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GARGAON COLLEGE

RESEARCH PAPERS

2019-2020



Name of the faculty with designation: Dr. Pakiza Begum, Assistant Professor

Department: Chemistry

DOI/link to paper: <https://dx.doi.org/10.1021/acscatal.9b04063>

Title of paper: Controlling and Stabilization of Ru Nanoparticles by Tuning the Nitrogen Content of the Support for Enhanced H₂ Production through Aqueous-Phase Reforming of Glycerol

Name of the Journal: ACS Catalysis

Link of the Journal: <https://pubs.acs.org/journal/accacs>

ACS Catalysis

pubs.acs.org/acscatalysis

Research Article

Controlling and Stabilization of Ru Nanoparticles by Tuning the Nitrogen Content of the Support for Enhanced H₂ Production through Aqueous-Phase Reforming of Glycerol

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Cite This: ACS Catal. 2020, 10, 2489–2507

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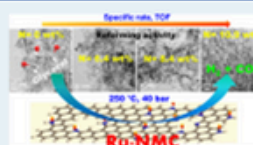
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ABSTRACT: The stable activity of catalysts is an important issue in catalysis, particularly aqueous-phase reforming (APR) of renewable oxygenates, of biomass origin, to get H₂. Sintering of metal nanoparticles on supports affects catalyst stability. To alleviate this problem, a series of highly stable Ru-supported catalysts with controlled metal nanoparticle sizes have been prepared via the easy incipient wetness impregnation method. These catalysts were used for APR of glycerol to produce H₂. Nitrogen-doped mesoporous carbons (NMCs) were utilized as supports and found to have a strong influence on the catalytic performance of the catalysts. Incorporation of nitrogen in the carbon framework significantly enhanced the catalytic activity compared to Ru catalysts on nitrogen-free supports. Notably, the catalyst (5 wt % Ru-NMC-3) with optimal N content (10.9 wt %) demonstrated improved stability and H₂ selectivity, which are better than those of many state-of-the-art catalysts. Nitrogen in the carbon framework has a dual relationship with the activity of the catalyst: (i) it creates basic environment over the catalysts support and (ii) it acts as an anchoring site for metal nanoparticles. Anchoring of metal nanoparticles has helped to curb their sintering, thus leading to better stability of the catalysts under APR reaction conditions. Various characterization techniques were employed to understand the nature of active catalytic sites responsible for higher H₂ production while minimizing CO formation. In situ CO-FTIR studies showed that the higher catalytic activity of 5 wt % Ru-NMC-3 catalyst was attributed to the enhanced WGS activity over this catalyst. Density functional theory calculations were performed to understand the stabilization of metal nanoparticles by different types of N present on the support and provide insights into the preferred sites of glycerol adsorption on the NMC support. Since 5 wt % Ru-NMC-3 was the relatively best catalyst, it was selected for the preparation of bimetallic catalysts. Accordingly, addition of Pt to this system helped to increase the stability of the catalyst. This bimetallic catalyst may, therefore, find application for wide use in APR of biomass oxygenates.

KEYWORDS: glycerol, H₂ production, aqueous-phase reforming, Ru/NMC catalyst, synergistic effect



1. INTRODUCTION

The atmospheric concentration of CO₂ has recently crossed 400 ppm with serious implications on the environment.^{1,2} It is well known that burning 12 g of carbon (C+O₂ ⇌ CO₂) releases a significant quantity (44 g) of CO₂, particularly when fossil fuel feedstock are used.¹ This release of greenhouse gas to the atmosphere has a detrimental effect on ecology, which is being witnessed in recent years.^{3–5} However, presently, >80% of our energy needs are met by using carbon-based fossil fuels.^{6–8} Therefore, it is imperative to replace the traditional sources of energy with renewable fuels, by which one can realistically expect a benign environment powered by green fuels like H₂. Hence, sustainable H₂ production is one of the options to reduce dependency on fossil fuels.^{9–12} But, developing such H₂ production processes requires tremendous research effort and involves economic challenges.

Traditionally, steam reforming of natural gas is a preferred route to produce H₂.^{13–15} But, this conventional energy-intensive process involves high reaction temperatures, hence

responsible for the release of large quantities of CO₂ to the atmosphere. Apart from steam reforming, there are other technologies to produce H₂, but all of them utilize fossil fuels leading to a high carbon footprint. Therefore, it is necessary to find alternate pathways to produce H₂ from renewable sources and shift the hydrocarbon-based economy to the one with a low carbon footprint. Moreover, using renewables for H₂ production is conceptually seen as a carbon-neutral process with considerable economic and environmental benefits. But, the efficacy of these processes is limited due to difficult process conditions and low H₂ yields.^{16,17}

The aqueous-phase reforming is one alternative route for efficient H₂ production from biomass-derived oxygenates (e.g.,

Received: September 22, 2019

Revised: December 25, 2019

Published: December 26, 2019



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DOI/link to paper: <https://gargaoncollege.ac.in/pdf/iqac/aqar-data/2022-23/Surajit%20saikia.pdf>

Title of paper: Homestead Garden in Rural Assam: A Means of Botanical Importance and Economic Sustainability

Name of the Journal: Journal of the Social Sciences

Link of the Journal: <https://gargaoncollege.ac.in/pdf/iqac/aqar-data/2022-23/Surajit%20saikia.pdf>

Journal of the Social Sciences
2

April 2020 Volume 48 Number

Homestead Garden in Rural Assam: A Means of Botanical Importance and Economic Sustainability

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Abstract

A study was conducted to assess the botanical importance and economic sustainability of homestead garden in Assam. Assessment was done by means of multistage random sampling from a total of 60 households using a semistructured questionnaire in the Koliapani Development block of Jorhat district of Assam. The study found great extent of diversity in horticultural plants, timber plants, cash crops, medicinal plants, spices, herbs etc. Moreover both crop and non-crop enterprises also found to a large extent in the homestead gardens of the study area. The diversity of homestead garden is considered great importance from the side of eco conservation and means of livelihood security to the Assamese family. In addition, analysis of existing management regime indicates that growers lack scientific information, almost every household still follows traditional management systems. A specific and sound homestead forest management plan at the local level, conservation of different homestead species diversity through scientific management and obtaining training and support from government was found highly desirable by this study.

Keywords: 1.Eco-conservation, 2.Economic sustainability, 3.Homestead garden, 4.Homestead diversification.

1. Introduction

Homestead garden is an operational farm unit, in which a number of crops (including tree crops), vegetables, fruits, and medicinal plants are grown along with livestock and fish production mainly to satisfy the farmers' basic need (Tejwani, 1994). Homestead farming system is a need based, self-provisioning, integrated, multi-species economically sustainable and environmentally safe farming system around the house where the soil is enriched by homemade biological formulations and integrated farming is undertaken (Bhattacharya et al. 2013). In Assam, homestead garden is an old age practice. People of Assam traditionally well sound in maintaining a homestead garden for both economic and ecological importance. The conservation of cultivated plants in homestead gardens of Assam not only preserves a vital resource for humankind but plays an important role in household food security, as it is a sustainable source of food, fruits and vegetables. Moreover, in Assamese society homestead gardens are considered to be the best source of traditional medicine that is used to a large extent in Assam.

Although the ecological and economic importance of homestead garden in Assam, very few studies have identified in the literature that explore the hidden importance of homestead garden. Some studies like DasTapasi and Ashesh Kumar Das, 2005; Saikia P, B. I. Choudhury & M. L. Khan, 2012; Barooah M. and A.



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DOI/link to paper: 10.35940/ijitee.F3539.049620

Title of paper: A Panel Data Analysis Model to Assess the Impact of Institutional Factors on Crop Diversification of Assam, India

Name of the Journal: International Journal of Innovative Technology and Exploring Engineering

Link of the Publication: <https://www.ijitee.org/>



International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-6, April 2020

A Panel Data Analysis Model to Assess the Impact of Institutional Factors on Crop Diversification of Assam, India



B. Gogoi, S. Saikia

Abstract: *The process of crop diversification is generally used in agriculture to mitigate both production and price risk. Crop diversification is a process through which farmers diversify his farm activities from one crop to different value added crops so that he minimizes the existing risk in his farm operation. Most of the studies in literature in context to crop diversification have identified different factors that influence crop diversification in their study area. However, very few studies have attempted to examine the impact of institutional factors on crop diversification at macro level by using district level panel data in Assam. Therefore, this study makes an attempt to examine the impact of institutional factors on crop diversification through panel analysis. To fulfill the objective of this paper secondary data have been collected from different issues of Statistical Hand Book of Assam, assamstate.com, RBI, etc. The overall results of this paper show that institutional factors like farm size have positive impact on crop diversification except institutional credit. Institutional credit has negative impact on crop diversification. This paper will definitely help to bring some policy changes in the macro level to optimize crop diversification in the region.*

Keywords: Institutional factors, crop diversification, climate change, risk mitigation

I. INTRODUCTION

A sustained economic growth, rising per capita income and growing urbanization are ostensibly causing a shift in the consumption patterns in favor of high-value food commodities like fruits, vegetables, dairy, poultry, meat and fish products from staple food such as rice, wheat and coarse cereals. The demand for and supply of these commodities have grown much faster than those of food grains [1, 2]. And this change is not confined to the higher income group of the Indian society only but is visible in the lower income or 'below poverty line' segment also. Such a shift in consumption patterns in

favor of high-value food commodities even among the poorest strata of the India society depicts an on-going process of transformation that is leading towards a 'silent revolution' of agricultural diversification. This revolution or process of transformation is also reflected in the rising exports of high-value agricultural products [3].

Diversification of Agriculture is a process that has several dimensions. It can be viewed, narrowly, as a larger mix of activities within agriculture involving crop substitution. Diversification can also involve a shift of resources from one crop to a larger mix of crops keeping in view the varying nature of risks and expected returns from each crop/livestock activity, and adjusting in such a way that it leads to optimum portfolio of income [4].

Uncertainties and risk are two important parts in the discussions of agricultural economics. Therefore, risk and uncertainties play vital role in any kind of decision making process in agriculture. Every day farmers face with a significant amount of uncertainty. As a result agricultural producers are forced to make decisions based on imperfect information. Born out of this uncertainty is the possibility of injury or loss. Risk and uncertainty are ubiquitous and varied within agriculture and agricultural supply chains. This stems from a range of factors including the vagaries of weather, the unpredictable nature of biological processes, the pronounced seasonality of production and market cycles, the geographical separation of production and end users, and the unique and uncertain political economy of food and agriculture sectors, both domestic and international [5].

Different researchers have found that crop diversification is one of the prominent strategies of risk mitigation in agriculture. The broad rationale for crop diversification emanates from the opportunities it offers to reduce production and price risks, increasing yields, natural resource sustainability, maintaining ecological balance, increasing flexibility and sustain productivity and growth. It also creates opportunities for more employment and higher incomes through more efficient use of resources and exploitation of comparative advantage [6, 7, 8, 9, and 10]

Frequent change in the climatic condition like increasing density of rainfall, more siltation in the river beds etc., stimulates devastating flood in Assam. Year after year the changing nature of flood in Assam extemporize more risk in agriculture.

Revised Manuscript Received on April 30, 2020.

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DOI/link to paper: <https://doi.org/10.1007/s40808-020-00772-3>

Title of the paper: An infrared thermography-based study on the variation in diurnal and seasonal land surface temperature at Dibrugarh city, India

Name of the Journal: Modeling Earth System and Environment

Link of the Journal: <https://link.springer.com/journal/40808>

Modeling Earth Systems and Environment
<https://doi.org/10.1007/s40808-020-00772-3>

ORIGINAL ARTICLE



An infrared thermography-based study on the variation in diurnal and seasonal land surface temperature at Dibrugarh city, India

Rituraj Neog¹ · Biman Lahkar¹ · Juri Baruah¹ · Shukla Acharjee¹ · Bijoy Shankar Gogoi¹ · Borakha Sonowal¹ · Dimpal Dutta¹ · Dimpee Chetia¹ · Jyotishma Baruah¹ · Madhusmita Gogoi¹ · Minakshi Patar¹ · Rajoshree Borah¹ · Tulika Das¹

Received: 28 January 2020 / Accepted: 2 April 2020
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Abstract

The understanding of surface urban heat island pattern above Dibrugarh City has been studied through in situ observation using non-contact infrared thermometer for a period of 4 months by covering 16 selected locations. The chosen locations envelop both urban and suburban sites. The study draws attention to urban hot spots toward the central part of the city all through the different months in addition to the seasons, owing to heat retention supported by the built environment with fewer vegetation cover. Seasonally winter uncovered utmost variability of LST indicated by higher CV value. The core locations/sites witnessed a least amount of variability and continuity of higher LST throughout the learning months. At diurnal pattern, LST designated a sharp decrease from morning to afternoon period through winter months, while contrastingly summer months witnessed a sharp fall of LST from afternoon to night period. Among all the surfaces, asphalt pavement noticed maximum surface temperature with maximum variability in both diurnal and temporal scales. Maximum assimilation with fewer albedo of asphalt surface along with drier soil and grass comes across maximum LST in the internal part of the city. In addition, traffic, pollution and anthropogenic heat emission supported warmer surface temperature of asphalt, grass and bare soil, which on the whole put into the growth of higher surface heat. The stronger affirmative correlation coefficient amid the temperature of different surfaces with air temperature and comparatively weaker unconstructive correlation with relative humidity witnessed the dominant role of air temperature on overall surface urban heat island process.

Keywords LST · Diurnal scale · Variability · Surface temperature · Intensity

Introduction

Land surface temperature (LST) and its diurnal variation are crucial for the physical, chemical and biological processes of Earth. Climate-related studies were carried out to assess the environmental conditions and management practices on Earth surfaces, and their surrounding atmosphere requires LST information on a useful scale (Becker and Li 1993). Urbanization is a driver which brings a noticeable change in the natural surface of the Earth, and the natural surface is converted from bare soil or green area to the newly built surface (e.g., asphalt, stone, metal, concrete, etc.), thereby causing a change in the land cover. An urban heat island

is a happening in which urban air temperature is comparatively higher than the adjoining rustic air temperature (Choi et al. 2014). Urban heat island intensity is mainly restricted by synthetic constructions in the urban environment as a consequence of extensive urbanization and industrialization (Oke 1973; Voogt and Oke 2003). Increased thermal capacity and relatively lower potentiality of evapotranspiration together with artificial temperature intensify the procedure of heat island intensity (Roth et al. 1989). Moreover, urban heat island consequences can as well be connected to climate strictures (Sundborg 1950; Chandler 1965; Unger et al. 2001). Further, skyscraping buildings and narrow roads reduce horizontal airflow (Liu and Zhang 2011). The unfavorable consequence of UHI is intense urban climate and thermal uneasiness (Almusaed 2011), rising utilization of power (Akbari and Konopacki 1998) and increasing per head water consumption, particularly during summer season (Guhathakurta and Gober 2007). It also leads to cool

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DOI/link to paper: <https://doi.org/10.1007/s10708-024-11072-z>

Title of the paper: Surface chlorophyll anomalies associated with Indian Ocean Dipole and El Niño Southern Oscillation in North Indian Ocean: a case study of 2006–2007 event

Name of the Journal: Environ Monit Assess

Link of the Journal: <https://link.springer.com/journal/10661>

Environ Monit Assess (2019) 191(Suppl 3): 807
<https://doi.org/10.1007/s10661-019-7754-z>

Surface chlorophyll anomalies associated with Indian Ocean Dipole and El Niño Southern Oscillation in North Indian Ocean: a case study of 2006–2007 event



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Sumit Dandapat · Arun Chakraborty

Received: 21 August 2018 / Accepted: 23 May 2019
© Springer Nature Switzerland AG 2019

Abstract North Indian Ocean witnesses varied dynamical response due to independent climate modes such as Indian Ocean Dipole (IOD)/El Niño Southern Oscillations (ENSO) and their co-occurrences. These modes have a significant impact on ocean productivity, which in turn shows feedback for the strengthening of these patterns. Keeping this in view, the present work attempts to analyze the biological activity during the combined influence of positive IOD with El Niño during 2006–2007 event. To divulge the biological variability along with the dynamical response, the study includes intra-annual variability surface chlorophyll anomaly with D20 anomaly using satellite observations. Here, the individual role of IOD and ENSO on both surface chlorophyll and D20 is segregated through partial regression analysis for a period of 25 years (1993–2017). By the regression method, it can be seen varied chlorophyll response for the 2006–2007 event with the IOD forcing leads to the major spatial and temporal variability with positive anomalies in Eastern Equatorial Indian Ocean (EEIO) (generally oligotrophic), Northwestern Bay of Bengal (NWBoB), and Northwestern Arabian Sea (NAS2) where production begins in fall

intermonsoon and peaks up during November. On the other hand, negative anomalies are observed around the southern tip of India (SBoB) and the Northern Arabian Sea (NAS1). While ENSO depicts the high surface chlorophyll variability in the Western Indian Ocean (WIO1, WIO2) with negative anomalies of surface chlorophyll. This study observed an asymmetric response of chlorophyll variability over the North Indian Ocean during the 1997–1998 and 2006–2007 events with a major influence of IOD mode compared with the El Niño. Therefore, understanding the chlorophyll anomalies during different climate modes will help us to better understand the interannual variability and improve the predictability of chlorophyll productivity regions.

Keywords Surface chlorophyll · Indian Ocean Dipole · El Niño Southern Oscillation · Partial regression · Interannual variability

Introduction

North Indian Ocean is a very productive basin, and it endorsed significant climate variability from the far past. Indian Ocean Dipole (IOD) and El Niño Southern Oscillation (ENSO) are dominant climate modes leading to both dynamical and biological variability in the North Indian Ocean. ENSO is a random periodic variation in atmospheric winds and sea surface temperature (SST) over eastern and central Pacific Ocean, which affects the weather globally through different dynamical

This article is part of the Topical Collection on *Terrestrial and Ocean Dynamics: India Perspective*

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DOI/link to paper: <https://antrocom.net/archives/2020/volume-16-number-1/the-pisai-a-study-on-the-village-administration-among-the-tiwa/>

Title of the paper: The Pisai: A study on the Village Administration among the Tiwa

Name of the Journal: Antrocom Journal of Anthropology

Link of the publication: <https://www.antrocom.net/index.html>

Antrocom Online Journal of Anthropology vol. 16, n. 1 (2020) 235-239 – ISSN 1973 – 2880



Antrocom Journal of Anthropology

journal homepage: <http://www.antrocom.net>



The Pisai: A study on the Village Administration among the Tiwa

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KEYWORDS

Village, Administration,
Tiwa, Culture, Pisai

ABSTRACT

The study of village administration as a part of traditional institutions has attracted the attention of policymakers, researchers and social scientists. It may be difficult to define and categorize traditional institutions into social, cultural, political and economic institutions since tradition in any given society is a composite whole. As a passive process, traditions stand for time-honoured customs and respected beliefs. It is seen as an ideal type construct and a stultifying force that engendered and enforced cultural homogeneity. This paper discussed the traditional Tiwa village administration and looks into the continuity of age-old custom and manners. It gives a brief descriptive account of the village administration and the role played by the pisai or the council of village elders in the management of the affairs of the village. This paper is primarily based on colonial and contemporary writings and field studies carried out during 2017-2018.

Introduction

Before embarking on a discussion of village administration among the Tiwa of North East India, it is necessary to give a brief introduction of the tribe under study. The Tiwa is one of the many tribal groups as well as one of the early settlers in North East India. Ancient scriptures mentioned the earliest inhabitants of Assam as the kirata. In the Puranas, the kirata are dubbed foresters, barbarians, or mountaineers (Baruah 1969:5). The Mahabharata mentioned these early inhabitants of Assam as mlechhas. According to K L. Baruah(1966:34-35), the kirata and mlechhas of ancient Kamarupa are Mongolians belonging to the Tibeto-Burman family of the Indo-Chinese group and their present day representatives are the Kacharis, Koches Rabhas, Lalungs (Tiwa), Garos. Settled in the Morigaon, Nagaon, Kamrup and Karbi Anglong districts of Assam and parts of Eastern Meghalaya, they have long been referred to as 'Lalung' by other neighbouring groups (Khasi-Jaintia, Karbi) and in colonial records. The people in question, however, refer to themselves as Tiwa. They are divided into two cultural and social divisions: those settled in the plains speak Assamese, follow a patrilineal descent system and bear Assamese patronyms, and those residing in the hills speak a Tibeto-Burmese language of the Bodo-Garo group, are primarily matrilineal and divided into clearly identified clans from which they trace their descent. Thus the Tiwa follow a bilinear descent system or more specifically an ambilinear descent. This system recognizes that a person descends from both parents, but allows for a choice in determining which descent group to be more affiliated to and is therefore characterized

Please cite this article as: Raktim Patar, Pisai: A study on the Village Administration among the Tiwa. *Antrocom J. of Anthropology* 16-1 (2020) pp. 235-239.



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DOI/link to paper: <https://www.tpnindia.org/index.php/sipn/article/view/6468>

Title of the paper: Funerary Rituals among the Tiwa of Brahmaputra Valley

Name of the Journal: Studies in Indian Place Names

Link of the Journal: <https://www.tpnindia.org/>

Studies in Indian Place Names
(UGC Care Journal)

ISSN: 2394-3114
Vol-40-Issue-60-March -2020

Funerary Rituals among the Tiwa of Brahmaputra Valley

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Abstract

Funerary rituals are an integral part of every human group which reflects their attachment and beliefs to the life after death. The study of rituals associated with death ceremony could provide a detail understanding of belief system of an ethnic group. The Tiwa are one of the important tribe of Northeast India among which a large section lives in the Brahmaputra valley and the rest in the hills of Karbi Anglong and Meghalaya. This paper is an attempt to study the details involved in the funerary rituals among the Tiwa of Brahmaputra valley.

Key words: Tiwa, Funerary, Ritual, Belief

Introduction

Death is obvious. Nevertheless, everyone is afraid of death. Hence every care is taken in the performance of the funerary rituals for the dead person and to satisfy the spirit all across the human groups. Funerary rituals are an integral part of every human group which reflects their attachment and beliefs to life after death. The study of rituals associated with death ceremony could provide a detailed understanding of the belief system of an ethnic group. This paper is an attempt to study the details involved in the funerary rituals among the Tiwa of Brahmaputra valley. It will also try to look into the continuity and changes that had occurred with the progress of time.

The Tiwa is one of the many tribal groups in North-East India. They are one of the early settlers of Northeast India. Ancient scriptures mentioned the earliest inhabitants of Assam as Kirata. In the *puranas* Kirata are designated as foresters, barbarians, mountaineers. The Mahabharata mentioned these early inhabitants of Assam as *Mlechhas*. The Tiwas are divided into two cultural and social divisions- those settled in the Plains, speak Assamese, follow a



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DDOI/link to paper: <https://doi.org/10.1177/004908571986390>

Title of the paper: Book review: Chaitanya Ravi, *A Debate to Remember ---The US-India Nuclear Deal*

Name of the Journal: Social Change

Link of the Journal: <https://journals.sagepub.com/home/SCH>

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[Volume 49, Issue 3](#) | <https://doi.org/10.1177/0049085719863902>

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Abstract

CHAITANYA RAVI, *A Debate to Remember—The US–India Nuclear Deal*. New Delhi: Oxford University Press, 2018, 309 pp., ₹995, ISBN-13: 978-0-19-948170-5 (*Hardcover*).

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