9 STATUS OF RICE PRODUCTION SYSTEM IN ASSAM: A RESEARCH PERSPECTIVE

B C Barah, Rajeev Betne and B C Bhowmick*
National Centre For Agricultural Economics and Policy Research
New Delhi
* Department of Agricultural Economics
Assam Agricultural University, Jorhat, Assam

Introduction

At present, rice occupies about two-third of the total cropped area in the state. Being the single major source of agricultural GDP, rice plays a significant role in the state economy. Further, its importance in the consumption basket (average monthly consumption per capita is about 13 kg) also speaks volumes on the rice orientation of the state. Another specialty is that the rice is traditionally-grown throughout the year viz. winter, autumn and summer seasons, with winter (kharif) rice as the main crop. Assam occupies a special place in the rainfed rice production system in eastern India (being a major rainfed rice-growing area) by covering about 9 per cent of the total rice area and contributes 8 per cent to the production. At the national level, the state contributes over 5 per cent of rice area and 4 per cent of rice production.

Though Assam produced about 3.4 million tonnes of rice in 1997-98, the state is deficient to the tune of a million tonne making the state a net importer of rice. Continuing deficiency of the major food item is a critical issue of food and nutritional security, causing concern to the policy makers. The productivity of rice has stuck a low at 1.35 tonnes per ha, well below the national average of about 2 tonnes. The regional and zonal disparities in the rice production system are also very intriguing. It is thus imperative to undertake an in-depth study of the changes in rice economy in the state.

---

1 Abridged version of a paper presented at the 4th workshop of the NATP project RRPS2 “Socio-economic dynamics of rice production system in eastern India” at the Central Rice Research Institute Cuttack, 9-11 July 2001
2 Dr Bhowmick provided the time series data on area, production and yield.
3 This study has been taken up as part of the larger study under NATP funding entitled “Socio-economic Dynamics of Changes in Rice Production System in Eastern India”. 
The objectives of the paper are to understand the evolution of rice production system since independence, examine the modern technological scenario in different agro-ecosystems, test the hypothesis of inter-zonal disparities of performance of rice technology and to identify the policy interventions in agriculture.

The relevant data from secondary sources have been utilized in the present study. Various publications and issues of Directorate of Economics and Statistics, Government of Assam and Government of India, CMIE, Ministry of Rural Areas and Employment and CRRI, Cuttack have been major sources of secondary data.

This paper has been broadly divided into two sections. The first section provides the trends, growth and instability, cropping pattern, the status of improved technology, yield gaps, risk in rice and rice research at the state level. The second section presents the disaggregate analysis of agro-climatic zones. The zonal analysis is carried out based on original undivided 10 districts of the state. The disaggregate analysis contains the share of rice by seasons, growth and stability and performance based ranking of the zones. An Agricultural Development Index (ADI) is calculated using nine indicators namely, credit, irrigation, HYV area, fertilizer consumption, road length, rural literacy, labour availability, labour productivity and infant mortality and regressed with rice yield across the seasons. The factors are aggregated into the index for each of the zones as a unifying measure to simplify the analysis. The indices (FI) of the individual factors are aggregated into ADI. The following formula is considered for the construction of the index.

\[
FI = \frac{(\text{Value of factor for a zone} - \text{minimum value of factor over all zones})}{\text{Range of values of the factor}}
\]

\[
\text{ADI} = \frac{\sum FI \times N}{100}, \text{where } N = \text{number of factors}
\]

The State Profile

Trends through 1950s: During fifty years since independence, the area under rice increased by about 64 per cent, while the production has more than doubled registering about 116 per cent growth, mainly on account of area expansion. The linear growth rate of productivity is barely 38 per cent during this long period, which is quite low. Winter (kharif) rice dominates in both area and production, followed by autumn (pre-kharif) rice and summer (rabi) rice. But, the share of winter rice declined from 78 per cent in 1952 to 66 per cent in 1999, though the absolute area shows an increment of about half a million ha. The area share of autumn rice remained constant while the summer crop has shown a quantum jump in growth from merely 0.27
per cent in 1952 to 10 per cent in 1999. Summer rice performed outstandingly in the last decade, recording over two-fold increase in productivity level. The incremental productivity of autumn and winter rice during the last four decades ranges from 220 to 420 kilogram per ha respectively. The yield of summer rice is marching close to the national average at 1.99 tonnes. Should not the state adopt appropriate strategy to enhance the yield of winter paddy at least to the level of national average? This is also a research challenge to crop scientists to develop required technology for the purpose.

**Growth and Instability**

The growth in agricultural production is essential for any economy, particularly in an agrarian economy where the food demand overstrips the supply due to population growth. In Assam, rice has been the major food in the consumption basket. However, the growth scenario of rice in the state has been quite unsatisfactory. Considering the unparallel population growth in the state, the matter requires greater attention. Figure 1 clearly indicates the fact that the state has by and large fallen in a situation of ‘food trap’ in the post-independent period where the growth in consumption demand of rice persistently exceeds the production growth for a longer period. The result, once a surplus state has become a net importer of rice from the early 1970s. Though there have been some achievements in the production, especially in the 1980s, the process again has weakened in the early 1990s. In this circumstance, the state must intervene by investing heavily on the strategic research on newer production frontiers so as to breakthrough the shackles of the yield barrier. Improved varieties, timely availability of seeds, infrastructural support system viz; irrigation, roads, electricity, market etc., mechanization, integrated nutrient management and speedy extension of technical knowhow hold the key to future growth pathway. The future policy should follow an integrated approach rather than often followed piecemeal approach.

Between 1952 and 1992, the total rice area increased steadily reaching a plateau at 2.55 million ha and thereafter slumped to negative growth mainly because of decline of winter rice area. It has resulted in decline of absolute rice area in the recent years. The path of growth of rice yield has been highly uneven in the state (Figure 2). Until the mid-1970s, the yield was stagnant at low level. The scenario has changed to positive growth in the subsequent period, which reached the peak of 1.31 per cent per annum during the 1980s. The growth rate of yield of summer rice however, is at an impressive rate of over 4 per cent per annum as compared to that of the winter rice yield at 1.36 per cent per annum. More adoption of high-yielding varieties, expansion of irrigation and a rapid shift in summer cultivation practices has improved the performance of summer and winter rice. But,
this growth pattern could not be sustained in the 1990s. Fewer technological options and inadequate infrastructure support affected the recent performance. The production growth followed the similar pattern as that of yield. However, the slow down of yield growth coupled with negative growth in area resulted in declining rate of production during 1990s. The variability of rice area, production and yield in the state has been moderately low. Coefficients of variation during the fifty years have remained quite low ranging from 0.03 per cent to 6.26 per cent annually (Figure 3). The highest variability was observed in production during 1960s due to rapid increase in the rice area and uneven yield trends. The phenomenon of stability at low level of rice production in the state is clear indication of stagnation. In fact, the low variability, though a desirable trait, when coupled with low level of productivity, symbolizes a sluggish nature of the performance of rice in the state. Why does the low-level yield barrier remained unbroken in the state, is another critical question?

![Fig. 1 : Good trap in Assam](image1)

![Fig. 2 : Growth scenario of rice in Assam](image2)
Cropping Pattern and Rice

Rice is grown in varied eco-systems viz. rainfed/irrigated upland, lowland, flood-free and flood-prone, medium land, deep water and hill eco-system. Among the predominant crop sequences, the following; viz, Autumn rice-winter rice–mustard, Winter rice-wheat/mustard/pulses, Jute-winter rice-vegetables and Autumn rice-winter rice are the main crop sequences followed in the rice-based production system. It is observed that diversification is taking place over the years, though the crop diversification index is heavily influenced by rice, which commands about 64 per cent of the gross cropped area. The share of rice in GCA has decreased by about 12 per cent in the last 50 years due to increase in the gross cropped area under other crops, hence the absolute rice area in the state remained unchanged by and large. In a positive side, the increase in area under boro rice has not only improved the utilization of rabi fallow, but enhance the cropping intensity to about 145 per cent. The oilseeds, such as rapeseed and mustard, and vegetables like potato have improved their position. Fiber crops particularly jute and mesta are the losers, whose absolute area has declined. Area under wheat recorded an increase, especially during mid-1980s to mid-1990s, thereafter started declining. Thus, changing cropping pattern made minimal impact in the sector.

Varietal Status

About 26 modern rice varieties are available in Assam for diverse eco-systems such as deep water, shallow water, irrigated and upland (Table 1). However, most of the varieties are released between 1967 and early 1990s and practically, no newer improved variety has come by in recent years.

Fig. 3: Trends in variability in rice in Assam
times [in the latest list of centrally released varieties for the states, no varieties are earmarked for the state of Assam (ICAR Annual Report 2000-2001)]. The non-availability of seeds of recommended varieties is another perennial problem.

Although, the government invested to some extent on research on varietal improvement in Assam in the earlier period, but now it must invest more on R&D programmes in agriculture. The ecosystems such as lowland, deep-water have been practically ignored in the existing varietal development programme. The deep-water rice (locally called as Boa) is important in many pockets of Brahmaputra valley, thus improvisation of the production condition in this large-sized ecosystem is of urgent need. Most existing varieties are of long-duration and a very few are resistant to pests and diseases. Also only few modern varieties have the tolerance capacity to submergence. This is a serious issue considering the fact that most part of the state is ravaged by splashes of flood on a regular basis. Increased cultivation of boro paddy in rabi season could be potentially revolutionary, which is steadily spreading in the areas of assured irrigation. But the technological innovation for boro rice system needs to be followed with increased emphasis. The majority of the existing modern varieties are suitable only for kharif (winter rice) and pre-kharif (autumn) seasons. There is also need for more short-duration rice varieties so as to escape excessive rain during maturity and/or harvesting of the crop.

### Table 1: Varietal status of rice in Assam

<table>
<thead>
<tr>
<th>Varieties suitable for</th>
<th>No. of varieties</th>
<th>Resistance to pests and diseases</th>
<th>Average duration</th>
<th>Grown as</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shallow water Kharif rice</td>
<td>12</td>
<td>Poor</td>
<td>153</td>
<td></td>
</tr>
<tr>
<td>Irrigated eco-system</td>
<td>9</td>
<td>Poor</td>
<td>131</td>
<td>Pre-kharif rice</td>
</tr>
<tr>
<td>Upland eco-system</td>
<td>1</td>
<td>Poor</td>
<td>100</td>
<td>Pre-kharif rice</td>
</tr>
<tr>
<td>Boro (Rabi) cultivation</td>
<td>4</td>
<td>NA</td>
<td>160</td>
<td>Rabi rice</td>
</tr>
</tbody>
</table>


### Increasing yield as well as yield-gaps

Increasing the yield potential of staple crops has been one of the critical challenges to the agricultural research scientists. The biological scientists have put-forth their valuable efforts in enhancing the yield potential of rice in the state to around 5 tons per ha. (in term of rough rice), nonetheless, the growth in biological yield potential is also stagnating during the last
Bridging the gap between the biological potential and actual yield in one go is an uphill task, but an effort must be made in this direction. A success in the effort will contribute at least an additional tonne of paddy per hectare in the state. Here the extension services would play a very important role for the success of the technology. Of course, for the realization of the on-farm experimental yield, a number of interventions are needed particularly in the domain of input supply and other delivery system.

Interestingly, although the rice yield is increasing gradually, the gap between state average and the national level is also rapidly increasing posing a serious future policy challenge (Figure 4). Over the years, the gorge between average rice yield in Assam and India/ rest of India has increased from about 70 kg/ ha in 1970 to over 600 kg/ha in 2000. Increasing gaps also coincide with the poverty situation in the region. Apparently, there is high correlation between the yield gap and the poverty level (Planning Commission 2000). Should the technological solution be integrated with the socio-economic dimension of the problem? An introspection is essential on the choice of right technology in the region. Investments in the areas of infrastructure development and input marketing would be of great help to revitalize a non-starter green revolution. More research on socio-economic research would be useful to thoroughly diagnose the cause-effect relationship and advocate suitable policy measures to overcome this lag.

![Fig. 4: Inflating yield gaps in rice (Assam Vs India/ rest of India)](image)

**Rice and risk**

High risk of flood, low and static yield characterize the rice production system in Assam. According to an estimate about 2.41 lakh ha of rice fields are chronically affected by the floods and about a lakh ha are occasionally flood affected (Table 2). Moreover, large area under the standing crop
quite often faces varied degree of submergence. Heavy rains during May to August cause flooding and affecting the winter rice is adversely in the process. More often, the flood wave coincides with the maturing and/or harvesting period of summer and autumn rice in many areas and wash away valuable output. This has an adverse impact on the farm income and more importantly on the household food security.

The undependable input supply and fluctuating area under HYV add to the risk in the state. The Boro is an input, intensive crop, where timely irrigation influences the yield pattern. With about 10 per cent of rice area under irrigation in the state, the yield of Boro rice will be constrained severely. This also limits the adoption of HYV at about half of the total rice area in the state. Installation of shallow tubewells in the recent years has facilitated the summer rice in limited areas, which needs expansion. Providing assured input supply, could increase in the adoption rate of HYV and likely to reduce

Table 2: Estimates of flood-prone area of Assam (’000 ha)

<table>
<thead>
<tr>
<th>Agroclimatic zones</th>
<th>Net cropped area</th>
<th>Chronically flood-prone Area</th>
<th>Occasionally flood-prone area</th>
<th>Total flood-prone area</th>
<th>% to net cropped area</th>
</tr>
</thead>
<tbody>
<tr>
<td>North bank Plain</td>
<td>470</td>
<td>93</td>
<td>40</td>
<td>133</td>
<td>28</td>
</tr>
<tr>
<td>Upper Brahmaputra Valley</td>
<td>480</td>
<td>45</td>
<td>16</td>
<td>61</td>
<td>13</td>
</tr>
<tr>
<td>Central Brahmaputra Valley</td>
<td>295</td>
<td>16</td>
<td>8</td>
<td>24</td>
<td>8</td>
</tr>
<tr>
<td>Lower Brahmaputra Valley</td>
<td>920</td>
<td>92</td>
<td>17</td>
<td>109</td>
<td>12</td>
</tr>
<tr>
<td>Barak Valley</td>
<td>247</td>
<td>4</td>
<td>10</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Assam Total</td>
<td>2412</td>
<td>250</td>
<td>91</td>
<td>341</td>
<td>14</td>
</tr>
</tbody>
</table>


Note: The figures are the averages of 1968 through 1978
variability and risk of production. Hazell (1982) suggested that the increased variability in the production is not due to adoption of HYVs per se but an outcome of instability in the input supply.

In addition, development of rice varieties with stress tolerance capabilities to biotic and abiotic pressure must be taken up on priority basis. A participatory policy environment by involving the local masses in conservation of rainwater is necessary for efficient utilization of water resource. Ex-ante strategies such as share cropping, crop diversification, staggered planting for flood escape, income generation through off-farm employment and other self adjustment mechanism need to be popularized in the state. This requires long-term perspective plan to handle risk arising due to multifarious factors.

**Rice research in Assam**

Rice research in India has been highly rewarding, generating returns close to 30-50% (Jha and Kumar 1999). But, the agricultural research in eastern India requires particular emphasis on boosting research and development efforts for rainfed (upland and lowland) rice research system.

The basic rice research in the state, though far from adequate, has mostly been confined to the varietal development and improvement. Very little attention has been paid to the crucial areas such as sustainability, ecosystem research, efficiency, marketing etc. There are few micro-level case studies at the village level or at the block level and fewer at the district level. These case studies generally pertain to farmers’ adoption behaviour, gender, energy use pattern and impact assessment. The case studies are important for improving the production environment at the local level but hardly capable to address broader policy issues at the regional level. Studies at the zonal or regional level, based on homogenous agro-ecosystems, are very limited. Further, research in other frontier areas such as credit, constraints, risk management, crop diversification, efficiency, marketing and trade, export and socio-economics are necessary. These research areas are critical to Assam in the context of fast changing global agricultural order.

**Analysis by Agroclimatic Zones**

**Inter-zonal pattern of rice production:** Assam is divided into six agroclimatic NARP zones comprising of ten original districts (Map 1 and Table 3). The Lower Brahmaputra Valley Zone (LBVZ) contributes maximum to the total rice area and production in the state while hill zone (HZ) the

---

4 This section considers the classification based on NARP report (1991). The section considers only ten (10) original districts of the state.
least. However, the productivity of rice is the least in LBVZ. The productivity is satisfactory in the BVZ, UBVZ and in CBVZ in the order of magnitude.

**Table 3: Zone-wise share of geographical area, rice area and production (1998-99)**

<table>
<thead>
<tr>
<th>Agro-climatic zones</th>
<th>Geographical area as % of state area</th>
<th>Rice area (ha)</th>
<th>Rice production (ton)</th>
<th>Rice area as % of total rice area</th>
<th>Rice production as % of total rice production</th>
<th>Rice yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UBVZ</td>
<td>21</td>
<td>403512</td>
<td>660398</td>
<td>16</td>
<td>20</td>
<td>1636</td>
</tr>
<tr>
<td>Hill Zone</td>
<td>20</td>
<td>123744</td>
<td>173860</td>
<td>5</td>
<td>5</td>
<td>1404</td>
</tr>
<tr>
<td>NBPZ</td>
<td>18</td>
<td>454487</td>
<td>521369</td>
<td>19</td>
<td>16</td>
<td>1147</td>
</tr>
<tr>
<td>LBVZ</td>
<td>26</td>
<td>900048</td>
<td>959017</td>
<td>37</td>
<td>29</td>
<td>1065</td>
</tr>
<tr>
<td>BVZ</td>
<td>8</td>
<td>220294</td>
<td>386163</td>
<td>9</td>
<td>12</td>
<td>1752</td>
</tr>
<tr>
<td>CBVZ</td>
<td>7</td>
<td>352037</td>
<td>554025</td>
<td>14</td>
<td>17</td>
<td>1573</td>
</tr>
<tr>
<td>Assam</td>
<td>100</td>
<td>2454122</td>
<td>3254832</td>
<td>100</td>
<td>100</td>
<td>1326</td>
</tr>
</tbody>
</table>

Higher adoption of HYV and irrigated area under rice and higher fertilizer application per unit area are contributing to the higher productivity. Higher acreage under summer rice is also a contributing factor. In case of LBVZ and NBPZ, frequent occurrence of flood is hampering their performance pattern. The effect of the critical interaction among the factors is also responsible for the inter-zonal disparities. By raising the productivity level closer to the state average in these two zones (NBPZ and LBVZ), an additional 3 lakh tonnes of rice could be produced, which would potentially reduce the food deficit by over 30 per cent. Given the present resource endowment of the zones, this option can easily be adopted if necessary policy supports are provided. Improving utilization of *rabi* fallow could also be a necessary policy thrust.
Table 4: Zone-wise and season-wise distribution of rice in Assam

<table>
<thead>
<tr>
<th>Agro-climatic zones</th>
<th>Autumn 89</th>
<th>Autumn 99</th>
<th>Winter 89</th>
<th>Winter 99</th>
<th>Summer 89</th>
<th>Summer 99</th>
<th>1999 yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
<td>P</td>
<td>A</td>
</tr>
<tr>
<td>HZ</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>UBVZ</td>
<td>8</td>
<td>12</td>
<td>6</td>
<td>9</td>
<td>22</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>NBPZ</td>
<td>22</td>
<td>22</td>
<td>21</td>
<td>20</td>
<td>20</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>BVZ</td>
<td>5</td>
<td>11</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>LBVZ</td>
<td>48</td>
<td>37</td>
<td>52</td>
<td>31</td>
<td>26</td>
<td>25</td>
<td>42</td>
</tr>
<tr>
<td>CBVZ</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>Assam</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Note: A- area, P- Production
The share of rice area in the lower Brahmaputra zone is the highest, though it decreased in winter and summer in the period 1989 to 1999 (Table 4). There is not much change in the seasonal share in other zones. But, in case of summer crop, there are marked changes in the all the zones, except BVZ. Despite the fact that on an average about 17.0 thousand ha has been put under summer rice in the BVZ annually and significantly high proportion of area under summer rice in NBPZ, the performance of BVZ and NBPZ has not improved. The static productivity is once again the limiting factor in the zones. The figures 6 and 7 show zonal pattern of changes in the area.

Growth Performances

Barring a few exceptions, the growth performance of various zones in the last five decades has been identical to that of the state. Until 1970s the rate of growth in the rice area was impressive in all the zones except in NBPZ where the growth rates started increasing after 1970s (figure 10 & 11). During 1990s, the growth of area showed declining trends and in some cases crossed the horizontal axis (i.e. negative growth). On the contrary, the growth rates of yield showed improvement during and after 1980s (Figure 8 & 9). Hill zone is again the exception, which has registered highest growth in yield during 1960s and is the only region that looks promising during 1990s. However, on the whole, the yield growth seems to stagnate around 1.5 per cent in most of these zones. This endorses the general perception that green revolution has bypassed the state even at the zonal level. The decadal growth performance has been uneven and associated with substantial variability. The variability is much higher in case of summer crop as the crop is highly dependent on the input availability. As already indicated earlier, many factor interactions are responsible for the inter-zonal disparities in the performance. It is observed that the simplified index form (termed as agricultural development index ADI) provides a fair idea of the probable causes of the diverse performance of the zones. The ranking of the zone based on the index shows, as expected, that the flood-prone zones are highly disadvantaged and ranked the lowest, where yield is the lowest. Figure 16 to 18 sketches the simple relationship between the ADI and yield in six agro-climatic zones in Assam by season. A closer look at the factor interaction at disaggregate level is needed to understand the causality of the disparities.

Conclusion and Policy Issues

The rice has a historical significance and cultural relevance in the state of Assam, apart from being the staple food. Despite its importance in every

5 kindly refer back to Data and Methodology section
sphere of the agrarian economy, the performance of crop in the recent years has been unsatisfactory, which made Assam a net deficit state. The green revolution totally bypassed the state in the past, although some spillover effect may be seen during and after mid-1980s. The poor performance is caused by lack of required infrastructure support system and policy environment. The average yield of rice stands well below the national average. The growth path has been uneven and perpetuating the peculiar phenomenon of stability at low level of production trap, which is required to be eliminated. The sluggish growth of the crop is the result of production trap. The supply of technology, infrastructure, material inputs are the important governing factors for the betterment of rice production system, which are grossly inadequate at present. However, the sign of innovativeness of the farmers has been noteworthy, especially in the recent decade. The rapid expansion of high potential *Boro* cultivation of rice in the *rabi* season is a sign of improvement in the situation. Nonetheless, they have to be adequately nurtured through suitable input supply and better policy environment. The calculation shows that by enhancing the present level of productivity to the national average level, the state can produce at least a tonne of additional rice annually. The neglected zones like BVZ and NBVZ together can produce about 30 thousand tonnes of rice, if the productivity is enhanced.

There are disparities in the performance among the agro-climatic zones in the state. Broadly on account of the interaction effect among socio-economic and agro-biological factors has caused the uneven performance over the zones, which is rarely understood. That is why, the region with larger share of rice area and production such as LBVZ, is showing dismal yield performance. Noticeably, the performance of the summer rice (*boro*) has also been uneven in all the zones and no definite pattern of growth is observed, probably due to its high dependency on the input availability, especially irrigation.

The results of the study suggest greater emphasis on the research and development initiatives, specifically on socio-economic and policy research. For the purpose of enhancing future growth, strengthening the information system and development of comprehensive database at the disaggregate ecosystem level is highly recommended. Though there has been stagnation in the biological potential in rice, there still exists large yield gap of various degrees. Steady input supply and improving the knowledge dissemination service in the state would definitely help in bridging the gaps. The practice of cultivation of *boro* rice is in a budding stage in the state that needs to be nurtured through adequate irrigation network and more technological support. This would help gainfully utilize the vast tract of *rabi* fallow and improve cropping intensity. Reforms on the weaker input-output delivery system is also required for effective promotion of the system.
Fig. 6: Intra-zonal seasonal share (%) of rice area (1989 and 1999)

Fig. 7: Intra-zonal seasonal share (%) of rice production (1989 and 1999)
Fig. 8 & 9 : Zone-wise total yield growth pattern in Assam

Fig. 10 & 11 : Zone-wise growth pattern of rice area in Assam
Fig. 12 & 13: Zone-wise variability in total rice yield in Assam

Fig. 14 & 15: Zone-wise variability in total rice area in Assam
Fig. 16, 17 & 18: Zone-wise ADI, winter yield, autumn yield and summer yield
References

Bansil, P C, (1990), Agricultural Statistical Compendium, TERI, New Delhi


Central Rice Research Institute, (1995), Miracle Rice Varieties of India, Mimeo, Cuttack

CMIE, (1996), India’s Agricultural Sector, Mumbai

CMIE, (1996), Profiles of the Districts, Mumbai

CMIE, (2000), India’s Agricultural Sector, Mumbai

Govt. of Assam, (1976), Handbook of Assam, Directorate of Information and Public Relation, Guwahati, Assam

Govt. of India (1996), Basic Rural Statistics, Ministry of Rural Areas and Employment, New Delhi.

Hazell P B R, (1982), Instability in Indian Foodgrain Production, IFPRI, Washington DC, USA.


