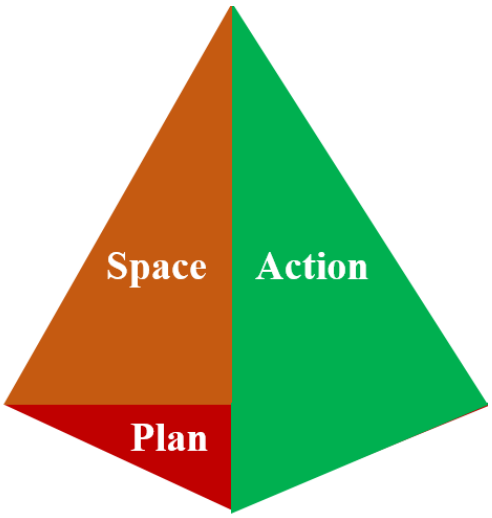
"Space as a tool to foster climate adaptation and mitigation"

'Space' for Sri Lankan paddy rice cultivation

Abstract

Ampara is a rural district with a high level of poverty (5.4%) primarily based on paddy rice cultivation in Sri Lanka. It is prone to the highest occurrences of droughts causing an increased migration of productive labor. ACCIMT[1], a regional innovation centre, thrives spaced-derived data based practices to devise sustaining paddy cultivation while adapting to and mitigating climate emergency perils. The institute faces challenges in harvest monitoring. National nourishment plan for vulnerable farming communities requires collaborative mechanisms among CCS[2] and the UNOOSA in post-pandemic circumstance.



Graphical Abstract; Space-Plan-Action (SPA) pyramid

Keywords: space-derived data; paddy cultivation; climate change; post-pandemic; *SPA*

[1] Arthur C Clarke Institute for Modern Technologies
[2] Climate Change Secretariat of Sri Lanka

Introduction

Paddy rice cultivation of Sri Lanka is extremely challenged

Amidst climatic urgency (UNFCC, 2016) levelled up with pandemic crisis, agro-livelihoods of the nation depending on paddy cultivation are about to cease having no solution. The Sri Lankan paddy harvesting model over 2 millennia was predictable. Sri Lanka harvests according to two well-known ancient seasons called *Yala*[3] and *Maha*[4] (Suppiah, 1985). Erratic weather due to severe climate change issues has completely shifted these two seasons and paddy cultivation is on the edge of collapse in next few decades (Samath, 2007).

Having gone through 30 years of civil war, consequences of terrorism in 2019 and COVID-19 crisis at the moment reflect a disastrous survival in the country. However, acquiring a self-sufficiency in paddy cultivation is economically critical for Sri Lanka.

Budding hope of adaptive and mitigating capacity; *space-based technology and space-derived data fostering paddy cultivation*

During infrastructure-oriented development of the country, enhancing agriculture especially the traditional *Yala* and *Maha* seasons of paddy cultivation was least prioritized. But an upcoming young institute has taken its step to resolve this. In 2018, a project on rice yield forecast and cultivation areas identification undertaken by Arthur C Clarke Institute for Modern Technologies (ACCIMT) of Sri Lanka lit up the livelihoods of paddy cultivators.

Ampara, a south-eastern rural district highly prone to droughts and other climate disasters in Sri Lanka was chosen for the implementation phase and the project has been successful. The institute currently works on strategizing the project for large and small scale cultivation regions. The project is modeled in such a way forecasting the yield in each harvesting seasons and the extent of cultivated lands (Figure 1). The project crew expects to process the forecasting for the harvest of the 2019-2021 *Maha* season (ACCIMT, 2018).

[3] Maha Season; from September to March in the following year.
[4] Yala season; during the period from May to end of August.
(Source; Department of Census and Statistics, Government of Sri Lanka)

The project has two broad scopes of adaptive and mitigating capacity towards climate change;

1. **Rice yield forecasting** helps local cultivators to economically figure out their finance for crops production and harvesting amidst unprecedented weather and thus stands as a plausible **adapting** mechanism within the capacity.
2. **Cultivated paddy area identification** quantifies the use of land areas for cultivation and monitoring over-exploitation of lands leading to deforestation. This eventually helps in **mitigating** the devastating effects of deforestation.

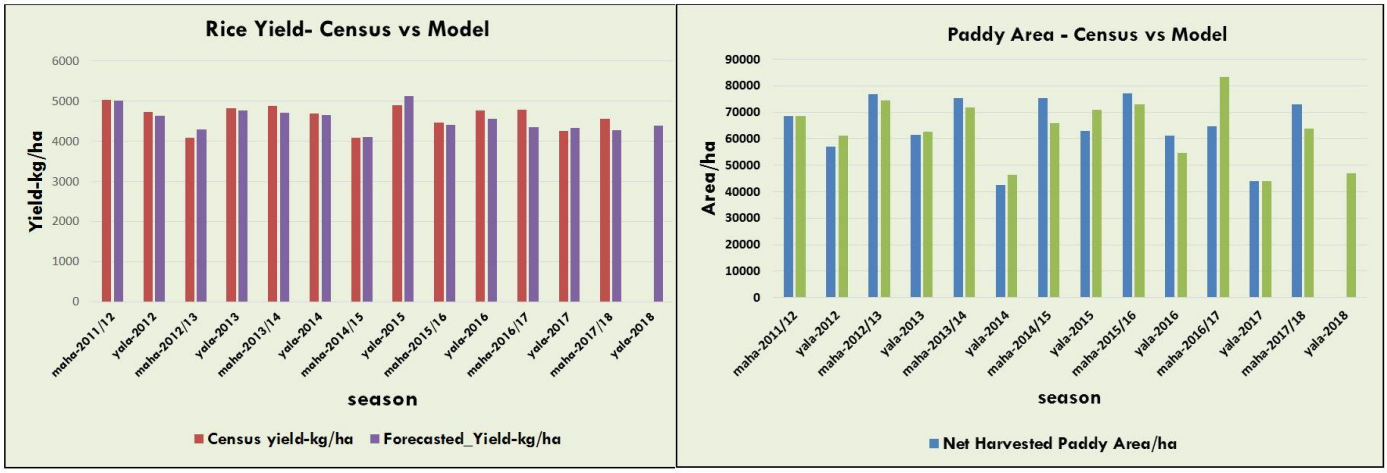


Figure 1. Rice yield harvest forecasts and cultivation area identification (Source; ACCIMT)

Sri Lanka is trapped in 'overdevelopment' which is evident that the 70% of the island's natural forest distribution in the last century had **shrunk to 20%** due to overexploitation in cultivation, irrigation and development (UN FAO, 2020) (Figure 2). This concern was not drawn with the highest attention due to internal civil and state instabilities. Now this problematic scene is highly adapted and mitigated with the project which employs the prediction of rice yield using MODIS[5] data (MODIS_NASA, n.d.) and expanding to the national level after pilot runs.

[5] Moderate Resolution Imaging Spectroradiometer

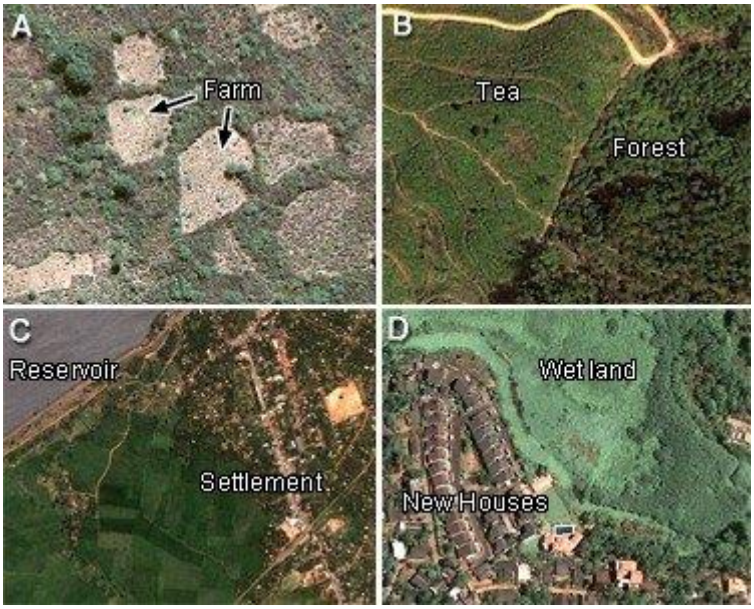


Figure 2. Deforestation monitored via high resolution satellite data through Google Earth
(Source; Perera, Herath, Apan and Tateishi, 2012)

In addition to this the ACCIMT leads a way to establish a national hub for utilizing Earth Observation Data (EOD) (ACCIMT, 2019). This will help to monitor agriculture, resource management and land usage which are potential sectors that were depleted to a great extent.

The nexus between the space-derived data-based *rice yield forecast and cultivation areas identification* and *national hub for EOD* (Figure 3) is significant for a sustainable space-based climate resilient agricultural practices and monitoring to improve the quality of lives.

Figure 3. Proposed EOD hub site in Homagama, shaded.
(Source; ACCIMT & Google Earth)

ACCIMT pilots; agricultural drought monitoring and early warning models

UN-ESCAP[6] is acknowledged for bringing a **regional cooperative action** for climate change in Sri Lanka. Satellite data are used to develop a regional drought mechanism including drought indices (NDVI[7]) (ACCIMT, 2015). The validation is in progress. The project helps disseminating space-based climate science, knowledge and skills within the country.

Author's novel concept; *SPA* for adaptation and mitigation in climate change sensitive agriculture; *Space-Plan-Action concept.*

Attributing to the potential of the space-derived data-based yield forecast and identification, a novel *Space-Plan-Action* (*SPA*) concept shall be effective, featuring inclusive of youth of Sri Lanka with intergenerational participation. Involvement of youth in Sri Lankan agricultural industry is very low as most of them migrate to urban areas for career opportunities. A budding culture practicing innovation in agriculture is observed meanwhile. This in fact shows the 'space' in between agricultural sector and technology like space-based one. A cooperative continuum of Climate Change Secretariat of Sri Lanka (CCS), Youth Council (YC), United Nations Office for Outer Space Affairs (UNOOSA) and Conference of the Parties 26 (COP26) around and with the ACCIMT will foster the country's adaptive capacity and mitigation scheme especially in crop cultivation. The ***SPA*** concept (Figure 4) emphasizes the adoption of space technology for climate-resilience of sectors based on sustainable development goals.

Figure 4. SPA concept when interconnected strongly using hinges leads to a tetrahedron model based on SDGs

[6] The United Nations Economic and Social Commission for Asia and the Pacific
[7] Normalized Difference Vegetation Index

COVID-19 as an opportunity; space-based technology for climate resilient cultivation in Sri Lanka

Agro-economy amidst the pandemic is risky but its potential reveals the attainment of ample paddy rice production harnessing space-based technologies. Pandemic has opened up a new strategic window for Sri Lanka to adopt cost effective cyber space for agriculture, education and finance which makes equity and equality more concerned (Abeysekera, 2020).

Inclusive COP26; nations like Sri Lanka can overcome climate change challenges with their adaptive capacities

COP25 focusing on climate finance falls short of devising mechanism for financially challenged communities to acquire adaptive capacity and responding modes once the limit of capacity is reached (Sharma et al., 2020). COP26 has a wide 'space' to recognise such nations using space-based technology and other such innovations to de-risk the vulnerability arising due to climate emergency menace. Present essay foresees a boosted operando for climate change resilience, adaptation and mitigation characterizing agricultural livelihoods in a post-COVID era (Figure 5).

Figure 5. UN SDG-13, Climate action is subsequently a combo of many other goals
(Source; Sustainable Development Goal 13: Climate action, IAEA, 2021)

Conclusions

Sri Lanka is at the initial phase of employing space-derived data and is not yet generalized within the local communities. Initiatives of yield forecasting, cultivation area identification and EOD are appraised but require global engagement. National documentation is not inclusive of these practices and this opens a new 'space' for reinforcing UN agencies for climate change, space affairs and youth engagement to join in hands with the nation on developing strategic post-pandemic plan for tackling climate change. Paddy rice cultivation, being the main food source has to be preserved which ultimately is a 'game' between life and death for many farmers. Lives are on options!

Even this moment you peruse this, me and my farming community may be prone to another climate risk!

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Annex; words count of the text

Section	Number of words
Abstract	99
Introduction and main text (excluding labels, in-text citations, abbreviations)	971
Conclusion	123