were dominating by the TCA over SCA and DCA (Table 1). The TCA had the major share of NCA in Adamdighi, Bogra *sadar*, Dupchachia, Kahalu, Nandigram, Shibganj and Sonatola upazilas of Bogra district, all five upazilas of Joypurhat district, Iswardi, Pabna sadar and Santhia of Pabna district and Kazipur of Sirajganj district. A few upazilas were dominated by DCA viz-Dhunat, Gabtali, Sariakandi, Sherpur and Shajahanpur of Bogra district. In Pabna district Atghoria, Bera, Bhangura, Chatmohar, Faridpur and Sujanagar upazilas and in Sirajganj district all upzilas except Kazipur were dominated by DCA over SCA and TCA (Table 1). The area which could not defined under SCA, DCA,

TCA or QCA was considered as others whose coverage is less than 1% of the NCA. For availability of irrigation water in dry season, supply of modern varieties of various crops, skilled technology transfer system, knowledge of modern crop management practices, good communication and marketing facilities helped increasing land use efficiency in a given area (FAO, 1988).

### Cropping patterns of Bogra

In total 177 cropping patterns were observed in Bogra region of which six cropping patterns with exclusive rice crop covers about 34% of the NCA. There were 55 cropping patterns with exclusive non-rice crop occupying over 12% of the NCA. Rest of the NCA i.e. about 54% area is covered by 116 rice - non rice cropping patterns (Appendix 1).

### Rice and non-rice crops at a glance

Table 2 presents six cropping patterns where rice was the only crop round the year. It comprises about 34% of the NCA in the region. Among them single rice, double rice and triple rice areas represent around 6%, 25% and 3% respectively. It reflects the unparallel dominance of rice in the cropping systems in Bogra region. In case of individual pattern, Boro-Fallow-T. Aman has the highest coverage (approx. 22%) and was recorded in 27 upazilas out of 35. The second dominant pattern single Boro area occupied 5.68% of NCA which was reported in 21 upazilas. Boro-Aus-T. Aman covered 3% of NCA and was obsrved in 15 upazilas. Single T. Aman area was very negligible (0.23%) with its existence in only two upazilas.

In the current investigation, 55 cropping patterns were identified that was free from rice. Among these 55 patterns first 40 have been arranged in descending order in Table 3. The rest 15 patterns with negligible area coverage (Table 9) where they are arranged with other patterns of different categories. Aggregate of the 55 patterns have engaged 82,815 hectares of land, which is equivalent to more than 12% of NCA in the region. In critical comparison it is clear that exclusive rice area is about three

**Table 1. Land use of different upazilas in Bogra region (area in hectare), 2014-15.**

| Upazila             | Area of upazila | Annual crop  | SCA          | DCA           | TCA           | QCA         | Other       | NCA           | C.I. (%)   |
|---------------------|-----------------|--------------|--------------|---------------|---------------|-------------|-------------|---------------|------------|
| 01 Adamdighi        | 16890           | 40           | 200          | 4450          | 7920          | 0           | 130         | 12740         | 261        |
| 02 Bogra            | 17734           | 150          | 0            | 1940          | 8700          | 300         | 110         | 11200         | 282        |
| 03 Dhunat           | 24712           | 50           | 920          | 14750         | 3570          | 150         | 100         | 19540         | 215        |
| 04 Dubchachia       | 16426           | 30           | 0            | 3090          | 10490         | 0           | 110         | 13720         | 277        |
| 05 Gabtali          | 24375           | 120          | 1210         | 12980         | 4710          | 0           | 140         | 19160         | 218        |
| 06 Kahalu           | 23879           | 30           | 60           | 4700          | 14310         | 0           | 130         | 19230         | 274        |
| 07 Nandigram        | 26551           | 10           | 0            | 9000          | 9500          | 3700        | 100         | 22310         | 276        |
| 08 Sariakandi       | 40858           | 40           | 3700         | 15620         | 4850          | 0           | 130         | 24340         | 205        |
| 09 Sherpur          | 29640           | 130          | 1490         | 15010         | 6390          | 790         | 130         | 16040         | 227        |
| 10 Shibganj         | 31148           | 150          | 0            | 3360          | 21960         | 0           | 120         | 23950         | 282        |
| 11 Shajahanpur      | 22108           | 620          | 630          | 7860          | 7290          | 0           | 130         | 26070         | 241        |
| 12 Sonatola         | 15693           | 150          | 730          | 5790          | 6920          | 130         | 130         | 13850         | 246        |
| 13 Akkelpur         | 14046           | 90           | 0            | 4100          | 6505          | 0           | 145         | 10840         | 260        |
| 14 Joyprhat         | 23864           | 800          | 100          | 6030          | 12340         | 0           | 130         | 19400         | 259        |
| 15 Kalai            | 16636           | 10           | 0            | 1485          | 12280         | 0           | 135         | 13910         | 289        |
| 16 Khetlal          | 14260           | 30           | 10           | 1010          | 10490         | 0           | 140         | 11680         | 291        |
| 17 Panchbibi        | 27853           | 570          | 0            | 9800          | 12100         | 0           | 200         | 22670         | 251        |
| 18 Atghoria         | 18380           | 220          | 800          | 6710          | 6130          | 30          | 130         | 14020         | 237        |
| 19 Bera             | 24871           | 700          | 3540         | 12330         | 1250          | 0           | 180         | 18000         | 183        |
| 20 Bhangura         | 13428           | 80           | 2170         | 6890          | 1780          | 0           | 160         | 11080         | 196        |
| 21 Chatmohar        | 29405           | 120          | 1150         | 17950         | 5700          | 0           | 150         | 25070         | 218        |
| 22 Faridpur         | 13897           | 40           | 1000         | 9350          | 1000          | 0           | 150         | 11540         | 200        |
| 23 Iswardi          | 26947           | 3500         | 30           | 2590          | 12530         | 0           | 150         | 18800         | 247        |
| 24 Pabna sadar      | 44259           | 700          | 1580         | 11000         | 22200         | 0           | 120         | 35600         | 256        |
| 25 Santhia          | 33152           | 270          | 0            | 5950          | 19100         | 0           | 150         | 25470         | 274        |
| 26 Sujanagar        | 33444           | 290          | 3750         | 16100         | 4370          | 0           | 180         | 24690         | 201        |
| 27 Belkuchi         | 16254           | 50           | 0            | 10300         | 2440          | 0           | 160         | 12950         | 219        |
| 28 Chowhali         | 23209           | 10           | 4440         | 4220          | 3940          | 0           | 100         | 12710         | 196        |
| 29 Kazipur          | 34763           | 300          | 9280         | 5840          | 7350          | 0           | 130         | 22900         | 190        |
| 30 Kamarkhanda      | 9163            | 120          | 540          | 4220          | 2700          | 0           | 140         | 7720          | 227        |
| 31 Raiganj          | 26667           | 400          | 1100         | 17880         | 2300          | 0           | 120         | 21800         | 203        |
| 32 Shahjadpur       | 32462           | 10           | 1870         | 16900         | 6000          | 0           | 120         | 24900         | 217        |
| 33 Sirajganj        | 30855           | 1500         | 1240         | 16550         | 4220          | 0           | 190         | 23700         | 206        |
| 34 Tarash           | 29732           | 10           | 3675         | 17635         | 3305          | 0           | 125         | 24750         | 198        |
| 35 Ullapara         | 41461           | 40           | 5440         | 18070         | 8390          | 0           | 150         | 32090         | 209        |
| <b>Bogra region</b> |                 | <b>11380</b> | <b>50655</b> | <b>321460</b> | <b>275030</b> | <b>5100</b> | <b>4815</b> | <b>668440</b> | <b>234</b> |

SCA-Single cropped area, DCA-Double cropped area, TCA-Triple cropped are, QCA-Quadruple cropped area, NCA-Net cropped area and C.I.-Cropping Intensity.

**Table 2. Cropping patterns with exclusive rice in Bogra region, 2014-15.**

| Cropping pattern                     | Area (ha)     | % of NCA     | Frequency (no. of upazila) |
|--------------------------------------|---------------|--------------|----------------------------|
| 01 Boro-Fallow-T. Aman               | 146250        | 21.87        | 27                         |
| 02 Boro-Fallow-Fallow                | 37300         | 5.58         | 21                         |
| 03 Boro-Aus-T. Aman                  | 19700         | 2.95         | 15                         |
| 04 Boro-B. Aman                      | 18650         | 2.79         | 10                         |
| 05 Fallow-Fallow-T. Aman             | 1550          | 0.23         | 2                          |
| 06 Boro-Aus-Fallow                   | 670           | 0.10         | 3                          |
| <b>Total area for exclusive rice</b> | <b>225000</b> | <b>33.66</b> | <b>-</b>                   |

NCA-Net cropped area.

**Table 3. Cropping patterns with exclusive non-rice in Bogra region, 2014-15.**

| Cropping pattern                           | Area (ha) | % of NCA | Frequency (no. of upazila) |
|--|-----------|----------|----------------------------|
| 01 Vegetab-Vegetab-Vegetab                 | 16030     | 2.40     | 22                         |
| 02 Onion-Jute-Fallow                       | 10080     | 1.51     | 5                          |
| 03 Lentil-Jute-Fallow                      | 6650      | 0.99     | 10                         |
| 04 Chilli-Jute-Fallow                      | 4620      | 0.69     | 10                         |
| 05 Groundnut-Fallow-Fallow                 | 4280      | 0.64     | 9                          |
| 06 Wheat-Jute-Fallow                       | 4090      | 0.61     | 11                         |
| 07 Vegetab-Vegetab-Fallow                  | 3730      | 0.56     | 10                         |
| 08 Maize-Jute-Fallow                       | 3300      | 0.49     | 6                          |
| 09 Onion-Vegetab-Vegetab                   | 3100      | 0.46     | 14                         |
| 10 Maize-Fallow-Fallow                     | 2520      | 0.38     | 5                          |
| 11 Wheat-Vegetab-Vegetab                   | 2100      | 0.31     | 3                          |
| 12 Millet ( <i>kaon</i> )+Sesame-Fallow    | 1720      | 0.26     | 4                          |
| 13 Chilli-Vegetab-Fallow                   | 1650      | 0.25     | 10                         |
| 14 Potato-Maize-Vegetab                    | 1500      | 0.22     | 1                          |
| 15 Vegetab-Jute-Fallow                     | 1240      | 0.19     | 4                          |
| 16 Fallow-Fallow-Blackgram                 | 1210      | 0.18     | 6                          |
| 17 Grasspea-Fallow-Fallow                  | 1005      | 0.15     | 3                          |
| 18 Vegetab-Onion-Aus                       | 1000      | 0.15     | 1                          |
| 19 Wheat-Sesame-Fallow                     | 1000      | 0.15     | 3                          |
| 20 Vegetab-Fallow-Fallow                   | 900       | 0.13     | 3                          |
| 21 Wheat-Fallow-Blackgram                  | 900       | 0.13     | 1                          |
| 22 Lentil-Sesame-Fallow                    | 810       | 0.12     | 4                          |
| 23 Groundnut-Fallow-Blackgram              | 800       | 0.12     | 1                          |
| 24 S.Potato-Jute-Fallow                    | 780       | 0.12     | 3                          |
| 25 Chilli-Fallow-Fallow                    | 710       | 0.11     | 4                          |
| 26 S.Potato-Fallow-Fallow                  | 675       | 0.10     | 14                         |
| 27 Coriander-Vegetab-Fallow                | 630       | 0.09     | 2                          |
| 28 Grasspea-Jute-Fallow                    | 550       | 0.08     | 3                          |
| 29 Sesame-Fallow-Blackgram                 | 500       | 0.07     | 1                          |
| 30 Wheat-Jute-Blackgram                    | 500       | 0.07     | 1                          |
| 31 Garlic-Jute-Fallow                      | 430       | 0.06     | 2                          |
| 32 Grasspea-Sesbania-Fallow                | 400       | 0.06     | 1                          |
| 33 Groundnut-Millet ( <i>kaon</i> )-Fallow | 380       | 0.06     | 2                          |
| 34 Vegetab-Jute-Vegetab                    | 380       | 0.06     | 1                          |
| 35 Onion-Sesame-Fallow                     | 350       | 0.05     | 2                          |
| 36 Garlic-Vegetab-Vegetab                  | 345       | 0.05     | 9                          |
| 37 Groundnut-Sesame-Fallow                 | 300       | 0.04     | 1                          |
| 38 Lentil-Vegetab-Vegetab                  | 270       | 0.04     | 5                          |
| 39 Wheat-Fallow-Fallow                     | 230       | 0.03     | 1                          |
| 40 Vegetab-Fallow-Blackgram                | 200       | 0.03     | 3                          |
| 41-55 Other 15 patterns (in Table 9)       | 950       | 0.14     | -                          |
| Total area for non-rice exclusive          | 82815     | 12.39    |                            |

folds of exclusive non-rice area. In Bogra region crop diversity is much wider than that of other regions like Sylhet and Chittagong where exclusive rice area covers 37 folds and 23 folds, respectively of exclusive non-rice

area (Muttaleb *et al.*, 2017; Shahidullah *et al.*, 2017). Appropriate cropping patterns may facilitate maximum possible land utilization as well as efficient use of other scarce resources in a sustainable manner. Diversified cropping

pattern may be an option for the farmers as a coping strategy against risks (Mandal and Bezbaruah, 2013). Typology of different cropping systems is the base for the managers of these systems to intensify production (Shriar, 2000).

### **Deep water rice**

Table 4 presents deep water rice dominating 21 patterns which together covered 9.48% of NCA. Among them, first 18 patterns cover 63,160 ha whereas other three minutely distributed patterns cover only 220 ha (Table 9). Boro-B. Aman cropping pattern covers the highest area of 18,650 hectares which represents about 2.79% of the regions NCA. This pattern is distributed over 10 upazilas out of 35. The second highest Wheat-B. Aman cropping pattern covers 7,920 hectares and distributed over only six upazilas. Grasspea-B. Aman is the third dominant cropping pattern under deep water ecosystem which is distributed over the highest number of upazilas. Deep water rice with lentil, maize, pea and grass pea were the narrow existence covered only 0.3 % of NCA. The water level of this ecosystem ranges between 150 and 400 cm, and water usually remains 3-4 months. Special rice varieties known as 'floating rice' are planted in these areas. In the past Bangladesh had had a land coverage of 3 million hectares for deepwater rice (Jackson *et al.*, 1972). In course of time the continuous effort on modern agriculture shifted DWR area mainly to modern Boro. Now the area under deep water rice in Bangladesh is reduced to 0.4 million hectares (Nasim *et al.*, 2017). Though this cropping system is less productive than other modern cropping systems, however, the specific fragile ecosystem still struggling because of no other alternatives.

### **Non-rice cereal crops**

There were forty-three cropping patterns recorded in Table 5. In these patterns wheat and maize were major crops whereas barley and millets (*cheena* and *kaon*) were recognized as minor crops. Wheat-Jute-T. Aman was the most dominant pattern which possessed 2.18% of NCA and reported in 24 upazilas out of 35.

In this documentation the aggregate of non-rice cereal cropping patterns covered 9.61% of NCA. The total area coverage under non-rice cereal crops is 64,475 ha where the first 31 patterns presented in the Table 5 covered 63,730 ha. The remaining 12 patterns are scatteredly distributed over the region which is presented in Table 9. The area coverage of these 12 patterns is only 745 ha which is about 0.11% of the net cropped area.

### **Oil-seed crops**

Table 6 presents 31 cropping patterns of oil seed crops. Among the patterns the first 34 patterns possessed 135,700 ha whereas other five patterns covered only 385 ha (Table 9). Mustard is covering the largest area whereas groundnut is cultivated in the smallest area among the oil-seed crops. The mustard crop alone was leading 15 cropping patterns with an area coverage of 111,050 ha which is equivalent to 16.61% of NCA in the region and it is four-fifths of the total oil-seed crop area. Mustard-Boro-T. Aman is a favorite cropping pattern reported in 25 upazilas in this region and the area coverage is about 6.00% of NCA although the highest area coverage among the oil-seed crops is covered by Mustard-Boro-Fallow cropping pattern (7.62% of NCA).

### **Pulse crops**

In total 41 cropping patterns of the pulse crops are enlisted in the Table 7. Among them grasspea was covering the largest area (17,445 ha) whereas pea is cultivated in the smallest area (680 ha). Lentil-Jute-Fallow was the dominant cropping pattern in respect of area coverage under pulse crop in the region on the other hand Grasspea-B. Aman was the most widely distributed pulse crop pattern over the region (Table 7). The total area coverage of pulse crop is about 49,585 hectares of which 34 patterns listed in the Table 7 covered 48,880 ha area. The remaining 705 ha area is covered by other seven patterns which are presented in the Table 9. In case of pea there are only two cropping patterns viz Pea-B. Aman and Pea-Aus-Vegetable. These two patterns together occupied only 0.1% of NCA. In the documentation of pulse

**Table 4. Cropping patterns under deep water rice ecosystem in Bogra region, 2014-15.**

| Cropping pattern                        | Area (ha) | % of NCA | Frequency (no. of upazila) |
|---|-----------|----------|----------------------------|
| 01 Boro-B. Aman                         | 18650     | 2.79     | 10                         |
| 02 Wheat-B. Aman                        | 7920      | 1.18     | 6                          |
| 03 Grasspea-B. Aman                     | 6470      | 0.97     | 12                         |
| 04 Mustard-Boro-B. Aman                 | 5000      | 0.75     | 4                          |
| 05 Onion-B. Aman                        | 3650      | 0.55     | 7                          |
| 06 Garlic-B. Aman                       | 3100      | 0.46     | 4                          |
| 07 Blackgram-B. Aman                    | 2950      | 0.44     | 5                          |
| 08 Grasspea-Boro-B. Aman                | 2600      | 0.39     | 2                          |
| 09 Mustard-B. Aman                      | 2300      | 0.34     | 3                          |
| 10 Blackgram (Fod)-Boro-B. Aman         | 2000      | 0.30     | 1                          |
| 11 Onion-Sesame+B. Aman                 | 1800      | 0.27     | 2                          |
| 12 Grasspea-Sesame+B. Aman              | 1700      | 0.25     | 1                          |
| 13 Fallow-Sesame+B. Aman                | 1400      | 0.21     | 2                          |
| 14 Lentil-Sesame+B. Aman                | 980       | 0.15     | 1                          |
| 15 Mustard-B. Aus+B. Aman               | 800       | 0.12     | 1                          |
| 16 Lentil-B. Aman                       | 790       | 0.12     | 4                          |
| 17 Maize-B. Aman                        | 650       | 0.10     | 2                          |
| 18 Pea-B. Aman                          | 400       | 0.06     | 2                          |
| 19-21 Other three patterns (in Table 9) | 220       | 0.03     | -                          |
| Total DW rice                           | 63380     | 9.48     |                            |

**Table 5. Cropping patterns for non-rice cereal crops in Bogra region, 2014-15.**

| Cropping pattern                           | Area (ha) | % of NCA | Frequency (no. of upazila) |
|--|-----------|----------|----------------------------|
| 01 Wheat-Jute-T. Aman                      | 14540     | 2.18     | 24                         |
| 02 Wheat-B. Aman                           | 7920      | 1.18     | 6                          |
| 03 Wheat-Aus-Fallow                        | 4700      | 0.70     | 2                          |
| 04 Wheat-Jute-Fallow                       | 4090      | 0.61     | 11                         |
| 05 Wheat-Aus-T. Aman                       | 3630      | 0.54     | 13                         |
| 06 Maize-Jute-Fallow                       | 3300      | 0.49     | 6                          |
| 07 Maize-Fallow-Fallow                     | 2520      | 0.38     | 5                          |
| 08 Wheat-Sesame-T. Aman                    | 2470      | 0.37     | 7                          |
| 09 Maize-Jute-T. Aman                      | 2255      | 0.34     | 4                          |
| 10 Wheat-Vegetab-Vegetab                   | 2100      | 0.31     | 3                          |
| 11 Wheat-Mungbean-T. Aman                  | 1990      | 0.30     | 6                          |
| 12 Millet ( <i>kaon</i> )+Sesame-Fallow    | 1720      | 0.26     | 4                          |
| 13 Wheat-Fallow-T. Aman                    | 1560      | 0.23     | 3                          |
| 14 Millet ( <i>kaon</i> )-Fallow-T. Aman   | 1500      | 0.22     | 1                          |
| 15 Potato-Maize-Vegetab                    | 1500      | 0.22     | 1                          |
| 16 Potato-Maize-T. Aman                    | 1200      | 0.18     | 4                          |
| 17 Wheat-Sesame-Fallow                     | 1000      | 0.15     | 3                          |
| 18 Wheat-Fallow-Blackgram                  | 900       | 0.13     | 1                          |
| 19 Wheat-Maize-T. Aman                     | 700       | 0.10     | 1                          |
| 20 Maize-B. Aman                           | 650       | 0.10     | 2                          |
| 21 Maize-Fallow-T. Aman                    | 640       | 0.10     | 5                          |
| 22 Wheat-Jute-Blackgram                    | 500       | 0.07     | 1                          |
| 23 Groundnut-Millet ( <i>kaon</i> )-Fallow | 380       | 0.06     | 2                          |
| 24 Maize-Maize-T. Aman                     | 330       | 0.05     | 4                          |
| 25 Maize-Aus-Fallow                        | 320       | 0.05     | 3                          |
| 26 Maize-Sesame-T. Aman                    | 300       | 0.04     | 1                          |
| 27 Potato-Maize-Aus                        | 300       | 0.04     | 1                          |
| 28 Potato-Maize-Aus-Vegetab                | 300       | 0.04     | 1                          |
| 29 Wheat-Fallow-Fallow                     | 230       | 0.03     | 1                          |
| 30 Millet ( <i>cheena</i> )-Jute-Fallow    | 170       | 0.03     | 1                          |
| 31 Barley-Fallow-Fallow                    | 15        | 0.00     | 2                          |
| 32-43 Other 12 patterns (in Table 9)       | 745       | 0.11     | -                          |
| Total for non-rice cereal crops            | 64475     | 9.61     |                            |

**Table 6. Cropping patterns of oil-seed crops in Bogra region, 2014-15.**

| Cropping pattern                           | Area (ha) | % of NCA | Frequency (no. of upazila) |
|--|-----------|----------|----------------------------|
| 01 Mustard-Boro-Fallow                     | 50940     | 7.62     | 15                         |
| 02 Mustard-Boro-T. Aman                    | 40110     | 6.00     | 25                         |
| 03 Mustard-Boro-B. Aman                    | 5000      | 0.75     | 4                          |
| 04 Groundnut-Fallow-Fallow                 | 4280      | 0.64     | 9                          |
| 05 Mustard-Jute-T. Aman                    | 2700      | 0.40     | 3                          |
| 06 Mustard-Boro-Aus                        | 2560      | 0.38     | 2                          |
| 07 Wheat-Sesame-T. Aman                    | 2470      | 0.37     | 7                          |
| 08 Mustard-Boro-Aus-T. Aman                | 2330      | 0.35     | 4                          |
| 09 Mustard-B. Aman                         | 2300      | 0.34     | 3                          |
| 10 Mustard-Aus-T. Aman                     | 2200      | 0.33     | 4                          |
| 11 Onion-Sesame-T. Aman                    | 2200      | 0.33     | 2                          |
| 12 Onion-Sesame+B. Aman                    | 1800      | 0.27     | 2                          |
| 13 Millet ( <i>kaon</i> )+Sesame-Fallow    | 1720      | 0.26     | 4                          |
| 14 Grasspea-Sesame+B. Aman                 | 1700      | 0.25     | 1                          |
| 15 Lentil-Sesame-T. Aman                   | 1680      | 0.25     | 6                          |
| 16 Fallow-Sesame+B. Aman                   | 1400      | 0.21     | 2                          |
| 17 Wheat-Sesame-Fallow                     | 1000      | 0.15     | 3                          |
| 18 Lentil-Sesame+B. Aman                   | 980       | 0.15     | 1                          |
| 19 Grasspea-Sesame-T. Aman                 | 970       | 0.15     | 2                          |
| 20 Lentil-Sesame-Fallow                    | 810       | 0.12     | 4                          |
| 21 Groundnut-Fallow-Blackgram              | 800       | 0.12     | 1                          |
| 22 Mustard-B.Aus+B. Aman                   | 800       | 0.12     | 1                          |
| 23 Mustard-Boro-Jute                       | 700       | 0.10     | 1                          |
| 24 Potato-Sesame-T. Aman                   | 600       | 0.09     | 2                          |
| 25 Groundnut-Jute-T. Aman                  | 500       | 0.07     | 1                          |
| 26 Sesame-Fallow-Blackgram                 | 500       | 0.07     | 1                          |
| 27 Mustard-Aus-Blackgram                   | 400       | 0.06     | 1                          |
| 28 Mustard-Mungbean-T. Aman                | 400       | 0.06     | 1                          |
| 29 Groundnut-Millet ( <i>kaon</i> )-Fallow | 380       | 0.06     | 2                          |
| 30 Onion-Sesame-Fallow                     | 350       | 0.05     | 2                          |
| 31 Mustard-Sesame-T. Aman                  | 320       | 0.05     | 2                          |
| 32 Groundnut-Sesame-Fallow                 | 300       | 0.04     | 1                          |
| 33 Maize-Sesame-T. Aman                    | 300       | 0.04     | 1                          |
| 34 Sesame-Aus-Fallow                       | 200       | 0.03     | 1                          |
| 35-39 Other five patterns (in Table 9)     | 385       | 0.06     | -                          |
| Total oil-seed crops                       | 136085    | 20.36    |                            |

crop grasspea reported its widest spreading in the region. One pattern is available in 12 out of 35 upazilas. Finally the aggregate area of the pulse crop cropping system stands for 7.42% of the NCA in Bogra region.

### Vegetables and spices crops

Fifty-three cropping patterns have been arranged in descending order according to area coverage (Table 8). Potato and other vegetables of Rabi, Kharif-I and Kharif-II; spices viz chilli, onion, garlic are included in this list. A row is included at the end of the Table 8 representing

an aggregate of 25 patterns of vegetables and spices, which is elaborately presented in the Table 9 with other patterns of different categories. The most contributing cropping pattern is Potato-Boro-T. Aman covering about 13.26% of NCA, which was distributed over 17 upazilas. Year round vegetable was the second most dominant cropping pattern which possessed 16,030 ha covering 2.40% of NCA and recorded in 22 upazilas out of 35. Onion-Jute-Fallow is the third dominant pattern but exists only in five upazilas. Among the spices onion occupied the major area under



**Table 7. Cropping patterns of pulse crops in Bogra region, 2014-15.**

| Cropping pattern                        | Area (ha) | % of NCA | Frequency (no. of upazila) |
|---|-----------|----------|----------------------------|
| 01 Lentil-Jute-Fallow                   | 6650      | 0.99     | 10                         |
| 02 Grasspea-B. Aman                     | 6470      | 0.97     | 12                         |
| 03 Lentil-Aus-T. Aman                   | 3340      | 0.50     | 9                          |
| 04 Blackgram-B. Aman                    | 2950      | 0.44     | 5                          |
| 05 Grasspea-Boro-Fallow                 | 2950      | 0.44     | 5                          |
| 06 Grasspea-Boro-B. Aman                | 2600      | 0.39     | 2                          |
| 07 B.gram(Fodder)-Boro-B. Aman          | 2000      | 0.30     | 1                          |
| 08 Wheat-Mungbean-T. Aman               | 1990      | 0.30     | 6                          |
| 09 Boro-Fallow-Blackgram                | 1960      | 0.29     | 7                          |
| 10 Grasspea-Sesame+B. Aman              | 1700      | 0.25     | 1                          |
| 11 Lentil-Sesame-T. Aman                | 1680      | 0.25     | 6                          |
| 12 Fallow-Fallow-Blackgram              | 1210      | 0.18     | 6                          |
| 13 Grasspea-Fallow-Fallow               | 1005      | 0.15     | 3                          |
| 14 Lentil-Sesame+B. Aman                | 980       | 0.15     | 1                          |
| 15 Lentil-Jute-T. Aman                  | 975       | 0.15     | 7                          |
| 16 Grasspea-Sesame-T. Aman              | 970       | 0.15     | 2                          |
| 17 Wheat-Fallow-Blackgram               | 900       | 0.13     | 1                          |
| 18 Lentil-Sesame-Fallow                 | 810       | 0.12     | 4                          |
| 19 Grasspea-Jute-T. Aman                | 800       | 0.12     | 1                          |
| 20 Groundnut-Fallow-Blackgram           | 800       | 0.12     | 1                          |
| 21 Lentil-B. Aman                       | 790       | 0.12     | 4                          |
| 22 Onion-Aus-Blackgram                  | 740       | 0.11     | 3                          |
| 23 Grasspea-Jute-Fallow                 | 550       | 0.08     | 3                          |
| 24 Sesame-Fallow-Blackgram              | 500       | 0.07     | 1                          |
| 25 Wheat-Jute-Blackgram                 | 500       | 0.07     | 1                          |
| 26 Boro-Aus-Blackgram                   | 410       | 0.06     | 2                          |
| 27 Grasspea-Sesbania-Fallow             | 400       | 0.06     | 1                          |
| 28 Mustard-Aus-Blackgram                | 400       | 0.06     | 1                          |
| 29 Mustard-Mungbean-T. Aman             | 400       | 0.06     | 1                          |
| 30 Pea-B. Aman                          | 400       | 0.06     | 2                          |
| 31 Lentil-Aus-Fallow                    | 300       | 0.04     | 3                          |
| 32 Pea-Aus-Vegetab                      | 280       | 0.04     | 1                          |
| 33 Lentil-Vegetab-Vegetab               | 270       | 0.04     | 5                          |
| 34 Vegetab-Fallow-Blackgram             | 200       | 0.03     | 3                          |
| 35-41 Other seven patterns (in Table 9) | 705       | 0.11     |                            |
| Total pulse crop                        | 49585     | 7.42     |                            |

cultivation. Vegetables like colocasia, okra, amaranths, brinjal, cucurbits, etc are grown in medium upland adjacent to rice fields during rainy season and potato, sweet gourd, cole crops, leafy vegetables etc are grown during winter season in Tripura (Das *et al.*, 2015).

#### **Sporadic and distinct cropping patterns**

There are some cropping patterns which are extremely location-specific, however, with a large area coverage. The Blackgram (fodder)-Boro-B. Aman is grown on 2,000 hectares (Table 7) in Shahjadpur upazila of Sirajganj

district. It is a unique pattern in Bangladesh. Shahjadpur is the main centre of the milch cattle/cow under the supervision of Milk Vita Cooperative Systems. Now-a-days other NGO and private enterprises are also going there for milk collection. For feeding these cattle the farmers of the locality has adopted this cropping system. In this system blackgram is grown as relay crop where the seeds of blackgram are broadcast in the standing deepwater rice at flowering stage. After harvesting of rice, blackgram is rapidly grown and are subjected to cattle feeding at green stage. Grasspea-

**Table 8. Cropping patterns for vegetables and spices crops in Bogra region, 2014-15.**

| Cropping pattern                     | Area (ha) | % of NCA | Frequency (no. of upazila) |
|--------------------------------------|-----------|----------|----------------------------|
| 01 Potato-Boro-T. Aman               | 88610     | 13.26    | 17                         |
| 02 Vegetab-Vegetab-Vegetab*          | 16030     | 2.40     | 22                         |
| 03 Onion-Jute-Fallow                 | 10080     | 1.51     | 5                          |
| 04 Onion-Jute-T. Aman                | 9330      | 1.40     | 12                         |
| 05 Vegetab-Boro-T. Aman              | 4760      | 0.71     | 7                          |
| 06 Chilli-Jute-Fallow                | 4620      | 0.69     | 10                         |
| 07 Boro-Vegetab(Float/Norm**)        | 4000      | 0.60     | 6                          |
| 08 Vegetab-Vegetab-Fallow            | 3730      | 0.56     | 10                         |
| 09 Onion-B. Aman                     | 3650      | 0.55     | 7                          |
| 10 Garlic-B. Aman                    | 3100      | 0.46     | 4                          |
| 11 Onion-Vegetab-Vegetab             | 3100      | 0.46     | 14                         |
| 12 Chilli-Jute-T. Aman               | 2300      | 0.34     | 2                          |
| 13 Potato-Boro-Aus-T. Aman           | 2250      | 0.34     | 2                          |
| 14 Onion-Sesame-T. Aman              | 2200      | 0.33     | 2                          |
| 15 Wheat-Vegetab-Vegetab             | 2100      | 0.31     | 3                          |
| 16 Vegetab-Aus-Fallow                | 2060      | 0.31     | 5                          |
| 17 Onion-Aus-T. Aman                 | 1910      | 0.29     | 3                          |
| 18 Onion-Sesame+B. Aman              | 1800      | 0.27     | 2                          |
| 19 Vegetab-Fallow-T. Aman            | 1790      | 0.27     | 6                          |
| 20 Potato-Vegetab-T. Aman            | 1670      | 0.25     | 5                          |
| 21 Vegetab-Aus-T. Aman               | 1665      | 0.25     | 6                          |
| 22 Chilli-Vegetab-Fallow             | 1650      | 0.25     | 10                         |
| 23 Potato-Maize-Vegetab              | 1500      | 0.22     | 1                          |
| 24 Potato-Jute-T. Aman               | 1280      | 0.19     | 7                          |
| 25 Vegetab-Jute-Fallow               | 1240      | 0.19     | 4                          |
| 26 Chilli-Aus-Fallow                 | 1210      | 0.18     | 4                          |
| 27 Potato-Maize-T. Aman              | 1200      | 0.18     | 4                          |
| 28 Vegetab-Vegetab-T. Aman           | 1030      | 0.15     | 4                          |
| 29 Garlic-Aus-T. Aman                | 1010      | 0.15     | 2                          |
| 30 Vegetab-Onion-Aus                 | 1000      | 0.15     | 1                          |
| 31 Vegetab-Jute-T. Aman              | 980       | 0.15     | 3                          |
| 32 Vegetab-Fallow-Fallow             | 900       | 0.13     | 3                          |
| 33 Potato-Boro-Fallow                | 750       | 0.11     | 3                          |
| 34 Onion-Aus-Blackgram               | 740       | 0.11     | 3                          |
| 35 Chilli-Fallow-Fallow              | 710       | 0.11     | 4                          |
| 36 Garlic-Jute-T. Aman               | 700       | 0.10     | 6                          |
| 37 Coriander-Vegetab-Fallow          | 630       | 0.09     | 2                          |
| 38 Potato-Sesame-T. Aman             | 600       | 0.09     | 2                          |
| 39 Chilli-Aus-T. Aman                | 430       | 0.06     | 2                          |
| 40 Garlic-Jute-Fallow                | 430       | 0.06     | 2                          |
| 41 Garlic-Fallow-T. Aman             | 420       | 0.06     | 5                          |
| 42 Vegetab-Jute-Vegetab              | 380       | 0.06     | 1                          |
| 43 Onion-Sesame-Fallow               | 350       | 0.05     | 2                          |
| 44 Garlic-Vegetab-Vegetab            | 345       | 0.05     | 9                          |
| 45 Potato-Boro-Vegetab               | 300       | 0.04     | 1                          |
| 46 Potato-Maize-Aus                  | 300       | 0.04     | 1                          |
| 47 Potato-Maize-Aus-Vegetab          | 300       | 0.04     | 1                          |
| 48 Vegetab-Boro-Jute                 | 300       | 0.04     | 2                          |
| 49 Pea-Aus-Vegetab                   | 280       | 0.04     | 1                          |
| 50 Lentil-Vegetab-Vegetab            | 270       | 0.04     | 5                          |
| 51 Boro-Vegetab-T. Aman              | 200       | 0.03     | 2                          |
| 52 Potato-Fallow-T. Aman             | 200       | 0.03     | 1                          |
| 53 Vegetab-Fallow-Blackgram          | 200       | 0.03     | 3                          |
| 54-78 Other 25 patterns (in Table 9) | 1485      | 0.22     | -                          |
| Total vegetab and spices             | 194075    | 29.03    |                            |

**Table 9. Rare cropping patterns covering non-significant area in Bogra region, 2014-15.**

|    | Cropping pattern                      | Area (ha) | % of NCA | Frequency | Upazila                  |
|----|---------------------------------------|-----------|----------|-----------|--------------------------|
| 01 | Mustard-Maize-T. Aman                 | 190       | 0.03     | 1         | Sherpur                  |
| 02 | Potato-Aus-T. Aman                    | 180       | 0.03     | 2         | Shahjahanpur+Pabna sadar |
| 03 | Blackgram-Jute-Fallow                 | 170       | 0.03     | 2         | Sonatola+Kazipur         |
| 04 | Millet( <i>cheena</i> )-Jute-Fallow   | 170       | 0.03     | 1         | Sariakandi               |
| 05 | Vegetab-Boro-Fallow                   | 170       | 0.03     | 1         | Chowhali                 |
| 06 | Grasspea-B.Aus+B. Aman                | 160       | 0.02     | 2         | Kazipur+Sirajganj sadar  |
| 07 | Coriander-Fallow-Fallow               | 150       | 0.02     | 2         | Bhangura+Chowhali        |
| 08 | S.Potato-Fallow-T. Aman               | 115       | 0.02     | 3         | Kalai+Khetlal+Kazipara   |
| 09 | Wheat-Mungbean-Fallow                 | 105       | 0.02     | 2         | Pabna sadar+Tarash       |
| 10 | Lentil-Mungbean-T. Aman               | 100       | 0.02     | 1         | Pabna sadar              |
| 11 | Maize-Aus-T. Aman                     | 100       | 0.02     | 2         | Shajahanpur+Pabna sadar  |
| 12 | Mustard-Boro-Jute-T. Aman             | 100       | 0.02     | 1         | Sonatola                 |
| 13 | Potato-Boro-Jute-T. Aman              | 90        | 0.01     | 1         | Sherpur                  |
| 14 | Onion-Fallow-T. Aman                  | 80        | 0.01     | 2         | Dubchachia+Khetlal       |
| 15 | Pea-Fallow-T. Aman                    | 80        | 0.01     | 1         | Chowhali                 |
| 16 | Vegetab-Maize-T. Aman                 | 80        | 0.01     | 2         | Shajahanpur+Tarash       |
| 17 | Maize-Vegetab-T. Aman                 | 70        | 0.01     | 1         | Shajahanpur              |
| 18 | Onion-Aus-Fallow                      | 70        | 0.01     | 2         | Adamdighi+Kazipur        |
| 19 | Onion-Maize-T. Aman                   | 70        | 0.01     | 1         | Sherpur                  |
| 20 | Potato-S.gourd-Aus                    | 70        | 0.01     | 2         | Gabtali+Akkelpur         |
| 21 | Garlic-Fallow-Fallow                  | 60        | 0.01     | 1         | Dhunat                   |
| 22 | Coriander-Sesame-T. Aman              | 55        | 0.01     | 2         | Pabna+Tarash             |
| 23 | Blackgram-Aus-T. Aman                 | 50        | 0.01     | 1         | Sherpur                  |
| 24 | S.Potato-Vegetab-Fallow               | 50        | 0.01     | 1         | Bogra sadar              |
| 25 | Blackcumin-Jute-Fallow                | 40        | 0.01     | 1         | Chowhali                 |
| 26 | Chilli-Vegetab-T. Aman                | 40        | 0.01     | 1         | Dubchachia               |
| 27 | Grasspea-Aus-T. Aman                  | 40        | 0.01     | 1         | Atghoria                 |
| 28 | Maize-Maize-Fallow                    | 40        | 0.01     | 1         | Shajahanpur              |
| 29 | Muskmelon-Fallow-Fallow               | 40        | 0.01     | 1         | Sirajganj sadar          |
| 30 | Chilli-B. Aman                        | 30        | 0.00     | 1         | Bera                     |
| 31 | Coriander-Jute-Fallow                 | 30        | 0.00     | 1         | Kazipur                  |
| 32 | Garlic-Aus-Fallow                     | 30        | 0.00     | 1         | Adamdighi                |
| 33 | Maize-Sesame-Fallow                   | 30        | 0.00     | 1         | Tarash                   |
| 34 | Potato+S.gourd-Aus-T. Aman            | 30        | 0.00     | 1         | Sonatola                 |
| 35 | W.Melon-B. Aman                       | 30        | 0.00     | 1         | Tarash                   |
| 36 | Blackcumin-Jute-T. Aman               | 20        | 0.00     | 1         | Kazipur                  |
| 37 | Maize-Vegetab-Fallow                  | 20        | 0.00     | 1         | Shibganj                 |
| 38 | Potato-Maize-Fallow                   | 20        | 0.00     | 1         | Sirajganj sadar          |
| 39 | Barley-Fallow-Fallow                  | 15        | 0.00     | 2         | Chowhali+Tarash          |
| 40 | Chilli-Fallow-T. Aman                 | 10        | 0.00     | 1         | Kalai                    |
| 41 | Fallow-Sesame-T. Aman                 | 10        | 0.00     | 1         | Sherpur                  |
| 42 | Millet( <i>cheena</i> )-Fallow-Fallow | 10        | 0.00     | 1         | Sonatola                 |
| 43 | Potato-Onion-T. Aman                  | 10        | 0.00     | 1         | Khetlal                  |
| 44 | Wheat-Vegetab-T. Aman                 | 10        | 0.00     | 1         | Khetlal                  |
| 45 | S.Potato-Jute-T. Aman                 | 5         | 0.00     | 1         | Akkelpur                 |
|    | Total                                 | 3045      | 0.46     |           |                          |

Sesame+B. Aman is grown on 1,700 hectares in Chowhali upazila of the same district. Millet (*kaon*)–Fallow–T. Aman is cultivated on 1,500 hectares only in Sariakandi of Bogra district. The millet is a small grain cereal crop, which stands on the bank of extinction for its low yield and less economic value, although it is a very nutritious food. Only some marginal land like *charland* is used for its cultivation (FAO, 1988).

### Rare cropping patterns

In the present investigation, 45 cropping patterns have been identified as rare cropping patterns with negligible area coverage with seldom existence (Table 9). These are location specific system and are limited in one or two upazilas of the region. Total area coverage of the 45 patterns is far less than 1% of NC Among them the highest area was allotted for Mustard–Maize–T. Aman (190 ha) and it is recorded only in Sherpur upazila of Bogra district. The smallest area was recorded for S.Potato–Jute–T. Aman cropping patterns whose coverage was only five hectares (Table 9) and is recorded only in Akkelpur upazila of Joypurhat district.

### Most dominant cropping pattern

Boro–Fallow–T. Aman was the most dominant cropping pattern in Bogra region. It covers 21.88% of NCA in the region and is available in 27 upazilas out of 35 (Table 10). The highest area under this cropping was recorded 16,500 hectares in Raiganj upazila of Sirajganj district which represents 11.28% of the total Boro–Fallow–T. Aman area of the region. In consideration of individual upazila it also covered the highest area and it is 77.10% of its NCA for this pattern alone. Chatmohar and Bhangura upazila of Pabna district had negligible area coverage for this pattern. In some portion of the double rice area some short duration Rabi crops can be grown before Boro transplanting if appropriate varieties and other related technologies are made available (FAO, 1988). In the country-wide compilation of data it was observed that Boro–F–T. Aman was the most dominant cropping pattern in Bangladesh covering 2.31 million ha (27% of NCA in the country) with its distribution in 426 upazilas of 63 districts (Nasim *et al.*, 2017).

### Second dominant cropping pattern

The second dominant cropping pattern in Bogra region is Potato–Boro–T. Aman. It belongs to 13.26% of NCA of the region and spread over 17 upazilas (Table 11). Shibganj upazila of Bogra district holds the highest area coverage (18,200 ha) under this cropping pattern. Kalai upazila ranks in second position in terms of area coverage (11,800 ha) however this upazila allotted the biggest share (84.83%) of the upazila NCA. In the country-wide compilation of data it was observed that Potato–Boro–T. Aman was the 8<sup>th</sup> dominant cropping pattern in Bangladesh covering 1.80 lac ha (2.11% of NCA in the country) with its distribution in 115 upazilas of 33 districts (Nasim *et al.*, 2017).

### Third dominant cropping pattern

Mustard–Boro–Fallow cropping pattern holds the third largest area coverage 50,940 hectares in Bogra region. This area is an equivalent to 7.62% of NCA in the region. This pattern Mustard–Boro–Fallow is distributed over only 15 upazilas. Shahjadpur and Ullapara upazila have the highest area coverage under this pattern and it is 13,000 ha for both the upazilas which stands for 25.52% of the total area under this pattern in the region for both the locations (Table 12). Belkuchi upazila ranks in third position for this cropping pattern, however, Panchbibi, Santhia and Kazipur covers a minute area of 200 ha for each upazila.

### Fourth dominant cropping pattern

Fourth dominant cropping pattern Mustard–Boro–T. Aman has occupied 40,110 hectares representing 6.0% share of NCA in Bogra region (Table 13). This pattern is distributed over 25 upazilas where Kahalu ranked in top position. This upazila has 4,800 ha area of Mustard–Boro–T. Aman which is 24.96% of upazila NCA. Dupchachia upazila ranks in third position with 3,700 ha area for this pattern; however, this upazila has allotted the biggest share (26.94%) of its NCA.

### Fifth dominant cropping pattern

Fifth dominant cropping pattern Boro–Fallow–Fallow had been covering 37,300 hectares

**Table 10. Distribution of the most dominant Boro-F-T. Aman cropping patterns in Bogra region, 2014-15.**

| Upazila            | Area (ha) | % of upazila NCA | % of the pattern in region |
|--------------------|-----------|------------------|----------------------------|
| 01 Raiganj         | 16500     | 77.10            | 11.28                      |
| 02 Sherpur         | 13600     | 57.14            | 9.30                       |
| 03 Dhunat          | 13100     | 67.18            | 8.96                       |
| 04 Gabtali         | 11500     | 60.37            | 7.86                       |
| 05 Sirajganj sadar | 9000      | 40.54            | 6.15                       |
| 06 Tarash          | 8700      | 35.15            | 5.95                       |
| 07 Nandigram       | 8000      | 35.87            | 5.47                       |
| 08 Sariakandi      | 8000      | 32.92            | 5.47                       |
| 09 Panchbibi       | 7900      | 35.75            | 5.40                       |
| 10 Shajahanpur     | 6500      | 40.88            | 4.44                       |
| 11 Joypurhat sadar | 5700      | 30.65            | 3.90                       |
| 12 Kahalu          | 4700      | 24.48            | 3.21                       |
| 13 Sonatola        | 4700      | 34.31            | 3.21                       |
| 14 Atghoria        | 4500      | 32.61            | 3.08                       |
| 15 Adamdighi       | 4100      | 32.28            | 2.80                       |
| 16 Akkelpur        | 3900      | 36.28            | 2.67                       |
| 17 Kazipur         | 3200      | 14.16            | 2.19                       |
| 18 Dubchachia      | 3000      | 21.90            | 2.05                       |
| 19 Iswardi         | 2000      | 13.07            | 1.37                       |
| 20 Bogra sadar     | 1800      | 16.29            | 1.23                       |
| 21 Sujanagar       | 1800      | 7.38             | 1.23                       |
| 22 Kalai           | 1400      | 10.07            | 0.96                       |
| 23 Shibganj        | 1200      | 4.72             | 0.82                       |
| 24 Kamarkhanda     | 800       | 10.53            | 0.55                       |
| 25 Khetlal         | 300       | 2.58             | 0.21                       |
| 26 Chatmohar       | 200       | 0.80             | 0.14                       |
| 27 Bhangura        | 150       | 1.36             | 0.10                       |
| Bogra region       | 146250    | 21.88            | 100.00                     |

**Table 11. Distribution of the 2<sup>nd</sup> dominant Potato-Boro-T. Aman cropping pattern in Bogra region, 2014-15.**

| Upazila            | Area (ha) | % of upazila NCA | % of the pattern in region |
|--------------------|-----------|------------------|----------------------------|
| 01 Shibganj        | 18200     | 75.99            | 20.54                      |
| 02 Kalai           | 11800     | 84.83            | 13.32                      |
| 03 Khetlal         | 8900      | 76.20            | 10.04                      |
| 04 Kahalu          | 8600      | 44.72            | 9.71                       |
| 05 Dubchachia      | 6600      | 48.05            | 7.45                       |
| 06 Pachbibi        | 6100      | 26.90            | 6.88                       |
| 07 Bogra sadar     | 6000      | 53.56            | 6.77                       |
| 08 Joypurhat sadar | 5500      | 28.35            | 6.21                       |
| 09 Akkelpur        | 5000      | 46.12            | 5.64                       |
| 10 Shajahanpur     | 4000      | 16.98            | 4.51                       |
| 11 Adamdighi       | 3300      | 25.90            | 3.72                       |
| 12 Sonatola        | 2300      | 16.61            | 2.60                       |
| 13 Gabtali         | 1300      | 6.78             | 1.47                       |
| 14 Sherpur         | 360       | 1.38             | 0.41                       |
| 15 Ullapara        | 250       | 0.78             | 0.28                       |
| 16 Kamarkhanda     | 200       | 2.59             | 0.23                       |
| 17 Tarash          | 200       | 0.81             | 0.23                       |
| Bogra region       | 88610     | 13.26            | 100.00                     |

**Table 12. Distribution of the 3<sup>rd</sup> dominant Mustard- Boro–Fallow cropping pattern in Bogra region, 2014-15.**

| Upazila       | Area (ha) | % of upazila NCA | % of the pattern in region |
|---------------|-----------|------------------|----------------------------|
| 01 Shahjadpur | 13000     | 52.20            | 25.52                      |
| 02 Ullapara   | 13000     | 40.51            | 25.52                      |
| 03 Belkuchi   | 6000      | 46.33            | 11.78                      |
| 04 Tarash     | 5100      | 20.60            | 10.01                      |
| 05 Chatmohar  | 4000      | 15.96            | 7.85                       |
| 06 Faridpur   | 4000      | 34.64            | 7.85                       |
| 07 Bera       | 1400      | 7.80             | 2.75                       |
| 08 Bhangura   | 1100      | 9.92             | 2.16                       |
| 09 Raiganj    | 800       | 3.66             | 1.57                       |
| 10 Gabtali    | 740       | 3.86             | 1.45                       |
| 11 Sujanagar  | 700       | 2.84             | 1.37                       |
| 12 Sirajganj  | 500       | 2.11             | 0.98                       |
| 13 Panchbibi  | 200       | 0.88             | 0.39                       |
| 14 Santhia    | 200       | 0.79             | 0.39                       |
| 15 Kazipur    | 200       | 0.87             | 0.39                       |
| Bogra region  | 50940     | 7.62             | 100.00                     |

**Table 13. Distribution of the 4<sup>th</sup> dominant Mustard-Boro–T. Aman cropping pattern in Bogra region, 2014-15.**

| Upazila        | Area (ha) | % of upazila NCA | % of the pattern in region |
|----------------|-----------|------------------|----------------------------|
| 1 Kahalu       | 4800      | 24.96            | 11.97                      |
| 2 Panchbibi    | 4200      | 18.52            | 10.47                      |
| 3 Dubchachia   | 3700      | 26.94            | 9.22                       |
| 4 Ullapara     | 3700      | 11.53            | 9.22                       |
| 5 Adamdighi    | 3200      | 25.12            | 7.98                       |
| 6 Joypurhat    | 3000      | 15.46            | 7.48                       |
| 7 Dhunat       | 2000      | 10.23            | 4.99                       |
| 8 Kamarkhanda  | 2000      | 25.86            | 4.99                       |
| 9 Sirajganj    | 1600      | 6.74             | 3.99                       |
| 10 Khettal     | 1400      | 11.99            | 3.49                       |
| 11 Sonatola    | 1300      | 9.39             | 3.24                       |
| 12 Shariakandi | 1200      | 4.93             | 2.99                       |
| 13 Sherpur     | 1100      | 4.67             | 2.74                       |
| 14 Shibganj    | 1100      | 4.22             | 2.74                       |
| 15 Akkelpur    | 1100      | 10.15            | 2.74                       |
| 16 Belkuchi    | 1000      | 7.72             | 2.49                       |
| 17 Raiganj     | 900       | 4.11             | 2.24                       |
| 18 Bogra       | 800       | 7.14             | 1.99                       |
| 19 Shajahanpur | 600       | 3.74             | 1.50                       |
| 20 Kazipur     | 350       | 1.53             | 0.87                       |
| 21 Tarash      | 260       | 1.05             | 0.65                       |
| 22 Kalai       | 200       | 1.44             | 0.50                       |
| 23 Atghoria    | 200       | 1.43             | 0.50                       |
| 24 Bhangura    | 200       | 1.80             | 0.50                       |
| 25 Santhia     | 200       | 0.79             | 0.50                       |
| Bogra region   | 40110     | 6.00             | 100.00                     |

representing 5.58% share of NCA in Bogra region (Table 14). This pattern is distributed over 21 upazilas where Kazipur ranked in top position. This upazila had 7,600 ha area for single Boro pattern which is 33.17% of upazila NCA. Ullapara upazila ranked in second position in respect to area coverage. In the country-wide

compilation of data it was observed that the single Boro was the 2<sup>nd</sup> dominant cropping pattern in Bangladesh covering 1.14 million ha (13% of NCA in the country) with its distribution in 342 upazilas of 59 districts (Nasim *et al.*, 2017). This pattern is frequent and concurrently experienced by early flash

**Table 14. Distribution of the 5<sup>th</sup> dominant Boro–F–F cropping pattern in Bogra region, 2014-15.**

| Upazila        | Area (ha) | % of upazila NCA | % of the pattern in region |
|----------------|-----------|------------------|----------------------------|
| 01 Kazipur     | 7600      | 33.17            | 20.38                      |
| 02 Ullapara    | 5400      | 16.83            | 14.48                      |
| 03 Tarash      | 3000      | 12.12            | 8.04                       |
| 04 Chowhali    | 2400      | 18.88            | 6.43                       |
| 05 Bhangura    | 2100      | 18.94            | 5.63                       |
| 06 Sariakandi  | 2000      | 8.21             | 5.36                       |
| 07 Sujanagar   | 1800      | 7.29             | 4.83                       |
| 08 Shahjadpur  | 1800      | 7.23             | 4.83                       |
| 09 Pabna       | 1500      | 4.21             | 4.02                       |
| 10 Bera        | 1400      | 7.80             | 3.75                       |
| 11 Gabtali     | 1200      | 6.26             | 3.22                       |
| 12 Sherpur     | 1000      | 3.84             | 2.68                       |
| 13 Chatmohar   | 1000      | 3.99             | 2.68                       |
| 14 Faridpur    | 1000      | 8.66             | 2.68                       |
| 15 Raiganj     | 1000      | 4.57             | 2.68                       |
| 16 Atghoria    | 800       | 5.70             | 2.14                       |
| 17 Shajahanpur | 600       | 2.55             | 1.61                       |
| 18 Sonatola    | 600       | 4.33             | 1.61                       |
| 19 Kamarkhanda | 500       | 6.46             | 1.34                       |
| 20 Dhunat      | 400       | 2.05             | 1.07                       |
| 21 Adamdighi   | 200       | 1.57             | 0.54                       |
| Bogra region   | 37300     | 5.58             | 100.00                     |

in April and cold injury at reproductive stage. Diversified cropping pattern may be resort for the farmer as a coping strategy with flood related risk (Mandal and Bezbaruah, 2013) but scope of diversification is limited due to environmental and climatic condition (FAO, 1988).

#### **Crop diversity and cropping intensity**

Higher number of available crops under cultivation in an area dictates its higher diversity. Number of cropping patterns is also a gross indicator of crop diversity. A total of 177 cropping patterns were identified in the whole area of Bogra region under this investigation. The highest number of cropping patterns was identified 36 in Kazipur upazila of Sirajganj district and that was 34 in Sonatola upazila in Bogra district (Table 15). The lowest number of cropping patterns was identified six in Nandigram followed by nine in Dubchachia and Kahalu upazila. The higher number of cropping patterns is generally related to higher level of diversity indices for cropping pattern. The upazilas having lower number of cropping patterns were related to either low land area or water logging or both. The highest value of

diversity index for cropping pattern was found 0.950 in Bera upazila that was followed by 0.912 in Chatmohar upazila. The lowest CDI was reported 0.718 in Raiganj of Sirajganj district followed by 0.734 in Kalai upazila in Joypurhat. The highest value of CDI was observed 0.978 in Pabna sadar followed by 0.972 in Bera upazila. The range of cropping intensity values was recorded 183-291%. The maximum value was for Khetlal upazila of Joypurhat district and minimum for Bera upazila of Pabna district. As a whole the CDI of Bogra region was calculated 0.966 and the average cropping intensity at regional level was 234%. In a simultaneous study, the investigators identified 316 cropping patterns for whole Bangladesh; where the CDI value was 0.952 at national level and the national average of cropping intensity was 200% (Nasim *et al*, 2017). Diversification of crops helps risk reduction as diversification allows a producer to balance low price in one or two crops with reasonable prices in other. (Blade and Slinkard, 2002). The farmers of Kerala diversified their cropping pattern to minimize risk of crop failures and price fluctuations (Mahesh, 1999).

**Table 15. Crop diversity and cropping intensity in Bogra region, 2014-15.**

|    | Upazila      | No. of identified pattern | No. of crop | Diversity index for cropping pattern | Crop diversity index (CDI) | C.I. (%) |
|----|--------------|---------------------------|-------------|--------------------------------------|----------------------------|----------|
| 01 | Adamdighi    | 14                        | 13          | 0.762                                | 0.909                      | 261      |
| 02 | Bogra        | 16                        | 18          | 0.675                                | 0.879                      | 282      |
| 03 | Dhunat       | 22                        | 17          | 0.535                                | 0.794                      | 215      |
| 04 | Dubchachia   | 9                         | 13          | 0.827                                | 0.866                      | 277      |
| 05 | Gabtali      | 20                        | 16          | 0.614                                | 0.831                      | 218      |
| 06 | Kahalu       | 9                         | 11          | 0.677                                | 0.878                      | 274      |
| 07 | Nandigram    | 6                         | 7           | 0.692                                | 0.893                      | 276      |
| 08 | Sariakandi   | 19                        | 17          | 0.852                                | 0.929                      | 205      |
| 09 | Sherpur      | 32                        | 15          | 0.660                                | 0.863                      | 227      |
| 10 | Shibganj     | 16                        | 15          | 0.499                                | 0.810                      | 282      |
| 11 | Shajahanpur  | 22                        | 14          | 0.761                                | 0.905                      | 241      |
| 12 | Sonatola     | 34                        | 22          | 0.835                                | 0.936                      | 246      |
| 13 | Akkelpur     | 19                        | 15          | 0.647                                | 0.859                      | 260      |
| 14 | Joypurhat    | 14                        | 15          | 0.795                                | 0.920                      | 259      |
| 15 | Kalai        | 12                        | 13          | 0.270                                | 0.734                      | 289      |
| 16 | Khetlal      | 17                        | 12          | 0.402                                | 0.783                      | 291      |
| 17 | Panchbibi    | 13                        | 10          | 0.768                                | 0.908                      | 251      |
| 18 | Atghroria    | 28                        | 13          | 0.868                                | 0.949                      | 237      |
| 19 | Bera         | 29                        | 20          | 0.950                                | 0.972                      | 183      |
| 20 | Bhangura     | 16                        | 13          | 0.859                                | 0.931                      | 196      |
| 21 | Chatmohar    | 20                        | 16          | 0.912                                | 0.961                      | 218      |
| 22 | Faridpur     | 11                        | 14          | 0.816                                | 0.906                      | 200      |
| 23 | Iswardi      | 18                        | 17          | 0.904                                | 0.954                      | 247      |
| 24 | Pabna sadar  | 34                        | 21          | 0.942                                | 0.978                      | 256      |
| 25 | Santhia      | 25                        | 16          | 0.891                                | 0.962                      | 274      |
| 26 | Sujanagar    | 28                        | 19          | 0.843                                | 0.922                      | 201      |
| 27 | Belkuchi     | 14                        | 14          | 0.759                                | 0.894                      | 219      |
| 28 | Chowhali     | 26                        | 26          | 0.901                                | 0.944                      | 196      |
| 29 | Kazipur      | 36                        | 21          | 0.845                                | 0.940                      | 190      |
| 30 | Kamarkhanda  | 19                        | 18          | 0.832                                | 0.919                      | 227      |
| 31 | Raiganj      | 21                        | 17          | 0.425                                | 0.718                      | 203      |
| 32 | Shahjadpur   | 19                        | 16          | 0.703                                | 0.870                      | 217      |
| 33 | Sirajganj    | 25                        | 21          | 0.831                                | 0.917                      | 206      |
| 34 | Tarash       | 28                        | 22          | 0.799                                | 0.899                      | 198      |
| 35 | Ullapara     | 26                        | 18          | 0.777                                | 0.900                      | 209      |
|    | Bogra region | 177                       | 35          | 0.919                                | 0.966                      | 234      |

## CONCLUSION

The cropping intensity of the Bogra region was higher than the national average. Boro-Fallow-T. Aman, Potato-Boro-T. Aman, Mustard-Boro-Fallow, Mustard-Boro-T. Aman and single Boro were the dominant cropping patterns in the region. Exclusive rice area is about three folds of exclusive non-rice area. In Bogra region crop diversity is much wider than that of other regions. Based on the findings of the study, the following recommendations were made.

- Initiative to be taken to increase productivity of exclusive rice based cropping pattern.
- Effort might be given so that a portion of double-rice area could be brought under Potato-Boro-T. Aman and/or Mustard-Boro-T. Aman cropping systems.
- In the single Boro area suitable vegetables might be grown on floating bed system in wet season.
- The upazilas having unique or exceptional cropping patterns with large area coverage



might be studied in-depth to extrapolate to similar environments.

- Scope might be explored for the establishment of agro-food industry on the basis of potato crop.

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Appendix 1. List of cropping patterns in Bogra region, 2014-15.

| Cropping pattern              | Area (ha) | Cropping pattern                    | Area (ha) |
|-------------------------------|-----------|-------------------------------------|-----------|
| 001 Boro-Fallow-T. Aman       | 146250    | 067 Chilli-Aus-Fallow               | 1210      |
| 002 Potato-Boro-T. Aman       | 88610     | 068 Fallow-Fallow-Blackgram         | 1210      |
| 003 Mustard-Boro-Fallow       | 50940     | 069 Potato-Maize-T. Aman            | 1200      |
| 004 Mustard-Boro-T. Aman      | 40110     | 070 Vegetab-Vegetab-T. Aman         | 1030      |
| 005 Boro-Fallow-Fallow        | 37300     | 071 Garlic-Aus-T. Aman              | 1010      |
| 006 Boro-Aus-T. Aman          | 19700     | 072 Grasspea-Fallow-Fallow          | 1005      |
| 007 Boro-B. Aman              | 18650     | 073 Vegetab-Onion-Aus               | 1000      |
| 008 Vegetab-Vegetab-Vegetab   | 16030     | 074 Wheat-Sesame-Fallow             | 1000      |
| 009 Wheat-Jute-T. Aman        | 14540     | 075 Lentil-Sesame+B. Aman           | 980       |
| 010 Onion-Jute-Fallow         | 10080     | 076 Vegetab-Jute-T. Aman            | 980       |
| 011 Onion-Jute-T. Aman        | 9330      | 077 Lentil-Jute-T. Aman             | 975       |
| 012 Wheat-B. Aman             | 7920      | 078 Grasspea-Sesame-T. Aman         | 970       |
| 013 Boro-Jute-T. Aman         | 7020      | 079 Vegetab-Fallow-Fallow           | 900       |
| 014 Lentil-Jute-Fallow        | 6650      | 080 Wheat-Fallow-Blackgram          | 900       |
| 015 Grasspea-B. Aman          | 6470      | 081 Boro-Sesbania-T. Aman           | 880       |
| 016 Mustard-Boro-B. Aman      | 5000      | 082 Lentil-Sesame-Fallow            | 810       |
| 017 Vegetab-Boro-T. Aman      | 4760      | 083 Grasspea-Jute-T. Aman           | 800       |
| 018 Wheat-Aus-Fallow          | 4700      | 084 Groundnut-F-Blackgram           | 800       |
| 019 Chilli-Jute-Fallow        | 4620      | 085 Mustard-B.Aus+B. Aman           | 800       |
| 020 Groundnut-Fallow-Fallow   | 4280      | 086 Lentil-B. Aman                  | 790       |
| 021 Wheat-Jute-Fallow         | 4090      | 087 S.Potato-Jute-Fallow            | 780       |
| 022 Boro-Vegetab(Float/ Norm) | 4000      | 088 Potato-Boro-Fallow              | 750       |
| 023 Vegetab-Vegetab-Fallow    | 3730      | 089 Onion-Aus-Blackgram             | 740       |
| 024 Onion-B. Aman             | 3650      | 090 Chilli-Fallow-Fallow            | 710       |
| 025 Wheat-Aus-T. Aman         | 3630      | 091 Garlic-Jute-T. Aman             | 700       |
| 026 Lentil-Aus-T. Aman        | 3340      | 092 Mustard-Boro-Jute               | 700       |
| 027 Maize-Jute-Fallow         | 3300      | 093 Wheat-Maize-T. Aman             | 700       |
| 028 Garlic-B. Aman            | 3100      | 094 S.Potato-Fallow-Fallow          | 675       |
| 029 Onion-Vegetab-Vegetab     | 3100      | 095 Boro-Aus-Fallow                 | 670       |
| 030 Blackgram-B. Aman         | 2950      | 096 Maize-B. Aman                   | 650       |
| 031 Grasspea-Boro-Fallow      | 2950      | 097 Maize-Fallow-T. Aman            | 640       |
| 032 Mustard-Jute-T. Aman      | 2700      | 098 Coriander-Vegetab-Fallow        | 630       |
| 033 Grasspea-Boro-B. Aman     | 2600      | 099 Potato-Sesame-T. Aman           | 600       |
| 034 Mustard-Boro-Aus          | 2560      | 100 Grasspea-Jute-Fallow            | 550       |
| 035 Maize-Fallow-Fallow       | 2520      | 101 Groundnut-Jute-T. Aman          | 500       |
| 036 Wheat-Sesame-T. Aman      | 2470      | 102 Sesame-Fallow-Blackgram         | 500       |
| 037 Boro-Sesbania-Fallow      | 2450      | 103 Wheat-Jute-Blackgram            | 500       |
| 038 Mustard-Boro-Aus-T. Aman  | 2330      | 104 Chilli-Aus-T. Aman              | 430       |
| 039 Chilli-Jute-T. Aman       | 2300      | 105 Garlic-Jute-Fallow              | 430       |
| 040 Mustard-B. Aman           | 2300      | 106 Garlic-Fallow-T. Aman           | 420       |
| 041 Maize-Jute-T. Aman        | 2255      | 107 Boro-Aus-Blackgram              | 410       |
| 042 Potato-Boro-Aus-T. Aman   | 2250      | 108 Grasspea-Sesbania-Fallow        | 400       |
| 043 Mustard-Aus-T. Aman       | 2200      | 109 Mustard-Aus-Blackgram           | 400       |
| 044 Onion-Sesame-T. Aman      | 2200      | 110 Mustard-Mungbean-T. Aman        | 400       |
| 045 Wheat-Vegetab-Vegetab     | 2100      | 111 Pea-B. Aman                     | 400       |
| 046 Vegetab-Aus-Fallow        | 2060      | 112 Groundnut-Millet(kaon)-F        | 380       |
| 047 B.gram(Fod)-Boro-B. Aman  | 2000      | 113 Vegetab-Jute-Vegetab            | 380       |
| 048 Wheat-Mungbean-T. Aman    | 1990      | 114 Onion-Sesame-Fallow             | 350       |
| 049 Boro-Fallow-Blackgram     | 1960      | 115 Garlic-Vegetab-Vegetab          | 345       |
| 050 Onion-Aus-T. Aman         | 1910      | 116 Maize-Maize-T. Aman             | 330       |
| 051 Boro-Jute-Fallow          | 1900      | 117 Maize-Aus-Fallow                | 320       |
| 052 Onion-Sesame+B. Aman      | 1800      | 118 Mustard-Sesame-T. Aman          | 320       |
| 053 Vegetab-Fallow-T. Aman    | 1790      | 119 Groundnut-Sesame-Fallow         | 300       |
| 054 Millet(kaon)+Sesame-F     | 1720      | 120 Lentil-Aus-Fallow               | 300       |
| 055 Grasspea-Sesame+B. Aman   | 1700      | 121 Maize-Sesame-T. Aman            | 300       |
| 056 Lentil-Sesame-T. Aman     | 1680      | 122 Potato-Boro-Vegetab             | 300       |
| 057 Potato-Vegetab-T. Aman    | 1670      | 123 Potato-Maize-Aus                | 300       |
| 058 Vegetab-Aus-T. Aman       | 1665      | 124 Potato-Maize-Aus-Vegetab        | 300       |
| 059 Chilli-Vegetab-Fallow     | 1650      | 125 Vegetab-Boro-Jute               | 300       |
| 060 Wheat-Fallow-T. Aman      | 1560      | 126 Pea-Aus-Vegetab                 | 280       |
| 061 Fallow-Fallow-T. Aman     | 1550      | 127 Lentil-Vegetab-Vegetab          | 270       |
| 062 Millet(kaon)-F-T. Aman    | 1500      | 128 Wheat-Fallow-Fallow             | 230       |
| 063 Potato-Maize-Vegetab      | 1500      | 129 Boro-Vegetab-T. Aman            | 200       |
| 064 Fallow-Sesame+B. Aman     | 1400      | 130 Potato-Fallow-T. Aman           | 200       |
| 065 Potato-Jute-T. Aman       | 1280      | 131 Sesame-Aus-Fallow               | 200       |
| 066 Vegetab-Jute-Fallow       | 1240      | 132 Vegetab-Fallow-Blackgram        | 200       |
|                               |           | 133-177 Other 45 patterns (Table 9) | 3045      |