PA33B - 1820

A Historical Analysis of the Relationship Between Rice Production and PDSI Values in Sri Lanka

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I. INTRODUCTION

In Sri Lanka, farmers in major rice production areas of the country are already struggling to produce enough rice, a staple food of the local diet, and a severe wet or dry spell could be ruinous. Faced with a changing climate and a growing demand for rice, it is important to be able to anticipate how climatic changes will affect rice production. We conducted an analysis of historic temperature, precipitation, and rice production statistics in order to determine the effects of extreme wet and dry spells on rice production. Historical temperature and precipitation data were used to calculate the Palmer Drought Severity Index (PDSI) for a number of stations distributed throughout the Mahaweli River watershed (MRW). Significant correlations between PDSI and rice production were found in the Matale and Trincomalee districts.

II. BACKGROUND

FIGURE 1: Major rice producing districts in the MRW
Modified from http://en.wikipedia.org/wiki/File:Sri_Lanka_relief_location_map.jpg

- MRW is the major rice producing region of Sri Lanka
- Two growing seasons
  - Yala (May-August)
  - Maha (September-March)
- Three climate zones
  - Wet (Kandy, Matale)
  - Intermediate (Matale, Polonnaruwa)
  - Dry (Polonnaruwa, Trincomalee)
- Irrigation schemes
  - Entirely irrigated (Polonnaruwa, Trincomalee)
  - Mix of irrigated and rain-fed (Kandy, Matale)
  - Reservoirs and tanks are mostly upstream near Kandy and Matale

III. RESEARCH QUESTION AND APPROACH

- ***How are rice production and PDSI values correlated in the Mahaweli river watershed?***
  - Calculate PDSI for major rice production districts in the watershed
  - Compare PDSI values to historic rice production data

IV. METHODOLOGY

Calculate PDSI

- Temperature data was gathered from Kandy and Trincomalee. Values in between the stations were interpolated using historical temperature averages.
- Precipitation data were obtained from Sri Lankan Department of Meteorology
- PDSI was calculated for each temperature station and those within or near the districts were average to find the district average for each growing season

Compare to historic rice data

- Production and yield (production/harvested area) statistics were plotted against PDSI values for each season in each district. PDSI values in upstream districts were also plotted against production and yield statistics in downstream districts
- Correlation coefficients and *p* values were calculated for each plot

V. RESULTS

No correlation between rice and PDSI was found in the Polonnaruwa and Kandy districts. In the Trincomalee district, significant correlation was found between detrended rice production and PDSI in the Yala season. In the Matale district, significant correlation was found between detrended yield and PDSI for the Maha season.

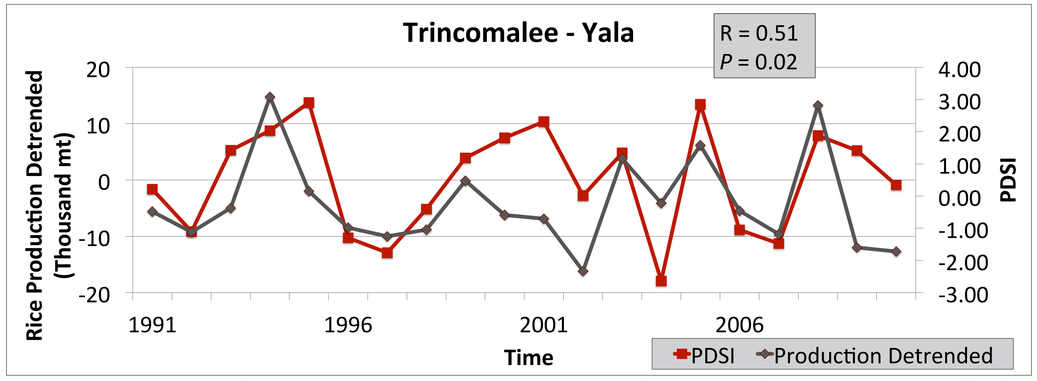

FIGURE 2: Detrended rice production values for the Yala growing season in the Trincomalee district are plotted against PDSI values for the Trincomalee district. There is a significant ($p < 0.05$) positive correlation between detrended rice production values and PDSI.

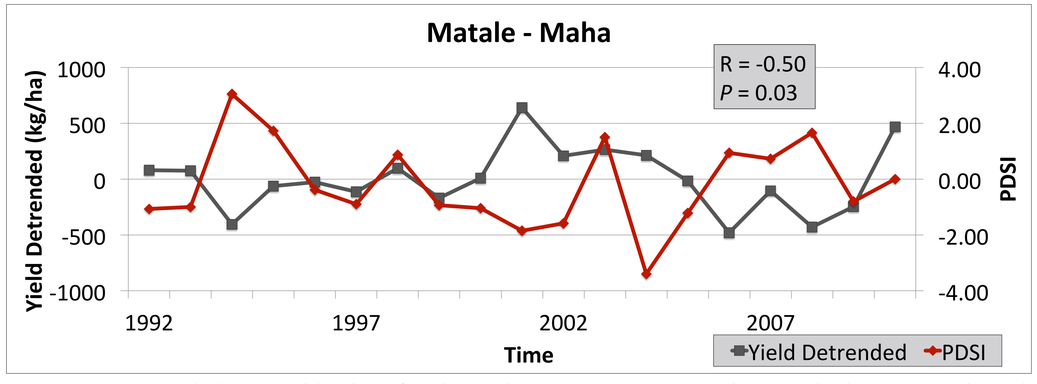

FIGURE 3: Detrended rice yield values for the Maha growing season in the Matale district are plotted against PDSI values for the Matale district. There is a significant ($p < 0.05$) negative correlation between detrended rice yield values and PDSI.

VI. DISCUSSION

- **Trincomalee District**
  - Positive correlation between rice production and PDSI
  - Located in the dry zone
  - 0% rain-fed
  - Furthest district from the majority of tanks and reservoirs
  - Dry conditions (low PDSI) have a more direct impact due to susceptibility to reduced irrigation flows

- **Matale District**
  - Negative correlation between rice yield and PDSI
  - Located on border of intermediate and wet zones
  - ~24% rain-fed
  - Already in a very wet part of the country
  - District receives enough rain to grow rice without irrigation in most years
  - Wetter conditions than normal (high PDSI) may flood fields and result in a lower yield

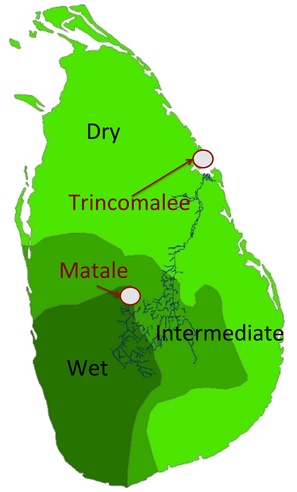

FIGURE 4: Climate zones of Sri Lanka
Modified from http://cecar.org/groups/csdsiacc/wiki/7fd8e/

	Matale	Trincomalee
Total Harvested Area (ha)	19,684	13,116
% Rain-fed Area	24	0

VII. CONCLUSIONS

- Climate zone has a clear impact on relationship between rice production and PDSI
  - Wet climate in Matale makes the district more susceptible to wet conditions while the opposite is true in Trincomalee
  - Region specific nature of PDSI must be taken into account when analyzing results

- Position in irrigation system also has an impact on relationship between rice production and PDSI
  - Districts further away from reservoirs and tanks can be more likely to experience disruptions in supply of irrigated water

- A modified PDSI is needed to further analyze correlation between rice production and PDSI
  - Polonnaruwa, the major rice producing district in the MRW, is almost completely irrigated
  - A drought index that takes into account irrigated water supply will be developed to determine effects of PDSI on rice production

VIII. ACKNOWLDGEMENTS

This work was supported by VIEE and the National Building Research Organization of Sri Lanka.