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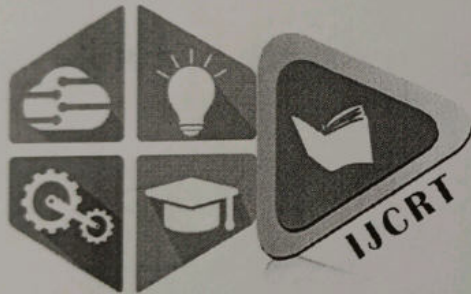# JOURNAL OF
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WOMEN IN VEDIC PERIOD: A SOCIO-POLITICAL ANALYSIS

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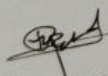
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WOMEN IN VEDIC PERIOD: A SOCIO-POLITICAL ANALYSIS

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Abstract

In every era the status and position of women is one of the most fundamental matter to study. Without any hesitation the Vedic women in India enjoyed high position in society and their situation was quite satisfactory. In high spiritual and intellectual ground their participation was very spontaneous. Even that period was also free from social superstitious rituals like sati system, early marriage etc. The aim of this paper is to analyze the status and position of women in Vedic period in India. In account of wide narrative it represents and pursues to analyze women's situation in various areas like social, religious, educational, legal etc.

Index Terms

Women Status, Vedas, Religious, Rights.

Introduction

"Divine souls take birth in such houses where the women are respected, where they are not respected, all works become useless there" (Manusmriti 3/56).

Men and Women are two fundamental element of our human community, where both of them depend upon each other. Around the world in generally and especially in the context of Indian society socio-political philosophers and others have try to evaluate the issues faced by women over the years. We know that men and women are two wings of a bird, and it is not possible for a bird to fly on only one wing. Same as, a society never improved without women.

Women's endeavor plays the key role to en-strength the dynamism of human civilization by dint of their superiority and confinements to make a rapid progress of it in all spheres on this globe since ages. Although the tale of women's accomplishment remained subdued in history, yet the ancient Indian texts symbolizes women's visibility in this regard where women's status had varied with space and time (Chakravarti & Roy, 1988).

Without study the status and role of women in society, any kind of improvement of civilization is incomplete. Women represent the keystone in the arch of Indian culture. Indian culture constructs on the spirit that women's cause in men. In connection with social role structure, privileges, right and duties refers the status and position of women in society. It also refers to her right and responsibilities in family and social life. The position and reputation of women is normally evaluated in the account of honor and appreciation accorded to her with that of man.

The Vedic society was a liberal and humanistic society. In this period the Aryans distinctly favor male child to female child. However, females were as liberal as their male fellow. In Vedic era the women in India consumed high position in society and their

EMPOWERMENT OF WOMEN: THE BUDDHIST PERSPECTIVE

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Abstract

Buddha, being a great thinker and a social reformer, instituted an ethical faith to free human minds from the age old orthodoxies and opened a new vista of religious experience called Buddhism. His towering personality, simplicity and loving kindness for the impoverished and the sick, his denial of caste consideration for the attainment of salvation, his emphasis on conduct over birth and his admission of women into the *Sangha*, were the principles of a very high order incomprehensible in his era and they are quite applicable even today. This paper shows the position of women and the feministic philosophical view in Buddhism. By following the way of Buddha's teaching, many women in his time achieved highest goal, the state of ever happiness. Buddhism does not consider women as being inferior to men. For imposing the eight *Garudhammas*, many critics misjudged Buddha and consider that Buddha hesitated to give recognition to the right of women for two times. But, it was because of that, *Bhikkhuni Sangha* was well organized during the life time of Buddha. When they became skilled to defend themselves, Buddha withdrew *Garudhammas* observing their ability to run the *Bhikkhuni Sangha* progressively more. Keeping pace with men, they contributed Buddhism in many ways. The contribution of *Gautami, Visakha, Patachara, Sujata,* etc. will be highly appreciated always. Among the Bhikkhunis, many were learned in religion and philosophy. *Therigatha* is a strong evidence to eradicate the confusion about the role of women in early Buddhism. Women in Buddhist societies have enjoyed a much higher degree of freedom, independence and more often than not even equality of status.

Keywords: women, empowerment, Buddhism, Bhikkhuni Sangha, Garudhammas.

Introduction

The arrival of Buddhism in the 5th century B.C., created a minor rouse against Brahmin dogma and superstition. Buddhism rejected the caste structure, excessive ritualism and sacrifice. The basic doctrine of

preach the Dharma like the *Bhikkhus*. Buddha considered *Bhikkhuni Sangha* like as *Bhikkhu Sangha*. The Buddha gave woman an independent status and places her on a footing of equality with men. According to Ambedkar, "no caste, no equality, no superiority: all are equal. That is the Buddha stood for". Buddhism is a religion of humanity and is a religion of welfare of human beings (Bahu jana hitaya and bahu jana sukhaya). He gave his teachings to human beings so that their suffering can be removed. The main motto of his teachings was to bring happiness for human beings and make them free from sufferings. Being ordained in Buddhism, women developed themselves not only in spiritualism but also in creativity in the early Buddhist era.

Religious Freedom for Women

The establishment of the Bhikkhuni Sangha, the Order of Nuns, had really paved the way for full religious freedom for women in the days of the Buddha. Buddhist practice has no place for ritual. It is in the conduct of rituals in most religions that sex-typing becomes important and questions of precedence, ritual purity and the like arise. Later developments, in some Buddhist countries, have seen the emergence of some ritual, but even this kind of simple ritual has not involved any typing by the sex of the devotee. Buddhist ritual usually involves simple forms of worship or chanting or symbolic offerings, and all these are available to men and women on equal terms. In this connection it must also be mentioned that Buddhism has no place for a priestly class. Buddhist monks are sometimes mistakenly referred to as "Buddhist priests". The role of the priest in religious life is to officiate between the faithful and the God, and Buddhism being essentially atheistic has no place for God or priest. In practice Buddhist monks have assumed some kind of priestly role as when they recite stanzas of blessings to the lay followers. This is part of the process by which Buddhism has been made into a religion, but it was not one in its original form.

There were many eminent nuns who shone brilliantly in the study and practice of the Dhamma. The Buddha did not place any restrictions on the nuns in the matter of teaching and preaching of the Dhamma. The Bhikkhuni Order produced a remarkable number of brilliant preachers and exponents of the Dhamma e.g. Sukha, Patachara, Khema, Dhammadinna and Maha Pajapati (the foster mother of the Buddha). Buddhism never supported the Brahmin's view that a son was essential for the father's passage to heaven. Daughters became quite as good as sons and marriage was no longer a compulsory necessity. Women under Buddhism had the liberty to lead an independent life and go through their own business. The Buddha by granting women an active share in the religious life also helped to raise their status in secular life as well. However, the admission of women into the Order was a step in advance for the period. Whenever an innovation or improvement was in advance of the thinking and development of a people during a particular era, the people were unable to adapt themselves to the improved conditions and tended to regress back to the society that they were used to.

in Buddhism. Buddhists accept that whatever is real is free from any sort of constructions. Construction is a sort of *jneyavarana.*

Hence, within the framework of Buddhist thought, it can be said that instead of solving the woman's problem through attempts based on a dualistic model, it is better to transcend this difference and accept that each individual is an aggregation of *panchaskandha,* he is a unique individual. Each individual, either man or woman has good as well as bad qualities. Accordingly, he or she is morally good or bad. Buddhism has not only advocated this thought but through the dialogues between Mara, one of the symbolic men, and the Buddhist nuns, Buddha has shown that it is possible.

Conclusion

Thus, we may conclude that the advent of Buddha and the emergence of Buddhism opened a new horizon for women in society. By the inspiration of all women and with the counter-plea of Buddha, the women got the right of doing the work according to their will. In fact, the establishment of *Bhikkhunis Sangha* was very important to bring social change for women. Buddhist Era is the golden age for women's education and movement. But after the great passing of Buddha, *Bhikkhunis* again started to face the problem and slowly it was extinct in 11th and 12th century.

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महाभारतं सांख्यकारिकाञ्च अवलम्ब्य प्रकृतितत्त्व-निरूपणम्

मणिमाला मण्डलः
सहकारी अध्यापकः
संस्कृत विभागः
गुसकरा महाविद्यालयः
पश्चिमवङ्गः

कथासारः

महाभारतं इति ग्रन्थरत्नंसर्वशास्त्राणां भावनया समृद्धं जातम्। विशेषेण तु भारतीय षड्दर्शनस्य चिन्तयासम्यग्रूपेणअस्य ग्रन्थस्य पुष्टिं सञ्जातम्। महाभारते वेदान्तादि षड्दर्शनचिन्तासु सांख्यदर्शनचिन्तायाः समधिकं प्रभावं परिलक्ष्यते। सांख्यदर्शनस्य पञ्चविंशतितत्त्वेषु प्रकृतितत्त्वं तत्र सविशेषं पर्यालोचितम्। सांख्यदर्शनस्य अधुनाप्राप्तं एकमात्रं प्रामाण्यं ग्रन्थं ईश्वरकृष्णप्रणीतं'सांख्यकारिका' इति मन्यन्ते पण्डिताः। सांख्यकारिकायां ईश्वरकृष्णेन प्रकृतिस्वरूपं प्रतिपादितम्।अतः उभयग्रन्थप्रतिपादितं प्रकृतितत्त्वमवलम्बनेन तुलनात्मकस्य अलोचनायाः अवकाशमस्ति। तत्र परिलक्ष्यते उभयग्रन्थप्रतिपादितयोः प्रकृतितत्त्वयोर्मध्ये यद्यपि तादृशं किमपि समधिकं भेदं न विद्यते, तथापि महाभारते प्रकृतितत्त्वस्योपरि अपरमेकं तत्त्वं स्वीकृतं येन प्रकृतिः नियन्त्रिता भवति। सांख्यकारिकायांतु प्रकृतिनियन्त्रकरूपेण किमपि अपरं तत्त्वं न स्वीकृतम्।

शब्दसंकेतः - महाभारतम्, सांख्यकारिका, प्रकृतिः, अव्यक्तम्, गुणम्

महाभारतं भारत-इतिहासस्य अमूल्यं उपादानम्। महाभारतस्य महति कलेवरेविधृतमस्ति भारतसभ्यतायाः पूर्णः इतिहासः। महाभारतस्य एतादृशं माहात्म्यं यथार्थमुपलभ्य भिन्टारनित्स् महोदयेन उक्तम् - "The Mahabharata is a whole literature"। यद्यपि अलंकारशास्त्रानुसारेण महाभारतं 'महाकाव्यम्' इति संज्ञया विभूषितं, तथापि इदं महाकाव्यं यथार्थरूपेण एकः संकलनग्रन्थःइति मन्यते।महाभारतं न केवलं शान्तरसप्रधानमार्षमहाकाव्यम्, इतिहास-पुराणं वा, अपि तु पञ्चमवेदः धर्मार्थकाममोक्षरूपं सर्वशास्त्रमयं ग्रन्थं चेति। एतस्मात् महाभारतस्य माहात्म्यं कीर्त्तनार्थं सगौरवेन उच्यते - "यन्नेहास्ति न तत् क्वचित्।" महाभारतंभारतीय-सभ्यतायाः संस्कृतेश्च सर्वाङ्गीणः इतिहासः, सम्पूर्णं साहित्यं, सम्पूर्णं दर्शनञ्च - इति यत् कथ्यते, तत् न अतिकथनम्, यथार्थमेव।

महाभारतं तस्य अष्टादशपर्व्व-समन्विते महति शरीरे विविधविषयेन सह भारतीयदर्शनचिन्तनमपि धारयति वहति च। अखिले महाभारते प्रतिपादितानि दर्शनचिन्तानि सर्वान्येव सांख्यादि षड्दर्शन-सम्भुतानि। किन्तु तत्र षड्दर्शनेषु सांख्यदर्शनस्य प्रभावं समधिकं परिलक्ष्यते। विशेषेण तु शान्तिपर्वे भीष्मपर्वे च सांख्यमतं महाभारतकारेण सम्यग्रूपेण पर्यालोचितम्।

सुप्रसिद्धे सांख्यग्रन्थसमूहे प्रकृतितत्त्वस्य स्वरूपं येन प्रकारेण ज्ञापितं महाभारते तदपेक्षया किञ्चित् भिन्नरूपेण प्रतिपादितम्। यद्यपि उभयत्र 'प्रकृति' इति शब्दस्य अर्थः समानमेव। यथा सांख्यकारिकायां प्रकृतेः - 'प्रधानं', 'अव्यक्तं' चेति

विषादात्मकस्तमोगुण इत्यर्थ:।"१८ अर्थात् जीव: तस्य देहे मनसि च प्रकृत्या: सत्त्वगुणजनितं सुखं, रजोगुणजनितं दु:खं तमोगुणजनितं मोहं च अनुभवति। अस्मिन् प्रसङ्गे एतद् कथनमावश्यकं यत् विज्ञानभिक्षुणा सत्त्वादिगुणानां सुखाद्यतिरिक्तानि अपरानि विविधधर्माणि उल्लिखितानि। तस्य मतेन सुखात् ऋतेऽपि सत्त्वगुणस्य प्रीति:, तितिक्षादि, रजोगुणस्य शोकादि तमोगुणस्य च निद्रा, आलस्यादि धर्माणि सन्ति। किन्तु सत्त्वादि गुणानां सुखादि धर्माणां प्राधान्यत्वात् संक्षेपेण सत्त्वगुण: सुखात्मक:, रजोगुण: दुखात्मक: तमोगुणश्च मोहात्मक: कथित:। सुखादि सर्वैव सत्त्वादि-गुणानां कार्यं एतत् महाभारतेऽपि पुन: पुन: कथितम्। यथा शान्तिपर्वे युधिष्ठिरेण पृष्ट: सन् भीष्मेण ज्ञापितमेतत् यत् काये मनसि वा यत् प्रीतिसंयुक्तं भवति तत् सात्त्विकभावस्य कार्य, यत् आत्मदु:खसंयुक्तं अप्रीतिकरं वा तत् रजोगुणस्य कार्य यत् च् काये मनसि वा मोहं सञ्जायते तत्र च अनिर्वचनीयं अज्ञेयभावं च सञ्जायते तत् तमोगुणस्य कार्यम् -

अत्र यत् प्रीतिसंयुक्तं काये मनसि वा भवेत्।
वर्त्तते सात्त्विको भाव इत्युपेक्षते तत्तथा॥
अथ यद्दु:खसंयुक्तमप्रीतिकरमात्मन:।
प्रवृत्तं रज इत्येव तदसंरभ्य चिन्तयेत्॥
अथ यन्मोहसंयुक्तं काये मनसि वा भवेत्।
अप्रतर्क्यविज्ञेयं तमस्तदुपधारयेत्॥१९

गुणानां कार्यविषये नीलकण्ठकृते भारतभावदीपटीकायां समुल्लिखितं वक्तव्यमपि लक्षणीयम्। तत्रोक्तं सत्त्वगुणात् दयादि, रजोगुणात् आसक्ति कामादि वा तमोगुणाच्च मोहादि धर्म समुत्पन्नते - "सत्त्वस्य गुणां धर्मादीन् रजस: प्रवृत्यादीन् तमसोऽप्रवृत्तादीन् . . .।"२०

कार्यसाधने सत्त्वादि गुणत्रयाणां भूमिकानुसारेण सांख्यशास्त्रे तेषां स्वरूपाणि चरित्राणि वा निरूपितम्। अस्मिन् विषये सांख्यकारिकायां ईश्वरकृष्णेन उक्तं यथा सत्त्वगुण: लघु: प्रकाशकं वा, रजोगुण: प्रवृत्तिशीलं चपल: वा तथा क्रियाशील: तमोगुणश्च गुरु आवरणकं वा -

सत्त्वं लघु प्रकाशकमिष्टमुपष्टम्भकं चलं च रज:।
गुरु वरणकमेव तम: . . ,॥२१

साख्यकारिकोक्तस्य वक्तव्यस्य प्रायानुरूपं वक्तव्यं नीलकण्ठकृते टीकायां परिलक्ष्यते। तत् यथा - "तामसान् क्रोधादीन्, राजसान् प्रवृत्तादीन्, सात्त्विकान् प्रकाशादीन् ।"२२ अपि च नीलकण्ठ महोदयेन सत्त्वादिगुणत्रयाणां शुक्लादि वर्णधारणस्य हेतुरूपेण स्वच्छत्वं रजकत्वं मलिनत्वं च उल्लिखितम्। स्वच्छत्वादि पक्षान्तरे सत्त्वादि गुणत्रयाणां यथाक्रमेण प्रकाशत्वादि धर्मेव निर्दिश्यते - " क्रमेण स्वच्छत्वाद्रञ्जकत्वान्मलिन्त्वाच्च सत्त्वादीनि शुक्ललोहितकृष्णाणि . . .।"२३ अत: एतावधि पर्यालोचनानुसारेण कथनमेतत् न असमीचिनं भवति यत् गुणस्वरूपविषये कार्यविषये च महाभारतस्य सांख्याकारिकायाश्च मतं समानुरूपम्।

त्रिगुणात्मकं प्रकृतितत्त्वमेव अव्यक्ततत्वम् एतत् प्रकृत्या: पर्यायशब्दालोचनावसरे प्रागेव उक्तम्। प्रकृति-पुरुषतत्वद्वयं व्यतीतं व्यक्ततत्त्वं महदादि-त्रयोविंशति विकारपदार्थ: - " तत्र व्यक्तलक्षणमाह प्रोक्तमिति। तच्च महदादि- विकारान्तं त्रयोविंशकम्।"२४ अव्यक्ततत्त्वं अववोधार्थं व्यक्तत्त्वस्य पूर्वज्ञानं आवश्यकम्। तेन अव्यक्तस्वरूपं सुवोध्यं भवति एतत् महाभारते कथितम् –

संस्कृतभाषायाम् :

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শঙ্খ ঘোষের শিশুসাহিত্য
বিশেষ সংখ্যা

সম্পাদক

আসরফী খাতুন

শঙ্খ ঘোষের ছড়ায় প্রকৃতি চেতনা

কোহিনূর বেগম

লোকসাহিত্যের অন্তর্ভুক্ত সৌন্দর্যময় সৃজনশিল্প ছড়া। মানুষের মুখে মুখে ঝংকারময় এই পদ্যপ্রবাহ যুগ থেকে যুগে চিরপ্রবহমান। ধ্বনিমাধুর্য ও সুরঝংকারই ছড়ার প্রধান ও প্রথম বৈশিষ্ট্য। অর্থময়তা এখানে ম্লান। যেমন 'ছেলে ঘুমালো পাড়া জুড়ালো বর্গী এল দেশে, বুলবুলিতে ধান খেয়েছে খাজনা দিব কিসে'।- এই ছড়াটি কোনো রাজনৈতিক সমস্যা জাত নয়, চিরন্তন মানবিক সমস্যাজাত। সেটি হল ছোট্ট বাচ্চা শিশুকে মায়ের ঘুম পাড়ানোর সমস্যা। তাই ইন্দসুরের পাখায় ভর দিয়ে ছড়া শিশু মনস্তত্ত্বের উপযোগী হয়ে উঠেছে। কবিগুরু রবীন্দ্রনাথ বলেছেন– 'বুঝিতে পারি না, কেন এত মহাকাব্য এবং খণ্ডকাব্য এত তত্ত্বকথা এবং নীতিপ্রচার, মানবের এত প্রাণপন প্রযত্ন এত গলদঘর্ম ব্যায়াম প্রতিদিন ব্যর্থ এবং বিতৃত হইতেছে, অথচ এই সকল অসঙ্গত অর্থহীন সদৃচ্ছাকৃত শ্লোকগুলি লোক-স্মৃতিতে চিরকাল প্রবাহিত হইয়া আসিতেছে।" ছড়ার এই বৈশিষ্ট্যের আলোকেই আধুনিক কবি শঙ্খ ঘোষ শিশু মনস্তত্ত্বের উপযোগী বিখ্যাত ছড়াগুলি রচনা করেছেন। প্রকৃতি চেতনা তাঁর ছড়ায় কতখানি প্রভাব বিস্তার করে শিশুমনকে উদ্দীপ্ত করেছে তা বিচার করার প্রয়াস করবো।

আজন্ম বঙ্গ প্রকৃতির বুকে মগ্ন হয়ে কবি শঙ্খ ঘোষ হৃদয় দিয়ে অনুভব করেছেন বাংলার নদী, মাঠ, প্রান্তরকে। রূপকথা, নদী, পাহাড়, বৃষ্টি, ভ্রমণ যেগুলি শিশু প্রকৃতিকে গভীরভাবে নাড়া দেয় সেই বিষয়গুলিকে নিয়ে তৈরি করেছেন শিশুমনন। আমরা কবির 'ছড়া সমগ্র' গ্রন্থের কবিতাগুলো কেন্দ্র করে এই আলোচনায় অগ্রণী হয়েছি। পাহাড়ে চড়ার অভিজ্ঞতাকে শিশুর মানসিকতায় কবি লিখেছেন–

মানো বা না মানো একথা সত্যি

নিজে নিজে আমি উঠেছি পাহাড়ে

মন হয়ে গেছে খুশিতে ভর্তি

দশ দিককার রূপের বাহারে।

মানো বা না মানো এ কথা সত্যি।

আমি নেই আর সে একরত্তি।'

('পাহাড়ে' পৃ: -১৪৪)

পাহাড়ে চড়ার প্রথম খুশী ছোট্ট শিশুর মনকে কতখানি আবেগে-আবেশে বিহ্বল করে তোলে তার প্রকৃষ্ট প্রমাণ এই ছড়াটি। বাংলা প্রকৃতিতে আষাঢ়-শ্রাবণের আগমন মানেই জলভরা মেঘের বারিধারা। কিন্তু যদি এর ব্যতিক্রম ঘটে তখন শিশুর কাছেও তা অসহনীয় হয়ে ওঠে। সে বলে ওঠে
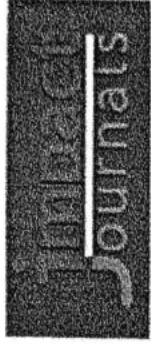
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THE ROLE OF WOMEN IN POLITICS

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ABSTRACT

The ideals of democracy are very far from destination, especially for women in India. Women play a marginal role in politics. Their political participation is almost not visible. But the importance of women's political participation has been increased in all corners of the world. In any country women constitute nearly half percent of the total population, but if it has to adopt a democratic system, it cannot run successfully with half of the population. It will become a crippled democracy. So, a democratic government is impossible without their participation and to empower them socially, economically and politically, their decision-making capabilities are necessary. Moreover, women have various problems, demands and aspirations which cannot be aptly expressed by men. The various problem issues of the people, such as, education, employment, health and nutrition besides foreign policies, relationships with other countries, issues of war and peace, science and technology, protection of the environment do need a women's angle, as they will affect them too in a particular manner. But the world scenario gives us a gloomy picture barring a couple of exceptions, such as, most of the Parliaments have ninety three percent male representatives and just only seven percent are women. The importance of increasing women's participation in Politics had been restated in the World Congress of Women at Beijing in 1995 and in its "Platform of Action" the ways and means had been recommended to increase "space for and visibility" of women in political institutions and processes. This is the most important first step towards women's empowerment. The Women's Reservation Bill in legislatures has shown some light at the end of the dark tunnel. Merely lamenting upon the state would not lead us anywhere. The movement for creating adequate space for women in the process of decision-making, right from within the home to the state and national legislature is required to be taken to its logical end. This article shows the need and imperatives towards enhancing women's participation in politics. An attempt has also been made to glance into the history of women's participation in politics.

KEYWORDS: *Women, Participation in Politics, Decision Making, Democratic Society*

INTRODUCTION

Politics is the process by which people in groups make decisions. It consists of social relations relating to authority or power, and refers to the rules and regulation of a political unit, and to the tactics used to formulate and apply policy. These units have both men and women, but men are always dominated in the field.

Jean Jacques Rousseau had advocated the idea of women's exclusion from politics in 1762. The American Declaration of Independence had also denied the right of equal political participation of women. But afterwards many thinkers like J.S. Mill had advocated gender equality in every field including politics. In post-World War II, the sensitivity

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Bhakti Movement: Roots of Indian Feminism

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Abstract

The Bhakti movement had been an all India phenomenon and not restricted to any particular area, language speaking people or followers of religion of India with the participation of women. The Bhakti movement was originated as a reaction against caste division, untouchability and ritualism in India. All the steps taken clearly indicate that the movement was for promoting, preserving and respecting the Indian womanhood taking all their affecting factors into consideration. The Bhakti women laid the roots of feminism in India. With sheer bravery, tenacity and their devotion to God, they created an autonomous space for themselves and refused to be tied down by societal norms. They did the unspeakable, and displayed the true strength of a woman's spirit. They created their own path to freedom, and inspired many others to follow their own will. They transcended the social identities and material realities into a universal spiritual realm. Saints like Chaitanya, Nanak, Kabir, Meera, Ramdas, Tulsi, Tukaram advocated women's rights for religious worship and as a result women secured certain social freedom too. In this way the Bhakti Movement and roots of Indian Feminism had grown up.

Key Words: Bhakti Movement, Brahmanism, feminism, societal norms.

Introduction

The Muslim period had witnessed several indicators of low status of women, particularly the Hindu women. The child marriage became a rule to safeguard the chastity and honour of the girls. In many cases the Hindu girls were given marriage before the age of nine or ten. This clearly indicated that the Hindu girls denied education by the force of society. During this period polygamy and 'purdah' system were also practiced. The Hindu widow spent her days in the most pathetic condition. The practice of child marriage resulted in rapid increase in the number of child widows. The death of a woman was preferred to her falling into evil hands. The practice of 'Sati' was encouraged and the widows who did not perform 'Sati' were looked down by the society. From the second invasion by the Muslims in the eleventh century till the mid-eighteenth century, India experienced the breakdown of social institutions, the upsetting of traditional political structure and economic depression. All these had effect on the social life, especially among women. However, during the fifteenth century Ramanujacharya organized the Bhakti movement. The movement brought new trends in the social and religious life of Indian women. Saints like Chaitanya, Nanak, Kabir, Meera, Ramdas, Tulsi, Tukaram advocated women's rights for religious worship and as a result women secured certain social freedom too. During the Bhakti movement, women were encouraged to educate themselves.

The Bhakti Movement

The term 'bhakti' is defined as "devotion" or passionate love for the Divine. The Bhakti movement in India was originated in ancient Tamil Nadu in the seventh century and spread to the north during the late medieval ages when North India was under Islamic rule. The movement was spontaneous and originated as a reaction against caste division, untouchability and ritualism in

to work as a maid in the upper-caste family of Namdev, one of the most revered of the Bhakti poet-saints. While within this household, she continued to serve Namdev, both as a servant and as his devotee. Janabai wrote over three hundred poems focusing on domestic chores and the restrictions facing her as a low-caste woman.

Muktabai or Muktai was a saint in the Varkari tradition who wrote forty-one abhangs. She was born in a Deshastha Brahmin family, the last of the four children of Vitthal Govind Kulkarni and Rukmini, a pious couple from a village near Paithan on the banks of the Godavari. Vitthal lied about his marriage to be initimated into sanyas. When found out, the couple was excommunicated from the caste. Later Vitthal and Rukmini ended their lives, hoping their children would be accepted into society after their death. The orphaned children had to resort to begging, but all four went on to contribute abhangs and commentaries on the Gita. Her most popular abhanga is *Tatiche Abhanga* (The Song of the Door).

Lalla or Lai Ded was one of the earliest Kashmiri mystic poets of the fourteenth century. She refused to stay confined to domestic tyranny and its power hierarchy. She adopted a famous Kashmiri Shaiva saint as her spiritual guide, and became an ardent devotee of Shaivism. She was also a yogini, a mendicant ascetic, who wandered about preaching the yogic doctrines as the best means of ultimate absorption into the Supreme. The true saint, according to her, was, 'the servant of all mankind through his humility and loving kindness'. She did not believe in the efficacy of external observances, ritualism, or idol worship. She insisted on the performance of duty for duty's sake.

Mirabai, or Mira, a Bhakti poet of the fifteenth century, is said to have been born into a ruling Rajput family. Mirabai's poetry tells of her vision of Lord Krishna when she was a child; from that point on Mira vowed that she would forever be his bride. Despite her wishes, she was married to Prince Bhoj Raj of the Rajput kingdom of Mewar at a young age. Her husband died after some years. The hostility increased as Meera refused to commit sati. She neither wore the mourning garb, nor followed any of the customs expected of a royal woman grieving a lost husband. Instead she claimed that now she was free to devote herself completely to the worship of Krishna. Mira's devotional practices became increasingly intense. She often sang and danced herself into ecstasies, even in public places like temples. News about her spread all over India and she soon attracted a following of devotees from all social groups and castes. She became the foremost exponents of the Bhakti movement and a remarkable example of feminism in India.

Conclusion

Thus, we may conclude that all over Medieval India had an atmosphere of immense discrimination, with patriarchy held in the highest regard. Women sought Bhakti to move out the restricted domestic spaces and oppose patriarchy and Brahminical hegemony. The rejection of the power of the male figure that they were tied to in subordinate relationships became the terrain for struggle, self-assertion and alternative seeking.

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A STUDY ON THE HEALTH AND NUTRITION EDUCATION FOR WOMEN

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Abstract

Health is a common theme in most cultures. Health plays a vital role in our lives. In context to women's health it is a valuable asset for them. Women have a special role in healthy nutrition of the population. The woman breastfeeds the newborn baby and prepares meals for members of her family. Women employees in food manufacturing, trade, public catering, health care and education account for the majority. In addition, public health depends upon women's understanding of healthy nutrition issues. Women, therefore, play a key role in implementing a healthy nutrition policy, both in the family and in society as a whole. In most Indian household the women of the house eats last, after feeding the whole family. Though there are more illiterate women than men, we find that women learn more quickly and respond more rapidly. So, women need health and nutrition education for the development of society. Health and nutrition education aims at enabling women and men both to gain control over the determinants of health and health behaviour and the condition that affect their health status. This paper analyses the significance of health education to women and thus to society.

Keywords: health, women, nutrition, education.

Introduction

Health is a prerequisite for human development and is an essential component for the wellbeing of the mankind. The common beliefs, customs, practices related to health and disease in turn influence the health of the human beings. Health can be regarded as a state of mental, social and economic wellbeing and not the mere absence of disease. Health is a function, not only of medical care, but also of the overall integrated development of society – cultural, economic, educational, social and political. Therefore, to have sound health, the other depending factors are also to be looked into.

Health is one of those terms which most people find it difficult to define although they are confident of its meaning. Therefore, many definitions of health have been offered from time to time, including the following:

Webster: "The condition of being sound in body, mind or spirit, especially freedom from physical disease of pain".

Oxford English Dictionary: "Soundness of body or mind; that condition in which its functions are duly and efficiently discharged". "A condition or quality of the human organism expressing the adequate functioning of the organism is given conditions, genetic and environmental".

Perkins: "A state of relative equilibrium of body forms and functions which results from its successful dynamic adjustment to forces tending to disturb it. It is not passive interplay between body substance and forces impinging upon it but an active response of body forces working toward readjustment".

WHO definition: The widely accepted definition of health is that given by the World Health Organization (1948) in the preamble to its constitution which is as follows – "Health is a state of complete physical, mental and social wellbeing and not merely an absence of disease or infirmity". In recent years, this statement has been amplified to include the ability to lead a "socially and economically productive life".

Health Problems of Indian Women

The health of Indian women is intrinsically linked to their status in society. Research on women's status has found that the contributions Indian women make to families often are overlooked, and instead they are viewed as economic burdens. There is a strong son preference in India, as sons are expected to care for parents as they age. This son preference, along with high dowry costs for daughters, sometimes results in the mistreatment of daughters.

Indian women, further, have low levels of both education and formal labour force participation. They typically have little autonomy, living under the control of first their fathers, then their husbands, and finally their sons. All of these factors exert a negative impact on the health status of Indian women. Poor health has repercussions not only for women but also their families. Women in poor health are more likely to give birth to low weight infants. They also are less likely to be able to provide food and adequate care for their children. Finally, a woman's health affects the household economic well-being, as a woman in poor health will be less productive in the labour force.

Many of the health problems of Indian women are related to or exacerbated by high levels of fertility. Utter Pradesh, the most populous state in India, has a total fertility rate of over 5 children per woman. On the other hand, Kerala, which has relatively high levels of female education and autonomy, has a total fertility rate under 2. High levels of infant mortality combined with the strong son preference motivate women to bear high numbers of children in an attempt to have a son or two survive to adulthood. Numerous pregnancies and closely spaced births erode a mother's nutritional status, which can negatively

i) stresses the complex web of interrelationships that determine mental health and that the factors that determine health operate on multiple levels.

ii) goes beyond the biological and the individual.

iii) acknowledges the crucial role of the social context.

iv) highlights the importance of justice and equality in determining mental well being.

Gender configures both the material and symbolic position women occupy in the social hierarchy as well as the experiences which condition their lives. Understood as a social construct, gender must be included as a determinant of health because of its explanatory power in relation to differences in health outcomes between men and women. These asymmetries are manifested not only in terms of differential susceptibility and exposure to risks - for example vulnerability to sexual violence, but also, fundamentally, in the power of men and women to manage their own lives, to cope with such risks, protect their lives and influence the direction of the health development process. This balance of power has generally favoured men and relegated women to a subordinate, disadvantaged position.

A gendered, social determinants model offers the only viable framework for examining evidence on all relevant factors related to women's mental health. From this perspective, public policy including economic policy, socio-cultural and environmental factors, community and social support, stressors and life events, personal behaviour and skills, and availability and access to health services, may all be seen to exercise a role in determining women's mental health status.

The importance of gender differences in mental health is most graphically illustrated in the significantly different rates of major depression experienced by women compared with men. The need to focus on ill health and morbidity has also been emphasized in the area of women's health. Health related data that is solely bio medically based cannot adequately inform an understanding of the morbidity experienced by women. As mortality rates decline, it becomes increasingly critical to address physical and psychological morbidity, increase satisfaction with health care services and improve quality of life, if improvements in women's health are to be achieved.

The tools currently in use to measure health status exacerbate this difficulty by themselves having a gender bias. Reducing morbidity is an essential prerequisite to the improvement of women's mental health. As women in many countries are approximately twice as likely as men to experience depression and it is the most prevalent psychiatric disorder any significant reduction in the overrepresentation of women who are depressed would make an important contribution to lessening the global burden of disease. Women's mental health is a significant public health issue.

The promotion of women's mental health, like health promotion in general, relies on establishing a process composed of a variety of possible elements that singly or together enable women as individuals or members of their communities to increase control over the determinants of their mental health and thereby be in a position to improve their health status and health outcomes. A strong inverse relationship exists between social position and physical and mental health outcomes. Adverse health outcomes are two to two

role in influencing all health related sectors to see that their policies and actions are in congruence with the national health objectives. It has to play a key role of an advocacy so that people are motivated and play effective role in educating and adapting sound health practices. Thus, it is well said that "Health is beauty", as beauty is only a by-product of good health. So, let's wake up and enter into the adventure and remember that Health is a fundamental Human Right.

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Dynamics of plant mosaic disease propagation and the usefulness of roguing as an alternative biological control

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ABSTRACT

In this research article, an epidemiological model is formulated for mosaic disease considering plant and vector populations. Plant host population has been divided into three compartments namely healthy, latently infected and infected ones, and vector population is divided into two compartments: non-infective and infective vectors. The system possesses three equilibria: plant-only, disease-free and endemic equilibrium. Plant-only equilibrium is always unstable; disease-free equilibrium is stable when the basic reproduction number, R_0, is less than unity and unstable for when it crosses unity, and ensure existence of an endemic equilibrium which may be stable or can undergo a Hopf bifurcation. Finally, impulse periodic roguing with varied rate and time interval is adopted for cost effective and eco-friendly disease control and future direction of agriculture management. The dynamics of the impulsive system has also been analysed. Detailed numerical simulations are employed to support the analytical results. We found that roguing is most cost effective and useful management for mosaic disease eradication of plants if applied at proper rate and interval.

1. Introduction

Plant viruses are an important constraint to crop production worldwide especially in developing countries (Fereres et al., 2000; Thackray et al., 2000; Waterworth and Ahmed, 1998), in several cases, causing large-scale damage to crops resulting in whole regions going out of production. Examples include cocoa swollen shoot in Ghana (Owusu, 1983; Thresh and Owusu, 1986) and banana bunchy top in Australia (Allen and Barnier, 1977; Thresh et al., 1988). Most plant viruses are vectored by arthropods (Nault, 1997) (for eg. whitefly) and the vector activity and behaviour, especially in relation to virus transmission; and these are important determinants for dispersion and outbreak of disease (Spence, 2001).

Mosaic disease is an emerging and epidemic disease that affects the productivity of different plants such as *Cassava*, Tomato etc. including biofuel crop *Jatropha curcas*. *J. curcas* is a small woody plant belonging to the family Euphorbiaceae and can grow on marginal land in tropical and subtropical regions and produces seeds containing up to 30% oil contents. It serves as biodiesel feed stock and has high economic importance for overcoming future fuel crisis (Gao et al., 2010). Like many other plants, *Jatropha* is also affected by the mosaic virus. There are also reports of *Jatropha* plants being affected by the cucumber mosaic virus (Raj et al., 2008). Mosaic virus is a type of plant virus that causes the leaves of plants to have spotted and speckled look. This virus can move frequently in the environment and its spreading is mainly dependent on the abundance of vector whitefly (Basir et al., 2018; 2017) i.e. spread of the virus is highly vector-density dependent. A single whitefly is sufficient to infect a host plant but transmission of the disease increases when numerous infective whiteflies scatter and feed on host plants. Besides this, whiteflies are tremendously productive; after coming into contact with any part of the host plant (around the home or garden), they will voluntarily roam and try to attack any other immediate adjacent vegetation (Gao et al., 2010; Venturino et al., 2016). Normally whiteflies need three hours feeding time to procure the virus and a latent phase of eight hours. It requires only about ten minutes to contaminate the young leaves. Symptoms seem to appear in the infected plants after a latent period of three to five weeks (Fargette et al., 1994).

Propagation of a virus is specifically dependent upon several factors including (but not limited to) host plant density, incubation time duration and infection pattern. It ultimately affects the intensity of overall yield and quality decline, price of final product and farming efficiency (Tang et al., 2010). Effective control measures must be aimed at decreasing virus incidence and that too must be economically justified (cost effective). When dispersion of a disease exceeds a certain threshold value (Tang et al., 2010), any single control measure alone

$$\frac{dx}{dt} = rx\left[1 - \frac{x + l + y}{K_1}\right] - \lambda xv,$$

$$\frac{dl}{dt} = \lambda xv - \alpha l - ml,$$

$$\frac{dy}{dt} = \alpha l - (\delta + m)y,$$

$$\frac{du}{dt} = bu\left[1 - \frac{u + v}{K_2}\right] - \beta yu,$$

$$\frac{dv}{dt} = \beta yu - dv, \tag{1}$$

with initial condition:

$$x(0) > 0, \; l(0) > 0, \; y(0) > 0, \; u(0) > 0, \; v(0) > 0. \tag{2}$$

The region of attraction is given by:

$$\mathcal{D} = \{(x, l, y, u, v) \in \mathbb{R}_+^5 : 0 \le x + l + y \le B_1, \; 0 \le u + v \le B_2\}, \tag{3}$$

where, $B_1 = \max\{x(0) + l(0) + y(0), K_1\}$, $B_2 = \max\{u(0) + v(0), K_2\}$, i.e. all solutions of the system (1) that start in $\mathcal{D}$ are uniformly bounded and remains in $\mathcal{D}$.

3. Equilibria and their stability

The model system (1) has three equilibria, namely, plant-only equilibrium $E_a(K_1, 0, 0, 0, 0)$, disease-free $E_0(K_1, 0, 0, K_2, 0)$ and endemic equilibria $E^*(x^*, l^*, y^*, u^*, v^*)$, where

$$l^* = \frac{(\delta + m)y^*}{\alpha}, \quad y^* = \frac{\alpha rx^*(K_1 - x^*)}{rx^*(m + \delta) + r\alpha x^* + K_1(m + \alpha)(\delta + m)},$$

$$u^* = \frac{d(m + \alpha)(\delta + m)}{\alpha \lambda \beta x^*}, \quad v^* = \frac{(m + \alpha)(\delta + m)y^*}{\alpha \lambda x^*},$$

and x^* is the positive root of the cubic,

$$P_1 x^3 + P_2 x^2 + P_3 x + P_4 = 0, \tag{4}$$

with

$$P_1 = \alpha r \beta K_2 > 0,$$
$$P_2 = brK_2(m + \delta + \alpha) - \alpha r \beta K_2 + br(m + \alpha)(\delta + m)\lambda^{-1},$$
$$P_3 = b(m + \alpha)(\delta + m)[K_1 K_2 \alpha \beta \lambda - rd(m + \delta + \alpha) - \alpha \beta r](\alpha \beta \lambda)^{-1},$$
$$P_4 = -bdK_1(m + \alpha)^2(\delta + m)^2(\alpha \beta \lambda)^{-1} < 0. \tag{5}$$

Following theorem ensures the existence of feasible endemic equilibrium.

Theorem 1. *Let*

$$\Delta = 18P_1 P_2 P_3 P_4 - 4P_2^3 P_4 + P_2^2 P_3^2 - 4P_1 P_3^3 - 27P_1^2 P_4^2. \tag{6}$$

be the discriminant of (4). Now, if $\Delta > 0$, and either $P_2 > 0, P_3 > 0$ or $P_2 < 0, P_3 < 0$, then equation (4) has a single positive root. If $\Delta > 0$ and $P_2 < 0$, and $P_3 > 0$, then Eq. (4) has two positive roots.

3.1. Stability of equilibria

Stability of any steady state $E(x, l, y, u, v)$ is determined by the eigenvalues of the Jacobian J_E evaluated at that steady state,

$$J_E = \begin{bmatrix} r\left(1 - \frac{2x + l + y}{K_1}\right) - \lambda v & -\frac{rx}{K_1} & -\frac{rx}{K_1} & 0 & -\lambda x \\ \lambda v & -(\alpha + m) & 0 & 0 & \lambda x \\ 0 & \alpha & -(m + \delta) & 0 & 0 \\ 0 & 0 & -\beta u & b - \frac{2bu + v}{K_2} - \beta y & \frac{-bu}{K_2} \\ 0 & 0 & \beta u & \beta y & -d \end{bmatrix}$$

At the disease-free equilibrium, E_0, two roots are $-r < 0, -d < 0$

and rest of the roots satisfy

$$\xi^3 + L_1 \xi^2 + L_2 \xi + L_3 = 0, \tag{7}$$

where $L_1 = (\alpha + \delta + 2m + d) > 0$, $L_2 = d(m + \delta) + d(\alpha + m) + (\alpha + m)(\delta + m) > 0$, and $L_3 = d(\alpha + m)(m + \delta) - \alpha \beta \lambda K_1 K_2$.

Let us define the basic reproduction number, R_0, as follows

$$R_0 = \frac{\alpha \beta \lambda K_1 K_2}{d(\alpha + m)(m + \delta)}. \tag{8}$$

Then, we have the following theorem which characterise the stability of E_0.

Theorem 2. *Disease free equilibrium E_0 is stable if $R_0 < 1$ and unstable otherwise, undergoes a forward bifurcation at $R_0 = 1$, giving rise to a feasible co-existence equilibrium E^*.*

Remark 1. It is important to note that R_0 depends on δ and m, hence, they are important parameters in the eradication of infection. At the same time, taking a limit of $\alpha \to \infty$ gives

$$\lim_{\alpha \to \infty} R_0(\alpha) \equiv R_0^\infty = \frac{a\lambda \beta K_1 K_2}{d(m + \delta)}.$$

Note that R_0 is monotonically decreasing with increasing m, this suggests that eradication of mosaic disease, as represented by a stable disease-free steady state E_0, is only possible if $R_0^\infty < 1$, and one of the available means to achieve this is by increasing roguing (the rate of removal of infected plant).

Characteristic equation at E^* becomes of degree five in ξ

$$\xi^5 + A_1 \xi^4 + A_2 \xi^3 + A_3 \xi^2 + A_4 \xi + A_5 = 0 \tag{9}$$

with

$$A_1 = \frac{rx^*}{K_1} + \alpha + 2m + \delta + \frac{bu^*}{K_2} + d > 0,$$

$$\begin{aligned} A_2 = {} & \frac{r\lambda v^* x^*}{K_1} + \frac{rx^*(\alpha + m)}{K_1} + \frac{rx^*(\delta + m)}{K_1} + (\alpha + m)(\delta + m) + \frac{rbu^* x^*}{K_1 K_2} \\ & + \frac{bu^*(\alpha + m)}{K_2} + \frac{bu^*(\delta + m)}{K_2} + \frac{b\beta y^* u^*}{K_2} + \frac{drx^*}{K_1} + d(\alpha + 2m + \delta) \\ & + \frac{dbu^*}{K_2} > 0, \end{aligned}$$

$$\begin{aligned} A_3 = {} & \frac{r\alpha \lambda v^* x^*}{K_1} - \frac{r\lambda(\delta + m)v^* x^*}{K_1} + \frac{(\alpha + m)(\delta + m)rx^*}{K_1} - \lambda \alpha \beta x^* u^* \\ & - \frac{rb\lambda v^* u^* x^*}{K_1 K_2} + (\alpha + m)\frac{rx^*}{K_1}\frac{bu^*}{K_2} + \frac{rx^*}{K_1}(\delta + m)\frac{bu^*}{K_2} \\ & + (\alpha + m)(\delta + m)\frac{bu^*}{K_2} - \frac{rx^*}{K_1}\frac{bu^*}{K_2}\beta y^* + (\alpha + m)\frac{bu^*}{K_2}\beta y^* \\ & + (\delta + m)\frac{\beta y^* bu^*}{K_2} - \frac{rd\lambda v^* x^*}{K_1} + \frac{r(\alpha + m)dx^*}{K_1} + \frac{(\delta + m)drx^*}{K_1} \\ & + d(\alpha + m)(\delta + m) + d\frac{rx^*}{K_1}\frac{bu^*}{K_2} + d(\alpha + m)\frac{bu^*}{K_2} + d(\delta + m)\frac{bu^*}{K_2}, \end{aligned}$$

$$\begin{aligned} A_4 = {} & -\frac{rx^*}{K_1}\lambda x^* \alpha \beta u^* - \lambda x^* \lambda v^* \alpha \beta u^* - \lambda v^* \alpha \frac{rx^*}{K_1}\frac{bu^*}{K_2} - \lambda v^*(\delta + m)\frac{rx^*}{K_1}\frac{bu^*}{K_2} \\ & + \frac{rx^*}{K_1}(\alpha + m)(\delta + m)\frac{bu^*}{K_2} - \lambda x^* \alpha \beta u^* \frac{bu^*}{K_2} + \lambda x^* \alpha \beta u^* \beta y^* - \frac{rx^*}{K_1}\lambda v^* \frac{bu^*}{K_2}\beta y^* \\ & + \frac{rx^*}{K_1}(\alpha + m)\frac{bu^*}{K_2}\beta y^* - \frac{rx^*}{K_1}(\delta + m)\frac{bu^*}{K_2}\beta y^* + (\alpha + m)(\delta + m)\frac{bu^*}{K_2}\beta y^* \\ & + \frac{rx^*}{K_1}\lambda v^* \alpha d - \frac{rx^*}{K_1}\lambda v^* d(\delta + m) + d\frac{rx^*}{K_1}(\alpha + m)\delta + m) - d\frac{rx^*}{K_1}\lambda v^*\frac{bu^*}{K_2} \\ & + d\frac{rx^*}{K_1}(\alpha + m)\frac{bu^*}{K_2} + d\frac{rx^*}{K_1}(\delta + m)\frac{bu^*}{K_2} + d(\alpha + m)(\delta + m)\frac{bu^*}{K_2}, \end{aligned}$$

$$\begin{aligned} A_5 = {} & -\lambda x^* \alpha \beta u^* \frac{rx^*}{K_1}\frac{bu^*}{K_2} - \lambda x^* \lambda v^* \alpha \beta u^* \frac{bu^*}{K_2} + \lambda x^* \alpha \beta u^* \beta y^* \frac{rx^*}{K_1} \\ & + \lambda x^* \lambda v^* \alpha \beta u^* \beta y^* - \beta \lambda \alpha v^* y^* \frac{rx^*}{K_1}\frac{bu^*}{K_2} - \frac{rx^*}{K_1}\lambda v^*(\delta + m)\frac{bu^*}{K_2}\beta y^* \\ & + (\alpha + m)(\delta + m)\beta y^* \frac{rx^*}{K_1}\frac{bu^*}{K_2} - d\lambda v^* \alpha \frac{rx^*}{K_1}\frac{bu^*}{K_2} \\ & - d(\delta + m)\frac{\lambda rv^* x^*}{K_1}\frac{bu^*}{K_2} + d(\alpha + m)(\delta + m)\frac{rx^*}{K_1}\frac{bu^*}{K_2}. \end{aligned}$$

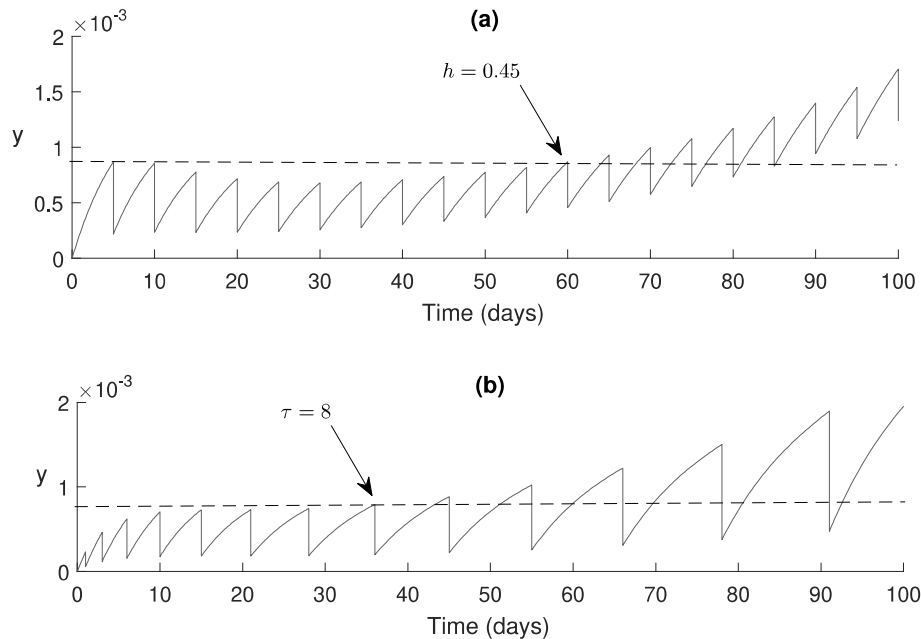According to Routh–Hurwitz conditions, (9) has roots with negative

Fig. 8. Effect of roguing: (a) Effect of roguing with varying roguing interval τ i.e. τ is changing each iteration. Initially $\tau = 1$, then increase by 1 in each iteration, (b) with varying roguing rate h. Initially $h = 0.75$, then it is reduced by 0.025 in each iteration.

cultivated plants) is important and best effective method for plant disease eradication. In agriculture, roguing refers to the act of identifying and removing plants with undesirable characteristics from agricultural fields. Rogues are removed from the fields to preserve the quality of the crop being grown. But for agriculture, roguing should be maintained at rate that maximizes the crop production rate as well as minimize the disease infection rate and also cost effective. So, for that purpose, the effect of roguing on system is thoroughly studied by means of four ways: (1) by changing roguing interval (τ) at fixed roguing rate as example intervals of 10, 15, 20 days; (2) by changing roguing rate h at fixed roguing interval namely $h = 0$, 0.25, 0.5, 0.75 etc.; (3) by changing roguing interval (τ) at increasing order such as 1, 2, 3, 4 days etc. That means in every time roguing interval time should be increased by 1 day from the previous; (4) by changing roguing rate (h) in decreasing order from starting rate 0.75 at early stage of disease management. That means during successive roguing attempts, roguing time should be decreased by 0.025 from the previous.

6. Discussion and conclusion

In this research article, a mathematical model has been formulated to study the dynamics of plant mosaic disease and its possible biological control by applying roguing for cost effective maximization of crop yield. From an ecological and economical point of view, a holistic model incorporating maximized crop yield while minimizing the hazards of chemical pesticides is required. This model can help in understanding the range of effects for implementing alternative eco-friendly control strategies, which in this case is impulsive roguing.

Here the basic reproductive number R_0 is used as a parameter for understanding the stability of the model at disease free situation. When $R_0 < 1$, the system seems to achieve disease free condition and is stable. For $R_0 > 1$, the disease free equilibria is unstable and system becomes endemic. The endemic equilibrium undergoes Hopf bifurcation through periodic oscillations for the critical values of λ. So, first and foremost, the effects of major controlling factors such as disease transmission rate (λ), vector infection rate (β) etc. on the dynamics of the system have been studied.

From the above study, it can be concluded that disease transfer rate, vector growth rate and vector infection rate are inversely related to

infection rate. So, if these concerned rates increase beyond their threshold values then the system become unstable even at a low infection rate. Not only that, it also becomes difficult for the system to return back to stability, or more specifically to achieve the disease free equilibrium point. So, from a practical applicability point of view, it can be said that for maximum crop yield the goal should be fixed to maintain minimum disease transfer rate, vector growth rate and vector infection rate in addition to minimum infection rate. All these rate parameters are mostly controlled and modified by use of pesticides.

In the second part of this study, impact of another useful biological control method – roguing and its effect on agricultural field are studied in detail. Here two important parameters of this control method, namely, time interval and roguing rates are very crucial with respect to cost effective maximum crop production, since roguing rate is directly related to crop production rate but inversely related to production or cultivation cost and on the other hand, opposite results are depicted in case of time interval for roguing. So, the primary goal should be to balance between crop yield and production cost. For that purpose, effect of roguing time interval at fixed roguing rates as well as effect of different roguing rates at fixed time interval on plant and vector densities have been studied numerically.

From the above study it is clear that crops have maximum yield at considerably higher roguing rates as well as lower time interval for the same. But, since disease infection rate depends on densities of vector and pest population, roguing process with a constant rate and at constant time interval is not appropriate to maintain disease free situation for the whole duration of crop life cycle. Variations in these two parameters should be studied for maximum incidence to maximum eradication of mosaic disease in agricultural field. During maximum incidence the roguing rate should be higher and time interval should be lower but the interval time should be increased at ascending order during disease eradication process. From this study it can be seen that at higher time interval ($\tau = 8$ days) and also at comparatively lower roguing rate ($h = 0.45$) the system reaches stability point and considerably maximum crop yield in contrast to previous case is achieved.

Cost effectiveness is brought about by applying roguing at lower rates and with higher time intervals. It can be concluded from the observations that a disease free stable system can be achieved when roguing is applied at an interval of $\tau = 8$ days and at a rate of $h = 0.45$

which brings about the maximum cost effectiveness for crop production.

It can be concluded from the current study that roguing method is most cost effective and useful management of mosaic disease eradication in plants if proper rate and interval of roguing can be determined. This approach can be applied for other plant virus eradication management in economically valuable crops namely Cassava, *Jatropha*. So, the proposed model can be useful for agriculture researchers and workers. They can utilize the model to help predict the behavior of the epidemic and its management. This model can also be used for predictions and may encourage plant and insect researchers to gather the data necessary for the model. With availability of data collected from field, the parameters can be modified to fit any particular situation that may subsequently result in eradication of the disease.

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রূপনারায়ণপুর পশ্চিম বর্ধমান থেকে প্রকাশিত দ্বি-মাসিক পত্রিকা

আজকের

যোধন

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বৈশাখ-১৪২৬ / এপ্রিল-২০১৯

মন যোগায় না, মন জাগায়

আজকের যোধন

(বর্ধমান জেলা লিটল ম্যাগাজিন সংঘের সদস্য)

সম্পাদক
বাসুদেব মণ্ডল

সহ-সম্পাদক
কালাচাঁদ ঘোষ, রমাকান্ত মণ্ডল,
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আমাদের কথা

প্রতি বছরের মতো এবছরও আমরা ছয়টি সাধারণ সংখ্যা এবং চারটি বিশেষ সংখ্যা প্রকাশ করব–এই আশা ও ভরসাকে সামনে রেখে আমাদের এই বাংলা নববর্ষের বিশেষ সংখ্যাটি প্রকাশিত হল। আর আমরা আশা রাখলাম যে,—প্রতিটি সংখ্যার মত এই সংখ্যাটিও পাঠক বর্গকে মুগ্ধ করবে এবং আনন্দ প্রদান করবে।

Hemanta Bala Devi : An Emancipated Woman in 20ᵗʰ Century Bengal.

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Hemanta Bala Debi is no stranger to the readers' of Bengali literature. After the publication of Ninth volume of letters in 1964, the curiosity about the recipient of the letter was awakened by many. The words of Rabindranath's heart are profound beliefs, philosophy of life, and discussion of castetism of Hindu- Muslim relations. Politics, even the intimate thoughts of particular moments of his mind, have long been published in the pages of the longest letters. The letter of the ideology wasthirty-seven years old, mother of two, the husband, the mother- in-law, the father-in-law, the bride of one of the noble enlightened families.

Early life : Hemanta Bala Devi was born in the year 1894 at 26-Bechu Chatterjee Street, Kolkata. Her father, Brajendra Kishore Roy Chowdhury a land lord of Gouripur at Maymonsingha, and mother Ananta Bala Devi were liberal and admirer of poet Rabindranath Tagore. As a first child, she was developing very well and independently. The way the daughters of that times were celebrated in the conservative surroundings, the neighbourhood, Hemanta Bala's fact was much more than that. Seeing Hemanta Bala's written 'Nijerkatha' (Owns words), she went to Bhagalpur with her father and went on to 'dholoke'. Even, she used to taking flower in the garden with her father. Like the boys, chalking in her hand is the day of Saraswati Puja. While travelling to Madhupur with her father, gave him the bat, wicket and leg-pad to Hema. She used to play cricket with boys. At one time Bengalarir's vow, cooking spell like her free movement was as false as she was. She used to lie in the form of 'babu', acting master etc. She earned the character of modern 'Tom Boy'.

Advocacy in Hemanta Bala was a special part of her special love affair. She liked the beauty of girls in Brahma household. She used to cry bitterly to her mother, especially in the energetic spots. Natural beauty attracts her most. Grandiose Durgapuja create more question in her mind. She never realized that, how can see accept the idol as Maa Durga? So, she asked several types of questions and her mother reduke her. She used to ride palanquin at the time of Vijaya Dashami and this marginal behaviour compelled her to think as equal as her father.

From very childhood she wrote several types of poetry, songs etc. She wrote several types of essays on different idols. After a very movement when she initiated in Vaisnava Dharma, she wrote many songs of God Radhakrishna, ordered by her Srithakur and Sreema. She wrote versatile notes and journals about her religious concept, named as 'Satyabani Devi'. She wrote 'Urbashi', 'Mohila', 'Mohilamahal', 'Ghoroya', 'Golpobharati' etc. She also wrote essays, short stories with her own. It is unfortunate that, her works were in vain because more remain in rough sketch.

Before marriage she heard that Rabindranath set-up a school named 'Brahmacharya', where the wicked children became good. She started her study in Gouripur but at that time she was seven only. Her teacher was Gurudas Chakravarty. Her tyrammous work revealed her childhood and her works "Nijer Katha" (Owns voices) established her words. She wrote,–"ঐ শিক্ষক মহাশয়ের কাছে পড়বার সময় একটা জিনিসের দিকে দৃষ্টি পড়ে আমার পড়ার ব্যাঘাত হত বলে সেটি তিনি সরিয়ে রাখেন। পরে অনেক আকৃতি-মিনতির পর সেটি যখন আমি ফিরে পাই। পরের দিন না তার পরের দিন, এবং সম্পূর্ণ নিজের করে পাই, তারও পরে, এবং তার পরে ভেঙে দেখি, ওর রহস্যভেদ করতে পারি কিনা—তখনও বস্তুটির সুদূর রহস্য ও স্বপ্নময়তা কোথায় চলে গেছে। বস্তুটি হচ্ছে মোটা কাঁচের গোলাকৃতি একটি কাগজচাপা। তার ভিতরে লাল, সাদা, সবুজ নানা রঙের মত দ্রব্য ঘেঁষাঘেঁষি করে থাকে।"[1]

This is not only girlhood character but also her curiosity of that time phrase.

Married Life : Hemanta Bala got married at the age of ten with Brajendrakanta, son of the land lord of Rongpur and nephew of Jagadindranath Roy, king of Nator. From her in-laws she had a distant relation with Tagore family. The relationship between Hemanta bala Devi and Rabindranath Tagore was grandfather and granddaughter. Hemanta

Bala had a troubled married life, starting from age of ten to end of her life. Married in a traditional zamindar family, her movement was restricted in the andar mahal only. The born rebel Hemanta Bala could not adjust with her husband.

At the age of fifteen years she became mother and the age of twenty she took initiation in vaishnav dharma from a sadhu, name Kishorananda. By then she was separated from her husband. For some period of time separation and again reunion continued throughout her life. From her 'teen' she was familiar with Tagore's writings but after her Guru's death Hemanta Bala became more closer to Tagore's writings and took refuge in Tagore. In her restless mental situation she read "Jogajog", "Sheser Kobita"and identified herself with the heroin Kumu of "Jogajog" (Tagore's Novel). Hemanta Bala could see a lot of resemblances with 'Kumudini'. Not only in literature but also in real life she would think of a lot of Kumudinis in our society. Even, we come to know about Hemanta Bala's liberated self in her various works and literary practices. Though, Hemanta Bala was not educated in general sense of the term, she was educated in a special sense and openness of her mind and love for literature finally made her a poet and a writer.

Came under the influence of Rabindranath Tagore : "Puranodiner Katha" (The voices of old era of Hemanta Bala) which was written by Hemanta Bala. There has she also discussed about her birth, childhood memories, marriage and marriage life, cultural activities, religious matter etc. In the second chapter, named "Rabindrasmriti" introduced us the first meeting between Rabindranath and Hemanta Bala, several events of her life. Apart from those the essay entitled "Rabindranath O Harokumari Pici Maa" disclosed the secret meeting between Rabindranath & Hemanta Bala Devi, which was very interesting and funny. In the end of this chapter, "Amar Moner Katha" (Owns Voices of Hemanta Bala) we discovered the character of Hemanta Bala, who was very open minded practical in life and free from any religious orthodoxy.

While engrossed in reading the Tagore's writings, Hemanta Bala found solace and there grew a desire in her to write letters to Tagore to get acquainted with him. Tagore was famous for replying letters of his admirers and this proved to be true in Hemanta's case also. She received reply

within a few days. Then started flow of letters from both sides. Tagore wrote 264 letters Tagore to Hemanta Bala, and may be a greater number of letters from Hemanta Bala to Tagore. Hemanta Bala was one of the four women recipients of Tagore's large number of letters. The others are Indira Devi, Ranu Adhikary, later she became Lady Ranu Mukharjee and Rani Mahalanbish. These exchange of letters between two lasted for eleven years. Starting from 1930 to 1941 the last days of Tagore. From these letters we find different sides of the myriad minded poet.

These letters were mostly on religious issues. Hemanta Bala was a staunch Hindu a devotee of vaisnava faith, believer and follower of all kinds of rituals. On the other hand, Tagore was against all ritualism. A liberal man his religion was the religion of man, a true lover of humanity. The letters between two opposite characters are interesting. Some letters are humorous, and personal in nature, some letters are related with the critics of Tagore. The first four letters of Hemanta Bala carry her pseudonym 'Jonaki' and 'Daksha Bala'. And interestingly in santiniketan these were kept in 'Pagla file'. Gradually, poet realized the potentiality of Hemanta Bala and the letters of 'Pagla file" were shifted to another file "Hemanta Bala and Rabindranath correspondence".

Hemanta Bala was neither a family member of Tagore nor a devotee in the strict sense of the term at the beginning. But, gradually through exchange of letters and meetings she came closer to Tagore. Descriptions of her meetings with Tagore show the condition of the then Hindu society. Her reminiscences of meeting with Tagore were really interesting and hilarious. From this correspondence the religious idea of Tagore becomes clear and distinct. His revolt against untouchability pomp and grandeur of Hindu worship are clearly expressed. Hemanta Bala's debate with Tagore was interesting. But more interesting is the transformation of a woman under 'Purdah' and her blooming into a flower. At the end of her life she turned to be a non-believer of any ritualistic orthodox religion. In her lonely days in the last lap of her life in Puri (Swarnachol) her only companion was Tagore's 'Geetabitan' and 'Santiniketan'.We find in her letters and appeal to poet to be her 'Guru', show her the path of realization. We know that Digambari Devi (wife of Prince Dwarakanath Thakur) was a fully devoted Vaisnava. And considering this trail we can see the influence of Vaisnava

religion on Rabindranath. On the other hand, Hemanta Bala Devi is an indoctrinated Vaishnava devotee. Rabindranath Tagore was not only 'Jiban Devota' of Hemanta Bala Devi. But she was highly influenced by his idealism. She established 'Rabibortika' (a Centre for practicing literature & music) to spread Tagore idealism thought out the nation. We can see find all these aspects in their letters. Even, Hemanta Bala wants to free from all kinds socialistic burden. She was informing these own words to Rabindranath. We can see her many letters which are send to Rabindranath. One of these is,—"আপনি আশির্বাদ করুন, আমি যে গণ্ডীতে নিজে বাধা, ঠাকুরকেও বেঁধেছি, একদিন যেন তার থেকে মুক্ত হতে পারি,–জোর করে বাঁধন ছিঁড়ে নয়, পাখি যেমন করে আপনা আপনি ডিম থেকে মুক্ত হয়, তেমনি করে।...দাদা, আমার গণ্ডী খুবই সঙ্কীর্ণ। একমাত্র উদ্দেশ্য নিয়ে নির্দিষ্ট কটি প্রাণী তার মধ্যে নিজেকে দান করেছে। বাহিরের কোনো কিছুর সঙ্গে যোগ রাখা তার নিষিদ্ধ।"[2]

We also know that the crisis time of Hemanta Bala after death of Rabindranath from their letters. She depicted the picture of her life which was full of poverty, though she was daughter and daughter-in-law of rich land lord. We came to know about her last days of life which was pathetic. Through reading their letters, the prominent feature which we can stress is the conflict of ideas of Tagore and the ideas of Hemanta Bala Devi. One that is constructed by society and other which is self-judgment of Hemanta Bala Devi that grew up within herself. We have a particular belief in an ideology that is guided by the person. For this context, each woman has an individual religious belief which is inherent in her. For this reason, she can differ herself to other. But in the patriarchal system of our society, this inherent quality of woman is considered as valueless. However, the main focus of my argument is that the creative ideas of woman are cramped by the rules and regulation that is created by patriarchy. So, we don't allow their own thoughts rather we are imposing the rules and laws that already created by our society. So, we can say that this kind of system is a very obstructive to woman's emancipation and also equally harmful to their empowerment, capability and development. Above all this subject matter focuses the point of paralysed condition of woman in society.

It is not true that the patriarchal system of our society is responsible for absence of all-round development and empowerment of woman.

Because, so many countries where development of woman had not been possible in spite of matriarchy of those country. The similar picture of woman's development does not found still in India where matriarchy is going on. So, I will discuss about this issue elaborately to my research work. Here, I am talking about the relevance of exchanging letters between Rabindranath and Hemanta Bala. Because, Hemanta Bala is a woman who belongs to the category of an ordinary woman. In this context like an ordinary woman of our society, sometimes she accepts all the barrier and restriction of societal norms. Most of the times she rejected to accept the rules and restrictions imposed upon her. Those rules became obstruction to her, she can't freely express her personal view. In this context we can differ her from other woman. She was free minded and freely expressed her opinion without any hesitation. But it is very interesting to point out that she was not radical thinker or autocratic. She was self-guided and was not orthodox free to accept the others' view and opinion. We know that there are three levels of power of women's development. Firstly, in the stage of maidenhood she acquires the potential accumulation of power. Then comes womanhood where we noticed development of their power. At the last stage they achieve the realization of motherhood and where they flourish their power. From this perspective we can judge Hemanta Bala Devi explored her through self-development among these three levels. It is very clear that Hemanta Bala Devi (1894-1976) came at the ultimate level of women's empowerment relating to societal norms and barrier religion—literature. And thus, she came to the very close proximity of Tagore.

In spite of being daughter-in-law and daughter of a land lord, she had to face many struggles in life and has to cross the hardship of life. So, as per as she can be considered the pioneer of woman emancipation. Neither she was confined within curtain system nor was she truly entrapped into familial bonding. She became bride in early childhood, was devotee in womanhood and the last stage of her life, the religious curiosity made her restless. And she began to lead her life like a nun. We can portray the picture of women's condition of the the then society through her way of life. Side by side devotion in literature pursuit in music and love towards birds are the subject matter which will be another important focal point of my research. So, the main point of my research is the empowerment,

respect, the all-round development of woman which traditionally comes from the last two and half decades of centuries. Hemanta Bala Devi is pioneer of this kind of tradition.

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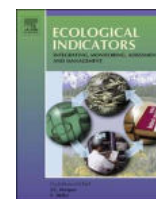
Environmental factors as indicators of dissolved oxygen concentration and zooplankton abundance: Deep learning versus traditional regression approach

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ABSTRACT

Presence of optimal levels of dissolved oxygen (above critical level of 4.5 mg L^{-1}) and presence of zooplankton community are indicators of good water quality of an aquatic ecosystem and also of the health of the same. Reservoirs being artificially created water bodies present hybrid systems containing features of both lotic and lentic systems and thus have unique organization that are representative of both rivers and lakes. Since any reservoir is primarily a fresh water system, presence of a large array of zooplankton (diverse community structure) implies its good health and also presence of optimal dissolved oxygen levels supports sustenance of life. In this study, artificial neural network modelling approach has been utilized to predict the level of dissolved oxygen and zooplankton abundance in the Bakreswar reservoir and their variation in relation to the environmental factors. Use of neural network modelling is exceedingly capable of determining correlation among apparently non correlated environmental data and in the current study these are capable of accurately predicting the variations in the levels of dissolved oxygen as well as the abundance of zooplankton. From this study, it has been observed that chemical factors like productivity, nitrates, salinity, *pH*, phosphates, total dissolved solids, etc. are mostly responsible for control of dissolved oxygen and zooplankton variation at certain points of the study site (stations 1 and 3) whereas at other points (station 2) physical factors like solar radiation, humidity, etc. are more effective. These models are capable of finding the important environmental controllers of such variations and prove to be a powerful alternative to traditional approaches like multiple regression analysis.

1. Introduction

Purposefully designed artificial water bodies like dams and reservoirs create hybrid ecosystems that collectively present combined qualities of two characteristically diverse (lotic and lentic) systems (Kennedy, 1999; Soballe et al., 1992). Three different aspects of reservoirs – the physical, chemical and biological subsystems (Straškraba and Tundisi, 1999) work in unison to maintain a healthy system that serve not only the primary objective of fresh water supply to irrigational fields, but also provide other ecosystem services including drinking water supply, generation of hydroelectric power, area for stock and culture fishery, provisioning for recreational opportunities and also flood control. Thus exhaustive research should be focused on managing proper health of these aquatic resources that can implement

environmentally sound and feasibly concrete management practices (FAO, 1995; Li et al., 2010).

Quantification of ecosystem health is not something that can be easily achieved by focusing research in any one direction. In order to successfully determine the health of any ecosystem, different indicators like system indices (system robustness, resilience, organization, species distribution patterns, eco-exergy content, etc. obtained from study of trophic structure, spatial patterns of variation of biological components and influence of environmental factors on the various subsystems of any ecosystem, etc.) present various results that can be used to successfully decipher the ecosystem status – its health (Banerjee et al., 2018, 2017b; Connell, 1963; Hull et al., 2000; Jørgensen, 1986; Rakshit et al., 2017; Scharler et al., 2018; Ulanowicz, 1986; Venturino et al., 2016; Williams, 1976). A multitude of distinctive elements can be used as system health

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indicators including for example important chemical factor like dissolved oxygen (DO) content of the water body or biological aspect like the abundance of zooplankton in the same and so on.

Oxygen is one of the primary requirements of life without which, it would be impossible for aerobic organisms to survive. For aquatic heterotrophic organisms, dissolved oxygen (DO) is the only source of oxygen and this acts as a vital factor not only in life sustenance but also in regulating their metabolic activities and subsequent trophodynamics (Hull et al., 2008, 2000). *DO* is a critical variable in evaluating water quality in lakes, reservoirs or any fresh water system. Low *DO* concentrations of water bodies directly affect abundance of fish and other organisms thus altering ecological balance. Frequent occurrences of hypoxia due to sudden lowering of *DO* have caused significant reduction of fishery harvests, toxic algal blooms and loss of biotic diversity (Howarth et al., 2000; Paerl, 1988). The minimum level required is 4.8 mg L^{-1} (critical level of *DO*) to mark any water body as healthy (EPA, 2000; Gürel et al., 2005). Below this level, adverse effects comes into play ultimately affecting biological, ecological as well as economical processes as well (Breitburg, 2002; Nelsen et al., 1994) with disruption in their proper functioning. *DO* level in an aquatic system is regulated by two key processes which are – (i) production (photosynthesis by phytoplankton, aquatic macrophytes and periphyton) and (ii) consumption (respiration by aerobic communities, biological and chemical oxygen demand, organic matter mineralization etc.). Environmental (physical and chemical) factors like water *pH*, atmospheric and water temperature, salinity, atmospheric exchange and also hydrodynamic water column processes contribute to the maintenance of dissolved oxygen levels (Hull et al., 2008; Mandal et al., 2012; Sallam and Elsayed, 2018; Smith and Piedrahita, 1988; Tuchkovenko and Lonin, 2003). The controlling processes are summed up in the following conceptual diagram – Fig. 1.

Similarly, the presence of a healthy assemblage of zooplankton community (having diverse composition and abundance) is another suitable indicator of water quality (Karjalainen et al., 1996; Moss et al., 1997; Muylaert et al., 2006). Zooplankton in most cases occupy the second trophic level in an aquatic food web and serve as the main link of energy transfer from producers to the higher trophic level heterotrophs (Deivanai et al., 2004; Ismail and Mohd Adnan, 2016; Santos-Wisniewski et al., 2006). Zooplankton show vertical as well as horizontal distribution alongside diel migration patterns that can be attributed to several factors including solar radiation, species assemblage

and various other environmental factors as mentioned above (Cisewski et al., 2010; Dini and Carpenter, 1992; Lampert et al., 2003; Lienesch and Matthews, 2000; Vijanen et al., 2009). In addition to showing quick responses to changes in the environment, variations in community structure (relative abundance of species in a community) can be observed in response to changes in physico chemical factors also (Gannon and Stemberger, 1978). Previous reports suggest that different zooplankton groups are good indicators of eutrophication, acidification of water body as well as turbidity of lakes and reservoirs (Attayde and Bozelli, 1998; Burns and Galbraith, 2007; Pinel-Alloul et al., 1990; Sousa et al., 2008). Increased nutrient inflow can result in eutrophication of water bodies thus resulting in phytoplankton bloom. However, zooplankton communities present in the water body can act as top-down controller feeding on phytoplankton thus decreasing chlorophyll-*a* concentration and enhancing water transparency (Yang et al., 1998). Consequently, the study of abundance of zooplankton groups and relating this to the controlling effects of environmental factors provides much insight into organization of the aquatic system (Sehgal et al., 2013). Fig. 2 below summarizes the conceptual framework of zooplankton abundance control in an aquatic ecosystem.

Several authors have till date used various methods for the study in variations of *DO* (Mandal et al., 2009; Prasad et al., 2014; Scavia et al., 2003; Singh et al., 2009; Wu et al., 2000; Zhao et al., 2007) and species abundance in different systems using a multitude of techniques (Geraldes and Boavida, 2004; Haury et al., 1991; Lienesch and Matthews, 2000). Traditional methodologies like spatial pattern analyses of community structure and dynamic modelling of particular aspects can provide useful insights to various facets of the system concerned but often fail to correlate the large number of controlling environmental factors to the same (Chakrabarty et al., 2017; Connell, 1963; Sarkar and Pandey, 2015; Williams, 1976).

Since the proper introduction of mathematical modelling in limnology, a growth surge has been observed in the use of ecological modelling and various forms of its application (Jørgensen, 1999). Over the years, mathematical modelling has evolved considerably. Some very complex and highly evaluative modelling approaches are capable of adapting to ecosystem changes in response to forcing functions and can modify and evolve to incorporate those changes (Jørgensen and Bendoricchio, 2001). Artificial neural network (ANN) modelling approaches have gained popularity particularly during 2000–2006 along with structural dynamic models and also individual based models
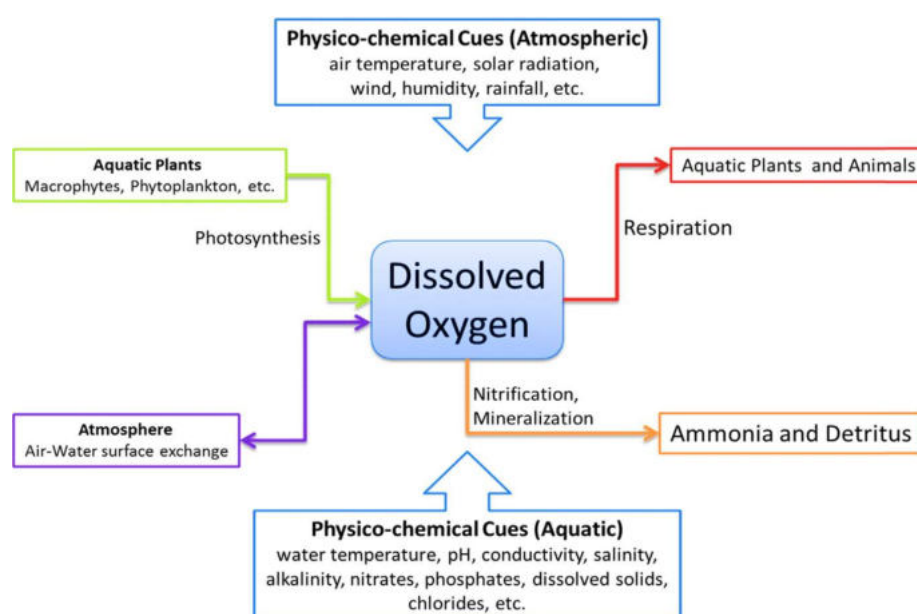

Fig. 1. Conceptual diagram of different processes maintaining the level of dissolved oxygen in the water column.
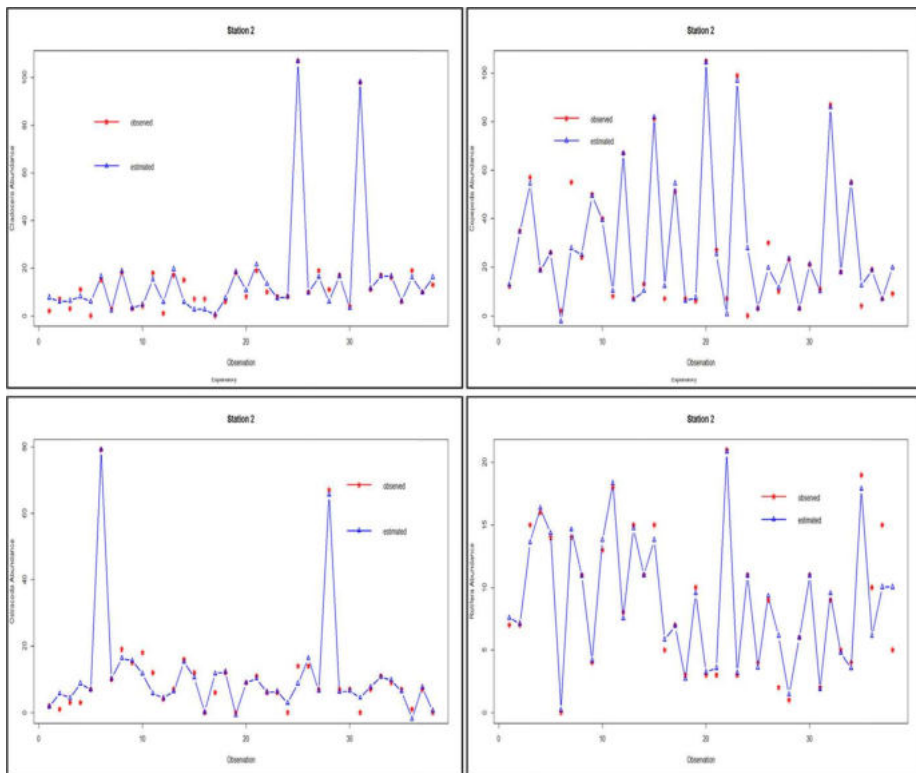
Fig. 6b. Comparisons between model outputs (blue triangle) and observed values (red star) for Zooplankton abundance of S2. The plots represent (clockwise from top left) Cladocera, Copepoda, Rotifera and Ostracoda abundance respectively with the X-axis showing the number of observations and Y-axis shows zooplankton count. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
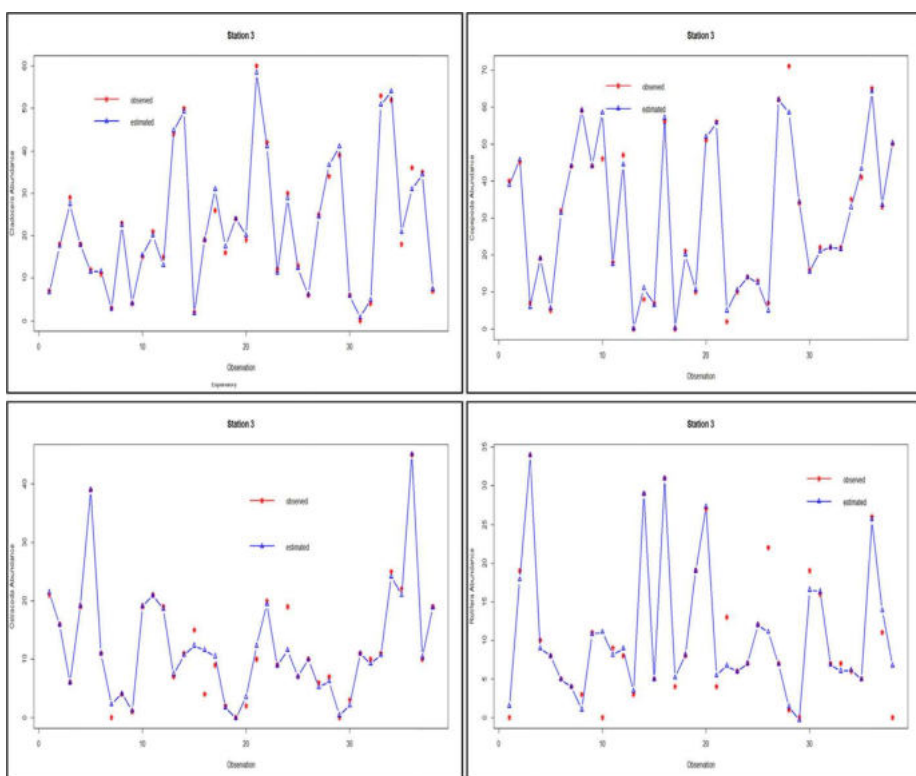

Fig. 6c. Comparisons between model outputs (blue triangle) and observed values (red star) for Zooplankton abundance of S3. The plots represent (clockwise from top left) Cladocera, Copepoda, Rotifera and Ostracoda abundance respectively with the X-axis showing the number of observations and Y-axis shows zooplankton count. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

the variation in ranking of each independent (predictor) factor in the control of *DO* and zooplankton. The most important factors are found to be productivity, biological oxygen demand, phosphates, nitrates, salinity, *pH* etc. thus implying a chemical control of the reservoirs water quality and these observations are in agreement with previous observations as well (Banerjee et al., 2015; Chakrabarty et al., 2017; Hujare, 2008; Tarkan, 2010).

S1 and S3 are situated further away from the reservoir dam and the water level here faces lowering during warm summer time and subsequently increases in the monsoon (Banerjee et al., 2015). This leads to an increased presence of turbidity and also increased concentration of different chemical attributes like *Nit-N*, *TDS*, S_{AL}, *Phos-P* etc. following increased evaporation of water in the dry seasons and shallow water depth in these two stations (Hujare, 2008; Medudhula and Samatha,

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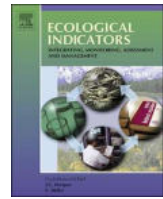
An approach towards quantification of ecosystem trophic status and health through ecological network analysis applied in Hooghly-Matla estuarine system, India

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ARTICLE INFO

ABSTRACT

The structure and function of food web of Hooghly-Matla estuarine system (HMES) including Sundarban mangroves is studied to assess the health of the system. HMES, provides shelter and make a home to many economically important shell and fin fishes. This estuary is exposed to various threats such as increasing salinity, deterioration of soil fertility and productivity, pollution and loss of biodiversity. Ecological network analysis (ENA) is applied for the HMES to model the trophic flows in 22 ecological compartments using Ecopath (a software for network analysis), integrating ecological data for the 2013–2015. ENA is performed, including a set of indices, keystoneness and trophic spectrum analysis to describe the contribution of the 22 groups to the HMES functioning. Results show that 22 compartments of the HMES including primary producers (trophic level TL 1) to the top consumers (elasmobranch, TL 3.5), the ecotrophic efficiency ranges from 0.016 to 0.989. Small demersal fishes, prawns, shrimps and crabs are the most exploited groups of this ecosystem. Herbivory and detritivory ratio is 1:1 indicating relative absence of top predators and low maturation level. Maturity of the system, organization, relative order and disorder within the system, diversity of flow of material among compartments and overhead of the system has been assessed. Biomass over Total system throughput ratio (*TB/TST*), Total primary production over total respiration ratio (*TPP/TR*), Total primary production over biomass (*TPP/TB*) and system omnivory index (*SOI*) indicate the moderate maturity level of the system. The HMES trophic network has a moderate recycling level (FCI = 12.99%), a high total system throughput (TST = 22976.03 tonnes $km^{-2} yr^{-1}$) and a low ascendency (A = 25799 tonnes $km^{-2} yr^{-1}$), but a relatively low connectance (CI = 0.27), high internal relative ascendency (A = 29.6%) and a high omnivory index (OI = 0.203), indicating that this estuary is immature but relatively organized and complex, with strong production. HMES has some unique features in comparison to similar functioning geographically close estuaries or estuaries with similar environmental characteristics. System robustness and exergy are also estimated to assess ecosystem health and compared with other tropical systems. From a holistic point of view, present study conveys fundamental information and categorizes the status of the system.

1. Introduction

Estuaries along with its vast biodiversity support extensive fisheries causing disproportionately high economic values (Blaber et al., 2000) and most extensively modified and threatened ecosystems on earth (Costanza et al., 1997; Blaber et al., 2000). Estuarine system endows with abundant food supply for organisms of different trophic levels (Schelske and Odum, 1962; Teal, 1962; Odum, 1968; Nixon, 1980) and refuge from predation for juveniles of several fish and invertebrate species (Robertson and Blaber, 1993; Paterson and Whitfield, 2000). Estuaries serve as important sites for fish, both as nursery and reproduction grounds and also migration routes. Functioning of estuaries

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engrosses complex interactions among the components of the ecosystem. The estimation of material or energy flow through diverse compartments of the system and efficiency of energy assimilation, transfer and dissipation provides an essential insight to reveal the structure and function of the system (Baird and Ulauowicz, 1993). Application of thermodynamic and network oriented indicators to coastal systems could have a powerful tool to assess ecosystem health and maturity (Vassallo et al., 2006). This study attempts to summarize and integrate existing trophic structure and to depict a larger picture of interactions among biological components and their functions in the ecosystem using a mass-balanced model of HMES.

Stability of the estuarine system comes from the availability of resources for its components and trophic interactions among these components (Polis and Strong, 1996). Thus, information on material flow and trophic structure are fundamental for the understanding of the persistence of these communities through time (Polis, 1994; Polis and Strong, 1996). A good number of detailed food web studies have been done for lakes (Chea et al., 2016; Vander Zanden and Vadeboncoeur, 2002), rivers (Jepsen and Winemiller, 2002) and even large open ocean areas (Davenport and Bax, 2002; Sherwood and Rose, 2005) and also in estuaries (Lobry et al., 2008; Scharler and Baird, 2005; Baird et al., 2004a; Wolff et al., 2000). Generally, estuaries are in stressed condition due to anthropogenic activities (Diaz and Rosenberg, 2008; Blaber et al., 2000). There is still scope in detailing relationships between species and among the estuarine community specially, in tropics as a whole. Inspite of prevalent estuarine systems in tropics, there are only few of studies food web including network analysis (Patrício et al., 2004; Scharler and Baird, 2005; Mohamed et al., 2005). Under this circumstance, we study one important tropical estuarine system emphasizing on the system health. Health of an ecosystem is related to its fundamental attributes, functioning, maturity and stability. These factors are dependent on the complexity of the system which, in turn, dependent on the trophic interactions of the food web.

ENA, a cluster of algorithms, with holistic approach towards ecosystem analysis to unravel several system properties is described in detail by Ulanowicz (1986, 2004), Wulff and Ulanowicz (1989) and Kay et al. (1989). Several studies have been carried out exploring various aspects of ecosystem functioning using ENA; such as, trophic models of the exploited benthic ecosystem (Ortiz and Wolff, 2002), evaluation of environmental and anthropogenic stress and use of these indices for ecosystem health management (Tecchio et al., 2015), trophic structure, function, efficiency and productivity among ecosystem types (Blomberg and Montagna, 2014), impact of the top predators of the system (Lercari et al., 2015), species relationships by energy transfers, trophic fluxes, and assimilation efficiency (de Mutsert et al., 2012), effect of stress on the structure and functioning of food web (Baeta et al., 2009), general status and development trends (Duan et al., 2009), assessment of nutrient supply and habitat structure (Scharler and Baird, 2005; Baird et al., 2004b) etc. Ecopath model using ENA was first applied by Christensen and Pauly (1992) to evaluate the maturity among 41 aquatic ecosystems through 31 attribute parameters provided by the statistics analysis. Ecopath is steady-state trophic model which evokes transfer of material or energy within the components of ecosystems (Brey, 2012).

The tidal freshwater areas of estuaries have received little attention in ecological research although they are often heavily stressed by environmental impacts. Significant degradation and loss of coastal wetlands have been observed due to the establishment of increasing human populations near lagoons, gulfs and bays (Entsua-Mensah, 2002; Ibe and Sherman, 2002; Scheren et al., 2002; Wolanski et al., 2004). The Sundarbans, the lush mangrove vegetation between India and Bangladesh, is a unique ecosystem with high biodiversity including the HMES which is one of the most important estuarine systems in south-east Asia. HMES has been declared as World Heritage Site by UNESCO in 1985 and in 1989, a Biosphere Reserve in India which carry out a variety of ecosystem services. Litterfall of mangroves supplies the detritus,

nutrients and regulates the productivity and is the home for many economically important shell and fin fishes. Research on HMES have focused on the biogeochemical cycles (nitrogen and carbon), carbon flux, phytoplankton assemblage, water quality assessment and mangrove litterfall dynamics and fish faunal assemblage (Mukherjee et al., 2013; Roshith et al., 2013; Roy et al., 2012; Hossain et al., 2012; Dutta et al., 2012; Choudhury and Pal, 2011; Mukhopadhyay et al., 2006; Ray and Straskraba, 2001). Few works describing partly or whole estuarine area explaining the present condition of the system have been done (Ray et al., 2000; Ray, 2008; Ullah et al., 2012). Fishery in this area is at a stake due to over exploitation, the catch per unit effort (CPUE) and overall system health is declining as an invariable outcome (Dutta et al., 2016; Rakshit et al., 2017). Major ecological problems in this area are - increasing soil and water salinity, subsequent deterioration of soil fertility and productivity, pollution of soil and water ecosystem and loss of biodiversity. Human society interaction with environment is intense and natural resource consumption to the extent of overexploitation is quite common here. Huge discharges of untreated domestic and industrial effluents, from nearby industries are the major cause of water pollution at this site. Alterations to and removal of mangrove vegetation over time has become another threat. This environmentally and economically important area can step towards an uncertain future if proper solutions are not taken into consideration. Therefore, the objective of this study are (1) construct a steady-state trophic model of HMES to reveal the trophic interactions among the compartments within this system through ENA, (2) analyze the ecosystem maturity and trophic functioning using an ecosystem characterization index resulting from network analysis, (3) to assess the health of this ecosystem.

2. Method

2.1. Study site

The HMES, the first deltaic offshoot of the Ganges lies approximately between 21°31′–23°20′ N and 87°45′–88°45′ E. This tropical coastal estuary with its lush mangroves is shared between two countries – India and Bangladesh. The Indian part of HMES is shown in Fig. 1. The area considered for the study is from Diamond harbour to the coastal areas of Bay of Bengal along coastline of West Bengal state of India. Data on fish catch has been collected from fishing stations of Diamond harbor, Kakdwip, Namkhana, Bokkhali, Frasergunj.

2.2. Overview of ecopath model

A potential key to understand ecological complexity is to apply ecosystem approach which considers all species in the system, the food web along with all flows and processes. The static modelling approach has been considered using Ecopath as a tool to understand the food web of the system, taking important functional groups from each of the trophic level. Static modelling approaches employ a series of linear equations to estimate values of all flows taking place in a system, which can then be analyzed with ENA indices. Ecopath is modelling software which captures a static mass balanced snapshot of the whole system (Christensen and Pauly, 1993; Christensen et al., 2005). The algorithm of Ecopath is based on parameterization of the two master equations known as:

(1) Production = catch + predation + net migration + biomass accumulation + other mortality;
(2) Consumption = production + respiration + unassimilated food,

It can be simplified and expressed as follows (Christensen et al., 2005):

Table 3

System attributes and important ratios of HMES.

Parameters	Value	Unit
Sum of all consumption	9468.333	t/km^2/yr
Sum of all exports	1346.267	t/km^2/yr
Sum of all respiratory flows	6032.349	t/km^2/yr
Sum of all flows into detritus	6129.079	t/km^2/yr
Total system throughput	22976.03	t/km^2/yr
Sum of all production	10702.32	t/km^2/yr
Mean trophic level of the catch	2.347	
Calculated total net primary production	9160	t/km^2/yr
Total primary production/total respiration	1.51848	
Net system production	3127.651	t/km^2/yr
Total primary production/total biomass	28.28844	
Total biomass/total throughput	0.01409326	/year
Total biomass (excluding detritus)	323.8072	t/km^2
Throughput cycled (excluding detritus)	759.41	t/km^2/yr
Predatory cycling index	7.09	% of throughput without detritus
Throughput cycled (including detritus)	2984.02	t/km^2/year
Finn's cycling index	12.99	% of total throughput
Finn's mean path length	3.114	
Ascendency	25799.0	flowbits
Overhead	61478.3	flowbits
Developmental capacity	87277.2	flowbits
Average mutual information	1.123	
Shanon's diversity index	3.799	

pedigree routine for the EwE model. The current model has a pedigree index of 0.567 with a measure of fit 3.0 which shows that the model is reliable with a high level of confidence.

3.3. Ecosystem properties and ENA indices

The statistics routine of Ecopath and flow indices list all the ecosystem attributes (Christensen et al., 2005; Lindeman, 1942; Ulanowicz, 1986) for the HMES in Table 3. The total system throughput of the estuarine ecosystem has reached 22,976.03 t km^{-2} y^{-1}, of which 41.20% derived from consumption, 5.85% from exports and 26.25% from respiration with 26.67% eventually flowing into detritus. The values of ascendancy and overhead are 29.6% and 70.4% respectively for HMES (Table 3).

3.4. Ecosystem health assessment

3.4.1. Robustness

For HMES, the robustness curve demonstrates that the robustness value for the system is near the apex ("window of vitality", Ulanowicz et al., 2009) if we compare that with the hypothetical curve.

3.4.2. Exergy

Table 5 (see appendix) lists the relative β values for different organisms proposed by Jørgensen (1997). It is applied to calculate the exergy of the system. Using the β values listed in Table 5 and the tonnes km^{-2} biomass in Table 2 following exergy of the each compartment of the system is obtained expressed as g detritus equivalents m^{-2} (Appendix 1, Table 5). Total exergy of the system is 20192.16315 gm detritus equivalents m^{-2} and specific exergy is 58.05563783.

4. Discussion

4.1. HMES trophic structure

Salient features of ecosystem such as maturity, organization, fundamental processes involved with material and energy transfer can be determined by static modelling of a system using Ecopath as a tool. In the current study, data obtained from published literature with models having similar consumer organisms (Mustafa, 2003; Ullah et al., 2012;

Vivekanandan et al., 2003; Mohamed and Zacharia, 2009) and also from direct field observations. Pedigree index and the associated 't' measurement reveals the uncertainty of the data used for the model and the results are quite acceptable when compared to the pedigree value of other Ecopath models. Additionally, the model also makes out the importance to bridge in data gaps and highlights the requirement to progress knowledge about specific parts of the system. For instance, the microbial and microphytobenthos compartments, which could be imperative for the trophic structure and symbolize high biomass (Abarca-Arenas and Ulanowicz, 2002; Rybarczyk et al., 2003), are not measured in the model. In spite of the problem of merging bacteria with detritus, bacteria is allocated to the detritus compartment here, as suggested by Christensen and Pauly (1992) and practiced by numerous authors.

All the eleven fish groups in HMES having the total biomass 50.94 tonnes km^{-2} y^{-1} and shows EE values towards the higher range (> 0.5). Five fish groups have trophic level higher than 3. High predation pressure of the top predators poses a high exploitation rate to the middle trophic layer, such as zooplankton, prawns, benthic herbivore having EE values 0.951, 0.95, 0.814 respectively. This highly exploited middle layer gives less grazing pressure to the primary producers level as evident from low EE values of this level. This exerts top down effect in the system. The high exploitation of fish groups due to fishing pressure in this region because of high market value of this resource and this region serves as one of the most economically important export stations in south-east Asia. Though mangroves have the largest individual biomass among all the other components of the estuarine trophic structure, is not utilized in efficient manner by the consumers as evident from EE values. It may be due to the difficulty of successful utilization of live individuals (Christensen et al., 2005). It might also be an indication of non-availability of their predators in the ecosystem or in the model. Though crabs feed on the fallen leaves of the mangroves and the dead and decayoing parts mainly contribute to the detritus pool of the system (Mukherjee et al., 2013). EE value implies low exploitation of some fish groups (small demersal, medium demersal) which belong to the higher trophic levels. This may be due to the fact that export of these groups (via fishing) is not beneficial to the fishermen and is thus unusual.

High predation pressure of top predators (mostly by many fish groups) exerts on middle trophic groups. Due to top-down effects the biomass of these middle groups decrease and in turn the biomass of primary groups (lower trophic levels) increase. However, external pressure such as overfishing on top predators balances this condition and maintains the normal functioning of this system.

In present study, it is specified that both gazing pathway as well as detrital pathway are almost equally important in this estuary (consider the similar EE values for primary producers (except mangroves) and the detritus group). This fact is to some extent contradictory to most available literature where the detrital pathway is of higher importance (Fig. 3). But the transfer efficiencies (TE) varied greatly between the successive trophic levels. The initial values of TEs increase from TL-II to TL-III, towards the higher trophic levels. The TE between trophic level 1 (TL-I) and trophic level 2 (TL-II) of ecosystems is higher whereas, much food is available for TL-III. TE from primary producers is 8.8% whereas from detritus is 8.6%. TE put forward an example of low herbivore transfer efficiencies, higher efficiencies on trophic level 3 and lower efficiencies at the higher levels. Most of the production may not be originated from phytoplankton but also from the mangroves whose energy is only available to its consumer after decaying into detritus (Patrício and Marques, 2006). This kind of TE has already been seen in different systems (Christensen and Pauly, 1992; Baird and Ulanowicz, 1989). The mean transfer efficiency among different trophic levels of the ecosystem is 8.6% in our study, slightly lower than the 10% proposed by Lindeman (1942), but lying within the acceptable range of EE values reported in the published literature (Libralato et al., 2008; Pauly and Christensen, 1995). Among all groups of HMES, the maximum primary production is required by medium benthopelagic fish, followed

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ORIGINAL RESEARCH PAPER

Physical Education

ECONOMIC IMPACT OF SPORTS ON SOCIETY

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ABSTRACT

Sports and Physical activity is linked solely to the sport at schools, colleges, universities and leisure activities, undermining its contribution to a number of other processes and activities. For example, sport is closely linked to education, tourism, health and entertainment. Each of the above has made up a major role in the national economy. Entertaining people during their time off from work as always been a primary role of both participation and spectator sports. Although in the past sport entertainment was usually casual & relaxed, today's sport is often organized, mechanized, marketed and administered as a business. Commercial interest influenced virtually every decision in sports. Events are rated by television audience share, tickets sales, website hits, concession sales, sponsor revenue and media coverage. Wins and losses are important because they influence all of these standards of measurement. As sport in growing more into business, the corporate model is entering into the organization of every sport entity and governing body. Athletes are encouraged to provide their services for the good of the larger entity, to contribute to the bottom line. Coaches are becoming the supervisors of athletes who are sometimes asked to go against their personal choices for the better good of the team or organization. As the sports industry in growing in economic power, it is also attaching commercial interests who could benefit from that power by influencing its organization. As the industry is developing, the role of the athlete is becoming to serve the organization.

INTRODUCTION:

Sports economic is a discipline of economics focused on its relationship to sports. It covers both the ways in which economists can study the distinctive institution of sports and the ways in which sports can allow economists to research many topics, including discrimination and antitrust law. The theoretical foundations of the discipline are heavily based on micro economics. Sports economics modules offer a range of transferable and specific skills that can be applied to a range of role opportunities, particularly in the ever growing sports and leisure industries, local government & tourism. Sports economics possesses substantial experience in economic consulting to the sports industry, with specific knowledge of the economic impact of facilities, event, and teams so considering the publicity and scrutiny surrounding such studies, it is imperative to select a firm that not only has substantial experience, but also has a reputation for consistently providing an accurate assessment of economic impact. Economists and scientists have widely studied the sports role in economic growth as well as the importance of sport for people's physical activity promotion. However in the light of the growing role of sport in economic processes, it is necessary to do an in depth study for theoretical aspects of sports economics. Many people love sport. Thus, sports economics provides an opportunity to analyze some key economic concepts can be used to analyze and understand the role that economics incentives play in determining the behavior of controlling bodies, leagues, clubs, players, fans, sponsors, the media and government.

HISTORY OF SPORTS ECONOMICS:

Throughout human history, many societies has used sport as form of public entertainment. However never before has commercial sports been as pervasive as it is in contemporary industrial society. Money is the motivator of athletes. Players and owners give their primary allegiance to money rather than to play. Playing for high monetary stakes is existing for funs too. Television money dictates schedules, the timing of time outs, and even controls what sport casters say. Super athletes can become millionaires.

Modern sport is corporate sport. The original purpose of sport –

pleasure in the activity has been lost in the process. Sports has become work. Sports has become the product of publicity agents using super hyper methods. Money has superseded the content as the ultimate goal.

Eitzen's statement emphasizes the notion that commercialization has changed sport dramatically. We will focus on four topics.

1) The factors contributing to the emergence and growth of commercial sport.
2) The effects of commercialization on the form and content of sport.
3) The legal status and incomes of athletes.
4) The owners and sponsors of commercial sports we know that whenever any sport is converted into a form of commercial entertainment, success depends on its man's appeal. Although spectators are adverse group with a variety of motives underlying their attachments to sport, their interest in any sports event are usually related to a combination of three factors:

(I) The uncertainty of the event's outcome,
(ii) The risk or the financial rewards associated with the involvement of the athletes and
(iii) The display of excellence or heroics by the athletes. In other words, when spectators refer to a 'good game' they are usually referring to one in which the outcome was in doubt until the very end of the consist, one in which the stakes were so high that the athletes were totally committed to end engrossed in the action, or one in which there were a number of excellent or heroic performances.

When an event is characterized by all three of these factors it is likely to be discussed and remembered for a long time. It spectators are attracted by uncertainly, high stakes, and noteworthy performances, the commercialization of sport is bound to create certain changes.

This fact has led to the question of whether commercialization corrupts sport or whether it simply changes sport in ways that make it available to a greater number of players and spectators.

IMPORTANCE OF ECONOMICS IN SPORTS

Now-a-days sports are evaluated in terms of gate receipts and revenues from the sale of concessions, licensing fees, merchandise, and media rights. Games and events are evaluated in terms of market share, ratings points, and advertising potential. Athletes are evaluated in terms of endorsement potential and on-camera image, their very popularity may depend on their ties to

corporate names and logos. Stadiums, teams and athletic events now are named are larger corporations rather than historical figures and places with local meaning. Corporate interests influence everything from the choice of team colours to the times events are scheduled and the ways they will be covered by the media. In fact, media companies own a growing number of sport teams and sponsor more and more events. Sports are now corporate enterprises, integrally tied to marketing concerns and processes of global capitalist expansion. The names of transnational corporations have become synonymous with the athletes, events, and sports that provide pleasure in peoples live.
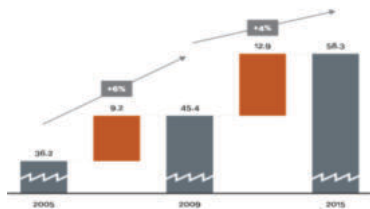
Seven Sectors of the Sports Economy

National income accounting provides the framework for the suggested analysis, consistent with the National Accounts. It allows for a division of the sports economy into these seven sectors.

Consumers – including the personal or household sector. This shows mainly sports related expenditure, like spending on sports clothing and footwear.

Commercial sport sector – including sports good manufacturers and retailers. We classify companies such as Nike and professional football clubs in this sector.

Commercial non-sport sector – including suppliers for the production of sport-related goods and services. This sector includes companies that don't provide a sport product, but assist through the supply of inputs or revenue for production.

Voluntary sector – including non-profit making sport organizations such as amateur clubs run by their participants. Identifying the income and expenditure flows towards voluntary clubs is an important element in the economic assessment.

Local Government – including income from local government sport facilities, sports-related grants from central government and rates from the commercial and voluntary sector. It expenses wages for labour and grants to the voluntary sector.

Central Government – including taxes grants and wages on sport related activities.

Twelve ways of sports – make a positive impact.

a. Economic Impact
b. Jobs
c. National Unity
d. City Pride
e. Role Models
f. Helping Kids Get Active
g. Employment Outlook
h. Community Relations
I. Make a Wish
j. Honoring Heroes
k. Team & Player Foundations
l. Emotion

Effects of Sports on Indian Economy over the past two decades there has been increased competition among cities, regions and countries to host mega sporting events. Therefore Government and other proponent's of major sporting events usually seek to back up their claims of the event providing an economic boost by commissioning an economic impact statement.

Hosting a sport event has revealed a number of benefit in our communities and of those benefits, some reasons like increasing community visibility, positive psychic income, and enhancing community image are all common and acceptable postulations. Economic impact in sporting events can be defined as the net change in an economy resulting from a sport event and the change is caused by activity involving the acquisition, operation, development and use of sport facilities and services which in turn generate visitor's spending, public spending, employment, opportunities and tax revenue. In study of economic impact expenditure can be categorized as direct, indirect and induced effects.

Economic Benefits of Promoting Sports

Sports is divided into play, game physical activity, medical treatment, rehabilitation & competition targets everyone & everybody, regardless of gender, age, religion, race, social status teaches ethics, discipline fair play, pride, dignity & honor. It is a source of fun, enjoyment, recreation & relaxation. It is a tool for democracy, freedom & equality encompasses the entire population of a nation. It is like religion, the opium of the people induces a sense of patriotism & unity. It is a prime factor in decreasing chances of heart disease, Alzheimer & Parkinson's, Reduces mental instability. As sport as a concept is quite vast, it is not very easy to define it, yet an academic definition on which all would agree, is that sport is a form of involvement, it is a recreational activity, a social institution and a cultural product. In short, sport is a social phenomenon that brings together peoples and nations under unity, patriotism and moral values.

CONCLUSIONS:

In current scenario economic impact studies have become standard operating procedure for supporters of public funding for sports events. It has led to acceptance of their findings by the government and public due to their prevalence with no critical evolution. Entertaining people during their time off from work has always been a primary role of both participation and spectator sport. Although in the past sport entertainment was usually casual and relaxed, today's sport is often organized, mechanized, marketed, and administered as a business commercial interests influence virtually every decision in sports. Events are rated by television audience share, tickets sales, concession sales, sponsor revenue and media coverage. Wins and losses are important because they influence all of these standards of measurement. As sport is growing more into a business, the corporate model is entering into the organization of every sports entity and governing body. Athletes are encouraged to provide their services for the good of the larger entity, to contribute to the bottom line; coaches are becoming the supervisors of athletes, who are sometimes asked to go against their personal choices for the better good of the team or organization.

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2019-20

ORIGINAL RESEARCH PAPER

Sports Science

COMMUNITY, SPORTS & SOCIALIZATION

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ABSTRACT

Socialization is a process of learning the ways of one's society and becoming a functioning member of it along with exhibiting standards of behaviour in accordance with its rules, laws and customs, which have been formed due to our interaction in the community. Sports socialization occurs through contact with socializing agents. Man is a social animal and is distinctive from other animals due to his ability to learn. For a primitive man, food, shelter and clothing were his basic needs. Education, health, recreation etc. came to be added to his growing list of secondary needs. These needs can be classified as biological, sociological and psychological aspects of life. Through socialization people develop ideas about themselves and about those with whom they interact. Inevitably, socialization is a two-way process that affects everyone to a greater or lesser degree. It takes place throughout one's life, but it is during the early years that the most crucial phases occur. In these phases a person's sense of self, social identity and relationships with others are shaped.

INTRODUCTION:

Sports is a factor or a media, or an agent, or a force which humanizes and socializes the individuals. Sports and socialization will go hand in hand. They are inseparable and indispensable for developing personality has to be ensured through participation of physical activity programmes. The physical education, and sport scientist believed that physical education is a social experience. Sports is helping the individual to make personal adjustment as worthy member of the society. Physical activity programmes inculcate social needs of the individuals as self respect, love; recognition, belongingness acceptance etc. are a few of them. Physical education and sports develop social qualities such as co-operation, friendship, sympathy, honesty, fair play, sportsmanship, respect for authority and so on are the important aspects of culture as well as socialization. Thus sports and physical education totally transform the human animal into human being, of converting the biological being into a social being.

Sports Converts Biological-being into Social-being

Man is so born social. He becomes social by virtue of the programmes of physical education. It is a made it very clear that only through constant practice and training the new born child becomes social in nature.

Community Sports and Socialization

Community sports is full of recreative activities. Recreation is a basic need for living in a democratic society. There are a number of coordinating organizations that function in the community. In the community, there are a number of social agencies such as private and public working together for understanding, co-ordination of services, consultations on policy and programme, joint planning and study and trying to meet total community needs through various programmes.

Recreation Develops Socialization

The parents' role is very important to develop the socialization. Parents education, personality characteristics their emotional and social behavior, then mutual, affection, love and quarrel, their interest and attitude and general characters etc. are important components of socialization. No one is born with the spirit of cooperation, coordination, sportsmanship, honesty, courtesy etc. but all such qualities are developed through sports and games.

Contributes to the Development of Personality

The aim of physical education and sports is not to achieve anything in the society but to achieve the wholesome development of the personality of the individuals. Physical education and sports must strive to make every child physically, mentally, morally, socially and emotionally fit. It also develops in him such personal and social qualities as will keep him to live happily with others and with himself and build him up as a good citizen of tomorrow.

Produces a Worthy Citizen

Socializing process in physical education is aimed to develop individuals who must become worthy citizens of tomorrow. They should be able to take up civic responsibility in their family or in the groups. Physical education and sports develop humanitarian attitude and tolerance for all races and religions, who conform to rules and regulations as the players do during sports competitions. Physical education and sports make the individual share responsibility leading to democratic life. Sports in variable develops these qualities among the participants. An educated person needs such qualities.

Eliminates Social Distance

Sports is a factor or an agent which is held responsible for eliminating social distance among the children. Sports is a socializing agent which is providing equal opportunities to all the children irrespective of their abilities. One of the causes of faculty socialization is "social distance". Through sports different types of antisocial behavior has been eliminated and washed away during the time of play. It gives changes for interacting and interdependent on each others. Here, no rich and poor, high caste and low caste, inferior and superior treatments. But it gives opportunities to think "a feeling of oneness" and "a feeling of equals".

Helps to Create a Bright Future

Sports and socialization are complementary to each others. The product of sport is socialization. Socialization and sports are the powerful instruments of changing the destiny of mankind. It is through sports, the individual can establish a new life. Sports thoroughly change the behaviour of the individuals. By giving appropriate training to the new born children the coming generation can be altered significantly.

Develops Social Integration

Without social integration, sports cannot flourish. Both will go together culture, in its developments has revealed a tendency to be consistent. At the same time different parts of culture are interconnected. Social quality has been developed through sports. The cultural quality has been acquired only through playing the games and sports. Man is not only a social animal but also a cultural being. Man's social life has been made possible because of culture. That way, the cultural aspect of integration and sports are thickly related to each others.

Develops International Understanding

Sports is not only producing a worthy citizen, and developing social integration but also it develops international understanding between the countries and continents. Today,

as everybody knows, sports is being played between the countries in terms of world cups in football, hockey, volleyball and handball, invitation tournaments in various games and sports, test matches in cricket, Wimbledon and Davis Cup tournaments in tennis etc. Directly or indirectly sports plays a predominant pole to develop the spirit of assimilation, interaction, accommodation and cooperation of the social and democratic virtues among the citizens. Strictly speaking, sports itself is a transmitter of socialization to the worthy members of the society. Wherever understanding exists, there the concept of socialization develops, because understanding is one of the most important aspects of socialization.

Social Moral & Cognitive Development

To understand the characteristics of learners in childhood, adolescence, adulthood, and old age, educational psychology develops and applies theories of human development. Often represented as stages through which people pass as they mature, developmental theories describe changes in mental abilities (cognition), social roles, moral reasoning, and beliefs about the nature of knowledge.

Sports Programme and Sports Policy

The implementation of this sports policy needs substantial additional financial outlays by the central and State Government. Investment in the promotion of sports and physical education, being investment in health, fitness, productivity and social well-being of the people, which is really for upgradation of our human resources for development. Such investment in sports and physical education should, therefore, be adequately increased. The Government of India should review alongwith the State Government, every five years, the progress made in the implementation of this national policy and suggest further course of action as may be necessary as a result of such review. The programmes implemented by the Govt. of India are as follows:
(I) Grants formation of sports infrastructure.
(ii) Purchase of sports.

In these cases the most important factors are equipment and development of playground synthetic playing surfaces, promotion of sports in Universities and Colleges, assistance of national sports federation, sports capacity search scholarship scheme etc. Through these factors we get a wonderful sports infrastructure.

CONCLUSION:

Socialization is the process of social interaction through which people acquire personality and learn the way of life of their society. Socialization is the essential link between the individual & society a link so vital that neither individual nor society could survive without it. Socialization enables the individuals to learn the norms values, language, skills, beliefs and other patterns of thought and action that are essential for social living. An socialization enables the society to reproduce itself socially as well as biologically thus ensuring its continuity from generation to general socialization is a lifelong process, for we continually encounter new or changing conditions and must learn how to adjust to them. The most important socialization, however, occurs in the early years of infancy and childhood when the basic foundation of later behavior and personality are laid.

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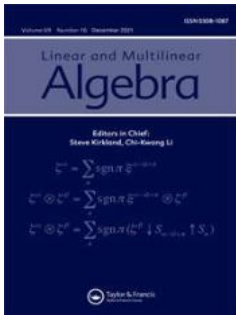
Characterization of symmetric points in lpn-spaces

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Proof: Let $(x_1^0, x_2^0, \ldots, x_n^0) \in S_{\mathbb{X}}$ be a left-symmetric point such that $x_j^0 = 0$ for some $1 \leq j \leq n$. Since $(x_1^0, x_2^0, \ldots, x_n^0) \in S_{\mathbb{X}}$, at least one of the coordinates must be non-zero. Let us assume without loss of generality that $x_n^0 \neq 0$. We may further assume without loss of generality that $x_i^0 \geq 0$ for all $i \neq j$. If $(x_1^0, \ldots, x_{j-1}^0, 0, x_{j+1}^0, \ldots, x_n^0) \perp_B (x_1, x_2, \ldots, x_n)$, we must have

$$(x_1, x_2, \ldots, x_n) = \left(x_1, \ldots, x_{n-1}, -x_1 \left(\frac{x_1^0}{x_n^0} \right)^{p-1} - \cdots - x_{j-1} \left(\frac{x_{j-1}^0}{x_n^0} \right)^{p-1} \right.$$
$$\left. -x_{j+1} \left(\frac{x_{j+1}^0}{x_n^0} \right)^{p-1} - \cdots - x_{n-1} \left(\frac{x_{n-1}^0}{x_n^0} \right)^{p-1} \right),$$

that is,

$$(x_1^0, \ldots, x_{j-1}^0, 0, x_{j+1}^0, \ldots, x_n^0) \perp_B \left(x_1, \ldots, x_{n-1}, -x_1 \left(\frac{x_1^0}{x_n^0} \right)^{p-1} - \cdots - x_{j-1} \left(\frac{x_{j-1}^0}{x_n^0} \right)^{p-1} \right.$$
$$\left. -x_{j+1} \left(\frac{x_{j+1}^0}{x_n^0} \right)^{p-1} - \cdots - x_{n-1} \left(\frac{x_{n-1}^0}{x_n^0} \right)^{p-1} \right),$$

for all $x_i \in \mathbb{R}$, $1 \leq i \leq n-1$. In particular, choosing $x_j = 0$, we have

$$(x_1^0, \ldots, x_{j-1}^0, 0, x_{j+1}^0, \ldots, x_n^0) \perp_B \left(x_1, \ldots, x_{j-1}, 0, x_{j+1}, \ldots, x_{n-1}, -x_1 \left(\frac{x_1^0}{x_n^0} \right)^{p-1} - \cdots \right.$$
$$\left. -x_{j-1} \left(\frac{x_{j-1}^0}{x_n^0} \right)^{p-1} - x_{j+1} \left(\frac{x_{j+1}^0}{x_n^0} \right)^{p-1} - \cdots - x_{n-1} \left(\frac{x_{n-1}^0}{x_n^0} \right)^{p-1} \right),$$

for all $x_i \in \mathbb{R}$, $1 \leq i \leq n-1$, $i \neq j$. This implies that

$$(x_1^0, \ldots, x_{j-1}^0, x_{j+1}^0, \ldots, x_n^0) \perp_B \left(x_1, \ldots, x_{j-1}, x_{j+1}, \ldots, x_{n-1}, -x_1 \left(\frac{x_1^0}{x_n^0} \right)^{p-1} - \cdots \right.$$
$$\left. -x_{j-1} \left(\frac{x_{j-1}^0}{x_n^0} \right)^{p-1} - x_{j+1} \left(\frac{x_{j+1}^0}{x_n^0} \right)^{p-1} - \cdots - x_{n-1} \left(\frac{x_{n-1}^0}{x_n^0} \right)^{p-1} \right). \tag{2}$$

Using left-symmetry of $(x_1^0, \ldots x_{j-1}^0, 0, x_{j+1}^0, \ldots, x_n^0)$, we get

$$\left(x_1, \ldots, x_{j-1}, 0, x_{j+1}, \ldots, x_{n-1}, -x_1 \left(\frac{x_1^0}{x_n^0} \right)^{p-1} - \cdots - x_{j-1} \left(\frac{x_{j-1}^0}{x_n^0} \right)^{p-1} \right.$$
$$\left. -x_{j+1} \left(\frac{x_{j+1}^0}{x_n^0} \right)^{p-1} - \cdots - x_{n-1} \left(\frac{x_{n-1}^0}{x_n^0} \right)^{p-1} \right) \perp_B (x_1^0, \ldots x_{j-1}^0, 0, x_{j+1}^0, \ldots, x_n^0),$$

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নবনীতা দেব সেনের শিশুসাহিত্য
বিশেষ সংখ্যা

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বিশুদ্ধ আনন্দরস সঞ্চারের জন্য যে স্বপ্নময় রঙিন জগৎ স্রষ্টা-সাহিত্যিক সৃষ্টি করেন তাই-ই হল শিশুসাহিত্য। এই সাহিত্য পড়ে শিশুরা যেমন আনন্দ পায়, মনের খোরাক পায় তেমনি জগৎ ও জীবন সম্পর্কে কৌতূহলী হয়ে ওঠে। আনন্দ ও মজা গ্রহণের সঙ্গে সঙ্গে তারা সহজেই পেয়ে যায় জাগতিক শিক্ষা। বিবর্তনের ধারাপথ বেয়ে পরিবেশ জীবন যেমন পাল্টে যায় তেমনই বদলে যায় সমাজ-সংস্কৃতি শিল্প সাহিত্য। পরিবর্তিত এই সংস্কৃতির সঙ্গে তাল মিলিয়ে শিশু-সাহিত্যও ক্রমশ বদলে যাচ্ছে। রচনা বিষয় বৈচিত্রের বদলের সঙ্গে তৈরি হচ্ছে নতুন নতুন প্রকরণ, সৃষ্টি হচ্ছে নতুন ধারার রচনা এবং নির্মাণ হচ্ছে নতুন নতুন আঙ্গিক। তাই আজকের শিশুসাহিত্য শুধু ছোটোদের আনন্দ দেয় না, তার মাঝে কিভাবে জ্ঞানবিজ্ঞানের চেতনা ঢুকিয়ে দেওয়া যায়, বিশ্বজগতের বিশাল ভান্ডারকে জড়ো করে তাদের সামনে হাজির করানো যায়, দেশের ঐতিহ্য সম্পর্কে বোঝানো যায়-তার চেষ্টাও চলেছে। ফলে আজকের শিশুসাহিত্য মননে চেতনায় ঐতিহ্য জাগরিত এক সমৃদ্ধ সাহিত্য ফসল।

বাংলা শিশুসাহিত্যে সেই সমৃদ্ধির নতুন স্রষ্টা সাহিত্যিক হলেন নবনীতা দেব সেন। বহুমুখী প্রতিভার অধিকারী এই সাহিত্যিক গল্প বলার কৌশলে শিশু মনকে সহজেই জয় করে নিয়েছেন। কবি দম্পতি নরেন্দ্র দেব ও রাধারানী দেবীর সুযোগ্যা কন্যা সাহিত্যিক নবনীতা দেবসেন নিজেই বলেছেন- 'এক কবির গর্ভে আরেক কবির ঔরসে আমার জন্ম। অক্ষরের জগৎটাই যার ভিটে মাটি, ঘর-সংসার, সে আর কবিতা লিখবে না কেন!' এক অর্থে তার লেখা ছোটোদের গল্পগুলিও যেন এক একটি কবিতা। জাদু আয়নার সাহায্যে তিনি অদ্ভুত রূপকথার জগৎ তৈরি করেছেন, যেখানে চেনা জানা ঘরোয়া পরিবেশও রূপকথার জগৎ হয়ে উঠেছে। মানবিক লেখিকা গল্পের মধ্যে দিয়ে শিশুদের মনে জাগিয়ে তুলেছেন এক অনাস্বাদিত সত্য জ্ঞানের জীবনবোধ। অসংখ্য গল্পকথা লিখেছেন তিনি। এপর্যন্ত প্রকাশিত ছোটোদের গল্পগ্রন্থগুলি হল- ১. নবনীতা দেব সেন শুকতারার সেরা গল্প (দেবসাহিত্য কুটীর প্রাইভেট লিমিটেড) ;২. নবনীতা দেবসেন ছোটদের ২৫ টি সেরা গল্প (দীপ প্রকাশনী); ৩. রূপকথা সমগ্র (পত্রভারতী) শিশুসাহিত্যিক নবনীতা দেবসেনের মূল্যায়নে আমরা চারটি গল্পকে বেছে নিয়েছি। এগুলি হল- 'উত্তরকান্ড' 'ঊষসী', 'এক চাষীর তিন মেয়ে' এবং 'ইয়ং সাহেবের গাড়ি'। গল্পগুলি বিশ্লেষণ করলেই নবনীতা দেবসেনের শিশুমন সমীক্ষার পারদর্শিতা সহজেই বোঝা যাবে। রামায়ণের কাহিনিকে যেমন তিনি নবরূপ দান করেছেন তেমনি রূপকথার

ইতিমধ্যে উত্তর দেশের এই রাজকুমার ঊষসী কে বিয়ে করে রাজপ্রাসাদে নিয়ে গেছে তবুও তার সংযম সাধনা এগিয়ে গেছে ভাইদের মুক্তির লক্ষ্যে। এরমধ্যে ঊষসীর একটি ছোট মেয়ে হলো কিন্তু দুষ্টুবুদ্ধির রানিমা জানালা দিয়ে মেয়েটিকে ফেলে দিলে পরিরানি নেকড়ে সেজে তাকে নিয়ে চলে যায়। অনেক দুঃখ-যন্ত্রণা কষ্টের পথ অতিক্রম করে, কঠোর সংযম ব্রত পালন করে, ঊষসী বারো জন ভাইকে বুনোহাঁস থেকে মনুষ্য জীবনে ফিরিয়ে এনেছে।

মানবিক গুণের অধিকারী লেখিকা দুষ্টুবুদ্ধি রানিকে মৃত্যুর শাস্তি দেন নি। বরং 'বহু দূর মরুভূমির প্রান্তে ছেড়ে দিয়ে এসেছেন। কিছুদিন একটু তিনি কষ্ট করুন, তারপর স্বভাব শুধরে যাবে। তখন তিনি ফিরে আসবেন বাড়িতে।' অর্থাৎ রানিকে স্বভাব-শোধরানোর সুযোগ করে দিয়েছেন। দিদিমা, ঠাকুরমার গল্প বলার ঢঙে গল্প তিনি যেভাবে শুরু করেছেন শেষ করেছেন ঠিক সেই ভাবেই। "আমার কথা ফুরিয়ে গেল, বুনো হাঁসরাও উড়িয়ে গেল যাঃ—"

শারদীয়া শুকতারা ১৪০৩ বঙ্গাব্দে প্রকাশিত নবনীতা দেব সেনের একটি গল্প হল 'এক চাষীর তিন মেয়ে'। গল্পে তিন মেয়ে হল- শশীকলা, শরৎশশী, ও কিরণশশী। সহজ সাবলীল ভাষায় ছোটোদের মন ছুঁয়ে লেখিকা বলেছেন- 'তারা যত বুদ্ধিমতী, ততই কর্মঠ, তেমনি বুঝদার। বাবার সঙ্গে মাঠেও কাজ করে, মার সঙ্গে ঘরেও কাজ করে, আর তিনজনেই গ্রামের পাঠশালাতে সবটা পড়া শেষ করেছে। কিন্তু 'রূপে গুণে স্বভাবে' শিক্ষায় মেয়েগুলির বিবাহের উপযুক্ত পাত্র আশপাশের কোনো গ্রামে ছিল না।

তাই ঝড়ের দেবতার সঙ্গে শশীকলার, ভূমিকম্পের দেবতার সঙ্গে শরৎশশীর এবং বন্যার দেবতার সঙ্গে কিরণশশীর বিবাহ হয়ে গেল। এ যেন প্রকৃতির সঙ্গে মানুষের অপূর্ব সমন্বয়। পরবর্তী প্রজন্ম নেমে এল পৃথিবীর বুকে ঝঞ্ঝা-সমীরণ , ভূদেবী-ভূঁইদোল, তরঙ্গ-প্লাবন নাম নিয়ে। গল্প পড়তে পড়তে ছোট্ট মনে দোলা দেয় লেখিকার অভিব্যক্তিতে—" যাচ্ছে, যাচ্ছে, যাচ্ছে, এবার একটা ন্যাড়া পাহাড়ের পথ আটকে গেল। সন্ধেবেলা কোথায় যাবে? ঐ পাহাড়েরই একটা গুহায় ঢুকে রাত্রের আশ্রয় নিল দুজনে। তখন সেই গুহায় থাকতো এক রাক্ষস"। এভাবেই বলা ও বর্ণনার দক্ষতায় শিশুমনের অন্তহীন কৌতূহলকে জাগিয়ে তুলতে সক্ষম হয়েছেন। প্রকৃতির কোপ থেকে কোনো ধর্ম রক্ষা পায় না সেই শিক্ষামূলক ভাবনার অভিব্যক্তিও তিনি গল্পে প্রকাশ করেছেন- " আমি ভূমিকম্পের দেবতা। আমি এসেছি তোমার মেজ মেয়েকে বিয়ে করতে। ভয় কেন পাচ্ছ। আমার তো রকম সকম এই রকমই। বলতে না বলতেই হুড়মুড় করে মন্দিরটি ভেঙেই পড়ল আর মসজিদের দেয়ালটা ফেটে চৌচির।" ছোট্ট ছোট্ট মনে এই ভাবে লেখিকা গল্পের ছলে বোধের জাগরণ ঘটানোর চেষ্টা করেছেন।

গল্পের শেষে চাষী ও চাষী বৌ এর তীর্থ ভ্রমণ পূর্ণ করল তার নাতিনাতনীরা

থামার কোন লক্ষণ নেই কারণ ব্রেকহীন গাড়িটির সবকিছু পরীক্ষা করা হলেও ব্রেক পরীক্ষা করা হয়নি। ড্রাইভার মেজোমামা সিদ্ধান্ত নিয়েছেন– তিনি দূরে লাল পাঁচিলের গায়ে গাড়িটিকে নিয়ে হালকা ধাক্কা দেবেন আর ঝাঁপ দিয়ে প্রত্যেককে লাফিয়ে পড়তে হবে। গাড়িতে বসা গর্বিত সদস্যদের মুখ ও মনের অবস্থা কেমন হতে পারে তা আমাদের বুঝতে বাকি থাকে না। কিন্তু শেষ রক্ষা হল না, পাঁচিল ভেঙে গাড়ি ঢুকলো আমবাগানে। গাড়ির ক্রিন ভেঙে চুরমার হলেও ভিতরের প্যাসেঞ্জাররা সবাই অক্ষত ছিল। কৌতুকমিশ্রিত এই গল্পে মেজোমামার লজিকটি ছিল– 'গাড়িটা ঠিকঠাক থামবে কিনা, এটা তো দেখা উদ্দেশ্য ছিল না'।

এখানে বোঝা যায় লেখিকা ছোটদের মননে কিভাবে হাসির ফোয়ারা ছড়িয়ে দিয়েছেন। শেষ পর্যন্ত ইয়াং সাহেবের গাড়িটি বিভিন্ন কাজে ব্যবহৃত হল। গাড়ির সামনের সিটটি হারিয়া রিক্সাওয়ালার রিক্সায় লাগলো, ভবানীবাবু গাড়ির পিছনের সিটটি বেঞ্চিতে পেতে রাখলেন খদ্দেরদের বসবার জন্য। হর্নটি দেওয়া হল মেজোমামাকে, পাড়ার আটাকলের হিন্দুস্থানী মালিক ইঞ্জিনটি কিনলেন আটা পেষাই কলের জন্য। কিছুদিন পর কথকের ঠাকুরদার কাছে ইয়াং সাহেবের চিঠি আসে গাড়িটি কেমন আছে জানার জন্য। উত্তরে তিনি জানিয়েছিলেন– 'শুনে সুখী হবে যে, নানাভাবে তোমার প্রিয় গাড়িটি এখনও এদেশে যথার্থই সমাজসেবার কল্যাণকর্মে লাগছে। 'বস্তুত, গল্পবলার ধরন, শব্দপ্রয়োগের কৌশল এবং কৌতুকের আবরণে গল্পটি শিশুমনকে নাড়িয়ে দিয়েছে।

উপসংহারে বলা যায় বর্তমান যুগ ও সমাজের বলিষ্ঠ, শক্তিশালী শিশুসাহিত্যিক সবনীতা দেব সেন একেবারে মৌলিক যে গল্পগুলি তিনি লিখেছেন বলা ভালো বলেছেন তা যেমন প্রতিদিনের কথা অন্যদিকে তেমনি তা অপরূপ রূপকথা। শিশুদের মনের মতো করে বলা ও তাদের জগৎকে সমনে তুলে ধরার অসাধ্যসাধনের কাজটি তিনি সহজেই করতে পেরেছেন বলে শিশুদের মন জয় করে নিয়েছেন। রাহুল দাশগুপ্তের ভাষায়– 'মানবিক সম্পর্কের উষ্ণতায়, আবেগমথিত উন্মোচনের তীব্রতায়, প্রজ্ঞা ও অনুভবের গভীরতায়, শেকড়ের প্রতি নাড়ির টানে, দৃষ্টিকোণ ব্যবহারের বহুত্বে, আখ্যান কৌশলের অভিনবত্বে, জীবনের নানা অপ্রত্যাশিত মোচড়ে নবনীতার রচনা পাঠকের কাছে এক অনাস্বাদিত জগতের সন্ধান দিয়ে যায়।" শিশুদের পত্রিকা 'শুকতারা'র লেখিকা হিসাবে তিনি তাদের উপহার দিয়েছেন বিভিন্ন স্বাদের গল্পকথা। আবার গল্প শোনানোর ছলে জীবনের অনেক গূঢ় সত্যকে তাদের কাছে তুলে ধরেছেন। এইভাবে শিশুসাহিত্যিক নবনীতা দেব সেন শিশুমননে আলোক বর্তিকা জ্বালিয়ে চলেছেন আজও। আর সেই সম্মানের স্মারকবাহী তাঁর সাহিত্য একাডেমি পুরস্কার। লেখিকাকে আমার সশ্রদ্ধ প্রণাম জানাই।

তথ্যসূত্র:

১) বাংলা উইকিপিডিয়া
২) নবনীতা দেবসেনের শুকতারার সেরা গল্প (দেব সাহিত্য কুটীর প্রাইভেট লিমিটেড)
৩) নবনীতা দেবসেন ছোটদের ২৫ টি সেরা গল্প (দীপ প্রকাশন)
৪) নবনীতা দেব সেনের রূপকথা সমগ্র (পত্রভারতী)

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- समीरणः रायः

{ संस्कृतसाहित्ये अङ्गुलीपर्वसु नर्तितनामधेयेषु कविपुङ्गवेषु भक्तवरेण्यः मधुसूदनसरस्वती सर्वदा मूर्ध्नि राजते इत्यत्र नास्ति मनागपि आरेकः । अद्वैतवेदान्ती मधुसूदनसरस्वती नैकेषां प्रसिद्धग्रथानां ग्चयिता । अम्य कृष्णकुतूहलम् इति नाटकं बिभर्ति किञ्चन माहात्म्यमिति कथने स्वल्पापि अतिशयोक्तिः न विद्यते इति प्रतीमोवयम् । प्रकृते लेखे कवेः काव्यगुणान्, रसान्, अलङ्कारान् इत्यादीन् भृशं व्यामार्क्षीत् लेखकः। - सम्पादकः }

प्रख्यातपण्डितो दार्शनिकः परमभक्तः सन्न्यासी श्रीमधुसूदनसरस्वती वांलादेशान्तर्गते फरिदपुरजिला-कोटालिपाडापरगणास्थिते ऊनशिया इति ग्रामे अजायत। परन्तु तस्य कर्मभूमिरासीत् मुक्तिनगरी वाराणसी। विद्वानयं पोडश-ममदशशतके विद्यमानासीत्। तस्य जननी अरुन्धतीदेवी जनकश्च प्रमोदन-पुरन्दराचार्य-नारायणः। सन्न्यासग्रहणात्पूर्व तस्य नाम आसीत् कमलनयनः। अद्वैतवेदान्ती मधुसूदनसरस्वती अद्वैतसिद्धिः, परमहंसप्रियाख्यागीताव्याख्या, सिद्धान्तविन्दुः, वेदान्तकल्पलतिका, गूढार्थदीपिका, प्रस्थानभेदः, अद्वैतरत्नरक्षणम्, भक्तिरसायनम्, मन्दाकिनीकाव्यम्, कृष्णकुतूहलनाटकादीनां रचयिता।

कृष्णकुतूहलमित्याख्यस्य सप्ताङ्कविशिष्टस्य श्रीराधाकृष्णमधुरलीलामयस्य नाटकस्य नायकः श्रीकृष्णः, नायिका श्रीराधा प्रतिनायिका च श्रीचन्द्रावली। नाटकेऽस्मिन् गोप्यः, प्रतिनायिका चन्द्रावली राधा च श्रीकृष्णं प्रति अनुरक्ता। श्रीकृष्णेऽपि ताः प्रति अनुरूपं प्रेम परिलक्ष्यते। किन्तु राधां प्रति तत् प्रेम समधिकमेव। राधाकृष्णयोः अनुरागः क्रमशो वर्धते। सखीभिः तयोः मिलनं संघटितं भवति, अपि च रासलीलायां राधां समधिकसौभाग्यं प्रदानं

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सात्त्विकभावा रोमाञ्चपुलकादयः। व्यभिचारिभावा औत्सुक्यहर्षावहित्थनिद्राप्रभृतयः। स्थायिभावश्च मधुरारतिः। अनेन प्रकारेण नाटकेऽस्मिन् मधुरभक्तिरसो मुख्यतया वर्णितः।

अङ्गरसरूपेण वत्सलभक्तिरसस्य निदर्शनं परिलक्ष्यते तृतीयाङ्के गोपवालकैः सह वनादागतस्य पुत्रस्य कृष्णस्य मलिनमुखक्लान्ति दृष्ट्वा जनकनन्दोक्त्याम्। कृष्णसहचराणाम् अभिप्रेतकर्मैव श्रीकृष्णस्य प्रीत्युत्पादनम्, इमानि कर्माणि एव प्रेयोभक्तिरसस्य निदर्शनानि। युद्धवीररसस्य निदर्शनमेव कृष्णचाणूरयोर्युद्धम्। वैष्णवरसशास्त्रोल्लिखितावशिष्टहास्यादीनां रसानामपि प्रतिपादनमत्र नाट्यकारेण सुचारुतया सम्पन्नम्।

नाटकस्यास्य वनसौन्दर्यवर्णनं, गोपरमणीनां वर्णनं, विरहदशाग्रस्ताराधायाः, विविधायाः कृष्णलीलायाः तथा रासलीलायाः मनोहरं शोभाकरञ्च वर्णनं न्यूनमाकर्षयति सहृदयचित्तम्। कवेः माधुर्यादिगुणपूर्णं पदलालित्यं, प्रायसकलालङ्काररसानां सुसंबद्धप्रयोगं, व्याकरणस्य नियमे आबद्धा प्रौढा रचनाशैली, कथावस्तुविश्लेषणचमत्कारित्वं, चरित्रचित्रणं काव्यनाट्यशास्त्रयोः सकलनियमानां यथार्थरूपायणं च अत्यन्तमुत्कृष्टं कलात्मकम्। नाट्यकारः मधुसूदनसरस्वती सन्त्यासी परमभक्तः सन् अपि स्वनाटके अपार्थिवां नान्दनिकतां सम्प्रसार्य सहृदयहृदये रोपयति कृष्णप्रेम। अस्यैव कृते कवेः इयं नाट्यचेष्टा, या पूर्णतया साफल्यमण्डिता।

ग्रन्थपञ्जी

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भक्तिरसामृतसिन्धु:, रूपगोस्वामी – (सम्पा.) पुरी दास:, मयमनसिंह:, १९४६

भक्तिरसायनम्, मधुसूदनसरस्वती – (सम्पा.) कृष्णशर्मा, वाराणसी, १९५०

साहित्यदर्पण:, विश्वनाथ: – (सम्पा.) विमलाकान्त मुखोपाध्याय, कलकाता, संस्कृत पुस्तक भाण्डार, २०१३

साहित्यदर्पण:, विश्वनाथ: – (सम्पा.) शेषराजशर्मा रेग्मी, वाराणसी, कृष्णदास अकादेमी, २००२

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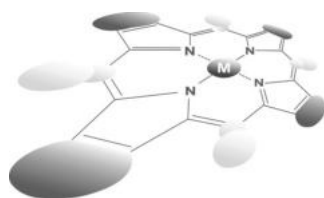
Diameter-dependent structural and electronic property of fused porphyrin nanotubes: A density functional study

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ABSTRACT: We have systematically carried out a density functional theory-based investigation to understand the structural and electronic properties of various fused metalloporphyrin nanotubes (MPNT; M = Sc and Ti) by varying their diameters ranging from 7.91 Å to 18.70 Å for ScPNT and 7.90 Å to 18.59 Å for TiPNT. Binding energies and curvature energies are calculated to access the binding strength and stability of the nanotubes (NTs). From band structure and density of states, it is observed that the ScPNTs are metallic in nature and TiPNTs are semiconductors with small band gaps. The energy gap increases with increasing tube diameter. Our study also indicates that the transition metal atoms play an important role in determining the electrical nature (metallic or semiconducting) of the NTs. Furthermore, work functions for the fused NTs are found to decrease with increasing tube diameter. These results may have direct relevance to the technological applications in terms of band gap engineering or controlled thermionic emission.

KEYWORDS: fused porphyrin nanotube, density functional theory, band structure, work function.

INTRODUCTION

Properties of nanostructured materials have made technological advances possible and hence the scientific research in the field of nanoscience has grown exponentially in last few decades. For instance, carbon-based nanosheets, nanotubes, nanoribbons and nanowires have been synthesized for their potential applications in developing technological devices. Among the nanostructured materials, one-dimensional nanomaterials such as nanowires and nanotubes have drawn tremendous interest among researchers due to their unique electronic, optical and mechanical properties. In 1991, Iijima first synthesized carbon nanotubes (CNT) successfully [1]. After the exposure of the unique properties and potential applications of CNT, the scientific community investigated the properties of functionalized carbon nanostructures. These investigations further motivated researchers to examine the possibility of formation of nanotubes of other materials. As

a result, experimental efforts have been given for the synthesis of nanotubes of non-carbon materials such as WS_2, MoS_2, BN, AlN, GaN, ZnO, ZnS, CdS, CdTe, $H_2Ti_3O_3$, NiCl, TiO_2 and Si. Attractive results of these materials further encouraged exploration of the possibility of formation of tubular structures constituted by organic molecules.

Porphyrins are organic compounds and with extremely symmetrical, planar structures and they have been found to be stable. Four heterocyclic pyrrole rings connected by methine units constitute the backbone of the molecules. The four nitrogen (N) atoms from the four pyrrole rings strongly bind to the central metal atom to decorate in a tetra-coordinated fashion. The structure itself imparts mainly three types of possible modifications — at the pyrrolic β-sites, at the central metal atom and to the *meso* position at the methine bridges. Porphyrin plays a ubiquitous role in some natural biological processes, viz. photosynthesis, respiration, electron transport, *etc*. [2–3]. Due to the structural uniqueness, porphyrin shows some potential for applications such as dye sensitized solar cells (DSSC) [4–7], non-linear optics [8], gas sensing [9], catalysis [10–11] and chemical sensors [12–13].

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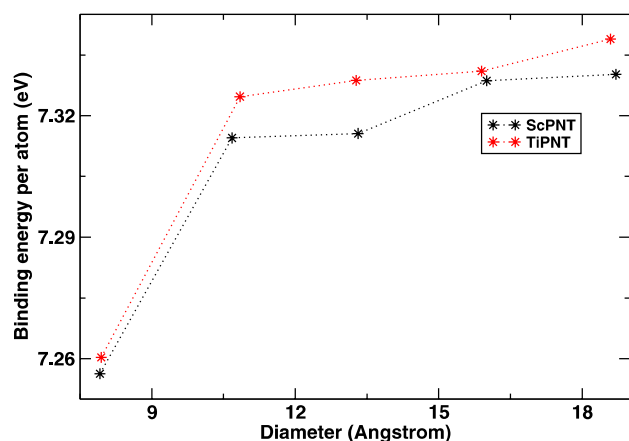
Fig. 5. Graphical representation of the variation in binding energy per atom with diameter for the ScPNTs and TiPNTs.

Table 1. Diameter (D) and binding energy (BE) of the ScPNTs and TiPNTs.

System	Tube name	Diameter (D) (Å)	BE (eV)
ScPNT	3ScPNT	7.91	7.256
	4ScPNT	10.68	7.314
	5ScPNT	13.31	7.315
	6ScPNT	16.00	7.328
	7ScPNT	18.70	7.330
TiPNT	3TiPNT	7.94	7.260
	4TiPNT	10.84	7.324
	5TiPNT	13.27	7.328
	6TiPNT	15.89	7.331
	7TiPNT	18.59	7.338

Table 2. Diameter (D) and curvature energy (E_c) of the ScPNTs and TiPNTs.

System	Tube name	Diameter (D) (Å)	E_c (eV)
ScPNT	3ScPNT	7.91	0.228
	4ScPNT	10.68	0.176
	5ScPNT	13.31	0.133
	6ScPNT	16.00	0.089
	7ScPNT	18.70	0.054
TiPNT	3TiPNT	7.94	0.193
	4TiPNT	10.84	0.146
	5TiPNT	13.27	0.103
	6TiPNT	15.89	0.065
	7TiPNT	18.59	0.035

the diameter range 7.91 to 18.70 Å and for TiPNTs, it varies from 7.2603 eV to 7.3389 eV in the diameter range 7.94 to 18.59 Å (Table 1). Our calculations reveal that

the TiPNTs are energetically more favorable compared to ScPNTs. Therefore, it appears that the transition metal atoms play a crucial role in determining the binding strength of the fused porphyrin nanotubes. In ScPNT and TiPNT, both Sc and Ti are in tetracoordinated "+2" state, *i.e.* Sc^{+2} and Ti^{+2}. The Sc^{+2} and Ti^{+2} have one and two electron(s) in their 3d orbitals, respectively. This excess electron density of Ti^{+2} compared to Sc^{+2} most probably provides higher binding ability to TiPNT than that in ScPNT. It is further observed that the BE of ScPNT and TiPNT increases with increasing diameter (*i.e.* from 3MPNT to 7MPNT). Any tubular-shaped nanostructures are generally designed from 2D nanosheets by folding in a particular direction. Thus, the nanotube can be considered structurally as the folded state of a nanosheet. In the case of MPNS, it is a highly symmetric, planar and aromatic 2D sheet. By the transmutation of the MPNS into nanotube (MPNT), the planarity as well as aromaticity is lost and as a result the strain is developed into the tubular structure. As a tube with smaller diameter has larger curvature, its strain becomes larger, and on the other hand a tube with larger diameter corresponds to smaller curvature and leads to develop a lesser strain.

In order to access the strain associated in the MPNTs, it is important to calculate the curvature energies (strain energies) of the nanotubes. Curvature energy is defined as the energy required for bending a 2D sheet into a nanotube. The curvature energy (E_c) is defined as the difference of binding energies between a 2D nanosheet and the corresponding nanotube (Equation 2):

$$E_c = E_{BE}(MPNS) - E_{BE}(MPNT) \qquad (2)$$

where $E_{BE}(MPNS)$ is the binding energy of a 2D planar porphyrin nanosheet and $E_{BE}(MPNT)$ is the binding energy of the porphyrin nanotube constructed from the 2D nanosheet. The curvature energies thus calculated for both ScPNT and TiPNT are presented in Table 2. In fact, curvature energy carries the signature of the mechanical tension of a nanotube. According to the classical elasticity

Table 3. $1/D^2$ and curvature energy (E_c) of the ScPNTs and TiPNTs.

System	Tube name	$1/D^2$ (Å)	E_c (eV)
ScPNT	3ScPNT	0.01597	0.228
	4ScPNT	8.766×10^{-3}	0.176
	5ScPNT	5.642×10^{-3}	0.133
	6ScPNT	3.905×10^{-3}	0.089
	7ScPNT	2.857×10^{-3}	0.054
TiPNT	3TiPNT	0.01584	0.193
	4TiPNT	8.505×10^{-3}	0.146
	5TiPNT	5.674×10^{-3}	0.103
	6TiPNT	3.958×10^{-3}	0.065
	7TiPNT	2.892×10^{-3}	0.035

the diameter increases from 7.94 Å to 18.59 Å. For both the cases, the work function increases with the increasing diameter. Furthermore, both kinds of tubes are found to obey classical elasticity behavior. Therefore, we conclude that the nanotubes consisting of metal-induced organic molecules may be used as band gap material for practical technological applications.

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A CRITICAL STUDY ON CHETAN BHAGAT AS A NOVELIST

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ABSTRACT:

The introduction of English education to India by colonial legislation resulted in the emergence of Indian English literature. Numerous Indian English writers have made significant contributions to modern English literature. Fiction is becoming the most influential form of literary expression in English-language Indian literature. The novel is usually regarded as the most appropriate literary vehicle for exploring contemporary experiences and conceptions, and Indian English literature occupies its legitimate place in the literary landscape. Chetan Bhagat, a novelist, is profiled in this paper in a variety of ways.

Keywords: Chetan Bhagat, Literature, Novelist, Legislation, Indian.

INTRODUCTION:

Chetan Bhagat's phenomenal success as a novelist is a marvel of an amazing technology. His management skills, the emergence of thousands of modern private engineering colleges requiring his mastery of simple past tense, his justification of depraved instinctive human actions in the guise of new age realism, and, above all, one word from the great Hindu philosophy known as Prarabdh-Throw a lucky man into the sea, and he will come up with a fish in his mouth Since the beginning of time, the best-selling English language author has been Chetan Bhagat. As the master of young generation feelings, a name and place, both in the hearts of their darling hearts and in society, the legend demands some serious examination and judgement. Five Point Person, The Three Mistakes of My Life, One Night @ The Call Center, Two States of My Marriage Life, and Revolution 2020 are among his five novels, which include adventure, romance, background

music, and expert commentary on financial, political, and educational frameworks [1]. This writing style is widely recognised as one of the main developments happening in the field of novel writing. Since publishing his first novel Five Point Someone in the year 2004, Chetan Bhagat has described the literary taste of maturing book lovers [2].

CHETANBHAGAT IN MODERN ENGLISH LITERATURE:

With the relentless emphasis on the sheer Indians, these writers have effectively smashed the Western tradition of seeing the East as the other, or sub-standard as set out by Edward Said in his Orientalism published in the year 78. The Call Center introduces itself as a trend setter in such a sense of Realism on the basis of urban setting and sophisticated bent by Chetan Bhagat One Night @. Published in 2005, this novel is more or less totally different from those written by Mulk Raj Anand, Raja Rao and the three great authors [3].

R.K. Narayan and other authors in a similar vein. Because of their focus on the crisis of self-problems, these writers attempted to develop a national Indian identity in their fiction. Following in the footsteps of Salman Rushdie, Arundhati Roy, Upamanyu Chatterjee, and Amitav Ghosh, Chetan Bhagat discovers a ready market for English writing in India. Chetan Bhagat is far more daring than the first-year masters, which is to be expected. This audacity is apparent in his portrayal in particular. It's worth noting that the vast majority of the characters portrayed by great Indian writers are, at their core, Indians. In Raja Rao's Kanthapura, for example, Moorthy is an idealist and a supporter of Gandhiyan Ahimsa and Satyagraha who wishes to overcome the traditional caste barriers—as is characteristic of a post-Independence educated Indian [4].

In R.K. Narayan's *Guide*, the character of Raju is a total conversion of his role as a tour guide to that of various Ashrams from Bramhcharya to Sanyas that is in keeping with the traditional Indian idea of purity. The porter boy Munno, in Mulk Raj Anand's *Coolie* points out the reality of the important Indian social system. Thus, it is very much clear that the ―trio had their primary task cut out for them-building a national Indian individuality. Contrary to all of this, the characters of Bhagat have basically Indian nonentity about them [5]. The key characters, the six executives of the Call Center – Esha, Radhika, Priyanka, Varun, Military Uncle and Shyam – may in reality belong to any other nationality. In their denial of the typical Indian value system, the surfacing of a new India can be located on India which is worlds apart from the Indian reality

with the exception of the length, which is a score or so more dense pages than the other three novels.

The tale depicts the ideal Indian mentality of rejecting intercaste marriages and the tradition of adhering to an age-old conservative and unworkable attitude. According to the novels, India is a deeply religious country, with older people holding strong religious beliefs and young people finding it difficult to respond. According to Bhagat, India urgently needs to solve the generational divide. The elder generation grew up in a time of scarcity and valued a suffocating social order in which everyone had their own but equal life. With a radical attitude that runs opposite to Indian caste and religion norms, the young are practically a race apart. The novelist expresses his optimism for inter-state marriage as a means of national integration that will significantly increase greater understanding between cultures, resulting in much-needed final unity, the absence of which has been explained by the novelist in My Life's Three Errors as the cause of the chaos in a country known for its tolerance around the world. Revolution 2020 calls for action on India's compromised education system, in which political elites utilize all of their power to line their own pockets rather than rule wisely and serve society. Chetan Bhagat encapsulates the thoughts of a new generation. His characters are not old folks, but rather young people. In his Five Points, the author discusses three IIT convicts. In his novel The Three Mistakes of My Life, the main character is someone, who is accompanied by three pals, whereas in One Night @the Call Centre, the main protagonists are a group of Call Center executives. He is well aware that India has the world's greatest youth population, and he is clever enough to target these inexperienced individuals.

CHETAN BHAGAT: THE ADVOCATE OF IMMORALITY

Chetan Bhagat, despite being widely read, does not convey any message to the nation's youth. None of his characters are heroic, and none of them have attractive human characteristics. The novelist is known for his greatest sellers, not for the creation of any intelligent characters; rather, most of the characters in his works are led by impulse, such as sleep, food, fear, sex, and self, and above all, unusual foolishness, which the money-minded author overvalues everywhere. Wilde, in the critic as Artist has made a witty statement:

The distinction between literature and journalism is that journalism is unreadable; so, there is no

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Editor speaks.............

Literature is always believed to be reflecting the society in different ages and genres. The pangs and panics, the trials and tribulations, the challenges and opportunities of life have been the co-travellers in the course of human progression. Celebration of successful episodes and expression of grief and frustration at the loss of targeted goals have remained the synonym of life. In the present day, the Corona pandemic panic has become a nightmare of human civilization. Literature is replete with the themes dwelling on epidemics and pandemics. And the renditions of heart rending episodes of the people have left indelible impression in the pages of history. Human civilization cannot forget the heart throbbing incidents that occurred during partition of India resulting in migration of people from one part of the country to the other for the safety and wellbeing of their families. The Pulitzer Prize winning picture of 'Starving Child and Vulture' (1993) of Kevin Carter reflecting the deplorable life during the famine in Sudan had once moved the whole world. The present pandemic has resulted in innumerable incidents that seem simply stories on the pages of books or sketches on canvas – millions of workers turning jobless, hoards of workers on foot covering hundreds of kilometers, wife losing husband, toddler playing hide and seek with the dead mother's sari, mother pulling the sleeping son atop a trolley bag, minor carrying the parents on a rickshaw, husband dragging the pregnant spouse on a self prepared toy trolley, father substituting the bullock in pulling the cart carrying his family, train running over the sleeping pedestrians on track, patients in developed countries sleeping beside numerous corpses, hoards of corpses getting cremated together and above all the whole world being locked down. The practice of social distancing, isolation and quarantine are given priority to check Covid-19 from spreading in an age when the world is a global village. The virus has taught the world to be united in waging a war against it with the motto "Vasudheiva Kutumvakam". In a state of the world coming back to the track, The Rock Pebbles family wishes its contributors, readers and well-wishers a healthy, safe and creative life.

-Editor

CONTENTS

Portrayal of Women in Literature in English and Bengali films: A Quest for Converging and Diverging Ideologies

Tamali Neogi

Through a detail thematic analysis of three texts and three Bengali films (not adaptions) which from the aspect of time are linked to three waves of feminism, the author tries to find the paths of convergence and divergence between the ideologies developed in literature and their plausible reflection in Bengali films in relation to the portrayal of women. Interesting is the finding to see that women in Bengali films are portrayed in a more positive mode than in literature in English, which further is supposed to create a 'correct' impression about women, mostly in Bengali society and hopefully nationwide because of its greater reach as a medium.

Key words : literature, film, women, ideologies-converging, diverging

> *"In general, divergence of readings is more interesting than convergence...."*

Jonathan Culler, *The Pursuit of Signs*, 51.

Literature and film do essentially share certain common aspects as both of them are super structures reflecting reality. Not surprisingly, both, the author and the director, at a specific historical period, may share the same goals and ideologies. "Cinema and literature constantly tend both to converge and to diverge, and not only in the case of film adaption" (Ed. Casetti 1999). However, the portrayal of women in cinema and literature is the biggest cliché to be addressed by the feminist literary criticism. Eventually in Indian context (Indian history of feminism traditionally indicates a division into three phases _first phase ranging from 1850s to 1915, the second from 1915 to 1947 and the third one from 1947 onwards), because of variations at the degree of growth, the history of feminism does not always reflect the same parameters of development as maintained in the westernized history of feminism, categorized into first(19th and early 20th century), second(up to 1970s) and third(1980s to 2012)waves. Viewing the portrayal of women in Bengali films and literature in English, the author of the present paper wishes to examine two specific aspects as follow: How do post-independent Bengali films(Bengali talkies got started in 1931 and in different opinion 1934) reflect the attitude of women towards acquiring their rights and moreover

Draupadi) is tortured and raped throughout that night. After the brutalities, Dopdi doesn't complain or wail or behave like a helpless victim. In the morning she simply refuses to put on clothes. She walks naked towards Senanayak, the army chief, in the open daylight, very uplifted and straight. 3-The message of the short story to the author is, women should not view their body as point of weakness but that one of strength as that of Kali. Dopdi uses her "muscularity" by using her 'toned' body as a weapon against the army. Army men rape Dopdi incessantly throughout the night. In the next morning Dopdi converts her body into a revenge body and she successfully uses it as a weapon against the army chief, the agent of torture.

"Parama"(1984), which is said to be the most feministic film of the director, is made to celebrate womanhood and the concept of new, free woman. The story, the script, the symbolic pattern lead the author to the following conclusions:1-Parama is subjected to gender oppression in the familial context; her capabilities in music and her sexual desires are strongly suppressed by her family. 2-In main stream society, in an affluent middleclass family, a woman is respected as goddess till she submits to all its rules and performs all of her roles _in the context of the film, a daughter-in-law, a wife and a mother _in an uncomplaining manner(symbolically presented by the Durga Puja celebration). 3- The film raises the question "are these contexts are enough to define her entire existence to the exclusion of her independent identity? "(Ed. Ghosh and Bose 1996). The film raises another question whether a woman who has so far performed all the roles successfully, has any right to be happy in her own way or not? And most importantly the other question is asked too that is, can a woman at all depend on a man to fulfill herself? The probable answer is 'no' as at the end it no longer matters to Parama whether Rahul who vanishes all of a sudden can be traced or not. The newspaper cutting, containing a report on Rahul's activity is symbolically just blown away in the air and Parama does not try a bit to have a hold on that. 4- The double-standardness of society on gender issue inside home, has been the most significant agenda of second wave feminists worldwide. Whatsoever, the film raises this question as to how a man who continuously mix business with sexual pleasure(be it wife or secretary) and himself occasionally tries to seduce girls (during business trips), can pose such as having high moral standards? Parama significantly confronts her husband with this question: "Didn't you ever commit a mistake?" 5- The condescending attitude of Subhash Chowdhury towards Parama(for instance while he talks with her over telephone, being at the business trip) reminds the author of Trovald Helmer's attitude towards Nora. Isn't it high time that a grown up woman should be taken by her male counterpart not as child-wife but a degree more seriously? 6- The next question that is asked is, whether a woman is only entitled to enjoy as much independence as is permitted by her family members or not? And furthermore, what is independence without economic independence? Parama comes to accept the job of a saleswoman finally, offered to her by her friend Sheela. 7- The film gives a caution that while seeking fulfillment at the outside world, a woman is to remember that it is full of the possibilities of betrayals, "sexual exploitation in the name of liberation"(Ed. Ghosh and Bose 1996). 8- The film even gives a lesson to the patriarchal society that on

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Strangers ''here and everywhere'': the Social Discourse in the Literature of Partition

Tamali Neogi

> "Many besides Angel have learnt that the magnitude of lives is not as to their external displacements but as to their subjective experiences."
>
> Thomas Hardy, *Tess of the D'Urbervilles*

Abstract

The paper aims to focus how in a literary text, (here Sunil Ganguli's *East West*) in contrast to any historical record, that is perceived to be distorted at times, through the subjective experiences of East Bengali refugees in West Bengal, a truthful account of dislocation and the consequent human tragedy caused by partition is created. How on part of the refugees, nostalgia for lost homeland causes inhibitions in developing the sense of belongingness to the new land is examined here in detail. To what extent the resettlement becomes a terribly problematic issue because of some crucial socio-political causes like Central Government's discrimination against them, the hostile and unwelcoming attitude of the locals towards them, is relevantly discussed here. Furthermore, the refugees' changing attitudes to their lost homeland and the place of migration over generations are captured here alongside their struggles to establish new identities at the foreign soil. More importantly, the author has tried to find out whether the displacement creates more challenges for the refugees in attaining new cultural identities in a new land or not, that is in other words, whether the displaced East Bengali community has to undergo the journey through the 'in-between space' of cultural hybridity or not (it happens to be a related crisis of dislocation), is the other major concern of the present paper.

Keywords: displacement, nostalgia, relocation, cultural identity

In August 1947, the subcontinent was partitioned into two independent nation states which immediately caused one of the greatest migrations in human history. The rearrangement of the map unleashed a torrent of bloodshed and violence scarcely seen before or since. An estimated fifteen million people were displaced with close to two million killed. Thus Partition forces millions of people to choose the life of exile. It is rightly said that

"Partition is central to modern identity in the Indian subcontinent'' (Dalrymple 2015). "Partition literature" embodies the pathos of dislocation, the insight of hardships that the common innocent people faced and endured. In his editorial in *The Pakistan Times,* 1947, Faiz Ahmad Faiz observes: "The Muslims have got their Pakistan, the Hindus and Sikhs their divided Punjab and Bengal, but I have yet to meet a person, Muslim, Hindu or Sikh who feels enthusiastic about the future. I can't think of any country whose people felt so miserable on the eve of freedom and liberation." Partition writers have tried to record the loss of home and identity, trauma and violence that people undergo during and after partition. There have been significant engagements with it in Bengali novels that throw light on the efforts of the East Bengali refugees to rehabilitate themselves in West Bengal. The author here has tried to understand the real nature of the crises of these displaced people.

To know the essential features of the existence of the marginal people the author's proposition is to explore the experience of the East-Bengali refugees through a literary text and not through historical records because History is, as perceives Butalia, largely "state-centric and nationalistic" (Butalia 1998) whereas literature is people centric in examining the lives of common, ordinary and marginalized people. Dr. Asaduddin says: Partition is "one of the most massive demographic dislocations in history, with its attendant human tragedy… it defies chronicles to come to grip with it in all its dimensions" (Ganie and Rathor 2016). Though the great Indian national leader Mahatma Gandhi was all against partition, his ultimate comment on partition is "Partition is bad. But whatever is past is past. We have only to look to the future" (Nix 2013). But to a poet who experiences partition, "Present means past." (My translation, ''Ak shringa gandar o nartaki" by Faiz Ahmed Faiz). Thus dichotomy persists to be there between the prevalent political history of a phenomenon and literature reflecting that in its own way. Just before Partition Gandhi says in an interview: "The question of the exchange of population is unthinkable and impracticable. This question never crossed my mind….The logical consequence of any such step is too dreadful to contemplate" (Ajgaonkar 2002). The author tries to explore the 'dreadful' subjective experiences of the displaced individuals from various dimensions, keeping in view the related aspects of timelessness and ambivalence of belongingness, nostalgia, confused spatial zones of existence, split identities, hybridity and the question of nation formation beyond boundaries, as are found in Sunil Ganguli's *East-West* . We are to remember that Partition does not mean the same for Punjab and Bengal as is aptly pointed out by Rituparna Ray (Ray 2009). The author further proposes to examine how does Sunil's *East-West* besides capturing the consequences of Partition, also gives us a most poignant portrayal of the plight of East-Bengali refugees, the victims of severe injustice.

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Quantum Anharmonic Oscillator with Velocity- and Position-Dependent Anharmonicities: an Exactly Solvable Model under Rotating Wave Approximation

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Abstract: The electromagnetic field coupled to a nonlinear medium of having nonvanishing polarizations and magnetizations could be modeled as a classical anharmonic oscillator with velocity- and position-dependent anharmonicities. The Hamiltonian corresponding to the quantum anharmonic oscillator with velocity- and position-dependent anharmonicities is obtained from the knowledge of its classical counterpart. Under rotating wave approximation, the solution of the oscillator with $q-dependent$ and $p-dependent$ anharmonicities exhibit the shifts of the resonance peak frequency. Interestingly, the shifts of the resonance peak of the oscillator due to the $q-dependent$ anharmonicity is opposite to those of the corresponding shifts due to the $p-dependent$ anharmonicity. Therefore, the shifts of the resonance peak frequency asserts the presence of particular anharmonicity as well (i.e $p-$ or $q-type$)

Keywords: Quantum anharmonic oscillator ; Normal ordered form ; Rotating wave approximation.

1 Introduction

The model of a simple harmonic oscillator (SHO) arises when a particle moves under the action of a restoring force. The SHO model is an ideal one and is extremely useful for the explanation of basic physics. However, for real physical systems, the inclusion of damping and or anharmonicities are inevitable. In the present investigation, we neglect the damping altogether. By anharmonic oscillator, we normally mean the presence of $q-dependent$ (q is the position coordinate of the oscillator) anharmonicity. Because of the wide range of applications and of the fundamental nature of the problem, the problems of anharmonic oscillator have attracted people from various branches of physics [1-8]. In addition to the $q-dependent$ anharmonicity, we often encounter the $p-dependent$ (p is the velocity of the oscillator with rest mass unity) anharmonic contribution due to the relativistic correction of the kinetic energy term [9-11]. Now, the Hamiltonian of a classical oscillator with unit mass and unit frequency with $q-dependent$ and $p-dependent$ anharmonicities is given by

$$H = \frac{p^2}{2} + \frac{q^2}{2} - k_1 p^{2l} + \lambda_1 q^{2m} \qquad (1)$$

where k_1 and λ_1 are small positive constants. Of course, the Hamiltonian (1) is extremely simple in structure since we neglect the coupling between k_1 and λ_1 if any. Note that $l \geq 2$ and $m \geq 2$ are integers. For $\lambda_1 = 0\,(k_1 = 0)$, the equation (1) corresponds the Hamiltonian of an $l\,(m)-th$ anharmonic oscillator with $p\,(q) - dependent$ anharmonicity. Now, the quantum mechanical counterpart of the Hamiltonian (1) is obtained by the replacement of the classically conjugate position $q(t)$ and momentum $p(t)$ by their corresponding operators. During the passage from classical anharmonic oscillator governed by the Hamiltonian (1) to the corresponding quantum mechanical oscillator, the fundamental equal time commutation relation between the position and momentum operators should be respected. Depending upon the problems of interests, we solve the quantum anharmonic oscillator in two different formalism. In Schrödinger formalism (SF), the time development of the eigenfunction and hence the energy eigenvalues are obtained. On the other hand, the Heisenberg formalism (HF) gives rise to the time development of the operators. Most of the problems involving quantum anharmonic oscillators are solved under SF. However, the quantum anharmonic oscillator under HF still unexplored to its full

In spite of the complicated nature of the analytical expressions (17) and (18), it is possible to adopt an approximate method to obtain the analytical solution to the Hamiltonian (17). However, it is our purpose to explore the analytical solution of the oscillator by neglecting the non-conserving energy terms. In order to obtain an exact analytical solution to the above Hamiltonian (17), we use the *rotating wave approximation* (RWA). The idea behind the RWA is to remove the fast rotating terms from the Hamiltonian (17). Removal of the fast rotating terms also ensure the conservation of the total energy. Under the RWA, the Hamiltonian (17) reduces to

$$
\begin{aligned}
\hat{H} = {} & \hat{a}^\dagger \hat{a} - \frac{k}{l} \hat{a}^{\dagger l} \hat{a}^l + \frac{\lambda}{m} \hat{a}^{\dagger m} \hat{a}^m \\
& - \frac{k_1}{2^l} \sum_{r=1}^{l} (2r-1)!!^{2l} C_{2r}{}^{2l} C_{l-r} \times \hat{a}^{\dagger l-r} \hat{a}^{l-r} \\
& + \frac{\lambda_1}{2^m} \sum_{r=1}^{m} (2r-1)!!^{2m} C_{2r} \times^{2m} C_{m-r} \hat{a}^{\dagger m-r} \hat{a}^{m-r}
\end{aligned} \tag{22}
$$

where $k = \dfrac{k_1 \times \{1\cdot3\cdot5\cdot7\cdot9 \cdots\cdots (2l-1)\}}{(l-1)!}$ and $\lambda = \dfrac{\lambda_1 \times \{1\cdot3\cdot5\cdot7\cdot9 \cdots\cdots (2m-1)\}}{(m-1)!}$ are proportional to k_1 and λ_1 and are called the anharmonic constants for $p-dependent$ and $q-dependent$ anharmonic oscillators respectively. The last two terms under summation signs appear due to the ordering of the field operators in normal form. These terms are proportional to k_1 and λ_1 respectively. Upon dropping the terms under summation signs, the Hamiltonian (22) reduces to the following form

$$
\hat{H}_c = \hat{a}^\dagger \hat{a} - \frac{k}{l} \hat{a}^{\dagger l} \hat{a}^l + \frac{\lambda}{m} \hat{a}^{\dagger m} \hat{a}^m \tag{23}
$$

For $l = 0$, the equation (23) corresponds the Hamiltonian for a $m-photon$ anharmonic oscillator [17-19]. Interestingly, this Hamiltonian is widely used to investigate the squeezing, phase properties and other nonclassical properties of the coherent light coupled to the $m-photon$ anharmonic oscillator [17-19]. By analogy, for $\lambda = 0$, the equation (23) corresponds the Hamiltonian for a $l-photon$ anharmonic oscillator. Of course, the nature of anharmonicities in these two cases are completely different. Admittedly, under Schroedinger formalism, Maduemezia [9-10] obtained the solution of an oscillator with $p-dependent$ anharmonicity. However, under Heisenberg formalism, the solution of an oscillator with $p-dependent$ anharmonicity is yet to be explored. In this way, the present investigation is a first one which takes care both these $p-dependent$ and $q-dependent$ anharmonicities. Now, the equation of motion for the annihilation operator $\hat{a}$ corresponding to the Hamiltonian (22) is given by

$$
\dot{\hat{a}} = -i \hat{O} \hat{a} \tag{24}
$$

where the operator

$$
\begin{aligned}
\hat{O}(t) = {} & 1 - k \hat{a}^{\dagger l-1} \hat{a}^{l-1} + \lambda \hat{a}^{\dagger m-1} \hat{a}^{m-1} \\
& - \frac{k_1}{2^l} \sum_{r=1}^{l} (l-r)(2r-1)!!^{2l} C_{2r} \times^{2l} C_{l-r} \hat{a}^{\dagger l-r-1} \hat{a}^{l-r-1} \\
& + \frac{\lambda_1}{2^m} \sum_{r=1}^{m} (m-r)(2r-1)!!^{2m} C_{2r} \\
& \times^{2m} C_{m-r} \hat{a}^{\dagger m-r-1} \hat{a}^{m-r-1}
\end{aligned} \tag{25}
$$

is constant of motion $(i.e\, [\hat{H}, \hat{O}] = 0)$. The time independent nature of the operator $\hat{O}(t) = \hat{O}(0)$ helps us to find the exact solution to the differential equation involving the annihilation operator $\hat{a}$ (24). The corresponding solution is given by

$$
\hat{a}(t) = \exp[-it\hat{O}(0)]\hat{a}(0) \tag{26}
$$

Obviously, the solution for the creation operator $\hat{a}^\dagger$ follows immediately by taking the Hermitian conjugate of the equation (26)

$$
\hat{a}^\dagger(t) = \hat{a}^\dagger(0) \exp[it\hat{O}(0)] \tag{27}
$$

The equations (26) and (27) could be used to establish that the relation (16) is valid indeed. By using the equations (14), the position and momentum operators are easily calculated to obtain the solution of the quantum oscillator governed by the Hamiltonian (23). Clearly, the solutions (26), (27) along with the operators $\hat{q}(t)$ and $\hat{p}(t)$ could be used to investigate the quantum statistical properties of the radiation field coupled to a nonlinear medium of having $q-$ and $p-dependent$ anharmonicities. Of course, these studies are altogether different issues and we do not have any intention to discuss here. Now, we rearrange the term $\hat{a}^{\dagger m} \hat{a}^m$ in the following convenient form

$$
\hat{a}^{\dagger m} \hat{a}^m = \hat{a}^\dagger \hat{a}(\hat{a}^\dagger \hat{a} - 1)(\hat{a}^\dagger \hat{a} - 2) \cdots\cdots (\hat{a}^\dagger \hat{a} - \overline{m-1}) \tag{28}
$$

where $m \geq 1$ is an integer. In terms of the number state basis, we calculate the expectation values of the operator $\hat{a}^{\dagger m} \hat{a}^m$

$$
\begin{aligned}
\langle n| \hat{a}^{\dagger m} \hat{a}^m |n \rangle &= n(n-1)(n-2)\cdots\cdots (n - \overline{m-1}) \\
&= n!/(n-m)!
\end{aligned} \tag{29}
$$

where n is the eigenvalue of the number operator $\hat{a}^\dagger \hat{a}$ corresponding to the eigenstate (number state) $|n\rangle$. By using the equations (14) and (26), the time evolution of the position and momentum operators of the oscillator under investigation may also be found. It is possible to calculate the dipole moment matrix elements from the knowledge of the position operator. The shifts of the frequency of the oscillator may also be evaluated from the knowledge of the dipole moment matrix elements. As a matter of fact, the shift of the frequency of the oscillator may also be obtained from the knowledge of the matrix elements $\langle n| \hat{a}(t) |n+1\rangle$. Hence, we have

$$
\langle n| \hat{a}(t) |n+1 \rangle = \sqrt{n+1} \exp(-itf) \tag{30}
$$

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Nonlinear effects on the dynamics of quantum harmonic modes coupled through angular momentum

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Abstract

We investigate nonlinear effects on the dynamics of entanglement and other quantum observables in a system of two harmonic modes coupled through angular momentum. The nonlinearity arises from a Kerr-type anharmonic term in each mode. The emergence and evolution of entanglement, non-Gaussianity, photon number, photon antibunching and squeezing are examined for different initial coherent product states and couplings, through exact diagonalization in a truncated basis. It is shown that the anharmonic terms, even if weak, can lead to very significant effects for such initial states, considerably enhancing and stabilizing entanglement and leading to a non negligible non-Gaussianity of the evolved states. They also affect other observables, stabilizing the dynamics after an initial transient regime, for not too small initial average populations of each mode. Analytic short-time approximate expressions are also provided.

Keywords: quantun dynamics, coupled harmonic modes, nonlinear effects, quantum entanglement

(Some figures may appear in colour only in the online journal)

1. Introduction

Nonlinear effects can lead to the development of non trivial phenomena in many distinct scenarios. In the field of quantum optics nonlinear processes give rise, for instance, to spontaneous parametric down conversion [1], a fundamental tool for generating entangled photons and hence of most importance in the field of quantum optics [2] and quantum information [3, 4]. Another well known process associated with nonlinearity is the Kerr effect [1, 2, 5], which plays a fundamental role in the emergence of a wide variety of nonclassical phenomena. Kerr nonlinearities were employed for generating squeezing in optical fields [5–8] and for obtaining macroscopic coherent states superpositions ('Schrödinger cat states') [9–12],

entangled coherent states [13, 14] and Bell-type states [15]. They have also been used for implementing quantum gates for quantum computation [3, 16–20], quantum teleportation [21] and other quantum information protocols [22, 23], through optical platforms. The effects of Kerr terms have been recently investigated in connection with the enhancement of entanglement and other non classical properties in short chains of non linear oscillators [24, 25] as well as in the context of Bose Einstein condensates [26–29] and parity-time ($\mathcal{P}T$) symmetric systems [30]. Kerr-like nonlinearities can now be also realized through Rydberg excitations in ultra-cold atomic ensembles (Rydberg nonlinear quantum optics) [31–33] and through Josephson junctions in microwave photonics [34, 35].

Motivated by these developments our aim is to investigate, in a system of two harmonic modes interacting through a

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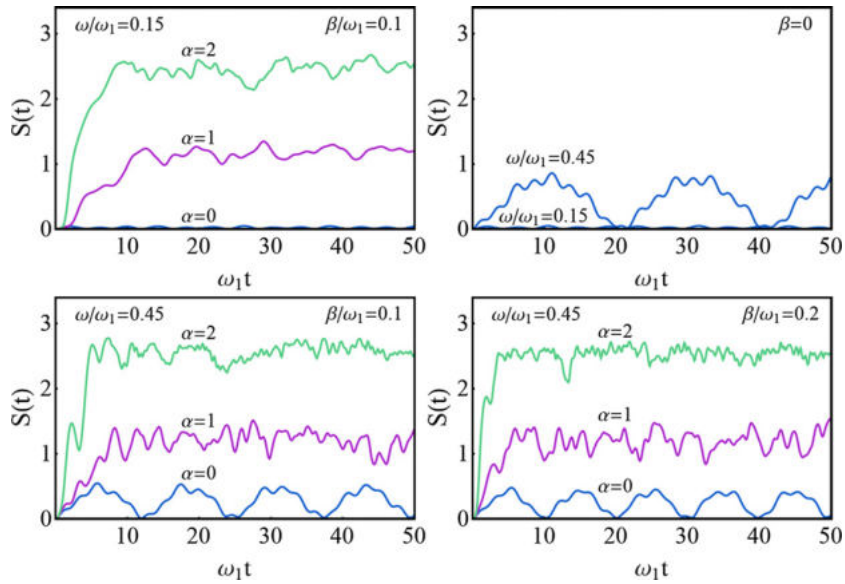
Figure 1. Evolution of the entanglement entropy $S(t)$ for coherent product initial states $|\alpha, \alpha\rangle$, equation (12), and different values of the quartic anharmonic coupling $\beta = \beta_1 = \beta_2$ in H for $\omega_2 = \omega_1/2$ and two values of the quadratic coupling ω in (7). For $\beta = 0$ (top right panel), entanglement is independent of α and significant just for sufficiently large ω. In contrast, for $\beta \neq 0$ (top left and bottom panels) entanglement depends strongly on the initial state, stabilizing around an average value which depends only weakly on β and ω (bottom panels).

in [56]. Equation (14) constitutes a proper Bogoliubov transformation (such that $[a_i(t), a_j^\dagger(t)] = \delta_{ij}$, $[a_i(t), a_j(t)] = [a_i^\dagger(t), a_j^\dagger(t)] = 0 \quad \forall\, t$). Averages at time t of any observable O can then be determined by replacing the operators $a_i, a_i^\dagger$ by $a_i(t)$ and $a_i^\dagger(t)$ respectively and evaluating the ensuing expression in the initial state (12). We have also checked that the numerical procedure employed for the complete Hamiltonian leads in the quadratic case to the same results obtained from the analytic expressions within the working tolerance.

3.1. Entanglement and non-Gaussianity

We will first analyze the emergence and evolution of entanglement between the two modes. It can be quantified through the entanglement entropy, which is the entropy of the reduced state of a single mode:

$$E_{12}(t) = S(\rho_1(t)) = S(\rho_2(t)), \tag{15}$$

where $S(\rho_i(t)) = -\mathrm{Tr}\rho_i(t)\log_2\rho_i(t)$ is the von Neumann entropy and $\rho_{1(2)}(t) = \mathrm{Tr}_{2(1)}|\Psi(t)\rangle\langle\Psi(t)|$ are the isospectral reduced density matrices of each mode.

In the quadratic case $\beta_1 = \beta_2 = 0$, the global state $|\Psi(t)\rangle$ will remain Gaussian at all times, implying Gaussian single mode reduced densities. The entanglement between the two modes will then be determined solely by the single mode covariance matrix, implying that it will be independent from the values of α_1, α_2 determining the initial coherent state, coinciding with that generated from the initial vacuum. Explicitly, in the quadratic case equation (15) becomes

$$S(\rho_i(t)) = S_g(f_i(t)) \quad (\beta_1 = \beta_2 = 0) \tag{16}$$

$$S_g(f_i(t)) = -f_i(t)\log_2 f_i(t) + (1 + f_i(t))\log_2(1 + f_i(t)), \tag{17}$$

where $f_i(t) = \sqrt{(\langle a_i^\dagger(t)a_i(t)\rangle - |\langle a_i(t)\rangle|^2 + \frac{1}{2})^2 - |\langle a_i^2(t)\rangle - \langle a_i(t)\rangle^2|^2} - \frac{1}{2}$, is the symplectic eigenvalue of the single mode covariance matrix, with $f_1(t) = f_2(t)$ in the quadratic case.

We remark, nevertheless, that in the presence of Kerr terms ($\beta_1 > 0, \beta_2 > 0$) equation (16) no longer holds and the generated entanglement is to be computed through equation (15). It will strongly depend on the initial values of α_1, α_2. Moreover, the difference between (17) and (15),

$$\Delta S_i(t) = S_g(f_i(t)) - S(\rho_i(t)), \tag{18}$$

is an indicator of non-Gaussianity of the evolved state.

Results for the evolution of the entanglement entropy are shown in figure 1, for different initial coherent states. We have set $\omega_2 = \omega_1/2$ and used two values of the coupling ω in (2): $\omega = 0.15\omega_1$ (weak quadratic coupling) and $\omega = 0.45\omega_1$ (strong quadratic coupling regime, where ω is close to ω_2 i.e. to the instability border of the quadratic case $\beta_i = 0$). We have also used two different values of the quartic anharmonic coupling, setting $\beta_1 = \beta_2 = \beta$.

It is seen that the presence of quartic terms in H has a very significant effect on the evolved entanglement, even for small β. In the first place the generated entanglement depends strongly on the initial value of α, i.e., on the initial average boson number, as seen in the left top and bottom panels, increasing substantially with α. This is in sharp contrast with the quadratic case $\beta_i = 0$ (top right panel) where it is independent of α, i.e., the same as that obtained when the initial state is the vacuum (an analytical result verified in the numerical calculations). In the pure quadratic case entanglement from the initial vacuum is generated by the pair creation terms in (2) (λ_2 coupling), rather than the λ_1 coupling, remaining then small in the weak coupling regime. However, for $\beta \neq 0$ the

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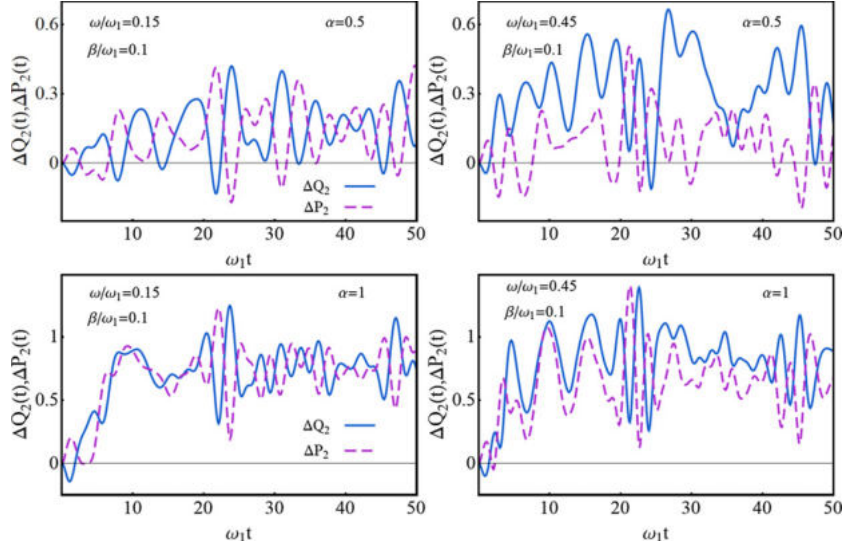
Figure 5. Evolution of the shifted squeezing ratios $\Delta Q_2(t)$ and $\Delta P_2(t)$ for $\beta = 0.1$ and $\omega/\omega_1 = 0.15$ (left panels) and 0.45 (right panels) for an initial coherent state with $\alpha = 0.5$ (top panels) and $\alpha = 1$ (bottom panels).

The exact equations of motion for the Heisenberg field operators $a_i(t) = e^{\imath H t/\hbar} a_i(0) e^{-\imath H t/\hbar}$ are

$$\dot{a}_1 = \frac{\imath}{\hbar}[H, a_1(t)] = -\imath\omega_1 a_1 + \lambda_1 a_2 + \lambda_2 a_2^\dagger - 2\imath\beta_1 a_1^\dagger a_1^2$$
$$\dot{a}_2 = \frac{\imath}{\hbar}[H, a_2(t)] = -\imath\omega_2 a_2 - \lambda_1 a_1 + \lambda_2 a_1^\dagger - 2\imath\beta_2 a_2^\dagger a_2^2,$$
(25)

where $a_i \equiv a_i(t)$. These equations are obviously nonlinear in the field operators for $\beta_i > 0$. From (25) we can obtain the second derivatives as $\ddot{a}_i = (\frac{\imath}{\hbar})^2[H, [H, a_i]]$:

$$\ddot{a}_1 = -(\omega_1^2 + \lambda_1^2 - \lambda_2^2)a_1 - \imath\lambda_1(\omega_1 + \omega_2)a_2 - \imath\lambda_2(\omega_1 - \omega_2)a_2^\dagger$$
$$- 4\beta_1\omega_1 a_1^\dagger a_1^2 - 2\imath\beta_2 a_2^\dagger(\lambda_1 a_2 - \lambda_2 a_2^\dagger)a_2 - 4\imath\beta_1 a_1^\dagger a_1$$
$$\times (\lambda_1 a_2 + \lambda_2 a_2^\dagger) - 2\imath\beta_1 a_1^2(\lambda_1 a_2^\dagger + \lambda_2 a_2) - 4\beta_1^2 a_1^\dagger a_1 a_1^\dagger a_1^2$$

$$\ddot{a}_2 = -(\omega_2^2 + \lambda_1^2 - \lambda_2^2)a_2 + \imath\lambda_1(\omega_1 + \omega_2)a_1 + \imath\lambda_2(\omega_1 - \omega_2)a_1^\dagger$$
$$- 4\beta_2\omega_2 a_2^\dagger a_2^2 + 2\imath\beta_1 a_1^\dagger(\lambda_1 a_1 + \lambda_2 a_1^\dagger)a_1 + 4\imath\beta_2 a_2^\dagger a_2$$
$$\times (\lambda_1 a_1 - \lambda_2 a_1^\dagger) + 2\imath\beta_2 a_2^2(\lambda_1 a_1^\dagger - \lambda_2 a_1) - 4\beta_2^2 a_2^\dagger a_2 a_2^\dagger a_2^2.$$
(26)

The first terms of the Taylor series of $a_i(t)$ around $a_i(0)$ are then given by

$$a_i(t) = a_i(0) + t\dot{a}_i(0) + \frac{t^2}{2}\ddot{a}_i(0) + O(t^3). \quad (27)$$

and the second order short time approximation is obtained neglecting terms $O(t^3)$. Setting now $a_i(0) = a_i$ we obtain

$$a_1(t) = [1 - \imath\omega_1 t - (\omega_1^2 + \lambda_1^2 - \lambda_2^2)\frac{t^2}{2} + \ldots]a_1 + [\lambda_1 t$$
$$- \imath\lambda_1(\omega_1 + \omega_2)\frac{t^2}{2!} + \ldots]a_2 + [\lambda_2 t - \imath\lambda_2(\omega_1 - \omega_2)$$
$$\frac{t^2}{2!} + \ldots]a_2^\dagger - [2\imath\beta_1 t + 4\beta_1(\beta_1 + \omega_1)\frac{t^2}{2!}]a_1^\dagger a_1^2$$

$$+ \left[2\imath\beta_2 a_2^\dagger(-\lambda_1 a_2 + \lambda_2 a_2^\dagger)a_2 - 4\imath\beta_1 a_1^\dagger a_1(\lambda_1 a_2 + \lambda_2 a_2^\dagger)\right.$$
$$\left. - 2\imath\beta_1 a_1^2(\lambda_1 a_2^\dagger + \lambda_2 a_2) - 4\beta_1^2 a_1^{\dagger 2} a_1^3\right]\frac{t^2}{2!} + \ldots$$

$$a_2(t) = [1 - \imath\omega_2 t - (\omega_2^2 + \lambda_1^2 - \lambda_2^2)\frac{t^2}{2} + \ldots]a_2$$

$$+ [-\lambda_1 t + \imath\lambda_1(\omega_1 + \omega_2)\frac{t^2}{2!} + \ldots]a_1$$

$$+ [\lambda_2 t + \imath\lambda_2(\omega_1 - \omega_2)\frac{t^2}{2!} + \ldots]a_1^\dagger$$

$$- [2\imath\beta_2 t + 4\beta_2(\beta_2 + \omega_2)\frac{t^2}{2!}]a_2^\dagger a_2^2$$

$$+ \left[2\imath\beta_1(\lambda_1 a_1^\dagger a_1 + \lambda_2 a_1^\dagger)a_1 + 4\imath\beta_2 a_2^\dagger a_2(\lambda_1 a_1 - \lambda_2 a_1^\dagger)\right.$$
$$\left. + 2\imath\beta_2 a_2^2(\lambda_1 a_1^\dagger - \lambda_2 a_1) - 4\beta_2^2 a_2^{\dagger 2} a_2^3\right]\frac{t^2}{2!} + \ldots. \quad (28)$$

By taking the Hermitian conjugate of (28) we obtain the creation operators for the two field modes. The commutation relations $[a_i(t), a_j^\dagger(t)] = \delta_{ij}$ are verified up to second order. These expressions can be used to determine the initial trend of the evolution of any observable. For instance, the population of the first mode $N_1(t) = a_1^\dagger(t)a_1(t)$ is given by

$$N_1(t) = a_1^\dagger a_1 + \left[\lambda_1(a_1^\dagger a_2 + a_2^\dagger a_1) + \lambda_2(a_1 a_2 + a_1^\dagger a_2^\dagger)\right]t$$

$$+ \left[-2(\lambda_1^2 - \lambda_2^2)a_1^\dagger a_1 + \imath\lambda_1(\omega_1 - \omega_2)\right.$$
$$\times (a_1^\dagger a_2 - a_2^\dagger a_1) + \imath\lambda_2(\omega_1 + \omega_2)(a_1^\dagger a_2^\dagger - a_1 a_2)$$
$$+ 2\lambda_1\lambda_2(a_2^{\dagger 2} + a_2^2) - 2\imath\left\{\beta_1 a_1^\dagger[\lambda_1(a_1^2 a_2^\dagger - a_1^\dagger a_1 a_2)\right.$$
$$+ \lambda_2(a_1^2 a_2 - a_1^\dagger a_1 a_2^\dagger)] + \beta_2 a_2^\dagger[\lambda_1(a_1 a_2^\dagger a_2 - a_1^\dagger a_2^2)$$
$$\left.\left. + \lambda_2(a_1^\dagger a_2^\dagger a_2 - a_1 a_2^2)]\right\}\right]\frac{t^2}{2} + \ldots. \quad (29)$$

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Private Tuition versus Regularity in Classes as Tools of Achieving Higher Score in Examination: Evidences from Purulia District in West Bengal

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Abstract

This study assesses the impact of private tuition, which is a common and dominant phenomenon in education system in India, on the scores of the students along with the regular attendance in the schools in Purulia district, a western most district in West Bengal. This empirical study is based on a set of primary data collected from 309 students of class X from 20 public schools of ten blocks in Purulia district in 2020. This study reveals that regular attendance is more important than spending on private tuition to achieve better score in examination. The average score is 5 percentage-points higher for the students with regular attendance over the year than other students. Other things remaining unchanged, if the household spend 100 rupees more per month for private tuition the average percentage of score increases only by 0.5 percentage points. Thus regularity in classes is far better instrument than private tuition for improving the scores in examination. We find that both the SC and ST students fall behind the students belonging to General castes and OBCs in respect of the percentage of score in last final examination. However, the interaction effect of private tuition expenditure with SC category increases the average score in last exam, while this interaction effect for ST students does not appear significant. Therefore, private tuition may help the students belong to lower social castes.

Keywords: Private Tuition, Purulia district, Regularity in School, Scoring function of Education

Introduction

The main purpose of education is all round development of a student. It is the human development purpose of education system. In this sense school education is crucial for building and maintaining the social structures and values of a nation. Partially, the education system helps students to learn a particular syllabus and assesses and classifies the students on the basis of educational achievement. Regularly higher achieving students are selected for higher education and for attractive occupation. This is referred to as 'scoring' function of education (Muralidharan, 2019). Traditionally Indian education system is driven by scoring rather than human development. With this end in view; Muralidharan, (2019) has argued that current Indian education system is best understood as a filtration system. There is nothing wrong with the scoring function of the education system. Every country in the world takes the help of academic scores at different stage of education to identify its most talented citizens and pick them for serving the society as a whole in an efficient manner. Further, employers use the scores of the student as signal of their capability. So parent considers expenditure on education as a good investment. Achievement in examination is considered as the return of investment. However, an important point is that, in scoring based education system there is no formal facility of teaching to the students with low scores in achievement. That is why; private tuition is needed for pushing the students with low scores and capacity as well as for

Father's Education: It is a time variable indicating the years of schooling of the father of the student. It is the control variable in our regression model.

Mother's Education: It is a time variable indicating the years of schooling of the mother of the student. It is also a control variable in our regression model.

Caste: We collect our data from four conventional castes i.e., GEN, OBC SC, and ST But in regression model we have included two dummies; one for caste SC (SC=1 and 0 otherwise) and another caste ST (ST=1 and 0 otherwise). We have included these caste dummies to understand the variation of academic result across the social strata. Finally, to accesses the importance of private tuition for the students from lower social castes, we have incorporated two interaction variables for the caste dummies with the monthly private tuition expenditure of the households.

The regression model has been estimated applying ordinary least squares addressing the problem of multicollinearity, heteroscedasticity and autocorrelation if any.

Empirical Findings and Discussion

This section discusses the findings of our primary survey and estimated results. The study has surveyed 20 government aided secondary schools from Purulia district which is backward in respect of education and other infrastructure. Most of the people in this district live in village. From the selected schools this study collected information from 309 students who have been selected using lottery method. Table-1 deals with the frequency distribution of the categorical variables of the households of our sample students. Our sample comprises 60 per cent female students. This is because of the selection of some exclusive girls schools. We have interviewed students from four strata of social castes. Almost one fourth of our sample students belong to general castes. Among the sample students 28.5 (15.5) per cent are belonging to scheduled castes (scheduled tribe). Most of the sample students are Hindu. With this composition of caste and religion our sample is matching with the caste religion distribution of the population in Purulia district. More than two third of the sample students comes from nuclear households. In our sample 30 per cent students belongs to landless households. Among the sample students 46 per cent has reported that their households don't have ownership of agricultural land. Therefore, incidence of landlessness and poverty are not negligible in the district of Purulia. Mothers of only 13 per cent of the students are in labour force whereas fathers of 98 percent students are participating in labour force. It shows that there is a huge gender gap in labour force participation in the society which is an important feature of patriarchal society. It is not surprising that among our sample students 30 per cent students don't have access to safe drinking water in their home. Still now in Purulia, 4.2 per cent of the sample students at night do their home task in the light of kerosene and one fourth of the student don't have access to improved sanitation facility in their residential premises.

Table 1 Socio-Economic Background of the Sample Students. (N=309)

Category	Frequency	Percent
Gender of the Students (1=Female)	183	59.2
Caste of the Students (1=General Caste)	74	23.9
Caste of the Students (1= Scheduled Caste)	88	28.5
Caste of the Students (1= Scheduled Tribe)	48	15.5
Caste of the Students (1= Other Backward Classes)	99	32
Religion of the Students (1=Hindu)	282	91.3
Student belong to Nuclear Family	224	72.5
Student belong to Agricultural Landless Household	93	30.1
Economic Status of the Students(1=BPL card holder)	144	46.6

lower social castes or for the students who obtain lower marks in midterm examinations or in class tests. For this purpose government may take the help of school teachers and local educated persons with some honorarium.

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A study of non-positive operators between real normed linear spaces

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Abstract. We introduce the concept of non-positive operators with respect to a fixed operator defined between two real normed linear spaces. Significantly, we observe that, in certain cases, it is possible to study such type of operators from a geometric point of view. As an immediate application of our study, we explicitly characterize certain classes of non-positive operators between particular pairs of real normed linear spaces. Furthermore, we present a complete characterization of smooth and strictly convex Radon planes in connection with non-positive operators.

1. Introduction

Although the study of dissipative operators was first initiated in Hilbert spaces, later on it was extended by Lumer and Philips [10] to the setting of normed linear spaces by using the concept of semi-inner-product [4, 9, 15]. We also refer the readers to [11] for some nice applications of dissipative operators. In case of real Hilbert spaces, the concept of dissipative operators coincides with that of non-positive operators. Likewise non-positive operators on real Hilbert spaces, through the method introduced by Lumer and Philips [10], we can study non-positive operators on real normed linear spaces. The purpose of the present article is to study a generalization of such operators. Observe that the study of non-positive operators on real Hilbert spaces as well as on real normed linear spaces is strictly restricted to the case when the domain space and the codomain space of the operator are identical. In our present work, we remove this restriction. Here we introduce and study the notion

of non-positive operators with respect to a fixed operator. The usefulness of our consideration lies in the fact that the notion of non-positive operators obtained from [10] is actually a special case of the newly introduced non-positive operators proposed by us. Now onwards we call our presently introduced non-positive operators as generalized non-positive operators. From [10], it is clear that for a bounded linear operator on a real normed space, the property of being non-positive is invariant under any semi-inner-product consistent with the norm of the respective space. We prove that a similar type result holds true for the generalized non-positive operators, introduced in the present article. Before proceeding further, let us first mention some useful notations and terminologies relevant to this article.

Since the concept of semi-inner-product in a normed linear space is very crucial to the study of non-positive operators between real normed linear spaces, let us first recall the definition of semi-inner-product [9]. Note that throughout this present article, the letters $\mathbb{X}, \mathbb{Y}$ stand for real normed linear spaces and $\mathbb{H}$ stands for a real Hilbert space. We use the symbol θ to denote the zero vector of any normed linear space other than the scalar field $\mathbb{R}$.

Definition 1.1. Let $\mathbb{X}$ be a normed linear space. A function $[\ ,\ ]\colon \mathbb{X} \times \mathbb{X} \to \mathbb{R}$ is said to be a *semi-inner-product* on $\mathbb{X}$, if for all $x, y, z \in \mathbb{X}$ and for all $\alpha, \beta \in \mathbb{R}$ the following conditions are satisfied:
 (1) $[x, x] > 0$ for every non-zero x,
 (2) $[\alpha x + \beta y, z] = \alpha[x, z] + \beta[y, z]$,
 (3) $[x, y]^2 \leq [x, x][y, y]$,
 (4) $[x, \alpha y] = \alpha[x, y]$.

It was proved in [4] that, corresponding to any normed linear space $\mathbb{X}$, there exists at least one semi-inner-product $[\ ,\ ]$ consistent with the norm of $\mathbb{X}$ in the sense that $[x, x] = ||x||^2$ for all $x \in \mathbb{X}$. In this article, whenever we talk about semi-inner-product on a normed linear space $\mathbb{X}$, we always mean that the semi-inner-product is consistent with the norm of $\mathbb{X}$. Moreover, there exists a nice connection between semi-inner-product and supporting functionals. Let $\mathbb{X}^*$ denote the dual space of $\mathbb{X}$. A functional $f_x \in \mathbb{X}^*$ is said to be a supporting functional at $x \in \mathbb{X}$ if $f_x(x) = ||x||^2$ and $||f_x|| = ||x||$. A non-zero point $x \in \mathbb{X}$ is said to be a smooth point if there exists a unique supporting functional at x. It follows from the arguments given in [4, 10], in the construction of semi-inner-products that corresponding to each supporting functional $f_x \in \mathbb{X}^*$, there exists a semi-inner-product $[\ ,\ ]$ on $\mathbb{X}$ such that $[y, x] = f_x(y)$. Conversely, corresponding to each semi-inner-product $[\ ,\ ]$ on $\mathbb{X}$, and any non-zero $x \in \mathbb{X}$, there exists a unique $f_x \in \mathbb{X}^*$ such that $[y, x] = f_x(y)$ for all $y \in \mathbb{X}$, where f_x is a supporting functional at x. Consequently, if each $x \in \mathbb{X}$

Let us now choose a point $x = (x_1, 0, \ldots, 0, x_j, 0, \ldots, 0) \in \mathbb{X}$ with $x_1 = \pm 1$, $x_j \neq 0$ for some $n + 1 \leq j \leq m$. Without loss of generality, let $x_1 = 1$. Then, as T is A-non-positive, this implies that $a_{11} + a_{1j}x_j \leq 0$ for all $x_j \in \mathbb{R}$. This is possible only when $a_{1j} = 0$ for each $j = n+1, n+2, \ldots, m$. In a similar manner, we obtain $a_{ij} = 0$ for all $n + 1 \leq j \leq m$, and for all $i = 1, 2, \ldots, n$.

Next, we consider an extreme point $x = (x_1, x_2, \ldots, x_m) \in S_{\mathbb{X}}$. It is well known that $x = (x_1, x_2, \ldots, x_m)$ is an extreme point of $S_{\mathbb{X}}$ if and only if $x_i = \pm 1$ for all $i = 1, 2, \ldots, m$. Clearly, $Ax = (x_1, \ldots, x_n)$ will also be an extreme point of $S_{\mathbb{Y}}$. As T is A-non-positive, if $x_1 = 1$ then Theorem 2.5 implies that $a_{11} \pm a_{12} \pm \cdots \pm a_{1n} \leq 0$ which implies $\pm a_{12} \pm \cdots \pm a_{1n} \leq -a_{11}$. Again, if $x_1 = -1$ we have $-a_{11} \pm a_{12} \pm \cdots \pm a_{1n} \geq 0$ which implies that $a_{11} \leq \mp a_{12} \mp \cdots \mp a_{1n}$. Therefore, we obtain $\pm a_{12} \pm \cdots \pm a_{1n} \leq |a_{11}|$. In a similar spirit, one can check that $\sum_{j=1, j \neq i}^{n} \pm a_{ij} \leq |a_{ii}|$ for all $i = 2, \ldots, n$. This completes the proof of the necessary part of the theorem.

Let us now prove the sufficient part. Let $T \in L(\mathbb{X}, \mathbb{Y})$ be such that

$$T(x_1, x_2, \ldots, x_m) = (a_{11}x_1 + \cdots + a_{1m}x_m, \ldots, a_{n1}x_1 + \cdots + a_{nm}x_m),$$

where $\sum_{j=1, j \neq i}^{n} \pm a_{ij} \leq |a_{ii}|$, $a_{ii} \leq 0$ for all $i = 1, 2, \ldots, n$, and $a_{ij} = 0$ for all $j = n + 1, \ldots, m$. To prove that T is A-non-positive, it suffices to show that, for all $z \in S_{\mathbb{X}}, [Tz, Az] \leq 0$ for some semi-inner-product $[\,,\,]$ on $\mathbb{Y}$. If, for some $z \in S_{\mathbb{X}}$, $Az = \theta$ then there is nothing to show. Let us choose $z \in S_{\mathbb{X}}$ such that Az is an extreme point of $S_{\mathbb{Y}}$. Then, from the above hypothesis, one can verify that $f_{Az}(Tz) \leq 0$ for every supporting functional f_{Az} corresponding to each facet meeting at Az. This implies that for all supporting functionals f_{Az} at Az, $f_{Az}(Tz) \leq 0$. Next we consider $z \in S_{\mathbb{X}}$ such that Az is either a non-zero, non-smooth, non-extreme point of $S_{\mathbb{Y}}$ or a smooth point of $\mathbb{Y}$. For each $i = 1, \ldots, n$, $\sum_{j=1, j \neq i}^{n} \pm a_{ij} \leq |a_{ii}|$ implies that $\sum_{j=1, j \neq i}^{n} \pm k_j a_{ij} \leq |a_{ii}|$ for all $|k_j| \leq 1$. Using this one can check that at every non-extreme point Az, $f_{Az}(Tz) \leq 0$ for all supporting functionals f_{Az} at Az. As we know that corresponding to every supporting functional at a non-zero point of a normed linear space it is possible to construct a semi-inner-product $[\,,\,]$ on $\mathbb{Y}$, applying Theorem 2.5, we conclude that $[Tz, Az] \leq 0$ for all semi-inner-products on $\mathbb{Y}$. This implies that T is an A-non-positive operator. This completes the proof of the sufficient part of the theorem and establishes it completely. ∎

Remark 3.2. If $m = n$ in the above theorem, then A will be the identity operator. Therefore, $T \in L(\mathbb{X})$ with $T(x_1, x_2, \ldots, x_n) = (a_{11}x_1 + \cdots + a_{1n}x_n, \ldots, a_{n1}x_1 + \cdots + a_{nn}x_n)$ is non-positive if and only if $a_{ii} \leq 0$ and $\sum_{j=1, j \neq i}^{n} \pm a_{ij} \leq |a_{ii}|$ for all $i = 1, 2, \ldots, n$.

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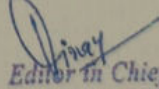
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EDUCATION FOR WOMEN EMPOWERMENT : VIVEKANANDA IN PRESENT SCENARIO

◻ Sourish Dey*

ABSTRACT

Swami Vivekananda a great thinker and reformer Of India represented the country on the global platform as a unique culture with its diversity. He has always dreamt of an education which would serve the function of man-making. Swamiji feels that the sole obstacle behind the nation development is its negligence towards women- in India women are always treated as the 'other' and are subjected to suppression, repression and oppression. Swamiji realizes that if the womankind wants to come out of this situation to exert their 'Self' they need the light of the education. Now a day we clearly feel the usefulness of women education. Various women colleges, universities were opening today for this purpose. In this paper the author tries to show the ideas of Vivekananda's Philosophy on women education and his perspective with the current scenario.

Keywords : Women Education, Empowerment, Equality, Curriculum

Research Methodology :

The methodology followed in this paper is analytical. The paper has analyzed Vivekananda's philosophical thought and mission on women education. Also the paper has discussed the relevance of his ideals in present scenario.

Introduction :

Swami Vivekananda a monk, a teacher, a great leader and above all a great philosopher who had incessantly worked for India and represented the country on the global platform as a unique culture with its diversity. According to him, "education is the manifestation of perfection already in men." To him, education was not only collection of information, but something more meaningful. He has always dreamt of an education which would serve the triple function of man-making, life giving and character building.

Swamiji feels that the sole obstacle behind the nation development is its negligence towards women- in India women are always treated as the 'other' and are subjected to suppression, repression and oppression. Swamiji realizes that if the womankind wants to come out of this situation to exert their 'Self' they need the light of the education. He also opined that a women needs education because on her rests the fate of the nation. She is the one who moulds the minds of the generation that comes after next. He gave highest priority to the upliftment of women through education.

Vivekananda predicted that if India wants to get back its lost honor and pride, it has to try to better the condition of women. He considered men and women as two wings of a bird, and it is not possible for a bird to fly on only one wing. So the progress and welfare of the world depends on the improvement of the condition of women. So the need for women education is two-fold – it is essential for the development of the nation and also for the upliftment of the womenfolk. So, on this point he utmost emphasis on women education. In their way of journey only education can bring the light.

Swamiji's Vision of Education :

Swamiji defines education as, "the manifestation of the perfection already in men". This implies that something already exists and is waiting to be expressed. In his view, it is a fact that knowledge is not coming from any out sources but it's coming from internal sources.

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Actually knowledge is an intrinsic quality of human mind. The stimulus of education causes the friction that ignites the fire of knowledge. It refers to a human being's potential, which is the range of the abilities and talents, known and unknown that is born with.

The concepts of education refer by Swamiji known to us as man-making education. Our practical need and value of education pointed out by this concept. In the case of proving practical value of education his experiences were very helpful. At the time of travelling in European cities he observed that poor persons were educated and also living with comfort. This picture is very rare in India. So education is the most valuable thing throughout the world which easily differentiates the living condition of two countries. So education was perceived to be an agent who elevated the level of individual human existence as well as the social existence level. In Indian society education was granted as the primary need. Only education can develop the position of backward classes in our society.

In Swamiji's view, spirituality can attain through education. Through this way own salvation can be possible. The way to achieve spiritual development and diversity within oneself only can be possible by those ideas which are the gift of education for a person. In the fields of humanities, social sciences and technology he expressed the practical need for the prevailing secular education. For improving the material conditions of man's life this kind of education was considered as necessary. So, in his view education must be considered a continuous and lifelong process.

Swamiji's Views on Women Education :

Since last decades world is busy enough including India to discuss about women empowerment and development. In this context gender discrimination is also an alarming issue which should abolish. Women are struggling for equal rights parallel with men and it is a global problem towards upliftment of women power.

Raja Rammohan, Vidyasagar were also engaged for the service of women before Swami Vivekananda. They eradicated the burning of a chaste wife on the funeral pile of her husband, child marriage and polygamy and so on. But Swamiji was the man different pole. The main goal of his mission of women education was to make them strong, fearless and conscious of their charity and dignity. If women take a strong position, then they can solve their problems in their own way.

Through Swamiji's view the progress of a society somehow depends on female literacy. He also said, that it is totally unfair to discriminate between sex and gender system. Because there is no sex distinction in 'Atman (soul)'. The soul has neither sex nor caste. It was his suggestion that only human beings are exists. Men and women- the differentiation created by society is not important. Swamiji said that the eastern ideals of women hood are mother, where the western ideals are wife. He explains the matter by looking back into the past where there were many glorious women like Sita, Savtree, Maitrayee who uplifted social status. But when we look on mediaeval age to colonial era where women suppressed by society.

In past there were many examples where monks decided that women are obstacle in the way to attain moksha, where Swamiji's view were extremely opposite. He viewed that, unless the situation of women are improved, there is no possibility of any welfare of the world. He also said that, It is not possible for a bird to fly on one wing. Soul has no gender bias. Every soul is potentially divine.

It was his realization that, proper education needed for women's in our country for their right upliftment. To achieve a position and to solve their problems it is important to educate women in a proper way. Training like nursing, sewing, culinary art etc. can enhance their inner quality. Then he suggests for vocational skills and training which can change with time and technology and also enhance way of living.

Vivekananda was against the marginalization of women and try to improving the situation of women. In 1895 when he was in England, he met Margaret Elizabeth Noble who was an Irish lady and was in the midst of learning about the Buddha. She was influenced by Swamiji and known to us as Bhagini Nivedita. She had a vital role in promoting the rights of women in rural India. She started a school for the basic education for girls which was motivated by Swamiji, established in

November 1989. Today the school known as 'Ramkrishna Sarada Mission Sister Nivedita Girl's School', situated in Bagbazar in North Kolkata.

Swamiji's Curriculum for the Women Education :

In Swamiji's view, the best medium of women education is mother tongue. After thinking on some social status of women he suggested a different curriculum which includes- moral value, literature and Sanskrit, grammar, craft and cooking, home science along with yapa, worship, meditation. In the present era the necessity of those curriculum suggested by Swamiji is proving its value for women. He also suggests that women should learn the lesson of self-defense with those curriculums.

The main goal of education are man making and character building. Men and women will parallel participate in every custom of society. It was his wish to build schools in rural areas, where some devoted nuns will teach. He suggested religion centric education for women and all the other trainings will be secondary rather than religion. Religious training, the formation of character and observance of the vows of celibacy these should be attend to Brahmacharinis of education and character should take up the task of teaching. The Brahmacharinis should strive for the female education and for this purpose they should open centers in villages and towns. Through such religious preaches of character, there will secular education. It was Swamiji's opinion that women should not imitate men when they acquired proper education. Instead of that through this education they would be modern Sita, Savtree, Maitrayee, and Gargy. 'Sarada Math' was established by Swamiji for the purpose of education for women in a proper way. He wished that, women should follow Ma Sarada as their idol of life. 'Example is more important than advice'- is thought of Ma Sarada, which was experienced by her in her entire life.

Vivekananda's Thought in Today's Relevance :

After 1947 when India got independence women education became an important issue in India which was Vivekananda's mission towards women empowerment. To fulfill the purpose of education for all women government took various steps. As a result, literacy rate in India have risen sharply from 16.7% in 1951 to 74.07% in 2011 in which enrolment of women in education have also risen from 7.3% to 65.46%.

The ongoing situation is very crucial for us. Today we can realize why Swamiji utmost emphasis for the women education as well as overall development and advancement occur on flow. Now we realize the value of women education. In every field of life now a day's women are working parallel with men. Swamiji also says- "500 males can win India in 50 years which can be done with a few weeks by 500 women". According to educational psychology mother is the first teacher of her children and they always learn from their mother and other family member also. It is a fact that education and ideal culture both together may control children future. Swamiji's mission for women education and related issues with women education can be fulfills through inaugurating women colleges and institutions for their higher studies.

In 1999 when the 81 report of the committee on value based education focused on the need to inculcate the principles of truth, rightness conduct, peace, love and non-violence which are the religious values lightened by Swamiji.

The development issue of the twenty first century for the purpose of education as the main objective of women empowerment follows those valuable issues said by Swamiji in 19th century. The millennium development goals envisage that education of women increases their productivity, raising output and reducing poverty. In 19th century Vivekananda wished that, women can be a decision maker in every field of their life, and in present era this lesson promote gender equality.

Conclusion :

To conclude, education serves as the main pillar in the women empowerment which would ultimately lead to the regeneration of the nation both socially and culturally and to a great extent economically. So Swamiji sees women education and women empowerment as the manifesto to the growth and progress of the nation. That is why he calls everybody as, "arise, awake and stop not till the goal is reached". For this purpose his objective is to take out the womenfolk from the cocoon and revive their lost confidence so that they may lead a dignified life of

their own. This can be done only through proper education. But one is to bear in mind this is not so easy a task and cannot be done overnight.

Swamiji ardently felt that unless women achieve a respectable place in the society it would be difficult for the nation to march forward. So the government should take care and put emphasis on the proper education on every girl child. Only then the nation would become successful in every sphere. It is the fact that at present time the educated women played a very significant role in overall development and progress of the country. The rise of outstanding women administrators, scientists, writers is gradually proving the truth of these prophetic words. No wonder Vivekananda's words and propagations are relevant even today's context. In fact he has a great contribution in the improvement of the state of women education.

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word is in the centre of all deliberations in contrast to the western tradition of grammar where 'Artha' or meaning acquires the centre point.

But, as described by Burnell, Aindra grammar prescribes four fold division of words (padas) namely: nām (noun), ākhyāta (verb), upsarga (preposition) and nipāta (particles).

In Pāṇini, the parts of speech are treated in a more complicated way. Although it uses the terms upsarga and nipata but not with that significance as found in the Aindra Grammar.

For, nāma (noun) Pāṇini used 'sup' and 'subanta' and for ākhyāta (verb) he uses 'tin' which apparently are more artificial and technical and belong to a far more advanced state of analysis.[1]

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The Idea of 'Puruṣa' in Śrimad-Bhāgavata and the Sāṃkhyakārikā: A Comparative Study

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Summary

The nature of 'puruṣa' has been discussed in both Īśvarakṛṣṇa's Sāṃkhyakārikā and the Srimad Bhāgavata Purāṇa. Issues include its dharma, its role in the process of creation etc. An analysis of the two shows that in place of differences there are instead broad similarities in their handling of the issues in majority of the cases. Sāṃkhyakārikā's assertion that puruṣa is nirguṇa, moral, nirviṣaya, extraordinary and above all sense-imbued and eternal is repeated in the Bhāgavata. The function of prakṛti in creation is the same across both texts and so is that of the puruṣa when it comes in contact with prakṛti. Context and author intentionality reflect itself in the theory of puruṣa as fundamentally distinct in both the texts. In the Sāṃkhyakārikā puruṣa is shown to be independent and acknowledged as the Supreme Being, while in the Bhāgavata a superior force is seen to override its supremacy.

Key Words: Sāṃkhyakārikā, Bhāgavata, Īśvarakṛṣṇa, Puruṣa, Nirguṇa

Scholars of Sāṃkhya accept Īśvarakṛṣṇa's Sāṃkhyakārikā as one of the texts which plays an explanatory role within the confines of Sāṃkhya philosophy. The theory and nature of the Puruṣa being one of the major terms thus dealt with. The Bhāgavata, on the other hand, is a key source for the Vaiṣṇavas. The latter, while discussing the theory of Bhāgavata, pulls in its ambit the terms and theories from Sāṃkhya including puruṣa. It would be pertinent here to keep in mind that the two texts are from two different chronological periods, one being philosophical and the other being devotional. Sāṃkhyakārikā was written in circa 4th-5th CE[1] while the Bhāgavata was composed in circa 11th to 12th centuries CE.[2] According to Larson, these differences reflect in their approach and use of puruṣa as well.[3] This provides the possibility for a study of the different approaches to the term in the texts which will be the concern of the essay.

Puruṣa appears in various skandhas of the Bhāgavata where the author of this Purāṇa tries to explain soul's (jīva) salvation following the achievement of viveka-jñāna. Knowledge of puruṣa as well as an understanding of its role is essential for achieving viveka-jñāna. In the 16th adhyāya of the 3rd skandha Kapila while speaking to his mother Devāhuti discusses the character and nature of the 25 principles, one of which being puruṣa. He says –

anādirātma puruśo nirguṇah prakṛteh parah l

pratyagdhāmā swayaṃjyotiviśwaṃ yenasamanvitam ll [4]

The *puruṣa*, according to Kapila, is *nitya, nirguṇa, atīndriya, swayaṃprakāśa* and is separate from *prakṛti* and the *paramātmā*. Again in the 7th *skandha* Prahlāda while explicating *puruṣa* to his companions follows Nārada to describe it as –

ātmā nityo'vyayah śuddhah ekah kṣetrajnah āśrayah l

avikriyah svadṛgheturvyāpako'sañjñanāvṛtah ll [5]

The *ātmā* is permanent, indestructible, not corrodible, pure, unparalleled, omniscient, unadorned, root of all things, always by oneself.

As *puruṣa* has neither the origin nor the destruction hence it is eternal. Due to the absence of *sattva, tamas and rajas* from the character of the *puruṣa*, it is called as *nirguṇa*. In fact, these *guṇas* are attributed to the *prakṛti*. The *puruṣa* is not perceived by the senses as it is formless and indefinite. The sense-organs being born from *prakṛti* can only feel and understand those that are mothered by it. *Puruṣa*, as mentioned above, is beyond the features related to *prakṛti*. *Īśopaniṣad*'s assertion bolsters this argument -

nainaddevā āpnuvan pūrvamarṣat l [6]

Even the Mīmāṃsakas are of the opinion that *puruṣa* cannot be known and understood as material objects.

mīmāṃsakādyavimata jñānaviṣayatvaṃ vārayati - swayaṃjyotih [7]

That is, the *puruṣa* is the knower not the matter to be known. Although both *puruṣa* and *prakṛti* are eternal the non-existence in the former and existence in the latter of the three *guṇas* makes them distinct and different. *Puruṣa* is stable and the *guṇas* do not effect changes in it. Being immutable it is *avyaya*. The *Śrutis* opine that *puruṣa* is,

ṛico 'kṣare parame vyomanniti śruteh [8]

The *puruṣa* being free from pleasure and misery is pure and pristine. The *puruṣa* is ubiquitous, endless and unembellished.

sa imāllokān sṛjate'ti śruteh [9]

The *puruṣa* is all-knowing

vijñātāramadhikena vijanīyaditi śruteh [10]

The *Sāṃkhyakārikā* explains the *puruṣa* opposite to the similarity that exists between *vyakta* and *avyakta*. Īśvarakṛṣṇa notes that the *puruṣa* is -

triguṇamaviveki viṣayah sāmānyamacetanaṃ prasavadharmi l

vyaktaṃ tatha pradhanām, tadvīparītastatha ca pumān ll [11]

Thus the *puruṣa* is *nirguṇa*, i.e. beyond the three *guṇas*. Possessing knowledge it is discerning, exceptional, conscious and constant. But, it should always be kept in mind that the *puruṣa* though possessing of avyakta characters of not being born of anything and eternal, it also has *vyakta*'s plural character. Īśvarakṛṣṇa also notes the same. All created objects are the combination of two or more of the tri-*guṇas* hence *saguṇa*, while the *puruṣa* is not so and hence is discerning. The *puruṣa* cannot be known or used as material objects. There is nothing common or mundane about it. To the contrary all unconscious things are revealed in the light of the *puruṣa* who is conscious and possessed of the said light. Commenting on the unchangeable and non-productive nature of *puruṣa* Gauḍapāda notes that:

aprasavadharmī puruṣo nahi kiñcit puruṣatprasūyate [12]

As mentioned above, the *puruṣa* does not undergo any change in reality. The 2nd *kārikā* refers to *puruṣa* as '*jña*' the knowing and not to be known. Aniruddha in *Yuktidīpikā* while discussing the term *jña* says

cetanāśaktirūpatvā (cetanāśaktirūpatvāt) ccitram guṇavṛttaṃ jānātīti jñah [13]

The above discussion shows that in broad terms there is no major difference regarding the character and nature of *puruṣa* as stated both in the *Bhāgavata* and the *Sāṃkhyakārikā*. However, as has been stressed earlier, it should be noted that the difference in nature of the texts and their period of composition has left their marks on their interpretations of the same terms. The divergences are visible not only in the texts but in their commentaries as well and hence are targets for discovery.

Śrīdharasvāmī, the famous commentator of the *Bhāgavata*, talks about two forms of the *puruṣa* – the *jīva* and the *īśvara*. The undiscerning *puruṣa* coming under the thrall of *prakṛti* and getting entangled in *saṃsāra* is the *jīva*. The discerning Puruṣa, on the other hand, controlling *prakṛti* and bringing about creation is called the *īśvara* - *puruṣaśca jīveśvararūpeṇ dvividhah, tatra yah prakṛtyavivekena saṃsarati sa jīvah, yastu prakṛtiṃ vaśīkṛtya viśvasṛṣṭyādi karoti sa parameśvarah*[14]

Moreover in the 4th *skandha* of the *Bhāgavata* Dhruva has stated different features in characters of the *jīva* and the *īśvara* thus emphasising the acceptance of two forms of *puruṣa*. *Īśvara* being unbound, pure, omniscient and immutable is different from the *jīva*.

tvantu vyatiriktah jīvavilakṣaṇa ebasse tiṣṭhati[15]

It is with the blessings of the *īśvara* that *jīva* achieves salvation -

jīvastu tvat prasādānmucyate[16]

Jīva is sullied, ignorant, somnolent, transient, exists under the auspices of the *triguṇa* and so the features of the *īśvara* are reverse to those of the *jīva*. The difference between *jīva* and *īśvara* is further clarified in the 11th *skandha*.

suparṇavetau sadrṣyau sakhāyau yadṛcchaitau kṛtanīḍau ca vṛkṣe /

ekastayoh khādati pippalānnamanno niranno 'pi balen bhūyān //

ātmānamanyañca sa veda vidyānapippalādo na tu pippalādah /

yo 'vidyayā yuk sa tu nityabaddho vidyāmayo yah sa tu nityamuktah //[17]

Bhāgavata's contention follows Upaniṣadic thought in this regard. The *Muṇḍakopaniṣad* while talking about *jīva* and *īśvara* states:

dwā suparṇā sayujā sakhāyā samānaṃ vṛkṣaṃ pariṣasvajāte /

tayoranyah pippalaṃ svādvatti anaśnannanyo avicākaṣīti //[18]

In the *Sāṃkhyakārikā* Īśvarakṛṣṇa while stating about the plurality of the *puruṣa* never comments about its dual form – *jīva* and *īśvara*. In contradiction, the *Bhāgavata* claims about its dual formal nature which, furthermore, is superceded by *bhagavāna*, the ultimate entity. The cogitation of the *Bhāgavata* regarding the *ātmā* are deeply influenced by Vedānta. In the Vedānta the ultimate consciousness is recognised as *brahma*, *īśvara* and *jīvātmā*. This idea is very much similar to *Bhāgavata*'s *paramapuruṣa bhagavāna*, *īśvara* and *jīvātmā*. This can be seen as a major difference between the approaches of the *Sāṃkhyakārikā* and those of the *Bhāgavata* regarding the *puruṣa*.

The division of the *puruṣa* as stated in the *Bhāgavata* raises the question whether it supports the existence of pluralism of *puruṣa* or the idea of a single one. A cursory glance would give the impression of it supporting the former idea. However, Prahlāda, while describing *ātmā* calls it the one (*eka*) and Śrīdhara further explains the term *eka* in his commentary quoting the *Śruti* -

ekah – ekamevādvitīya 'miti śruteh /[19]

This idea of oneness has been emphasised for several times in the *Bhāgavata* through the comments of Śukadeva in the 12th *skandha*:

nahi satyasya nānātvamavidvān yadi manyate /

nanatvaṃ chidrayoryadvajjyotiṣorvātayoriva //[20]

Śrīdhara stresses this oneness further when he is saying '*upādhikṛta ityāha nānātvamiti.*[21]

It seems that the *Bhāgavata* intends to impose potentiality of *jīvā*'s salvation by giving stress on the 25 principles of Sāṃkhya and the role of *prakṛti* and *puruṣa* in achieving consciousness i.e. the *viveka-jñāna* without eschewing influence of Vedānta as well. Maybe the need of the bhakta for complete self-sacrifice at the feet of an individual deity pushed the *Bhāgavata* more towards Vedānta rather than Sāṃkhya, the latter asserting the existence of many *puruṣa*s. This shows a fine differentiation between the *Bhāgavata* and the *Sāṃkhyakārikā* regarding the status and forms of *puruṣa*.

It appears that Sāmkhya's *puruṣa* in the *Bhāgavata Purāṇa* becomes enveloped by the idea of *avatāras*. It should be mentioned here that Samkhya's idea of *puruṣa* is quite similar to *Bhāgavata*'s *avatāra-puruṣa*. In explaining the theory of creation the *paramatattva* is always required for such creativity as the causative principle in all the *Śāstra*s such as the *Upaniṣads, Darśana, Purāṇa*s etc.. This causative principle has been termed as *brahma, paramātmā, puruṣa, bhagavāna* etc. in various texts. But as the *paramatattva* is eternal, *nirguṇa* and passive, the act of creation requires the presence of another principle. This principle, a part of *paramatattva*, is the *Upaniṣadic hiraṇyagarbha* or *kāryabrahma*, Vedantic *Īśvara* and Puranic *puruṣāvatāra*.

The idea of *avatāra* germinated in the *Puraṇic* texts has no relevance in the early Indian philosophical musings or *Upaniṣadic* thoughts -

sa aikṣat bahusyāṃ prajāyeyam, tat sṛṣṭvā, tadebanupraviśat[22]

Scholars are trying to find out that there are possibilities inherent in the *Upaniṣadic* and Vedic thoughts for existence of something akin to the idea of *avatāra* and their *līlā*. The *Bhāgavata* defines *avatāra* as - *aprapañcāt prapañce avataraṇam avatārah*[23]

It further notes that the creation of the universe is the result of the action of the *puruṣāvatāra*, a part of the *paramatattva* -

jagṛhe pauruṣaṃ rūpaṃ bhagavān mahadādibhih I
śambhūtaṃ ṣoḍaśakalamādau lokasisṛkṣayā II[24]

While describing the nature of *bhagavāna* the *Bhāgavata* recounts that the presence of *Puruṣa* activates *Prakṛti* to create. This *Puruṣa* referred to as *bhūmā puruṣa* is nothing but an *avatāra* of the *paramatattva*.

ādyo'vatārah puruṣah parasya[25]

The idea of *Bhāgavata puruṣāvatāra* in its role as the catalyst of *prakṛti*'s efforts to create is majorly similar to the ideas as expounded by the *Sāṃkhya*, especially *Sāṃkhyakārikā*. However, it can be stressed enough that in the *Bhāgavata*, *puruṣa* is not the independent principle as it is dependent on other principles. The *prakṛti-puruṣa tattva* is the ultimate principle in the *Sāṃkhya* system but this *tattva* is not of much importance in the *Bhāgavata*. This is emphatically postulated time and again in the *Bhāgavata*. Mahādeva in his dialogue to *Bhagavāna* says that someone calls you *bhagavāna* while *parapuruṣa* of the *prakṛti-puruṣa* by others.

twāṃ brahma kecidavayantyuta dharmameka eke paraṃ sadasatoh puruṣaṃ paresham I[26]

Śrīdhara in his commentary says something alike when he clearly states that the Vedāntics refer to *bhagavāna* as *brahma* while *Sāṃkhya* talks about it as *parapuruṣa*, who is, in fact, above the *prakṛti-puruṣa*.

twāṃ brahma vedantino'vayānta manyante I....prakṛtipuruṣayoh paraṃ pumaṃsaṃ sāmkhyah I[27]

That the *Sāṃkhya* system accepts *bhagavāna* as a principle above the *puruṣa*, is admitted by the *Bhāgavata*. But the *Sāṃkhyakārikā* does not give recognition to the statement of the *Bhāgavata*. The existence of the *paramatattva* at the top of the *puruṣa*, which moreover, is seen as a part of the former relegates the *Sāṃkhya-puruṣa* to dependence. *Puruṣa* in the *Sāṃkhya* system is glorious in its independence and unfettered. It is the *paramatattva* and not the *bhagavāna*. Gauḍapāda in his commentary of '*tadviparītastathāca pumān*' explicates the term '*tathāca*' of this *kārikā* thus —

kiṃ ca paratantraṃ vyaktaṃ svatantramavyaktaṃ tathāca pumānapi svatantrah[28]

In conclusion it should be stated that though there are differences between the two texts regarding the status of *puruṣa* and the existence or non-existence of principles higher on the hierarchy than *puruṣa* its importance as well as its role in Creation is the common platform where *Bhāgavata* and *Sāṃkhyakārikā* completely agree with each other. Both agree to the theory that it is the unification of *prakṛti* and *puruṣa* that germinates the universe. Even *Bhāgavata* with its insistence of the supra-*puruṣa* principle of *paramatattva* or *paramātmā* complies with the existence of the *prakṛti-puruṣa* theory as the first condition of creation. The *Śrimad Bhāgavata*, the scripture of eternal emancipation is full of devotional sentiment. Thus, in this devotional scripture the philosophical thought which is apparently less in sentiment, is germinated by the devotional sentiment and finally it is manifested in a new form in the world of philosophy.

Note: BP in the endnotes stands for *Śrimad Bhāgavata Purāṇa*

Endnotes

1. Hulin, p. 127
2. *Basel*, p. 4
3. Larson, p. 15
4. BP 3.26.3, p. 1191
5. BP 7.7.19, p. 2811
6. *Īśopaniṣad* 3, p. 5
7. Śrīdhara's Commentary, BP 3.26.3, p. 1191
8. Śrīdhara's Commentary, BP 7.7.19, p. 2811
9. *ibid*, p. 2811
10. *ibid*, p. 2811
11. *Sāṃkhyakārikā* 11, p. 117
12. Gauḍapāda's Commentary, *Sāṃkhyakārikā* 11, p. 55
13. *Yuktidīpikā*, *Sāṃkhyakārikā* 2, p. 55
14. Śrīdhara's Commentary, BP 3.26.4, p. 1191
15. Śrīdhara's Commentary, BP 4.9.15, p. 1468
16. *ibid*, Śrīdhara's Commentary, p. 1468
17. BP 11.11.6, p. 163-64
18. *Muṇḍakopaniṣad* 3.1.1, p. 165
19. Śrīdhara's Commentary, BP 7.7.19, p. 1191
20. BP 12.4.30, p. 499
21. Śrīdhara's Commentary, BP 12.4.30, p. 500
22. *Śrībhāgavatāmritvarṣiṇī*, BP 1.3.1, p. 70
23. *ibid*
24. BP 1.3.1, p. 70
25. BP 2.6.42, p. 593
26. BP 8.12.9, p. 3074
27. Śrīdhara's Commentary, BP 8.12.9, p. 3075
28. Gauḍapāda's Commentary, *Sāṃkhyakārikā* 11, p. 57

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Salun: A potters' village; Sociology of Pottery Making Culture in a Village in the District of Purba Bardhaman

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The history and development of ceramic art and industry is traced by an enquirer since remote antiquity till recent times. The development of ceramic art and industry is closely intertwined with the socio-cultural aspects of life led by those who devoted themselves throughout to the ceramics popularly known as potters, *Kumor* or *Kumbhakaras*. The ethno-archaeological study centering round the ceramics is spread over a vast territorial jurisdiction of this country. But at present I have concentrated only on the district of Purba Bardhaman. The areas surveyed by me in this district include rural, semi-urban, urban areas inhabited by a large number of potters' families, those who are divided among castes and sub-castes with their characteristic socio-cultural orientation. This study is an attempt to make an in depth study of the socio-cultural cum economic aspects of the ceramic artists' inhabiting in some parts of Purba Bardhaman District. The potters of these areas are found to follow their age-old or traditional techniques with some modern ones. My contention may be verified by the actual survey I have made in the village Shalun, in this district.

The district of Purba Bardhaman is geographically divided by river Damodar from the district of Bankura. On the southern part of the district we find a number of blocks. Khandogosh is one of such blocks that have a number of potters' dominated villages. On the northern part of this block we see a small village Salun. Salun is a Hindu dominated village with multi caste settlements grown in the village. Beside the large concentration of potters, we find here different Hindu caste groups such as *Brahmin, Kayastha, Goala, Kamar, Bene,* Bagdi*, Bouri* etc. Census 2001 confirms us that it encompasses an area of 280.0 hectares of land with a big population of 3060, of which 1552 are male and 1508 are female. This large section of people live in 7 localities divided into 644 households. This report enumerates that the village has a sizeable schedule caste population of 1486 and with 192 schedule tribe people.[1]

Salun is connected with Bardhaman town and with Bankura by a pacca road. The village has two Primary schools, one I.C.D.S. centre, one Adult Literacy Centre, one Sub- health Centre etc. The village stands nearer to river Damodar as well as to river Shali. So the village is enriched by alluvial soil of Damodar basin. The land of this area is much fertile for growing crops. The villagers have been enjoying wide spread irrigation facilities. A fair number of villagers directly or indirectly depend on agriculture.[2] Census 2001 records that, the total numbers of workers in the village is 1346 among which 172 are cultivators and 445 are agricultural labourers. The report also reveals that the number of household workers in the village is 92. Salun is well known in the district as a potters' village. The chief cottage industry in the village is pottery though the village has developed some brick industry as well.[3]

river-sand and kiln-ash as temper. Colour clay or pigment, another important raw material known as *Banak* and used as slip is obtained from a village field near Sonamukhi, Bankura. Two types of slips are used, red and white, known to the potters as '*Lal Banak* 'and '*Kalo Banak*'. At present the potters go in a group to collect this colour clay and bring it jointly which costs nearly Rs. 3000/ per truck.

Slip-

Like the *Radh*i potters of Bardhaman, Bankura and Birbhum the potters of Salun make slips of two colours stated above, through the process of decantation with the help of rain water.[13]The experienced potters maintain that a good quality of red slip could only be obtained from rain water. Slips are applied on both side of rim, neck, and on belly portion of the exterior side of a vessel. (Fig.-11)

Kiln (*Poan***)**

Kiln is of two types vertical and horizontal, both of which are used by the potters of West Bengal as well as of India.[14] The potters of Salun bake their vessels only in a vertical kiln (*Gol Poan*), unlike the potters of other districts in West Bengal. (**Fig.-12**) Kiln is known to them as '*Pon*,' '*Poan*' or '*Shal*'. There are 14 kilns in the village which are used by the 21 potters' families working in the village. All the kilns are of vertical type with two different shapes, rectangular and circular, though the former one being a few in numbers. It is learnt that previously they used horizontal kiln (*Kulo Pon*), but at present they use only vertical one with having a number of perforations on its girth. The size of this type of kiln varies between 8 feet to 10 feet in diameter in case of circular one and in case of rectangular; it ranges between 8 feet to 12 feet in length and 6 feet to 9 feet in breadth. The girth or the muffle stands almost 36 inches above the ground. The potters of this village make the kiln chamber wide enough. The size of the perforated girth indicates that at least 350 to 400 vessels of different sizes can be accommodated at a time for firing. The vessels are arranged inverted in a circular manner. (**Fig.-13**)

Fuel (*Jal***)**

The potters use saw dusts, hays, dry leaves etc. as fuel. While arranging the vessels, it is seen that they put pieces of woods in between the rows to make the pots baked well. They hold that it takes about 4 hours to bake the vessels well. Cost of firing as told by them is Rs. 900 to 1100 per firing. It is also learnt that at the initial stage of first two hours, fuels are supplied slowly and after that the intensity of supplying fuels is increased and are fed fast.   The potters of Salun maintain that they bake 350 to 400 pots at a time in a kiln which worth about Rs. 3000 to 4000, of which Rs. 2000 to 2500 come as profit to them. It is also learnt that most of the potters fire their pots once or twice in a month, with the exceptions of Jaladhar Pal and Haladhar Pal (Two brothers) who can arrange the same once in a week. (**Fig.-14**)

Throwing of vessels on wheel (*Bhiyano***)**

In the process of manufacturing vessels throwing is the principal job or making of the vessel by wheel. Whether it is wheel made or hand made every vessel has to go through the process of manufacturing by a wheel. Throwing is the process rather different stages of manipulation of fingers by the potters to make a pot or vessel. (**Fig.- 6,7**) This stage actually exhibits their craftsmanship or excellence to make various pots wit different shapes and designs.

Marketing --It is well known to the people of Bardhaman, Birbhum and Bankura that Salun is famous for its traditional earthen ceramic or pottery. The potters sell their products through agents and by them from their houses as well. The aged potters hold that their products had a larger market in the districts of Purba and Paschim Bardhaman, as well as in Bankura too. It is learnt that they generally sell their product in different village *Hat*, such as in Khandogosh, Rasulpur and in Patrasayer etc and in various shops in Bardhaman town. They also hold that a number of male and female agents from neighboring villages as well as from different places

Fig.13. Arrangement of vessels on kiln

Fig.14. Firing in kiln

Fig.15. Wheel made vessels(Red Ware)

Fig.16. Wheel made vessels (Black Ware)
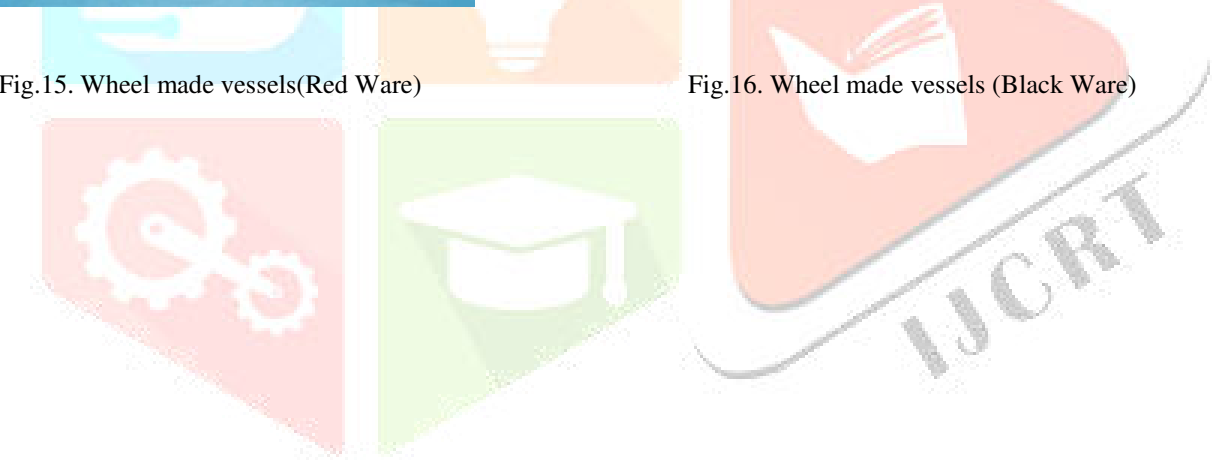
THE STUDY OF TRADITIONAL POTTERY MAKINGIN WEST BENGAL AND IT'S CONNECTION WITH MEGALITHIC CULTURE

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Introduction

The present paper is an attempt to explore the possibility for tracing the relationship of the pottery making activities between the potters of Megalithic culture and the others of eastern India. Though my basic knowledge about pottery making activities and the communities involved in such activities with reference to West Bengal, in this paper I have tried to trace the relationship of the above cultural matrix. We are aware about the fact that the Chhotanagpur plateau played an important role in the evolution of so called Megalithic Cultural tradition both informed as Sepulture and the non-sepulchral. It is also evident from the wide distribution of Dolman, Menhir and other types of memorial stones including Vir Sthambha (Hero stone) and other.[1] Pottery is also reported from such Megalithic site. In this context it is to be noted that Asura cultural sites of the core areas of Chhotanagpur plateau like Palamo, Ranchi, Santal Pargana, Singbhum areas had association with Megalithic tradition.[2]Hope my paper will also focus on the pottery making activities of Asura culture and its association with West Bengal pottery making activities. Excavation at Saratkhel (Ranchi) confirmed the pottery making activities of Asura culture bearing social groups and their association with so called Megalithic Culture. Therefore, I will also try to trace the relationship between the tribal communities and the non- tribal communities of Eastern India in the context of pottery making activities. This study is

Forming (*Garan Kara or Uchho Dewa*) –The stage of forming succeeds thinning the wall. In this stage we observe the use of a tool first in the process of throwing. The tool which helps to some extend to give the desired shape of the vessel is called *Uchho*. It is a bamboo shaper.

Collaring- It is the technical acumen of a potter that forms various types of rim and neck of a pot with his fingers and the bamboo shaper. Here is an interesting point to be noted that each and every wheel thrower of a village has got a distinct feature of his product so far the neck and rim of a vessel is concerned**. (Fig.-5)**

Smoothening- (*Nyata Dewa***)** Smoothening of a vessel while on wheel, takes place after the stage of collaring. Smoothening is done generally either by a wet mop which the potters call as '*Nyata*' or by the bamboo shaper (*Uch*o).

Cutting off- (*Pagui Namano)*** Once the act of smoothening is completed the potters get them ready to detach or cut off the vessel from the remaining clay. Here an important point is to be noted that thread is used only in cases of small vessels, which are made complete on wheel. On the other hand a needle or a small thin bamboo slice is used to detach those vessels which are made half or incomplete, keeping a hole on the lower portion for luting to make them complete. The *Konnoujia* and *Maghaiya* potters of Malda, the tribal potters and the traditional potters of Bengal use thread to detach pot since all of them make large and medium size vessels pots on wheel.

The megalithic vessels recovered from Ranchi District and from other sites of Jharkhand and Bihar are mostly wheel turned and medium to thick fabric. The bowls, dishes, large and deep basins, large and medium vase and Handi or other cooking vessels recovered from those sites must had required joining or luting as it is said earlier.

Beating after throwing-Beating of wheel thrown pots is entirely done by the potter himself or by any male member of his family. It is only in case of handmade vessels where female potters are seen to beat vessels to make them complete one. It is to be noted that the potters of various groups entirely depend on their women folk for manufacturing handmade pots. Beating is done to enlarge a vessel as well as to give it the required shape with the help of an anvil and beater. The *Konnoujia* and *Maghaiya* potters in the districts of Purba Bardhaman, Bankura and Birbhum do not require beating since they manufacture complete small pots.

Slip treatment- Use of slip in earthen ceramics is a well known phenomenon in pottery manufacturing technology. It is important to note that categorization of ceramics in India is done according to the slips applied on them. For example, when we say Northern Black Polished ware, it presumes the slip of black applied to them. Archaeological excavations in Ranchi district as well as in other areas of Jharkhand, Bihar and in Chhotanagpur plateau areas unearthed kinds of potteries not only with various shapes and fabrics but

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শ্রীমদ্ভাগবতমহাপুরাণ ও *সাংখ্যকারিকার* প্রকৃতি-ভাবনা : একটি তুলনাত্মক আলোচনা

মণিমালা মণ্ডল

সারসংক্ষেপ

ঈশ্বরকৃষ্ণের *সাংখ্যকারিকা* ও *শ্রীমদ্ভাগবতপুরাণ* – এই উভয় গ্রন্থে প্রকৃতিতত্ত্বের স্বরূপ নিরূপিত হয়েছে। প্রকৃ স্বরূপ, ধর্ম, সৃষ্টি প্রক্রিয়ায় তার ভূমিকা, এই সকল গুরুত্বপূর্ণ বিষয় সমূহকে উভয় গ্রন্থের নিরিখে পর্যবেক্ষ দেখা যায় অধিকাংশ ক্ষেত্রে তাদের পরস্পরের মধ্যে তেমন কোন মতপার্থক্য নেই, বরঞ্চ মতাদর্শগত সাদৃশ্যই চোখে পড়ে। প্রকৃতি অহেতুমৎ, ত্রিগুণাত্মক, অবিবেকী, বিষয়, সামান্য, অচেতন এবং প্রসবধর্ম বিশিষ্ট – *সাংখ্যকারি* এই ব্যক্তব্য সম্পূর্ণ অবিকৃত রয়েছে *শ্রীমদ্ভাগবতে*। সেইরূপ জগৎ সৃষ্টিতে প্রকৃতির ভূমিকা উভয়ত্র প্রায় একই ব্যাখ্যাত হয়েছে। পুরুষের সান্নিধ্যে প্রকৃতির সংক্ষোভের বিষয় নিয়েও কোন মতান্তর নেই। তবে আধারের প্ আধেয় যেহেতু কিছুটা প্রভাবিত হয়ে থাকে তাই একই প্রকৃতিতত্ত্বগত চিন্তায় গ্রন্থদ্বয়ের নিজস্ব মৌলিক চিন্তর ঘটেছে। *সাংখ্যকারিকায়* প্রকৃতিতত্ত্ব সম্পূর্ণ স্বতন্ত্রতত্ত্ব রূপে প্রতিপাদিত হয়েছে, এখানে প্রকৃতি স্বাধীন। ভগব প্রকৃতির স্বতন্ত্রতা সেইভাবে অক্ষুণ্ণ থাকেনি, প্রকৃতি এখানে পরাধীন।

শব্দসংকেত : *সাংখ্যকারিকা, শ্রীমদ্ভাগবতপুরাণ, ঈশ্বরকৃষ্ণ, প্রকৃতি, গুণত্রয়, স্বতন্ত্র*

সাংখ্যাচার্য্য ঈশ্বরকৃষ্ণ বিরচিত *সাংখ্যকারিকা* গ্রন্থটি সাংখ্যদর্শনের অন্যতম প্রামাণ্য গ্রন্থ রূপে প্রসিদ্ধ। এ গ্রন্থে সাংখ্যদর্শনের অন্যান্য তত্ত্বের সঙ্গে মুখ্যতত্ত্ব প্রকৃতির স্বরূপ প্রতিপাদিত হয়েছে। অন্যদি *শ্রীমদ্ভাগবতমহাপুরাণ* হল বৈষ্ণব সম্প্রদায়ের অন্যতম আকর গ্রন্থ। এই গ্রন্থেও ভগবত্তত্ত্বের আলোচ প্রসঙ্গে সাংখ্যদর্শনের অন্যান্য তত্ত্বের সঙ্গে প্রকৃতিতত্ত্বের স্বরূপ আলোচিত হয়েছে। *সাংখ্যকারিকা* দর্শ গ্রন্থ, *শ্রীমদ্ভাগবত* ভক্তিমূলক গ্রন্থ এবং গ্রন্থদুটি ভিন্ন ভিন্ন সময়ে রচিত। *সাংখ্যকারিকার* রচনাকা আনুমানিক খ্রিস্টিয় চতুর্থ থেকে পঞ্চম শতক[১] এবং ভাগবতের রচনাকাল আনুমানিক খ্রিস্টিয় একাদ থেকে দ্বাদশ শতক।[২] সেই কারণে দুটি গ্রন্থে প্রতিপাদিত একই প্রকৃতিতত্ত্বগত ভাবনা স্বাভাবিক ভাবে

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[১১] সাংখ্যকারিকা – ৩, পৃ. ৩৫।

[১২] তত্ত্বকৌমুদী, সাংখ্যকারিকা – ৩, পৃ. ৩৬।

[১৩] মাঠরবৃত্তি, সাংখ্যকারিকা – ৩, পৃ. ১১২।

[১৪] ভাগবত – ৩/২৬/৪, ১১৯১।

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[১৬] মাঠরবৃত্তি, সাংখ্যকারিকা – ২, পৃ. ১১২।

[১৭] শ্রীধরটীকা, ভাগবত – ৩/২৬/১০, ১১৯৪।

[১৮] গৌড়পাদভাষ্য, সাংখ্যকারিকা – ১০, পৃ. ৫২।

[১৯] তত্রৈব।

[২০] ভাগবত – ৩/২৬/৪, পৃ. ১১৯১।

[২১] শ্রীধরটীকা, ভাগবত – ৩/২৬/৪, পৃ. ১১৯১।

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[২৬] সাংখ্যসূত্র – ১/৯২, পৃ. ৭০।

[২৭] তত্ত্বকৌমুদী, সাংখ্যকারিকা – ৫৯, পৃ. ৩৩৩।

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চিত গ্রন্থপঞ্জি

কৃত :

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Immunotoxic role of organophosphates: An unseen risk escalating SARS-CoV-2 pathogenicity

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ABSTRACT

Consistent gathering of immunotoxic substances on earth is a serious global issue affecting people under pathogenic stress. Organophosphates are among such hazardous compounds that are ubiquitous in nature. They fuel oxidative stress to impair antiviral immune response in living entities. Aside, organophosphates promote cytokine burst and pyroptosis in broncho-alveolar chambers leading to severe respiratory ailments. At present, we witness COVID-19 outbreak caused by SARS-CoV-2. Infection triggers cytokine storm coupled with inflammatory manifestations and pulmonary disorders in patients. Since organophosphate-exposure promotes necroinflammation and respiratory troubles hence during current pandemic situation, additional exposure to such chemicals can exacerbate inflammatory outcome and pulmonary maladies in patients, or pre-exposure to organophosphates might turn-out to be a risk factor for compromised immunity. Fortunately, antioxidants alleviate organophosphate-induced immunosuppression and hence under co-exposure circumstances, dietary intake of antioxidants would be beneficial to boost immunity against SARS-CoV-2 infection.

1. Introduction

With the advancement of scientific revolution, human beings have made the existing anthropocene more comfortable for their daily life. From agricultural field to the industrial sector, human populations are blessed with the use of modern technologies and equipments, which not only reduce energy for production but also enhance yield at the same time. But the darker side of such advancement includes consistent gathering of detrimental chemicals in the environment contaminating almost every component of biosphere. These chemicals have secured their apparent presence in several drugs, food stuffs, household products, drinking water, agrochemicals and so on. Organophosphates (OPs) are among such hazardous compounds that are being globally used on a regular basis.

OPs are amides, esters, or thiol derivatives of phosphoric acid. These chemicals are extensively used in agriculture, horticulture, forestry, veterinary-medicine, domestic purpose and also for the control of vector-borne diseases. Certain OPs are being used to treat head-lice, scabies and crab-lice in humans (Idriss and Levitt, 2009). In agricultural sector, OPs are extensively applied to eradicate pests including locusts, aphids, leaf miners, fire ants, thrips and caterpillars. These pesticides augment both quantity and quality of agricultural products (Chang et al., 2017). OPs namely tris-(2-chloro, 1-methyl-ethyl) phosphate, tris-(2-chloroethyl) phosphate, tri-n-butyl phosphate, tri-iso-butyl phosphate, triphenylphosphate and tris-(butoxyethyl) phosphate are admired flame retardants and plasticisers at public places

suppressor of cytokine signaling-3 (SOCS3) which acts as negative regulator of cytokine signaling. Results from a cytokine/chemokine secretion analysis revealed the proinflammatory properties of Tris (1, 3-dichloropropan-2-yl) phosphate, Triphenyl phosphate and Tris (2-butoxyethyl) phosphate (Li et al., 2020). These compounds reduce the production of anti-inflammatory cytokines (IL-10 and IL-13) and trigger the release of proinflammatory cytokine (TNF-α). In another study, exposure to chlorpyrifos suppressed production of IFN-γ, TNF-α and IL-6 following LPS stimulation in mice (Singh et al., 2013). *In vitro* study by Zhao et al. (2020) has claimed that, malathion can suppress the synthesis of IL-2, IFN-γ, IL-4 and granzyme-B whereas chlorpyrifos is able to decrease the production of IL-6 in splenic lymphocytes.

4.6. Suppressed delayed-type hypersensitivity reaction

Delayed-type hypersensitivity (DTH) is a reflection of cell mediated immune response. Study conducted by Moon et al. (1986) revealed that, subchronic exposure of rodents to certain OP compounds viz. fenitrothion, fenthion and diazinon resulted in marked suppression of DTH and Arthus reaction. Malathion applied epicutaneously for 2 days or over 4 weeks failed to elicit DTH in female BALBc mice pointing towards impaired cell mediated immune response (Cushman and Street, 1983). Immunotoxicological investigation by Undeger et al. (2000) using footpad swelling assay revealed that, dimethoate at a dose of 28.2 mg/kg/day reduced DTH reaction in treated rats. A dose dependent decrease in DTH was also observed following exposure to phosphamidon. Ethephon, at a dose rate of 1995 ppm suppressed DTH response to SRBC as measured by thickness of edema in hind paw in mice (Abou-Zeid et al., 2018). Similar observation was recorded following exposure to diazinon at a dose of 10 mg/kg in male Wister rats (Ibrahim, 2014). In a recent study, acute intoxication of malathion (0.5 LD$_{50}$) resulted in reduced function of Th1 lymphocytes, DTH reaction and production of IFN-γ in random-bred albino rats. Monocrotophos suppresses DTH reaction, lymphocyte count and lymphocyte stimulation in sheep (Khurana and Chauhan, 2003). Low dose oral exposure to acephate can modulate humoral immune response and DTH response to SRBCs in rodents (Sankhala et al., 2012).

4.7. Autoimmune responses

There is small but evolving body of literature that advocates OP induced autoimmune responses leading to several chronic manifestations. Systemic autoimmunity is measured by anti-nuclear antibodies. OP insecticide diazinon has been positively associated with serum antinuclear antigens in occupationally exposed male farmers (Parks et al., 2019). In another finding, farmers having experience of long-term exposure to diazinon, fenitrothion, methidathion, malathion, chlorpyrifos, parathion and profenofos had elevated level of blood antinuclear antibody. Rheumatoid arthritis (RA) is a systemic autoimmune inflammatory disease. Its incidence of occurrence was higher in fonofos applicators (Meyer et al., 2017). Koureas et al. (2017) conducted a cross sectional study among pesticide sprayers dealing with chlorpyriphos, phosmet and dimethoate in Thessaly (Greece). Multinomial analysis revealed that, frequencies for RA and allergic rhinitis were significantly higher in OP pesticide sprayers compared to control group. Rheumatoid factor (RF) is the autoantibody that targets healthy tissues in the body. Rodgers (1997) has reported that, malathion administration at non-cholinergical doses can potentially increase serum RF and anti-dsDNA antibodies. Moreover, it can exacerbate progression of systemic lupus erythematosus which is an autoimmune disease with diverse clinical and immunological manifestations. Long-term exposure to dichlorvos can promote development of autoimmune hepatitis (Zhao et al., 2015). Thus, OP compounds have certain implications for autoimmunity and organ damage.

5. Mechanism of immunotoxicity: OPs versus SARS-CoV-2

People with under-performing immune system may be at high-risk of receiving SARS-CoV-2 infection. They may also remain infectious for a longer duration than others. Numerous studies have claimed that, OP induced disruption of immune system may intervene antiviral immune responses. OP compounds are the promoters of apoptosis in lymphoid organs. Studies have shown that, OP mediated cell death is triggered by increased levels of pro-apoptotic proteins (Bax and caspase 3) and reduced levels of anti-apoptotic proteins (p-Akt and Bcl2) (Venkatesan et al., 2017). Moreover, OP triggers activation of NF-κB via p53 signaling pathway that further escalates tissue damage (Lee et al., 2014) in lymphoid organs. Cellular demise in thymus, spleen and lymph nodes results in reduced titer of neutralizing antibodies against viral infection (Matter et al., 2011). Immunocytes like NK cell, LAK cell and CTL play crucial role in clearance of virally infected cells by releasing serine proteases (granzymes). OP inhibits activity of these serine proteases to impair cell mediated anti-viral functions. In addition, FasL/Fas pathway is targeted by OP compounds to hinder the activity of killer cells (Li, 2007). OPs injure dendrites of DCs more likely through inhibition of protein kinases such as Akt family or ERK which are essential for cell proliferation and survival (Schäfer et al., 2013). Pro-oxidative impact is exerted via Cytochrome P450 based ROS production. ROS can overwhelm the cellular antioxidant status to manifest OS - a major trigger to necroptosis, pyroptosis, and parthanatos in immunocytes (Robinson et al., 2019). Alongside, ROS mediated disruption of mitochondrial membrane exposes cardiolipin and mtDNA to cytosol thus provoking NLRP3 to compose inflammasome (Iyer et al., 2013). C-reactive proteins are elevated following OP exposure and higher level of this inflammatory marker can contribute to immunosuppression (Yoshida et al., 2020; Taghavian et al., 2016). IFN constitutes the first line of defense against viral infections (Ivashkiv and Donlin, 2014). Inability to mount an effective IFN-response results in systemic infection (Baskin et al., 2009). Efficiency of a virus to evade IFN-response is crucial for viral replication, transcription and onset of pathologies (Iyer et al., 2017). Virions unable to escape IFN-response, usually fail to replicate in host (Iyer et al., 2017). OP promotes IFN-depletion (Singh et al., 2013) and therefore can rupture the protective-shield against viral-attack.

Similar to OPs, SARS-CoV-2 can be detrimental to immune machinery and convergence of both can worsen the outcome of COVID-19. Virions utilize ACE-2 receptors to invade target cells. However, certain essential oils like geranium and lemon strongly reduces expression of ACE-2 in epithelial cells that can subvert viral invasion (Senthil Kumar et al., 2020). Molecular docking and molecular dynamics studies have revealed that, hesperidin can distort the bound structure of ACE-2 and spike protein fragment that could have potential anti-SARS-CoV-2 implication (Basu et al., 2020). However, many structural, non-structural and accessory proteins of SARS-CoV-2 adopt multiples strategies to modulate cytosolic interactome and subsequent immune function (Fig. 1). For instance, ORF8 down-regulates MHC-I to disrupt antigen presentation by macrophages and DCs (Park, 2020). Indeed a recent literature has demonstrated that, ORF-8 can directly bind to MHC-I molecule at endoplasmic reticulum to drive auto-lysosomal degradation (Zhang et al., 2020a,b). NSP5 interacts with epigenetic regulator histone deacetylase-2 to modulate MHC-II expression and cytokine production (Gordon et al., 2020). SARS-CoV-2 infection promotes subverted IFN-I synthesis in patients (Acharya et al., 2020). Such response is facilitated by coronavirus PLpro that disrupts IFN genes such as STING–TRAF3–TBK1 complex (Báez-Santos et al., 2015). In addition, other SARS-CoV-2 proteins like NSP13, NSP14, NSP15 and ORF6 have been suggested to antagonize IFN function by suppressing nuclear localization of IRF3 (Yuen et al., 2020). Notably, viral M protein interacts with RIG-1/MDA-5/MAVS signaling pathway to hinder IFN-I and IFN-III production (Zheng et al., 2020). Interestingly, certain essential oil components such as (E,E)-α-farnesene, (E,E)-farnesol and (E)-nerolidol have better binding affinity for SARS-CoV-2 proteins like Mpro

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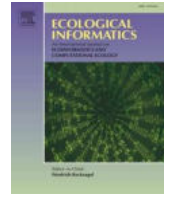
Importance of benthic-pelagic coupling in food-web interactions of Kakinada Bay, India

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ABSTRACT

Benthic components occupy the sediment layer of aquatic ecosystems and play a definitive role in overall system functioning and maintenance. The exchange of inorganic and organic materials between the sediment and water column through benthic-pelagic coupling plays a very important role especially in shallow water ecosystems. It is facilitated mainly by trophic interactions between the benthic and pelagic food webs, or specifically, between the coupling links i.e. the nodes that participate in coupling. Aquatic ecosystem models incorporating benthic food web in details have been few. In the present study, a food web model incorporating both benthic and pelagic food webs has been developed using EcoPath with EcoSim software, for Kakinada Bay ecosystem of Coastal Andhra Pradesh, India and has been analysed to get an idea about this system's functioning and integrity. Hypothetical perturbation scenarios (perturbation of biomass of two important benthic components – microphytobenthos and suspension feeding invertebrates) were applied to the model to study the effects of these two components on overall system robustness and integrity. The analysis of the base model revealed that while the bay system has not yet attained maturity, it also does not face much stress. While the system saw a decline in maturity with increase in microphytobenthos (MPB) biomass, increase in biomass of suspension feeding invertebrate (SFI) resulted in the exact opposite. Study of SFI biomass perturbation scenario also highlighted its role in coupling. Modelling studies incorporating benthic components as separate groups have been few. This work aims to provide a better insight into how benthic components may affect the whole system. Information regarding system health and resilience provided by such models can also be used as guidelines for fishery management and policy making.

1. Introduction

Benthic organisms, also called 'benthos', comprise of a community of organisms that occupy the sediment layers of intertidal coastal zones and open ocean or freshwater aquatic ecosystems. In shallow ecosystems where light reaches the sediment, i.e. in the euphotic zone, phytobenthos (photosynthetic bacteria and benthic algae) can flourish and photosynthesize (MacIntyre et al., 2004). Though, macrophytobenthos are also present, microphytobenthos (MPB)(consisting primarily of microscopic photosynthetic algae) has a much higher contribution to the productivity of the benthic system (Daehnick et al., 1992). It has been estimated that MPB assemblages can contribute up to 50% of the total estuarine autochthonous primary production (Underwood and Krom-kamp, 1999). Thus understanding roles played by different benthic components in a system is of paramount importance when delving into sustainable management practices.

The benthic food chain predominantly comprises of detritivores and scavengers as primary consumers. Filter feeders such as sponges and bivalves (seen to occupy hard sandy bottom layers) and deposit feeders such as polychaetes (present on softer bottom layers) are other
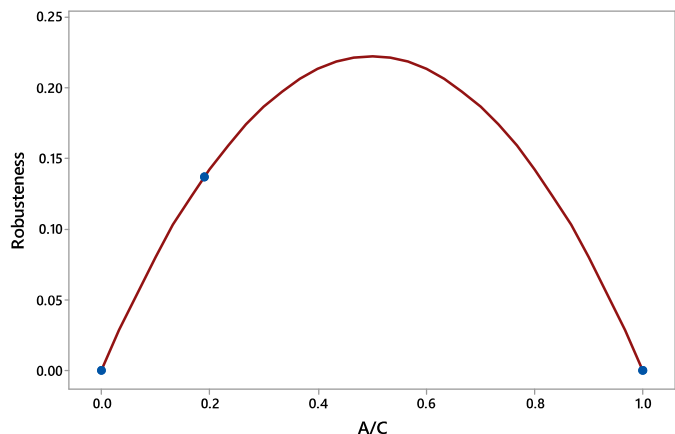
Fig. 3. Relation between degree of order and the corresponding robustness of the unperturbed system.

(Fig. 5c). Detritivory to herbivory ratio (*D/H*) however follows an opposite trend and decreases as MPB biomass increases (Fig. 5c).

System robustness value increased up to 5.91% of system base value with decrease in biomass and up to 4.67% of the same with increase in biomass (Fig. 5b & 6).

The exergy value followed an increase in the biomass of MPB and showed an increase of 15% from the system base value at the highest biomass of MPB (Fig. 7).

3.2.2. Suspension feeding invertebrates perturbation scenario

Both *TST* and *FCI* values show an increasing trend along with increase in biomass of SFIs (Fig. 8a). Unlike the MPB perturbation scenario, redundancy is directly proportional and *A/C* is indirectly proportional to biomass of the SFIs (Fig. 8b).

An increase in SFI biomass was accompanied by a decrease in *TPP/TR* and *TPP/TB* ratios and increase in *D/H* ratio (Fig. 8c).

System robustness was also indirectly proportional to SFI biomass and showed a range of −1.06% to 3.91% of system base value (Fig. 8b & 9).

Exergy value showed almost 18% increase at the highest biomass

value of SFI (+99%) (Fig. 7).

4. Discussion

4.1. Unperturbed scenario ➔

The average ecosystem trophic level for the Kakinada Bay is 2.67 which is quite similar to the same for Hooghly-Matla estuarine system, India (2.72; Rakshit et al., 2017) but a bit higher than the average trophic level of Kuosheng Bay, Taiwan (2.35; Lin et al., 2004). The difference in the trophic level between Kakinada bay and Kuosheng bay may be attributed to the fact that the Kakinada bay model has higher number of carnivorous fish groups.

The Kakinada Bay trophic model comprised of ten discrete trophic levels and the mean transfer efficiency of 12.94% was found to be comparable with Chiku Lagoon (12%; Lin et al., 1999) and Tongoy Bay (14%; Wolff, 1994). The transfer efficiency is however quite higher than that of Kuosheng Bay (6.5%; Lin et al., 2004); the difference is due to the comparatively lower *D/H* ratio of Kakinada Bay which indicates that the flow to detritus is higher in Kuosheng bay than in Kakinada bay. This correlation between *D/H* ratio and trophic transfer efficiencies is evident in other systems as well (Table 5). Most of the transfer efficiencies of this system (Table 1) were found to be within the range of 10%–20% commonly reported in literature Odum and Barrett (1971).

Both *TPP/TR* (1.29) and *TPP/TB* (3.36) indicate the system is yet to attain maturity since *TPP/TR* approaches unity and *TPP/TB* ratio declines as the system approaches maturity (Christensen et al., 2005).

The total system throughflow of Kakinada Bay (169.17 t km^{-2} year^{-1}) is quite low when compared to the *TST* of other similar systems (Table 5) even though the total biomasses of the different systems were comparable. *TPP/TB* ratio of Kakinada Bay is much lower than that of the other systems cited which accounts for the low *TST* (Heymans et al., 2002). The low *TST* value in turn results in low *A/C* ratio.

This is evident from the robustness value of the system which lies outside of the 'windows of vitality' towards the left-hand side (Fig. 2) indicating that while the system is resilient to stress it does not utilise maximum potential (Ulanowicz et al., 2009). The system has more alternate pathways between different compartments (which results in increased resilience to stress) than is necessary for efficient performance. As the system is still not mature, an increase in efficiency of the
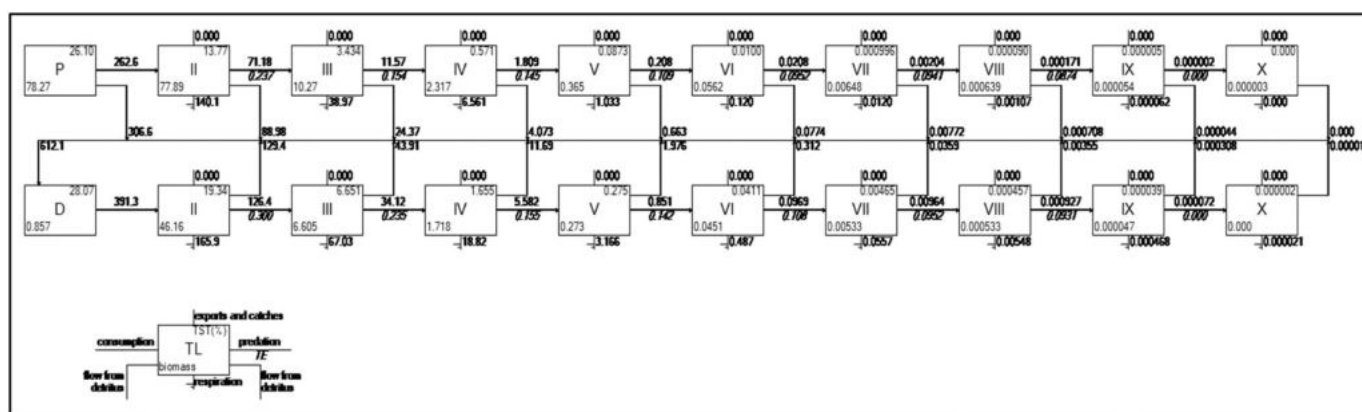
Fig. 4. Lindeman spine of Kakinada Bay; P represents producers and D represents detritus.

Table 4
Transfer efficiencies for Kakinada Bay.

Source\Trophic level	II	III	IV	V	VI	VII	VIII	IX	X	%values
Producer	23.71	15.44	14.54	10.95	9.519	9.407	8.742			13.19
Detritus	29.97	23.52	15.47	14.2	10.81	9.517	9.307			16.11
All flows	27.37	20.77	15.23	13.42	10.56	9.497	9.214	7.783	2.597	12.94

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ATOMIC PHYSICS

Exactly Solvable Model of Classical and Quantum Oscillators of Time Dependent Complex Frequencies: Squeezing Properties of Coherent Field

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Abstract
The exact analytical solution for a classical oscillator with time-dependent frequency is explored. We establish that the closed form solution for such an oscillator is possible provided the frequency is complex and obeying some stringent conditions. The complex nature of the frequency very often occurs in several physical problems. Therefore, the present model calculations are of relevant in fundamental and in practical situations. The solution of the classical oscillator of time-dependent complex frequency is used to obtain the solution of its quantum mechanical counterpart. The possibilities of getting the squeezed states and the nonclassical properties of the initial coherent radiation field coupled to the oscillator are discussed.

Keywords Quantum oscillator with complex frequency · Time-dependent frequency · Squeezing of coherent light · Wronskian

1 Introduction

The explanation of basic physics requires some simple models. The harmonic oscillator is perhaps the most useful one among them. A particle subject to a restoring force gives rise to the model of a harmonic oscillator. Interestingly, the model of a simple (one-dimensional) harmonic oscillator (SHO) with constant frequency and constant mass provides exact solutions both in classical and in quantum pictures. The situation becomes quite complicated if the parameters (mass and frequency) are time dependent. For example, the equations of motion corresponding to the classical harmonic oscillator with time-dependent complex frequency is given by:

$$\ddot{x} + \omega^2(t)x = 0. \tag{1}$$

Now, Eq. (1) does not have closed form analytical solution even when ω is a real function of time t. Of course, for real frequency $\omega(t)$, Eq. (1) could be reduced to the so-called Ermakov equation [1–3]. Unfortunately, the Ermakov equation does not

give closed form exact solution. In spite of these, the Ermakov equation is well studied in various contexts [1–3]. Recently, by using the Ermakov-Lewis invariant appearing in KvN mechanics, the oscillator with time-dependent frequency is investigated [4]. Note that the oscillator with time-dependent mass and/or frequency are well studied by large number of researchers [5, 6, 8–14]. In all these cases [1–6, 8–19], the solutions are approximate and are involving real $\omega(t)$. It is already mentioned that the presence of real $\omega(t)$ in Eq. (1) does not warrant the closed form solution since the differential equation is involving time-dependent coefficient. Of late, we obtain exact analytical solution for a quantum oscillator with time-dependent frequency $\omega(t) = \omega(0)\sqrt{1 + \frac{\beta_0 t}{T}}$, where β_0 and $\omega(0)$ are constant [19]. Of course the identical time-dependent frequency is investigated in the context of time-dependent harmonic oscillator in an electromagnetic field [20] and in the dynamics of Paul trap [5]. Interestingly, we also obtain the solution in terms of the elliptic function of second kind when the frequency $\omega(t) = \omega(0)\sqrt{1 + \beta_0 \cos \Omega t}$. Therefore, we are still in search for a closed form solution to Eq. (1) with few more functional dependence of $\omega(t)$. In this context, it is to be remembered that the real ω corresponds the unitary evolution [16]. Now, the nonunitary evolution for ω corresponds the presence of damping. The complex nature of the frequency $\omega(t)$ in Eq. (1) is certainly unexplored to date. On the other hand, in different contexts, we find investigation where the complex nature of the frequency is considered [21–23]. The

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quantization of the oscillator is ensured since the Wronskian is time invariant. Now, we express the position and momentum operators in terms of the usual annihilation and creation operators $a(t)$ and $a^\dagger(t)$. Therefore, we have

$$\hat{x}(t) = \frac{1}{\sqrt{2}}\big((a(t) + a^\dagger(t)\big), \tag{16}$$

and

$$\hat{\dot{x}}(t) = -\frac{i}{\sqrt{2}}\big((a(t) - a^\dagger(t)\big). \tag{17}$$

Therefore, the annihilation and creation operators are expressed in terms of the position and momentum operators. Hence, we have

$$\begin{aligned} a(t) &= \frac{1}{\sqrt{2}}\Big(\hat{x}(t) + i\hat{\dot{x}}(t)\Big), \\ a^\dagger(t) &= \frac{1}{\sqrt{2}}\Big(\hat{x}(t) - i\hat{\dot{x}}(t)\Big). \end{aligned} \tag{18}$$

Now, it follows

$$[a(t), a^\dagger(t)] = 1, \tag{19}$$

where Eq. (15) is used. Instead of defining annihilation and creation operators as function of time, it is also possible to define those operators as function of cavity length [27]. Now, we claim that the solution of the quantum mechanical oscillator of time-dependent frequency might be useful for investigating various quantum optical phenomena. These include squeezing, photon antibunching, higher ordered squeezing, and the nonclassical photon statistics. In order to substantiate the claim, we calculate the second-order variances involving the position and momentum operator available through Eqs. (13) and (14). Assuming the initial coherent radiation field coupled to the oscillator, we have

$$\bar{x} = < \alpha|\hat{x}(t)\alpha> = \frac{A_1 - iA_2}{\sqrt{2}}\alpha + \frac{A_1 + iA_2}{\sqrt{2}}\alpha^*, \tag{20}$$

where $\alpha = |\alpha|e^{i\theta}$ is a complex eigenvalue of the annihilation operator corresponding to the coherent state. The parameters $|\alpha|^2$ and θ are the photon numbers and the phase angle respectively of the coherent radiation field. The average momentum can be obtained by differentiating Eq. (20). Now, the second-order variance of the position and momentum operator follow as:

$$\begin{aligned} (\Delta x)^2 &= < \alpha|\hat{x}^2|\alpha> - < \alpha|\hat{x}^2|\alpha>^2 = \tfrac{1}{2}(A_1^2 + A_2^2), \\ (\Delta \dot{x})^2 &= < \alpha|\hat{\dot{x}}^2|\alpha> - < \alpha|\hat{\dot{x}}^2|\alpha>^2 = \tfrac{1}{2}(\dot{A}_1^2 + \dot{A}_2^2). \end{aligned} \tag{21}$$

Now, we obtain the Heisenberg uncertainty relation $(\triangle x)(\triangle \dot{x}) = \frac{1}{2}\sqrt{(A_1^2 + A_2^2)(\dot{A}_1^2 + \dot{A}_2^2)}$. For $t = 0$, $A_1(0) = 1$, $A_2(0) = 0$, $\dot{A}_1(0) = 0$, and $\dot{A}_2(0) = 1$. Hence, for $t = 0$, the minimum uncertainty condition $(\triangle x)(\triangle \dot{x}) = \frac{1}{2}$ is achieved. Now, the

squeezing in $x - quadrature$ ($\dot{x} - quadrature$) is obtained at the cost of $(x - quadrature)$ if $(\triangle x)^2 < \frac{1}{2}((\triangle \dot{x})^2 = \frac{1}{2})$. By knowing the functional form of the time-dependent frequency $\omega(t)$, it is possible to calculate A_1, A_2, $\dot{A}_1$, and $\dot{A}_2$ and hence to investigate the squeezing. The solutions (16) and (17) can also be used to investigate other nonclassical properties of the radiation field coupled to the oscillator with time-dependent frequency.

4 Conclusion

The classical harmonic oscillator with time-dependent frequency is investigated. We establish that the exact analytical solutions of the oscillator with time-dependent frequency are possible if the frequency is complex. The complex frequency of the oscillator is expressed as the sum of real and imaginary parts with suitable parameter which is of dimension of frequency. The exact analytical solutions of the time-dependent oscillator are obtained when the defined parameter is integrable with respect to time. In order to substantiate our claim, we give few examples for which the oscillator with time-dependent frequency is analytically solved in an exact manner. The solution of the classical oscillator with time-dependent complex frequency is exploited to obtain the solution of the quantum mechanical counterpart of the oscillator. The analytical solution of the quantum mechanical oscillator of time-dependent frequency is used to discuss the possibility of getting squeezed and other nonclassical phenomena of the input coherent radiation field coupled to the oscillator. We hope that the solutions of the oscillator with time-dependent complex frequency will be of use in wide range of applications.

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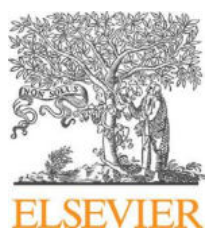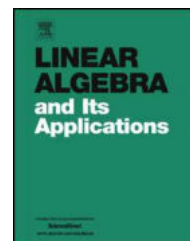
Orthogonality of bilinear forms and application to matrices ☆

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A R T I C L E   I N F O

A B S T R A C T

We characterize Birkhoff-James orthogonality of continuous vector-valued functions on a compact topological space. As an application of our investigation, Birkhoff-James orthogonality of real bilinear forms are studied. This allows us to present an elementary proof of the well-known Bhatia-Šemrl Theorem in the real case.

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$v \in C_1$. Similarly, assuming $\mu > 0$, it can be shown that $v \in C_2$. Therefore, $C_1 \cup C_2 = \mathcal{M}_f$, as desired.

Next, we claim that both C_1, C_2 are non-empty. Indeed, following the same arguments used in the proof of Theorem 2.1, one can easily verify that $C_1, C_2 \neq \emptyset$. Finally, we claim that C_1, C_2 form a separation of $\mathcal{M}_f$. To establish our claim, we observe that $\bar{C}_1 \cap C_2 = \emptyset$ and $C_1 \cap \bar{C}_2 = \emptyset$, as otherwise we can find $u_0 \in \mathcal{M}_f$ such that $f(u_0) \perp_B g(u_0)$. However, this is a contradiction to the fact that $\mathcal{M}_f$ is connected. This completes the proof of the theorem. $\square$

The above theorem may not be true if $\mathcal{M}_f$ is not connected. We furnish the following example in support of this fact.

Example 2.2.1. Let $\mathcal{U} = [0, 2] \subset \mathbb{R}$ and $\mathbb{X} = \mathbb{R}$. We define $f, g \in \mathcal{C}(\mathcal{U}, \mathbb{X})$ by $f(u) = sin\ \pi u$ and $g(u) = 1$ for all $u \in [0, 2]$. Clearly, $\mathcal{M}_f = \{\frac{1}{2}, \frac{3}{2}\}$. Now, $f(\frac{1}{2})g(\frac{1}{2}) > 0$, i.e., $g(\frac{1}{2}) \in f(\frac{1}{2})^+$ and $f(\frac{3}{2})g(\frac{3}{2}) < 0$, i.e., $g(\frac{3}{2}) \in f(\frac{3}{2})^-$. Then from Theorem 2.1, it follows that $f \perp_B g$, however, $g(v) \neq 0$ for any $v \in \mathcal{M}_f$, i.e., $f(v) \not\perp_B g(v)$ for any $v \in \mathcal{M}_f$.

Our next theorem, in some sense, assimilates the above two theorems. This turns out to be an important tool in our further developments. We omit the proof as it is trivial in view of Theorem 2.1 and Theorem 2.2.

Theorem 2.3. *Let $\mathcal{U}$ be a compact topological space and let $\mathbb{X}$ be a normed linear space. Let $f, g \in \mathcal{C}(\mathcal{U}, \mathbb{X})$ be non-zero. Let $\mathcal{D}_f \subseteq \mathcal{M}_f$ be such that $\mathcal{D}_f$ is connected. Then the following conditions are equivalent:*

(i) *There exist $u_1, u_2 \in \mathcal{D}_f$ such that $g(u_1) \in f(u_1)^+$ and $g(u_2) \in f(u_2)^-$.*
(ii) *There exists $u_0 \in \mathcal{D}_f$ such that $f(u_0) \perp_B g(u_0)$.*

As mentioned in the introduction, we obtain some of the earlier results on the Birkhoff-James orthogonality of linear operators as simple corollaries to Theorem 2.1 and Theorem 2.2.

Corollary 2.3.1. *[7, Theorem 2.2] Let $\mathbb{X}$ be a finite-dimensional real Banach space. Let $T, A \in \mathbb{L}(\mathbb{X})$. Then $T \perp_B A$ if and only if there exist $x, y \in M_T$ such that $Ax \in Tx^+$ and $Ay \in Ty^-$.*

Proof. The proof of the sufficient part is trivial. To prove the necessary part, we first observe that

$$\|T + \lambda A\|_{S_{\mathbb{X}}} = \|T + \lambda A\| \geq \|T\| = \|T\|_{S_{\mathbb{X}}},$$

for all $\lambda \in \mathbb{R}$. In other words, $T, A \in \mathcal{C}(S_{\mathbb{X}}, \mathbb{X})$ (by considering the respective restriction operators on $S_{\mathbb{X}}$) with $T \perp_B A$. Therefore, it follows from Theorem 2.1 that there exist

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Atomic-Ordering-Induced Modulated Properties of Zigzag ZnTe Nanotubes

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In this work, zigzag ZnTe nanotubes of various diameters are constructed from a ZnTe sheet and are optimized geometrically through density functional theory based energy minimization calculations. The energetically optimized nanotubes are then used to examine their electronic properties. It is found that the band gap of a nanotube may be adjusted over a wide range from 0.5 to 2.3 eV and the work function of a nanotube may be adjusted in the range from 4.7 to 5.8 eV by choosing a nanotube of appropriate diameter. Thus, zigzag ZnTe nanotube may serve as an important band gap material for technological purposes.

1. Introduction

Basic investigation of the electrical, magnetic, optical, and catalytic properties of materials with the variation of their shapes, sizes, and compositions has become a predominant area of research to meet contemporary technological demands. For instance, nanostructures of diverse shapes such as quantum dots, nanorods, nanocones, and nanotubes have proven to exhibit interesting properties. However, 1D nanostructures, namely, nanowires and nanotubes, are expected to take a leading role in practical applications due to their unique structural features. In fact, the synthesis of carbon nanotubes[1] triggered enormous research activity in the domain of 1D nanomaterials. Intriguing features of carbon nanotubes encouraged further investigation of the formation of nanotubes composed of various other elements. Accordingly, a large number of experiments were performed and nanotubes of several binary compounds, such as BN, SiC, ZnO, ZnS, CdSe, CdS, GaN, and HgSe were successfully synthesized.[2–9]

Among noncarbon materials, ZnTe, a group II–VI semiconductor, exhibits some remarkable features such as relatively small resistance, bandgap of 2.2–2.3 eV and a very high photo-absorption coefficient of $\approx 3 \times 10^4 \mathrm{cm}^{-1}$ under 540 nm.[10–13] Because of these intriguing features, ZnTe nanostructures were

shown to be useful in solar cells, green LEDs, photovoltaic devices, thermoelectric devices, and photodetectors.[14–18] ZnTe nanostructures were also used in nonlinear optics, generation and detection of terahertz signals.[19–22] In another study, Minegishi et al. observed superior incident-photon-to-current conversion efficiency using ZnTe-based photocathodes and obtained hydrogen from water using sunlight by the process of photoelectrochemical water splitting.[23] Such a possibility of wide range of applications led to several experiments for the synthesis of various ZnTe nanostructures such as quantumdots, nanoplates, thin films, nanowires, nanoribbons, and nanotubes.[24–32] For example, Zarei et al.[33] synthesized ZnTe thin films by glancing angle technique and observed that they were useful in optoelectronic devices. In a study, Das et al.[34] synthesized various ZnTe nanoparticles and reported their size-dependent structural, optical, and vibrational properties. Again, ZnTe nanomaterials may be doped easily and therefore, their properties could be tuned to the desirable level.[35,36] For instance, transition-metal-doped ZnTe nanostructures have shown appealing magnetic and fluorescent properties.[37–42] From this discussions, it is clear that various ZnTe nanostructures are important for practical applications due to the emergence of important properties.

As the tubular structures of different materials are known to exhibit useful properties, it is inspiring to explore the features of ZnTe nanotubes. It is also known that the properties of the nanotubes are sensitive to the chirality of the nanotubes; i.e., the zigzag nanotubes may show distinct properties from armchair nanotubes. In a previous work, we extracted the properties of ZnTe nanotubes in the armchair configuration.[43] However, the properties of ZnTe nanotubes with zigzag configuration are yet to be examined. Apart from chirality, atomic positioning also plays a distinct role in directing the characteristics of a nanotube.[44,45] In this article, we probe the properties of zigzag ZnTe nanotubes by changing the atomic configurations. We assume two classes of zigzag ZnTe nanotubes on the basis of the atomic ordering, namely, class-1 and class-2. In the class-1 pattern, every Zn atom is directly connected by three Te atoms and in class-2, each Zn atom is directly connected by two Te atoms and one Zn atom. In the next section, we narrate the procedures along with the essential parameters. The outcomes are discussed in Section 3 and finally we abridge our findings in Section 4.

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wrinkled-surface structure emerged as a result of the radially outward displacement of the Te atoms (more electronegative) and radially inward displacement of the Zn atoms (less electronegative). More electronegative atoms possess extra electronic charges and therefore, they try to move far off the tube axis to minimize the electron–electron repulsion. In any molecular structure, it is observed that the less electronegative atom occupies the central position to minimize the electron–electron repulsion. An analogous wavy surface was also noted in CdS, ZnS, and CdSe nanotubes.[50–52] Because of the relative displacements of the Zn and Te atoms, such a relaxed nanotube resembles a coaxial cylindrical structure: The external one is built up with Te atoms, while the internal one is made up of Zn atoms. We may approximate the diameter of a tube by calculating the average of the external and internal diameters. We may further evaluate the wall width of the tube by subtracting the internal radius from the external radius. We have computed the diameter and wall width of the nanotubes and display the results in **Table 1** and **2**. It is perceived that in the class-1 pattern, the deviation in diameters of the nanotubes due to energy optimization ranges from 2.04% to 2.51% and in the class-2 pattern, deviation ranges from 3.04% to 4.35%. We have shown the variation of wall width with respect to diameter in **Figure 4**. This figure conveys that the wall becomes thinner with an enlarging diameter of the nanotube.

For understanding the energetic stability of the nanotubes, we have estimated their cohesive energy per atom.

Figure 4. Dependence of the wall width on diameters of the both classes of zigzag ZnTe nanotubes.

Cohesive energy per atom, E_c, can be calculated by utilizing the expression

$$E_c = -\frac{E(Zn_x Te_y) - xE(Zn) - yE(Te)}{(x+y)} \qquad (2)$$

where $E(Zn_x Te_y)$ is the energy of the relaxed system made up of x numbers of Zn atoms and y numbers of Te atoms. $E(Zn)$ and $E(Te)$ represent the energy of isolated Zn and Te atoms, respectively. We realize that the cohesive energies of class-1 and class-2 sheets are 2.334 and 1.991 eV, respectively. However, for a class-1 nanotube the cohesive energy ranges from 2.292 to 2.323 eV (refer to Table 1). In case of class-2, the cohesive energy rises from 1.951 to 1.983 eV (see Table 2). We have plotted the cohesive energies with respect to the diameter in **Figure 5**. This figure exhibits that for both classes of nanotubes the cohesive energies increase with diameter and approach the values of the corresponding two dimensional sheets. It is recognized that the cohesive energies of class-1 nanotubes are slightly higher than those of the class-2 nanotubes; i.e., class-1 nanotubes are more favorable over class-2 nanotubes. We obtain a similar trend in case of armchair ZnTe nanotubes.[43]

The knowledge of bandgap and its variation with respect to tuneable parameters is important for designing new nanoscale devices with desired applications. To judge the significance of ZnTe nanostructures in various technological applications, we have determined the bandgaps of various ZnTe nanosheets

Table 1. Estimated structural parameters of class-1 nanotubes. Here, D, d, N, and E_c represent the diameter, wall width, atom number in the supercell, and cohesive energy per atom, respectively.

System	D [Å]	d [Å]	N	E_c [eV]
ZnTe (8,0)	11.571	0.550	32	2.292
ZnTe (9,0)	13.015	0.510	36	2.298
ZnTe (10,0)	14.454	0.475	40	2.304
ZnTe (11,0)	15.876	0.442	44	2.310
ZnTe (12,0)	17.315	0.418	48	2.315
ZnTe (13,0)	18.742	0.397	52	2.318
ZnTe (14,0)	20.171	0.380	56	2.321
ZnTe (15,0)	21.613	0.365	60	2.323

Table 2. Various structural parameters of class-2 nanotubes. Here, D, d, N, and E_c denote the diameter, wall width, atom number in the supercell, and cohesive energy per atom, respectively.

System	D [Å]	d [Å]	N	E_c [eV]
ZnTe (8,0)	11.782	0.761	32	1.951
ZnTe (9,0)	13.234	0.708	36	1.958
ZnTe (10,0)	14.642	0.663	40	1.964
ZnTe (11,0)	16.085	0.629	44	1.970
ZnTe (12,0)	17.521	0.604	48	1.974
ZnTe (13,0)	18.924	0.583	52	1.978
ZnTe (14,0)	20.352	0.564	56	1.981
ZnTe (15,0)	21.824	0.548	60	1.983

Figure 5. The cohesive energy per atom versus diameter plot for different zigzag ZnTe nanotubes. The red straight lines denote the cohesive energies of the ZnTe sheets.

Data Availability Statement

Research data are not shared.

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অতিমারী কোভিড ও ভারতীয়-দর্শন প্রসঙ্গ

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Abstract:

The human world faces its greatest threat of disaster in the form of the COVID-19 pandemic. Infected by the virulent coronavirus the daily life of humans is under severe risk. The continuity and severity of this asymmetric warfare against the virus has tested the limits of human resilience. However, the extended struggle has been further prolonged asking for more struggles from us. Economic, psychological, physical and more such difficulties have not able to stop our fight against this disaster. We have presented a largely unflinching face to this adversity. Texts and traditions of the various societies, facing the danger as it is, have played an essential part in the building of the character of the people. The same is the case for India's populace. Indian philosophical traditions have provided the people here with clues to keep themselves both mentally and physically robust. Analysis of the well-accepted traditions such as that of Śāṃkhya, Yoga, Vedānta show that their deep interpretations assist us in the path of achieving physical and mental equilibrium.

Keywords: *Pandemic, philosophy, Upaniṣads, Śāṃkhya, Yoga, Vedānta, disaster*

যখন কোন সংক্রামক ব্যাধির সংক্রমণ সীমিত পরিসর অতিক্রম করে বৃহৎ পরিসরে বিস্তারলাভ করে অর্থাৎ ক্ষুদ্র অঞ্চলে সীমাবদ্ধ না থেকে ক্রমবর্ধমান সেই ব্যাধি ভৌগোলিক সীমা ছাড়িয়ে অন্যত্র দেশ দেশান্তরে ছড়িয়ে পড়ে তখন সাধারণভাবে তাকে অতিমারী রূপে চিহ্নিত করা হয়।[1] যে কোন প্রাকৃতিক বিপর্যয়ের ন্যায় জনজীবনে এটাও একপ্রকার ভয়ানক বিপর্যয়, তবে অন্যান্য প্রাকৃতিক বিপর্যয়ের সঙ্গে এর মূল পার্থক্য হল এর স্থায়ীত্বকাল তুলনামূলকভাবে অনেক বেশি তাই এর সঙ্গে মোকাবিলা করাটাও স্বাভাবিকভাবেই অনেক বেশি কঠিন হয়ে থাকে। বর্তমান সময়ে সমগ্র বিশ্ব তেমনই এক ভয়ানক বিপর্যয়ের সম্মুখীন। 'কোরোনা' নামক ভাইরাস ঘটিত ব্যাধি যা 'কোভিড-১৯' নামে পরিচিত, এখন তার প্রথম আবির্ভাব স্থলের সীমা লঙ্ঘন করে বিভিন্ন দেশে অনুপ্রবেশ করেছে। সমগ্র বিশ্বের অনন্য ২০০টি দেশের প্রায় প্রতিটি দেশই এই মারণ ব্যাধির দ্বারা আক্রান্ত। তদুপরি অতি সংক্রামক আগন্তুক এই রোগের নিরাময়যোগ্য প্রতিষেধক মানুষের কাছে নেই বললেই চলে, স্বল্প পরিমানে যা আছে তাও প্রায় দুর্লভ হয়ে উঠেছে। মানুষ একপ্রকার বিনা অস্ত্রেই কোভিডের বিপক্ষে যুদ্ধে অবতীর্ণ হয়েছে। বিশেষ করে তৃতীয় বিশ্বের দেশ ভারতবর্ষের অবস্থা সেই প্রকারই বলা চলে। মানুষ আজ বড় অসহায়। একরাশ আতঙ্ক, শঙ্কা আর অনিশ্চয়তা নিয়ে দিনযাপন করছে যা মৃত্যুরই নামান্তর। অপ্রতিরোধ্য এই রোগের প্রকোপে কেবলমাত্র বিশ্বস্বাস্থ্যই ভেঙে পড়েনি তার

সঙ্গে তীব্র ধাক্কা খেয়েছে রাষ্ট্রব্যবস্থা, অর্থনীতি, কর্মজীবন। স্বাভাবিক জীবনধারার গতি প্রায় রুদ্ধ হয়ে গেছে। সর্বোপরি মানুষের মানসিক স্বাস্থ্যের অবস্থা তথৈবচ। এইভাবে জীবনধারণের মূল স্তম্ভগুলি দুর্বল হয়ে পড়ায় মানুষ আজ দিশাহীন। তবুও এই তীব্র প্রতিকূল পরিস্থিতিতে সর্বশেষ জীবনীশক্তিটুকু নিয়ে বেঁচে থাকার আপ্রাণ চেষ্টা চালিয়ে যাচ্ছে। বহু বিষয়ই আছে যা প্রত্যক্ষভাবে তাদেরকে বিগত এক বছরের অধিক সময় ধরে নিরবিচ্ছিন্ন এই লড়াইয়ের শক্তি যোগান দিচ্ছে। তবে তাদের মধ্যে ভারতীয় দর্শনের ভাবনা-প্রসূত জীবনাদর্শ সেক্ষেত্রে পরোক্ষভাবে হলেও অনেকখানি পুষ্টিবর্ধকের ভূমিকা পালন করে চলেছে বলে আমার মনে হয়।

যে কোন যুদ্ধ জয়ের অমোঘ অস্ত্রগুলি হল নিজের প্রতি আস্থা, নির্ভীকতা এবং অবশ্যই ধৈর্য। আমাদের কারো অজানা নয় যে ভারতের স্বাধীনতা আন্দোলনের যোদ্ধারা তাদের আন্তরশক্তিকে অটুট ও মজবুত রাখতে বার বার শরণ নিয়েছে গীতা, উপনিষদের। এখানে বলে নেওয়া দরকার যে, গীতা, উপনিষদ প্রভৃতি বেদান্ত-দর্শনের অন্তর্গত। বেদান্তের লক্ষণে বলা হয়েছে – 'বেদান্তো নাম উপনিষৎ-প্রমাণং তদুপকারীণি শারীরক-সূত্রাদীনি চ'।[2] বস্তুজগতের কোন উপকরণ তাদের সেই বলবৃদ্ধিতে সহায়ক হতে পারেনি। এই মুহূর্তে বিশ্বের প্রতিটি মানুষ তদপেক্ষা ভীষণ এক যুদ্ধে সামিল হয়েছে টিকে থেকে জয়লাভের লক্ষ্যে। আর সেই লক্ষ্যে পৌঁছে দেওয়ার চালিকাশক্তিরূপে এই পরিস্থিতিতে ভূমিকা পালন করছে অন্তরের গভীরে প্রচ্ছন্ন থাকা দর্শনভাবনা। এই বিষয়টিকে কেন্দ্র করেই আমার বর্তমান প্রবন্ধের আলোচনা। এখানে উল্লেখ্য যে ভারতীয়-দর্শনের কথা বললেও বাহুল্য বর্জন করতে কতিপয় দর্শনের প্রাসঙ্গিকতা আলোচনা করা হয়েছে।

বিগত একশো বছর ধরে মানুষের মহামারী এবং অতিমারী সম্পর্কে অর্জিত যা কিছু জ্ঞান তা সবই প্রায় ইতিহাস, উপন্যাস বা গল্প নির্ভর। বাস্তব অভিজ্ঞতা লাভের তেমন কোন সুযোগ প্রায় আসেনি বললেই চলে। কিন্তু একবিংশ শতকের এই দ্বিতীয় থেকে তৃতীয় দশকের সন্ধিক্ষণে গ্রন্থ নিহিত সেই সকল গল্প-কাহিনী যেন কোন দুর্দৈবের করস্পর্শে এক লহমায় জীবন্ত হয়ে উঠেছে। এই মুহূর্তে রক্তমাংসের মানুষ বাস্তবের মাটিতে অত্যন্ত নগ্নভাবে তাকে প্রত্যক্ষ করছে। কোন প্রকার পূর্বাভাস ছাড়া অতিমারীর আকস্মিক আগমনের এই ধাক্কা বিশ্বের জীবনধারার স্বাভাবিক সরল গতির ছন্দকে সম্পূর্ণভাবে বিনষ্ট করে দিয়েছে। এই রোগ অতি সংক্রামক, অন্যদিকে একে প্রতিরোধ করার মত ঔষধিব্যবস্থা চিকিৎসাশাস্ত্রে প্রায় নেই বললেই চলে। তাই মানুষের জীবনরক্ষার একমাত্র উপায় হল সাবধানতা অবলম্বনের মাধ্যমে সংক্রমণের গতিকে যথাসম্ভব স্তিমিত করা ও অবরুদ্ধ করা। সেই উদ্দেশ্যকে সফল করার জন্য বিশ্ব স্বাস্থ্য সংস্থার স্বাস্থ্যবিধি মেনে মানুষকে হতে হয়েছে গৃহবন্দী। বন্ধ হয়েছে যানবাহন, দোকানপাট, অফিস আদালত সহ সরকারি-বেসরকারি সকল কর্মক্ষেত্র। এমনকি পারস্পরিক সাক্ষাৎকারটুকুও বন্ধ রাখতে হয়েছে। এর ফলে তৈরী হয়েছে অর্থসংকট, কর্মহীনতা, খাদ্যাভাব, নিসঙ্গতা, একাকীত্ব। ধনী থেকে দরিদ্র সর্বস্তরের মানুষ কমবেশি এই সমস্যাগুলির দ্বারা অহরহ পিড়ীত হয়ে চলেছে। এককথায় বলা যায় মানুষের স্বাভাবিক জীবনধারা আজ বিপরীত মুখে বহমান। তবুও এহেন প্রতিকূল স্রোতের বিরুদ্ধে মানুষ সর্বশক্তি প্রয়োগ করে নিজেকে টেনে নিয়ে চলেছে বাঁচার লক্ষ্যে। লড়াইটা অসম লড়াই। সব যুদ্ধে প্রতিপক্ষের প্রতি প্রবল বিরুদ্ধ শক্তি প্রয়োগ করাটাই জয়লাভের একমাত্র উপায় নয়। কখনো কখনো শত্রুর সামনে টিকে থাকাটাও যুদ্ধজয়ের কৌশল হয়ে থাকে। আজ মানুষ সেই কৌশলই অবলম্বন করেছে। শতকষ্ট সহ্য করে সমস্ত রকম পরিবর্তিত পরিস্থিতির সঙ্গে নিজেকে মানিয়ে নেওয়ার চেষ্টা করে চলেছে। এই যে তার হারতে হারতে হার

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[4] ঈশোপনিষদ - ১

[5] ছান্দোগ্যোপনিষদ, ৩.১৪.১, পৃ. ৪২৮

[6] ছান্দোগ্যোপনিষদ, ৬.৮.৭, পৃ. ৫২৭

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[11] যোগসূত্র ২.৪৯, পৃ. ২২৭

[12] যোগসূত্র ৩.১, পৃ. ২৩৩

[13] যোগসূত্র ১.৩৩, পৃ. ৯১

[14] যোগসূত্র ১.৩৪, পৃ. ৯২

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Assessment Of The Novels With Special Reference To Chetan Bhagat

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ABSTRACT:

The basic historical perspective of Indian English literature attempts to contextualize the genre's development and rise from its inception to its current popularity. British colonialism in India coincided with the rise of Indian English literature and history. Although academics agree that the first good Indian English work dates from the early 1800s, opinions differ. The adoption of English literature and language by the Indian upper-response class, as well as educational reform by the British administration and missionary efforts, all contributed to its rise. This article highlights about the assessment of the novels with special reference to Chetan Bhagat.

Keywords: Chetan Bhagat, Novels, Assessment.

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21.	OVERVIEW OF SELECTED WORK-LIFE BALANCE VARIABLES IN THE CONTEXT OF HIGHER EDUCATION SECTOR: AN APPROACH	Neyha Malik Prof. A.K. Saxena

Tamali Neogi

EFFICACY OF PERFORMANCE METHOD OVER LECTURE METHOD: TEACHING SHAKESPEARE AND MAHESH DATTANI RURAL INDIAN CLASSROOM

ABSTRACT

The proposed paper aims to compare and contrast the learning outcomes of two texts of drama from the UG syllabus of Honours (BU University), in an attempt to examine how far performance teaching can be successfully adapted in rural Indian classroom to teach Shakespeare and simultaneously relevance of this adaption so far as teaching Indian writing in English (Mahesh Dattani) is considered basis of a survey, the author has reached some interesting findings that on the one hand accepts the performance method of teaching over lecture method but on the other hand doesn't wholly overthrow of lecture method particularly when teaching Indian literature in English is considered. More findings of those aspects where even performance method fails to address the limitations of teaching process.

Keywords: Performance method, Lecture method, Shakespearian drama, Mahesh Dattani, Variation index

The English Honours syllabus of UG level (CBCS) is a multidimensional one. The problems of learning and teaching English literature at rural colleges are so multi-faceted that it is really puzzling to decide what should be the beginning point of this discussion. Putting aside the question of so called 'completing' [a very vague terminology] the due portion of the syllabus within a fixed period (here a semester), the problems can be categorized likewise – (i) orientation of a rural Indian student (ii)confused goal of learning English(iii) confused aims of traditional evaluation system (iv) non-availability of trained teachers in a changed scenario and their relevant confusion regarding the aims and methodology of teaching. Low language proficiency levels, lack of reading, writing and speaking skills, low motivation level, poor self-confidence and cultural prejudices can be assigned to the first-category. About ninety percent of the students studying have not studied English as first school levels. As second language, them learning a set of rules. When college level, still then they do pronunciation, spelling and grammar not have the idea of proper (Bhandari, 2009). Besides, the between the students for whom the and the decoded subject matters of the syllabus, as rightly pointed Sarkar(www.cje.ids.czest.), is Secondly, there is confusion supposed goal of learning English of the students, it seems to be, As Bhandari puts it, "the sole and the learner remain to clear the never realize the importance of

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মহাভারত ও সাংখ্যকারিকার নিরিখে প্রকৃতি – একটি সমীক্ষা

মণিমালা মণ্ডল

সহকারী অধ্যাপক, সংস্কৃত বিভাগ, গুসকরা মহাবিদ্যালয়, পশ্চিমবঙ্গ, ভারত

Abstract:

The Mahābhārata is one of those Smṛti texts that have a lot of material on Indian śāstras along with which is morals and teachings associated with the Indian schools of philosophy. Throughout the vast expanse of the text Vedānta and other schools of philosophy are represented but arguably the most importance has been accorded to the Sāṃkhya system. Of the 25 Sāṃkhya tattvas the prakṛtitattva has featured prominently in the Mahābhārata and has gotten treatment which is unique to the grand epic. The prakṛtitattva has received its proper and elaborate treatment in Īśvarakṛṣṇa's Sāṃkhyakārika and this opens the arena for a comparative analysis of the tattva in terms of their treatment in the Mahābhārata and the Sāṃkhyakārika. What emerges is that the principle has been handled almost similarly except for the introduction of the concept of Īśvara in the Mahābhārata which sits atop prakṛti and controls its actions, while in the Sāṃkhyakārika it is completely independent.

Keywords: Mahābhārata, Sāṃkhyakārika, prakṛti, avyakta, guṇa

মহাভারত ভারত-ইতিহাসের পূর্ণাঙ্গ দলিল। মহাভারতের সমগ্র সাহিত্য কাঠামোয় প্রলিপ্ত হয়ে আছে ভারত সভ্যতার সর্বাঙ্গীন ইতিহাস। আলংকারিক বিচারে মহাভারত মহাকাব্যের সংজ্ঞায় বিভূষিত হলেও মূলত এটি একটি সংকলন গ্রন্থ। ভারতীয় বিদ্যার এমন কোন ক্ষেত্র নেই যা মহাভারতের দ্বারা স্পৃষ্ট হয়নি। তাই মহাভারতের মহাত্ম্য কীর্তন করতে গিয়ে নির্দ্বিধায় উচ্চারিত হয় – যন্নেহাস্তি ন তৎ ক্বচিৎ। অর্থাৎ যা নাই ভারতে তা নাই ভারতে। মহাভারতকে আমরা যেভাবেই অন্বেষণ করি সে সেইভাবেই ধরা দেয়। একথা বললে অত্যুক্তি হবে না যে মহাভারত হল একই আধারে ভারতীয় সভ্যতা সংস্কৃতির সর্বাঙ্গীন ইতিহাস, সম্পূর্ণ সাহিত্য, সামগ্রিক সমাজবিদ্যা ও পরিপূর্ণ নীতিবিদ্যা ও পূর্ণ দর্শন।

আঠারোটি পর্বের সমন্বয়ে গঠিত বিপুলাকার শরীরে মহাভারত অন্যান্য বিবিধ বিষয়ের ন্যায় ভারতীয় দর্শন চিন্তাকেও ধারণ করেছে ও তাকে বহন করে নিয়ে চলেছে। মহাভারতের সমগ্র আয়তনের বিভিন্ন অংশে যে দর্শনভাবনাগুলি প্রস্ফুটিত হয়েছে তাদের পুঙ্খানুপুঙ্খ বিশ্লেষণ করলে সুস্পষ্টভাবে বোঝা যায় যে এগুলি সবই ছয়টি আস্তিক দর্শনের কোন না কোন নীতির চিন্তাপ্রসূত। অর্থাৎ মহাভারতের সমগ্র দর্শনচিন্তা প্রকৃতপক্ষে ভারতীয় ষড়দর্শনেরই চিন্তা। এই ছয়টি দর্শনের মধ্যে আবার বিশেষ মাত্রায় প্রাধান্য পেয়েছে

সাত্ত্বিকভাবের কার্য, যা নিজের দুঃখযুক্ত ও অপ্রীতিকর হয় তা রজোগুণের কার্য এবং যা দেহ ও মনকে মোহমুক্ত করে এবং তাতে অনির্বচনীয় ও অজ্ঞেয় ভাব সঞ্জাত করে তা তমোগুণের কার্য –

> অত্র যৎ প্রীতিসংযুক্তং কায়ে মনসি বা ভবেৎ।
>
> বর্ততে সাত্ত্বিকো ভাব ইত্যুপেক্ষেত তত্তথা।।
>
> অথ যদ্দুঃখসংযুক্তমপ্রীতিকরমাত্মনঃ।
>
> প্রবৃত্তং রজ ইত্যেব তদসংরভ্য চিন্তয়েৎ।।
>
> অথ যন্মোহসংযুক্তং কায়ে মনসি বা ভবেৎ।
>
> অপ্রতর্ক্যমবিজ্ঞেয়ং তমস্তদুপধারয়েৎ।।[19]

গুণসমূহের কার্য বিষয়ে নীলকণ্ঠের ভারতভাবদীপ টীকার বক্তব্যটিও বিশেষভাবে লক্ষণীয়। সেখানে বলা হয়েছে সত্ত্বগুণ হতে দয়া প্রভৃতি, রজো থেকে আসক্তি বা কাম প্রভৃতি এবং তমো গুণ থেকে মোহ প্রভৃতি ধর্ম উৎপন্ন হয়ে থাকে – 'সত্ত্বস্য গুণাম্ ধর্ম্মাদীন্ রজসঃ প্রবৃত্ত্যাদীন্ তমসোহপ্রবৃত্ত্যাদীন্...'।[20]

কোনো কার্য সাধনের ক্ষেত্রে সত্ত্বাদি গুণত্রয় যেরূপ ভূমিকা পালন করে থাকে তার উপর ভিত্তি করে সাংখ্যশাস্ত্রে গুণগুলির চরিত্র নিরূপণ করা হয়েছে। এবিষয়ে ঈশ্বরকৃষ্ণ সাংখ্যকারিকায় বলেছেন সত্ত্বগুণ হল লঘু ও প্রকাশক, রজোগুণ প্রবৃত্তিশীল ও চঞ্চল অর্থাৎ ক্রিয়াশীল এবং তমোগুণ গুরু ও আবরণক –

> সত্ত্বং লঘু প্রকাশকমিষ্টমুপষ্টম্ভকং চলং চ রজঃ।
>
> গুরু বরণকমেবতমঃ ...।।[21]

সাংখ্যকারিকার এই বক্তব্যের সমর্থন মেলে নীলকণ্ঠের টীকায় – 'তামসান্ ক্রোধাদীন্, রাজসান্ প্রবৃত্ত্যাদীন্, সাত্ত্বিকান্ প্রকাশাদীন্'[22]। তাছাড়াও নীলকণ্ঠ ভারতভাবদীপে সত্ত্ব, রজো ও তমো গুণের শুক্ল, লোহিত ও কৃষ্ণবর্ণ ধারণের হেতুরূপে স্বচ্ছত্ব, রঞ্জকত্ব ও মলিনত্বকে উল্লেখ করেছেন যা পক্ষান্তরে সত্ত্বাদি গুণের যথাক্রমে প্রকাশত্ব, ক্রিয়াশীলত্ব ও আবরকত্ব ধর্মকেই নির্দেশ করে – 'ক্রমেণ স্বচ্ছত্বাদ্রঞ্জকত্বান্মলিন্ত্বাচ্চ সত্ত্বাদীনি শুক্লোহিতকৃষ্ণানি...'[23]। অতএব উপরোক্ত আলোচনার ভিত্তিতে বলা যায় যে গুণের স্বরূপ, ধর্ম ও কার্য বিষয়ক বক্তব্যে মহাভারত ও সাংখ্যকারিকার মধ্যে কোন বৈসাদৃশ্য নেই।

ত্রিগুণাত্মিকা এই প্রকৃতি তত্ত্বই যে অব্যক্ত তত্ত্ব একথা প্রকৃতির পর্যায়শব্দ আলোচনার প্রসঙ্গে পূর্বেই বলা হয়েছে। ব্যক্ত তত্ত্ব হল প্রকৃতি ও পুরুষ ব্যতীত মহদাদি তেইশটি বিকারযুক্ত পদার্থ – 'তত্র ব্যক্তলক্ষণমাহ প্রোক্তমিতি। তচ্চ মহদাদি বিকারান্তং ত্রয়োবিংশকম্'[24]। মহাভারতে বলা হয়েছে অব্যক্ততত্ত্বের স্বরূপ অবগত হওয়ার পূর্বে ব্যক্ততত্ত্বকে জানা প্রয়োজন কারণ তাতে অব্যক্ত সহজবোধ্য হয়ে ওঠে –

> 'তত্রাব্যক্তময়ী বিদ্যাং শৃণু ত্বং বিস্তরেণ মে।
>
> তথা ব্যক্তময়ঞ্চৈব সাংখ্যে পূর্ব্বং নিবোধ মে।।[25]

ব্যক্তের যা ধর্ম অব্যক্ত তার বিপরীত ধর্মবিশিষ্ট। ব্যক্তের ধর্ম নির্দেশ করে মহাভারতে বলা হয়েছে ব্যক্ত হল জন্ম, বৃদ্ধি, জরা ও মরণ এই চারটি লক্ষণযুক্ত –

> প্রোক্তং তদব্যক্তমিত্যেব জায়তে বর্দ্ধতে চ যৎ।
>
> জীর্য্যতে ম্রিয়তে চৈব চতুর্ভিলক্ষণৈর্যুতম্।।[26]

[29] সাংখ্যকারিকা - ১০, পৃ ১১৭

[30] তত্ত্বকৌমুদী, সাংখ্যকারিকা - ১১, পৃ. ১২৭

[31] মহাভারত, ১২.৩০২.১২, পৃ. ১৬৭২ (পুণা সংস্করণ)

[32] মহাভারত ১২.৩০২.১৩, পৃ. ১৬৭২ (পুণা সংস্করণ)

[33] গৌড়পাদভাষ্য, সাংখ্যকারিকা - ১০, পৃ. ৪৯-৫০

[34] মহাভারত, ১২.২৯৪.৩৩, পৃ. ১৬৩৫ (পুণা সংস্করণ)

[35] সাংখ্যকারিকা - ২১, পৃ. ১৯৭

[36] ভগবদ্গীতা ১৩.২৬, পৃ. ৪২৩

[37] ভগবদ্গীতা ৯.৭-৮, পৃ. ৩১৪

[38] ভারতকৌমুদী, মহাভারত, ১২.২৯৯.২২, পৃ. ৩১৬৯

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Content

ASCERTAINING THE MEANING OF SĀṂKHYA

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Abstract
Naming of any idea or material is extremely important as it provides one with a general introduction and basic or initial conception of the idea under discussion. Amongst the *Ṣaḍadarśana*, except for the case of Sāṃkhya, a very definite connection to a particular root-word and their nomenclature can be established. For example, the term *'vedānta'* refers to the end or termination point or the ultimate philosophical maxims of the Veda as encapsulated in the phrases *brahmavidyā* or *ātmajñāna*. Therefore, there is no confusion regarding the naming of the Vedānta school of philosophy. Etymologically *sāṃkhya* means *samyaka jñāna* or complete knowledge. But, at different times and in different texts such as the *Mahābhārata* and *Arthaśāstra* terms such as *anvīkṣā, parisaṃkhyāna* provides it with differing interpretations. Therefore, the emergence and the naming of Sāṃkhya as a philosophy that expounds the *tattva*s related to the interplay of *prakṛti-puruṣa* gives rise to a host of questions. And these can only be answered by complete explanation of the term *sāṃkhya*.
Key Words: *Sāṃkhya, saṃkhyā, parisaṃkhyāna, samyaka jñāna, anvīkṣā, Mahābhārata, Arthaśāstra*

Of the six systems of Indian philosophy Sāṃkhya is one which is very well-known, acclaimed as being ancient and has been well-analysed. Studies of its antiquity were very common in the 19th century and were noted as such even by the German scholar Garbe. Larson quoting him says that, 'there can be no doubt…. that Sāṃkhya is one of the oldest philosophies of the Indian tradition.'[i] In the *Śāntiparva* of the Mahābhārata the importance and depth is enthusiastically proclaimed by the authors when they record the following – *nāsti sāṃkhyasamaṃ jñānaṃ.*[ii] Similarly, the *Śvetāśvatara Upaniṣad* states – '*tatkāraṇaṃ sāṃkhya-yogādhigamyam'*[iii] – meaning that the Universal Cause can only be accessed by *Sāṃkhya-yoga*. In many of the *Smṛtis* the term *'sāṃkhya'* was used various times as a synonym for *jñāna*. For example, in the *Bhagavata Gītā jñāna-yoga* is referred to as *jñānayogena sāṃkhyanām*[iv] or as '*yat sāṃkhyaih prāpyate sthānam'*[v] *Sāṃkhya* is also affirmed as '*kṛtānta*', – *sāṃkhye kṛtānte proktāni siddhaye sarbakarmaṇām*[vi] – its acclamation as the pathway to inference of the *ātman*. The above-mentioned laudatory examples from an eminent text such as the *Bhagavata Gītā* show the high prestige it had amongst the *brāhmaṇa*s. The adulation provided by the *Gītā* shows the importance that was accorded to the Sāṃkhya system of knowledge,

It would be prudent at this moment in this paper to define the meaning of the term *sāṃkhya*, a very difficult task when put in contrast to defining the other members of the Ṣaḍadarśana such as Vedānta, Mīmāṃsā, Nyāya etc. These terms come with their meaning laden in them, not something that can be said for *sāṃkhya*. The definition provided by the dictionaries for the latter does not indicate any specific system or school of philosophy and therefore the basics of the philosophy that the appellation indicates are not found easily. And hence the need for explicating the term becomes essential. In this paper my attempt would be to explain the definition(s) of Sāṃkhya, specific to the contexts, to find the reasons for the establishment of the term as a system of philosophy that originated in the works of *Maharṣi* Kapila.

The affixation of 'sam' with the 'khyā' root gives the word 'saṃkhyā'. 'Saṃkhyā' in common parlance translates as numbers, 1, 2, 3, etc.[vii]. It is from this word the term Sāṃkhya emerges. Hence the

complete vision which can be understood as complete philosophy which results in the complete knowledge or *satya jñāna*. The knowledge that helps in the discernment of perpetual, predictable and therefore inanimate and passive matter or *jaḍaprapañca* from *puruṣa* who is continually changing and animation itself is *satya jñāna*. This has moreover, been termed as *vyaktāvyakta-vijñāna, vivekakhyāti, viveka-jñāna* etc. *Saṃkhyā samyagvivekenātmakathanamityarthah* – this quotation by Vijñānabhikṣu in *Sāṃkhyapravacana-bhāṣya* makes it crystal clear that the word *saṃkhyā* here is used in its epistemological sense. And, moreover, he had no intention of using the word in its numerological denotation.

sāṃkhyadarśanametāvatparisaṃkhyānadarśanam

sāṃkhyam prakurute caiba prakṛtim ca pracakṣate[xviii]

tattvāni ca caturviṃśat parisaṃkhāya tattvatah

sāṃkhyāh saha prakṛtyā tu nistattvah pañcaviṁśakah[xix]

A different reading of the last referred *śloka* of the Mahābhārata can be found in *Pravacana- bhāṣya* by Vijñānabhikṣu where he writes –

saṃkhyām prakurvate caiba prakṛtim ca pracakṣate

tattvāni ca caturviṃśat tena sāṃkhyām prakīrtitā[xx]

The word 'saṃkhyā' is used here as referring to the acquirement and analysis of self by way of complete *viveka*. Hence, there can be no doubt regarding its use and understanding by Vijñānabhikṣu. The mere numerological connotation of the term is not acceptable to him as exemplified here.

Several other scholars have followed Vijñānabhikṣu's interpretation of the term *saṃkhyā* as given in the Mahābhārata. They are also of the opinion that the use of term in Mahābhārata is primarily epistemological. This is based on the idea that the Mahābhārata talks of *paramapuruṣa*'s aim of achieving *mokṣa* or *kaivalya* as being attained by knowledge about the *vivekajñāna* of *prakṛti* and *puruṣa*. Since the Sāṃkhya philosophy as elucidated here is based completely on the idea of *vivekajñāna* and its achievement it would foolish to suggest any other usage or utilisation than epistemological. Even the synonymical *saṃkhyān* is used in the sense of theory of knowledge. For example, the Bhagavadagītā says – *procyante guṇasaṃkhyāne*[xxi]. Similar application can be viewed in the Bhāgavata Mahāpurāṇa when it states 'namo bhagavate mahāpuruṣāya sarvaguṇasaṃkhyānāyānantāyāvyaktāya nama iti'.[xxii] This is made manifest in Śrīdhara's commentary when he notes - *sarveṣāṃ guṇānāṃ saṃkhyānāṃ prakaśo yasmāt*.[xxiii] He is explicit of the root of 'saṃkhyā' being 'sāṃkhya', the latter meaning comprehensive knowledge or *samyaka jñāna*, and Sāṃkhya Śāstra is the repository wherein it resides.[xxiv] Even the Mahābhārata supports this when it says - *sāṃkhyajñānaṃ pravakṣyāmi parisaṃkhyānadarśanam*.[xxv]

However, it should be mentioned that though the epistemological interpretation of the term *saṃkhyā* as explained by the attainment of comprehensive knowledge of *viveka* by understanding the nature of the relation between *prakṛti- puruṣa* has been given primacy the numerological explanation of it should not be ignored at all. Many scholars, both from, Orient and Occident have given special attention to such an explanation.

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Holocaust Consciousness in V.S. Naipaul's *In a Free State* - A Different Perspective

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Abstract

The paper attempts to show why in the postcolonial world the term 'Holocaust' can never be considered as a specific historical phenomenon; rather it must be used in its wider implication as the world we inhabit is full of human suffering in view of the painful plights of displaced communities worldwide. Besides bringing out V.S.Naipaul's Holocaust consciousness manifested in his portrayal of unhappy lives of displaced people, lives pathetically 'free' from any sense of belongingness, their challenges and predicaments in the context of In a Free State*, the author tries to justify the use of 'comic' in Holocaust comedies keeping in view Naipaul's unique use of 'comic.'. Moreover by finding parallelisms from Holocaust film comedies Naipaul's use of 'comic' is considered. The paper tries to theorize the need of taking resort to 'comedy' in order to survive in a world full of threats and challenges.*
Keywords: Displacement, Holocaust, comic, Parallelisms

> "It's amazing. The race that has suffered the most is obviously the Jews in the Holocaust, and the Jewish humour is very much a part of suffering."
>
> Walcott and Baer 1996, 171

> "I took refuge in humour – comedy, funniness, the satirical reflex, in writing as in life, so often a covering up for confusion".
>
> *The Enigma of Arrival* 1987, 167

Introduction

Comedy for ages has remained a matter of controversy in literature. The arguments traditionally placed against comedy are: "Addressing motifs of ridicule, comedy is itself ridiculous and can, thus not be taken seriously. It cannot prove a source of insight as tragedy can" (Dadlez and Luthi 2018:81). Tragedy is viewed as the highest kind of literary form whilst comedy is held inferior to it. As says Stolnitz, comedy is "lower than tragedy not only because of the lesser intensity, complexity and subtlety of our response…but also because it lacks the compactness and vividness of structure which, as tragedy unfolds in time, creates a tightly-knit, climactic and integrated experience in the spectator" (Stolintz 1955:60). However, the similarities between tragedy and comedy have been underlined by a number of

and Linda to get from their lives in the land of their self-chosen exile. Bobby is tortured at the barrack room by the army and it sends an echo back to the persecution of man in the regime of Nazi Germany. In the "Epilogue" we are once more disturbed when Naipaul shows how the whipping of the Egyptian beggar boys can be entertaining to the travelers and the book ends with reference to the "ragged waiters" (Naipaul, 246), "agitated peasant crowds" and "defeated soldiers" who are to know total defeat in the desert" (Naipaul, 247). Thus, throughout the book Naipaul's focus is on helplessness, suffering and victimization of poor mankind. Holocaust never needs to be mentioned. But its absence never lets one forget the "presence" of it as the torture and persecution of mankind and the resultant pain and suffering of poor human folk is as present as ever. Only the machinery of torture gets changed in ages. However, not only thematically but also in his use of 'comic' Naipaul's novella has resemblances with that of a Holocaust film comedy.

A Holocaust comedy does not end happily. Similarly, here neither of the stories has happy ending. The marriages that take place in the first two stories are not indicative of better future. Naipaul uses humour mostly to show the wrongness of the situations. For instance, sometimes we are tempted to view Santosh as a comic character. At times his situations appear to us funny. But beneath that what is apparently amusing, there lies the central sadness of his position. The very first day Santosh comes to Washington, he starts feeling completely "enclosed" Santosh's discomfort at the sound of air-conditioner or the sense of enclosure of a man who has never been in an aeroplane before or has never used an elevator is comic. But the suggestions of an incremental enclosure serve to underline the systematic reduction of freedom attending the life of a migrant. It seems that in Holocaust comedy when no more laughter is possible, the hero tends to achieve a tragic dignity; he becomes almost a heroic figure. It applies to Naipaul's second story which is almost devoid of the comic touches. One major function of humour is that it helps one to go through the trauma of living. But in this story the narrator is to suffer so terribly, that he fails to retain his sense of humour. It further causes a severe nervous breakdown and though he recovers from it, he ultimately becomes a pathetic figure. But he is still heroic in the sense that he is not a completely defeated character. He thinks of sending a message of death to his home but he does not commit suicide even in the face of utter hopelessness. In the final story Linda is allowed to employ her sense of humour to go through her sense of trauma. But finally it is the horrible situation all around her that makes her sense of humour stop working. In the final story once again there are some sources that give rise to comic pleasure as the characters here attempt to have comic escape. It is true that the situation is so horrible that they are not allowed such escapes but their attempts to take resort to humour to go through the trauma of living almost symbolizes Naipaul's attempt to represent the horror of living comically. However, it is to be noted that the principal feature of a Holocaust film comedy is to present horror comically. The task is a difficult one as at the same time it should not appear as a comic entertainment. Though Naipaul uses 'comic', the novella cannot be called a comedy. The book is even not a tragedy as no great tragedy befalls any of these characters. Zizek (Zizek 2000:26-29) discusses the failure of tragedy and comedy genres to represent the Holocaust. Naipaul writes here from the deepest ironic vision, in the words of Friedlander the "tragic-ironic" vision (Friedlander 1988:289), the same that permeates a Holocaust comedy.

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এবং মহুয়া

বাংলা ভাষা, সাহিত্য ও গবেষণাধর্মী মাসিক পত্রিকা

বাংলার নবজাগরণের প্রাণপুরুষ
রাজা রামমোহন রায় ও বর্তমান সমাজ
সরোজ কুমার সরকার

সার সংক্ষেপ :

আগামী বছর ২০২২ সাল রাজা রামমোহন রায়ের ২৫০ তম জন্মবার্ষিকী। ভারতের প্রধানমন্ত্রী শ্রী নরেন্দ্র মোদী ঘোষণা করেছেন ২৫০তম জন্মজয়ন্তী সারা ভারতে পালন করা হবে, রামমোহনের ভাবনা ও কর্মধারার মূল্যায়ণে। তাঁর মৃত্যুর প্রায় দ্বিশত বৎসর পরেও তিনি আমাদের সামাজিক, রাজনৈতিক অর্থনৈতিক জীবনে, চিন্তা চেতনা ও মানবিকতার ক্ষেত্রে কতটা প্রাসঙ্গিক তা এই প্রবন্ধে ব্যক্ত করার ক্ষুদ্র প্রয়াস মাত্র। তিনি বাংলার নবজাগরণের প্রাণপুরুষ। মহৎ সমাজ সংস্কার, বহু ভাষাবিদ, শিক্ষাবিদ, ভারতের প্রথম নারীবাদী ও একজন মানবতাবাদী।

প্রতিপাদ্যবিষয় :

রাজা রামমোহন রায় বাংলার নবজাগরণের পথিকৃৎ। ইউরোপের নবজাগরণের ক্ষেত্রে সেই দেশের শিল্প, সাহিত্য, ধর্ম দর্শন, বিজ্ঞান, যুক্তিনিষ্ঠা ভাবনা, ব্যক্তিস্বাতন্ত্র্যবাদী জীবন পদ্ধতি, প্রকৃতিবাদ ও মানবতাবাদী ভাবনার বিকাশ লক্ষ্য করা যায়। রামমোহন রায়ের ভাবনা ও কর্মে ইউরোপের নবজাগরণের প্রায় সকল বৈশিষ্ট্য লক্ষ করা যায়। ধর্মকে কেন্দ্র করেই আমাদের নবজাগরণের আন্দোলন প্রথম আত্মপ্রকাশ করেছিল। ধর্ম কেন্দ্রিক ভারতবর্ষে এটা স্বাভাবিক। কিন্তু ধর্মান্দোলনের মূল উদ্দেশ্য হল একটি সুস্থ জীবনাদর্শ প্রতিষ্ঠা, এই সত্য ভুলে ধর্মের বহিরঙ্গ আলোচনায় এবং বিভিন্ন ধর্মের তাত্ত্বিক বিচার বিশ্লেষণে মত্ত ছিল মধ্যযুগীয় ধর্ম বেত্তাগণ। পুরোহিত তন্ত্রের প্রাধান্য ও তাদের বেদ ও শাস্ত্রের অপব্যাখ্যা, নানা আচার বিচার, কুসংস্কার জনগণের উপর চাপিয়ে দিয়ে অন্ধকারে নিমজ্জিত রাখা ছিল একমাত্র লক্ষ্য। ১৮২৮ সালে তিনি ব্রাহ্মসভা প্রতিষ্ঠা করেন, পরে তা ব্রাহ্মসমাজ নামে পরিচিত হয়। তিনি বিভিন্ন ধর্মগ্রন্থ অধ্যায়ণ করে উপলব্ধি করেন 'একেশ্বরবাদী' ধারণা। তিনি ইসলাম, খ্রীষ্টানধর্মের সঙ্গে বেদান্তের মিলন ঘটিয়েছেন। তিনি বহুধাবিভক্ত হিন্দুধর্মের সংস্কার করে বেদান্ত ধর্মকে জাতিয় ধর্ম হিসাবে প্রতিষ্ঠা করতে চেয়েছিলেন। তাঁর ধর্ম চিন্তার মূল কথা হলঃ এক ঈশ্বরের অস্তিত্বে বিশ্বাস, মানবপ্রীতি প্রকৃত আধ্যাত্মিকতার অঙ্গ, আত্মার সঙ্গে পরমাত্মার সম্পর্ক এবং অলৌকিক বা অতিপ্রাকৃত বিষয়সমূহের অসারতা এবং নিরাকার ঈশ্বরকে পৌত্তলিকতা ও অথহীন আচারে আবদ্ধ না করা।[১] তিনি তাঁর ব্রাহ্মসভাকে সকল ধর্মের মানুষের জন্য উন্মুক্ত করে দেন।

In silico study reveals binding potential of rotenone at multiple sites of pulmonary surfactant proteins: A matter of concern

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ABSTRACT

Rotenone is a broad-spectrum pesticide employed in various agricultural practices all over the world. Human beings are exposed to this chemical through oral, nasal, and dermal routes. Inhalation of rotenone exposes biomolecular components of lungs to this chemical. Biophysical activity of lungs is precisely regulated by pulmonary surfactant to facilitate gaseous exchange. Surfactant proteins (SPs) are the fundamental components of pulmonary surfactant. SPs like SP-A and SP-D have antimicrobial activities providing a crucial first line of defense against infections in lungs whereas SP-B and SP-C are mainly involved in respiratory cycle and reduction of surface tension at air–water interface. In this study, molecular docking analysis using AutoDock Vina has been conducted to investigate binding potential of rotenone with the four SPs. Results indicate that, rotenone can bind with carbohydrate recognition domain (CRD) of SP-A, N-, and C- terminal peptide of SP-B, SP-C, and CRD of SP-D at multiples sites via several interaction mediators such as H bonds, C–H bonds, alkyl bonds, pi-pi stacked, Van der Waals interaction, and other. Such interactions of rotenone with SPs can disrupt biophysical and anti-microbial functions of SPs in lungs that may invite respiratory ailments and pathogenic infections.

1. Introduction

Pesticide pollution is a major global health concern. Indiscriminate application of pesticides has contaminated almost every component of the biosphere. Till date, numerous pesticides have been formulated. According to the target organism, pesticides are classified as herbicides, fungicides, insecticides, rodenticides, nematicides, and molluscicides. These chemicals target specific metabolic pathways in pests to control their population. However, they may interrupt various biomolecules in organisms other than pests to elicit toxic responses. Numerous studies have reported pesticide-induced oxidative stress, cytotoxicity, and organotoxicity on human and model organisms (Mandi et al., 2020; Khatun et al., 2018; Rajak et al., 2018; Sarkar et al., 2018; Nicolopoulou-Stamati et al., 2016; Podder and Roy, 2015; Rajak et al., 2015). Additionally, pesticide exposure can disrupt protein homeostasis and augment pathogenicity of infectious as well as fatal diseases (Rajak et al., 2021; Rajak and Roy, 2018).

Rotenone is a colorless, odorless and crystalline heteropentacyclic broad-spectrum insecticide derived from the roots and stems of *Lonchocarpus* and *Derris* species. It is lipophilic in nature and therefore can easily cross lipid bilayer of cells in several tissues. Rotenone is an established inhibitor of complex I of the mitochondrial electron

3.2. Rotenone ~ SP-B interaction

Rotenone interacted with binding site 1 of N-terminal peptide of SP-B with affinity of −6.8 kcal/mol. ARG12 formed two conventional H-bonds of 2.099 Å and 2.208 Å length with rotenone. Other covalent interactions were also evident between rotenone and several amino acid residues.

Rotenone interacted with N-terminal peptide (binding site 2) of SP-B with affinity of −5.6 kcal/mol. Two H-bonds between ligand and ARG17 were noticed with bond length of 2.382 Å and 2.421 Å. ILE15 established Van der Waals interaction with the ligand. Further, Pi interactions were also recorded between rotenone and PHE1, LEU14, ILE18, and MET21 of SP-B.

Rotenone binds with C-terminal peptide of SP-B with various bonds and interactions. Amino acids such as MET3 and LEU4 formed H-bonds with rotenone. Bond lengths were measured as 2.567 Å for MET3 and 3.01 Å for LEU4. Pi interaction was established between ligand and ARG10 & LEU13 of SP-B. Affinity for C-terminal peptide of SP-B was recorded as −5.6 kcal/mol (Fig. 4).

3.3. Rotenone ~ SP-C interaction

Rotenone interacted with binding site 1 of SP-C with affinity of −5.8 kcal/mol. Three H-bonds were established between rotenone and ARG10 with bond length of 2.339 Å, 2.402 Å, and 2.434 Å. Alkyl and Pi-alkyl interactions were contributed by PRO9 and ARG12. Ligand established Van der Waals interaction and C–H bonds with SER1 and PRO3 respectively.

Interaction between binding site 2 of SP-C and rotenone was stabilized by conventional H-bond (bond length: 2.155 Å) shared by LYS23. Other interactions involved Pi interaction (ILE15, PRO19, VAL20, LEU22, LEU26) and Van der Waals interaction (PHE17). Affinity for binding site 3 was recorded as −5.5 kcal/mol.

Rotenone interacted with binding site 3 of SP-C using conventional H bond between ligand and ALA8 (bond length: 2.420 Å and 2.438 Å). C–H bond was shared between ligand and ALA7. Van der Waals interaction was stabilized by amino acid residues viz. PRO9, ARG10, and PRO16. ILE15 and PHE17 established other non-covalent interactions with the rotenone. Affinity for binding site 3 was recorded as −5.3 kcal/mol (Fig. 5).

3.4. Rotenone ~ SP-D interaction

Interaction between rotenone and binding site 1 (CRD) of SP-D was stabilized by three conventional H bonds shared by ASN288, ALA290, and ARG343. Other interactions included Van der Waals (GLU289, THR336, ARG349) and Pi interaction (GLU333, PHE335). Affinity was measured as −6.3 kcal/mol.

Rotenone can bind CRD (binding site 2) through conventional H bond (GLN258; bond length: 2.047 Å) and C–H bonds (SER294, SER298). Van der Waals interaction was stabilized between ligand and amino acids such as PHE254, MET295, THR296, TYR306, PRO307, THR305, and GLY309. Rotenone interacted with binding site 2 of SP-D with affinity of −6.3 kcal/mol.

Rotenone binds at neck region (binding site 3) of SP-D with two conversional H bonds shared between the ligand and amino acid ARG272 (bond length: 2.745 Å) and SER273 (bond length: 2.047 Å). Other interactions included Van der Waals (GLY241, GLU242, GLU354, PHE355) and Pi-interactions (GLU276, VAL240, LYS243, ALA275). Affinity for binding site 3 was recorded as −6.2 kcal/mol (Fig. 6).

Binding between rotenone and CRD domain (binding site 4) of SP-D was stabilized by one H-bond (ARG343), several Van der Waals interactions (GLU289, THR336, ARG349, GLU321, GLU329, ASN323, ASP325, ASN341), Pi-Pi interaction (PHE335) and other

non-covalent interactions (GLU333, ALA-290). Affinity was measured as −6.0 kcal/mol.

Interaction of rotenone with CRD of SP-D at binding site 5 was mediated by two conventional H bonds. Amino acids ARG-272 and SER-273 participated in convensional H bond formation between SP-D and rotenone. GLY241, GLU242, and GLU354 were involved in Van der Waals interaction between protein and ligand. Binding of ligand was further stabilized by Pi-interactions stabilized by VAL240 and ALA275. Other non-covalent interactions were established by LYS243 and GLU276. Affinity for binding site 5 was recorded as −5.9 kcal/mol (Fig. 7). Table 1 represents hydrogen and hydrophobic interactions between SPs and ligand.

### 3.5. Affinity of rotenone and other pesticides for SPs

Molecular docking analyses have shown that rotenone has higher affinity for SPs compared to other pesticides (Table 2; Fig. 8). Rotenone showed 2–2.19 fold higher affinity than the dichlorvos, acephate, and ethion for SP-A. Affinity of rotenone for SP-B was 1.94–2.06 fold higher than the other three pesticides. Rotenone had 1.70, 1.81, and 1.87 fold greater affinity for SP-C when compared to dichlorvos, acephate, and ethion respectively. Rotenone showed higher affinity (1.70–1.96 fold) than dichlorvos, acephate, and ethion for SP-D.

4. Discussion

The present in silico study has revealed potential of rotenone to bind pulmonary surfactant proteins at multiple sites.

Rotenone was detected to interact with multiples sites of CRD of monomeric SP-A. Interactions were stabilized by conventional H bonds, C–H bonds, alkyl/pi-alkyl contacts and Van der Waals interaction between the ligand and the several amino acid residues of SP-A. CRD is critical to most SP-A mediated biophysical functions and is needed for maintenance of proper respiratory cycle. In addition, globular domain of CRD interacts with carbohydrate or other ligands of microbial pathogens in lungs and blocks further infection. For instance, CRD of SP-A binds with surface glycoprotein of *Pneumocystis carinii*, a common cause of life-threatening pneumonia and enhances adherence to alveolar macrophages (McCormack et al., 1997). It helps in neutralization, agglutination, and clearance of *Pneumocystis carinii*. SP-A acts as an important modulator of alveolar macrophage function that is required for enhanced capacity of phagocytosis of *Mycobacterium tuberculosis* (Gaynor et al, 1995). Respiratory syncytial virus (RSV) is the leading cause of bronchiolitis in developing world. Trimeric units of SP-A effectively neutralize RSV in human bronchial epithelial cells and reduce the level of infection (Watson et al., 2017). Moreover, SP-A via its Sialic acid residues functions as an opsonin in the phagocytosis of influenza A virus (H1N1 and H3N2) by alveolar macrophages (Benne et al., 1997; Benne et al., 1995). *Aspergillus fumigates* is an opportunistic fungal pathogen that causes allergic bronchopulmonary aspergillosis. Studies have clearly indicated that, SP-A interacts with the glycosylated antigens and allergens of *Aspergillus fumigates* and thereafter lowers risk of allergic reactions like high levels of IgG, IgE, blood eosinophilia, and extensive infiltration of lymphocytes (Madan et al., 2001). In another study, SP-A null mice was observed to be more susceptible to pulmonary fungal infection with *Histoplasma capsulatum* than age-matched wild-type control mice (McCormack et al., 2003). The increased susceptibility was associated with reduced number of CD8^{+} cells in lungs of SP-A null mice. Carboxyl-terminal domain of SP-A containing C-type lectin CRD has antioxidant property. It directly protects surfactant phospholipids and macrophages from lipid peroxidation and oxidative cellular injury (Bridges et al., 2000). Thus, binding of rotenone to CRD at multiple sites can disrupt the interaction between SP-A and several microbial pathogens that can further result in exacerbated infection in alveoli
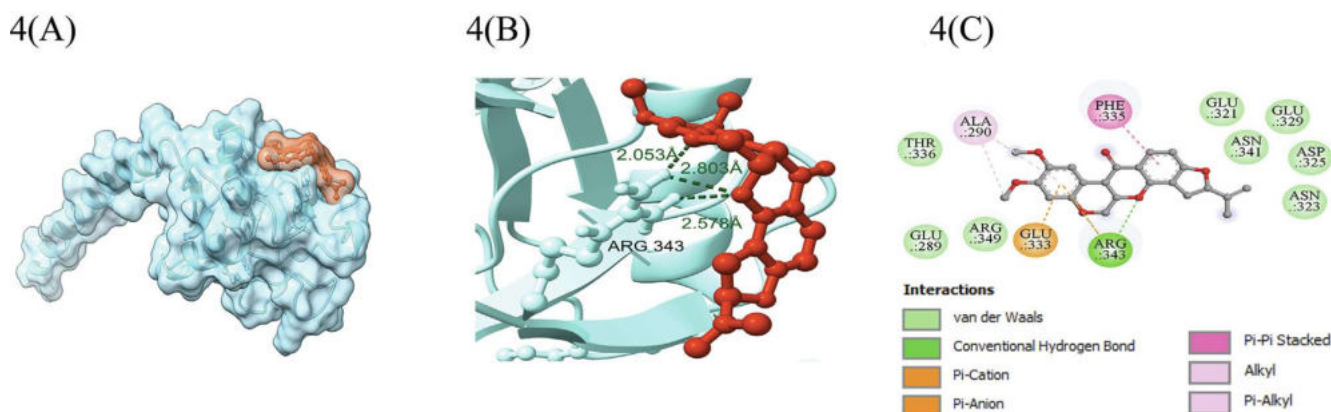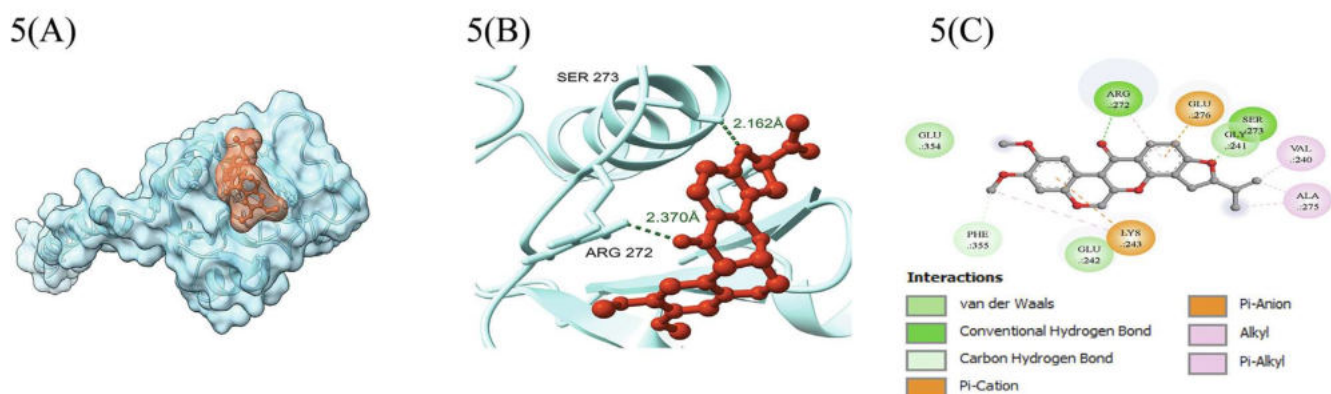
Fig. 7. The figure demonstrates binding of rotenone at binding site 4 and 5 of SP-D. Figure in first column (A) provides information regarding the binding of rotenone at a particular site of the protein. Column (B) represents H-bonds with bond length between the amino acid residues of protein and ligand. Column (C) represents all the polar and non-polar interactions between various amino acid residues of protein and ligand.
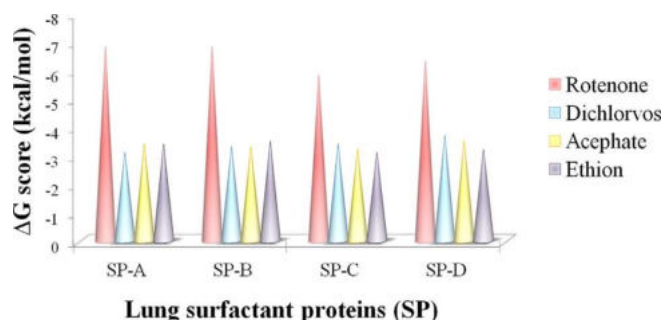

Fig. 8. Clustered cone diagram showing binding affinity of pesticides such as rotenone, dichlorvos, acephate, and ethion for surfactant proteins (SP-A, SP-B, SP-C, and SP-D). Cones indicate greater binding affinity (lower ΔG scores) of rotenone for SPs where as other pesticides show comparatively lower binding affinity (higher ΔG scores) for SPs.

cytokine release and subsequent lung tissue injury through different signaling pathways such as TLR4 (Arroyo and Kingma, 2021). SP-D inactivity in severe asthma is involved in disease persistence. SP-D enhances binding and internalization of allergen-containing sub-pollen particles with primary bronchial epithelial cells and facilitates their clearance (Schleh et al., 2010). Therefore, lack of functional SP-D may result in allergen-mediated breathing ailments. Importantly, phagocytosis and pulmonary clearance of RSV in airways are enhanced by SP-D as CRD recognizes RSV glycoproteins in a Calcium-dependent fashion (LeVine et al., 2004). Influenza virus is also targeted and opsonized by SP-D (White et al., 2008). Interestingly, recombinant fragment of human SP-D has been shown to interact with spike protein of SARS-CoV-2: the causative agent of ongoing pandemic disease coronavirus disease-19 (COVID-19) (Madan et al., 2021). In this study, recombinant fragment of human SP-D inhibited SARS-CoV-2 replication more efficiently than antiviral drug, Remdesivir. In another study, SP-D showed a dose-responsive binding to receptor binding domain and acted as entry inhibitor of SARS-CoV-2 pseudo-typed viral particles (Hsieh et al., 2021). These findings have suggested that, depletion in functional SP-D might result in increased susceptibility to COVID-19. SP-D also inhibits bacterial LPS-triggered inflammatory cell response (Atochina-Vasserman et al., 2010). Various ligands such as 1,3-β-D-glucan, 1,6-β-D-glucan, galactosaminogalactan galactomannan, glucuronoxylomannan, and mannoprotein 1 of pathogenic fungi are recognized by CRD that aids to fungicidal activity of SP-D (Madan and Kishore, 2020). It agglutinates *Aspergillus fumigatus conidia* and escalates uptake of opsonized conidia by alveolar macrophages and neutrophils (Madan et al., 1997). SP-D also binds with acapsular

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(ψ, φ)-Wardowski contraction pairs and some applications

Ankush Chanda[1,2] · Hiranmoy Garai[1,3] · Lakshmi Kanta Dey[1] · Vladimir Rakočević[4] · Tanusri Senapati[5]

Abstract

In this paper, we propose the notion of (ψ, ϕ)-Wardowski contraction pairs and achieve a common fixed point theorem consistent with such kind of contractions in complete metric spaces. One of the main motivations of this article is to define a contractive condition which does not compel the mappings to be continuous at their common fixed points, an interesting question posed by Rhoades (Contemporary Math 72:233–245, 1988). Besides, we provide some applications of our obtained results in certain type of operator equations, fractional differential equation boundary value problems, functional equations arising in dynamic programmings, and a particular type of non-linear quadratic integral equations which are relevant to events arising in physics, economics, engineering, operations research, and many other relevant disciplines.

Keywords Common fixed points · (ψ, ϕ)-Wardowski contraction · Fractional differential equation · Dynamic programming · Quadratic integral equations

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which is impossible. This implies that

$$d(Tu, w) = 0 \Rightarrow Tu = w = Su,$$

and u is a coincidence point of S and T. Therefore, in all cases, u is a coincidence point of S and T.

To prove that u is the unique point of coincidence of S and T, let $v(\neq u)$ be another point of coincidence. Then, $Tu = Su$ and $Tv = Sv$. We have $d(u, v) = d(Tu, Tv) > 0$. Considering Definition 2.5, we have

$$\phi(d(Tu, Tv)) \leq \psi(\phi(M_{T,S}(u, v))), \tag{2.6}$$

where

$$\begin{aligned} M_{T,S}(u, v) &= \max \Big\{ d(Su, Sv), d(Su, Tu), d(Sv, Tv), \\ &\quad \frac{1}{2}\, [d(Su, Tv) + d(Tu, Sv)] \Big\} \\ &= \max\{d(Su, Sv), 0, 0, \frac{1}{2}\, [d(Su, Sv) + d(Su, Sv)]\} \\ &= d(Su, Sv) \\ &= d(u, v). \end{aligned}$$

Now, from (2.6), we obtain

$$\begin{aligned} \phi(d(u, v)) &= \phi(d(Tu, Tv)) \\ &\leq \psi(\phi(d(u, v))) \\ &< \phi(d(u, v)), \end{aligned}$$

and we arrive at a contradiction. Hence, T and S have a coincidence point in $\mathcal{X}$. $\qquad\square$

The subsequent example affirms our obtained result.

Example 2.7 Let $\mathcal{X} = \mathbb{R}$ be equipped with the metric $d(z, w) = |z - w|$. We define two mappings T and S by

$$Tz = \begin{cases} 0, & \text{when } z = 0; \\ z + 1, & \text{when } z \neq 0, \end{cases}$$

and

$$Sz = \begin{cases} 0, & \text{when } z = 0; \\ 3z + 1, & \text{when } z \neq 0. \end{cases}$$

Here, one can easily check that $T(\mathcal{X}) \subseteq S(\mathcal{X})$ and $S(\mathcal{X})$ is complete. Also, we take $\phi(t) = t$ and $\psi(t) = \alpha t$, where $\frac{1}{3} < \alpha < 1$. Now, we have two possible cases as follows:

Case-I: when $w = 0, z > 0$; then, $d(Tz, Tw) = d(Tz, T0) = d(z + 1, 0) = z + 1$, $\phi(z + 1) = z + 1$.

We have

$$\begin{aligned} M_{T,S}(z, 0) &= \max \Big\{ d(Sz, S0), d(Sz, Tz), d(S0, T0), \frac{1}{2}\, [d(Sz, T0) + d(Tz, S0)] \Big\} \\ &= \max \Big\{ d(3z + 1, 0), d(3z + 1, z + 1), d(0, 0), \frac{1}{2}\big[d(3z + 1, 0) \\ &\quad + d(z + 1, 0) \big] \Big\} \end{aligned}$$

Now, we deliver the ensuing result concerning the existence and uniqueness of solution to the boundary value problem.

Theorem 4.3 *Let us consider the boundary value problem* (4.1), (4.2) *and assume that any one of the following conditions hold:*

($F1$) *there exists a real number β with $0 \leq \beta < 1$, such that*

$$|f(\zeta, u(\zeta)) - f(\zeta, v(\zeta))| \leq \beta |f(\zeta, u(\zeta))| - \beta \sup_{0 \leq \tau \leq 1} |u(\tau)|$$

   for all real-valued continuous functions $u(\zeta)$, $v(\zeta)$ defined on $[0, 1]$, and $\lambda K_1 \geq 1$;

($F2$) *there exists a real number β with $0 \leq \beta < 1$, such that*

$$|f(\zeta, u(\zeta)) - f(\zeta, v(\zeta))| \leq \beta |u(\zeta) - v(\zeta)|$$

   for all real-valued continuous functions $u(\zeta)$, $v(\zeta)$ defined on $[0, 1]$, and $\lambda K_0 \leq 1$.

Then, the problem has a unique solution in $C[0, 1]$.

Proof Let us consider the complete metric space $(C[0, 1], d)$, where d is the sup metric. We define a self-map T on $C[0, 1]$ by

$$(Tu)(\tau) = \lambda \int_0^1 G(\tau, \zeta) f(\zeta, u(\zeta)) d\zeta$$

for all $u \in C[0, 1]$ and $\tau \in [0, 1]$. Then, the fixed point(s) of T is the solution(s) of the boundary value problem (4.1), (4.2). First, we assume that condition ($F1$) holds. Then, we have

$$\lambda G(\tau, \zeta)|f(\zeta, u(\zeta)) - f(\zeta, v(\zeta))| \leq \beta \lambda G(\tau, \zeta)|f(\zeta, u(\zeta))| - \beta \lambda G(\tau, \zeta) \sup_{0 \leq \tau \leq 1} |u(\tau)|.$$

Hence

$$\int_0^1 \lambda G(\tau, \zeta)|f(\zeta, u(\zeta)) - f(\zeta, v(\zeta))| d\zeta$$
$$\leq \int_0^1 \beta \lambda G(\tau, \zeta)|f(\zeta, u(\zeta))| d\zeta - \int_0^1 \beta \lambda G(\tau, \zeta) \sup_{0 \leq \tau \leq 1} |u(\tau)| d\zeta$$

and

$$\int_0^1 |\lambda G(\tau, \zeta) f(\zeta, u(\zeta)) - \lambda G(\tau, \zeta) f(\zeta, v(\zeta))| d\zeta$$
$$\leq \int_0^1 \beta \lambda G(\tau, \zeta)|f(\zeta, u(\zeta))| d\zeta$$
$$- \int_0^1 \beta \lambda K_1 \sup_{0 \leq \tau \leq 1} |u(\tau)| d\zeta$$
$$\leq \int_0^1 \beta \lambda G(\tau, \zeta)|f(\zeta, u(\zeta))| d\zeta - \beta \lambda K_1 |u(\tau)|$$
$$\leq \int_0^1 \beta \lambda G(\tau, \zeta)|f(\zeta, u(\zeta))| d\zeta - \beta |u(\tau)|$$
$$\leq \beta \left| \int_0^1 \lambda G(\tau, \zeta) f(\zeta, u(\zeta)) d\zeta - u(\tau) \right|. \tag{4.3}$$

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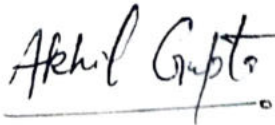
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अनन्ता

मधुसूदनसरस्वतीप्रणीते कृष्णकुतूहलनाटके श्रीकृष्णः

समीरणः रायः

शोधसारः

गौडीयवैष्णवसाहित्ये मधुसूदनसरस्वत्या एकं विशिष्टमवदानं वर्तते। प्रख्यातपण्डितो दार्शनिकः परमभक्तः सन्न्यासी श्रीमधुसूदनसरस्वती बांलादेशे फरिदपुरजिलान्तर्गते कोटालिपाडापरगणास्थिते ऊनशिया इति ग्रामे अजायत। ईश्वीयः षोडश-सप्तदशशतकः तस्य समयकालः। सर्वतन्त्रपारङ्गमस्य तस्य मातुर्नाम अरुन्धतीदेवी पिता च प्रमोदन-पुरन्दराचार्य-नारायणः। सन्न्यासग्रहणात्पूर्व तस्य नाम आसीत् कमलनयनः। अद्वैतवेदान्ती मधुसूदनसरस्वती अद्वैतसिद्धिः, अद्वैतरत्नरक्षणम्, भक्तिरसायनम् इत्यादीनि ग्रन्थानि रचयित्वा वैष्णवसाहित्यं तथा संस्कृतसाहित्यं समृद्धमकरोत्। परं कृष्णकुतूहलमिति नाटकं तस्य कीर्तिकेतुं वहति। नाटकस्यास्य राधाकृष्णयोरपार्थिवलीलास्वादनेन आह्लादिता भवन्ति सहृदयाः।

कृष्णकुतूहलं सप्ताङ्कविशिष्टमेकं नाटकम्। राधाकृष्णयोः चन्द्रावली-कृष्णयोर्गोपिकासु च कृष्णस्य लीलावर्णनेन भक्तिरसस्य प्रतिपादनमेव नाट्यकारस्य मुख्याशयः। नाटकेऽस्मिन् नायकः श्रीकृष्णः, नायिका श्रीराधाः प्रतिनायिका च श्रीचन्द्रावली। श्रीमद्भागवत्-पद्मपुराणात्मके अस्मिन्नाटके न केवलं कृष्णस्य कैशोर-यौवनविषयकस्य वर्तमानचरितस्य, अपि तु कंसवधरूपस्य भाविचरितस्य वर्णनमस्ति। एवंविधस्य कृष्णकुतूहलनाटकस्य मधुसूदनसरस्वतीचित्रितस्य श्रीकृष्णचरित्रस्य समीक्षात्मकमध्ययनं शोधप्रबन्धेऽस्मिन् विधीयते।

कूटशब्दाः – कृष्णकुतूहलम्, श्रीकृष्णः, मधुसूदनसरस्वती।

प्रस्तावना

गौडीयवैष्णवसाहित्ये मधुसूदनसरस्वत्या एकं विशिष्टमवदानं वर्तते। प्रख्यातपण्डितो दार्शनिकः परमभक्तः सन्न्यासी श्रीमधुसूदनसरस्वती बांलादेशे फरिदपुरजिलान्तर्गते कोटालिपाडापरगणास्थिते ऊनशिया इति ग्रामे अजायत। परन्तु तस्य कर्मभूमिरासीत् मुक्तिनगरी वाराणसी। ईश्वीयः षोडश-सप्तदशशतकः तस्य समयकालः। सर्वतन्त्रपारङ्गमस्य तस्य मातुर्नाम अरुन्धतीदेवी पिता च प्रमोदन-पुरन्दराचार्य-नारायणः। सन्न्यासग्रहणात्पूर्व तस्य नाम आसीत् कमलनयनः। अद्वैतवेदान्ती मधुसूदनसरस्वती अद्वैतसिद्धिः, परमहंसप्रियाख्यागीताव्याख्या, सिद्धान्तविन्दुः, वेदान्तकल्पलतिका,

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समीरणः रायः
सहकारी अध्यापकः संस्कृतविभागः,
गुसकरा महाविद्यालयः
पूर्ववर्धमानः, पश्चिमबङ्गः, भारत

नारदप्रणीतं गर्भनाटकं दृष्ट्वा प्रीत्वा च नाटकस्य कुशीलवानां नाट्यकारनारदस्य च अभीष्टं प्रदत्तवान्। श्रीकृष्णानुग्रहे एव गन्धर्वसुदर्शनः शापात् मुक्तिं लब्धवान्। श्रीकृष्णः सुदक्षः मल्लयोद्धापि, मल्लयुद्धेनैव चाणूरं हन्ति। सुमधुरसुरसृष्टौ तस्य दक्षता प्रख्यातीता। तस्य मुरलाध्वने: माहात्म्यं वर्णयन्ति राधासख्यः –

पीयूषं विषयन् विषं च सुधयन् निर्जीवितं जीवयन्
सञ्जातः कुलजायशोद्रिकुलिशः कोऽप्येष वंशीस्वनः॥"9

एषा वंशीध्वनिः कर्णपथमाध्यमेन हृदयं प्रविष्ट्वा गोपरमणीः आकुलीकरोति, तेऽपि कुलं, मानं, यशं, पतिप्रेमानं सर्वं तुच्छं कृत्वा उपस्थिताः जाताः कृष्णसम्मुखे। एतानि सर्वाणि चारित्रिकवैशिष्ट्यानि अतिक्रमं करोति कृष्णस्य प्रेमिकस्वरूपः। द्वितीयाङ्के वृन्दावनशोभादर्शनावसरे अनङ्गसेना-कमलमाला-चम्पककलिका-कामाङ्कुराप्रमुखाः गोपवालाः प्रति आसक्तः सस्पृहः कृष्णः तेषां नामानाम् अन्वयार्थौ विचारपूर्वकं वर्णयति –

"यत्पत्युपचितलक्ष्मीरथगजलीलातुरङ्गसम्पत्तिः।

तथा च कमलमालायाः अपि वर्णनं कृतं तेन –

"चरणौ कमले कमले च करौ युगलं कुचयोरपि तन्मुकुले।
वदनं कमलं नयने कमले सुतनोः कमलान्यखिलैव तनुः॥"
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गोपीगणापि कृष्णप्रेमनि उन्मत्ताः। श्रीकृष्णं पतित्वेन प्राप्तुं ते कात्यायणीपूजां कुर्वन्ति। कृष्णदर्शनमपि येषां समीपे परमसौभाग्यं ताः गोपवनिताः कृष्णकृपालाभे न वञ्चिताः। मुरलीध्वन्या आह्वानं कृत्वा रासलीलायां ताः परमानन्दं ददाति, कालेऽस्मिन् वाधास्वरूपं भद्रमुखं गृहे प्रेरणेऽपि श्रीकृष्णः अकुण्ठितः। चन्द्रं तिरस्कर्तुं समर्था यस्याः वदनचन्द्रिका तां चन्द्रावलीं दृष्ट्वा श्रीकृष्णः तां प्रति आकृष्टं भवति अपि च एतावत् पर्यन्तं तस्याः अदर्शनाय आक्षेपयति –

"व्यामोहयति भुजङ्गानङ्गीकुरुते महत्तमं ज्योतिः।
अतनुविषज्वरहरणी रमणी किमियं महामणिश्रेणी॥"11

श्रीकृष्णदर्शनमात्रे चन्द्रावली अपि मोहिता जाता। अनङ्गसेनादीनां गोपीनामपेक्षया चन्द्रावलीं प्रति श्रीकृष्णस्य प्रेमामीत् समधिकमेव। सः चन्द्रावलीकुञ्जे चन्द्रावल्या सह सहास्यपरिहासं वर्गानुपमां पश्यति। चन्द्रावल्याः कोपप्रशमनाय स्वं दासरूपेण उल्लिखितम्, तस्याः पदाघातं प्रार्थितं तथा निःशङ्कोचेन चन्द्रावलीचरणतले पतितम्। अपि च कन्दर्पहर्म्यस्वरूपां श्रीराधां दृष्ट्वा तामपि वर्णितं तेन श्रीकृष्णेन –

"कराङ्घ्रिमुखलोचनं नयनरञ्जनं नीरजैर्वपुः प्रकृतिसुन्दरं
कनकचम्पकैः कल्पितम्।
स्तनद्वयमनुत्तमं स्तवकसम्पदा स्वस्तरोद्धनं
कुसुमधन्वनस्तादिह राधिकैवाधिकम्॥"12

कृष्णहृदयः व्याकुलं भवति राधाहृदयसंवादनिमित्ताय। हृदयाद् आरभ्य अपरहृदये यद् समाप्तं भवति तदेव प्रेम। हृदयानन्दप्रदायिन्याः राधिकायाः विरहवशात् श्रीकृष्णः प्राणधारणे अक्षमः। प्रियतमायाः मनोभावं ज्ञात्वा आश्वस्तः जातः सः। क्षणमात्रविरहोऽपि परस्परयोः समीपे असहनीया प्रतिभाता। रासलीलायां श्रीकृष्णः प्राणधिकप्रियां ददाति सर्वाधिकसौभाग्यम्। अतः एकाधिके प्रियायां आसक्तः सन् अपि माधवः एकान्ततः राधायाः, श्रीराधिकायां निवेदितः। राधाकृष्णयोर्मधुरलीला यद्यपि संस्कृतसाहित्ये तथा भारतीयजनमानसे सुप्रसिद्धा तथापि नाट्यकारः मधुसूदनसरस्वती तस्य अपूर्ववस्तुनिर्माणक्षमाप्रतिभया तामभिनवरूपेणैव उपस्थापितवान्, यः न्यूनमाकर्षयति सहृदयचित्तम्। सन्न्यासी परमहंसपरिव्राजकाचार्यः परमभक्तः सन् अपि स्वनाटके अपार्थिवां कृष्णलीलां ग्रथयित्वा सहृदयहृदये स्फुटयति कृष्णप्रेम। अतः कृष्णकुतूहलनाटके श्रीकृष्णः मूलतः नाट्यकारस्य स्वस्य कवित्वशक्तिना निर्मितः।

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Understanding the cross-talk between mediators of infertility and COVID-19

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ARTICLE INFO

ABSTRACT

COVID-19 is the ongoing health emergency affecting individuals of all ages around the globe. Initially, the infection was reported to affect pulmonary structures. However, recent studies have delineated the impacts of COVID-19 on the reproductive system of both men and women. Hence, the present review aims to shed light on the distribution of SARS-CoV-2 entry factors in various reproductive organs. In addition, impacts of COVID-19 mediators like disrupted renin angiotensin system, oxidative stress, cytokine storm, fever, and the mental stress on reproductive physiology have also been discussed. For the present study, various keywords were used to search literature on PubMed, ScienceDirect, and Google Scholar databases. Articles were screened for relevancy and were studied in detail for qualitative synthesis of the review. Through our literature review, we found a multitude of effects of COVID-19 mediators on reproductive systems. Studies reported expression of receptors like ACE-2, TMPRSS2, and CD147 in the testes, epididymis, prostate, seminal vesicles, and ovarian follicles. These proteins are known to serve as major SARS-CoV-2 entry factors. The expression of lysosomal cathepsins (CTSB/CTSL) and/ neuropilin-1 (NRP-1) are also evident in the testes, epididymis, seminal vesicles, fallopian tube, cervix, and endometrium. The binding of viral spike protein with ACE-2 was found to alter the renin-angiotensin cascade, which could invite additional infertility problems. Furthermore, COVID-19 mediated cytokine storm, oxidative stress, and elevated body temperature could be detrimental to gametogenesis, steroidogenesis, and reproductive cycles in patients. Finally, social isolation, confinement, and job insecurities have fueled mental stress and frustration that might promote glucocorticoid-mediated subnormal sperm quality in men and higher risk of miscarriage in women. Hence, the influence of COVID-19 on the alteration of reproductive health and fertility is quite apparent.

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Contents

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Box 2. SARS-CoV-2 mediated Cytokine storm.

Infection with SARS-CoV-2 causes a cytokine storm that can lead to organ damage. The S1 subunit of the viral spike protein interacts with TLR7/8 to recruit downstream adaptors (MyD88, IRAK 4/1, and TRAF6). TRAF6 with dimeric ubiquitin conjugating enzyme complex (Ubc13-Uev1A) activates TAK1/TAB1/2 and IKKα/IKKβ. IKKα/IKKβ phosphorylates Ikβ to promote the nuclear translocation of NF-kβ involved in the transcription of various proinflammatory cytokines responsible for the cytokine storm. Endosomal dsRNAs through TLR3/4 are also implicated in the direct activation of NF-kβ through the recruitment of adaptor proteins namely TRIF, TRAF6, and RIP1. PAMPs and damage associated molecular patterns (DAMPs) also interact with NLRP3 to assemble procaspases-1 and ASC (apoptosis-associated speck-like protein containing CARD) into a multimeric component i.e. inflammasome. Activated caspase-1 cleaves proIL1β and proIL18 to generate the active version of proinflammatory cytokines. In addition, caspase-1 cleaves Gasdermin-D at Asp276 to separate N- and C-terminus domains. Active N-termini create pores in lipid bilayer to elicit pyroptosis and subsequent organ damage. Intense inflammation invites epididymal and testicular immunopathologies in men whereas impairs ovulation and endometrial receptivity in females.

Aberrant expression of IL10 in decidual T-lymphocytes is evident in women with recurrent miscarriage [71]. Dysregulation of inflammatory mediators are known to promote endometriosis-associated reproductive failure [72]. Cyclooxygenase 2 (COX2) production is enhanced by cytokines, and inhibitors of COX2 are implicated in treatment of dysmenorrhoea and heavy menstrual blood loss [73]. This indicates the possible contribution of COX2 to female infertility. Moreover, COX2 has links with endometrial carcinomas [74]. Finally, synthesis of Prostaglandin E2 (PGE2) is triggered by proinflammatory cytokines [75]. Dysregulated PGE2 is responsible for menorrhagic endometrium and excessive menstrual bleeding in women [76,77].

Therefore, the above suggested that cytokine storms caused by COVID-19 could be detrimental to the reproductive organs and reproductive physiology of both men and women.

4.3. Oxidative stress and disturbed reproductive health

Oxidative stress (OS) is a physiological condition in which the redox equilibrium is disrupted as a result of excessive reactive oxygen species (ROS) production at the subcellular level. SARS-CoV-2 mediated disruption of the RAS can lead to accumulation of ANG–II in blood plasma, and then promote ROS production via the NADPH oxidase (NOX)-protein kinase C (PKC) dependent pathway (Box 3) [78]. Hypoxia is a common symptom of COVID-19 and it acts as a stimulant for ROS generation [79]. Meta-analysis of 1210 COVID-19 cases has revealed reduced hemoglobin levels (5.9 g/L-7.1 g/L) [80] which might be related to anemic hypoxia and cellular ROS production in patients.

The nuclear factor erythroid 2–related factor 2 (Nrf2) is a transcription factor that maintains redox balance in a living system. Respiratory viruses can abrogate the Nrf pathway to impose OS [81]. Moreover, proinflammatory cytokines can increase ROS production [82], putting redox-equilibrium in

jeopardy. Excessive production of ROS and disturbed antioxidant defense machinery have been found to be evident during coronavirus infection [83]. Some researchers have argued that coronavirus induced lung injury is triggered by OS and NF-kB signaling in patients [84].

Excessive ROS and subsequent OS in male gonads can impair genesis, motility, and fertilization capacity of mature sperms. Surprisingly, a Canadian research group has discovered substantial ROS generation in 40 % of the semen collected from infertile men [85]. Related to this, the cell membranes of spermatozoa are rich in polyunsaturated fatty acids (PUFAs) that are extremely vulnerable to ROS-induced lipid peroxidation (LPO). LPO promotes the disruption of membrane fluidity and the rapid loss of ATP from spermatozoa, leading to axonal damage, midpiece defects, and reduced sperm motility and viability [86]. Excessive ROS is also positively correlated with varicocele in men [87], which is a leading cause of male infertility.

Other effects of ROS and OS on male gonads have also been observed. For example genetic materials of spermatozoa are highly vulnerable to ROS-induced base modification and degradation [88]. Single or double stranded DNA breaks in gametes can lower the reproductive potential of fertile men. Moreover, infertile men with greater ROS levels tend to have more apoptotic spermatozoa than control individuals [89]. Massive ROS also impairs sperm motility, morphology, and ability to penetrate oocytes [90], and Sertoli cells injured by ROS lead to decreased sperm count and motility [91]. Additionally, Steroidogenesis is sensitive to redox dyshomeostasis and increases in the activities of COX2 and MAPK [92], and chemicals inducing ROS production impede testosterone synthesis in Leydig cells [93,94]. Finally, OS promotes long-term changes in epididymis and maturing spermatozoa resulting in declined sperm quality [95].

Optimum levels of ROS are implicated in the proper maintenance of female reproductive health. However, recent studies have

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Box 3. NOX and Nrf cascades linked to Oxidative Stress.

The interaction between ANG-II and AT₁R triggers PKC and Src kinase mediated signaling pathways. PKC activates NOX, which is involved in ROS production. NOX is a multimeric protein composed of two membrane subunits (gp91-*phox*, p22-*phox*), three cytosolic subunits (p47-*phox*, p67-*phox*, p40-*phox*), and one G-protein *Rac*. Glycoprotein (gp)91-*phox* is NOX-2 specific and its homologs (DUOX1 and DUOX2) are detected in NOX-1, 3, 4, and 5. PKC phosphorylates p47-*phox* to facilitate its binding with the p67-*phox*/p40-*phox* complex. A trimeric complex is thus formed that translocates to the cell membrane and interacts with p22-*phox*. Src kinase activates *Rac* which independently move to the membrane and forms the active NOX complex. NOX then oxidizes molecular Oxygen into ROS. Nrf2 is a transcription factor, playing crucial role in redox-homeostasis. The activity of Nrf2 is regulated by Keap1 (Kelch-like ECH-associated protein-1) via cullin-3 dependent proteosomal degradation. Several kinases (PKC, PI3K/Akt, GSK-3β, JNK) phosphorylate Nrf2 and block its degradation. Phosphorylated Nrf2 then translocates into the nucleus and forms a heterodimer with Maf (masculoaponeurotic-fibrosarcoma) to bind antioxidant response elements (AREs) on nuclear DNA. AREs are implicated in the synthesis of endogenous antioxidants that alleviate OS. Respiratory viral infections can inhibit Nrf2 signaling and therefore promote ROS production and subsequent OS in host.

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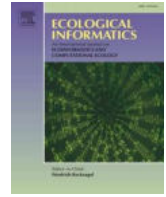
Ecosystem modelling to understand the trophic dynamics and ecosystem health of a small tropical Indian estuary

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ABSTRACT

Estuaries provide enumerable ecosystem services to mankind in terms of provisional, regulating, supporting, recreational and information services. However, the persistent human-environment interactions for these services altered the ecological integrity of estuaries. Although the small estuaries receive little attraction in scientific studies due to their low surface area and regional importance, these ecosystems are more vulnerable to anthropogenic pressures and require urgent attention from the scientific fraternity. The Terekhol Estuary (TRE) is a small tropical estuary situated along Goa, west coast of India, gaining recognition in recent years due to the pollution risk from tourism activities. Moreover, the estuary also behaves as an extension of the marine realm during the dry season. The food web structure and network flow indices of the TRE was assessed to reveal its present ecological status. The Ecopath modelling approach was employed to delineate the ecosystem structure and trophic functioning of the estuary distributed in 22 ecological compartments from 2018 to 2019. The trophic level of the food web ranged from detritus (TL-1) to sharks (TL- 4.53). The ecosystem structure demonstrated a grazing chain (herbivory) based organization over the detritus-based pathway. The proportion of exports to the total flows was 35% for the TRE. The model has a high total system throughput (12,043.6 t km^{-2} $year^{-1}$), low system omnivory index (0.17) and connectance index (0.21), and a moderate relative ascendency (45.1%). Finn's cycling index (2.17%) indicated very low recycling in the system. All these indicators along with the eco-exergy index (8567.22 g detritus equivalent m^{-2}), specific eco-exergy (38.25) and robustness index (0.11) classified the estuary as be immature, less stable and less organized and is in the initial stages of its development. The ecological indicators analyzed here point towards a medium to a high level of impact in the TRE due to anthropogenic activities. We also highlight the management measures to be implemented in order to restore the ecological quality of the TRE.

1. Introduction

Estuaries are transitional systems that provide ecosystem services in the form of material resources (fish, sand, silt, etc.), tourism, navigation routes, recreation and culture, water quality regulation, and carbon sequestration (Beck et al., 2001). Estuaries function as nursery habitats, migration channels, and reproduction sites for fish and other aquatic organisms (Elliott et al., 2007; Nicolas et al., 2010). They also provide foraging habitats for aquatic species at all levels of the trophic hierarchy

and offer fisheries resources to traditional fisherfolk living on the banks of these ecosystems (Beck et al., 2001; Cabral et al., 2007; Sreekanth et al., 2020a). However, these ecosystems are under stress all over the world because of various anthropogenic pressures such as overfishing, pollution, and habitat destruction (Coates et al., 2007; Diaz and Rosenberg, 2008; Elliott et al., 2007; Lal et al., 2021). The ecological functioning of an estuary is supported by diverse functional groups and their complex trophic interactions with each other, which ultimately reflects the ecosystem integrity (Lal et al., 2021; Lobry et al., 2008;

Table 2 (*continued*)

Group name		Value	Reference
	P/B	1.4 year^{-1}	Estimation from empirical formula, data from current study
	Q/B	7.1 year^{-1}	Estimation from empirical formula, data from current study
	EE	0.71	Estimation from Ecopath
	Diet composition	79 samples	Current study and field sampling
17	Large pelagics		
	B	0.03 t km^{-2}	Estimation from empirical formula, data from current study
	P/B	2.1 year^{-1}	Estimation from empirical formula, data from current study
	Q/B	6.9 year^{-1}	Estimation from empirical formula, data from current study
	EE	0.53	Estimation from Ecopath
	Diet	96 samples	Current study and field sampling
18	Small benthic carnivores		
	B	0.55 t km^{-2}	Estimation from empirical formula, data from current study
	P/B	3.1 year^{-1}	Estimation from empirical formula, data from current study
	Q/B	16.73 year^{-1}	Estimation from empirical formula, data from current study
	EE	0.91	Estimation from Ecopath
	Diet	386 samples	Current study and field sampling
19	Jellyfish		
	B	1.13 t km^{-2}	Duan et al. (2009); Sreekanth et al. (2020a)
	P/B	2.70 year^{-1}	Duan et al. (2009); Sreekanth et al. (2020a)
	Q/B	21.4 year^{-1}	Duan et al. (2009); Sreekanth et al. (2020a)
	EE	0.49	Duan et al. (2009); Sreekanth et al. (2020a)
	Diet	76 samples	Current study and field sampling
20	Sharks		
	B	0.04 t km^{-2}	Estimation from empirical formula, data from current study
	P/B	0.03 year^{-1}	Estimation from empirical formula, data from current study
	Q/B	14.22 year^{-1}	Estimation from empirical formula, data from current study
	EE	0.33	Estimation from Ecopath
	Diet	75	Current study and field sampling
21	Birds		
	B	0.001 t km^{-2}	Mohamed et al. (2008); Sreekanth et al. (2020a)
	P/B	0.04 year^{-1}	Mohamed et al. (2008); Sreekanth et al. (2020a)
	Q/B	19.51 year^{-1}	Mohamed et al. (2008); Sreekanth et al. (2020a)
	EE	0.00	Estimation from Ecopath
	Diet		Etezadifar and Barati (2011); Sivaperuman and Javson (2011)
22	Detritus		
	B	200 t km^{-2}	Estimation from empirical formula, data from current study
	EE	0.07	Estimation from Ecopath

B: biomass, P/B: production/biomass, Q/B: consumption/biomass, and EE: ecotrophic efficiency.

were averaged over the sampling sites and over the 2 years (2018 and 2019), and biomass was expressed in tonnes per square kilometre.

2.5. Birds

The major species of aquatic birds identified from the estuary were Great Egret (*C. albus*), Western Reef Egret (*E. gularis*), and Little Cormorant (*Phalacrocorax niger*). For birds, B, P/B and Q/B values were collected and modified from those for similar ecosystems (Duan et al.,

2009; Mohamed et al., 2008; Pitcher et al., 2002; Rybarczyk and Elkaïm, 2003; Sreekanth et al., 2020a). The diet composition for these species was collected from secondary sources. The diet and feeding habit data for Great Egret, Little Cormorant, and Western Reef Egret were collected from published literature from the estuarine wetlands of Kerala, India (Sivaperuman and Javson, 2011) and Hara Biosphere Reserve, Persian Gulf (Etezadifar and Barati, 2011). Expert ecological knowledge of ornithologists and enthusiasts was also used in determining the diet composition of birds.

2.6. Zooplankton

Zooplankton density was recorded as the number of individuals per cubic metre of water and was used for arriving at the biomass values based on the average weight of individuals calculated using image analysis (Alcaraz et al., 2003); P/B values were calculated from the empirical formula used by Selleslagh et al. (2012) using the weighted average individual body weight (W) of the subgroups:

$$\frac{P}{B} = 0.6457 \times W^{-0.37} \tag{5}$$

Values of Q/B for zooplankton were collected from published sources (Mohamed et al., 2008; Sreekanth et al., 2020a, 2020b) and modified as required.

2.7. Phytoplankton and benthic producers

The sampling sites for phytoplankton were marked in the estuary map, and we collected the samples during the dry saline phase in 2018 (December and March) and 2019 (December and March). The phytoplankton was sampled from surface waters of the estuary at high tide ±2 h and the samples were fixed using 1% Lugol's iodine solution. The density was used for calculating the biomass after obtaining the weighted average individual body weight for each subgroup (diatoms, dinoflagellates, and blue-green algae) (Mahlmann et al., 2008; Wang and Seibert, 2017; Wasmund et al., 2017). The biomass of benthic producers and P/B values for phytoplankton and benthic producers were collected from published sources (Mohamed et al., 2008; Sreekanth et al., 2020a) and modified as required.

2.8. Jellyfish

The values of biomass, P/B, and Q/B for jellyfish were collected from secondary sources (Duan et al., 2009; Sreekanth et al., 2020a).

2.9. Heterotrophic and sessile benthos

Heterotrophic and sessile benthos were sampled at high tide ±2 h using a Van Veen grab (sampling an area of about 250 cm^2 to a sediment depth of about 10 cm), preserved in polythene bags, transported to the laboratory, and washed and gently sieved over a 1 mm mesh. All organisms were stained with Rose Bengal and preserved in 5% formaldehyde buffer for subsequent identification and their biomass was recorded. For benthic groups, the P/B values were calculated using the formula P/B = 0.6547 W$^{-0.37}$, where W is the weighted average individual body weight of the benthos components; Q/B values for the benthos component were collected from other similar Ecopath models (Mohamed et al., 2008; Selleslagh et al., 2012; Sreekanth et al., 2020a) and modified as required.

2.10. Detritus

The biomass of detritus was calculated using the empirical equation from the primary production (PPR) data collected from the chlorophyll-*a* method (APHA, 2005) from the sampling sites mentioned in the study area and euphotic depth suggested by Christensen and Pauly (1993):

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GENERALIZED QUASI-CONTRACTIONS ON WEAK ORTHOGONAL METRIC SPACES

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Abstract. In this sequel, we introduce and study the concept of the weak orthogonal metric spaces as a generalization of the orthogonal metric spaces. Besides, we define and study the generalized quasi-contractions on such spaces and illustrate several non-trivial examples to endorse our obtained results. Among other things, as corollaries we obtain the main results of some of the pioneering articles existing in the literature. Finally, we answer the open question posed by Gordji et al. [On orthogonal sets and Banach fixed point theorem, Fixed Point Theory, 18(2):569-578, 2017].
Key Words and Phrases: Weak orthogonal relation, orthogonal metric space, orbital O_w-continuity, Banach $\perp$-contraction, fixed point.
2020 Mathematics Subject Classification: 47H10, 54H25.

1. INTRODUCTION AND PRELIMINARIES

Let (X, d) be any metric space and let T be a self-mapping on X. Then the set $Fix(T) = \{x \in X : Tx = x\}$ is the fixed point set of T. An operator T is said to be a contraction on X if

$$d(Tx, Ty) \leq rd(x, y)$$

holds for all $x, y \in X$ and for some $r \in [0, 1)$. The well-known Banach contraction principle [3] states that if T is a contraction on a complete metric space X, then T has only one fixed point.

Over the years, the metric fixed point theory has enthralled many a number of mathematicians in finding new theories, solving many real-life phenomena and therefore, a considerable number of research articles were put in print where the generalized versions of the metric notion are investigated by making alterations to the basic metric axioms. Eventually, there are a handful of metric structures which have come into

Proof. **(A)** We consider a sequence (x_n) in X such that $x_n = 1 - \frac{1}{n+1}$ for all $n \in \mathbb{N}$. Clearly, this sequence is an O-sequence and converges to 1. For all $n \in \mathbb{N}$, $Tx_n = 2$ and $T1 = 1$, which implies that T is not an O-continuous mapping. It is easy to check that T is an orbitally O-continuous mapping.

(B) To prove this, we consider the following cases:

Case-I: Let us consider $x \in (0, 1)$. Then

$$
\begin{aligned}
O_T(x) &= \{T^n x : n = 0, 1, 2, \dots\} \\
&= \left\{x, 2, \frac{1}{3}, 2, \frac{1}{3}, \dots\right\}.
\end{aligned}
$$

Similarly for $x > 1$,

$$
O_T(x) = \left\{x, \frac{1}{3}, 2, \frac{1}{3}, 2, \dots\right\}.
$$

Therefore for all $x \in (0, 1) \cup (1, \infty)$, $O_T(x)$ contains two subsequences. However, the subsequence $(y_n) = \{\frac{1}{3}\}$ is the only Cauchy O-sequence which converges in X.

Case-II: For $x = 1, O_T(x) = \{1, 1, 1, \dots\}$ contains a constant sequence which is a Cauchy O-sequence.

From the above two cases we deduce that $(X, \perp, d)$ is a T-orbitally O-complete metric space. Now we consider a sequence (x_n) in X such that $x_n = \frac{1}{n}$ for all $n \in \mathbb{N}$. Clearly, this sequence is a Cauchy O-sequence, but not convergent in X. Therefore, $(X, \perp, d)$ is not an O-complete metric space.

In the sequel, we extend the above notions in weak orthogonal metric spaces.

Definition 2.16. Let $(X, \perp, d)$ be an O_w-metric space and let T be a self-mapping on X. Then T is said to be orbitally O_w-continuous at $z \in X$ if for every O_w-sequence (y_n) in $O_T(x)$ for any $x \in X$,

$$
y_n \to z \Rightarrow Ty_n \to Tz.
$$

Definition 2.17. Let $(X, \perp, d)$ be an O_w-metric space and let T be a self-mapping on X. Then X is said to be T-orbitally O_w-complete if every Cauchy O_w-sequence (y_n) in $O_T(x)$ for any $x \in X$, converges in X.

3. Main results

This section comes up with the definition of generalized quasi-orthogonal contractions in a weak orthogonal metric space and it presents a fixed point result concerning such kind of maps. We also illustrate an example to validate our findings.

Definition 3.1. Let $(X, \perp, d)$ be an O_w-metric space and let T be a self-map on X. Then T is a generalized quasi $\perp$-contraction if

$$
d(Tx, Ty) \leq kM(x, y)
$$

holds for all orthogonally related elements $x, y \in X$, where, $0 \leq k < 1$ and

$$
\begin{aligned}
M(x, y) = \ &\max\{d(x, y), d(x, Tx), d(y, Ty), d(x, Ty), d(Tx, y), \\
&d(T^2x, x), d(T^2x, Tx), d(T^2x, y), d(T^2x, Ty)\}.
\end{aligned}
$$

Now we discuss one fixed point result related to such kind of contractions.

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ROCK PEBBLES

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Editor speaks.........

It is high time the focus of the critics and research scholars shifted from urban/ metropolitan to rural/tribal or Adivasi literature.The forces of the urbanisation,print culture and commecialisation have resulted not only in keeping the Adivasi communities marginalised but also have adversely affected their laguages and literary cultures .Tribes in India are still thousand miles away from the mainstream of the society: the urban and metropolitan.However,it should not be pushed to oblivion that the roots of Indian literary tradition lies in the rich oral literature of the tribes/Adivasi/Banavasi.Their verses , in the form of songs or chantings are expressions of their existence and close connection with their soil and the world of nature.The folktales,songs and literature have been orally transmitted from one generation to another and survived for ages in the face of several threats like modernisation and advancement in various fields. Yes, we have achieved materialistic prosperity but on the other hand become aesthetically bankrupt to appreciate the undying beauty of the unwritten literature by making proper study.It is a pity that a large number of folktales of the tribes, in other words their rich literature are already lost due to the very fact that those are in oral forms.

Hence, attempts must be made with concerted efforts at an accelerated pace for collection and conservation of tribal languages and their rich literature that are under serious threats.We may lose an invaluable part of our history and rich literary heritage in case we fail to document the tribal history, literature that are in oral forms.

So, there is an urgent need to create a space for the study of tribal literature within the canonised written texts .Identifying and reading literature in which orality is not dissmissed as casual utterances in different dialects need to be ensured .

'Rock Pebbles' has been constantly trying to publish research works on marginal literature,Adivasi/Banabasi and other socially vulnerable people of the country.

Our heart-felt gratitude to the scholars, literature enthusiasts and well wishers for their unconditional support to make the journal a 'Rock of Gibraltar'.

- Chief Editor

■ ■

Indian Democracy: A Case Study
in Political Violence and Peace Building

Saroj Kumar Sarkar

India is the largest liberal democratic country in the world. For more than seventy four years we have been witnessing the conduct of successful elections, peaceful changes of government at the Centre and in the States, people exercising freedom of expression, movement and religion. India has also been developing and transforming economically and socially. At the same time we, quite often, listen complains about prevalent inequalities, injustice or non-fulfillment of expectations of certain sections of the society. Indian democracy has been suffering so many problems as like as political violence, intolerance, poverty, illiteracy, casteism, communalism and religious fundamentalism, unemployment, corruption, criminalisation of politics. At present time , Indian democracy is passing through various crises and difficulties. Political violence and political murders are rapidly increasing at present times in India. It is dangerous threat to Indian democracy.

Keywords: Democracy, casteism, criminalization,Political murder, competitive politics.

India is the largest democratic country in the world. It is a democratic country which is mentioned in our Constitution . What is Democracy ? Meaning of Democracy long back, former President of the United States of America, Abraham Lincoln said, "Democracy is a government of the people, for the people, and by the people." [1] Today , democracy is defined as a form of government in which the supreme power is vested in the people and exercised by them directly or indirectly through a system of representation usually involving periodic free elections. Democracy has been defined in many ways. Bryce believes that "Democracy really means nothing more or less than the rule of the whole people, expressing their Sovereign will by their votes". [2] In the present age, democracy is just not limited to political democracy. It means more than a mere form of government. In its comprehensive form, democracy means, or ought to mean, (i) a form of government, (ii) a type of state, (iii) a pattern of social system, (iv) a design of economic order, and (v) a way of life and culture. [3]

Political Violence: Political violence is the deliberate use of power and force to achieve political goals.(WHO,2002). Political violence is characterized by both physical and psychological acts aimed at injuring or intimidating populations . [4] Violence has been

political violence in our country. BJP is the political branch of the RSS. The RSS declared cultural Nationalism which mean 'one nation, one state and one culture. BJP and the like minded organisations like Vishaw Hindu Parishad (VHP) , Brajrang Dal and Shiv Sena want to spread Hindu nationalism resulting in politicization of Hinduism, and national secularisation. The resultant, political violence is increasing at present times throughout India which creates problem in democratic atmosphere and damages national integrity and peace among the people.

India is a multi-party state. There are many national parties, state level parties, regional parties in India. These are created on the basis of caste, language, region and religion. Different regional parties are involved in competitive vote bank politics. They want to capture political power. In this way they are involved in conflict and create violence.

Political violence is correlated with Political criminalization. In recent years, criminalization of politics in India has become a debatable issue. There have been allegations that there are some elements in politics that do not have faith on democratic values and practices. They indulge in violence and take refuge in other unhealthy, undemocratic methods to win elections. Undoubtedly, this is not a healthy trend in politics and there is an urgent need to apply serious check on such tendencies. Criminalization of politics is the very negation of democratic values and has no place in a democratic set up. Democracy can be strengthened by adopting and promoting democratic values and shunning criminal activities. Recently, the judiciary, while taking a serious note of criminal tendencies in politics, has showed signs of adopting remedial measures to apply a serious check on such elements. The Central government and many State governments have been taking steps to address this issue effectively. This is a matter of great satisfaction and a healthy sign for the successful functioning of democracy in our country. We, as awakened citizens and as voters of the largest democracy in the world, can also contribute by discouraging such persons who have a criminal background, from contesting elections. We find some unfair means like booth capturing, vote ragging, threatening the voter by the party muscleman or *goonda* in election period. The general voters are failed to vote as per their own choice. It is a very bad culture in our country which is increasing day by day.

Unemployment is also related with political violence. Educated unemployed men join with different political parties with a hope to earn. They take it as a source of income, so we find group conflict in a party which creates violence among them. Party members and cadres want to grip the power which moved the competition and conflict.

Casualties: The victims in these clashes are mostly innocent people like students, teachers, labourers, farmers, agricultural workers and small shopkeepers. Most affected people in West Bengal pre and post poll violence are from *Dalit* community[15].

Political violence is implicated in a range of mental health outcomes, including depression and anxiety. It is a great threat to the democratic values and peaceful situation in

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A CRITICAL STUDY ON THE CORRUPTION IN INDIA AND ITS REMEDIES.

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Abstract: Corruption in India is an issue which affects the economy of central, state and local government agencies in many ways. Corruption is a great problem in India. It is not only Indian problem but also world wide problem. We have found it every countries less or more. India is largest democratic country in the world. It has long history of financial, Political, Administrative corruption. After independence, we have noticed many corruption and Financial scam which were done by political leader or Ministers, and bureaucat in our conntry. It has spread top to bottom in nation. It is a great challenge to remove from our administration. People are losing their faith on administration, judiciary system, and political leaders. Social morals and values are spoiling day by day. It has so many causes as like as Political patronge, nepotism, greediness, lack of transparency, increasing of unemployment, low wage of government officials, etc. It badly affected our society. Our country has taken so many measure to prevent it but fail to cure this disease at all.

Keywords: Corruption, Political patronge, Greediness, Nepotism, Democratic.

Introduction:

 Corruption in public life has been a major concern in India. In 2019, India was ranked 80th of 180 countries defined as corrupt in Transparency International's Corruption Perceptions Index (CPI). India fell to 85 rank in **Corruption** Perceptions Index in 2021[1] In fact, corruption is rampant in all walks of life, be it land and property, health, education, commerce and industry, agriculture, transport, police, armed forces, even religious institutions or socalled places of spiritual pursuits. Corruption continues to exist in covert and overt ways at all three levels - political, bureaucratic and corporate sector. One can see the nexus between the politicians, the bureaucrats and the industrialists which has resulted into corruption and corrupt practices. The tentacles of corruption have affected all organs of government, including the judiciary. India is corrupted democracy; corruption is found from top to bottom. Decentralisation of power is a main

are given prominent positions like members of parliament or even higher posts. Instead of being disrespected, they are respected.

8. Lack of Public Unity: The public openly criticizes corruption, but interestingly there is no unity among the public to stop corruption. If a person wants to get his done his work, he gets it done by corruption means if possible and then later criticizes the corrupt official. If the public stands united against corruption so that no one is ready to offer bribes to get their work done, then the corrupt officials will have no other option but to work in a corruption-free manner. During the election, politicians try to lure the people by offering money and other things. If these politicians win and get power, they try to regain 10 to 100 times the amount spent in the process.[4]

9. Lack of transparency in affairs and deals: Many seat selection processes like in education, contracts for the job, employee income reports (wealth possession), etc., lack transparency.

10. Lack of Independent detective agency: Lack of an independent detective agency to investigate with full power and freedom to expose the corrupt individuals. The existing agencies are under the control of either the government or the armies and are not free to work. Hence anyone who commits offense will not be afraid of the investigation as they can escape from it by taking the help of those controlling them.

11. Lack of state funding for elections: State funding for polls is the best way to beat corruption. Political parties receive party donations and will not disclose them to the fullest. In doing so, they encourage corruption.

They collect massive amounts from industrialists with a promise to help when in power. The presence of state funding can abolish party donations and minimize corruption.

12. The option of many political parties: In a democracy, anyone can establish a political party. So there are chances for the corruption of many political parties in the country.

If a political party wins, then the party members will desire to expand the party all over the country. To do so, they need enough financial reserves. Once they come into power, they opt for corrupt means to make the wealth needed to expand the party.

13. Lack of enough powers to the judicial system: and other independent organizations. Like the election commission cannot ban a politician from contesting in case they make a mistake or do not comply with the rules during the poll campaign (like distributing money to people etc.). Similarly, **the judicial system has low options to punish someone who is found to be**

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PERSPECTIVE

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The impact of MOFs in pH-dependent drug delivery systems: progress in the last decade

Diptiman De and Prithidipa Sahoo 🆔 *

Metal–organic frameworks (MOFs) are porous crystalline materials consisting of one-, two-, or three-dimensional networks created by metal ions/clusters and multidentate organic linkers through coordination bonding. MOFs are one of the most favorable candidates for biological applications such as wound dressings, cardiac prosthesis, tissue engineering, bioimaging, and drug delivery and as cancer theranostic systems due to their high surface area and porosity for the high loading of therapeutic agents and facile modification of their physical (*e.g.*, pore size and shape) and chemical properties. Drug delivery involves the administration of drugs using a suitable carrier for achieving treatment without unwanted side effects. In the last few years, several types of MOFs have been synthesized including Zn-based MOFs, MIL series MOFs, and Zr-based MOFs and evaluated for their use in different biomedical fields, especially drug delivery. After Fe, zinc is the second most available element in the body, and hence Zn-based MOFs can be considered enduring platforms for various biomedical uses, especially drug delivery applications. MIL series composites and Zr-based biomaterials are also suggested for several biomedical applications due to their good mechanical properties, biocompatibility, and bioactivity. This review highlights the different types of Zn-based and MIL series MOFs that have been used as suitable pH-responsive drug delivery systems and summarizes the Zr-based MOFs that have been used as suitable pH-responsive or reverse pH-responsive drug delivery systems and also discuss their drug-releasing phenomenon at different pH ranges.

Introduction

Metal–organic frameworks, abbreviated as MOFs, represent a new class of periodic, crystalline, and highly porous (up to 94% space) materials. Generally, MOFs are formed by the linkage of inorganic metal (*e.g.*, transition metal and lanthanide metal) ions/clusters as the node with organic ligands (*e.g.*, carboxylates, phosphonates, imidazolates, and phenolates), which are called linkers, exhibiting high porosity and thermal stability (Fig. 1).[1] Various common ligands are used in the synthesis of MOFs, as presented in Fig. 2. In the past two decades, metal–organic frameworks (MOFs) have been shown to possess conventional properties such as different pore shapes, desirable pore size, large surface areas, and the ability to encapsulate compounds and drugs.[2] In 1965, the journey of the metal–organic framework started with the synthesis of thermally stable Zn coordination polymers.[3] Thereafter, in 1990, the research group of Hoskins and Robson proposed scaffold-like 3D frameworks.[4] In 1995, Yaghi and co-workers designed the selective binding and removal of guest molecules

in a microporous MOF composed of 1,3,5-benzenetricarboxylate (BTC) and cobalt cation,[5] while the same group reported the design and synthesis of MOF-5 in 1999.[6] MOF-5 contains 1,4-benzenedicarboxylate (BDC) and Zn_4O clusters and shows an exceptionally high Langmuir surface area of 2900 m^2 g^{-1}. A brief history of metal–organic frameworks is schematically represented in Scheme 1. Presently, researchers are focused on exploring different types of luminescent MOFs for the development of advanced practical applications.[7] Metal–organic-framework (MOF) materials are increasingly gaining interest in various applications such as gas storage and separation,[8] chemical separation,[9] catalysis,[10] sensing,[11] semiconductors,[12] magnetism,[13] and bioimaging[14] (Scheme 1). During the past

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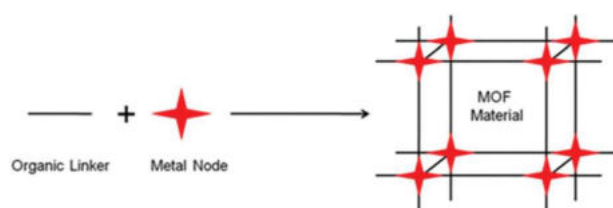
Fig. 1 Basic structure of a metal–organic framework (MOF).

methods, the total specific surface area and pore volume of the Ins-GOx/ZIF-8 hybrid composites were shown to be 1219 m^2 g^{-1} and 0.501 cm^3 g^{-1}, which were lower than that of pure ZIF-8 (1449 m^2 g^{-1} and 0.646 cm^3 g^{-1}), respectively. The protein-embedded ZIF-8 appeared to be able to respond to a decrease in surface area and average pore size. The insulin release profile of Ins-GOx/ZIF-8 at different glucose concentrations was studied to analyze the glucose response features of Ins-GOx/ZIF-8. At the hyperglycemic level, a rapid insulin release rate (roughly 420 g mL^{-1}) was found after 4 h. At 24 h, about 84 and 145 g mL^{-1} of loaded insulin were released at the control and normoglycemic levels, respectively. When a high quantity of glucose was detected, a large amount of glucose entered the pore of the composites and contacted GOx, causing glucose to be oxidized to gluconic acid and H$_2$O$_2$. The decrease in pH facilitated the release of insulin stored in ZIF-8 to achieve the goal of lowering the blood glucose level (Fig. 8). The MTT assay on HeLa cells confirmed that the biocomposite had very low cytotoxicity, having good biocompatibility. Consequently, it could be utilised for subcutaneous insulin injections, minimizing the need for frequent glucose monitoring and multiple injections.

Interestingly, Qu and co-workers reported an aAuNCs-MOF as a viable option in cancer therapy due to its unique properties of increased luminescence, negligible cytotoxicity, dramatic pH-dependent luminescence, and the ability to encapsulate hydrophobic drugs.[58] Zn(NO$_3$)$_2$·6H$_2$O, aAuNCs, and 2-methyl imidazole methanol solution were used to prepare aAuNCs-MOF. Given that the aAuNCs aggregate in methanol with enhanced luminescence and ZIF-8 could be produced in methanol, ZIF-8 was a good choice for encapsulating aAuNCs among the various MOFs. According to this study, aAuNCs-MOF exhibited a rhombic dodecahedron shape, which was consistent with that of pure ZIF-8. Type I isotherms were observed for aAuNCs-MOF with a surface area of around 1674 m^2 g^{-1} and an average micropore diameter of 0.99 nm. The decrease in the gravimetric Brunauer–Emmett–Teller (BET) surface area of AuNCs-MOF compared to pure ZIF-8

(1745 m^2 g^{-1}, 1.20 nm) indicated the encapsulation of nonporous AuNCs in MOF. The hydrophobic drug camptothecin (CPT) was chosen as the guest molecule in the controlled release study. The loading efficiency of CPT in aAuNCs-MOF was 9.4%. Given that ZIF-8 was stable in neutral and alkaline aqueous solution but quickly degraded in acid solution, the drug release rate from aAuNCs-MOF was substantially faster at pH 5.0 and pH 6.0 than at pH 7.4. The green fluorescence from fluorescein in CPT became stronger as the incubation time increased from 4 to 24 h, whereas the luminescence of AuNCs became weaker, indicating that the fluorescein molecules and AuNCs were released from aAuNCs-MOF due to the degradation of the MOF in the endo/lysosomes (pH 5–6). Consequently, aAuNCs-MOF could track the release of hydrophobic drugs in real time (Fig. 9). CPT@aAuNCs-MOF had better cytotoxic efficacy than free CPT, indicating that aAuNCs-MOF is a potential platform for delivering medicines to cancer cells. This phenomenon has led to the development of new luminescent drug delivery systems to increase opportunities for biological and medical applications.

Nowadays, motile metal–organic frameworks are used as small-scale robotic platforms for applications such as environmental remediation, targeted medication delivery, and nanosurgery. In 2019, Luis and co-workers showed novel motile RhB@ZIF-8@ABFs that could transport therapeutic payloads to a designated location within a cell culture to demonstrate their targeted drug delivery capabilities in a biologically relevant medium. The group successfully manufactured magnetic helical microstructures coated with a zinc-based MOF, zeolitic imidazole framework-8 (ZIF-8) and assessed their biocompatibility and pH-responsive properties.[59] They made helical swimmers, commonly known as artificial bacterial flagella (ABF), with 2PP and coated them with nickel, and sub-
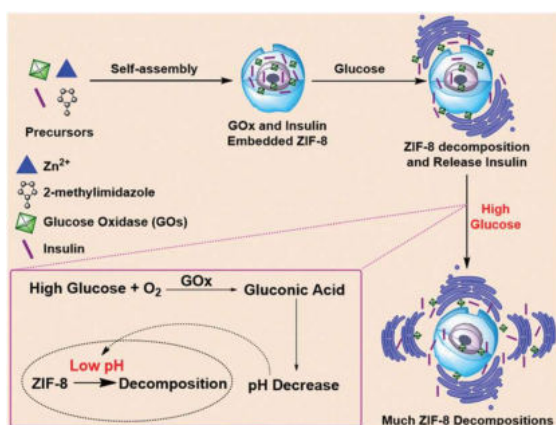
Fig. 8 Representation of glucose-triggered insulin release from the MOF-based nanosystem.
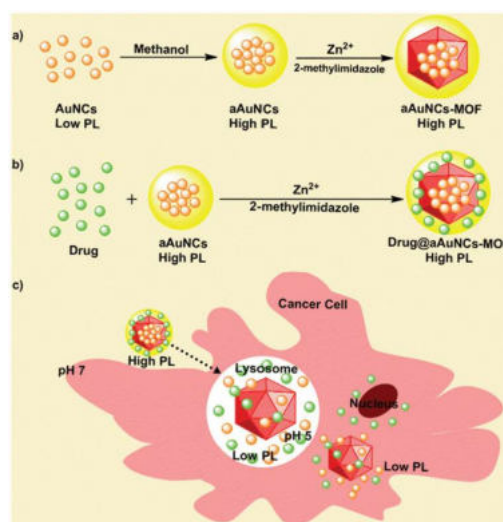
Fig. 9 (a) Representation of encapsulation of aggregated AuNCs in metal–organic framework to enhance their luminescent efficiency. (b) Encapsulation of in aAuNCs-MOF. (c) aAuNCs-MOF served as a tracking agent for the real-time imaging of hydrophobic drug release.

efficiently. In a series of PBS of pH 7.4, 6.5, and 5.5 over 168 h, the cumulative release profiles of Van from MOF-53(Fe)@Van (0.8 mg mL^{-1}) and Fe^{3+} from MOF-53@Van NPs (100 g L^{-1}) were studied. The degradation degree of MOF-53(Fe) in PBS at pH 7.4 was 0.75% and 0.17% at pH 5.5, demonstrating the high stability of the system (Fig. 13). The release amount of Fe^{3+} increased according to the increase in pH value, which indicated that the MOF-53(Fe) NPs were more stable under acidic settings than under neutral conditions. This result was in agreement with the amount of Van released at the various pH levels. With the partial breakdown of MOF-53(Fe), the rate of Van release was enhanced. Specifically, because the MOF-53 (Fe) NPs decomposed partially in neutral conditions, the amount of Van released may have a larger burst effect. IN contrast, the MOF-53(Fe) NPs degraded slower under acidic conditions (pH 5.5) and Van was released more slowly. This finding can aid in the treatment of bacterial infections in acidic environments. The antibacterial activities of Van-loading MOF-53(Fe) were investigated using the spread plate method, and the results revealed that Van-loading MOF-53(Fe) has a long-lasting antibacterial impact and high antibacterial effectiveness without cytotoxicity.

Sadr and co-workers prepared a novel magnetic and pH-responsive porous nanocomposite *via* the surface grafting of β-cyclodextrin on Fe$_3$O$_4$@Silica@MIL-100 (Fe) in 2018.[65] The fabrication of the Fe$_3$O$_4$@Silica@MIL-100 (Fe)/-CD nanocomposite as a magnetic and pH-responsive drug delivery vehicle was described in this research study. Using cephalexin as a drug model, the smart behaviour of the nanocomposite in drug loading and release was thoroughly explored. The TEM images of the Fe$_3$O$_4$@Silica NPs revealed that they possessed a diameter of less than 50 nm, making them appropriate for drug delivery applications. The ability of Fe$_3$O$_4$@Silica@MIL-100 (Fe)/-CD as a pH-responsive drug delivery system was investigated using cephalexin as a drug model. The cephalexin release behaviour was studied using buffer solutions with pH values of 1.2, 5, and 7.4. The adsorbent decomposed at a severe pH of 1.2, resulting in a robust release. At lower pH, the weak π–π interaction between the drug and adsorbent led to a greater burst effect. The stability of the drug/-CD system was higher at physiological pH 7.4

than at pH 5. They discovered that the release was greater and faster at pH 5 than at pH 7. The adsorbent demonstrated considerable release and approximately 96%, 88%, and 99% of the drug was released in 50 h at pH 5, 7.4, and 1.2, respectively. Astonishingly, at pH 5, 7.4, and1.2 around 69%, 99%, and 55% of the medication was released, respectively in 8 h. It was also determined that the percentage of drug release increased with an increase in temperature. Finally, this research presented an efficient method for producing magnetic and smart sorbents that were inexpensive and performed well in drug delivery systems for a wide range of drugs.

Yang and co-workers developed a new type of porphyrin–iron metal–organic framework (Fe-MOF) nanocrystals in 2022 as an acid-degradable drug carrier and hydrogen donor by coordinating porphyrin and zero-valence Fe atoms.[66] The FeCl$_3$-MOF nanocrystals were prepared by combining FeCl$_3$ with 5,10,15,20-tetrakis(4-pyridyl)-21H,23H-porphine (TPyP), and then reducing them with sodium borohydride. The chlorine atoms were removed during the reduction, generating homogeneously dispersed zero-valence Fe atoms. Small-angle X-ray scattering (SAXS) suggested their outstanding structural stability, which favored steady drug delivery. Doxorubicin (DOX) was encapsulated in Fe-MOF in this investigation. After loading DOX, the specific surface area and pore volume of Fe-MOF nanocrystals were reduced from 117 m^2 g^{-1} and 0.35 cm^3 g^{-1} to 103.8 m^2 g^{-1} and 0.25 cm^3 g^{-1}, respectively. The decrease in the pore volume and specific surface area of the Fe-MOF nanocrystals (DOX@Fe-MOF) suggested that DOX was successfully loaded in their pore channels. Because of the microporous nature of Fe-MOF and the hydrogen interactions between the pyridyl groups of Fe-MOF and amino/hydroxyl groups of DOX, the DOX loading capacity of Fe-MOF was measured to be as high as 940 mg g^{-1}. In the acidic PBS environment, the Fe-MOF nanocrystals disassembled rapidly into free ions. Consequently, both hydrogen gas and the loaded medication DOX were produced in an acid-responsive manner. In pH 7.4 PBS, the Fe-MOF nanocrystals appeared to degrade slowly due to the high activity of the single-atom Fe (0). However, it was worth mentioning that Fe-MOF nanocrystals could remain stable for the first hour without observable degradation, hydrogen generation, or drug leakage. Notably, rapid drug release in the acidic environment of the tumor (pH = 6.5) favored tumor cell death, while slow drug release in normal tissues (pH = 7.4) avoided acute drug toxicity to normal cells/tissues and hydrogen gas not only enhanced the anticancer effects of the chemotherapeutic drugs but also reduced their toxic side effects and drug leakage (Fig. 14). The released hydrogen gas from the nanomedicine effectively sensitized the chemotherapy of MCF-7/ADR cells by down-regulating the expression of P-gp and decreasing the ATP levels, resulting in increased ROS-mediated DNA damage, which aided DOX in effectively inhibiting metastasis by immuno-activating M1 macrophages and suppressing MMP-2 expression. The good flexible Fe-MOF platform favored both high anti-MDR and anti-metastasis outcomes and high bio-safety of the
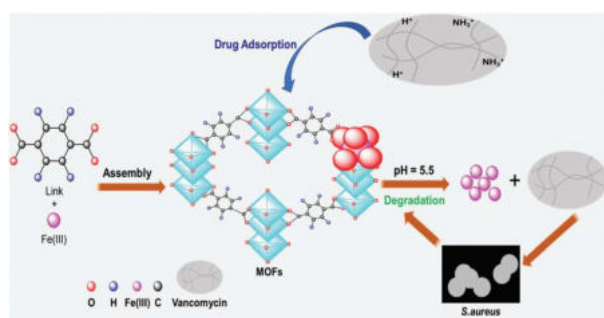
Fig. 13 Representation of MOF–53(Fe) structure and the process of MOF packing drug molecules for killing bacteria.

the impacts of exposure to numerous substances in their environment, such as moisture, solvents, acids, bases, and aqueous solutions containing coordinating anions. The capacity of MOFs to maintain their structural integrity when exposed to heat, vacuum, or pressure is frequently correlated with their thermal and mechanical stability. Over the last two decades, significant effort has been devoted the *de novo* synthesis of novel MOFs with high stability using various strategies, such as preparing high-valent metal–carboxylate or low-valent metal-azolate MOFs using azole-containing carboxylate linkers, mixed metal ions, and hydrophobic ligands, insertion of building blocks, and framework interpenetration. To improve the stability of existing MOFs, post-synthetic structural processing and composite material engineering have also been applied. Although much progress has been made in this field, there are still many obstacles to be overcome. It is difficult to find a universal technique that can be applied to diverse MOF systems due to the specific requirements of each strategy. In addition, many pre- or post-synthetic alteration procedures vary the pore characteristics of MOFs, which complicates their further applications. Some specific techniques, such as hydrophobic surface treatment may be worth further exploration to solve these concerns. Experiments can also be rationally integrated with computational design to produce new framework materials with great stability and specific features. These investigations can be used to explore the biomedical (*e.g.*, drug delivery and bio-imaging) use of nontoxic MOFs. Nontoxic MOFs can be investigated for application as strong supports for regular bioactive atoms to expand their timeframe of realistic usability and adequacy. Furthermore, MOFs should be assessed for their antibacterial and antifungal activity to examine their clinical and natural applications. Despite numerous outstanding studies, the research on MOF toxicity and biodegradation is still in its infancy. Before using these nanocomposites in the clinical setting, numerous hurdles must be overcome. Firstly, greater effort should be devoted to fabricating adaptable nontoxic or low-toxicity MOFs, which should also be biocompatible to accomplish prolonged blood circulation and ensure that the decomposition products can be digested by the body's metabolic system. To minimize adverse effects, future research should focus on constructing non-toxic MOF carriers using endogenous building blocks or functionalizing MOFs with bioactive molecules. Furthermore, thorough *in vitro* studies of the stability and degradation mechanisms of MOF-based nanocarriers are required and also systematic *in vivo* investigations are essential to optimize the performance of MOFs before their clinical applications. To highlight a key point, studying the therapeutic effects of nanocarriers and their effects on normal organs is insufficient. Additional efforts must be made to understand the metabolic mechanisms and pathways of nanocarriers in *in vivo* systems, and long-term monitoring of the organism is also necessary. Finally, future work should be concentrated on the development of multimodal MOF-based theranostic platforms with various mechanisms to achieve high anticancer efficacy and treatment of other disorders. Scientists have made

great advancements in developing theranostic MOFs for clinical applications, even though theranostic MOFs are still a long-standing challenge in nanomedical research. Nevertheless, it is believed that promising advances in MOFs for clinical use will be made in the near future. The fabrication of very stable MOFs is likely to remain a dream, but it would pave the way for their use in a variety of applications. For instance, stable and well-designed multivariate MOFs or MOF-based materials with the characteristics of each portion can provide exceptional performances for certain applications. Moreover, by using stepwise synthetic approaches to control the precise position of customizable functional groups within stable MOFs, their considerable potential or optimal performance for a variety of applications will be understood. The analysis of the mechanism for device engineering and applications is a probable fascinating aim to achieve stable MOFs in the future.

Author contributions

D. D. searched all the articles, interpreted data and prepared the manuscript. P. S. conceptualized the review, wrote and edited the manuscript.

Conflicts of interest

There are no conflicts to declare.

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RESEARCH ARTICLE

Exploring the ecosystem health of a tropical Indian estuary using mass-balanced ecosystem model

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Abstract

Estuaries provide life support to aquatic biota and livelihood support to fishermen and local inhabitants. However, the ecosystem function of estuaries is impaired due to anthropogenic stressors and hence, the assessment of ecosystem health using ecological indicators will deliver the status of stability, maturity, and integrity of an estuary. In this paper, we compiled comprehensive ecological data into an Ecopath model from 2018 to 2019 for a tropical Indian estuary, Mandovi (ME) located along the western coast of India. The functional groups (22) identified in the food web ranged from primary producers (trophic level (TL) = 1) to dolphins (TL 4.4). The indices: biomass/total system throughput (0.01), primary production/respiration (11.04), and primary production/ biomass (35.7) showed that the estuary is a developing ecosystem far from maturity. The ME food web is an immature, complex and organized trophic network with a medium rate of recycling (Finn's Cycling Index = 9.75%), high total system throughput (17,132.33 tons km^{-2} $year^{-1}$), low ascendency (19,610 tons km^{-2} $year^{-1}$), high relative ascendency (47.8%), moderate connectance (0.36), and omnivory indices (0.26). The health indices: eco-exergy index (21,471.33 gm detritus equivalent m^{-2}) and system robustness (0.153) showed that the ecosystem is immature but resilient to unexpected perturbations in the ecosystem. The ecological indicators were compared with other global estuaries, and the environmental indices were developed for the ME. Based on the ecological indices, the estuarine system is immature, moderately developed, and not well organized in terms of its ecological components. The study also indicates that an ecological approach would be more appropriate and essential in analyzing tropical transitional waters' health and sustainability.

Keywords Eco-exergy · Ecopath model · Ecosystem health · Robustness · Tropical estuary · Trophic organization

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Introduction

Estuaries are essential to coastal livelihoods and possess ecological, biological, environmental, cultural, educational, and socio-economic values (Costanza et al. 1997). Estuarine ecosystems, which are transitional, highly productive, and diverse, help aquatic species by assimilating nutrients, diversifying habitats, maintaining biodiversity, and serving as a nursery, a source of food, and a shelter. Estuaries also help in carbon sequestration and flood and storm surge control (Costanza et al. 1997) and support a variety of fisheries of high economic value—making them the most threatened ecosystems on earth (Beck et al. 2001; Selleslagh et al. 2009). The quantification of materials, biomass, or energy flow through various ecological compartments and energy efficiency in the ecosystem's assimilation, transfer, and dissipation offers crucial insights into its structure and functioning (Christensen et al. 2005). Therefore, analyzing

Table 2 Basic parameters of the mass-balanced trophic model for Mandovi estuary (Biomass in t km^{-2} year^{-1})

Groups	Trophic level	Biomass	P/B	Q/B	EE	P/Q	KSI	RTI
Dolphins	4.51	0.005	0.04	13.2	0.06	0	− 0.8	0.2
Birds	4.46	0.004	0.08	20.1	0.09	0	− 0.1	0.7
Large pelagics	4.22	0.016	2.1	6.9	0.71	0.3	− 0.9	0.1
Large benthic carnivores	4.11	0.014	4.9	14	0.73	0.35	− 0.5	0.6
Cephalopods	3.85	0.51	3.9	11.5	0.53	0.34	− 0.5	0.5
Bentho-pelagics	3.82	0.23	2.9	8.3	0.69	0.35	− 0.2	0.8
Piscivores	3.82	0.25	2.3	7.6	0.58	0.3	− 0.3	0.6
Medium benthic carnivores	3.79	0.27	3.8	10.6	0.74	0.36	− 0.3	0.7
Rays and skates	3.73	0.002	1.7	7.1	0.73	0.24	− 2.4	0
Small benthic carnivores	3.31	0.3	4.1	19.1	0.81	0.21	− 0.3	0.9
Crabs	3.01	0.58	7.2	23.3	0.62	0.31	− 0.5	0.7
Jellyfish	2.96	1.22	4.86	21.4	0.41	0.23	− 0.6	0.3
Shrimps	2.71	1.34	6.8	20.6	0.79	0.33	− 0.3	0.7
Benthic omnivores	2.65	7.1	3.2	12.5	0.53	0.26	− 0.4	0.8
Clupeids and anchovies	2.44	4.1	7.3	22.4	0.85	0.33	− 0.2	0.9
Heterotrophic benthos	2.38	18.6	3.4	12.7	0.63	0.27	− 0.4	0.8
Mackerel	2.21	0.41	6.4	19.6	0.46	0.33	− 0.8	0.2
Sessile benthos	2.15	18.1	7.3	32.8	0.91	0.22	− 0.2	0.7
Zooplankton	2.08	5.1	23.5	83.2	0.88	0.28	− 0.3	0.8
Benthic producers	1	103.2	11.2		0.09		− 1.2	0.2
Phytoplankton	1	63.7	91.62		0.22		− 0.1	0.8
Detritus	1	480			0.09			

P/B production/biomass, *Q/B* consumption/biomass, *EE* ecotrophic efficiency, *P/Q* production/consumption, *KSI* keystone species index, *RTI* relative total impact

benthos (0.83), bentho-pelagic (0.82), benthic omnivores (0.82), phytoplankton (0.81), and zooplankton (0.81) had the highest relative total impact (RTI) (Table 2). Considering the MTI and RTI values, these groups, thus, emerged as the keystone groups in the ME, forming the major links in transferring energy from the base trophic levels to the higher levels.

Ecosystem properties and indicators

In the ME, the net primary production (7920 t km^{-2} year^{-1}) was high enough to support rich biomass of medium trophic levels such as zooplankton, pelagic fish (clupeids and anchovies), small benthic carnivores, benthic omnivores, and heterotrophic benthos, which indicated a bottom-up control in the food web. Higher net primary production (t km^{-2} year^{-1}) is recorded from other tropical estuaries in India—Vellar, 12,300; Hooghly-Matlah, 9160; and Zuari, 10,162 and also from other estuaries around the world: Río de la Plata, 20 810; Sine-Saloum, 11 815; the Seine, 7680 (Rybarczyk and Elkaïm 2003); and Cameroon, 7105. However, the value was low (4959) in Ulhas estuary, India (Lal et al. 2021).

Diversity and biomass of benthos groups are also considered indicators of estuarine health (Sivadas et al. 2011,

2016; Gaonkar et al. 2013; Ingole et al. 2014). The diverse benthic groups (heterotrophic benthos, small benthic carnivores, benthic omnivores), provide food sources for most of the benthic carnivorous groups. Small benthic carnivores and benthic omnivores form the major secondary consumer groups, carrying energy from base groups to top benthic predators (Mohamed et al. 2008; Sreekanth et al. 2020a). Therefore, the benthos compartments provide a significant link between detritus and benthic carnivores or omnivores (Ingole et al. 2014).

Ecosystem maturity and stability

The primary ecosystem statistics of EwE and ENA indices cover all the attributes of the ME ecosystem (Table 3). The total system throughput, ascendency, relative ascendency, and FCI are the indices of an ecosystem related to its degree of maturity (Odum 1971). Total system throughput is the sum of consumption (SC), exports (SE), respiration (SR), and flows to detritus (SFD). For ME, the flows to detritus (46%) and exports (42%) seem to be the significant contributors to the TST—as they were in the Zuari estuary (SFD, 43% and SE, 38%) and indeed in most of the tropical, subtropical, and temperate estuaries. System size seems to

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Spatial Analysis A New Research Methodology in Economics An Application in the Study of Women's Empowerment in India

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Abstract

This paper has taken an attempt to conduct a spatial analysis of empowerment of the Indian women using state level spatial data generated from NFHS-4 reports, 2015-16. This study computed a women's empowerment index for each state considering geometric mean of six indicators found in NFHS report. These are; the percentage of women having decision making power in the family, labour force participation rate of the women, percentage of women having physical asset like land, house, etc., percentage of women having own bank account, percentage of women having own mobile, and percentage of women using hygienic method during menstrual period . We start with a spatial exploratory analysis using box map give the signal of spatial pattern of women's empowerment of the Indian states. Global Moran's I statistic value suggests that there is significant spatial autocorrelation for the variable state level women's empowerment index across the Indian states. Local Moran'I analysis using Local Indicators of Spatial Association (LISA) map suggests the presence of significant spatial clusters in several regions in India in respect of women's empowerment level.

Keywords: LISA cluster map, Moran's I statistic, Spatial Analysis, Women's Empowerment

Introduction

In capability approach, empowering women is an important component of the process of inclusive development. Literally, empowerment means giving power to powerless in a particular situation. In UNDP Human Development Report, 1995, women's empowerment has been defined as the expansion of choices for women and an increase in the women's ability to exercise choices. Empowerment is the power of decision making i.e. autonomy (Jejeebhoy, 1995). Alsop, et al. (2005) state that empowerment is the enhancing an individual's or group's capacity to make choices and transform those choices into desired actions and outcomes.

Existing literature has explored empowerment of women as a multidimensional aspect which has many indicators and socio-economic and demographic determinants. It has some developmental outcomesthrough improving income, child education, health and

happiness. However, how the empowerment level of women of it affects the empowerment level of women of it adjacent location of a be analysed in the literature. This study has tried to meet this gap.

Literature review and Objectives

In order to assess the impact of women's empowerment understand the determinants of it quantification of the empowerment women is important. Different studies have measured women empowerment in different ways. Some studies (Sen, 1999, al. 2002, Sridevi, 2005, Dutta, 2017) have attempted to measure degree of empowerment considering several dimensions of women empowerment. The degree of empowerment definitely makes personal and social welfare which in turn enhances empowerment identification of the linkage between women's empowerment development outcomes is the main contribution of the instrumental advocacy of women's empowerment. They have recognized women the agent of change.

There are several studies which have explored the determinants of women's empowerment. We find that education, income, employment level, urbanisation, different government programs like microfinance cash transfer programs etc. In this state level cross-section study all covariates cannot be considered for analysis and after all this is not our purpose. Against this back drop we have set two objectives as follows.

First, this study explore the position of the Indian states in respect of the level of women's empowerment. We thus compute a comprehensive index of state level women's empowerment index for each state.

Second, an attempt has been taken to exude the spatial distribution and nature of spatial autocorrelation of women's empowerment among the Indian states.

Methodology and data

Women's empowerment Index

State level Women's Empowerment Index (SWEI) for each state has been computed using six state level indicators mentioned by National Family and Health Survey (NFHS) report, 2015-16. These are; the percentage of women having decision making power in the family, labour force participation rate of the women, percentage of women having physical asset like land, house, etc., percentage of women having own bank account, percentage of women having own mobile, and percentage of women using hygienic method during menstrual period. SWEI has been constructed calculating the geometric mean of the selected indicators.

Spatial Autocorrelation Analysis

To explore the spatial distribution of women's empowerment the box map with hinge of 1.5 has been plotted for urbanization rate based on the state level scale map of India. The characteristics of SWEI has been analysed conducting spatial autocorrelation test by using Moran's index. Local spatial autocorrelation test by using Moran's index contiguity weight matrix has been computed. In Chase, it considers neighbour those that have common in Chase, it considers neighbour those that have common, including both common boundaries and common the GMI fails to provide a local pattern of association clusters across the spatial units. In order to explore the respect of SWEI we compute the local Moran's plot Local Indicators of Spatial Association (LISA)

data for the variables for computing state level women's and urbanization rate have been collected from the Health Survey (NFHS) report-4, 2015-16. We have used the Indian state boundaries from a repository developed A basic shapefile is a non-topological format for storing regarding the geometric location. Geographic locations in a represented by points, lines, or polygons. Using the software have merged the excel data file containing state level variables to this study collected from NFHS-4 reports.

Findings and Discussion

First, we discuss the basic information regarding the indicators of women's empowerment and the urbanisation. Table 1 displays that only (87 per cent in average) of ever married women take part in the household decision making process. In average 40 per cent of women in the states own physical assets like land, house etc. However, there is wide variation across the states in respect of physical asset holding by the women. In an average 54 percentage women of Indian states holds bank account with lowest disparity among disparities of the indicators of women's empowerment. More than half of the ever married women of the states use their own mobile phone. However, only one fourth of the women in Indian states participate in workforce with wide disparity among the states. Therefore, women's workforce participation has low mean and high variance. In respect of this indicators Indian women are really less empowered.

Among the ever married women two third of the women in the states have hygienic practices during menstrual periods with a high variation across the states. Therefore, values of the indicators of state level women's

empowerment except decision making power in household have disparity. In order to address the influence of this disparity in index of empowerment this study has considered the geometric mean of the indicators as state level women's empowerment index. The descriptive statistics of the state level women's empowerment indicates empowerment of the women of the states in average is low (0.48) which varies widely across the states from 0.35(Bihar) to 0.60 (Manipur). Thus we have to traverse a long journey for achieving the state of complete women's empowerment. It also indicates the partial failure of the existing policies and programs for empowering women in Indian states. We should, therefore, re-examine the effectiveness of the existing policies or find out other factors behind the low mean and moderate variance of women's empowerment. In literature, the spatial distribution and autocorrelation of women's empowerment in Indian states has not been explored yet. This study has been designed for exploring the spatial distribution, autocorrelation of the empowerment of women of a state.

Table 1: Description of the Indicators and Women's Empowerment Index (N=29)

Variable in percentage	Mean	Median	Std Dev	CV
women having household decision making power	87.31	89.1	6.01	6.88
women who own asset either in terms of land or house	39.83	35.2	14.7	36.9
women holding bank account	54.6	56.6	12.5	22.89
women having access to mobile	53.07	47.9	15.58	29.35
workforce participation rate for women	24.97	22.8	8.85	35.44
women who have hygienic practices during menstrual periods	66.09	67.5	17.55	26.55
State level Women's Empowerment Index	0.48	0.47	0.06	12.5
Population residing in Urban area	34.54	32.2	13.31	38.52

Source: Authors' computation based on secondary data

The box map shows that seven states namely Bihar, Madhya Pradesh, Uttar Pradesh, Rajasthan, West Bengal, Chattisgarh and Assam belong to lower quartile of the distribution of women's empowerment. The box map shows that there is a geographical connection among the states such that state with low level of empowerment is surrounded by a state with low level of empowerment. Thus the spatial exploratory study using box map indicates the possibility of spatial cluster of the states in respect of women's empowerment.

Figure 1 Box map for the State Level Women's Empowerment index in 2015-16
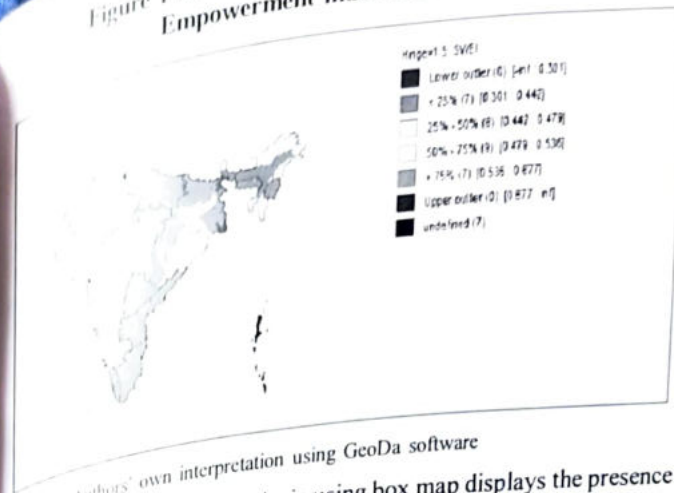
Source: Authors' own interpretation using GeoDa software

The exploratory spatial analysis using box map displays the presence of spatial cluster in respect of women's empowerment. In order to examine the statistical significance of the spatial clusters for state level women's empowerment we have computed global Moran's I (GMI) statistic for the spatial data of women's empowerment. The results of the global autocorrelation analysis, the GMIis found 0.382 with pseudo p=0.001, indicatethat spatial clustering for State Level Women's Empowerment Index (SWEI) in India is statistically significant.

In order to further explore the cluster type of SWEI, we have conducted a local autocorrelation analysis for SWEI and found a LISA cluster significance map depicted in figure 4. Figure 4 shows that that the significant spatial clusters of SWEI are mainly of two types: high–high and low–low, among which high–high type is mainly distributed in southern India, particularly Karnataka. The low–low types are mainly located in north eastern regions, such as Uttar Pradesh, Madhya Pradesh, Bihar and Jharkhand. This analysis suggest that the significant spatial dependence of the Indian states in respect of the state Level Women's Empowerment Index. In order to gauge the spatial dependence of the sites we have to move on the spatial regression analysis.

Figure 5 LISA ClusterSignificance Map of State Level Women's Empowerment Index in India in 201-16
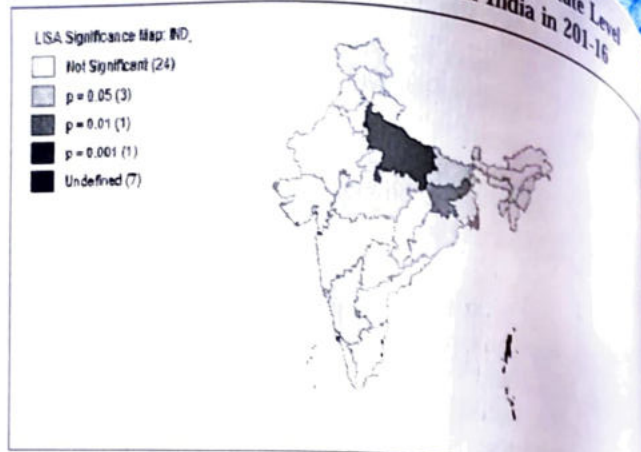
Source: Author's own interpretation from spatial data of Indian states using GeoDa software

Concluding Remarks

The study has taken an attempt to explore the new dimension of the analysis of women's empowerment. Using the state level secondary data a comprehensive index of women's empowerment of the Indian states have been computed using a standard methodology and explore the position of the states in respect of women's empowerment. The spatial distribution of the state level women's empowerment index presented in box map shows that women's empowerment level of the states are not spatially complete random, there is a prominent spatial pattern of women's empowerment. This observation has been confirmed by the GMI statistics indicating the presence of spatial autocorrelation for the SWEI. In other words it confirms the presence of spatial cluster of the women's empowerment level. The LMI analysis using LISA cluster map shows locations of the significant spatial clusters of women's empowerment. Our systematic analysis reveals that higher the women's empowerment level of states accelerate the women's empowerment of the neighbor state in India. So far, the study has a limitation such that it is based on small sample for the year 2015-16. This limitation restricts us to include more covariates of women's empowerment live education, income, castes etc. one can overcome this limitation considering the panel data analysis of more than one round data of NFHS in India for the same variables.

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Protective Potential of Vitamin C and E against Organophosphate Toxicity: Current Status and Perspective

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Abstract

Pesticides are an integral part of our daily life, used in agricultural fields, store rooms, residences and educational institutions to kill or repel pests. Several chemical subtypes of these compounds are available, of which organophosphate (OP) is major one. These are broad spectrum pesticides used to kill insect pests. OPs are useful but indeed they are most frequent reasons of pesticide poisoning across the globe. OP inhibits acetylcholinesterase activities that results in continuous hyper-excitable state of nicotinic and muscarinic receptors at neuromuscular junctions. Intentional or unintentional exposure to OPs causes abdominal pain, diarrhea, vomiting, muscular weakness, dementia, Central Nervous System (CNS) dysfunction and even death. Besides acetylcholinesterase inhibition, OPs are also known to trigger ROS generation within the cellular machinery which results in Oxidative Stress (OS). Free Radicals (FRs) are neutralized by antioxidant-defense system of the body. Vitamin C and vitamin E are the major exogenous antioxidants that scavenge a large amount of free radicals by donating their own electrons to FRs. This phenomenon reduces ROS and hence, OS is prevented. Therefore, vitamin C and E can be considered for daily dietary intake which might be providing prophylactic advantage against OP induced OS and pathophysiology in human beings.

Keywords: Ascorbic Acid, Organophosphates, Oxidative Stress, ROS, Tocopherol

1. Introduction

Our environment is full of various ubiquitous stressors such as UV radiation, pathogens, allergens, and different chemical pollutants. Pesticides are among the major chemical pollutants that have become an integral part of the ecosystem and affect mammals along with other non-target organisms. These are formulated to kill or repel pests to reduce economic loss[1,2]. These chemicals are in one way beneficial in increasing crop production through crop protection and reduction in need for man-power in farms and store houses. But, increasing rate of pesticide resistance due to frequent usage creates an open competition among the manufacturers to synthesize more effective and potent pesticides which might have greater side effects on human and other living creatures. Pesticide exposure has emerged as a global public health issue because of their wide-spread application, unintentional exposure, and release into environment[3,4]. Such chemicals are known to cause environmental pollution that exerts human health-issues resulting from acute and chronic exposure. Approximately among the 3 million cases of pesticide poisoning reported every year across the world, more than 250,000 deaths occur as per reports of World Health Organization[5]. The high rate of pesticide poisoning might be due to irrational use, little or

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no knowledge about the side effects and, most importantly lack of adequate safety information on the pesticide packages[6]. Despite of such a high number of death cases, there is still a huge demand of these chemicals around the world.

Majority of pesticides belongs to four categories such as organochlorine, Organophosphates (OPs), pyrethroids, and carbamates. Organochlorine pesticides (OCPs) are synthetic organic compounds widely used all over the world. These agents are categorized under Persistent Organic Pollutants (POPs) and composed of carbon, hydrogen, and chlorine atoms. OCPs bind to neuronal sodium channels to increase their permeability for sodium ions. This increased permeability facilitates uncoordinated discharge of neurons which harms central nervous system of target pests. Common OCPs used in India and other developing countries like China, Pakistan, Sri Lanka, and Bangladesh include Aldrin, Dieldrin, Chlordane, DDT, Diazion, Endosulfan, Lindane, and Methoxychlor. OCPs are used to control soil insects such as termites, rice water weevil, wireworms, corn rootworm, and grasshoppers. OP Pesticides are synthetic pesticides actively released into environment. These compounds are esters of phosphoric acid or thiophosphoric acid and works by inhibiting Acetylcholine Esterase (AChE) in synaptic sites of central and peripheral nervous system. This leads to accumulation of acetylcholine at synaptic junctions of neurons resulting in hyperexcitability of nerve fibers followed by paralysis and death of target pests. Acephate, Chlorpyrifos, Parathion, Malathion, Dichlorvos, Diazinon, and Tetrachlorvinphos are popular OP pesticides in developing countries of South Asia. OP pesticides are applied to control pests like fire ants, saw flies, caterpillars, termites, aphids, and leaf miners. Pyrethroids are organic compounds similar to the natural insecticide Pyrethrin produced from the flowers of pyrethrums (*Chrysanthemum cinerariaefolium* and *C. coccineum*). Pyrethroids prevent closure of the voltage gated sodium channels in the axonal membranes. This leads to permanent depolarization of axonal membrane and paralysis of the target animal. Common Pyrethroids include Cypermethrin, Permethrin, Deltamethrin, and Bifenthrin. These pesticides are used to control cockroaches, fleas, and termites in houses and other buildings. Carbamates are the N-methyl Carbamates derived from Carbamic acid (NH_2COOH). They cause carbamylation of AChE at neuronal synapses and neuromuscular junctions. Carbamates reversibly bind with AChE at synaptic region leading to paralysis and death of the target pests Aldicarb, Methomyl, Carbofuran, Trimethacarb, Carbaryl, Oxamyl, Ethienocarb, Propoxur, and Fenobucarb are common agents under this category. Carbamates are effective against aphids, thrips, lygus, mites, nematodes, fleahoppers, leafminers, and spiders.

OPs are commonly used pesticides as well as phosphoric acid derivatives of amides, esters, or thiol groups. These chemicals are extensively used in horticulture, agriculture, veterinary-medicine, forestry, and also for the control of some vector-borne diseases. OPs like malathion is frequently used to control ticks and mites[7]. In agricultural-sector, OPs are extensively implicated in eradication of pests including locusts, aphids, leaf-miners, fire-ants, thrips, and caterpillars. These pesticides augment both quantity and quality of agricultural-products[8]. OPs namely tris-(2-chloro,1-methyl-ethyl)-phosphate, tris-(2-chloroethyl)-phosphate, tri-n-butylphosphate, tri-iso-butylphosphate, triphenylphosphate and tris-(butoxyethyl)-phosphate are admired flame-retardants and plasticisers at public places[9]. Due to massive use of OP chemicals, their residues have been detected in drinking-water, grains, vegetables, fruits, soft-drinks, and other food items and hence, it provokes a global health concern[10]. OPs are cholinesterase inhibitors and known to amplify free radical generation and therefore sub-cellular Oxidative Stress (OS). OS is involved in onset of a number of diseases like atherosclerosis, inflammatory diseases, cardiovascular maladies, neurological disorders, and others. Therefore, the community should work to minimize the usage of harmful pesticides including OPs, at the same time their side effects to restrict adverse impacts on human health.

Vitamin C (ascorbic acid) and vitamin E (alpha-tocopherol) are the major exogenous antioxidants that scavenge a large amount of free radicals by donating their own electrons to FRs[11]. This phenomenon reduces Reactive Oxygen Species (ROS) and hence, OS is prevented. Therefore, vitamin C and E can be considered for daily dietary intake which might be providing prophylactic advantage against OP induced OS and pathophysiology in human beings.

The present literature aims to present the OP induced health hazards in human and other animals along with a discussion on protective potential of vitamin C and vitamin E in it.

2. OP Pesticides

OP pesticides were introduced by German scientists in 1938 and have been used as nerve poisons and chemical weapon during World War II[12]. At present, they are available commercially worldwide for domestic and industrial use[13,14]. Nearly half of all insecticides used in the world belong to OP category and hence they pose a greater risk of threat on health of humans[15]. Human may be exposed to OP pesticides through inhalation, ingestion or skin contact[16]. OP toxicity is a major cause of morbidity and mortality in most of developing
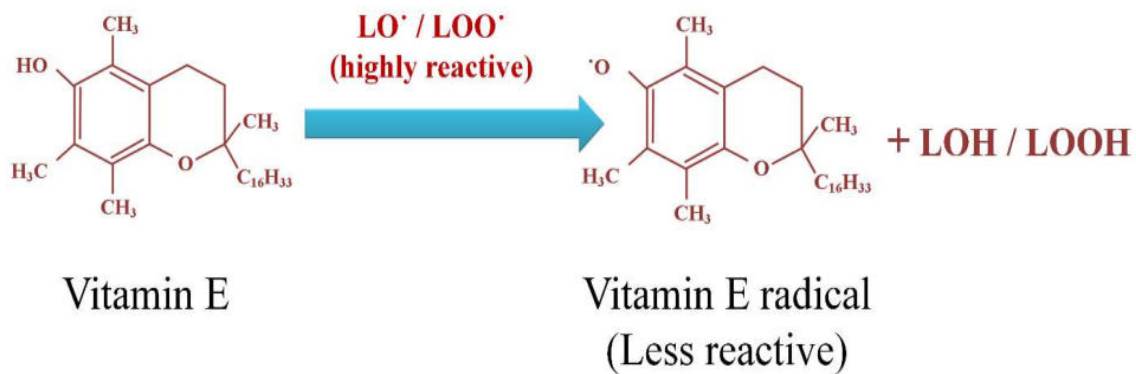
Figure 2. Vitamin E as a chain breaker during lipid peroxidation. Free radical like ˙OH attacks polyunsaturated fatty acids (PUFA) of biological membranes and generates lipid alkoxy radical (LO˙) or lipid peroxyl radicals (LOO˙) which initiate a chain reaction that damages adjacent membrane-bound PUFA. Vitamin E neutralizes LO˙ and LOO˙ thereby terminating the chain reaction.
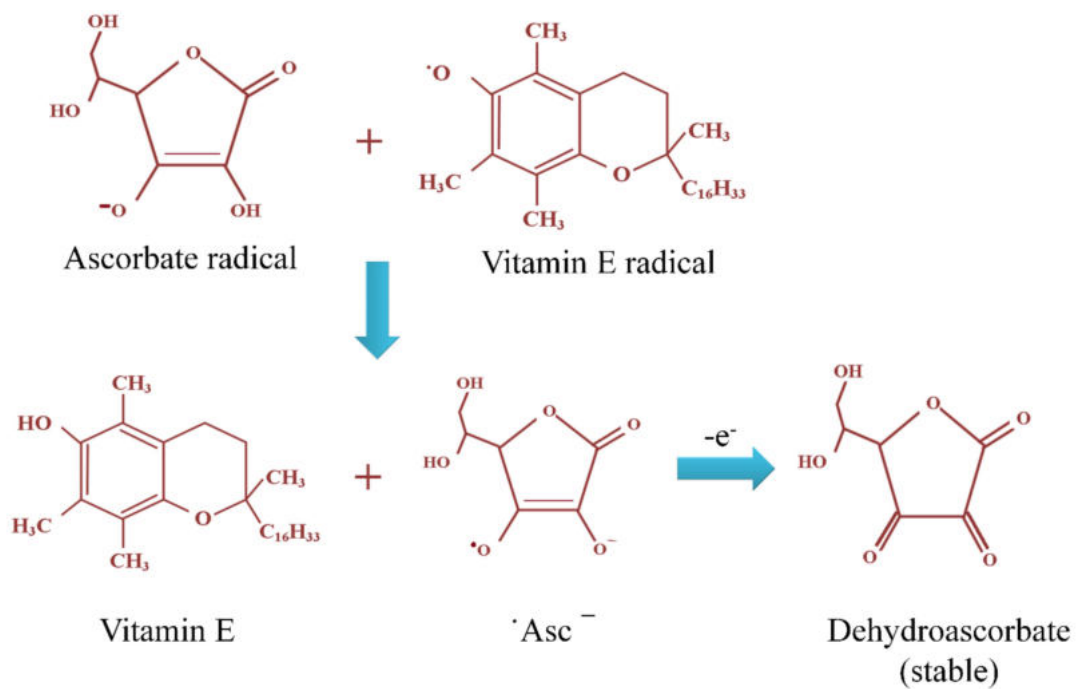

Figure 3. Regeneration of vitamin E (α-Tocopherol). Ascorbate through de-protonation converts vitamin E radical into its more stable configuration i.e., α-tocopherol. Upon loss of one electron, ˙Asc⁻ changes into dehydroascorbate which is stable.

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जनकल्याणे नीतिशतकस्य माहात्म्यम्

समीरणः रायः[1]

काव्यस्य साहित्यस्य वा मूलभूते प्रयोजने द्वे, अलौकिकानन्दानुभूतिः शिक्षा च । मनुष्याणां सर्वतः उन्नतेः प्रयत्नस्य पूर्णप्रतिफलनं संस्कृतसाहित्ये परिलक्ष्यते । प्राचीनभारतीयसभ्यतायाः संस्कृतेश्च समुन्नायको वेदवेदाङ्गादिः शास्त्रम् । मनुष्यजीवनस्य उत्कर्षः अपकर्षश्च एतेषां शास्त्राणामुपरि आधारितः । अस्मिन् मनुष्यजीवने केन सह कीदृशः व्यवहारः काङ्क्षितः, किं कर्तव्यम्, किमकर्तव्यम्, कः सन्मार्गः, कण्टकाकीर्णः मार्गः कः, कस्मात् आदर्शजीवनस्य प्राप्तिर्भवति – एतेषां प्रश्नानां निश्चितं निराकरणमस्ति नीतिशास्त्रे । कविना भर्तृहरिणापि शतकत्रये स्फुटतया अनुरूपः प्रयासः क्रियते । शतकत्रयान्तर्गतः शृङ्गारशतकं व्यक्तिजीवनेन सह, वैराग्यशतकं परमार्थजीवनेन सह तथा नीतिशतकं सामाजिकजीवनेन सह सम्बन्धयुक्तम् । शतकत्रयं मूलतः सत्य-शिव-सुन्दरतत्त्वं समन्वितम् । संस्कृतवाङ्मये शुक्र-विदुर-चाणक्य-भर्तृहरिप्रणीतेषु नीतिग्रन्थेषु भर्तृहरेः नीतिशतकस्य विशिष्टमेकं स्थानं वर्तते । अपूर्वेऽस्मिन् नीतिग्रन्थे कविना संसारस्य व्यवहारिकजीवनस्य सकलगूढं महत्त्वपूर्णं च विषयं चिन्तितम् । नीतिशतके मनुस्मृतिः इव शिक्षा, महाभारतमिव उपदेशः, पुराणमिव रसास्वादनम्, दर्शनशास्त्रमिव तर्कयुक्तिः उपलभ्यते । मानवकल्याणे नीतिशतकोक्तनैतिकशिक्षायाः माहात्म्यमस्य शोधप्रबन्धस्य आलोच्यविषयः ।

नी(प्रापणे/नये) धातोः उत्तर क्तिन् प्रत्यययोगे नीतिः शब्दो निष्पद्यते । कोशकारगणः विभिन्नेषु अर्थेषु शब्दस्यास्य प्रयोगं कृतवान् । यथा – निर्देशनम्, दिग्दर्शनम्, प्रबन्धः, आचारः, आचरणम्, आचारशास्त्रम्, व्यवहारः, कार्यक्रमः, औचित्यम्, नीतिकौशलम्, नीतिशास्त्रम्, शालीनता, बुद्धिमत्ता, योजना, उपायः, कूटनीतिः, राजनयः, अवाप्तिः, अधिग्रहणमित्यादयः । अतएव सकलप्रयोजनस्य सिद्धिदातृ एव नीतिशास्त्रम् । उच्यते च – "सर्वस्य लोचनं शास्त्रं नीतिविद्यां ददाति च ।" नीतिशास्त्रस्य व्यवहारात् ऋते संसारस्य कोऽपि मनुष्यः सुखपूर्वकं जीवनयापयितुं समर्थो न भवति । नीत्याश्रयेण नराः सांसारिकसमस्यायाः समाधानं कर्तुं शक्नुवन्ति । नीतिवेत्ता व्यक्तिः कठिनतरकार्यमपि अनायासेनैव सम्पादयति, परन्तु नीतिहीनव्यक्तिः न कदापि साफल्यम् आप्नोति । अस्मिन् प्रसङ्गे महाकविकालिदासस्य रघुवंशमहाकाव्यस्य उक्तिः स्मरणीया – "काले खलु समारब्धाः फलं बध्नन्ति नीतयः ।" (१२,६९) नीतिशतकं मुक्तकश्रेण्याः शतककाव्यम् । नामकरणानुसारेण अस्य शतसंख्यकश्लोकं काङ्क्षितं परन्तु अपरापरं शतककाव्यमिव अस्य ग्रन्थस्यापि श्लोकसंख्याविषये मतभेदं परिदृश्यते । नीतिशतकस्य प्रणेता सप्तमशतस्य महाकविः

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Synergistic action of organophosphates and COVID-19 on inflammation, oxidative stress, and renin-angiotensin system can amplify the risk of cardiovascular maladies

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ABSTRACT

Organophosphates (OPs) are ubiquitous environmental contaminants, widely used as pesticides in agricultural fields. In addition, they serve as flame-retardants, plasticizers, antifoaming or antiwear agents in lacquers, hydraulic fluids, and floor polishing agents. Therefore, world-wide and massive application of these compounds have increased the risk of unintentional exposure to non-targets including the human beings. OPs are neurotoxic agents as they inhibit the activity of acetylcholinesterase at synaptic cleft. Moreover, they can fuel cardiovascular issues in the form of myocardites, cardiac oedema, arrhythmia, systolic malfunction, infarction, and altered electrophysiology. Such pathological outcomes might increase the severity of cardiovascular diseases which are the leading cause of mortality in the developing world. Coronavirus disease-19 (COVID-19) is the ongoing global health emergency caused by SARS-CoV-2 infection. Similar to OPs, SARS-CoV-2 disrupts cytokine homeostasis, redox-balance, and angiotensin-II/AT_1R axis to promote cardiovascular injuries. Therefore, during the current pandemic milieu, unintentional exposure to OPs through several environmental sources could escalate cardiac maladies in patients with COVID-19.

1. Introduction

Scientists and health workers across the world are racing together to halt the recent COVID-19 pandemic triggered by SARS-CoV-2 infection. The disease was first detected in Wuhan province of China in December 2019 and rapidly extended to 213 countries. There have been 611,421,786 confirmed cases with 6,512,438 casualties as of 23rd September 2022 (https://covid19.who.int/). Potent vaccines have been developed by different laboratories and the vaccination program is still continuing in several countries. However, it is to be noted that, vaccines usually does not provide 100% protection from re-infection. Therefore even after vaccination, people have to be serious about COVID-19 and need to follow the proper guidelines released by World Health Organization and local governing bodies to minimize the risk of re-infection. Unfortunately, many European, African, and Asian countries are suffering from subsequent waves of COVID-19 due to emergence of new variants of the virus. The B.1.1.7 (Alpha), B.1.351 (Beta), P.1 (Gamma), B.1.427 (Epsilon), B.1.429 (Epsilon), and B.1.617.2 (Delta) variants detected in many countries are classified as variants of concern. These variants are unusually divergent, each possessing a unique constellation of mutations of potential biological importance and hence can evade the immune barrier developed from a previous SARS-CoV-2 infection.

In majority of cases, virions entering through naso-oral opening first colonize broncho-pulmonary epithelium and fuel necroinflammation-mediated pulmonary ailments (Rajak et al., 2021a). From lungs,

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Table 3
Organophosphate exposure and symptoms of cardiovascular ailments in human.

Organophosphate compound	Type and location of study	Type of exposure	Number of individuals studied	Signs of cardiotoxicity	References
Phorate	Case report; India	Accidental exposure	01	Abnormal ECG with sinus tachycardia, non-specific ST-T wave changes and a corrected QTc interval of 430–500 msec; elevated levels of Creatine kinase-MB and troponin I.	Muthu et al., 2014
Chlorpyrifos, dichlorvos, Methylparathion, Dimethoate, Profenfos, Chlorpyrifos, Triazos	Hospital-based cross-sectional study; Nepal	Acute exposure	115	Patients diagnosed with sinus tachycardia (49.6%), Hypertension (20%), ECG abnormalities (18.26%), ventricular extrasystole (12.2%) and ventricular fibrillation (0.3%).	Laudari et al., 2014
Mevinphos, Parathion, Phosphamidon, Parathion, Malathion, Tamaron, Diazinon	Clinical study, Israel	Acute exposure	15	Altered ECG (Q-T prolongation) and malignant tachyarrhythmias.	Ludomirsky et al., 1982
Parathion	Case report, India	Acute exposure	01	Patient detected with sinus bradycardia, left ventricular failure and elevated level of troponin I.	Joshi et al., 2013
Dichlorvos, parathion, methamidophos, phoxim etc.	Clinical study, China	Acute exposure	98	52% of patients with acute myocardial injury as evidenced by elevated levels of troponin I, creatine kinase-Mb and N-terminal pro B-type natriuretic peptide.	Chen et al., 2019
Chloropyrifos, dichlorvos, diazinon, parathion, methidathion, phenothoate etc.,	Clinical study, Republic of Korea	Acute exposure	99	11.1% patients experienced abnormal ECG (fluctuation in ST); 34.3% of patients with detectable troponin I levels.	Cha et al., 2014
Not specified	Case report, India	Accidental exposure	01	ECG revealed atrial fibrillation.	Maheshwari and Chaudhary, 2017
Not specified	Cross-sectional study, India	Acute exposure	107	Patients detected with prolonged Q-Tc (62.6%), sinus tachycardia (33.6%), elevated ST segment (25.2%), inverted T wave (19.6%) and first degree heart block (8.4%) as well as atrial fibrillation (4.6%).	Paul and Bhattacharyya, 2012
Not specified	Clinical study, Egypt	Acute exposure	46	Elevated levels of serum creatinine kinase and cardiac trophonin I; abnormal ECG with sinus tachycardia ((34.78%) and sinus bradycardia ((19.56%); prolonged QTc ((32.61%) and PR (8.70%) intervals; elevated ST segment (15.22%).	Kharoub and Elsharkawy, 2008
Not specified	Clinical study, Iran	Occupational (71 patients), suicidal (26 patients) and accidental (3 patients) exposure	100	63% of patients presented abnormal ECG with Sinus tachycardia (31%), non-specific ST-T changes (24%) and atrioventricular arrhythmia.	Taromsari et al., 2013
Not specified	Case report, USA	Acute exposure	01	Patient experienced sinus bradycardia, A-V dissociation, idioventricular rhythms, multiform ventricular extrasystoles, and prolongation of the PR, QRS, and QT intervals. Polymorphic ventricular tachycardia was also detected.	Brill et al., 1984
Parathion	Case report, Turkey	Acute exposure	01	Elevated levels of cardiac injury markers (Troponin I, creatine kinase-Mb); alerted ECG demonstrating ST-segment elevation and AVF derivations accompanied by ST horizontal depression in DI-AVL leads.	Karasu-Minareci et al., 2012
Methyl-parathion; Propoxur; Sichlorvos; Monocrotophos; Malathion; Dichlorovos	Clinical study, Nepal	Acute exposure	37	Patients established electrocardiographical abnormalities (37.8%); sinus tachycardia (40.5%); sinus bradycardia (18.9%); hypertension (13.5%) and hypotension (10.8%)	Karki et al., 2004
Parathion	Case report, India	Acute exposure	01	Myocardial infarction	Kidiyoor et al., 2009

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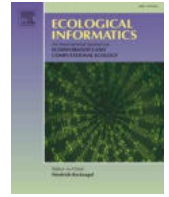
Zooplankton community of Bakreswar reservoir: Assessment and visualization of distribution pattern using self-organizing maps

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ABSTRACT

Self-organizing maps, otherwise known as *Kohonen*-maps, are one form of unsupervised artificial neural networks that can produce two-dimensional plots from multidimensional data. This tool is especially useful in community pattern analyses and has been previously used in spatial pattern analysis with different perspectives. The present study aims to find zooplankton's community pattern in the Bakreswar reservoir ecosystem. Bakreswar reservoir is a freshwater ecosystem in the Birbhum district of West Bengal, India. The reservoir is primarily used to supply freshwater to the Bakreswar thermal power plant. However, the local villages around the reservoir depend on it for drinking water and fishing sustenance. The data used in this study was collected over two years from three different stations. Thus, in addition to describing the spatial pattern of community distribution of zooplankton groups, the temporal variation was also studied. It is observed in the study that the four major groups of zooplankton – Copepoda, Cladocera, Ostracoda, and Rotifera – react differently to the different environmental attributes. Primarily directed by the physical environmental factors, the effect of the chemical factors on the patterning is also evident from the study. Copepods are the dominant group in the system, closely followed by cladocerans and rotifers. But this observation changes at different stations and throughout the study period. The temperature profiles of the reservoir primarily direct the occurrence of ostracods and rotifers, whereas cladocerans and copepods are inclined more towards a chemical factor directive. Rotifers are dominant in the monsoon, whereas the post-monsoon and winter seasons show an increased presence of copepods and cladocerans. The overall observation that the reservoir's water quality is good, and the trophic structure is healthy is in accordance with previous studies as well.

1. Introduction

One of the significant goals of ecology as a discipline is the study of system-level organizations instead of the organism as an individual (Odum and Barrett, 1971). Comparable transcending or functional processes (e.g., energetics, evolution, diversity, and so on) can be observed through different levels of the organization, starting from the cellular level and continuing to the ecosphere (Barrett et al., 1997). However, there are marked differences in the holistic properties of such organizations compared to the individual component properties. A holistic hierarchical organization often gives rise to newer emergent (non-reducible) properties that cannot be explained simply by studying components only at that particular organization level (Odum and Barrett, 1971). Hence, it often becomes necessary to extend ecological studies at a community level to analyze the different controls of feedback mechanisms regulating their dynamicity. These controls are often loosely implemented at these levels – a characteristic property termed homeorhesis (Barrett et al., 1997; Odum and Barrett, 1971).

Community patterns vary with perturbations in the environmental composition; thus, it is an important aspect that might significantly impact the system's health in general (Hawkes, 1979). Community function largely depends on community structure and organization

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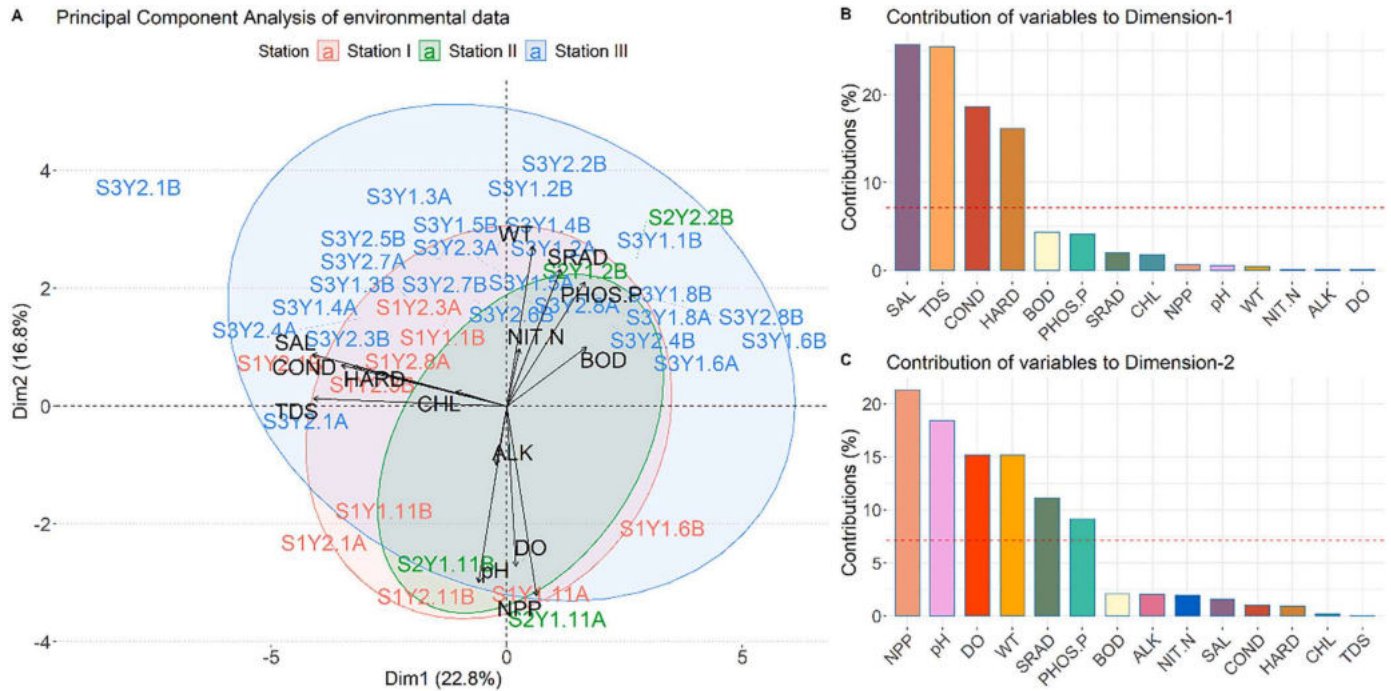 *E-mail address:* aranya.arnab@gmail.com (A. Banerjee).

Fig. 6. Figure representing (A) PCA biplot for Env-data, (B) and (C) contribution of variables to dimensions 1 and 2 respectively for Env-data PCA.
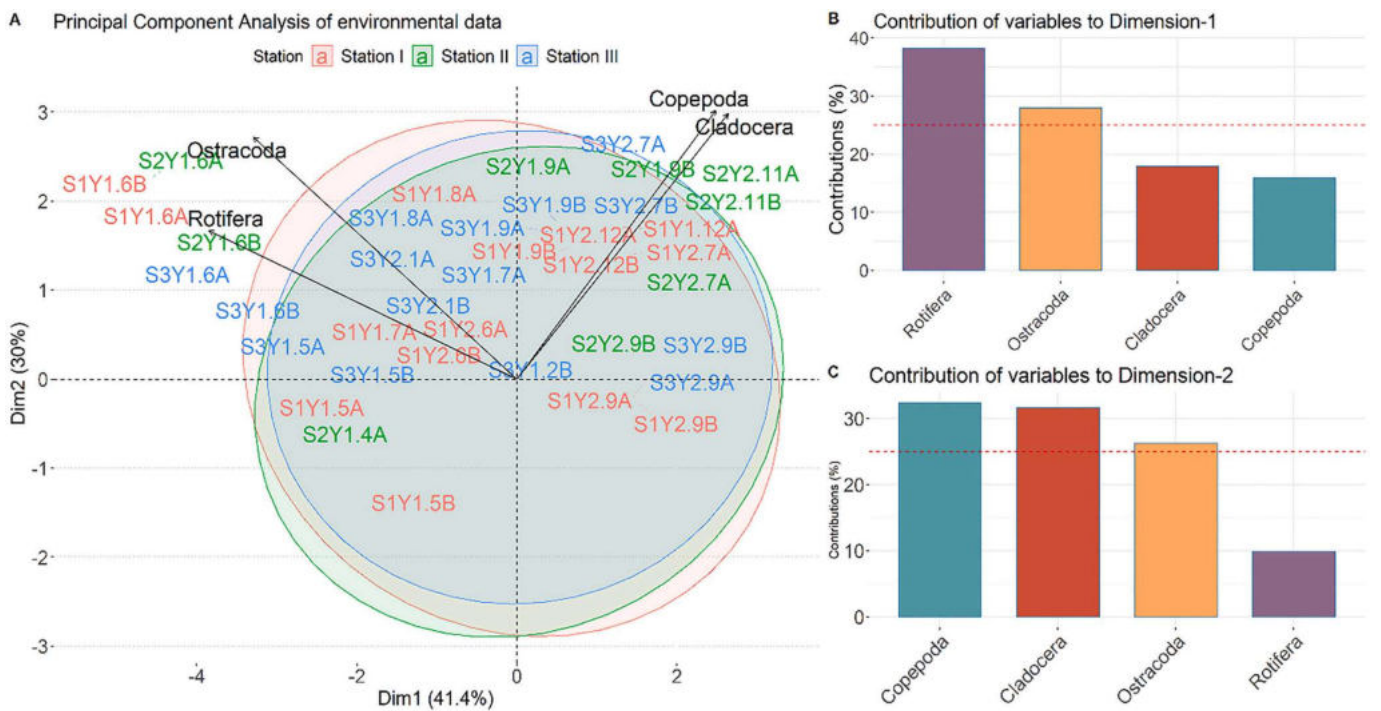

Fig. 7. Figure representing (A) PCA biplot for Zoop-data, (B) and (C) contribution of variables to dimensions 1 and 2 respectively for Zoop-data PCA.

descriptors are highly correlated among themselves. Four prime zooplankton groups – Copepoda, Cladocera, Rotifera, and Ostracoda-were collected over two years alongside environmental variable data. Before applying clustering and SOM workflow, this data was subjected to different tests, including correlation analysis, PCA, and collinearity tests. Results of correlation analysis (Figs. 3, 4, and 5) and PCA (Figs. 6 and 7) show a clear spatial ordination among the three stations.

Correlation analysis revealed that the different environmental factors have different effects on the distribution of zooplankton and,

consequently, on their community structure. Figs. 3, 4, 15, and 17 and Table 3 establish that the factors (chemical) responsible for characterizing the data points are primary production, dissolved oxygen, alkalinity, salinity, nitrates, phosphates, and total dissolved solids. Solar irradiation and water temperature are the most important physical attributes, followed by air temperature and humidity. However, the latter two factors have been excluded from the final analyses following VIF extraction and adjustment. The atmospheric or air temperature had a high positive intercorrelation with water temperature. Hence, this

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Assessment of Groundwater and Surface-Water Resources of Gushkara in Purba Bardhaman (West Bengal, India) using the Water Quality Index

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Abstract: Survival of life on earth indispensably depends on water. Population explosion and its consequences resulted in the usable water sources being unusable in many regions. Regular monitoring of water quality becomes necessary to protect public health. The present study aimed to evaluate the water quality status of various water resources of Gushkara (West Bengal, India). The result showed that the status of the water quality index (WQI) of the studied surface-water sources is 'poor' or 'very poor' (ranges 50.582 - 87.969) whereas the groundwater and municipal water supply are rather safer (ranges 15.804 - 36.210). There is also an indication of faecal coliform contamination in surface-water sites. Overall water quality is better in winter than other two seasons. Some parameters in surface-water crossed the recommended level while some reached near that level. So immediate attention is necessary to rectify the situation.

Keywords: Water Quality Index, Ground and surface-water, Seasonal variation, Gushkara, Coliform

Introduction

The amazing diversity of plants and animals on the globe is directly influenced by the sources of water. Today humans literally reached all the corners of the globe and explored all the possible places for establishing new habitats and activities. In the process, they explored and exploited almost all the resources of water. Most sources of freshwater are polluted to various degrees today and become unsuitable for their desired uses.

Globally, billions of people suffer and lose their lives every year from water-borne diseases (WHO, 2022). Standard drinking and usable groundwater and surface-water resources becoming scanty due to their indiscriminate unscientific use and

immediate attention (Mukherjee and Paramanik, 2022). The present study was conducted to understand the degree of water pollution, usability, and its seasonal variation at Gushkara. Analysis showed that the water quality parameters of the studied surface-water (ponds) are near or crossing the permissible limits in many cases. Contaminations from daily use, domestic, municipal, and/or agricultural sources are evident. Parameters of the groundwater (tube well and well) and the municipal supply are rather within safe limits. People use pond water for bathing, washing, and other domestic purposes, sometimes for drinking. WQI recommends immediate attention to the surface-water sources of the area.

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Multidimensional Deprivation: Cross-District Insights in West Bengal

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ABSTRACT

This study explores the intensity and inequality of multidimensional deprivation (MD)across the districts of West Bengal, a north-eastern state in India. The measure of MD covers the dimensions of Knowledge, Health and Living condition with the respective indicators. We have clustered the districts in accordance with the selected indicators. An attempt has also been taken to gauge the inequality for deprivation indicators and for multidimensional deprivation index (MDI) applying the class of Atkinson measures. This study has used the data published by Directorate of Population Census of India 2011. It is reported that value of MDI ranges from 0.013 to 0.675 across the districts in West Bengal. Purulia is the most deprived district followed by Jalpaiguri, Maldah. On the other hand, Kolkata is the least deprived among the districts preceded by North 24 Parganas, Purba Mendinipur. The cluster analysis reveals that Kolkata is the distinct from the other districts of West Bengal. It is found that Darjeeling district and Jalpaiguri district form two separate clusters. The districts of Dakshin Dinajpur, Murshidabad, Uttar Dinajpur, Maldah, Birbhum, Bankura and Purulia are similar in terms of the indicators of multidimensional deprivation. The districts of West Bengal are, of course, not highly diverse in terms of multidimensional deprivation. However, inequality for MDI is higher than that for HDI of the districts.

HIGHLIGHTS

◉ Average value of multidimensional deprivation index for the districts in West Bengal is 0.42 with range 0.013 to 0.675. Purulia is the most deprived district in West Bengal followed by Jalpaiguri, Maldah, Uttar Dinajpur

◉ Geographical closeness of the districts in West Bengal does not ensure the closeness of the districts in respect of the socio-economic deprivation indicators.

◉ The districts of West Bengal are not highly diverse in terms of multidimensional deprivation.

Keywords: Cluster Analysis, multidimensional deprivation index, normalized inverse euclidian distance, population census

The well-being of a person is best seen as an index of the person's functionings (Sen, 1987). Deprivation may be viewed as the failure to achieve the socially desirable functionings of the person. Personal achievement of functionings depends on many factors. Thus, deprivation of an individual or a community or a region is associated with the multiple aspects like health, education and access to descent living condition. India has some flagship programs like Pradhan Mantri Jan Dhan Yojana (PMJDY), Swarnajayanti Gram Swarojgar Yojana (SGSY), National Rural Employment Guarantee Scheme (NREGS), Public Distribution System, Universal Health programmes to smooth the achievement of functionings of the common people. Despite

where ε denotes the inequality aversion parameter, n stands for number of districts (19), x_i stands for the ith indicator or index of deprivation. μ denotes the mean of x_i. The value of ε ranges from 1 indicating no preference for equality to minus infinite indicating extreme preference for equality. In this study the values of ε = 0.5, 0 and -1 have been considered for measuring inequality of the indicators and indices under consideration.

The data for the indicators of multidimensional deprivation for the districts in West Bengal have been collected from Population Census Report 2011, Government of India. Data for HDI of the district have been collected from West Bengal Human Development report, 2004, the Government of West Bengal. We have considered all the districts in West Bengal during the census year 2011 and census data for studying the intensity and inequality in multidimensional deprivation.

RESULTS AND DISCUSSION

Table 2 displays the descriptive statistics of the indicators and indices of MDI. Average illiteracy rate of the districts in West Bengal is 25.14 per cent in 2011which varies from 12.98 per cent to 49.93 per cent across the districts. In West Bengal 52.9 per cent households have no access to banking facilities. Median value of this indicator tells us that in half of the districts, 57 per cent or more households are deprived of banking facilities. Thus financial illiteracy is a serious deprivation among the districts of West Bengal. Although, intensity of financial illiteracy is higher than that of academic

illiteracy, relative dispersion of financial illiteracy is lower than that of illiterate populations across the districts. We observe that in average 41.46 per cent households of the districts in West Bengal collect drinking water from unsafe source. Percentage of households having access to unsafe source of drinking water is highest in Darjeeling followed by Jalpaiguri and Purulia and it is lowest in South 24 Parganas district. There is a wide variation across the districts in terms of access to safe source of drinking water. Average percentage of households without improved sanitation facility in the districts of West Bengal is 46.22 per cent. We have observed that 88 per cent of households in Purulia district, which is highest among the districts in West Bengal, do not have access to improved sanitation. Access to improved sanitation is the highest in the district of Kolkata. In average 11.16 per cent households of the districts in West Bengal live in dilapidated house. It varies from 2.6 per cent to 16.6 per cent across the districts. In majority of the districts more than half of the households have no electricity or solar energy for lighting.

It is saddening that 82 per cent households of the districts in West Bengal have no access to improved fuel for cooking which ranges from 33 to 94 per cent. However, only 23 per cent households in average of the districts have no census assets. Thus poverty in terms of asset holding is not so serious in the districts of West Bengal. Therefore, from the analysis of individual indicator is it not sufficient to determine the relative position of the districts. We need a comprehensive index which covers multiple

Table 2: Description of the indicators of Deprivations in the districts of West Bengal

Indicators(%) /Index	Mean	Median	S D	CV	Skew	Max	Min
Illiterate population	25.14	25.03	8.05	32.04	0.34	40.93	12.98
Households having no access to banking facility	52.90	57.00	13.56	25.63	-0.44	73.50	16.20
Households use unsafe source of drinking water	14.46	8.20	15.67	108.34	2.03	60.10	2.60
Households have no improved sanitation facility	46.22	44.30	24.60	53.23	0.02	88.20	5.10
Households live in dilapidated residence	11.16	11.40	3.45	30.95	-0.74	16.60	2.60
Households have no access to electricity or solar power for lighting	46.59	50.60	19.18	41.16	-0.74	71.70	2.20
Households use dirty fuel for cooking	82.52	90.30	15.79	19.13	-0.83	94.30	33.80
Households do not have census asset	23.41	23.40	8.39	35.82	-1.93	36.30	3.60
HDI	0.58	0.60	0.09	14.94	0.33	0.78	0.45
MDI	0.42	0.46	0.17	39.80	-0.68	0.68	0.013

Source: *Authors' computation.*

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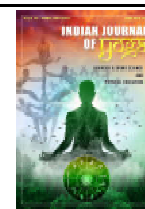
Discussion

THE IMPACT OF RECREATIONAL GAMES IN OUR SOCIETY

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A R T I C L E   I N F O

A B S T R A C T

Recreational Games are these activities where the primary purpose of the activity in participation, with related goals of improved physical fitness, for and social involvement often prominent. It is less stressful, both physically nd mentally on the participants. These are lower expectations regarding both performance and commitment to the sports in the recreational games in one of the most important area and it also create positive inter-relationship to every person. Recreational games are often done for enjoyment, amusement or pleasure and are considered to be 'fun'. In our busy schedule, recreational games gives us oxygen and in this way our new generation can explore many things for the development of society.

Introduction

The significance of the saying has increased many and various side in today's fast life and competitive world where students are forced by both their guardians and the conglomerate of society and situations as a whole to devote increasing hours in academic study whether theoretical or practical and knowledge enhancing activities, so that they can stay ahead in the rat race. Add to that the present way of life where people mostly stay in small nuclear families and with parents working the viability of our own home as a pace where we can have recreational time has diminished.

Recreation and Recreational Games

Recreation is the refreshment of strength and spirit after wine. It is also leisure time activity. The "need to do something for recreation", is an essential element of human biology and psychology when we continue doing a work or performing an activity regularly and continuously for some hours, it gives us physical and mental fatigue and strain. Recreational activity relieves us of the feeling of fatigue, restores our energy and

promote a sense of joy. Without recreation, life would be dull and miserable. Leisure activities mood, reduce stress and enhance a sense of wellness. In an increasingly complex world, more and more people are placing a high value on achieving the feelings of relaxation and peacefulness that contact with nature, recreation and exposure to natural open spaces bring. Recreational game involves participants in which the main function in providing fun and entertainment to participant. Recreational is a source of joy and provide relaxation for one's body and mind. Recreational games playing a very important role for all over age groups. The quality of life is determined with objective factors and also with subjective perception of factors which influence human life. Recreational actively play a very important role in subjective well-being because they provide opportunities to meet life values and needs. Through participation in leisure activities people build social relationships, feel positive emotions, acquire additional skills and knowledge and therefore improve their quality of live. Both physical & psychological benefits of leisure times with reduced level of stress, anxiety and depression,

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improved mood and higher levels of positive emotions. Engaging in recreational activities can also lower blood pressure and heartbeat. It can improve the mental health of individuals and have the significance of regulating the body and mind, alleviating the stress of life and providing a pleasant experience. It encourages people to experience freedom, which often leads to feeling of control, competence and improved self-esteem. Engaging in pleasurable activities stimulate the production of neuro-chemicals that in turn improve physical health.

Physical Activity and Recreational Games

Exercise is a body activity than enhances or maintains physical fitness and overall health and wellness. It is performed for various reasons, to aid growth improve strength, develop muscles and the cardiovascular system, weigh loss or maintenance, improve health or simply for enjoyment. Recreational game takes most important place in our present and future life. We all know that leading an active life style in good for us. If you participate regular moderate physical activity – running, jumping, throwing, walking you can expect to enjoy numerous health & social benefits, including:

- Encourage social inter-relationship
- Improve concentration and learning
- Increase personal confidence and self-awareness
- Reduce feelings of depression and anxiety
- Enhance self-esteem
- Improve quality of life
- Improve a more positive educational environment
- Reduction of antisocial behavior

Those who are engaging different types of physical activity and recreational games, they have less time to enjoy the negative or unnecessary situation. All time they think the positive effects of society and try to increase the awareness of different types of values in human mind. Recreational games are developing a good mental attitude, which is very much essential in our positive thinking. Emotion, both happy and sad, can effect cognitive functionary along with your energy level and other aspects of your physical performance. On the other hand recreational game improves the life skill such as:

- Focus and self-control
- Critical thinking and problem solving
- Empathy & perspective taking
- Patience and confidence
- Communication & listening
- Creativity and connecting ideas

It also helps in boosting memory as there is more practical experience and the information can be soaked up wholly by the brain in a fresher and fascinating.

Group games and individual games are also helps moral development of students. One way to encourage moral development to teach students to play fairly. In educational situation moral development plays an important role for the future endeavor of every human being.

It also enhances peer relationship and inter-personal skills. Student can also excel in areas other than academic where they have an interest. Recreational activity can give a chance to discover talents other than academic excellence which can tater help on the career and life as a whole.

Conclusion

Without any doubt it can be said that recreational activities help in overall development of a student's physical, mental, social and emotional. Recreational activity is not only helps to gather knowledge but also to use it ethically to lead a healthy and better life in future. It teaches one to think with reason and line with more practical approach to life. It also enhances ones all round development, thus helping to achieve success in on endeavours.

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ROCK PEBBLES

A Peer-Reviewed Journal of
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Gandhi, Ambedkar and Martin Luther King Junior: Three Pilgrims of Social Justice

Anand Mahanand

It is interesting to note that though the twentieth century witnessed the rise of two prominent dictators, Hitler and Mussolini, who ruthlessly suppressed their targeted people; it also   gave rise to many committed leaders who fought selflessly for the emancipation of different oppressed communities. M.K. Gandhi, Dr B.R. Ambedkar and Martin Luther King Jr are good examples of these saviours. Gandhiji fought for the freedom of the Indian people and also for the emancipation of the dalits in India. Ambedkar struggled for the upliftment of the untouchables of India and Martin Luther King jr fought for the rights of the Negros in the U.S.A. Gandhiji's guiding force was the Bhagavad Gita, Ambedkar drew inspiration from Buddhism whereas Martin Luther King Jr was inspired by Christianity. Martin Luther King however was deeply inspired by Gandhiji. Ambedkar on the other hand was a critic of Gandhiji's approach to the dalits. The reason for Ambedkar's difference with Gandhiji's ideals was due to their convictions. Both Gandhiji and Ambedkar had love and concerns for the dalits but each of them had different approaches for their freedom. Gandhi believed in the goodness of hearts of human beings. He thought the oppression of the dalits would end when people listened to their conscience whereas Ambedkar was not sure of that but was convinced that laws made in favour of the oppressed would safeguard them. Gandhiji, Ambedkar and Martin Luther King all followed the path of non-violence in their respective struggles. For the title, I have taken the phrase from King's essay "Pilgrimage to Non-violence" and called these three crusaders pilgrims of non-violence. One finds a lot of similarities as well as differences among these three. In this paper, I would like to study the select writings and speeches of these leaders and explore some of the common grounds of leadership in them. I would also like to study the difference in their approach. This will hopefully help in understanding the life, ideas and activities of these three great leaders.

Keywords: Gandhiji, Ambedkar, Martin Luther King Junior, emancipation, oppression, freedom

Dr. B.R. Ambedkar: A Champion of Human Rights

Saroj Kumar Sarkar

Babasaheb Dr. B.R. Ambedkar, the Chief Architect of Indian Constitution was a scholar par excellence, a philosopher, a visionary, and a true champion of human rights. He led a number of social movements to secure human rights for the oppressed sections of Indian society. He stands as a symbol of struggle for social justice even today.

Hinduism is divided into four Varna and so many castes and sub-castes. Casteism, for hundreds of years has been a crucial problem in Indian society. It not only creates social discrimination, but brings social and economic injustice among the citizens as well. Though the very notion of *ChaturVarna* has been referred in the Rigveda but afterwards more than three thousand castes and sub-castes have come into existence after the Later Vedic Period. The Brahmin community who were educationally and economically superior to the other communities took the advantage to exploit and oppress the lower communities in course of time. The notion of Varna and caste gave birth to untouchability which is a great damnation to humanity. Dr. B.R. Ambedkar being a Dalit was victimized throughout his life by the upper caste Hindus in several times. So he fought against caste-system and Untouchability. He wanted abolition of social discrimination, torture and disgrace of Dalit. He also wanted to bring social justice in our society. His main aim was to establish equality, liberty and fraternity among the citizens of our country. He was a real humanist and social reformer, a champion of human rights.

Keywords: Human rights, Social justice, Casteism, Untouchables, Humanist

Introduction:

Bhimrao Ramji Ambedkar was born in a Mahar family on 14th April, 1891. His father served in the British Indian Army at the Mhow cantonment in Central Province. Unlike most of the children of his caste, young Bhim used to go to school

scheduled caste, scheduled tribes and backward caste. He made several provisions in the form of articles in Indian constitution for development and upliftment of depressed caste.

Poona Pact and Dalits' Rights.

In 1932, British Govt. announced the formation of a separate electorate for "Depressed Classes" in the Communal Award. Gandhi fiercely opposed a separate electorate for untouchables, saying he feared that such an arrangement would divide the Hindu community. Gandhi protested by fasting while imprisoned in the Yerwada Central Jail of Poona. Following the fast, Congress politicians and activists such as Madan Mohan Malaviya and Palwankar Baloo organized joint meetings with Ambedkar and his supporters at Yerwada. On 25 September 1932, the agreement known as Poona Pact was signed between Ambedkar (on behalf of the depressed classes among Hindus) and Madan Mohan Malaviya (on behalf of the other Hindus). The agreement gave reserved seats for the depressed classes in the Provisional legislatures, within the general electorate. Due to the pact, the depressed class received 148 seats in the legislature, instead of the 71 as allocated in the Communal Award earlier proposed by British Prime Minister Ramsay MacDonald. The text uses the term "Depressed Classes" to denote Untouchables among Hindus who were later called Scheduled Castes and Scheduled Tribes under India Act 1935, and the later Indian Constitution of 1950. In the Poona Pact, a unified electorate was formed in principle, but primary and secondary elections allowed Untouchables to choose their own candidates.[6]

Theory of Social justice and B.R. Ambedkar

Social justice means equal social opportunities available to everyone to develop their personalities associated with equality and social rights. According to Oxford Concise Dictionary of Politics, Social Justice is an emphasis on the foundational character of justice of social life. According to Ambedkar the root cause of social injustice to the Scheduled caste and scheduled tribes is the caste system in Hindu society. He did not propound any specific definition or theory of 'Social Justice'. His thoughts are expressed through writings and speeches published posthumously. We can extract basic principles of writings and speeches of Ambedkar, through which justice can be dispensed in the society. These are:

1. Establishing a society where individual becomes the means of all social purposes

2. Establishing a society, based on equality, liberty, and fraternity

3. Establishing political, economic, and social democracy

4. Establishing democracy through constitutional measures and

5. Establishing democracy by breaking monopoly of upper strata on political power.[7]

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RESEARCH

An exact algebraic solution of two harmonic modes coupled through the angular momentum

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Abstract

Starting from the Hamiltonian of two oscillators coupled through the angular momentum, we obtain the equations of motion involving the field operators for two harmonic modes. These operator differential equations of motions are found coupled to each other. The noncommuting nature of the operators are on the way for getting the exact analytical solution directly. To get rid of these problems and on the basis of physical and mathematical considerations, the solutions are assumed in terms of some constant (independent of time) coefficients. The coupled differential equations involving these coefficients are finally decoupled at the cost of fourth order differential equations. Finally, we obtain the exact analytical solutions of these coefficients and hence the field operators involving the oscillators. As an application of these solutions, we investigate the well known squeezing effects of the input coherent light interacting with the oscillators coupled through the angular momentum. It is to be remembered that we retain the nonconserving energy terms for investigating the dynamical behaviour of the oscillators coupled through the angular momentum.

1 Introduction

To explain the basic physics behind the natural phenomena, we rely on some basic models. For example, the model of a harmonic oscillator arises when a particle moves under the action of a restoring force. Perhaps the model of a harmonic oscillator is the most useful one among the physical models for the explanation of basic physics. It is because of that the model of harmonic oscillator finds huge applications in various branches of physics. These include mechanics, spectroscopy, field theory and in the acoustics. On the other hand, we know that the real physical problems demand more beyond the model of a simple harmonic oscillator. For example, the inclusion of damping and the anharmonicities make the model of the harmonic oscillator more realistic and relevant to the physical problems. In addition to these, the demand of the physical situations are met through the model of coupled oscillators. The problem of coupled harmonic oscillators are investigated in a great way [1–19]. We find few investigation, where the coupling between the anharmonic oscillators is also studied [13–15]. The wide range of applications of the model of the coupled harmonic oscillators have attracted Physicists, chemists, mathematician and engineers. The coupled classical oscillators are useful in the studies of coupled vibrations, beats, and resonances. The infrared optical activities of dimer-like molecules are estimated by using the coupled oscillator model which is not otherwise unavailable through the usual infrared spectroscopy [1]. The coupled oscillator model is found useful for investigating quantum statistical properties of radiation field [2], coherent state propagator [3], non invariance group of many particle system [4], nonadiabatic Berry's phase, quantum entanglement and quantum teleportation [5], quantum phase [6], and in the Josephson tunneling [7]. Now, depending upon the strength of the coupling we categorize

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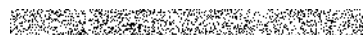
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$$\lambda_1 = \frac{1}{2}\left[\sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\kappa_1^2 - 2\kappa_2^2\right) + \sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\kappa_1^2 - 2\kappa_2^2\right)^2 - 4\left\{\left(\Omega_1\Omega_2 + \kappa_1^2 - \kappa_2^2\right)^2 - 4\kappa_1^2\Omega_1\Omega_2\right\}}}\right]$$

(18)

$$\lambda_2 = \frac{1}{2}\left[\sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\kappa_1^2 - 2\kappa_2^2\right) - \sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\kappa_1^2 - 2\kappa_2^2\right)^2 - 4\left\{\left(\Omega_1\Omega_2 + \kappa_1^2 - \kappa_2^2\right)^2 - 4\kappa_1^2\Omega_1\Omega_2\right\}}}\right]$$

By putting the value of λ_i, the Eq. (18) assume the following forms

$$\lambda_1 = \frac{1}{2}\left[\sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\xi^2\right) + \sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\xi^2\right)^2 - 4\left\{\left(\Omega_1\Omega_2 + \xi^2\right)^2 - \xi^2\left(\Omega_1 + \Omega_2\right)^2\right\}}}\right]$$

(19)

$$\lambda_2 = \frac{1}{2}\left[\sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\xi^2\right) - \sqrt{\left(\Omega_1^2 + \Omega_2^2 + 2\xi^2\right)^2 - 4\left\{\left(\Omega_1\Omega_2 + \xi^2\right)^2 - \xi^2\left(\Omega_1 + \Omega_2\right)^2\right\}}}\right]$$

Now, the solutions of the parameter u_i are quite straightforward and are given by

$$u_i = A_i \cos\lambda_1 t + B_i \sin\lambda_1 t + C_i \cos\lambda_2 t + D_i \sin\lambda_2 t \quad (20)$$

where $i = 1, 2, 3$ and 4. Now, the explicit analytical expressions for the parameter A_i, B_i, C_i, and D_i follow immediately

$$A_1 = \frac{\xi^2 + \Omega_1^2 - \lambda_2^2}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_1 = -\frac{\ddot{u}_1(0) - i\Omega_1\lambda_2^2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_1 = -\frac{\xi^2 + \Omega_1^2 - \lambda_1^2}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_1 = \frac{\ddot{u}_1(0) - i\Omega_1\lambda_1^2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_2 = -\frac{i\kappa_1\left(\Omega_1 + \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_2 = \frac{\ddot{u}_2(0) - \kappa_1\lambda_1^2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_2 = \frac{i\kappa_1\left(\Omega_1 + \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_2 = -\frac{\ddot{u}_2(0) - \kappa_1\lambda_2^2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_3 = 0, \quad B_3 = -\frac{2i\kappa_1\kappa_2\Omega_2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_3 = 0, \quad D_3 = \frac{2i\kappa_1\kappa_2\Omega_2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_4 = \frac{i\kappa_2\left(\Omega_1 - \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_4 = -\frac{\ddot{u}_4(0) + \lambda_2^2\kappa_2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_4 = -\frac{i\kappa_2\left(\Omega_1 - \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_4 = \frac{\ddot{u}_4(0) + \lambda_1^2\kappa_2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

(21)

In an identical manner, the solutions for v_i are obtained and are given by

$$v_i = A_i' \cos\lambda_1 t + B_i' \sin\lambda_1 t + C_i' \cos\lambda_2 t + D_i' \sin\lambda_2 t \quad (22)$$

where

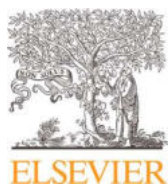$$A_1' = \frac{i\kappa_1\left(\Omega_1 + \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_1' = -\frac{\ddot{v}_1(0) + \kappa_1\lambda_2^2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_1' = -\frac{i\kappa_1\left(\Omega_1 + \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_1' = \frac{\ddot{v}_1(0) + \kappa_1\lambda_1^2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_2' = \frac{\xi^2 + \Omega_2^2 - \lambda_2^2}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_2' = -\frac{\ddot{v}_3(0) - i\Omega_2\lambda_2^2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_2' = -\frac{\xi^2 + \Omega_2^2 - \lambda_1^2}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_2' = \frac{\ddot{v}_3(0) - i\Omega_2\lambda_1^2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_3' = -\frac{i\kappa_2\left(\Omega_1 - \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad B_3' = -\frac{\ddot{v}_3(0) + \kappa_2\lambda_2^2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_3' = \frac{i\kappa_2\left(\Omega_1 - \Omega_2\right)}{\left(\lambda_1^2 - \lambda_2^2\right)}, \quad D_3' = \frac{\ddot{v}_3(0) + \kappa_2\lambda_1^2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$A_4' = 0, \quad B_4' = \frac{2i\Omega_1\kappa_1\kappa_2}{\lambda_1\left(\lambda_1^2 - \lambda_2^2\right)}$$

$$C_4' = 0, \quad D_4' = -\frac{2i\Omega_1\kappa_1\kappa_2}{\lambda_2\left(\lambda_1^2 - \lambda_2^2\right)}$$

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ELSEVIER

Full Length Article

In silico targeting of lipoxygenase, CYP2C9, and NAD(P)H oxidase by major green tea polyphenols to subvert oxidative stress

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ARTICLE INFO

ABSTRACT

Oxidative stress (OS) is a phenomenon caused by an imbalance between free-radical production and antioxidant activity within the body. Status of endogenous antioxidants is not always sufficient to mitigate the oxidative damage. In this case, exogenous antioxidants could help to minimize free-radical production and subsequent OS. Green tea is rich in several phenolic compounds that have strong antioxidant properties. However, their mechanism of action is still unclear. Hence, the present study aims to investigate binding affinities of six green tea polyphenols such as catechin, epicatechin, epicatechin gallate, epigallocatechin, epigallocatechin gallate, and gallocatechin for common ROS producers such as Lipoxygenase (LOX), CYP2C9, and NAD(P)H oxidase (NOX). Results indicated that polyphenols interacted with binding pockets of these enzymes through hydrogen bonds and other stable interactions such as van der waals, Pi-Pi, Pi-alkyl, and alkyl. All polyphenols showed varied binding affinities. Among them, epigallocatechin gallate and epigallocatechin showed the highest binding affinities for the ROS producers. Findings of the present study suggest that, apart from free radical scavenging activity, green tea polyphenols may directly interact with binding pockets of LOX, CYP2C9, and NOX to dampen ROS production and OS. However, studies involving animal models are required for additional validation of results.

1. Introduction

Oxidative stress (OS) is an imbalance between oxidant and antioxidant molecules in a biological system. Such an imbalance can be detrimental to various essential macromolecules like proteins, lipids, and nucleic acids with respect to their structure and biological functions. The role of OS is inevitable in the pathophysiology of human beings. Oxidants injure cells in several ways, contributing to various diseases, including atherosclerosis, chronic obstructive pulmonary disease (COPD), Alzheimer's disease, and cancer [1].

Oxidant-antioxidant imbalance is triggered by the disproportionate production of reactive species derived from oxygen and nitrogen. Production of these species is aggravated by stress, UV radiations, exposure to xenobiotics, infections, and pathological conditions [2–14]. Antioxidants may neutralize free radicals and prevent OS [15,16]. Nonetheless, scavenging superoxide radicals ($O_2^{\bullet-}$), hydroxyl radicals ($^{\bullet}OH$), perox-

ynitrite ($ONOO^-$), nitric oxide ($^{\bullet}NO$), and the hypohalous acids (HOX) by exogenous small molecules may not be enough if the source is not being targeted. Various enzymes have been considered as the sources of reactive species. Among them, Lipoxygenase (LOX), Cytochrome P450 (CYP2C9) and NAD(P)H Oxidase (NOX) are the sounding ones.

Lipoxygenase is a family of non-heme iron-containing enzyme that catalyses formation of hydroperoxides via oxidation of polyunsaturated fatty acids (PUFA) [17]. These enzymes are 700 amino acid long and classified into 5(S)-, 8(S)-, 12(S)-, and 15(S)-. Metabolites of PUFA profoundly impact the progression of inflammation and cancer. Therefore inhibition of PUFA metabolizing enzymes such as LOX could have therapeutic implications against such diseases.

Cytochrome P450 is a diverse group of enzymes that catalyzes oxidation–reduction reactions. They are involved in the biotransformation of various drugs and xenobiotics via phase I reactions. Therefore CYP450 plays a vital role in maintaining human physiology [18]. It is to
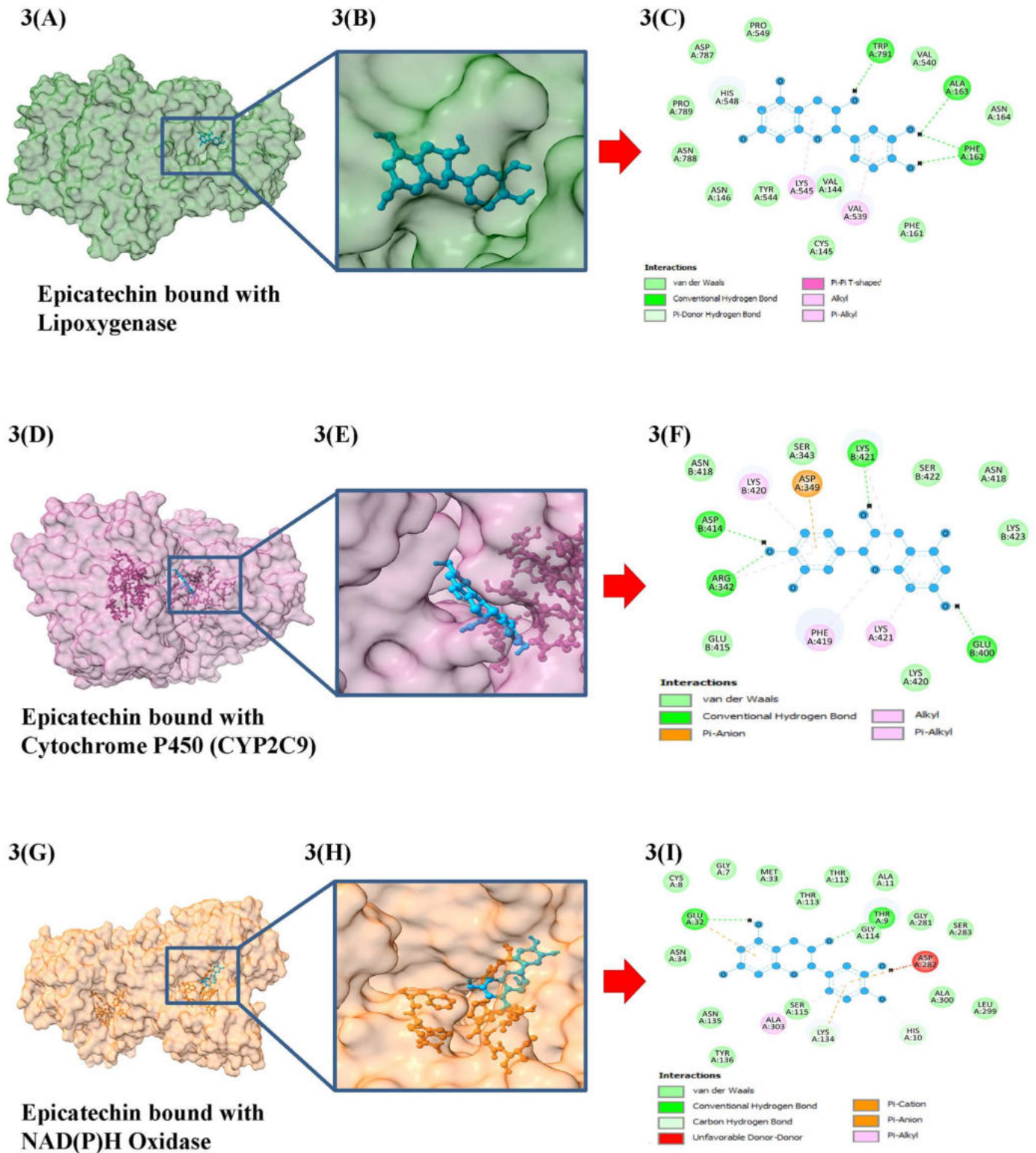

Fig. 3. Interaction between epicatechin and ROS producing enzymes. Epicatechin interacted with the binding pockets of LOX, CYP2C9, and NOX using hydrogen and various hydrophobic interactions. The first panel of the figure indicates the position where green tea polyphenol binds with the enzyme. The middle panel shows the enlarged view of the binding pocket where polyphenol interacted with the concerned enzyme. The last panel demonstrates the amino acids of ROS generating enzymes that established hydrogen and various hydrophobic interactions.

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Bizarre Insect (Order: Strepsiptera; Kirby, 1813) with a unique biology

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Abstract
Strepsiptera comprise a group of inquisitive, obligate endoparasitoids. The parasitoids of Strepsiptera are enthralling insects, whose neotenic females completely endoparasitoid, laying eggs in or on other insects while free-living adult males with a very short lifespan. They are widespread in most terrestrial ecosystems and exhibit vast ecological and biological diversity with many specific types of adaptations. The insects termed as macrynobiont refers for lengthening the life of the host. Since some of the hosts are pests of crops like, rice, corn, oil palm, areca nuts, coconuts mangoes etc. they have the effectiveness for use as biocontrol agents.

Keywords: strepsiptera, endoparasitoid, macrynobiont

Introduction
The Strepsiptera (Greek strepsi, "twisted"; pteron, "wing") commonly known as "stylops" encompass a group of entomophagous, obligate endoparasitoids with very unique morphology, biology, genetics and host–parasitoid relationship. They are cosmopolitan in distribution; largest numbers of species have been reported from the Australasian realm followed by the Oriental region. Owing to the endoparasitic life, the parasitoids are not easily noticed and remain an enigma to the entomologists. The males comprises unique hind wings with simple pattern of wing venation, fore wing reduced to look like a club like appendages termed as pseudohaltere, legs, rasp berry like eyes and flabellate antennae, superficially similar to flies, even though their mouths are not used for food, instead they are modified into sensory structures. They are non feeder, short–lived, usually surviving two to four hours. The male copulatory organ or aedaegus is minute and unique according to the different families of the order. Neotenic female except family Mengenillidae remains inside the host and completely endoparasitoid. Adult females are neotenic endoparasite projected inside a host body (rather than typical adult insects), 2–5 mm in length and without antennae, mouthparts, eyes, wings, legs and external genitalia. The cephalothorax encompasses of fused head, prothorax and mesothorax that obtruded through the host's synovial membrane, leaving the female's abdominal part inside the host's body [6]. Virgin females are said to discharge a pheromone from the Nassonow organ which the male employments to find them with the help of the Hofender's organ.
The families of Strepsiptera that are widespread in distribution are: Corioxenidae, Elenchidae, Halictophagidae and Stylopidae. The genera of parasitoids are restricted to the prevalence of the distribution of the hosts though the hosts in most cases are more widely distributed biogeographically than the parasitoids. Approximately 646 species [15, 16, 17, 18]. They are Corioxenos Blair, 1936; Dundoxenos Luna de Carvalho, 1956; Trizocera Pierce, 1909; Viridipromontorius Luna de Carvalho, 1985; Coriophagus Kinzelbach, 1971a; Halictophagus Curtis, 1832; Tridactylophagus Subramanian, 1932; Elenchus

Curtis, 1831; Myrmecolax Westwood, 1861; Lychnocolax Bohart, 1951; Stichotrema Hofeneder, 1910a; Paraxenos Saunders, 1872 and Pseudoxenos Saunders, 1872.

Methods used for observation
The insects were completely inspected under a zoom stereoscopic trinocular magnifying instrument (demonstrate Olympus SZX16, Japan and CARL ZEISS Stemmi 2000–C, Germany) for discovery of outward injuries or patches showing 'stylopisation' on the both sides of host abdomen. Such host insects were sacrificed with two fine needles in insect saline water (0.67%) for procuring male adults and different larval stages, pupae, and gravid females with eggs or with triungulins. They come out from abdomen with a slight pressure in the saline water.

Biology
They have displayed one of the foremost unconventional and complex life cycles with extraordinary sexual dimorphism. The free living males have unique hind wing with least venation and the fore wing reduced to form pseudohaltere. The males also have legs, eyes, and flabellate antennae externally comparable to flies, in spite of the fact that their mouthparts are not utilized for nourishing, or maybe they are altered as tactile structures. They are short–lived, as a rule surviving two to four hours [4]. Females except family Mengenillidae remain inside the host. In most Strepsiptera the male pupates and extrudes while female extrudes and gets to be mature but some incidence where the male extrudes and pupates in fifth instar host nymph. These nymphs don't actually appear to signal the start of a molting cycle [6]. Premature host parasitized by male puparia eventually die due to fungal growth on empty puparia left after the adult males coming out [14]. Only the cephalothorax is visible from the outside (Fig-1); the rest of the cylindrical body remains inside the host and lacks all the features of an adult insect [3]. Males mate by disrupting the female's brood canal. Sperm exceeds through the opening of brood canal by a process known as hypodermic insemination [12]. Each female thus turns out many first instar larvae termed as triungulins that come out from the brood opening, which projects outside the host's body (Fig 2). These first instar

Discussion

Impacts of stylopisation were examined prior on Hymenoptera. The foremost noteworthy changes due to stylopisation are that male hymenoptera tends to take after ordinary females and the pollen basket is diminished in females and males show a marked development. The interchange of characters in stylopised host has been referred to as "intersexes" [13]. Like hymenoptera parasitized Delphacidae (Hemiptera) (Table-1) were also thought to be "intersexes" [10, 11]. Stylopisation is known to cause numerous recognizable morphological, behavioral, dispersal and physiological changes within the hosts, even

- Driving to the arrangement of intersexes by alteration of the genitalia.

The results of stylopisation incorporate changes in antennae, wings, facial colouration, pilosity, pollen collecting apparatus and length of the digestive tract.

- Stylopisation can too disable ovarian egg improvement, and cause lessening of egg number, essential, auxiliary and tertiary sexual characters and fertility of the host.
- Stylopised host insects frequently ended up less active and may gotten to be unfit of setting up nests within the case of a few Hymenoptera [20].

Although Strepsiptera is an endoparasite, it has a wide host range relative to its species abundance and requires a mobile host to complete its life cycle. Strepsiptera parasitizes a wide range of hosts belonging to the seventh order of insects. The most common host species are Hymenoptera and Hemiptera.

Table 1: Records of stylopised Hemipteran host in India.

Host	Family &subfamily	Position of stylopisation
Atkinsoniella opponens (Walker, 1851)	Cicadellidae	Stylopisation mark on 6th to 9th sternite segments. There was no stylopisation encountered in the tergite segment till now.
Exitianus nanus (Distant, 1908)	Cicadellidae	Only one stylopised host was observed. Stylopisation took place at the lateral portion of the 7th sternite.
Exitianus indicus (Distant, 1908)	Cicadellidae	Stylopisation mark was found at 7th to 8th sternite segments.
Cofana spectra (Distant, 1908)	Cicadellidae	Stylopisation marks were observed on two different locations. One type encountered at the 5th to 6th tergite segments, considered as a male stylops and another one was encountered at the 6th to 9th sternite segments, considered as female stylops. Both types of stylopisation marks noticed on 15 numbers of specimens.
Nilaparvata lugens (Stål, 1854)	Delphacidae	Only two stylopised BPH were observed. Both stylopisation were encountered at the 4th abdominal tergite.
Sogatella furcifera (Horváth, 1899)	Delphacidae	Stylopisation marks were observed on two different locations. One type encountered at the 6th to 8th tergite segments, considered as a male stylops and another one was encountered at the 6th to 9th sternite segments, considered as female stylops.

At the early stage of host development Strepsiptera are not very active but have a exclusive immune avoidance mechanism. They form a pupal bag in the host cuticle. Strepsiptera are accounted to exercise control over the population level of host insect pests. The rate of parasitism fluctuates from 10% to 65% depending on several factors including temperature, humidity, rainfall and locations. Strepsiptera have the potential to be successful bio-control specialists but it is very difficult to practical implementation due to their low searching ability. Still such a venture is already in progress in Papua New Guinea where the female Strepsiptera, *Stichotrema dallatorreanum* Hofeneder is being used as a biocontrol agent for the long-horned grasshopper *Segestidea novaeguineae* [19]. Various questions almost hereditary qualities, sex deciding instruments, host location, various host spectrum, and change of host physiology in this baffling arrange of bizarre insect order still stay unanswered. One key feature is that, when parasitized by Strepsiptera, the host's life cycle is lengthened as long as they require to mature. This difference between strepsipterans suggests a trichotomous hypothesis concerning insect parasitoids, and the term macrynobiont (*macryno,* "lengthen"; *bionts*, "life"), refer for lengthening the life of the host due to Strepsiptera [8].
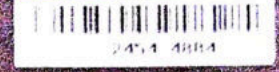
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সংশপ্তক

বিশেষ সংখ্যা

অসমের বাংলাসাহিত্য

এবং

অন্যান্য প্রবন্ধ

সম্পাদক
উত্তম দাস

মানবকল্যাণে শ্রীমদ্ভাগবত পুরাণের প্রাসঙ্গিকতা
ইন্দ্রাণী লাহা

সারসংক্ষেপ

এ জগতে ঈশ্বরসৃষ্ট সর্বশ্রেষ্ঠ জীব হল মানুষ। বহু বহু জন্মের পর দুর্লভ এই মনুষ্যজন্ম লাভ করে মানব জীবনের লক্ষ্য নির্ধারণ করা প্রত্যেকটি মানুষের প্রয়োজন। এবং সেই উদ্দেশ্য যেন যথার্থ মঙ্গল প্রদ হয়। এই পার্থিব জগতের ইন্দ্রিয় ভোগে আসক্ত হয়ে তাদের প্রকৃত উদ্দেশ্য ভুলে মায়ার কবলে কবলিত হয়ে ত্রিতাপ জ্বালা ভোগ করছে। এই প্রকৃত দুঃখের হাত থেকে মুক্তি দিতে পারে মহাজন নির্দেশিত পথ। বেদ পুরাণাদি বিভিন্ন ধর্মশাস্ত্র মানুষকে সঠিক দিশা দেখাতে পারে। মানবকল্যাণকারী এমনই এক গ্রন্থ হল শ্রীমদ্ভাগবত পুরাণ। মহর্ষি বেদ ব্যাস রচিত সংস্কৃত ভাষায় রচিত সর্বাঙ্গ বিভক্ত ১৮০০০ শ্লোক সমন্বিত এই গ্রন্থখানি। সমগ্র মানবসমাজকে যথার্থ আধ্যাত্মিক শিক্ষায় শিক্ষিত করে তুলতে পারে এই গ্রন্থখানি। পরম পুরুষ পরমেশ্বর ভগবান শ্রীকৃষ্ণের কথায় পরিপূর্ণ এই গ্রন্থখানি জীবের যাবতীয় শোক ও মোহ প্রশমিত করে। ভগবানে ভক্তিই জীবের একমাত্র কর্তব্য এবং তাঁর প্রতি ঐকান্তিক শরণাগতিই মানবজীবনকে সার্থক করে। মানুষের সাথে অন্যান্য জীবের পার্থক্য হল মানুষ উন্নতচেতনা সম্পন্ন জীব সে সমস্ত কিছু যুক্তি ও বুদ্ধি দিয়ে বিচার বিবেচন করে সিদ্ধান্ত গ্রহণ করে। তাই তারা যদি ধর্মাচরণে প্রবৃত্ত না হয়ে পশুর ন্যায় আহার, নিদ্রা, ভয়, মৈথুনেই রত হয়ে থাকে তাহলে পশুর সাথে তার প্রভেদ কোথায়? তাই মহাভারতে বলা হয়েছে —

"ধর্মেন হীনা পশুভিঃ সমানা।"

ভাগবতেও বলা হয়েছে সমস্ত মানুষের পরম ধর্ম হল অধোক্ষজ ভগবান শ্রীকৃষ্ণের প্রতি অহৈতুকী ভক্তি ও প্রীতি লাভ করা তাহলেই আত্মা যথার্থ প্রসন্নতা লাভ করবে।

বর্তমান কলিযুগের মানুষ হল স্বল্পায়ু, মন্দমতি, অলস, কলহপরায়ণ, নিরন্তর রোগব্যাধির দ্বারা জর্জরিত। কলিকাল দোষের সমুদ্র হলেও এর একটি মহৎ গুণ আছে তা হল হরিনাম সংকীর্তনের দ্বারাই ভগবানকে প্রসন্ন করা যায়। শ্রীচৈতন্য মহাপ্রভু এই কলিকালে আবির্ভূত হয়ে নিজে আচার ও প্রচার করে সমগ্র জগদ্বাসীকে শিক্ষা দিয়ে গেছেন। আজ সারা বিশ্বে এই ভাগবতধর্ম ব্যাপকভাবে প্রচারিত হচ্ছে। পাশ্চাত্যের ধনী দেশগুলিও মানসিক শান্তির খোঁজে ভারতবর্ষে এসে এই ভাগবত ধর্ম গ্রহণে ব্রতী হয়েছে। তাই আমরা যদি এই পুণ্যভূমি ভারতবর্ষে জন্মগ্রহণ করেও এই ধর্ম গ্রহণে ব্রতী না হই তাহলে তা আমাদেরই দুর্ভাগ্যের পরিচায়ক।

সূচক শব্দঃ ঈশ্বর, ধর্ম, মঙ্গল, মানবকল্যাণ, আত্মা, সাম্প্রদায়িক, ভক্তি, পরমাত্মা, প্রচারকার্য।

মূল প্রবন্ধ-

ভারতবর্ষ হল পুণ্যভূমি। সাধু মহাপুরুষগণের পবিত্র চরণরজে অভিষিক্ত এই ভূমি। আমাদের সৌভাগ্য যে আমরা ভারতবর্ষে জন্ম গ্রহণ করেছি। এই পবিত্রভূমিতে জন্মগ্রহণ করে আমরা যদি কল্যাণকর কর্মে যুক্ত হতে না পারি তাহলে সেটা আমাদেরই দুর্ভাগ্য। আধ্যাত্মিক সাম্যবাদ হল সমগ্র মানব সমাজের ঐক্য সাধন করা। এই আদর্শকে সফল করার কথা মহান চিন্তাশীল মানুষেরা উপলব্ধি করেছেন। আর এই কার্য সফল করার ক্ষেত্রে শ্রীমদ্ভাগবতের অবদান অনস্বীকার্য। সমগ্র মানব সমাজে শান্তি, সমৃদ্ধি ও মৈত্রীর প্রতিষ্ঠা করবে ভাগবতের এই অমূল্য বাণী।

মানুষ হল উন্নতচেতনা সম্পন্ন জীব। অন্যান্য প্রাণীদের সাথে মানুষের পার্থক্য হল মানুষ সব কিছু যুক্তি, বুদ্ধি দিয়ে বিচার বিবেচনা করে সিদ্ধান্তে উপনীত হয় কিন্তু অন্য প্রাণীরা তা পারে না। মানুষের মনেই প্রশ্ন জাগে আমি কে? এই জগতের

সৃষ্টি কর্তা কে? তাঁকে কি দেখা যায়? জগতে এত দুঃখ কেন? এই দুঃখের নিবৃতি কিভাবে হবে? ইত্যাদি নানা প্রশ্নের উত্তরের সন্ধানে সে অজানার উদ্দেশ্যে পাড়ি দেয়।

যুগে যুগে মহাপুরুষগণ তাদের সাধনালব্ধ জ্ঞানের দ্বারা মানুষকে সঠিক পথের নির্দেশ দিয়েছেন এবং শান্তির বাণী শুনিয়েছেন। শ্রীমদ্ভাগবত হল এমনই এক শাস্ত্রগ্রন্থ যা শুধু পারমার্থিক বিজ্ঞানই নয় পরন্তু মানুষের কর্তব্য ও ধর্ম সম্পর্কেও অবহিত করে।

ভাগবতের প্রথমেই শ্রীল ব্যাসদেব সেই পরমসত্যস্বরূপ পরমেশ্বরের ধ্যান করেছেন –

"ওঁ নমো ভগবতে বাসুদেবায়

জন্মাদ্যস্য যতোऽন্বয়াদিতরতশ্চার্থেষ্বভিজ্ঞঃ স্বরাট্

তেনে ব্রহ্ম হৃদা য আদিকবয়ে মুহ্যন্তি যৎ সূরয়ঃ।

তেজোবারিমৃদাং যথা বিনিময়ো যত্র ত্রিসর্গোऽমৃষা

ধাম্না স্বেন সদা নিরস্তকুহকং সত্যং পরং ধীমহি" ১।।

অর্থাৎ ভগবান শ্রীকৃষ্ণই যে আদি পুরুষ, পরমেশ্বর ভগবান তাঁর থেকেই সমস্ত কিছুর প্রকাশ। গীতাতেও ভগবান বলেছেন তাঁর থেকে মহৎ আর কিছু নেই। তিনিই জড় ও চেতন জগতের সমস্ত কিছুর উৎস স্বরূপ। এই তত্ত্ব যারা অবগত হয়ে শুদ্ধ ভক্তিসহ আমার ভজনা করেন। তিনিই হলেন যথার্থ জ্ঞানী।

"অহং সর্বস্য প্রভবো মত্তঃ সর্বং প্রবর্ততে।

ইতি মত্ত্বা ভজন্তে মাং বুধাভাবসমন্বিতাঃ" ২।।

ব্রহ্মসংহিতায় বলা হয়েছে —

"ঈশ্বরঃ পরমঃ কৃষ্ণঃ সচ্চিদানন্দ বিগ্রহঃ।

অনাদিরাদির্গোবিন্দঃ সর্বকারণকারণম্" ৩।।

অর্থাৎ সেই পরম পুরুষ শ্রীকৃষ্ণই হলেন আনন্দঘন আদি পুরুষ এবং তিনিই সর্ব কারণের কারণ স্বরূপ। ভগবান শ্রীকৃষ্ণের প্রতি অহৈতুকী ভক্তি উদিত হয় এই ভাগবত শ্রবণের ফলে এবং জীবের যাবতীয় শোক, মোহ, ভয় দূরীভূত হয়।

"যস্যাং বৈ শ্রূয়মানায়াং কৃষ্ণে পরমপুরুষে।

ভক্তিরুৎপদ্যতে পুংসঃ শোক-মোহ-ভয়াপহা" ৪।।

সুতরাং আমরা যদি সেই আদিপুরুষ গোবিন্দের ভজনা করি তাহলে আমাদের চিন্তার কিছু থাকবে না। এখন প্রশ্ন হল আমরা ভগবানের আরাধনা কেন করব? কারণ ভগবান হল আমাদের সচেয়ে বড় নিঃস্বার্থ বান্ধব। তিনি অন্তর্যামীরূপে প্রত্যেকটি জীব হৃদয়েই বাস করেন। তবে সকলেই যে তার আরাধনা করবে এমন নয় কারণ প্রত্যেকটি মানুষের চিত্তবৃত্তি ভিন্ন ভিন্ন। কিন্তু ত্রিতাপ জ্বালা থেকে মুক্তিলাভের এবং প্রকৃত সুখলাভ ভগবানের আরাধনা ব্যতীত অন্য কোন পথ নেই।

একদা সূতমুনি শৌণকাদি ঋষিগণের অনুরোধে জীবের প্রকৃত মঙ্গল কিসে হবে তর উত্তরে বললেন — এই কলিকালে সকল মানুষই প্রায় আসুরী স্বভাব সম্পন্ন, কলহপরায়ন, নিরন্তর রোগব্যাধিতে জর্জরিত। তাই তাদের মুক্তিলাভ একমাত্র ভগবান শ্রীকৃষ্ণের প্রতি একান্ত ভক্তি লাভেই সম্পন্ন হবে।

"স বৈ পুংসাং পরো ধর্মো যতো ভক্তিরধোক্ষজে।

অহৈতুক্যপ্রতিহতা যয়াত্মা সম্প্রসীদতি" ৫।।

এই দিব্যবাণী যদি আমরা নিজ জীবনে পালন করতে পারি তাহলে ধন্য হয়ে যাব। পাশ্চাত্যের ধনীদেশগুলি থেকেও মানুষ আজ ভারতবর্ষে এসে এই ভাগবত ধর্ম গ্রহণে ব্রতী হয়েছে। মহাপ্রভুর অনুগামী গৌড়ীয় বৈষ্ণব সম্প্রদায়ের সাধু ও সজ্জনগণ ব্যাপক ভাবে দেশে ও বিদেশে দিব্য হরিনাম প্রচার ও প্রসারে রত হয়েছেন শত বাধা অতিক্রম করে। তাই আমরা যারা নিজ মঙ্গলকামী তারা এই ভাগবদ্ ধর্মগ্রহণ ব্রতী হব। নিজেদের দেশের ও দশের কল্যাণে আমরা আন্তরিকভাবে প্রচেষ্টা করব, ঈশ্বরের কৃপায় সকলই সম্ভব।

তথ্যসূত্র

১) ভাঃ ১/১/১
২) ভঃগীঃ ১০/৮
৩) ব্রহ্মঃসঃ ৫/১
৪) ভাঃ ১/৭/৭
৫) ভাঃ ১/২/৬
৬) গীতা ৪/৭
৭) গীতা ৪/৮
৮) ভাঃ ১১/২০/৬
৯) ভাঃ ১১/৫/৩২
১০) ভাঃ ৫/১৯/২৮
১১) চৈঃ চঃ আদি ৯/৪১)

গ্রন্থপঞ্জী

১) ব্যাসদেব, শ্রীমদ্ভাগবত, গীতাপ্রেস গোরখপুর, ২০৪৩ বৈক্রমান্দ।

২) দীন ভক্তদাস, ভাগবত কথামৃত, অক্ষয় লাইব্রেরী, মাঘ ১৪২৫ সন, ইং- (ফেব্রুয়ারী ২০১৯)

৩) বন্দ্যোপাধ্যায় ধীরেন্দ্রনাথ, সংস্কৃত সাহিত্যের ইতিহাস, পশ্চিমবঙ্গ রাজ্যপুস্তক পর্ষৎ ১৯৮৮

৪) গোস্বামী শ্রী শ্রী জীব, ভক্তিসন্দর্ভ, কলকাতা বিশ্ববিদ্যালয় ১৯৬২।

৫) নাথ রাধাগোবিন্দ, চৈতন্যচরিতামৃতের ভূমিকা, ভক্তিগ্রন্থপ্রচার ভান্ডার, বালিগঞ্জ, কলকাতা, ১৩৫৫ বঙ্গাব্দ।

৬) দাস রাধেশ্যাম, ভগবদ্গীতার সারতত্ত্ব, ইসকন্, শ্রীমায়াপুর নদীয়া, ভক্তিবেদান্ত গীতা অ্যাকাডেমী, প্রথম সংস্করন ২০০৫।

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গবেষিকা সিকম্ স্কিলস্ ইউনিভার্সিটি , বোলপুর

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