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# Northeast monsoon rainfall and agricultural production in Tamilnadu and Andhra Pradesh

## I - Rainfall variability and its significance in agricultural production

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**सार** – मॉनसून भारतीय अर्थव्यवस्था का महत्वपूर्ण घटक है जो कृषि को प्रत्यक्षः रूप से प्रभावित करता है क्योंकि यह एक चौथाई जी.डी.पी. और कृषि पर निर्भर 60 प्रतिशत जनता की आजीविका को प्रभावित करता है। भारत में मुख्यतः दक्षिण–पश्चिमी मॉनसून ऋतु के दौरान वर्षा होती है। भारत में अक्तूबर से दिसम्बर के दौरान विशेषकर पूर्वी और दक्षिणी राज्यों में मानसूनोत्तर अवधि, जिसे उत्तर पूर्वी मॉनसून कहते है, में भी काफी वर्षा होती है। यह वर्षा कृषि के लिए और इन क्षेत्रों के संबद्ध सेक्टरों के लिए काफी महत्वपूर्ण होती है।

तमिलनाडु के पूर्वी तटीय जिलों में दक्षिण से उत्तर तक वर्षा में वृद्धि की प्रवृत्ति का पता चला है। इसके विपरीत आंध्र प्रदेश के तटीय दक्षिण पूर्वी जिलों में अधिक और उत्तर पूर्वी भागों में वर्षा में कमी की प्रवृत्ति का पता चला है। आंध्र प्रदेश की अपेक्षा तमिलनाडु में वर्षा की अधिकता के कारण उत्तर पूर्वी मानसून का दक्षिण पश्चिम मानसून वर्षा की तुलना में कृषि उत्पादन पर अधिक प्रभाव का पता चलता है। कृषि उत्पादन पर वर्षा के प्रभाव के अध्ययनों से आंध्र प्रदेश में चावल और मक्का के उत्पादन में उत्तर पूर्वी मॉनसून के सकारात्मक प्रभाव का पता चला है। मक्का की उपज में लगातार सकारात्मक प्रवृत्ति का पता चला है। उत्तर पूर्वी मानसून ऋतु के दौरान आंध्र प्रदेश के तटीय जिलों की तुलना में तमिलनाडु के तटीय जिलों में चक्रवात या अवदाब की वजह से भारी से अधिक भारी वर्षा और बाढ़ के कारण उत्पादन की कमी आई है।

परिवर्तिता के बारे में उचित जानकारी तथा उत्तर पूर्वी मानसून वर्षा के मौसमी पूर्वानुमान के साथ–साथ कृषि प्रचालनों के लिए विविध नीतियों का विकास करने से इन क्षेत्रों के कृषि और जलसंसाधन सेक्टरों के लिए निर्णय लेने में महत्वपूर्ण अनुप्रयोग भूमिका होगी।

**ABSTRACT.** Monsoon which directly impacts agriculture is an important component of Indian economy because it influences about a quarter of the GDP and livelihood of 60% of the population who depend on agriculture for their livelihood. India receives rainfall mainly during southwest monsoon season. A considerable rainfall also occurs in India during the post monsoon period called as northeast monsoon during October to December, particularly over eastern and southern states and this is of great significance in agriculture and allied sectors in these regions.

Increasing trend of rainfall is noticed from south to north in eastern coastal districts of Tamilnadu. On the contrary, it is higher in coastal southeast districts with decreasing trend in northeast parts of Andhra Pradesh. NE monsoon shows greater impact on agricultural production due to its higher quantum of rainfall compared to that of southwest monsoon rain in Tamilnadu than that in Andhra Pradesh. Studies on impact of rainfall on agricultural production revealed positive impact of NE monsoon on rice and maize production in AP. Maize yield is found to exhibit a consistent positive trend. Loss in production due to heavy to very heavy rain and flooding associated with cyclone or depression was more prominent along the coastal districts of Tamilnadu than that in the coastal districts of Andhra Pradesh during northeast monsoon season.

Proper understanding of the variability and developing diversified strategies for agricultural operations alongwith the seasonal prediction of northeast monsoon rainfall would have considerable application value for decision making in agriculture and water resource sectors of these regions.

**Key words** – Rainfall variability, Trend analysis, NE monsoon.

## 1. Introduction

The period October to December is referred to as the Northeast Monsoon season over southern peninsular India. Earlier this period was also referred to as "Post-Monsoon Season" or "Retreating southwest Monsoon Season". But the structural feature of Transition Monsoon Season (Oct-Dec) is distinctly different from a quasi - geostrophic type structure of the mid-summer monsoon circulation. Northeast Monsoon season is the major period of rainfall activity over south peninsula, particularly in the eastern half comprising of the meteorological subdivisions of Coastal Andhra Pradesh (AP), Rayalaseema and Tamilnadu - Pondicherry. For Tamilnadu this is the main rainy season, accounting for about 48% of the annual rainfall. Coastal districts of the State get nearly 60% of the annual rainfall and the interior districts get about 40-50% of the annual rainfall. This increase in rainfall activity over Andhra-Tamilnadu coasts, which takes place sometime around middle of October is generally considered as the "setting in of Northeast Monsoon". Normal date of onset of the northeast monsoon is around 20$^{th}$ October with a deviation of about a week on either side. Spells exceeding 4 days are much less (20%). Rainfall variability in NE monsoon, though high, yet it adds the water availability period and provides adequate soil moisture for longer duration crops and for the second crop in high rainfall zones of Tamilnadu. Similarly, in Andhra Pradesh, main crop season is SW monsoon with extended cropping in NE monsoon season in coastal AP and Rayalaseema. These additional resources of rainwater in NE monsoon in these two states have distinctly differentiated the cropping pattern and agricultural production with respect to the northern districts in AP. With increasing demand of food production, the strategies for crop production have also changed considerably in these region dominated by the NE monsoon. An attempt has been made in this paper to highlight the impact of NE monsoon in Tamilnadu and Andhra Pradesh.

## 2. Data and methodology

In the present study the NE monsoon data from India Meteorological Department (IMD) for the period 1990 to 2010 and Area, Production and Yield data for Tamilnadu and Andhra Pradesh from the Season and crop report of the respective states have been used to find the variability of the NE monsoon and its impact on the agricultural production in these states.

## 3. Results and discussion

The average rainfall series of Tamilnadu for the northeast monsoon months of October to December and the season as a whole were analyzed for trends, periodicities and variability. The trend analysis showed that there are no long-term trends of increasing or decreasing rainfall in the individual month or the season as a whole (Fig. 1). October is the heaviest rainfall month followed by November and December during this season, in Tamilnadu (Fig. 2).

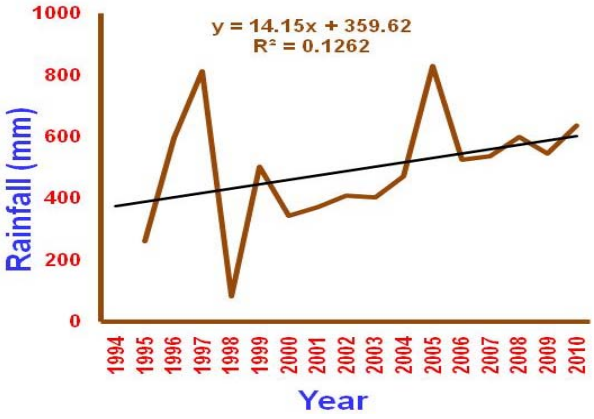



**Fig. 1.** Trend of NE monsoon average rainfall over Tamilnadu

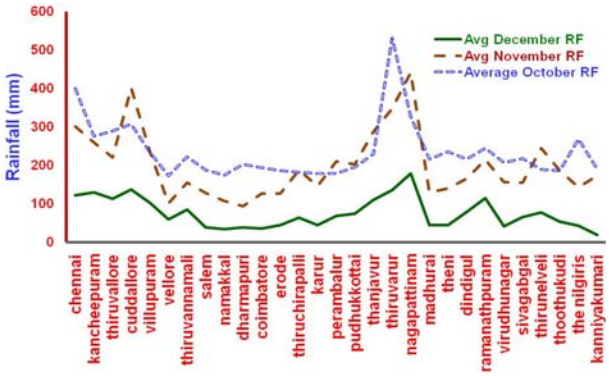



**Fig. 2.** District wise monthly average NE rainfall over Tamilnadu

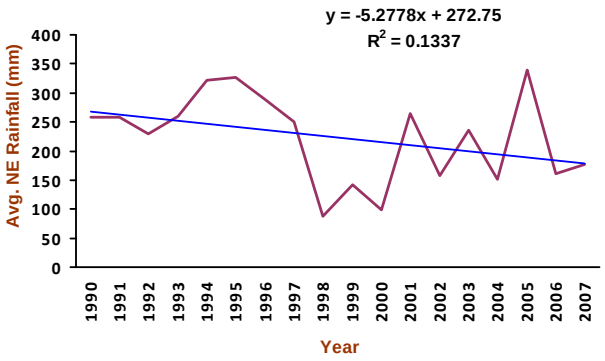



**Fig. 3.** Trend of NE monsoon average rainfall over Andhra Pradesh

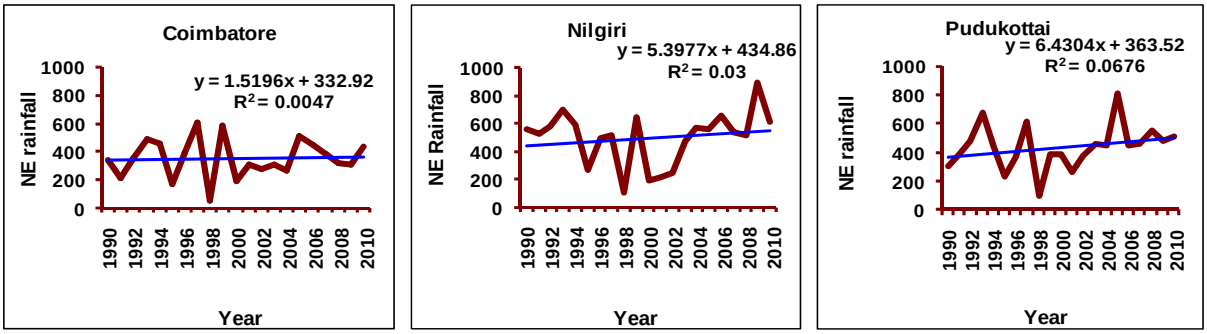



**Fig. 4(a).** Average NE monsoon rainfall over some districts of Tamilnadu

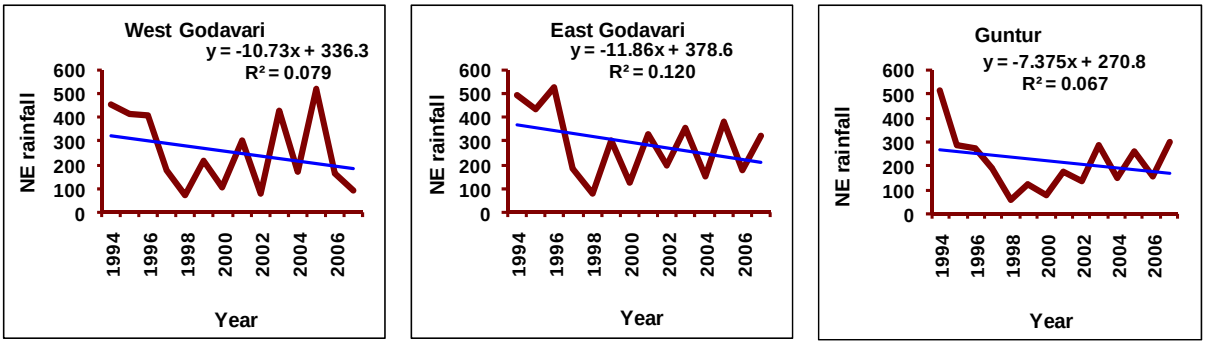



**Fig. 4(b).** Average NE monsoon Rainfall over some districts of Andhra Pradesh

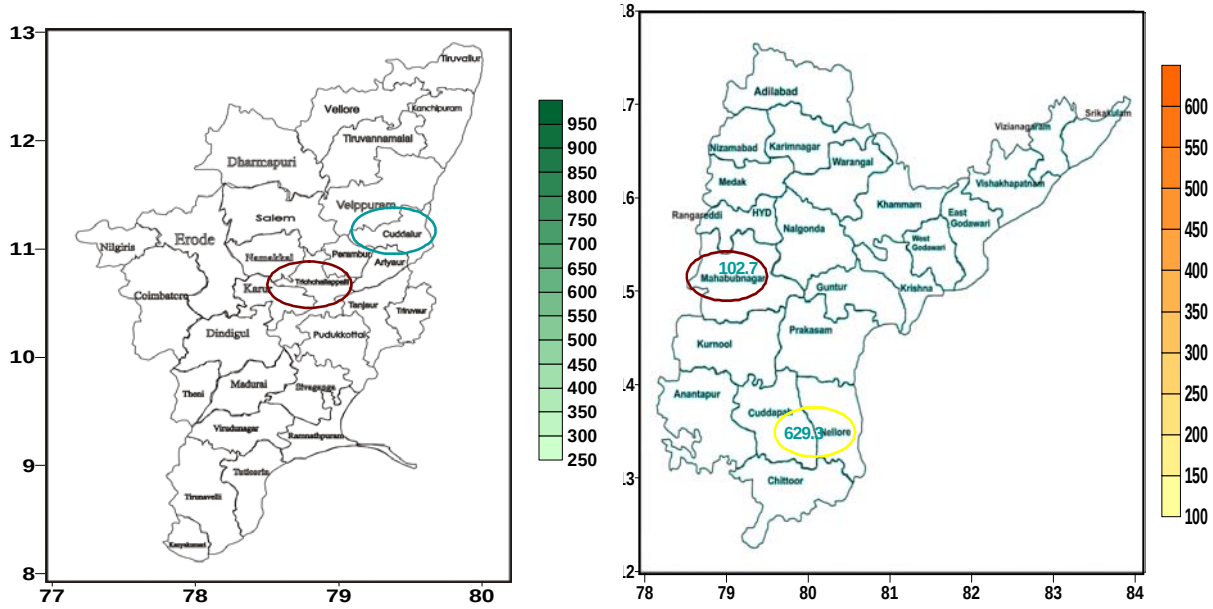



**Fig. 5.** District wise average NE monsoon rainfall over Tamilnadu and Andhra Pradesh

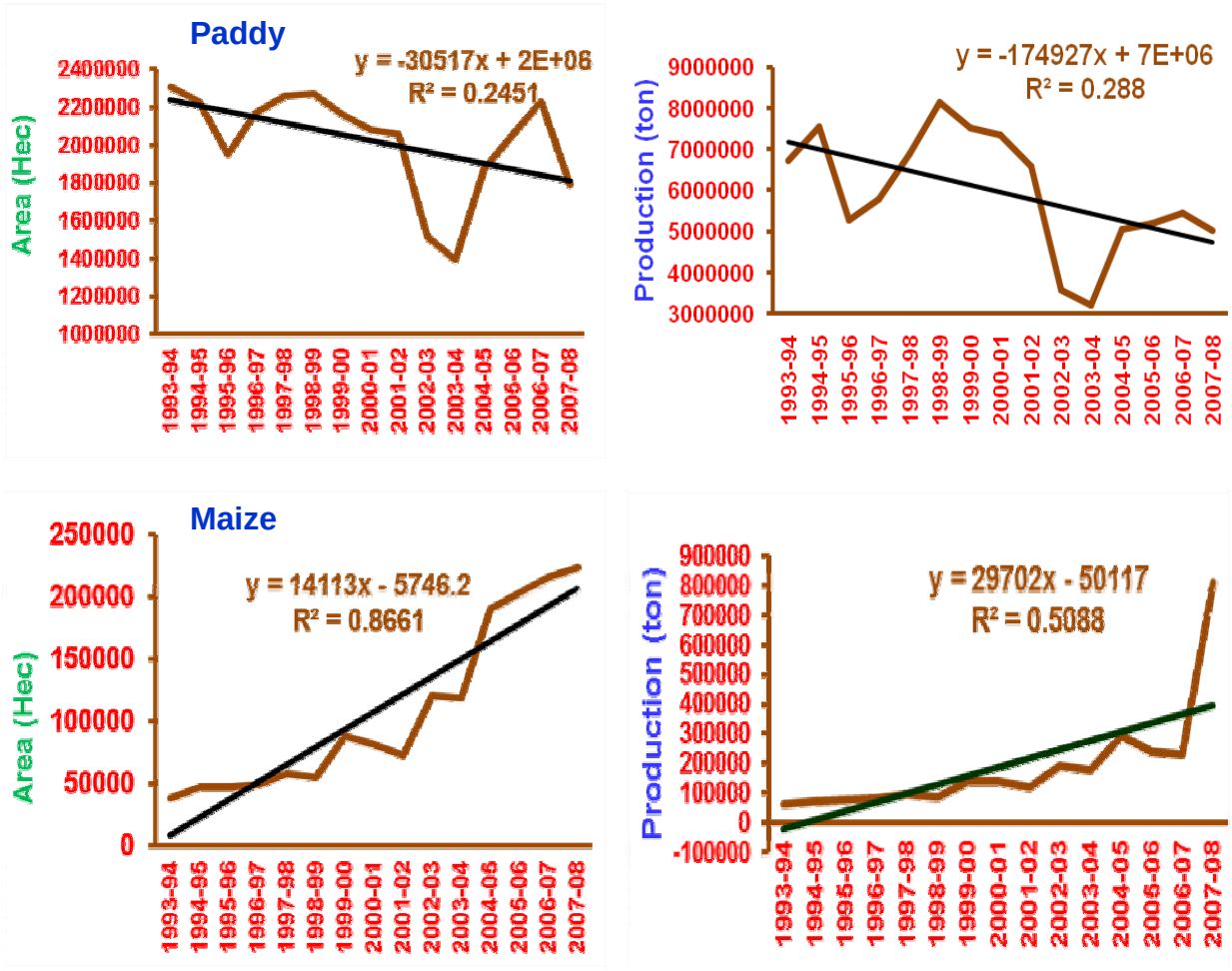
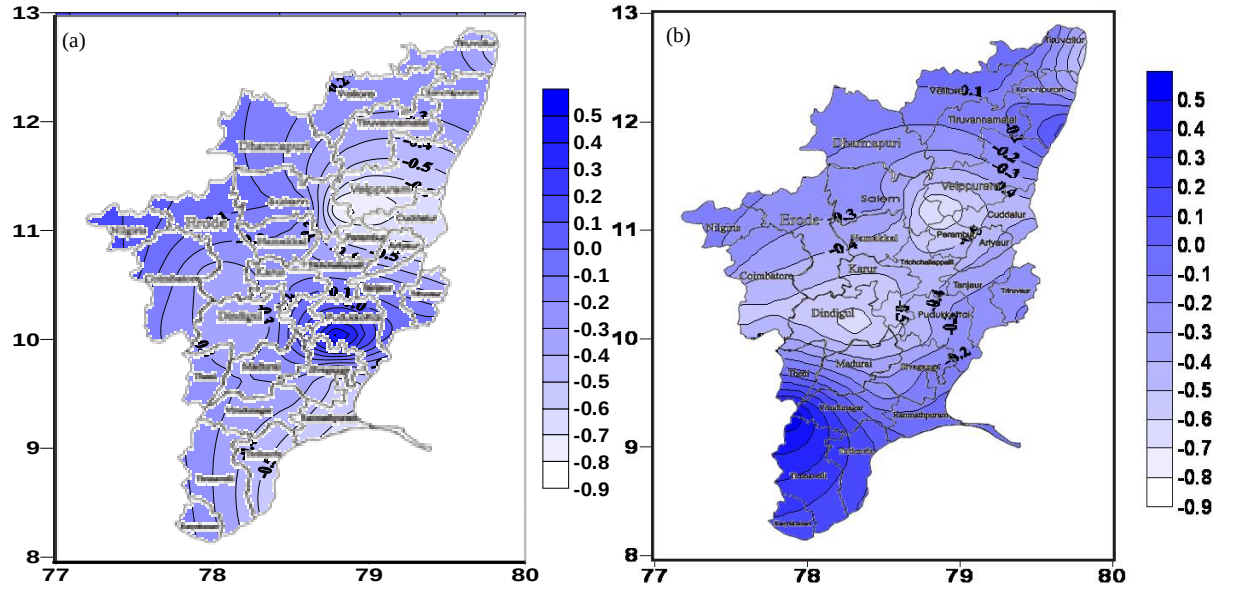
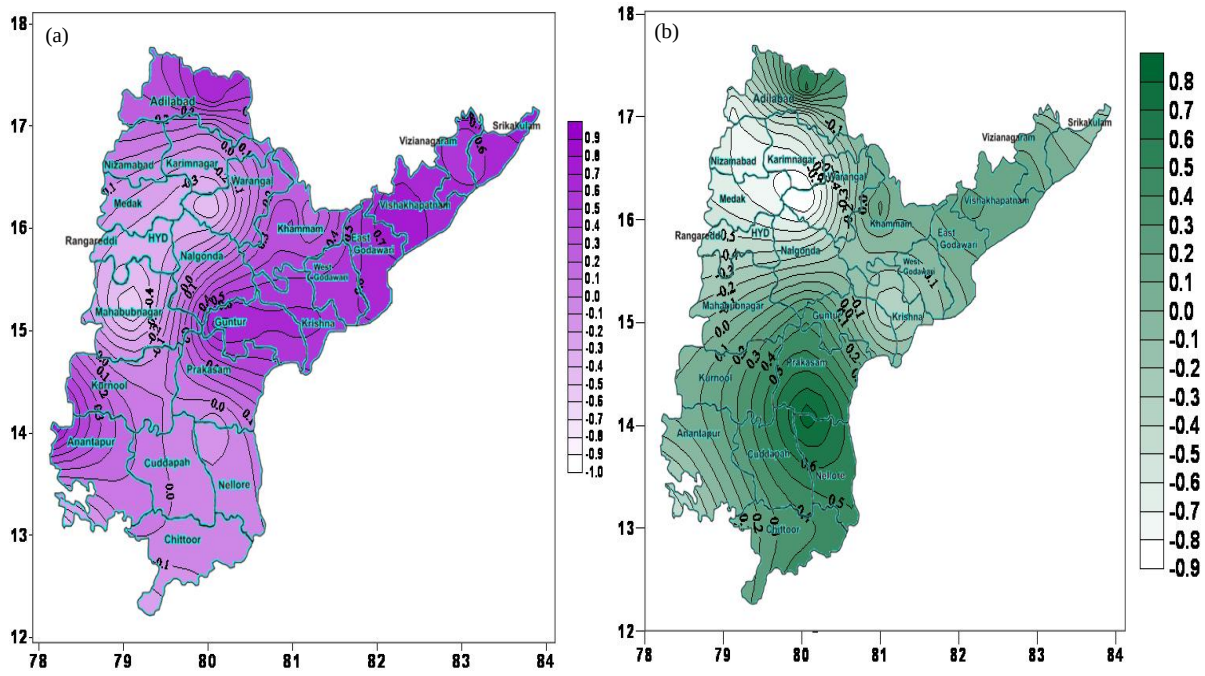



**Fig. 6.** Area and production of Paddy and Maize in Tamil Nadu during NE Monsoon Season




**Figs. 7(a&b).** CC of Kharif and Rabi rice yield *vs* rainfall for Tamilnadu




**Figs. 8(a&b).** CC of Kharif and Rabi rice yield *vs* rainfall for Andhra Pradesh

In Tamilnadu, the average NE monsoon rainfall shows an increasing trend. The years 1995 and 2005 showed good NE monsoon rainfall distribution while there is a deep drop in the year 1998 (Fig. 1). In Andhra Pradesh the NE monsoon rainfall showed a decreasing trend (Fig. 3). The year 1998 shows a minimum NE monsoon average rainfall of 86.9 mm while the year 2005 shows the highest average rainfall of 338.9 mm of rainfall over the study period.

Trend analysis of NE monsoon rainfall for the period 1990-2010 for the districts of Tamilnadu showed positive trend for all the districts except Chennai. Positive trend was observed for the districts of Nilgiris, Pudhukkottai, Ramanathapuram, Salem, Dindigul, Tanjavur, Kannyakumari, Madurai, Nagapattinam, Thirunelveli and Thiruvannamalai districts. The study revealed that the coastal districts of Tamilnadu received higher rainfall than the central districts. The rainfall trend showed increasing rainfall from south to north in eastern coastal districts while the western part showed no particular trend (Fig. 4). The central region showed rainfall between 325-450 mm. Chennai district recorded highest average rainfall of 939.6 mm while Thiruchirapalli district had the lowest average rainfall of 321.4 mm over the years 1990-2010 (Table 1).

Trend analysis of NE monsoon rainfall for the period of study for the districts of Andhra Pradesh showed negative trend for all the districts. The study showed increasing negative trend of rainfall from coastal northeast to southeast parts. Nellore recorded the highest average NE rainfall of 629.3 mm. Mehbubnagar recorded the lowest average NE monsoon rainfall of 102.7 mm (Fig. 5).

### 3.1. *Agriculture in Tamilnadu and Andhra Pradesh*

Tamilnadu has historically been an agricultural state and is a leading producer of agriculture products in India. In 2008 Tamilnadu was India's fifth biggest producer of rice. The Cauvery delta region of the composite Thanjavur district is known as the rice bowl of south India. The total cultivated area in the state was 56.10 million hectares in 2007-08. Production of paddy showed consistent trend after the year 2004 (Fig. 6). Area as well as production of Maize showed consistent positive trend. During the recent years the kharif foodgrain production was recorded to be higher than rabi foodgrain production in Tamilnadu. In the year 2006-07 yield of all foodgrain crops was relatively higher. The kharif yield was 2805 kg/ha whereas rabi yield was 2304 kg/ha. The year 2006 was a good rainfall year and the rainfall distribution was good in all districts

**TABLE 1**

**Average rainfall in districts of Tamilnadu (1990-2010)**

| District Name | Avg RF (mm) | District Name | Avg RF (mm) |
|---|---|---|---|
| Chennai | 939.63 | Tirunavelli | 521.14 |
| Coimbatore | 349.63 | Tiruvallur | 695.34 |
| Cuddalore | 880.81 | Tiruvannamalai | 468.01 |
| Dharmapuri | 334.20 | Tiruvarur | 813.47 |
| Dindigul | 478.20 | Trichy | 465.04 |
| Erode | 364.38 | Tuticorin | 439.17 |
| Kanchipuram | 713.49 | Vellore | 348.64 |
| Kanyakumari | 470.72 | Villupuram | 659.79 |
| Karur | 370.32 | Virudunagar | 413.54 |
| Krishnagiri | 359.68 | South Arcot | 580.86 |
| Madurai | 451.73 | Tiruchirapallai | 325.50 |
| Nagapatinam | 904.95 | Pondicherry | 715.06 |
| Namakkal | 332.66 | Chengalpattu M. G. | 547.47 |
| Nillgiri | 494.24 | North Arcot | 294.70 |
| Perambulur | 537.87 | Tiruchirapallai | 321.45 |
| Pudukottai | 434.26 | Periyar | 270.00 |
| Ramanathapuram | 565.62 | Kamarajar | 361.75 |
| Salem | 360.13 | P Muthuramalinga Thevar | 333.58 |
| Sivaganga | 470.52 | Chidambaranan | 377.28 |
| Thanjavur | 625.72 | Theni | 421.08 |

of Tamilnadu. The yield of bajra was above 1000 kg/ha during NE monsoon season. Rice is grown in both the seasons in Tamilnadu but it is seen that the yield during NE monsoon season is higher than the yield in SW monsoon season. In 2007 the rice yield was 4325 kg/ha during NE monsoon season whereas it was 3339 kg/ha during SW monsoon season. Similar trends were observed during NE monsoon season for groundnut, maize and oilseed crop.

The districts Thoothukudi and Namakkal showed beneficial effect of SW monsoon on the kharif rice production as observed from the correlation coefficients (c.c) of 0.60, 0.22 respectively. In all districts of Tamilnadu except Thoothukudi, Namakkal, Nilgiris, Theni, Perambalur and Thiruchirapalli production was affected which is reflected in the negative correlation coefficients. Central parts of the state shows increase in the kharif rice yield. Coastal parts of TN covering the

districts like Thirunelveli, Karur, Erode and Salem shows positive impact of SW monsoon on the yield of rice.

The rabi rice yield showed increasing trend in the districts like Ramanathapuram, Sivagangai and showed positive correlation while districts like Chennai, Cuddalore, were badly affected by the NE monsoon as indicated by strong negative correlation coefficients in the range of -0.93 to -0.83. The distribution of NE monsoon rainfall was not suitable for various rice stages. There is increasing trend of rabi rice yield from eastern to western as well as northern to southern districts. Northwestern parts recorded highest yield of rabi rice. Though there is no 1:1 correspondence between NE rainfall and yield, yet c.c. values indicate higher beneficial effect in the western regions where rainfall is comparatively less and normally not affected by cyclonic storms and very heavy rainfall.

In India, the area under maize in rabi is increasing. Karnataka is the largest producer contributing 18 percent to the country's production followed by Andhra Pradesh (16 %) and Tamil Nadu (5 %). Demand for maize is high in Tamil Nadu due to feed requirement for its poultry industry. It is mainly grown in Perambalur, Dindigul, Coimbatore, Salem, Erode and Virudhunagar districts of Tamil Nadu which constitutes 77 percent of the total area (2.02 lakh hectares). One of the major sowing seasons for maize is Thai Pattam (Jan-Feb). Farmers with irrigation facilities grow maize during this season.

Andhra Pradesh represents a transition from tropical to sub tropical India. Occurrence of rainfall in Andhra Pradesh is influenced by both SW and NE monsoons. The annual rainfall of the state is 941 mm varying from about 500 mm in Anantapur district of Rayalaseema region to 1200 mm in North Coastal and Northern Telangana districts of the state. The rainfall activity of Northeast monsoon is generally seen over Coastal AP and Rayalaseema regions of Andhra Pradesh. Andhra Pradesh receives 68% of rainfall from Southwest monsoon spread over the period from June to September and 22% rainfall from North east monsoon (Rao *et al*., 2004). The Northeast monsoon contributes only 11% in Telangana region while the coastal and Rayalaseema region receive over 30% of the annual rainfall during this period. Northeast monsoon rainfall contributes about 353 mm for the districts receiving NE monsoon rainfall in Andhra Pradesh. During the years 2006-07 to 2008-09 the NE monsoon rainfall over Andhra Pradesh was below normal.

In Andhra Pradesh it is seen that yield of rabi food grain production is more than kharif foodgrain production in almost every year from 1999-2009. The highest foodgrain yield, recorded during rabi 2008-09 was 3123 kg/ha.

The correlation coefficient between kharif rice yield and rainfall for the limited data period 2005 to 2008 showed that Kurnool, Nalgonda, Krishna and Guntur districts of AP have positive impact with correlation coefficient of 0.96, 0.93, 0.91 and 0.90 respectively. Karimnagar district was negatively affected by the SW monsoon which is reflected in the correlation coefficients of -0.92. However most of the places in AP show positive impact of SW monsoon on the yield of rice. Districts like Guntur, Krishna, Nellore, Prakasam are highly benefited from the SW monsoon. Districts like Medak, Warangal and Rangareddy are comparatively less benefited from the SW monsoon rainfall [Figs. 7(a&b) & Figs. 8(a&b)].

The correlation coefficient between rabi rice yield and rainfall showed that West Godavari, Cuddapah, Rangareddy and Mehabubnagar districts have greater positive impact with correlation coefficients of 0.87, 0.71, 0.64 and 0.60 respectively. While most parts of AP show positive impact of NE monsoon rainfall on the yield of rice, only districts like Nizambad, Karimnagar and Adilabad showed negative impact.

## 4. Conclusions

Tamilnadu ranks twelfth in total rice production in the country. Paddy productivity in Tamilnadu has always been the second highest in the country, next only to Punjab. Over the last decade, though average productivity increased gradually, yet production of rice in Tamilnadu showed decreasing trend due to decrease in area under cultivation. Maize is being cultivated in larger area due to its demand as poultry food. Intra and inter seasonal variability both in quantum of rainfall and its distribution from south to north and east to west in Tamilnadu and Andhra Pradesh have caused considerable variation in yield of foodgrains. NE rainfall in Tamilnadu has influenced foodgrain production significantly and impacted more compared to that in Andhra Pradesh. Correlation coefficient studies between rice yield and rainfall revealed that though NE rainfall was beneficial, heavy rainfall associated with cyclone and flooding is detrimental and caused reduction in yield in some eastern districts. The study highlights the need for detailed study on rainfall variability alongwith probability of dry and wet spells for kharif and rabi seasons for choosing suitable cropping patterns.

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