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Editorial

NEP 2020: Conceptualizing and Rejuvenating Academic Research in Higher Education

National Education Policy 2020 *envisages* a comprehensive restructuring of Indian educational system with a vision of transforming India into a knowledge-based economy. It rightly admitted the fact that knowledge creation and a robust research ecosystem are most critical in growing and sustaining a large and vibrant economy, uplifting society, and continuously inspiring a nation to achieve even greater heights. In fact, academic research is an integral part of the higher education system in most knowledge societies. The rapid global changes in the field of environment, climate change, population dynamics, biotechnology, digital marketplace, machine learning and artificial intelligence also justifies the need of an effective and sustainable academic research environment in higher educational institutions. However, despite this critical importance of academic research, present investment of India in the field of research is only 0.69% of GDP as compared to 2.8% in USA, 4.3% in Israel and 4.2% in South Korea.

To provide a research ecosystem and promote quality academic research in higher educational institutions, NEP 2020 envisions the establishment of a National Research Foundation (NRF). The Foundation will be provided with an annual grant of Rs 20,000 crore (0.1% of GDP). NRF is the outcome of realisation that quality research and innovations are key to the economic growth of the nation. It aims at providing the required impetus to grow the R&D agenda by way of building a research ecosystem comprising the government, universities, research institutes and industry. The collaboration between academia and industry envisioned by the NEP calls for a patent policy structure at the HEI's level to facilitate more patent applications. Such a policy will safeguard interests of all the entities involved, provide for a research environment, and ensure compliance with the national laws and regulations. A larger number of patents with commercial benefits will serve as incentives for continuous and sustained efforts in research. According to the NEP, "the NRF will work towards seeding, funding, coordinating, and monitoring research and innovation initiatives." It will also encourage research through merit-based peer evaluation of research projects along with incentives like awards for outstanding work. In particular, the NRF will provide a reliable base of merit-based but equitable peer-reviewed research funding, helping to develop a culture of research in the country through suitable incentives for and recognition of outstanding research, and by undertaking major initiatives to seed and grow research at State Universities and other public institutions where research capability is currently limited. The NRF will competitively fund research in all disciplines. Successful research will be recognized, and where relevant, implemented through close linkages with governmental agencies as well as with industry and private/philanthropic organizations. Thus NEP 2020 aims at mitigating the gap between private, state and central universities by equal and uniform opportunities for research ecosystem in the whole country through National Research Foundation.

The thrust of the NEP-2020 is to transform cross-disciplinary research in Higher Education Institutions (HEIs) of India by creating knowledge hubs and a sustainable research eco-

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system. It emphasises a multidisciplinary approach in education and the need to nurture a curious and creative mind with a view to develop analytical and critical thinking abilities at an early age. These are the skills essential for identifying the problems and chalking out its best research plan so that it led to the required and relevant solutions of the same. This approach will, therefore, be instrumental in giving a meaningful thrust to research and innovation serving as yet another significant harbinger in the long-term and sustainable research endeavour for India. With this aim it recommends continuing with a two-year Master's programme, with the second year devoted totally to research and a four-year bachelor's programme with research (who will be eligible for a one-year master's programme and PhD).

It is high time for India to develop and nurture a robust research ecosystem for higher education that is in tune with societal needs and capable of responding to current and future challenges. NEP 2020 can be considered to be the greatest opportunity for transforming India into a powerful and enlightened knowledge society and a global leader in the field of research and innovation.

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Mutational analysis of severe acute respiratory syndrome coronavirus 2 spike (S) protein

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ABSTRACT

The severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is a newly emerged coronavirus responsible for coronavirus disease 2019 (COVID-19); it become a pandemic since March 2020 and is spreading rapidly to people across the globe. SARS-CoV-2 attaches to the host cell surface to initiate the interaction between the receptor-binding domain (RBD) of its spike glycoprotein (S) and the human Angiotensin-converting enzyme (hACE2) receptor. SARS-CoV-2 mutates frequently, which challenges the antiviral development. Mutations can cause viruses to better evade host's immune systems, treatments and vaccines. Analysis of mutation of spike protein of SARS-CoV-2 isolated from different countries is important to understand the biology and pathogenicity of virus. In this study, mutational analysis of SARS-CoV-2 structural spike (S) protein was done by downloading 1311 sequences with high coverage genome of SARS-CoV-2 using the GISAID database. Moreover, docking study of spike protein with human ACE2 was done to understand whether the mutation helps the protein to bind more efficiently and hence becomes potentially more infectious. Further study mutation hot-spots will be helpful in designing suitable drugs and other therapeutics for the treatment of SARS-CoV-2.

Keywords: SARS-CoV-2, COVID-19, Mutation, Structural spike (S) protein, GISAID database

INTRODUCTION

The emergence of rapidly spreading variants of SARS-CoV-2, the causative agent for COVID-19, threatens to prolong an already devastating pandemic. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is the newest member of *Coronaviridae* family. After the COVID-19 (SARS-COV-2) infection broke out suddenly in Wuhan, China, it had spread across more than 200 countries worldwide affecting 70,476,836 people and causing 1,599,922 deaths as of 15th December 2020 (https://covid19.who.int/). The World Health Organization (WHO) declared this as a public health emergency of international concern (PHEIC) on 30th January 2020 and a pandemic on 11th March. Till date 500,186,525 infections and 6,190,349 fatalities occurred due to this corona virus pandemic as per WHO record. SARS-CoV-2 has some genetic similarity with MERS CoV (Middle East Respiratory Syndrome Coronavirus) and SARS CoV (Severe Acute respiratory Syndrome Coronavirus). Although there are some resemblances, a detailed study of the proteins helps us understand their differences in pathogenicity (Mousavizadeh and Ghasemi, 2020).

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The genome of SARS-CoV-2 shares about 80% identity with that of SARS-CoV and is about 96% identical to the bat coronavirus BatCoV RaTG13 (Zhou *et al*., 2020). Coronaviruses are enveloped, non-segmented, positive sense single-stranded RNA virus genomes in the size ranging from 26-32 kb, the largest known viral RNA genome. The virion has a nucleocapsid composed of genomic RNA and phosphorylated nucleocapsid (N) protein, which is buried inside phospholipid bilayers and covered by two different types of spike proteins: the spike glycoprotein homotrimer (S) that can be found in all CoVs, and the hemagglutinin esterase (HE) that exists in some CoVs. The membrane (M) protein (a type III transmembrane glycoprotein) and the envelope (E) protein are located among the S proteins in the virus envelope.

Sarbecoviruses express a large (approximately 140 kDa) glycoprotein termed spike protein (S, a homotrimer), which mediates binding to host cells via interactions with the human receptor angiotensin converting enzyme 2 (ACE2) (Letko *et al*, 2020; Wrapp, 2020; Walls *et al*., 2020). Coronavirus entry into host cells is mediated by the transmembrane spike (S) glycoprotein that forms homotrimers protruding from the viral surface. The spike glycoprotein (S protein) on the virion surface mediates receptor recognition and membrane fusion. During viral infection, the trimeric S protein is cleaved into S1 and S2 subunits and S1 subunits are released in the transition to the postfusion conformation. S1 contains the receptor binding domain (RBD), which directly binds to the peptidase domain (PD) of angiotensin-converting enzyme 2 (ACE2), whereas S2 is responsible for membrane fusion. When S1 binds to the host receptor ACE2, another cleavage site on S2 is exposed and is cleaved by host proteases, a process that is critical for viral infection. The S protein is highly immunogenic with the receptor-binding domain (RBD) being the target of many neutralizing antibodies (Berry *et al*., 2010). Individuals infected with coronaviruses typically mount neutralizing antibodies and a neutralizing response has been demonstrated for SARS-CoV-2 in an individual case from day 9 onwards against spike protein (Huang *et al*., 2020; Haveri *et al*., 2020). Therefore, analysis of mutation of spike protein of SARS-CoV-2 isolated from different countries is important to understand the biology and pathogenicity of virus. As on 12th May 2020, more than 15000 whole genomes of SARS-CoV-2 isolated from different countries have been deposited in the GISAID database.

Generally, the potential vaccine candidates comprise of either inactivated or live attenuated or subunit viruses, or DNA or RNA vaccines. Mutation becomes a very important factor in determining the sustainability of a vaccine. High mutation rate of a virus or its proteins sometimes makes the vaccine less effective after a period of time. In this study, analysis of the mutations in SARS-CoV-2 structural spike (S) protein, the most important viral protein required for entry into host cells, was done and also try to understand the regions in its genome where mutation is playing an important role so that it may help us to understand the dynamics of its evolution and guide us in designing a sustainable vaccine.

MATERIALS AND METHODS

Retrieval and curation of SARS-CoV-2 full genome sequence of Indian isolates

1311 sequences have been downloaded with high coverage genome of SARS-CoV-2 on 17th February 2021 using the GISAID database (https://www.gisaid.org/). Different criteria were applied such as gene size mismatch, internal stop codons, deletion, and ambiguous nucleotides other than A/T/G/C to study substitution polymorphism in the genome. The SARS-CoV-2 isolate Wuhan-Hu-1 genome consisting of 29,903 bases have been used as reference genome (NC_045512.2). The coding region (CDS) of each gene that encodes for structural, nonstructural, and accessory proteins including the regions of untranslated (UTR) ends of the genome have been extracted and used as query sequence to perform local BLAST and the filtered

Table 1. Preparation of Consensus sequences

Strains	N1	N2	N3	N4	N5	N6	N7	N8
1	A	G	T	C	A	A	G	A
2	A	A	T	C	T	A	C	C
3	A	G	C	C	A	A	G	C
4	A	G	T	G	A	A	G	G
5	G	G	T	C	A	A	A	C
6	A	T	C	T	T	A	G	C
7	A	G	T	G	A	A	G	C
8	A	G	C	C	T	A	G	T
9	T	G	T	C	A	A	A	C
10	A	G	T	T	A	A	G	C
Count of A	8	1	0	0	7	10	2	1
Count of G	1	8	0	2	0	0	7	1
Count of C	0	0	3	6	0	0	1	7
Count of T	1	1	7	2	3	0	0	1
CON (Most frequent nucleotide)	A	G	T	C	A	A	G	C

Table 2. Strain wise analysis the number of mutations

Strains	N1	N2	N3	N4	N5	N6	N7	N8	No. of Mutations
CON	A	G	T	C	A	A	G	C	0
1	A	G	T	C	A	A	G	A	1
2	A	A	T	C	T	A	C	C	3
3	A	G	C	C	A	A	G	C	1
4	A	G	T	G	A	A	G	G	2
5	G	G	T	C	A	A	A	C	2
6	A	T	C	T	T	A	G	C	4
7	A	G	T	G	A	A	G	C	1
8	A	G	C	C	T	A	G	T	3
9	T	G	T	C	A	A	A	C	2
10	A	G	T	T	A	A	G	C	1

sequence of 1059 strains were finally retained out of 1311 strains. Filtration of sequence and polymorphism analysis was performed using several computer programs written in Python language. A procedure of finding a consensus sequence and inferring polymorphism employed in this study is provided as Table 1 & Table 2.

If random, transversions (purine–pyrimidine changes) should be observed twice as often as transitions (purine to purine or pyrimidine to pyrimidine changes) solely due to the accessible mutations. In the present study observed ratio of ti/tv was close to 1.3 to 1.4 across the coding regions of structural and accessory genes and ti/tv of 2.8 was observed for genes encoding nonstructural proteins. Previously it was reported that RNA virus polymerases incorporate transition mutations at a frequency of 10^{-5} and transversions mutations at a frequency of 10^{-6} to 10^{-7} and the structural basis for fidelity of nucleotide selection is understood best for the RdRP of Poliovirus (3Dpol) (Castro et al., 2005). In fact, a previous report showed that RNA-dependent RNA polymerase of Influenza virus can make fewer trans-

versions than transitions (Pauly and Lauring, 2015).

In this study, computational structural biology methods was used to analyze the role of mutations in the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) variant, and the infectivity and immune escape properties.

Molecular Docking study

The review and comparative assessment of sequences of S protein among available SARS-CoV-2 genomes in the GISAID database showed three major mutations viz., H49Y, D614G, and T573I. Multiple crystallized 3D structures of S protein can be found in the Protein Data Bank (PDB) (Walls *et al*., 2020). However, to capture conformational changes in the 3D atomistic model, it is necessary to perform molecular dynamics (MD) simulations (Sikora *et al*., 2020). To determine if the mutated S proteins could affect its 3D structure conformations, here MD simulations were employed for full length atomistic models of S protein 3D structure and its mutant D614G. Autodock 4.2 software was used for docking calculations and docking results were analyzed using Autodock Tools 1.5.6 (Morris *et al*., 2009).

RESULTS

Coronavirus entry into host cells is mediated by the transmembrane spike (S) glycoprotein that forms homotrimers protruding from the viral surface (Tortorici and Veesle, 2019). S protein comprises two functional subunits, responsible for binding to the host cell receptor (S1 subunit) and fusion of the viral and cellular membranes (S2 subunit). For many Coronaviruses, S is cleaved at the boundary between the S1 and S2 subunits, which remain non-covalently bound in the pre-fusion conformation. This region is reported to be the most potent and indispensable for viral attachment and entry into host system (Walls *et al*., 2020). The miss-sense mutations in S protein those it was found are mostly single point mutations with few double and triple mutations (Table 3).

Any alteration could impact the structural and functional conformation of the protein which makes it more infectious. Although the clinical significance of the observed mutations is not readily available, our findings in Indian patients lay the ground work for India to understand the impact of SARS-CoV2 mutations on disease severity, host immune response, vaccine development and serological response.

The Spike (S) glycoprotein helps the virus to attach with ACE2 (Angiotensin-converting enzyme 2) and TMPRSS2 (Transmembrane serine protease 2). It is of length 1273 amino acids. Mul-

Table 3. Mutational Analysis of India (25th July 2020 to 17th February 2021)

Months	0	1	2	3	4	5	6	Total strains
July(2020)	50	33	10	2	1	0	1	97
August(2020)	211	159	89	24	4	3	0	490
September(2020)	71	146	56	25	9	2	1	310
October(2020)	11	10	2	3	3	0	0	29
November(2020)	17	14	10	4	2	0	0	47
December(2020)	6	10	24	8	6	0	0	54
January(2021)	3	4	14	3	4	4	0	32

tiple sequence alignment of SARS-CoV-2 S-proteins revealed unique mutations. Total 1059 isolates showed at least one mutation in the S protein sequences (Table 2).

In this study, the docking results are incorporated to make a comparative study of the interaction energy between the host proteins and the SARS-CoV-2 viral proteins. That is to check whether the mutation helps the protein to bind more efficiently and hence becomes potentially more infectious. In this regard, the spike glycoprotein becomes the most important viral protein as it is involved in direct contact with the host ACE-2 receptor which helps the virus to enter the human cells. The 3-dimensional structures were searched for both the wild and mutated variety of the spike glycoprotein in the protein data bank. The crystal structure of the SARS-CoV-2 spike protein bound to the human ACE2 receptor (PDB code: 6M0J) and the structure of the human ACE2 receptor (PDB code: 1R42) were downloaded from the Protein Data Bank.

Though the 3-dimensional structure for wild spike protein was found, unfortunately the complete structure of the mutated D614G spike protein was unavailable. The only structure available lacked the receptor binding domain (PDB ID: 6XS6). Considering the fact that the receptor bind-ing domain in the spike protein plays the key role in the binding of human ACE-2 and viral spike protein, it was at first apprehensive that docking the ACE-2 with an incomplete spike protein will not give the correct results. Thus, the ultimate goal of comparison remains unfulfilled due to the lack of protein structures in the database. Although, there is incompleteness in the pdb files, the blind docking was performed and the docking structures of both wild type (WT) as well as mutated Spike protein (D614G) with human ACE2 are given below in **Figure 1**.

D614G showed a more compact cluster distribution than the other mutated proteins, suggesting a reduction in conformational mobility due to single residue mutation; additionally, it showed a dissimilar conformer distribution along the subspace in comparison to the others mutated proteins systems, this behavior suggests that the trajectory sampled different regions of the phase space with different minima and small energy barrier, in this sense, D614G mutant affects the structural behavior of the protein.

DISCUSSION

The SARS-CoV-2 infection caused over 271.9
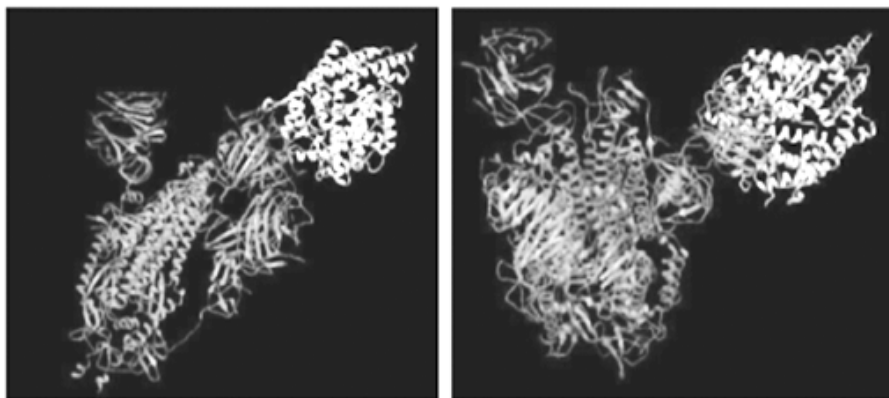
Figure 1. Docking Image of Spike Protein with human ACE2. Left image is of Wild Protein Docking and Right Image is of mutated protein (D614G spike protein) docking.

million confirmed cases of Coronavirus Disease 2019 (COVID-19), including over 5.3 million deaths. Despite mitigating efforts across the world, emerging variants continue to threaten the health of individuals, burden healthcare support, and destabilize the economy.

A significant mutation is observed in the Spike glycoprotein at position 614, where an aspartic acid (polar) is changed to a glycine (nonpolar). The mutation is in fact destabilizing the native spike protein (having both the S1–S2 domains) which may eventually influence its cleavage. This mutation lies close to the S1–S2 junction of the spike protein and it was found out that the point mutation has developed an additional cleavage site for elastase 2. From previous studies on coronavirus, it has been found that proteolysis at several points of the spike glycoprotein is essential for its entry inside the cell (Belouzard *et al*., 2009). So, it can be concluded from the data that the generation of a novel protease site at the vicinity of the S1–S2 junction has helped the virus enter the host cell more efficiently. This indicates that the mutated protein may be increasing the potential of the virus to attach with host receptors and undergo cleavage.
The genome of SARS-CoV-2 for mutations prevalent around the world was surveyed. From this study it can be stated that mutations in the proteins of SARS-CoV-2 are slow yet steady. It was also observed how the wild and mutated spike proteins tussled with each other and ultimately the mutated protein became more widespread.

The spike protein amino acid change D614G was noted to be increasing in frequency in April 2020 and to have emerged several times in the global SARS-CoV-2 population, and the coding sequence exhibits a high dN/dS ratio, suggesting positive selection at the codon position 614 (Korber, B. *et al*, 2020).Subsequent studies indicated that D614G confers a moderate advantage for infectivity (Hou *et al*, 2020; Yurkovetskiy *et al*, 2020) and transmissibility (Volz, E. *et al*, 2020). Several other spike mutations of note have now arisen. The extent to which mutations affecting the antigenic phenotype of SARS-CoV-2 will enable variants to circumvent immunity conferred by natural infection or vaccination remains to be determined. However, there is growing evidence that mutations that change the antigenic phenotype of SARS- CoV-2 are circulating and affect immune recognition to a degree that requires immediate attention. Consequently, mutations that affect the antigenicity of the spike protein are of particular importance. Prediction of the mutational pathways by which a virus such as SARS-CoV-2 will evolve is extremely challenging. Nonetheless, there is a rapidly expanding knowledge base regarding the effect of SARS-CoV-2 spike mutations on antigenicity and other aspects of virus biology. The integration of these data and emerging SARS-CoV-2 sequences has the potential to facilitate the automated detection of potential variants of concern at low frequency that is, before they are spreading widely.

CONCLUSION

A thorough study of the mutations that have occurred in various proteins encoded by the SARS-CoV-2 genome can also help researchers and medical personnel in designing suitable drugs and other therapeutics. Designing alternative vaccine strategies like peptide vaccines and mRNA vaccine can be boosted by this study as targeting the conserved regions of the proteins can only be done if one has sound knowledge regarding the mutation hot-spots. Computer-aided drug designing can also be improved with the help of this study. Further advanced study correlating COVID-19 symptoms with subtle mutational changes will be helpful for us to understand the virus better.

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Exploration of Traditional Medicinal Plants Used by the Mishing Community of Sonitpur, Assam for the management of Dysmenorrhea

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ABSTRACT

A vast majority of the developing world still depends on traditional medicines for the treatment of the common ailments. Open discussions about the reproductive disorders are generally considered taboo in most of the traditional homes even today. Therefore, these disorders are the common ones to be treated by traditional means. Assam, being the abode of many tribes acts as a hub for such remedies from ancient times. Lots of herbal medicines are used here for curing many diseases, including the reproductive ones. Therefore, the present study was designed to document the medicinal plants used by the Mishing community of Sonitpur district. Pieces of information were collected from the traditional healers with the help of interviews. A total of 46 medicinal plants were reported which belong to 19 families. The plant with high use value was *Acacia fernesiana*, followed by *Bambusa bambos*. The highly reported family was Malvaceae. A thorough study of the phytochemicals present in the reported plants and the validation of the mentioned ethnobotanical use are necessary. Identification and isolation of the compounds with pain healing properties, *in silico* interaction of the compounds with target proteins and clinical trials are recommended for drug development from the reported plants.

Keywords: Dysmenorrhea, Reproductive disorder, Traditional Medicine, *Acacia fernesiana*, *Bambusa bambos*

INTRODUCTION

Reproductive health of each human being is a matter of great concern. The importance of it is recognized globally in the name of reproductive rights. Reproductive health especially that of woman, is directly related with the long- term development of any country (Khaleghinezhad *et al.,* 2018). Menstrual cycle serves as the best indicator of reproductive health for every normal woman. The onset of menstruation indicates the beginning of puberty and generally occurs between the age of 10- 16 in every female, with a high range of variations (Omidvar *et al.,* 2018).

Menstruation in women of reproductive age is one of the most natural phenomena, characterized by blood discharge from uterus through the vaginal route, occurring at an interval of approximately one month (Rafique *et al.,* 2018). Though some women are blessed with comparatively painless menstrual cycle, 70% experience abnormalities related with menstruation (Khaleghinezhad *et al.,* 2018). There are a wide range of disorders associated with the menstrual cycle such as dysmenorrhea, premenstrual symptoms, menorrhagia, polymenorrhea, abnormal vaginal bleeding, amenorrhea, oligomenorrhea, and irregular menstruation. Menstrual problems are also associated with eco-

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nomic burden and work efficiency of women during those days (Rafique *et al.,* 2018).

Among all the menstrual abnormalities, dysmenorrhea is considered as an unsolved problem in medical science. 80% women in the world suffer from dysmenorrhea in the reproductive years (Pu *et al.,* 2015). This condition is characterized by acute pelvic pain during the periods, without any visible pelvic lesions. But it also shows symptoms of lower backache, nausea, vomiting, etc. (Omidvar *et al.,* 2018). This condition is categorized into two categories- primary and secondary dysmenorrhea. The primary type is very common while the secondary one is dependent on some other pelvic disorders. The pelvic pain is severe in 15% cases globally (Jesíno *et al.,* 2018).

Though the problem is quite unsolved, modern science uses some ovarian steroids for treatment of dysmenorrhea (Baruah *et al.,* 2019). In cases with moderate symptoms, nonsteroidal anti- inflammatory drugs are mostly used, but they come with some severe side effects after discontinuation of medication (Pu *et al.,* 2015). Due to this, use of some drugs with lesser side effects is recommended for use. In some traditional societies, some herbal medicines are used to fulfill this purpose. But survey and documentation of such traditional medicines are not sufficient till date. Therefore, the present study aims at the study and documentation of medicinal plants used for dysmenorrhea.

MATERIALS AND METHODS

Study and Documentation of Medicinal Plants:
Study Area:

The study area consisted of the Mishing tribe inhabited villages of Sonitpur district (26.6739ºN, 92.8577ºE). The villages selected for the study were- Bokagaon miri, Baligaon, Koloi, Kekakuli, Dalikati, Bamonipam, Towbhanga and Bor Dikhorai. The study was conducted from November 2020 to May 2021.

Collection of Data:

The traditional practitioners were selected based on their knowledge of medicinal plants in the study area. In the first visit, the purpose and nature of the project were explained to each practitioner to get prior informant consent. Then formal interviews were conducted in the local language 'Mishing' and the documentation of data of the data in the field was completed. The informants were asked to describe the medicines with their mode of usage. The details regarding the parts used, mode of preparing medicine and solvent used for administration were noted down.

Calculation of Use Value:

According to Phillips *et al..* (1994), the UV was calculated using the following formula:

$$UV = U/N$$

Where, "U" refers to the number of uses mentioned by the informants for a given species and "N" refers to the total number of informants interviewed. If a plant secures a high UV score that indicates there are many use reports for that plant, while a low score indicates fewer use reports cited by the informants.

RESULTS

A total of 46 plants used for the treatment of dysmenorrhea were documented in the survey (Table 1 to Table 6; Figure 1). The plants belong to a total of 19 families, the highest being of the family Malvaceae (12.24%). The use of leaves, roots, bark, flower, seeds, rhizome and pulp of the plants was reported for the treatment of menstrual pain. There was report of the highest use of the leaves followed by that of the roots.

Calculation of Use Value:

Use Value of *Acacia farnesiana,* UV = 3/49
= 0.0612
Use Value of *Bambusa bambos*,   UV = 2/49
= 0.0408
Use Value of Other Documented Species,
UV = 1/49
= 0.0204

Table 1. Information collected from traditional healer-1

Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Abroma augusta*	Kopashi ame	Malvaceae	Profusely branched roots and leaves are used for treatment
2	*Curcuma caesia*	Yakkan haldi	Zingiberaceae	Rhizome is consumed
3	*Eclipta prostrata*	Marsang	Asteraceae	Leaves are boiled in water and consumed as medicine
4	*Hydrocotyle sibthorpioides*	Manimuni	Araliaceae	Leaf juice is used for period cramps
5	*Leucas aspera*	Dhoron bon	Lamiaceae	Leaves are boiled in water and consumed as medicine

Table 2. Information collected from traditional healer-2

Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Acacia farnesiana*	Torua kadam	Fabaceae	Bark juice is consumed
2	*Paederia foetida*	Lapuk	Rubiaceae	Leaves and roots are squashed, mixed with water and drunk
3	*Sida acuta*	Varbei	Malvaceae	Leaves are crushed to produce juice and consumed
4	*Terminalia arjuna*	Aurjun aame	Combretaceae	Viscous juice of the bark is consumed

Table 3. Information collected from Traditional healer-3

Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Acacia farnesiana*	Torua kadam	Fabaceae	Bark juice is consumed
2	*Hibiscus rosa sinensis*	Jova ame	Malvaceae	Flower petals are taken with jaggery.
3	*Mikania micrantha*	Injo lota	Asteraceae	Leaves are crushed and mixed with water and drunk during periods
4	*Tinospora cordifolia*	Meshor	Menispermaceae	Leaf juice is taken
5	*Urena lobata*	Rinjin	Malvaceae	Juice of both root and leaf are consumed

Table 4. Information collected from traditional healer-4

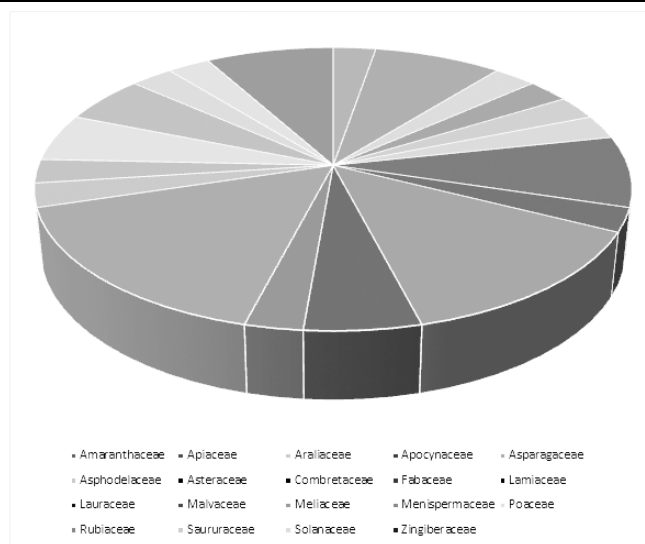| Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Abelmoschus moschatus*	Koroi ame	Malvaceae	Ground seeds are mixed with lukewarm water and consumed
2	*Bambusa bambos*	Divang	Poaceae	Decoction of leaves are taken
3	*Hibiscus mutabilis*	Podma ame	Malvaceae	Root extract is consumed
4	*Mimosa pudica*	Miktab ame	Fabaceae	Root juice is consumed during periods

Table 5. information collected from traditional healer-5

Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Albizia lebbeck*	Saw ame	Fabaceae	Bark and roots are pounded to make juice and taken
2	*Bambusa bambos*	Divang	Poaceae	Decoction of leaves are taken
3	*Drimia indica*	Yumya talap	Asparagaceae	Tunicate bulb-like portion is used to prepare juice and taken
4	*Targetes erecta*	Maloti appun	Asteraceae	Leaves are boiled in water and taken
5	*Vitex negundo*	Posotia appun	Lamiaceae	Fruit is consumed

Table 6. Information taken from traditional healer-6

Sl. No.	Scientific Name	Mising Name	Family	Use
1	*Aloe barbadensis*	Aloe vera	Asphodelaceae	Freshly prepared pulp juice is taken
2	*Amaranthus spinosus*	Gnyage	Amaranthaceae	Root juice is taken
3	*Cinnamomum verum*	Dal cheni	Lauraceae	Dried bark is boiled in water and consumed
4	*Curcuma amada*	Adi take	Zingiberaceae	A quarter inch long root is taken with lukewarm water
5	*Foeniculum vulgare*	Sofo ame	Apiaceae	Decoction of seed is taken
6	*Houttuynia cordata*	Yumya pan	Saururaceae	Juice of freshly collected leaves are consumed during periods
7	*Melia azedarach*	Chemene ame	Meliaceae	Bark juice is taken
8	*Neolamarckia cadamba*	Kodom ame	Rubiaceae	Leaf and bark juice is taken during periods
9	*Nerium indicum*	Korobi appun	Apocynaceae	Root or root bark juice is consumed

10	*Petroselium crispum*	Yumpa oli	Apiaceae	Freshly collected leaves are boiled in hot water and drunk
11	*Solanum nigrum*	Yakkan okkan	Solanaceae	Decoction leaves and berries are taken
12	*Trachyspermum ammi*	Jain aaye	Apiaceae	Seeds are boiled in water and taken with added honey
13	*Trigonella foenum-graecum*	Methi aye	Fabaceae	Seeds are soaked overnight and taken
14	*Zingiber officinale*	Take	Zingiberaceae	Rhizome is grated and taken with water

Legend: ■ Amaranthaceae ■ Apiaceae ▦ Araliaceae ■ Apocynaceae ■ Asparagaceae ▦ Asphodelaceae ■ Asteraceae ■ Combretaceae ■ Fabaceae ■ Lamiaceae ■ Lauraceae ■ Malvaceae ▦ Meliaceae ▦ Menispermaceae ▦ Poaceae ■ Rubiaceae ▦ Saururaceae ▦ Solanaceae ■ Zingiberaceae

Figure 1. Comparative presentation of plant families used for dysmenorrhaea treatment by the Mishing tribe of Sonitpur district, Assam

DISCUSSION

The traditional healthcare system has direct effect on the health of local people and most of the modern drugs have been tried and tested in their crude from, which is directly based on the traditional knowledge (Sasil-Lagoudakis *et al..*, 2012; Fabricant and Farnsworth, 2001). Information about the use of a particular plant in treatment of a specific disease reduces the cost of unnecessary trials (Panda *et al..,* 2018). In Assam, which is the home of various tribes, people use lots of herbal medicines for treatment of common diseases; proper knowledge of these traditionally used medicine may lead to development of new drugs (Kalita and Kalita, 2014).

Dysmenorrhaea is one of the most prevalent problems of reproductive system that may leave a woman bed-ridden for those days (Rafique and Sheikh, 2018). The root cause of the problem is improper proliferation and detachment of the uterine endometrial cells (Baruah *et*

al.., 2019). There are some reports of use of traditional medicines for the treatment of this problem and their trials on the laboratory animal models. However, the number of studies is very low.

In the present investigation, a total of 46 species were reported to be used by the Mishing tribe of Sonitpur district, Assam for treatment of dysmenorrhaea. All of the documented species were found to be locally available in the study area. Among them, the species *Acacia farnesiana* was having the highest use value. Other plants documented so far were *Abroma augusta, Leucas aspera, Paederia foetida, Terminalia arjuna, Hibiscus rosa sinensis, Mimosa pudica, Aloe barbadensis, Amaranthus spinosus, Houttuynia cordata, Zingiber officinale,* etc. Plants like *Hibiscus rosa sinensis, Paederia foetida, Aloe barbadensis, Zingiber officinale, etc.* were also reported by other authors for the treatment of dysmenorrhea in Barpeta district of Assam (Singh and Bhagawati, 2020).

Acacia farnesiana is known to possess lots of ethnopharmacological properties (Ramli *et al..,* 2011). It has been reported to have significant anti-inflammatory activity in acute and chronic inflammation models (Hukkeri *et al..,* 2002). The glycosydal fraction of the plant extract showed branchiodilator and anti-inflammatory effect (Ramli *et al..,* 2011). The proteins isolated from the *A. farnesiana* seeds have anti-inflammatory and analgesic activities (Leal *et al..,* 2016).

During the menstrual cycle, Dysmenorrhea patients induce visceral pain sensitization during the menstrual cycle that starts the viscerosomatic pain reflex and referred pain that results in chronic somatic pain as well as nociceptor hypersensitivity to inflammation (Jarrell and Arendt-Nielsen, 2016). A clear idea about whether the enhancement of such sensitivity to painful stimuli is the cause or the effect of recurrent menstrual pain is still lacking. This pain in long run can predispose to other chronic pain conditions (Iacovides *et al..,* 2015). The primary dysmenorrheal pain is a result of abnormal activity of the uterus, characterized by the release of chemical mediators like

prostaglandin, which is comparable to uterine contractility during labor or abortion (Chen *et al..,* 2013; Dawood, 2006). Dysmenorrhea is attributed to the high serum levels of prostaglandin E2 (PGE2), PGF2α and leukotrienes, leading to not only severe myometrial contraction but also to vasoconstriction and consequently the release of cytokines (Chen *et al..,* 2014; Deligeoroglou *et al..,* 2006). *Acacia fernesiana* root and stem extracts showed anti-inflammatory activity by reducing interleukin-6 (IL-6) and tumour necrosis factor -α (TNF-α) in a previous study (Mueller *et al..,* 2015). 8, diosmetin (13), and 3',4',5-trihydroxy-7-methoxyflavone (15) isolated from *A. fernesiana* also showed anti-inflammatory activity by secretion of elastase from human neutrophils (Lin *et al..,* 2009). Bioactive compounds like gallic acid, catechin and epicatechin were found in different extracts of *A. fernesiana* and they are also known to show anti-inflammatory activity (Claudia *et al..,* 2018). The methanolic bark extract is believed to possibly possess these compounds or some phytochemicals like them that help the patients relieve dysmenorrheal pain.

CONCLUSION

Tribal and rural communities in the developing world still depend on various traditional modes of treatment to get rid of minor and in some cases major ailments. Dysmenorrhea, being one of the common gynecological problems and a so-called topic of taboo is usually healed at home using some traditional methods. In the present survey, the traditional healers of the Mishing community of Sonitpur, Assam have informed about 46 medicinal plants for treating dysmenorrhea and the highly used one was reported to be *A. fernesiana*. This plant has exhibited multiple pharmacological properties in a few previous studies. However, there are few systematic studies on the phytochemicals and their interactions of the plant with the target proteins while treating a particular disease. Similar cases are seen with the other reported plants. Therefore, proper validation of the

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plants on the animal model for the mentioned ethnobotanical use is necessary. All the molecular and toxicological aspects and *in silico* studies should be taken into consideration for fruitful drug discovery strategies from the mentioned plants.

DECLARATION OF COMPETING INTEREST
The authors declare no conflict of interest.

ACKNOWLEDGMENTS

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Diversity of endolichenic fungi associated with three lichens of Assam

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ABSTRACT

The study was undertaken to isolate endolichenic fungi from three selected lichens viz., *Pyxine* sp., *Graphis* sp. and *Cryptothecia* sp. collected from Assam. Healthy looking lichen thallus were collected from Tezpur and Kaliabor of Assam. Lichen thallus were surface sterilized and were cut into smaller fragments. Surface sterilized fragments were then plated on PDA(Potato Dextrose Results showed that *Trichoderma viridae, Phoma* sp. and Morphotype 1 were the dominant endolichenic fungi recovered from *Pyxine* sp*., Cryptothecia* sp. and *Graphis* sp. respectively collected from Tezpur however Aspergillus, Morphotype 1 and Aspergillus niger were the dominant endolichenic fungi associated with *Pyxine* sp., *Cryptothecia* sp. and *Graphis* sp. respectively collected from Kaliabor, Nagaon. Study showed that there is a wide diversity of endolichenic fungi in these lichens. Further study might result in the discovery of unique endolichenic fungal diversity. This is the first recorded study on endolichenic fungi from Assam , no work has been reported yet.

Keywords: Endolichenic fungi, *Graphis, Pyxine, Cryptothecia*.

INTRODUCTION

Fungi represent a consortium of various biologically potent metabolites having wide importance be it as antimicrobial, anti-inflammatory etc. Fungi are ubiquitous in nature,they can be found in terrestrial, fresh waterand marine environments where they function as saprobes, symbionts, and pathogens (Kellogg and Raja, 2015). A Group of highly diversified fungi reside within the internal tissue of other organisms, living asymptomatically without any obvious sign of infection. Multiple reviews have highlighted the bioactive metabolite diversity and potential of endophytic fungi to produce pharmaceutically valuable natural products (Kaul *et al*. 2012; Nisa *et al*. 2015; Proksch *et al*. 2010; Strobel *et al*. 2004; Tan and Zou 2001). An analogous group of fungi inhabit the thalli of lichen in a similarly asymptomatic manner: the endolichenic fungi.

Lichen thalli is a combined structure of symbiotic association between a fungal organism (mycobiont) and at least one chlorophyll-containing photosynthetic organism (photobiont) such as a micro alga, a cyanobacterium, or both (Lutzoni and Miadlikowska 2009). In addition to the fungal partner of the lichen, the thallus is also a home to numerous, asymptomatic, cryptic microfungi that live in close association with the photobiont (Arnold *et al*. 2009). These diverse groups of fungi, which reside in the interior of a lichen thallus, have been termed as 'endolichenic fungi' (Arnold *et al*. 2009; Miadlikowska *et al*. 2004). Endolichenic fungi were discovered when

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attempts were compelled to isolate the Mycobiont of lichen into pure culture (Crittenden *et al*. 1995; McDonald *et al*. 2013; Petrini *et al*. 1990). These fungi are very much similar to the endophytic fungi (sometimes also referred to as endophyte-like fungi) (Arnold *et al*. 2009; U'Ren *et al*. 2016), which reside within healthy tissues of plants and they are phylogenetically and ecologically diverse without causing any diseased symptoms (Arnold 2001, 2007; Petrini 1991).

The endolichenic fungi, however, are dissimilar from mycobionts (Lutzoni and Miadlikowska 2009), which make up almost more than half part of the lichen thallus, and from lichenicolous fungi, an ecological group of meiosporic and mitosporic fungi that can often be observed on living lichens (Arnold *et al*. 2009). The endolichenic fungi consist of a number of horizontally transmitted, advantageous fungi, and include abundant taxa belonging to diverse classes, orders and families within the Ascomycota (Pezizomycotina), Deuteromycotina. (Arnold *et al*. 2009; Girlanda *et al*. 1997; Kannangara *et al*. 2009; Li *et al*. 2007; Petrini *et al*. 1990; Suryanarayanan *et al*. 2005; Tripathi and Joshi 2015; U'Ren *et al*. 2010, 2012). Endolichenic fungi have become a new approach for evaluation of bioactive secondary metabolite chemistry in natural products research, behind time.

Assam is rich in floral and faunal diversity and comes under the northeastern Indian biogeographic zone. The extraordinary physiographic topography makes the region suitable to colonize diverse organisms including many lichens. Despite being rich in biodiversity, the exploratory work on lichens of Assam is meagre. Floristic study on lichens in Assam was introduced by Stirton (1881), a Scottish lichenologist who described 39 lichen species only from tea plants. A few researchers made their contributions to the lichen biota of the state (Awasthi & Singh 1973; Pant & Upreti 1993; Rout *et al*. 2005, 2010; Gupta & Sinha 2011, 2016; Sinha *et al*. 2013; Daimari *et al*. 2014, Gogoi *et al*., 2019). Recently, Gupta & Sinha (2018) reported 300 species of lichen belonging to

83 genera and 26 families from Assam. Work on endolichenic fungi is limited from North east India,recently a work has been reported on *Cryptothecia* sp. collected from Arunachal Pradesh (Devi *et al*., 2022).However no work has been reported from Assam. This is the first study of endolichenic fungi reported from three selected lichens of Assam.

MATERIALS AND METHODS

Study area

Kaliabor is in Nagaon district and is located in Brahmaputra valley agro climatic zone, therefore the region is under subtropical humid climatic belt and it essentially enjoys characteristics of monsoonal climate. The district is characterized by excessive humidity, heavy summer rainfall, and cool dry winter. The mean annual rainfall was 141.5 mm and the mean annual temperature was 24.8□ during the period of 2010- 2013. During this period the major portion of rainfall received from May toSeptember and July is considered as the rainiest month of the year by receiving average rainfall as 377 mm. Tezpur is a city and urban agglomeration in Sonitpur district, Assam state, India. Tezpur is located on the banks of the river Brahmaputra, 175 kilometres northeast of Guwahati, and is the largest of the north bank cities with a population exceeding 100,000 as per Metropolitan Census 2011.Summer, winter and rainy season are experienced in the region. Variations of climate in the region are experienced due to the intermixing of hills and plains of different elevation. North east and south west monsoon governed the rainfall of the region. About more than three fourth of the total annual rainfall are influenced by the south west monsoon which operates from May/June to September/October. Rainfall during the month of November to April is governed by north east monsoon. Owing to its climatic conditions luxuriant growth of different lichen species was encountered in this region. For the present investigation two abundantly found lichens species were collected for study of endolichenic fungi.

Lichen identification

Healthy lichen thallus of 3 selected lichens viz., *Cryptothecia* sp. ,*Pyxine* sp., and *Graphis*sp.,was collected from Tezpur region (27.0274° N, 92.6102°E) and Kaliabor region (27.2109° N, 92.5067° E) of Assam which encloses parts of Indo-Burma belt. Morphological characterization was done under a Leica EZ4 and Leica S9i stereozoom microscope while anatomical details were examined under Leica DM2500 compound microscope. Chemical characterization was done through Spot tests and Thin layer chromatography was performed in solvent system C (Toluene:Acetic acid; 85:15 ml) (Orange *et al*., 2001). Identification of taxa was done by relevant published literature (Awasthi, 1991; 2001).

Isolation and identification of endolichenic fungi

The three lichen thallus was first surface sterilized following standard protocol (Guo *et al*., 2003). The surface sterilized thallus was cut into smaller fragments (0.5 × 0.5 cm) and was air dried. The dried surface sterilized lichen fragments were placed on PDA (Potato Dextrose Agar) which were supplemented with 0.01% Streptomycin sulphate. The plates were incubated at 28±2°C in BOD incubator until the growths of endolichenic fungi were appeared. The endolichenic fungi were identified on the basis of colony morphology and reproductive structures referring standard identification manuals (Barnett and Hunter, 1998 ; Gilman, 1971) and were inoculated in PDA slants and stored at 4°C.

Endolichenic fungi diversity data analysis

The relative colonization frequency (CF %) of endolichenic species was calculated using the same formula as applied to endophytic fungi:

CF % = (Ncol / Nt) × 100

Where, Ncol stands for the number of segments colonized by each endolichenic fungal isolates, and Nt stands for the total number of segments plated (Hata and Futai, 1995 and Tayung and Jha,2006).

RESULTS AND DISCUSSION

Identification of the lichen species

Identification of the collected lichen species was done by following the literatures of Awasthi (1991, 2007) and Jagadeesh Ram and Sinha (2016). Based on morphological and microscopic observations the selected lichen species were identified as *Cryptothecia* sp., *Graphis* sp. and *Pyxine*sp. Brief description and identifying features of each lichen species are presented below.

A) *Cryptothecia* sp.

Description: Thallus corticolus, epiphloeodal, greenish-grey, ecorticate; prothallus white, well developed; photobiont*Trentepohlia*.Ascigeros tissue scattered in the thallus, slightly elevated fertile areas; paraphysoids densely branched and interwoven, enclosing the asci; asci aggregated in ascigerous areas, globose to broadly clavate thick walled muriformascospores with wavy septa.
Chemistry: Thallus K–, C+ red, KC+ red, P–, medulla I+ blue; gyrophoric acid reported.

B) *Graphis* sp..

Description: Thallus crustose, epiphloeodal, whitish grey with greenish tinge, smooth to uneven, sparsely rimose; apothecialirellate, lirellae dense, semiemergent to emergent, prominent, simple, straight to slightly curved to flexuous, 0.5–3.5 mm long, ends round, margin thin, disc concealed, black epruinose,round; labia entire, black; exciplulum convergent with lateral thalline margin, laterally carbonized; hymenium hyaline, inspersed, 50–70 µm high; paraphyses simple, anastomosing; asci cylindrico clavate, 8- spored; ascospores hyaline, elongate ellipsoid, 5–7-septate, 15–25 × 4–6 µm, I+ blue.

Chemistry: Thallus K–, C–, KC–, P–; no lichen substances detected by TLC.

C) *Pyxine* sp.

Description: Thallus foliose, corticolous, orbicular to suborbicular, 3–6 cm diam., pale grey, tightly adnate to the substrate; lobes linear, dis-

crete, 0.5–1 mm wide, plane to concave, with diffused pruina mostly in the apical region; maculae marginal and laminal, distinct in the apical region, developing into pseudocyphellae and then into soralia; soralia orbicular, ellipsoid, linear or irregular in outline; soredia farinose to granular; lobes 110–220 µm thick; upper cortex paraplectenchymatous, 12–20 µm thick; medulla white; lower cortex brown to black, paler towards the margin, prosoplectenchymatous, 15–30 µm thick; rhizines ± dense, furcated. Apothecia not seen.

Chemistry: Spot tests: Cortex K−, C−KC−, P−, UV+ yellow; medulla K−, C−KC−, P−; TLC: lichexanthone.

3.2 Isolation and identification of endolichenic fungi

In the present study a total of about 162 number of isolates have been recovered from a total of 300 surface sterilised lichen fragments of *Cryptothecia* sp., *Pyxine* sp. and *Graphis* sp. Out of all the isolates Morphotype 1 is the highest occurring endolichenic fungal isolate from Tezpur, which is followed by *Trichoderma harzianum* (21 number of isolates).*Trichoderma harzianum* is the commonly occurring isolate among all the three lichens. Out of all the three lichens it has been found that maximum number of isolates has been recovered in *Pyxine* sp. (70 isolates) , followed by *Graphis* sp.(65 isolates) and lowest in *Cryptothecia* sp.(27 isolates).
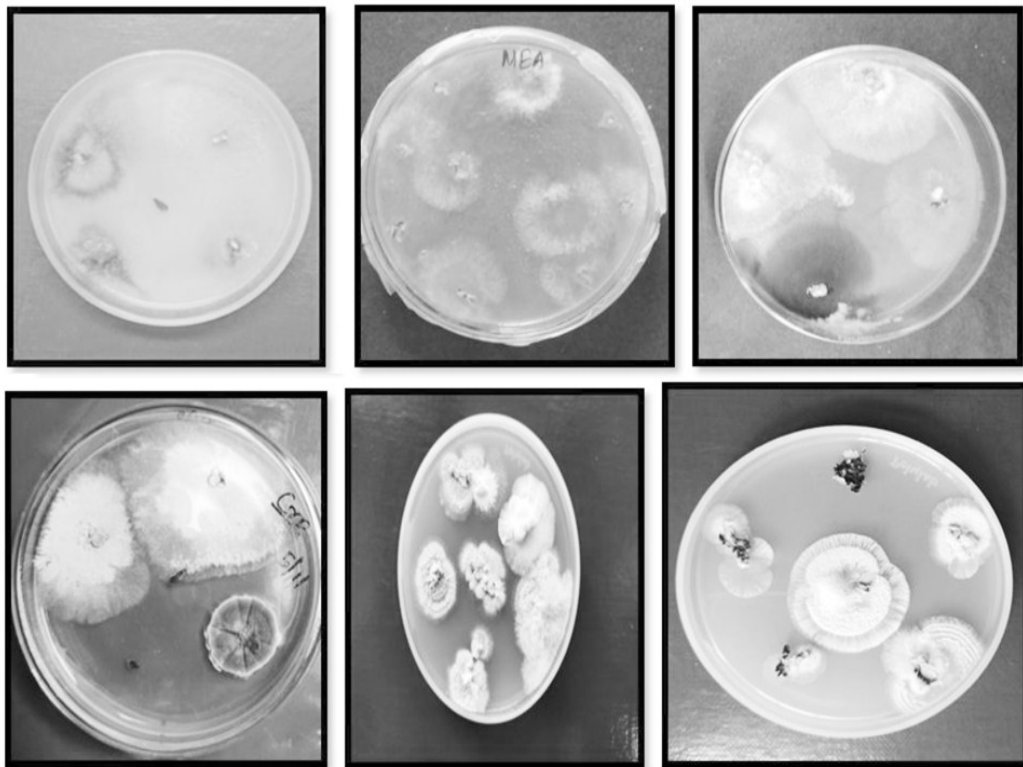
Figure 1. Photoplates representing endolichenic fungal isolates from surface sterilized lichen fragments of *Cryptothecia* sp., *Pyxine* sp. and *Graphis* sp.

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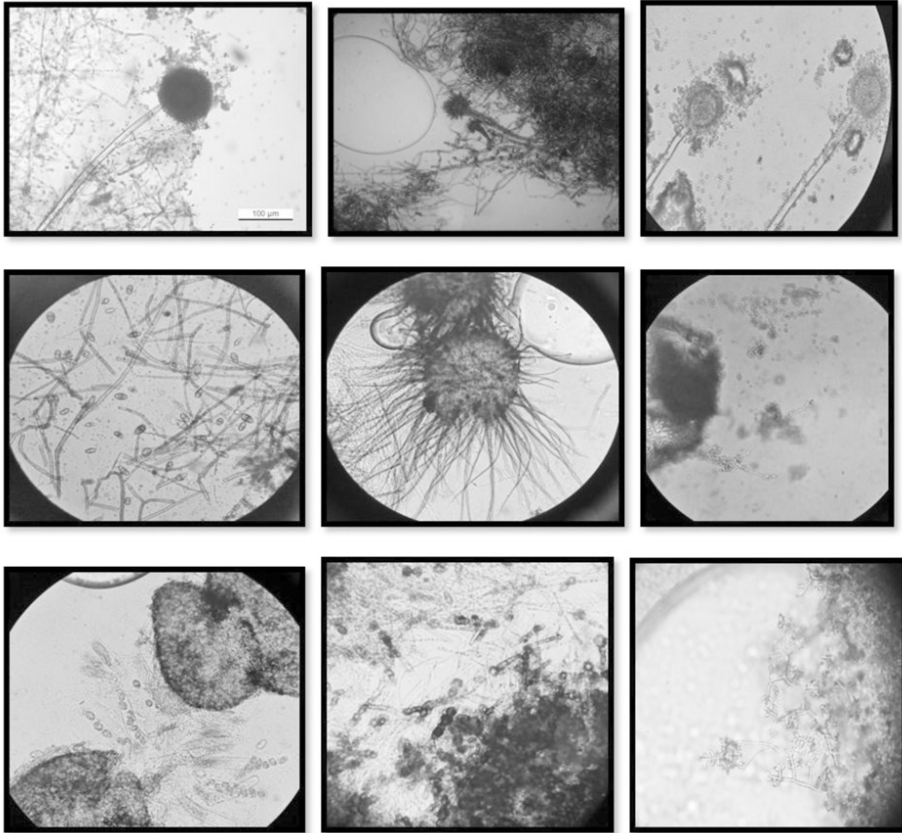
Figure 2. Photoplates showing microscopic image of the isolated endolichenic fungi
A- *Aspergillus niger* B- *Aspergillus* sp. C- *Aspergillus flavus* D-*Dreschlera* sp., E- *Chaetomium* sp. F-*Penicillium* sp. G- *Sordaria* sp. I-*Rhizoctonia* sp. J- *Trichoderma* sp. (Size-100 μm)

Table 1. Study of diversity pattern in endolichenic fungi from Tezpur

Lichen	Endolichenic fungal isolate	Number of isolates	Colonization rate (%)	Relative frequency
Pyxine sp.	*Rhizoctonia* sp.	2	2	3.50%
	Chaetomium sp.	1	1	1.75%
	Trichoderma harzianum	9	9	12.20%
	Trichoderma viridae	12	12	17.50%
	Penicillium sp.	2	2	3.50%
	Periconia sp.	1	1	1.75%

|				
*Graphis*sp.	Mycelia sterilia	31	31	54.38%
	Phoma sp.	20	20	38.16%
	Trichoderma harzianum	6	6	11.53%
	Trichoderma viridae	8	8	15.30%
Cryptothecia sp.	Mycelia sterilia	12	12	23.07%
	Trichoderma harzianum	6	6	9.30%
	*Rhizopu*s sp.	1	1	1.56%
	Aspergillus flavus	1	1	1.56%
	Sordariafimicola	1	1	1.56%
	Penicillium sp.	1	1	1.56%
	Morphotype 1	25	25	39.06%
	Morphotype 2	9	9	14.06%
	Morphotype 3	12	12	18.75%
	Acremonium sp.	2	2	3.12%

Isolation of endolichenic fungi from Kaliabor

In the present study a total of about 190 number of isolates have been recovered from a total of 300 surface sterilised lichen fragments of *Cryptothecia* sp., *Pyxine* sp. and *Graphis* sp. Out of all the isolates Mycelia sterilia is the highest occurring endolichenic fungal isolate from Kaliabor, which is followed by *Phoma*(20 number of isolates), whereas Morphotype 1 is the highest occurring endolichenic fungi from Tezpur . Out of all the three lichens it has been found that maximum number of isolates has been recovered in *Cryptothecia* sp. (74 isolates), followed by *Graphis* sp.(67 isolates) and lowest in *Pyxine* sp.(49).

Table 2. Study of diversity pattern in endolichenic fungi from Kaliabor

Lichen	Endolichenic fungal isolate	Number of isolates	Colonization rate (%)	Relative frequency
Cryptothecia sp.	*Bipolaris* sp.(Crp 04)	6	6	8.11%
	Bipolaris sp. 1 (Crp 08)	12	12	16.22%
	Bipolaris sp.2 (Crp 12)	6	6	8.11%
	Aspergillus sp.(Crp 03)	3	3	4.16%
	Mycelia sterilia	31	31	1.38%
	Penicillium chrysogenum	2	2	2.77%
	Penicillium chreasum	14	14	19.44%
Pyxine sp.	Myeceliasterilia	29	29	59.19%
	Aspergillus sp.	13	13	26.53%
	Sordariafimicola	05	05	10.20%
	Chaetomium sp.	02	02	4.08%

Graphis sp.	Mycelia sterilia	52	52	77.61%
	Aspergillus sp.	12	12	17.91%
	Penicillium sp.	2	2	2.96%
	Sordaria fimicola	1	1	1.49%
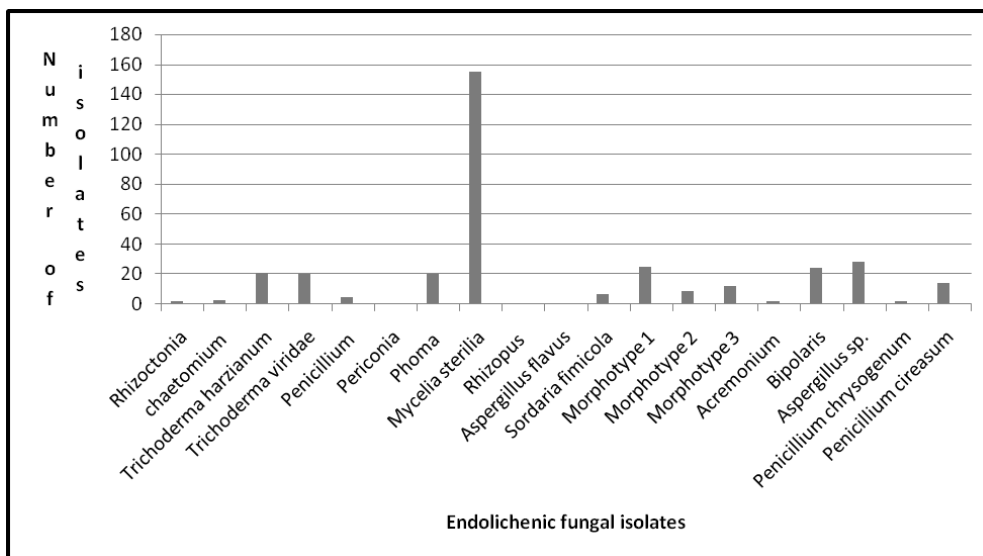
Figure 3. Graphical representation to the occurrence of endolichenic fungal isolates from two different sites

CONCLUSION

Endolichenic fungi are ubiquitous in nature as like endophytic fungi. Present study reveals the occurrence of endolichenic fungi from the two different sites of Assam particularly Tezpur and Nagaon.Study shows that both the region harbors many different endolichenic fungi.These three selected lichens basically known for their antimicrobial potential represents wide occurrence of endolichenic fungi.Studies have indicated that they produce potent bioactive metabolites with wide therapeutic applications. Considering the diminishing plant diversity which harbors maximum lichen flora research priority should be directed to study them especially in developing countries like India, because once lichens get extinct so will be the associated endolichenic fungi. The current study is an endeavor in this direction, and our study suggests that endolichenic fungi could be a potential source of antimicrobial agents.

ACKNOWLEDGEMENTS

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A study on butterfly diversity (Order: Lepidoptera) at Naltali, Kaliabor Subdivision, Nagaon, Assam, India

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ABSTRACT

A Survey was carried out to find out the diversity of butterflies at the Naltali, Kaliabor Subdivision, Nagaon, Assam which was carried out over a period of 6 months from September 2021 to March 2022. The survey area included the Village pathways, Agricultural lands and Flower Garden. The survey recorded a total of 348 individuals with a total of 42 species belonging to 5 families. Among them, Nymphalidae is the most dominant with 22 species followed by Papilionidae with 6 species, Pieridae with 6 species, Lycaenidae with 5 species and Hesperiidae with 3 species. The Simpson Index of Diversity was found highest in Village Pathways (0.91) followed by Agricultural Lands (0.93), and Flower Garden (0.80). Therefore, the study area is rich in butterfly diversity and further research could be conducted to obtain more details and documentation on butterfly diversity for their conservation.

Keywords: Butterfly, Lepidoptera, Nymphalidae, Simpson Index, Assam.

INTRODUCTION

Butterflies make up a large group of insects known under the order Lepidoptera in Phylum Arthropoda. Butterflies are wonderfully diverse in shape, size, and colour. They are found almost everywhere around the world (Abdullahi *et al.,* 2019). Butterflies are good indicators of climate conditions, seasonal and ecological changes, they can also serve in formulating strategies for conservation. Butterflies play a vital role in ecosystem and co- evolutionary relationship between them and plants as well as their lives are interlinked (Ghazanfar *et al.,* 2016).

Butterflies are one of the most prominent species of Earth's biodiversity. Being extremely responsive to any changes in their environment, namely temperature, humidity, light, and rainfall patterns (Murphy *et al*., 1988; Ghazanfar *et*

al.,2016; Sparrow *et al*., 1994; Spitzer *et al*., 1997; Brereton *et al*., 2011), these insects are identified as useful bio indicators (Harsh, 2014).

Butterflies contribute to ecosystem restoration because they supply pollination and a source of food. Increased butterfly populations may indicate an increase in plant diversity and other pollinator groups within restored areas. They have different requirements for different habitat types for mating, breeding and nectaring and are, thus, in sync with the diversity and quality of their habitats (Harsh, 2014).

In India, a total of 1504 butterfly species were recorded which accounted 8.74% of worlds butterfly (Kunte *et al.,* 2012). Around 1500 species of butterflies are reported from India of which nearly half are reported from Assam and N.E. India. The Swallowtail butterflies occupy an important place, and the IUCN has identified the

entire N.E. Region as Swallowtail rich zone under "Swallowtail Conservation Action Plan" (Assam state biodiversity board, 2022).

Therefore, there is a need to check out of those butterfly species. Hence, the present study aims to examine the potential diversity and distribution of butterflies from Naltali area, Kaliabor subdivision, Nagaon, Assam across different habitats of the area such as Flower Garden, Agricultural fields, and Village pathways.

MATERIAL AND METHODS

Study area:

The studied area Naltali is a small municipality in central Assam, under Kaliabor subdivision, Nagaon district. The area is located on the left bank of Brahmaputra river and very near to the Laokhowa wildlife sanctuary. Geographically, its location falls under latitude 26°32'46.6980"N and longitude 92°53'46.9608" E with an altitude of 76m above sea level, the climate here is mild, generally warm and temperate, the summers here have a good deal of rainfall. Climate of the area is mild throughout the year with annual average temperature ranging from 9^0C during winter to 38^0C during summer and the area receives average annual rainfall of about 34-1161mm (theweathernetwork.com,

2022). The locational map of the studied area is depicted in Figure 1.

Butterfly Census:

Pollard walks methodology (Pollard, 1982) was used for sampling butterflies. The survey of butterfly was carried out in the study area three times a week for the period of September 2021 to March 2022 from 6 am to 8 am, 9 am to 11 am and sometimes between 4:00 pm to 5:30 pm for shade loving butterflies. The butterflies were observed randomly, walking through different sites based on habitats present in the study area viz. Village pathways, agricultural lands and Flower Garden. Butterflies were photographed or captured, identified, and released immediately at the spot of capture. A butterfly net was used for this purpose.

Identification of butterfly

The photographs of butterflies during the survey were used for the identification of the species. Colour patterns, sizes and shapes as well as their designs were also considered in identification of the species of butterfly with the help of relevant literature as well as photographs described by Sunil *et al.* (2016) and Kumar *et al.* (2016). The specimens were also identified with the help of Butterfly identifying apps namely Picture insect

Figure 1. Location map of the studied area (Google satellite map).

app, Indian butterfly's app, Butterflies of India and Assam Biodiversity portal (https://assambiodiversity.indiabiodiversity.org).

Statistical Analysis of Data:

The identified butterfly species observed in the study area were analysed by using Simpson Index of diversity [D] formula adopted by Sunil *et al.,* 2016 and Ashok, 2017.

The Simpson index of diversity formula is giving as follows:

$$D = 1\left[-\frac{\sum n\ (n-1)}{N(N-1)}\right]$$

Here,

D = Simpson Index of diversity. The value of D ranges between 0 and 1. With the index, 1 represents infinite diversity and 0, no diversity.

$\sum$ = Sum of [Total]

n = the total number of individuals of a particular species

N = the total number of individuals of all the species

RESULTS

The present field study revealed that a total of 348 individuals with a total of 42 species of butterfly belonging to 29 genera and 5 families from different habitat were recorded. The butterfly species recorded during the survey were presented in Table 1, Fig. 2.
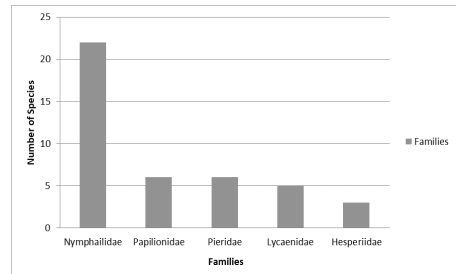
Figure 2. Number of the Species of butterfly in a family wise composition.

Table1. Checklist of the species of butterfly recorded in Naltali, Kaliabor subdivision, Nagaon, Assam

Sl. No.	Scientific Name	Common Name	Individual Number of Butterflies
		FAMILY I: HESPERIIDAE	
1.	*Matapa aria*	Common Red eye	6
2.	*Euphyes vestris*	Dun Skipper	4
3.	*Lambrix salsala*	Chestnut bob	7
		FAMILY II: LYCAENIDAE	
4.	*Castalius rosimon*	Common pierrot	9
5.	*Surendra quercetorum*	Common acacia blue	7
6.	*Cupido argiades*	Short Tailed blue	8
7.	*Pseudozizeeria maha*	Pale grass blue	10
8.	*Jamides bochus*	Dark cerulean	9
		FAMILY III: NYMPHAILIDAE	
9.	*Hypolimnas bolina*	Great Egg fly	8
10.	*Hypolimnas misippus*	Danaid Egg fly	6
11.	*Junonia atlites*	Grey pansy	12
12.	*Junonia lemonias*	Lemon pansy	14
13.	*Junonia almana*	Peacock pansy	11
14.	*Neptis clinia*	Clear sailor	5
15.	*Elymnias hypermnestra*	Common palm fly	9
16.	*Pantoporia hordonia*	Common lascar	1
17.	*Elymnias malelas*	Spotted palm fly	7
18.	*Parantica aglea*	Glassy tiger	6
19.	*Cethosia cyane*	Leopard lacewing	9

| 20.	*Cethosia neitneri*	Tamil lacewing	1
21.	*Cethosia hypsea hypsea*	Malay lacewing	4
22.	*Cethosia penthesilea*	Orange lacewing	6
23.	*Tirumala limniace*	Blue tiger	7
24.	*Danaus chrysippus*	Plain tiger	12
25.	*Danaus genutia*	Common tiger	9
26.	*Ariadne merione*	Common castor	13
27.	*Mycalesis perseus*	Dingy bush brown	5
28.	*Ypthima asterope*	Common three ring	8
29.	*Cercyonis pegala*	Common wood nymph	6
30.	*Discophora sondaica*	Common duffer	4
	FAMILY IV: PAPILIONIDAE		
31.	*Papilio polytes*	Common mormon	14
32.	*Papilio memnon agenor*	Great mormon	8
33.	*Papilio helenus*	Red helen	6
34.	*Papilio demodcus*	Christmas butterfly	14
35.	*Graphium sarpedon*	Common bottle blue	5
36.	*Graphium agamemnon*	Tailed jay	9
	FAMILY V: PIERIDAE		
37.	*Delias descombesi*	Redspot jezebal	12
38.	*Leptosia nina*	Psyche	11
39.	*Pieris canidia*	Indian cabbage white	16
40.	*Catopsilia pomona*	Lemon emigrant	12
41.	*Eurema hecabe*	Common grass yellow	10
42.	*Appias lyncida*	Chocolate albatross	8

Table 2. Results of different ecological indices for different habitats

| Ecological indices	Village pathway	Agricultural land	Flower garden
Abundance	104	92	152
Simpson Index of Diversity	0.91	0.93	0.80

DISCUSSION

Based on the field study, family wise Checklist of the butterfly species was prepared (Table 1) in which 42 species belonging to 5 different families were recorded. Here in Figure 2, the number of species of butterfly in a family wise composition were shown with bar diagram where it is clearly depicted that the family Nymphalidae was the most dominant among the five families representing 22 (52.38%) species belonging to 15 (48.38%) genera, followed by Papilionidae comprising of 6 (14.28%) species belonging to 6 (19.35%) genera,

as well the Pieridae which also comprise of 6 (14.28%) species belonging to 6 (19.35%) genera. Family Lycaenidae is represented by 5 (11.90%) species belonging to equal numbers of genera and Hesperiidae represents 3 (7.14%) species belonging to 3 (9.67%) genera. Figure 3, Family wise percentage composition of the species of butterfly were represented with pie diagram which also depicts that the Nymphalidae family was most frequently sighted group during this survey. The study is in the agreement with the findings of koneri and Nangoy (2019), which studied the status of Sangihe Island butterflies and recorded that the

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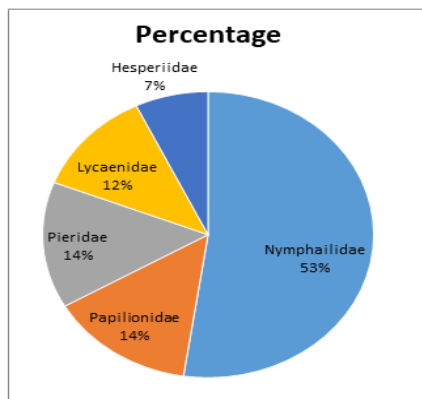
Figure 3: Family wise percentage (approx.) composition of the Species of butterfly
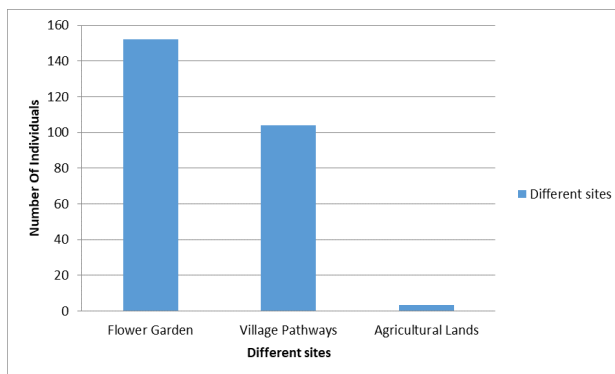
Figure 4. Showing the species richness of butterfly found in different sites of the study area

maximum number of the species were from the Nymphalidae family constituted with 53.81% followed by Papilionidae of 22.67% Pieridae with 15.57%, Lycaenidae having 7.31% and Hesperidae with only 0.64%. Another relevant studies reported by Mohammed et al. (2019), who was found that the Nymphalidae family was found to be maximum with 43% followed by 29% of Pieridae family, 14% of Papilionidae family and 14% of Lycaenidae family. Further the results were also in an agreement with Supriya et al. (2018), who found that the Nymphalidae Family is highest with 56% and 9% least with family Pieridae.

A total of 348 individuals were recorded from the different sites. Figure 4, depicts graphically that highest abundance of butterfly is found in Flower Garden (n=152) followed by village pathways (n=104) and Agricultural lands (n=92). The greatest Simpson index of Diversity was observed in the Agricultural Land (0.93) among the other sites (Table 2) indicating that the study area is more diverse of the species of butterfly. The species *Pieris canidia* belonging to Pieridae Family with 16 individuals which is maximum among the entire species and *Cethosia neitneri* belonging to Nymphalidae Family with 1 individuals which is least among all. The rich diversity of butterflies specially the Nymphalidae in the area indicates a varied assemblage of floral species. The flora of the area found to have mixed type with herbs and bushy shrubs.

Status of all species are categorised depending on the direct sighting during the survey, which showed 13 (30.95%) species out of 42 species were very common,19 (45.24%) species were common, 8 (19.04%) species are uncommon, 4 (9.52%) species were rare. The results are with the accordance with the findings of Bora and Meitei (2014) who observed Very Common (20), Common (34), Uncommon (29), rare (9) and very rare (4) of the species of butterfly in the Assam University Campus. Also with the accordance with the findings of Singh (2017) who observed and recorded the Butterflies of Eastern Assam, India.

CONCLUSION

From the present study, we can conclude that the area has quite high diversity of butterflies. Vegetation type has an important role in diversity pattern of butterfly community. Butterfly habitat protection should be taken as priority in any conservation programme. Assays of butterfly populations should be updated periodically so as to reveal species diversity and distribution patterns that could help provide an insight about the population status of these varied species, and in turn to initiate further research for their conservation.

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Physiological changes induced by Salicylic Acid and Putrescine and their impact on drought tolerance in *Lentil (Lens culinaris L.)*

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ABSTRACT

Lentil (*Lens culinaris* L.) is very nutritive and consumed as pulse and in many other preparations. With its high nutritional value, lentil is primarily a major source of protein, essential nutrients such as calcium, zinc and iron for the vegetarian populations. Drought stress is the most prevalent environmental factor that limits growth, survival, and productivity of lentil. Drought stress causes a broad range of physiological changes and impairments of metabolic processes. PGRs, such as, salicylic acid (SA) evidenced to provide tolerance in plants against different abiotic stresses, such as heat, salinity, heavy metal toxicity, and drought. Putrescine (Put) also plays a positive role in reducing the adverse effects of abiotic stresses on plants through its acid neutralizing and cell wall stabilizing capabilities. Our result showed that drought stress decrease some characteristics such as leaf area contents, net photosynthesis, transpiration rate and RWC but increases proline and sugar content. The application of SA and PUT improved all the measured traits and induced drought tolerance in the treated plants.

Key words: Lentils, drought stress, PGRs, salicylic acid, putrescine, proline

INTRODUCTION

Pulse crops are energy rich plants and an important part of Indian dietary. Among pulses, lentil (*Lens culinaris*. L) is the most important pulse crop in the country. Lentil (*Lens culinaris* L.) is very nutritive and consumed as pulse and in many other preparations. With its high nutritional value, lentil is primarily a major source of protein, essential nutrients such as calcium, zinc and iron for the vegetarian populations. Drought stress is one of the most devastating environmental stresses, limiting the productivity of crop plants around the world. Drought stress causes a broad range of physiological changes and impairments of metabolic processes, which result in accumulation of reactive oxy-

gen species (ROS) (Abid et al., 2018). Drought also causes a substantial reduction in crop productivity through negatively impacting plant growth, physiology, nutrient and water relations, photosynthesis, and assimilate partitioning. It has been shown that there is a significant correlation between the stomatal conductance and photosynthesis response under drought stress, which indicates that stomatal conductance play a major role in the reduction of leaf photosynthetic rates (Abid et al., 2018; Sarabi et al., 2019).

Plant growth regulators (PGRs) or hormones have been found to improve tolerance of plants against the damages caused by abiotic stresses. However, limited researches have been led to examine the possible benefits of exogenous

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application of PGRs under drouhgt stress conditions in lentil.

Salicylic acid (SA), a phytohormone, is a promising compound that can reduce the sensitivity of plants to environmental stresses through regulation of the antioxidant defense system, transpiration rates, stomatal movement, and photosynthetic rate (Nazar et al., 2015). It is evident that SA is a stress-signal molecule that activates abiotic stress-responsive gene expression (Li and Zhang, 1999), and induces the expression of biosynthetic enzymes and proteins in plants under environmental stresses (Nazar et al., 2015; Wang et al., 2019). Several studies have shown that the application of SA resulted in a positive effect by protecting plants against the oxidative damage caused by drought stress (Kang et al., 2012; Najafabadi and Ehsanzadeh, 2017; Wang et al., 2019; Sankari et al., 2019). In addition, SA is involved in the regulation of plant physiological processes including stomatal closure, chlorophyll and protein synthesis, nutrient uptake, transpiration, and photosynthesis (Shakirova and Sakhabutdinova, 2003). Some studies have indicated that exogenous application of SA may lead to improvements in morpho-physiological traits that are involved in determination of plant yield of wheat (*Triticum aestivum* L.) (Shakirova and Sakhabutdinova, 2003) and maize (*Zea maize* L.). Furthermore, SA affects isoprenoid (a-Tocopherol, carotenoids, and monoterpenes) accumulation in leaves of plants especially under water stress. Putrescine (Put) plays a positive role in reducing the adverse effects of abiotic stresses and improves tolerance against drought. In fact, the putrescine was successfully applied to tolerate drought condition (Amri and Shahsavar, 2010).

Put application by spraying increased leaf area, height, leaf area, and grain yield of wheat plants owing to the increase in chlorophyll, water status, and the content of Pro, amino acids, and soluble sugars (Gupta et al.,2012). Zhu et al., 2019 showed that foliar Put application to lettuce sub-jected to drought conditions triggered a reduction in stomatal density, keeping chloroplast structure and cell turgor. Similarly, Shallan et al., 2012 described that Put application as pre treatment in cotton plants improved root to shoot ratio, leaf area, number and setting of bolls, seed cotton yield, total soluble sugars, pigments content, Pro content, total free amino acids, total phenols, total soluble proteins, total antioxidant capacity, and antioxidant enzyme activities. Put treatment also reduces the sensitivity of *Medicago sativa* plants to PEG-induced drought stress by reducing the activity of the hydrolytic enzymes and increasing the polysaccharide, protein and photosynthetic pigment contents, and photosynthetic activity (Zaid and Shedeed, 2006). Put has the ability to improve anatomical features, retaining chlorophyll concentrations and accumulating total soluble phenolic compounds in *Thymus vulgaris* plants, which leads to improved oil yield under drought conditions (Abd Elbar et al., 2019)

MATERIALS AND METHODS

Relative water content (RWC, %):

Leaf relative water content was measured from the first fully expanded leaf from the top in normal and flooded plants at pre-flowering stage. Leaf relative water content (RWC) was estimated by measuring the turgid weight of 0.5 g fresh leaf samples by keeping in the water for 4 hours followed by drying in the hot air oven till constant weight was achieved.

T*otal chlorophyll content:*

The total chlorophyll content was determined in the first fully expanded leaves from the top in normal and flooding stressed plants by the method of Yoshida. For this, 500 mg leaves were washed properly after that, leaves crushed with the help of mortar and pestle by using 5 mL of 80% acetone solution and a pinch of fine sand followed by centrifugation of the crushed material at 5000

rpm for 10 minutes and then supernatant was collected in the flask and final volume was made up to 50 mL by adding the 80% acetone. Absorbance was recorded at the wavelength of 645 and 663 nm by using the spectrophotometer (ELICO SL-196).

Soluble sugar content:

Soluble sugar content was determined in the first fully expanded leaves from the top in the normal and flooding stressed lentil plant by the method of Dubois and expressed as mg g^{-1} fresh weight.

Estimation of total protein content:

The total protein content was determined in the leaves of lentils in normal and stressed plants at pre-flowering stage by the method of Lowry. Two hundred mg leaf sample was homogenized with 10 mL 80% ethanol using mortar and pestle and centrifuged it at 4000 rpm for 20 minutes. The supernatant was kept aside and the residue was hydrolyzed with 5 mL of 1 N NaOH for overnight and next day centrifuged it again at 4000 rpm for 20 minutes. Supernatant was collected and residue was again extracted with 5 mL of 1 N NaOH after 1 hour of adding it and then centrifuged. Both the supernatant were mixed and volume was made up to 10 mL. Then 0.5 mL supernatant and 5 mL alkaline copper solution were added and mixture was left for 10 min and after that 0.5 mL folin reagent was added and incubated at room temperature for 1 hour. A blue colour developed and thereafter absorbance of the blue colour was recorded at 730 nm by using spectrophotometer. Bovine serum albumin (BSA) solution was prepared to get the standard curve.

Quantification of Total Phenolic content (TPC)

Total phenolic compounds present in the aqueous extracts of lentils were quantified spectrophotometrically through the Folin Ciocalteu test following the protocol of Singleton *et al.* with specific modifications. Gallic acid (GA) was used as standard and distilled water as the blank sample. In a 10 ml volumetric flask, 4 ml of distilled water were mixed with 0.4 ml of the standard solution, the blank sample, or the extract to be analyzed. 0.4 ml of Folin–Ciocalteu reagent was then immediately added and the solution was allowed to react for 5 min. At the end of this period, 4 ml of a 7% Na_2CO_3 solution was added, the mixture was stirred, and the volumetric flask was brought up to volume with distilled water. After 90 min of incubation in the dark and at room temperature (± 23 °C), the solution absorbance was measured at 730 nm using a spectrophotometer. The TPC was expressed as mg equivalents of GA per g of dry matter (mg GAE/g).

Total Flavonoid content determination:

Total flavonoid content was determined by Aluminium chloride method 14 using quercetin as a standard. 1ml of test sample and 4 ml of water was added to a volumetric flask (10 ml volume). Add 0.3 ml of 5 % Sodium nitrite, 0.3 ml of 10% Aluminium chloride was added after 5 minutes. After 6 minutes incubation at room temperature, 1ml of 1 M Sodium hydroxide was added to the reaction mixture. Immediately the final volume was make upto 10 ml with distilled water. Absorbance of sample was measured against the blank at 510 nm using a spectrophotometer. All the experiment was repeated three times for precision and values were expressed in mean ± standard deviation in terms flavonoid content (Quercetin equivalent, QE) per g of dry weight.

Proline estimation

Proline and total amino acids may also be extracted using a cold extraction procedure by mixing 20-50 mg fresh weight aliquots with 0.4-1 ml of ethanol:water (40:60 v/v). The resulting mixture is left overnight a 4°C, and then centrifuged at 14000 g (5 min). The cold extraction procedure can be repeated on the pellet and supernatants pooled and used for the analyses by using spectrophotometer.

RESULTS AND DISCUSSION

In present study we found that drought stress led to a remarkable decrease in chlorophyll a and b compared to the control. Foliar application of SA and PUT significantly enhanced chlorophyll a and b. There was a significant difference in chlorophyll contents in different hormone treated and drought stress plants (Table 1, Figure 1). Exogenously applied SA improved photosynthesis in both control and drought-stressed plants compared to untreated plants. In drought condition in lentils the amounts of RWC is decreased remarkably (Figure 2). Salicylic acid treated plants exhibit increased amount of RWC in comparision to PUT treated plants. Therefore the improvement in RWC by exogenous application of SA and PUT may be the result of osmotic adjustment because of accumulation of compatible solutes like proline. The results also show that protein contents increased when plants were subjected to drought stress (Figure 3). SA and PUT application to plants under drought stress remarkebly increased soluble protein content compared to the plants only treated with drought. The effect of drought stress on sugar content is shown in. The results showed that drought stress signifi-

cantly enhanced the sucrose content compared to the control. Sucrose content was significantly higher in plants treated with SA compared to the control and PUT treated plants. This difference was even greater when the SA-treated plants were exposed to drought stress, as the highest sucrose content was observed in drought stressed-plants treated with SA. The effect of drought stress on flavonoid contents is shown in figure (Figure 5). The result showed that in drought stress, the flavonoids were remarkably increased. The plants treated with SA and PUT showed impressive results with increase amount of flavonoids. Under control condition there was no significance difference of leaf proline content during the experimental periods. But there was a large variation in proline content under drought stress and hormone treated plants e.g. SA and PUT (Figure 6). Proline contents in leaves of lentils remarkably increased under drought stress condition and slightly increased in hormone treated plants compared to control condition. Treatment with SA elevated the total phenolic content. PUT treated plant showed highest amount of total phenol content in comparison to SA and drought stress lentil (Figure 4).

Table 1. Effects of SA, PUT and drought on secondary metabolites of lentils under vegetative phase. Each value represents the Mean± SD of three replications

	Chlorophyll a+b	RWC	Protein content	Sugar content	Phenol	Flavonoids	Proline
Control	3.110±0.4899	0.028±0.12832	1.0±0.8164	0.026±0.13165	0.28± 0.64666	0.327±0.7132	0.136±0.67330
Salicylic acid	3.159±0.6638	0.137±0.05477	1.14±0.8717	0.39±0.50990	0.323±0.46404	0.622±0.41333	0.140±0.2160
Putrescine	3.782± 1.58797	0.030±0.11832	1.4±0.9486	0.37±2.856	0.33±0.46904	0.378±0.50497	0.137±0.17433
Drought	2.820±1.2465	0.024± 0.1	1.2±0.88881	0.35±0.48304	0.313±0.45752	0.608±0.63665	0.139±0.68068
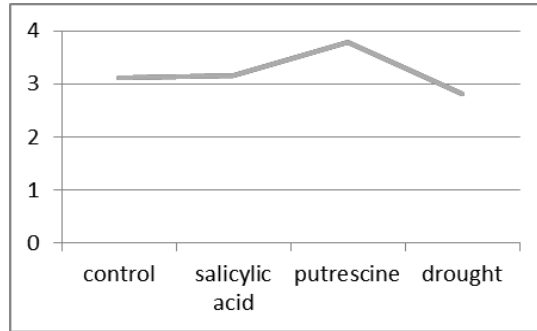
Figure 1. Effects of SA, PUT and drought on chlorophyll a+b of lentils under vegetative phase. Each line represents the Mean± SD of three replications
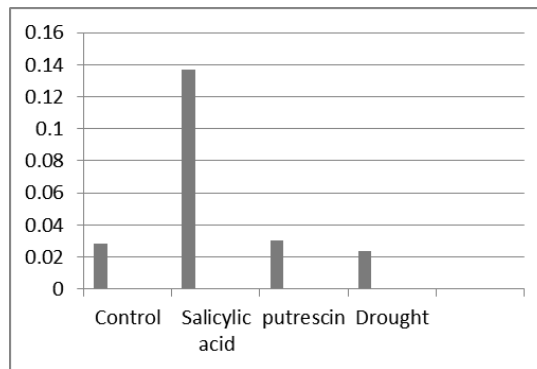
Figure 2. Effects of SA, PUT and drought on RWC contents of lentils under vegetative phase.
 Each column represents the Mean± SD of three replications

Figure 3. Effects of SA, PUT and drought on Protein contentsof lentils under vegetative phase. Each line represents the Mean± SD of three replications

Figure 4. Effects of SA, PUT and drought on Phenol contents of lentils under vegetative phase. Each column represents the Mean± SD of three replications

Figure 5. Effects of SA, PUT and drought on Flavonoids content of lentils under vegetative phase. Each columnrepresents the Mean± SD of three replications
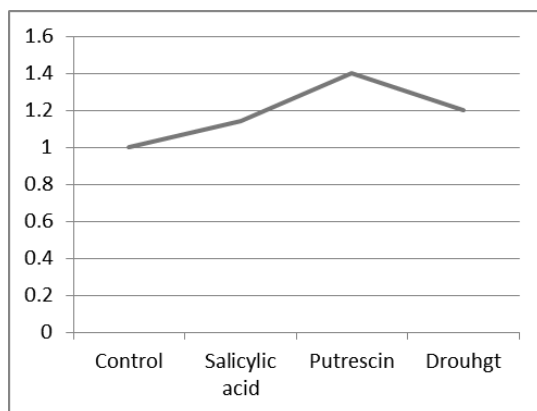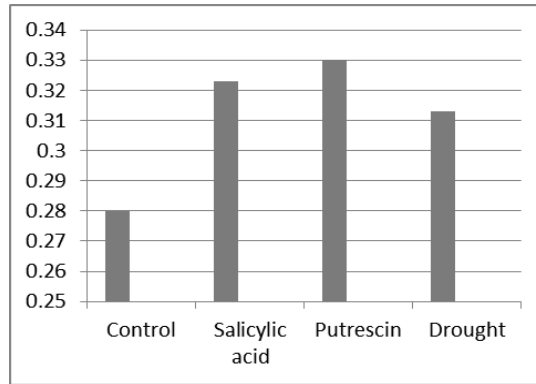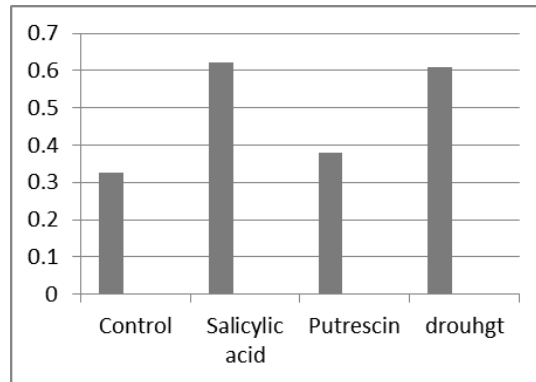

Figure 6. Effects of SA, PUT and drought on Proline contents of lentils under vegetative phase. Each line represents the Mean± SD of three replications
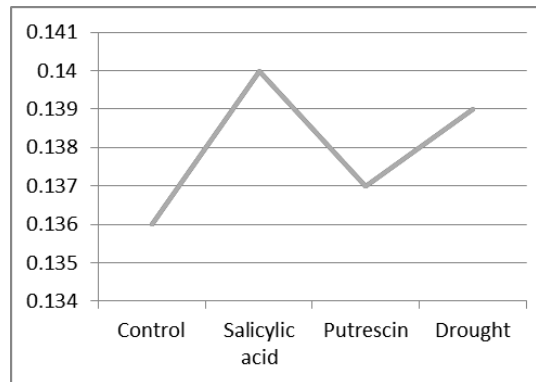
SA treatment enhanced the levels of soluble protein, and the abundance of many enzymes related to the accumulation of polypeptides in wheat under stressful conditions. Treating plants with SA induced an increase in abundance of protein spots (including ribulose-1,5- bisphosphate carboxylase activase, two Rubisco large subunit-binding proteins, carbonic anhydrase) (Kang et al., 2012), and appearance of two de novo polypeptides (630 and 141 KDa) (Azooz et al., 2011) in order to cope with drought stress. Previous studies demonstrated that the drought-induced reduction in chlorophyll content and chlorophyll fluorescence led to a decrease in photosynthesis and overall plant growth (Miller et al., 2010; Redzik, 2019). The SA and PUT treatment significantly enhanced the chlorophyll fluorescence and chlorophyll content values in lentil. Hassanzadeh et al., 2009 reported that decrease in RWC is related to the decrease in chlorophyll content and leaf fresh weight in sesame genotypes, however, the tolerant genotypes maintained higher RWC under stress condition and thus showed higher affinity for chlorophyll content and leaf fresh weight .Our results demonstrated that SA and PUT maintained efficient photo-system with improved water budget resulting in improved growth and productivity under drought stress condition. Higher accumulation of the total sugar content was also evidenced in our study due to SA and PUT treatment.

Our result showed that drought stress decrease some characteristics such as leaf area contents, net photosynthesis and RWC but increases proline and sugar content. The application of SA and PUT improved all the measured traits and induced drought tolerance in the treated plants. The results of this study support the hypothesis that Salicylic acid and Putrescin treatment might play an important role in modulating the physiological processes which eventually lead to protect plants under drought stress conditions. SA and PUT are of great potential to improve photosynthesis rate and chlorophyll content in lentils.

CONCLUSION

Drought is a major constraint on crop productivity worldwide and is expected to worsen in the near future. Hence, scientists are trying to understand different drought tolerance mechanisms of plants and to develop drought-tolerant crops. Phytohormones like SA and PUT trigger tolerance to drought stress via regulation of various morphological, physiological, biochemical and molecular processes. These phytohormones have great potential to develop drought tolerant crops.

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Cytological aspects of Aerides multiflora Roxb. from Nagaon District of Assam

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ABSTRACT

Orchids are accepted as the centre of attraction among the naturalist, botanist as well as the artists. It is because of its fascinating colours combinations, fragrance. It also occupy an important place in social belie in different ethnic groups of the world. Due to it's popularity among the people, Commercialization of Orchids become a source of very good earnings in many Countries. For Commercial exploitation of Orchids thousands of Hybrids of Orchids are being developed. For hybridization programme detail knowledge of cytology of the selected species is utmost important. Besides, cytology of a particular species also helps taxonomists for placing the species in appropriate position. Keeping the above mentioned points in mind cytology of *Aerides multilora* Roxb. from Nagaon district was carried out. In the present investigation the chromosome number of *Aerides multiflora* was found 2n = 22 i.e. 11 pairs. Out of the 11 pairs of chromosomes, 3 pairs are metacentric, 6 pairs are sub- metacentric, and 2 pairs are sub-metacentric with secondary constriction. The TF% counted was 39.45.

Keywords: *Aerides multilora* Roxb., Hybridization, Cytology.

INTRODUCTION

Orchids are considered to be the World's most exotic and fascinating flowers for their extraordinary Variety of sizes, shapes, colours, and markings. Besides the aesthetic value, Orchids have been occupying an important position in the folk culture and rituals of different races since ancient time. In ancient time Greeks paid their respect to root tubers of Orchids, which looks like human testis, as a symbol of virility. At the time of Confucius, the Chinese considered many Orchids as the "The plant of the King's fragrance." In India, there are legends related with the *Rhyncostylis retusa* and *Aerides* species. *Rhyncostylis retusa* were known as "Seeta Puspa" and *Aerides* species were known as "Draupati Puspa". These species are considered as symbol of purity and worn by Indian women with utmost reverence In Assam during Rangali Bihu festival (Mid April), the Assamese girls adorn the beautiful spike of *Rhyncostylis retusa,,* popularly known as Kopou phul, on their head. It symbolizes youthfulness during springtime. *Dendrobium hookerianum*, *Dendrobium nobile,. Dendrobium gibsoni* are generally found grown by Gonpas of Arunachal Pradesh as symbol of sancity. *Cymbidium grandiflorum* is used for holy worship by the Monpas of Arunachal Pradesh. In Tirap District, the wancho tribal houses are generally seen with *Vanda coerulea* popularly called "Rangpu" for their beautiful delicate blue flowers.

Orchidaceae is one of the largest plant families with about 20,000 wild species. All these species are diverse in their colour and odor. It is generally known that some genes, which are located in the chromosome, control most of the charac-

ters of an organism. In order to acquire the knowledge about the diverse behaviour of Orchids, it is important to study the chromosome behaviour in Orchids. Chromosome behavior also helps the Orchid taxonomists to arrange the Orchid in appropriate order. The chromosomes derive their prominence as a tool in taxonomy from their direct relation to the genetic system of which is an integral part (Lewis, 1957). Senghas (1975) stressed the use of cytogenetic data, microstructure analysis and numerical taxonomy in Orchid classification.

Besides, nowadays hybridization programme attains climax in its success. A large number of hybrids are registered every day. For hybridization programme it is very important to know the cytological behaviour of the selected plants for hybridization before the programme is taken in hand.

Chromosomes of distinct species may be expected to have differentiated to various degrees; chromosomes of closely related species would be more similar to each other than that in unrelated species. Thus chromosomes of related species are partially similar to each other and are known as homogenous chromosome. Successful hybridization between two species suggests some degree of relationship between them; hence interspecific hybrids would have two or more homogenous chromosomes. These homogenous chromosomes may show various degree of chromosome pairing depending upon the degree of homology.

A preliminary survey of the Orchids in Nagaon district reveals the presence of 32 species of orchid. *Aerides* and *Dendrobium* are widely distributed in the district of Nagaon. *Aerides multilora* bears excellent colour and good propagation rate. *Aerides multilora* show a good vase life period.

Considering all the aspects mentioned above the present work is aimed to carry out the cytological behavior of *Aerides multiflora* Roxb (**Figure** 1).

MATERIALS AND METHODS

Plant materials selected for cytological works were young root tips and were collected from the Or-

chidarium of Kaliabor College.

The method applied during cytological works was Sharma & Sharma (1980) method. The method includes pre treatment, fixation, and hydrolysis.

Pre treatment:

Root tips were collected during 11 - 11.30 am and washed. Collected root tips were placed in a test tube containing saturated solution of Para Dichloro Benzene. The test tube was then kept in a beaker containing ice cubes. The beaker was kept around 10^0 centigrade for 4 hours.

Fixation:

After 4 hours, the root tips were taken out and washed in running water for 45 minutes. Washed root tips were transferred to fixatives (1: 3 aceto-alcohols) and kept in the fixatives for over night.

Hydrolysis:

Next day root tips were taken out from the fixatives and again washed in running water for 45 minutes. Root tips were then placed in a test tube having 1N HCl and 2% aceto-orcein solution in the ratio of 1:9 and kept in oven at 60^0 centigrade for 45 minutes. Then the test tube was kept at a temperature of around 10^0 centigrade for two days.

Smear preparation:

After two days the test tube was taken out, root tips were gently warmed and smear preparation carried out. The staining solution used during the smear preparation was 2% aceto-orcin. Prepared slides were then observed under binocular research microscope, camera lucida drawings were prepared and cytological photographs were taken with the help of Nikon-100 digital Camera. From the camera lucida drawings idiograms were drawn and cytological analysis were carried out.

Arm ratios of the chromosomes were calculated following the methods of Adhikary (1974).

Statistical Tools:

Analysis of the findings of the investigations was done with the help of Bar diagram, Histogram, and measures of dispersion (Standard deviation)

RESULTS AND DISCUSSION

The somatic chromosomes of the *Aerides multiflora* Roxb. have been found 2n = 22. Most of the earlier workers found the chromosome number of *Aerides multiflora* Roxb, 2n = 38. However some species with chromosome number 2n = 40 and 2n = 22 were also reported from North East India (Chatterjee, 1986). In the present investigation the chromosome number found 2n = 22. On account of this, clear differentiation of primary as well as secondary constrictions could be determined in the microphotograph (**Figure** 2). However, an analysis of chromosome morphology was made from camera lucida drawings (**Figure** 3) and Ideogram (Fig 4).

The size of the chromosomes ranges from 4 μ micron to 10 μ. Among these chromosomes the first, second and fourth pair of chromosomes are medianly constricted. Third, fifth, sixth, eighth, ninth and eleventh pairs of chromosomes are sub medianly constricted. The seventh and tenth pairs are sub medianly constricted with secondary constriction. To locate the positions of centromere, arm ratio was calculated out following Adhikary (1974). On the basis of length, the chromosomes were categorized uniformly in two different classes as follows.-

Category 1: Short chromosome up to length 8 μ:
i. Chromosomes with median centromere = Type - A
ii. Chromosomes with sub-median centromere = Type - B
iii. Chromosomes with terminal centromere = Type - C

Category 2: Long chromosome up to length 8 μ to 10 μ:
i. Chromosomes with median centromere = Type - D
ii. Chromosomes with sub-median centromere = Type - E
iii. Chromosomes with terminal centromere = Type - F

Superscript 's' denotes satellite.

The observation was recorded on the basis of camera lucida drawn for this species. The karyotype formula obtained for the species is given hereunder -

Karyotypic formula:

$A_{3m} + B_{4sm} + B^s_{1sm} + E_{2sm} + E^s_{1sm} = 2n = 22$.

The somatic complements include 3 pairs with median i.e. type A; 4 pairs with sub-median and 1 pair sub-median with satellite i.e. type B. These are of first category i.e. short sized chromosome length up to 8 μ. Again 2 pairs sub-median and 1 pair sub-median with satellite are of second category i.e. long chromosome up to 8 -10 μ. The total length of the eleven pairs of chromosomes calculated is 73.5; while the absolute length is 147 μ. Mean length of chromosome is 6.68. The TF % calculated as 39.45.

CONCLUSION

One interesting thing about Orchid is variation in chromosome numbers. In some species the chromosomes show variation in number i.e. aneusomy and polysomy are of frequent occurrence (Kamemoto, Tanaka and Kosaki, 1961). For example, most of the earlier workers calculated the chromosome number of *Aerides multiflora* Roxb. As 2n = 38, but species were also reported from North East India with chromosome number 2n=40 and 22 (Chatterjee, 1986). In the present investigation the chromosome number of *Aerides multiflora* was found 2n = 22. Out of the 11 pairs of chromosomes, 3 pairs are metacentric, 6 pairs are sub-metacentric, and 2 pairs are sub-metacentric with secondary constriction. The TF% counted was 39.45.

Figure 1. *Aerides multilora* Roxb.

Figure 2. Mitotic Photograph of *Aerides multilora* Roxb.

Figure 3. Karyotype of *Aerides multilora* Roxb.
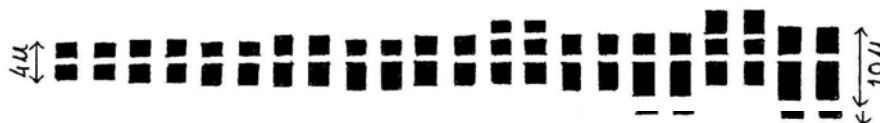
Figure 4. Idiogram of *Aerides multilora* Roxb.

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Certain Ethnomedicinal Plants used as Paediatric health care by the Adivasi community of Tingrai tea belt area of Tinsukia district, Assam: A case study

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ABSTRACT

Traditional and indigenous knowledge of use of herbal products for healing and curing differ-ent sorts of human diseases is a practice of thousand years. These types of information are sparsely available in documented forms. The present study was conducted to identify and doc-ument and prescribe measures to various herbal products for children health care by Adivasi community of Tingrai tea belt of Tinsukia district of Assam. Field survey were made during October and November 2019 and from May to July 2020 among tea tribe (Adivasi) communi-ty of Assam in Tingrai tea belt area which is surrounded by forest cover. Adivasi community consumes and use lots of herbal medicines for various child health care issue due to their tradi-tional and customary belief. It is very much important to explore and record such ethnobotani-cal information with pharmacological and toxicological elucidation for discovery and design-ing of new drug. The present study aimed with identification and documentation of these herb-al healers that are being traditionally used by the Adivasi community generation after genera-tion.

Keywords: Adivasi, Decoction, Fidelity level, Tingrai tea belt, Use value

INTRODUCTION

Use of plants and plant products as protective and curative measures against various diseases of hu-man and cattle is being a part of traditional medi-cine system which dates backs to the ages of Ve-das and Upanishads. The healing and curative power of these plants was documented in many pharmacological write up and documents of tradi-tional and Ayurvedic medicine system like "Charak Samhita", "Susrut Samhita" etc. "Lots of these kinds of herbal medicine are effective as sin-gle crude, mixed crude, single processed or as

mixed processed form to cure child diseases such as low immunity, gastrointestinal disorders, dental anomalies, respiratory problems etc" (Balamurugan, Karthick and Sasikumar, 2019). As per UNICEF's state of World's Chil-dren Reports (2019), 37 out of per 1000 children below the age of 5 years died due to various dis-eases or malnutrition. "Five main causes which ac-counted for 62% of child death in India are pneu-monia, diarrhoea, premature birth, low birth weight and birth trauma" (Balamurugan, Karthick and Sasikumar, 2019). Medicinal plants which are used as a part of customary belief or as herbal

medicine practices might be a potential treasure treat neonatal or paediatric disorders.

Assam with a geographical location of $24^0 44' N$ to $27^0 45'N$ latitude and $89^0 41'E$ to $96^0 02'E$ longitude comprise of 14 plain tribes and 15 hill tribes (Report submitted to Assam legislative Assembly by Chandan Brahma, Cabinet Minister, Department of welfare Plain tribes and backward classes, Govt of Assam; The Sentinel, 20 Feb. 2019). "The tea tribe community which migrated to colonial Assam during 1860-1890 from Jharkhand, Orissa, Chhattisgarh, West Bengal and Andhra Pradesh are now inhabitant of Brahmaputra and Barak valley with a population 6.5 million, and are called as Adivasi" (Sharma, 2019). "They work as skill labour (both men and women) in tea gardens" (Das, 2021). With poor socioeconomic condition and poverty, the health care of neonatal babies and child lack proper attention and care as a result they are more prone to various kinds of dis-

eases and disorders. "The use of indigenous knowledge and herbal medicine system at local level by traditional herbal medicine practitioners and local people of the said community for certain neonatal and paediatric disorders is found to be potential and interesting from pharmacological and ethnobotanical point of view" (Das, 2021). Therefore, present study was undertaken to survey and document the ethnomedicinal plants used by the tea tribe community of Assam for paediatric health care.

MATERIALS AND METHODS

Description of the study area

Tingrai area ($27^0 26'37"N$ and $95^0 35'38"E$) which comes under Tinsukia urban subdivision of Tinsukia district of Assam comprise of a mixed population of various casts and community. The area is co-dominated by agricultural land and for-

Table 1. Population data of Tea gardens (Source: respective tea garden hospital)

Sl. No.	Name of the garden	Approx. Population
01	Bogapani Tea Estate	6875
02	Holonghabi Tea Estate	1650
03	Srikrishna Tea Estate	1100

Figure 1. Map of the study area (Courtesy: Google Earth)

est cover. The area is surrounded by tropical wet evergreen rain forests namely Lakhipathar reserve forests of Dihing Patkai national park, Pengeri reserve forest and Doomdooma reserve forest in west, east and north point of the study area. Major part of agricultural land is covered by tea cultivation which is a major cash crop of Assam contribute a handsome amount in annual revenue of the state. Total area cover of the studied area is 32 sq. km with three large tea gardens. A majority population of the study area is tea tribe community (Adivasi). They further segregate into sub casts including Bhumij, Kohar, Kurmi, Kharia, Garh, Gowala, Ghatowal, Munda, Tanti, Orang, Suri etc. as their surname. Most of their livelihood is as tea garden worker and sparsely as traders and free launch labours also. Name and the population data of the three tea gardens are shown in Table 1.

METHODOLOGY

The study was designed in an explorative investigation manner including survey of the area and collecting information through interview of peer group of people of different ages, especially women and local herbal medicine practitioner about herbal medicinal plants used by the community for treatment and cure of child diseases. The data was collected during October and November 2019 and from May to July 2020 with due permission from interviewee and by following covid-19 protocol. During data survey hesitation in sharing the information due to customary believe and gender constrains were the major hurdles that were faced. During data collection, certain ecological, statistical and pharmacological parameters are considered like *habitat, Use value (UV), Fidelity level (FL)* (Bhattacharyya, Medhi, Borthakur, & Borkakati, 2020)*,* and parts of the plant used, treatment protocol.

Use Value (UV):

Use value (UV) determines the relative importance of plants known in a locality. It is calculated by using the following formula (Tardio, Pardo-de-Santayana, 2008) .

$$UV= \Sigma Ui/N$$

Where U_i is the number of uses mentioned by each informant for a given species and N is the total number of informants.

Fidelity level (FL)

Fidelity level (FL) is calculated to determine the percentage of information uses of certain plant species to treat a particular ailment in the study area (Alexiades. M.N. Sheldon, 1996).

$$FL(\%)= \frac{lp}{lu} \times 100$$

Where, lp is the number of informants who independently claimed the utilization of a plant species for the same major ailment and lu is the number of informants who mentioned the plant for any major ailment.

Plant Identification

"Standard method is followed during collection of photo data and preparation of herbarium. Binomial names (scientific name), family, vernacular names of the plants and specific disorders where they are used are also recorded" (Das, 2021). During identification and validation International Plant Name Index (IPNI) is followed (Baruah, C. & Ahmed, 2014).

RESULTS AND DISCUSSION

A total of 64 people of the Adivasi community were interviewed (including some local herbal medicine practitioners) to find out the information about use of various herbal medicine as a treatment measure of child diseases. Most of the information was received from the females of old age groups (50 years and above). The demographic pattern of these interviewees is shown in Table 2.

Table 2. Demographic pattern of interviewees.

Parameters	No. of Interviewee		% of information
Gender	Male	23	32.33
	Female	41	67.78
Age Group (Yrs)	18-30		16.47
	31-50		27.29
	50-65		23.33
	65 and above		32.91

Table 3. Ethnobotanical details of the plants used by the tea tribe community of Tingrai tea belt as Paediatric health care.

Sl. No.	Binomial name	Family	Vernacular name	Parts used	Disorders	Method of using	Use value (UV)	Fidelity level % (FL)
01	*Acorus calamus* Linn.	Araceae	Bos	Root	Used in Common cold, cough, Pneumonia & other respiratory problems.	Externally use by preparing a chain of beads of root of Bos and bulb of garlic tied in neck for 3-5 days.	0.87	69.30
02	*Bauhinia acuminata*	Caesalpinia-ceae	Kanchan	Bark	Used in mental anxiety and fever.	Paste of bark is prepared by mixing with root of *Acoras calamus*.	0.67	53.43
03	*Ricinus communis* L.	Euphorbia-ceae	Era	Root	Used in Jaundice.	Bark is grinded and taken with jiggery or honey orally for 7-10 days.	0.83	72.00
04	*Canscora andro-graphioides* Griff.ex C.B. Clark	Gentianaceae	Posotia	Leaf	Used in Wounds, tumours and boils.	Paste of leaf mixed with Sesame oil and applied externally for 5-7 days.	0.92	88.93
05	*Sesamum indicum* L.	Pedaliaceae	Til	Seed	Used in rodent ulcer.	Mixed with leaf & root of *Canscora andrographidoides* and paste applied in infected region.	0.57	63.93
06	*Mikania micrantha* Kunth.	Asteraceae	Japani lata	Leaf	Used in dysentery, stomach disorder.	Leaf grinded with pepper and taken orally thrice a day for three days.	0.44	73.66

07	*Psidium guajava* L.	Myrtaceae	Madhuri-amm	Leaf	Used in dysentery, stomach disorder.	Leaf sap mixed with lemon juice and rock salt feed orally for thrice a day for three days.	0.96	93.33
08	*Ipomoea aquatica* Forssk.	Convolvulaceae	Kolmou sak	Leaf and stem	Used against anaemia and blood loss.	Prepared soup by boiling or roasting and consume orally.	0.92	90.33
09	*Nyctanthes arbor-tristis* L.	Oleaceae	Sewali phul	Leaf	Used against fever, common cold, worms, blood infection.	Roasted leaf or leaf sap mixed with zinger rhizome taken orally twice daily for three days.	0.77	89.44
10	*Andrographis paniculata* (Burm.f.) Nees	Acathaceae	Kalmegh	Leaf	Used in Worms, indigestion and fever.	Young dried petiole is soaked in water overnight and water sap is consumed orally in empty stomach for 5-7 days.	0.86	93.45
11	*Cyperus rotundus* L.	Cyperaceae	Mutha-bon/Kecha-bon	Root	Used in Stomach problem, cough.	Root grinded and mixed with honey and consumed orally for 2-3 days.	0.17	13.33
12	*Colocasia esculanta* (L) Schott.	Araceae	Kola kachu	Corm and petiole of leaf	Used in Throat infection, Anaemia.	Corm is boiled and prepared curry and feed with meal.	0.92	84.40
13	*Sapindus saponaria* L.	Sapindaceae	Monichal	Seed	Used in Lice problem, skin diseases.	Paste of raw seed is applied externally.	0.33	54.21
14	*Commelina benghalensis* L.	Commelinaceae	Khona samilu	Shoot	Used in Ophthalmic problems.	Juice extracted from leaf and 1-2 drops are applied externally for 2-3 days.	0.14	17.23
15	*Piper betle* L.	Piperaceae	Beetle	Leaf and petiole	Used in Constipation, anti worm agent.	Grinded with zinger paste and consumed orally twice daily for three days.	0.36	53.33
16	*Terminalia arjuna*	Combretaceae	Arjun	Bark	Used in Stomach problems, dysentery.	Dry bark is grinded and consumed orally with honey for 2-3 days.	0.46	69.22
17	*Passiflora edulis* Sims.	Passifloraceae	Lota Bel	Fruit	Used in Jaundice, liver and Stomach problem.	Pulp of fruit is consumed orally with salt.	0.20	33.23
18	*Centella asiatica* (L.) Urb.	Apiaceae	Bor mani-muni	Leaf and stem	Used as Source of Iron which helps in building haemoglobin, stomach disorder.	Sap of leaf can be consumed orally in raw format or in form of curry.	0.85	83.55

| 19	*Hydrocotyl sibthorpioides* Lam.	Apiaceae	Saru mani-muni	Leaf and stem	Used as Source of Iron which helps in building haemoglobin, stomach disorder.	Sap of leaf can be consumed orally in raw format or in form of curry.	0.85	83.55
20	*Paederia foetida* L.	Rubiaceae	Bhedai lota or Bhabeli lota	Leaf	Used as Source of Iron which helps in building haemoglobin of the mother after child birth helps in healing internal injuries.	Sap of leaf can be consumed orally in raw format or in form of curry.	0.90	97.65
21	*Cissus quadrangularis* L.	Vitaceae	Harjora-lata	Twig	Effective against bone fracture and bone pain	Twig is tightened externally for 15-21 days	0.13	21.22
22	*Averrhoa carambola* L.	Averrhoaceae	Kordoi	Fruit	Effective against jaundice and liver disorder.	Raw fruit juice is mixed with water and consumed orally twice for 5-7 days.	0.67	77.33
23	*Azadirachta indica* A. Juss.	Meliaceae	Moha Neem	Leaf, Stem	Effective against skin problems and oral problems	Leaf is boiled in water and sap or leaf paste is applied externally.	0.88	95.77
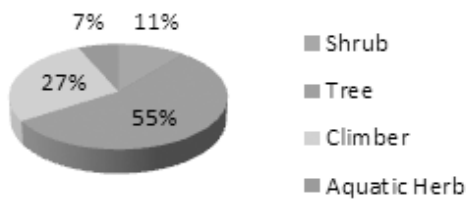
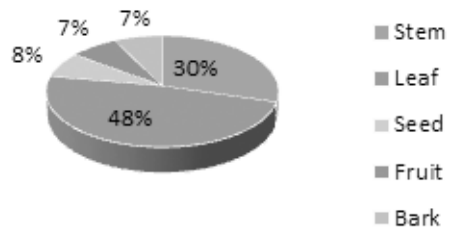**Figure 2.** Habitat of the Plants used

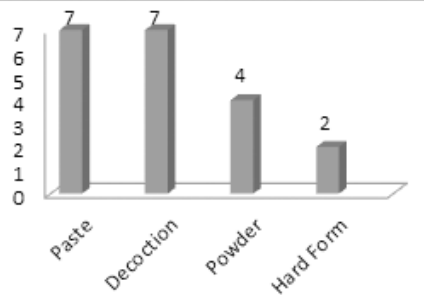**Figure 3.** Parts of the Plant used.
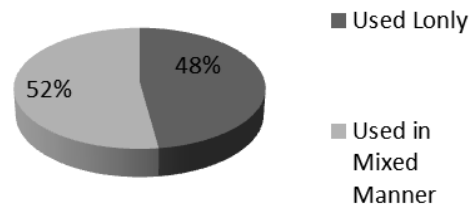

Figure 4. Percentage of remedy preparation

Figure 5. Percentage of drug used in mixed manner or in lonely manner.

In the study it is found that majority of the interviewee are aware of plant bioresources available in the study area for healing and curing of child diseases, and they know and identify these plant species with local or vernacular names which is a very common practice all over the world and it is a very useful tool for documentation of potentiality of these plant resource in the field of herbal medicine (Balamurugan, Karthick and Sasikumar, 2019).

Plants that are documented in the study showed all forms of habitat with slight dominance of trees over other habit (Figure 2) because the area signifies tropical rain forests characterized with dominancy of trees and climbers over herbs and shrubs. Out of 23 species that are recorded, in 48% species, leaves have medicinal importance, in 30% of species stem is viable, in 8% seed is viable and in 7% of the species, fruit and seed is viable (Table 2). As a remedy preparation, 7% of the plant is use as paste and decoction respectively, 4% as powder after thorough drying and 2% in hard form (Table4). In preparation of drug 52% of total plant recorded used in mixed manner with other product and 48% used lonely (Table 5). *Pisidium guajava* had highest *Use value* (UV) and *Fidelity level* (FL) followed by *Ipomoea aquatica* and *Canscora andrographiodes* as these are common trees found in this region. *Cissus quadrangularis* had lowest *Use value* (UV) and *Cyperus rotundus* had lowest *Fidelity level* (FL) as they are not very common and only few herbal medicine practitioners know about their use.

CONCLUSION

The present study focussed on various herbal medicines used by local herbal medicine practitioner of tea tribes of Assam for Paediatric health issues. These type information's are passed verbally from generation to generation. Their identification and potentiality as herbal medicine in documented form is utmost need for betterment of mankind. A lot of information gets lost due to lack of consciousness and scientific documentation. "So, it is very necessary to make thorough scientific study

of these data and protocol of their uses" (Das, 2021) [5]. Further chemical screening and elucidation, scientific trial and proper documentation of these potential herbal medicines is needed.

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Frauds in Indian Banking: Trends, Effect and Cures

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ABSTRACT

The financial frauds have been in existence for a very long time. The banking and financial services are the most represented sectors in the fraud cases. Banking industry is the bedrock of any developed and developing economy. It is therefore very important to find out any problem that disrupts the banking industry. Industrial development and established project financing are all done through banks; therefore eradication of fraud in banks is the concern of every worthy patriot of this great nation. The banking industry worries more about fraud because of the rather obvious damaging consequences of the acts on the health and for the existence of the institution. Perpetrators of fraud in banking transactions are liable to be prosecuted under the criminal law of the country for which adequate provision of punishment have been pre-scribed under Indian Panel Code. The present paper tries to study the trends of fraud cases in the banking sector. It tries to study the effect of fraud on the bank and the economy and to suggest some measures to reduce such frauds.

Keyword: financial fraud, banking sector, bank reputation, internal control

INTRODUCTION

Banks are an essential part of the Indian economy. Banks are dealing with public's money and hence it is imperative that employees should exercise due care and diligence in handling the transactions in banks. The term fraud can be defined in many ways. Bank fraud is the use of potentially illegal means to obtain money, assets, or other property owned or held by a financial institution, or to ob-tain money from depositors by fraudulently posing as a bank or other financial institution. Bank fraud is sometimes considered as a white-collar crime because it applies to actions that employ a scheme or artifice, as opposed to bank robbery or theft. RBI had not defined the term 'fraud' in its guide-lines on Frauds. A definition of fraud was, however, suggested in the context of electronic banking in the Report of RBI Working Group on Information Security, Electronic Banking, Technology Risk Management and Cyber Frauds, which reads as-'A deliberate act of omission or commission by any person, carried out in the course of a banking transaction or in the books of accounts maintained manually or under computer system in banks, re-sulting into wrongful gain to any person for a tem-porary period or otherwise, with or without any monetary loss to the bank.'

The Reserve Bank of India has been ad-vising bank from time to time about the major fraud prone areas and the safeguard measures nec-essary for prevention of frauds. According to RBI the primary responsibility for preventing frauds lies with banks themselves.

The banking industry worries more about fraud because of the rather obvious damaging consequences of the acts on the health of the bank and its existence. The stability of an economy is largely influenced by the financial system pertaining to that country. One of the main components of a financial system is the financial institution in the system. Any scam that hit the financial system will shake the foundation of an economy. The report on Occupational Fraud and Abuse, (Asia Pacific edition 2018) by Association of Certified Fraud Examiners, shows that banking is the second most industry hit by fraudulences (11% cases) second only to manufacturing (17%). The Government and public administration (10%) come in the third place. This result will definitely induce to examine the Indian scenario, especially in the banking arena because the majority of banks in India are under the Public Sector. John Maynard Keynes (1913) stated that "In a country so dangerous for banking as India, it should be conducted on the safest possible principles". So the importance of banking fraud identification and expel is clearly visible in his statement. The history of banking fraud is as old as the history of the bank; traceable evidence is available from Indian banking history literature. Few banking literatures point out the different type of frauds existed inthe 18th century that includes loan disbursement fraud, accounting, and clerical frauds, and corruption. The failure of the Presidency Bank of Bombay (1890) is an example of bank failure due to mismanagement and credit fraud. The current scenario is worse than ever as banks loss 410 billion in financial year 2017-18 which is 72% higher than a previous financial year and more than 5000 instances of bank fraud shook the Indian financial system. Due to the advent of technology, the dimension of banking fraud is larger than ever.

Literature review:
Chakrabarty (2013) revealed that while the number of frauds reported each year is actually coming down, the amount involved is going up substantially. While there is a pressing need to overhaul the system of monitoring, control, supervision and follow up of advances related frauds, their incidence in public sector banks in a large measure can also be trailed to comparatively poor corporate governance standards and lack of firm resolve by the Board and the Top Management in fighting this menace.[1]

Khanna and Bindu (2009) reveal that there is lack of properly trained and experienced persons. There is sudden and tremendous increase in banking business. The sudden expansive explosion has created a vacuum of personnel. New recruits often do not have adequate training or experience before they are put in responsible positions.[2]

Swain and Pani (2016) stated that while fraud is not subject that any bank wants to deal with, the reality is that most organisations experience fraud to some degree. Early detection through implementation of requisite programs or system to detect both emerging threats and the fraudster's moves can be an essential step towards containing and mitigating losses.[3]

Bhasin (2016) conducted a questionnaire-based survey in the 2012-13 period and revealed that the banks are not ready to accomplish zero tolerance arrangement towards frauds. The bank authorities are less conformed to national bank rules in instances of administration of passbooks, checks, inter-bank and internal account management and deposit account. The investigation likewise uncovered that junior official in the bank are less aware and prepared in the matter of frauds and also central bank guidelines in comparison with middle and senior managers.[4]

Kundu & Rao (2014) have pointed out that most of the bank scams or frauds are not disclosed because of the fear of mitigation of bank reputation. They also revealed reasons for increase in bank frauds viz; ignorance, situational pressure, and attitude of employees, procedural delay in detection and reporting.[5]

OBJECTIVE

The objectives of the study are:

1. To study the trends of frauds in the banking sector in India
2. To study the effect of bank frauds on banking industry and the economy
3. To give some suggestions to reduce frauds in banking sector

RESEARCH METHODOLOGY

➢ **Data collection:**
The study of bank frauds is based on the secondary data compiled from the following sources:

- The information of frauds from the year 2013-2022 is collected from various sources
- Articles published in the newspaper of The Economic Times, The Hindu, and Business Standards and so on.
- Published reports and surveys conducted by ASSOCHAM.
- Publication and circulars of Reserve Bank of India.

➢ **Period of study:**
The study undertaken took 2-3 months which is confined to data compiled from various secondary sources. It covers only the aspect of the total number of fraud and amount involved during the ten years period from 2013 to 2022 in different banking sector of the Indian economy.

➢ **Data analysis**
For the achievement of the objective of the study, the data compiled from various sources have been analysed and represented with the help of various charts and tabulations. The data has been presented to analyse the pattern of banking frauds in the different bank groups of the Indian Economy.

➢ **Limitations of study**
Due to time and resources constraints, the study is likely to undergo from following limitations. Some of these are mentioned here so that findings of the study may be understood in a proper perspective:

- The number of banks in India is so vast and the available data is so varied and diverse that it requires a lot much of time to analyse the whole data.
- As the study is totally based on secondary material, the possibility of unauthorised information cannot be neglected.

Discussion and Analysis:
Some statistics on bank fraud:

Table 1. Fraud Cases- Bank Group Wise (Amount in Rs. Crore)

Bank Group/Institution	2019-2020		2020-2021		2021-2022	
	Number of frauds	Amount involved	Number of frauds	Amount involved	Number of frauds	Amount involved
Public sector Banks	4410	148224	2901	81901	3078	40282
Private Sector Banks	3065	34211	3710	46335	5334	17588
Foreign Banks	1026	972	520	3280	494	1206
Financial Institutions	15	2048	24	6663	10	1305
Small Finance Banks	147	11	114	30	155	30
Payments Banks	38	2	88	2	30	1
Local Area Banks	2	-	2	-	2	2
Total	8703	185468	7359	138211	9103	60414

Source: RBI Supervisory Returns
-: Nil/Negligible
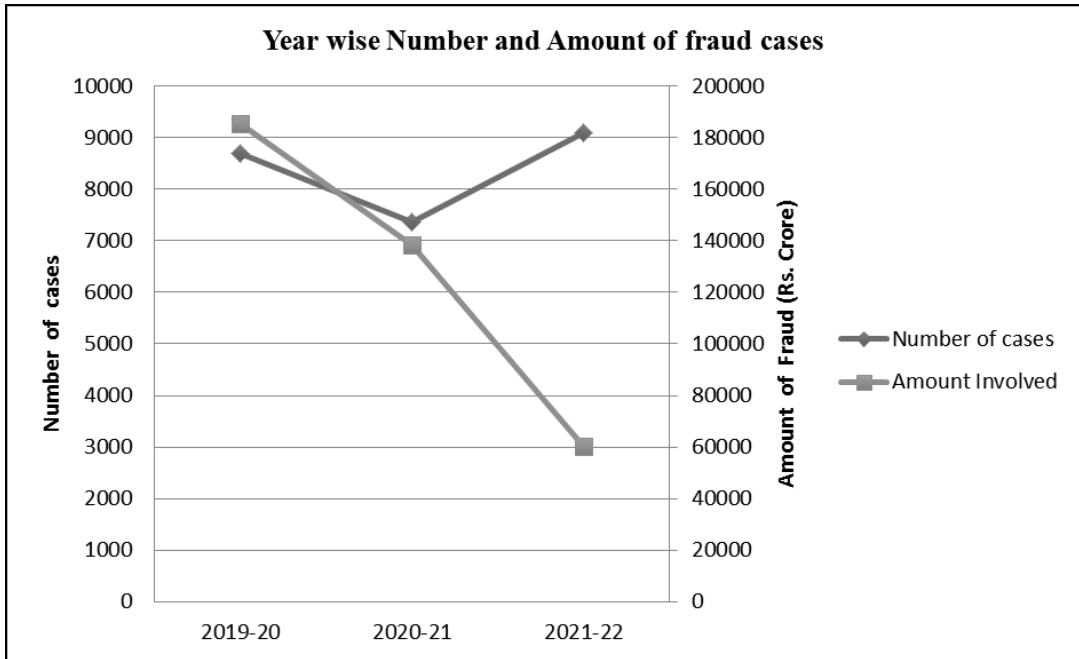
Figure 1. Year wise number and amount of fraud cases of different bank groups

Note:

1. The above data is in respect of frauds of Rs. 1 lakh and above reported during the period.
2. Frauds reported in a year could have occurred several years prior to the year of reporting.
3. Amounts involved reported do not reflect the amount of loss incurred. Depending on recoveries, the loss incurred gets reduced.

The table shows the number and amount involved in the fraud cases reported by RBI regulated entities as on March 2022.It shows a downward trend in the amount of fraud involved over the last few years. It indicates that while private sector banks reported maximum number of frauds, public sector banks contributed maximum to the fraud amount.[6] The share of Public Sector banks in the total amount of fraud involved is the highest.[7] The number of frauds in Public sector banks as shown by the data of last three financial years is 10389 as against 14776 in other bank groups. While the amount of fraud involved in public sector banks amounts to Rs. 270407 crores as against Rs. 113686 crores in other banks in the last three financial years. Public sector banks contributed around 67% in the total amount of fraud involved in 2021-22.

The above figure shows an upward trend in the number of fraud cases in 2021-22 compared to previous years while a downward trend in the amount involved over the last three financial years. In 2021-22, frauds to the tune of Rs 60,414 crore were reported, down 56.28 per cent from Rs 1.38 trillion in 2020-21.

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Table 2. Fraud Cases- Area of Operation

Area of Operation	2019-2020		2020-2021		2021-2022	
	Number of frauds	Amount involved (in Rs. Crore)	Number of frauds	Amount involved	Number of frauds	Amount involved (in Rs. Crore)
Advances	4608	181942	3497	136812	3839	58328
Off-balance Sheet	34	2445	23	535	21	1077
Forex Transaction	8	54	4	129	7	7
Card/Internet	2677	129	2545	119	3596	155
Deposits	530	616	504	434	471	493
Inter-Branch Accounts	2	-	2	-	3	2
Cash	371	63	329	39	649	93
Cheques/DDs etc	201	39	163	85	201	158
Clearing Accounts	22	7	14	4	16	1
Others	250	173	278	54	300	100
Total	**8703**	**185468**	**7359**	**138211**	**9103**	**60414**

Source: RBI Supervisory Returns

The above table shows the number and amount of frauds involved in different area of operation. The table shows that the advance category contributes maximum amount over the years. The fraud amount reported by public sector banks was mainly in loan portfolio. The frauds have been occurring predominantly in the loan portfolio (advances category), both in terms of number and value.

Table 3. Vintage of Frauds reported in 2020-21 and 2021-22

2020-21		2021-22	
Occurrence of fraud	Amount Involved (Rs. crore)	Occurrence of fraud	Amount Involved (Rs. crore)
Before 2011-12	6371	Before 2012-13	10930
2011-12	4365	2012-13	3272
2012-13	5016	2013-14	7270
2013-14	16143	2014-15	3451
2014-15	14635	2015-16	4661
2015-16	14167	2016-17	5620
2016-17	14486	2017-18	7346
2017-18	17293	2018-19	5448
2018-19	12851	2019-20	4912
2019-20	21432	2020-21	3719
2020-21	11452	2021-22	3785
Total	**138211**	**Total**	**60414**

Source: RBI Supervisory Returns

An analysis of the vintage of frauds reported during 2020-21 and 2021-22 shows a significant time-lag between the date of occurrence of a fraud and its detection. While the frauds framework focuses on pre-vention, early detection and prompt reporting, the average lag in detection of frauds remains long. The dates of occurrence of frauds detected in a financial year are generally spread over several previous years.
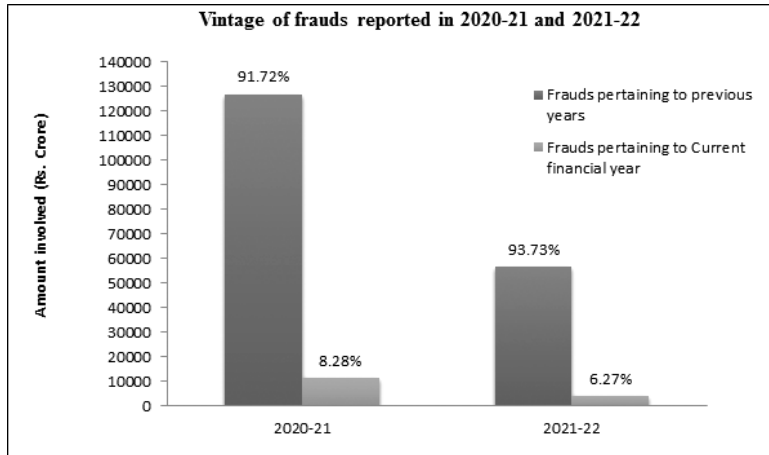
Figure 2: Vintage of frauds reported in 2020-21 and 2021-22

The above figure shows that 93.73% of the frauds in 2021-22 by value occurred in previous financial years as against 91.72% recorded in 2020-21.

Table 4. State-wise distribution of banking fraud cases involving staff (April 2013 to June 2016):

State	No. of cases	% to Total cases	Amount involved (Rs. Cr)	% to Total Loss
Tamil Nadu	170	14%	83.09	3%
Andhra	157	13%	148.41	6%
Karnataka	125	10%	89.34	4%
Maharashtra	107	9%	110.43	4.5%
Kerala	50	4%	30.53	1.2%
Rajasthan	38	3%	1096	45%
Chandigarh	03	0.2%	253.44	10%
Delhi	37	3%	188.22	8%
West Bengal	69	6%	167	7%
Overseas Branches	9	0.7%	41.6	1.7%
Other States	467	38%	241.53	10%
Total	1232	100%	2450	100%

Source: RBI (% & Figures Rounded Off Wherever Possible)

Data from April 2013 to June 2016 shows that a total of Rs 2,450 crore was lost to 1,232 frauds of Rs 1 lakh and more where employees were involved.[8] The above table shows that Southern states including Maharashtra have 49% (609) of all cases, but account for just 19% (Rs 462 crore) of the total money lost to such crimes. In comparison, Rajasthan which has just 3% (38) of cases with employee involvement accounts for 45% (Rs 1,096 crore) of money involved. Tamil Nadu, Andhra Pradesh, Karnataka and Maharashtra have the most cases of staff involvement in frauds in the country while Rajasthan, Chandigarh, Delhi and West Bengal lost the most money, collectively accounting for 70% of all the money lost.

Findings:

1. RBI Annual Report (FY22) saw more bank fraud but value decreased by half.
2. Public Sector Banks contributed around 67% in the total amount of fraud involved in 2021-22.
3. While Private sector banks contributed maximum in terms of number of frauds, Public sector banks contributed maximum to the amount involved in frauds.
4. There is a sharp decline in the amount of fraud in FY 2021-22 as compared to previous FYs. Frauds reported by banks and other financial institutions in value terms more than halved in 2021-22, despite the number of instances of fraud increasing.
5. Majority of fraud cases both in terms of number and amount involved belongs to advance category. Fraud in advance category contributes around 96% of the total amount involved in 2021-22. This means most frauds were committed by borrowers.
6. There is significant time-lag between the date of occurrence of frauds and its detection. The Reserve Bank of India's (RBI's) Annual Report for 2020-21 notes that the average time-lag between the date of occurrence of a fraud and its detection was 23 months; for large frauds (Rs 100 crore and above), it was 57 months.
7. A decadal analysis of data shows that out of the frauds detected in 2021-22, around 93.73% of the amount involved belonged to the previous FYs.

8. Effects of frauds:
   The number of bank frauds in India is substantial. The impact of fraud on banking system is undeniable. Some of the direct effects of bank fraud are as follows:

A. **Erodes public confidence:**
   The common man saves his earnings in public sector banks. The public sector banks account for 70% of India's household savings. Bank frauds directly affect the bank's reputation. Corporate frauds are eroding credibility of Indian Banking System. In September 2019, the Reserve Bank of India discovered that PMC Bank (Punjab & Maharashtra Co-operative Bank Limited) had allegedly created fictitious accounts to hide over Rs 4,355 crore of loans extended to Housing Development and Infrastructure Limited which was at the time almost bankrupt. After the scam came to light, RBI curtailed the bank's operations, capping withdrawals to Rs. 1000 once in six months.[9] This not only created huge panic among depositors but also stunned the banking and corporate circles.

B. **Depletion of stakeholders and bank capital base:**
   Frauds also affect the capital base of banks. Investors of fraud hit Punjab National have lost nearly Rs 15,400 crore since the Nirav Modi scam broke on February 14, 2018 as 40% of the bank's market capitalisation eroded during the period.[10] Recently, ABG Shipyard, now credited with India's biggest bank fraud, created a web of transactions to cheat a consortium of 28 banks of Rs 22,842 crores between 2012 and 2017, in a case which has come to light only now.[11] The banks include State Bank of India (SBI), IDBI and ICICI. As a result, the market cap of SBI fell to Rs 4,58,858.90 crore. Likewise Market cap of ICICI bank fell to Rs 5,29,977.61 crore on the BSE. SBI and ICICI Bank, otherwise known as 'too big to fail', have an exposure of Rs 2,925 crore and a staggering Rs 7,089 crore, respectively. ICICI Bank has the highest exposure in terms of loan granted to ABG Shipyard. The

fraud was first reported by SBI on November 8, 2019.

C. Diminishing the profitability of the bank:

Profitability of bank is also affected by frauds. In the last five years till 2016-17, PNB declared a loss of Rs 8999.17 crore on account of frauds-the highest among all state-run banks.[12] According to a data, SBI lost Rs 6228.01 crore during the same period due to fraud. According to the Reserve Bank of India's annual report released on May 27,2022, banks reported 9,103 frauds in FY22, involving Rs 60,414 crore. Interestingly, the total net profit of 12 state-run banks during FY22 stood at Rs 66,541 crore, which means the collective net profit of 12 state-run banks for the last financial year, which ended on March 31, 2022, was almost equal to the total frauds reported in the banking system during the same period.[13]

D. Effect on economy:

Frauds adversely affect the growth and development of the nation and cause significant damage to the economy of the country. It erodes confidence in financial credibility and stability of the nation. Bank scams cause a dis-balance in the economy often leading to weakening of the market. It erodes confidence in financial credibility and stability of the nation. Due to recent frauds in banking, foreign lenders became more reluctant to accept the guarantees from their local counterparts that underpin the loans. Due to such scams, stock markets face huge crashes thereby affecting the economy in a big way. This causes a slowdown in economic growth often leading to weakening of the economy and often disappearance foreign investment. The fraud announcements do affect the stock price of banks which experienced fraud. The highest abnormal loss is found in the stock price of Punjab National Bank (8.74 per cent) which involves the scam committed by the Nirav Modi.[14]

Recommendation:

Financial institutions are enhancing their processes, controls and fraud risk management frameworks to minimise the opportunities for fraud as well as reduce the time taken in their detection. The RBI had released a new framework to check loan frauds by way of early warning signals for banks and red flagging of accounts where defaulters shall have no access to further banking finance. It also plans to set up a Central Fraud Registry that can be accessed by all Indian banks.

The cost of fraud -both financially and to the bank's reputation -can be intensely damaging. With more than half of victim organisations unable to recover their losses, proactive measures to prevent fraud are critical. Some of the recommendations of the study are as follows:

- Fraud should be detected and declared early. It is important that all internal and external audits are completed on time at branch level. The audit reports should be shared with the government's auditors and examined by RBI, which should conduct a separate audit every year.

- Rotation of employees at periodical interval should be adhered. As per Central Vigilance Commission guidelines, all officers should be rotated every three years.

- Bank should not only adhere to 'Know Your Customer' (KYC) norms but also on 'Know Your Employee' to check frauds. Several frauds are insider jobs. Due diligence on other professionals like Chartered Accountants, Valuers and advocates involved in loan assessment and sanctioning process is also an essential safeguard.

- The data collection mechanism in banks is very archaic and needs a revision. The banks should employ the best available IT systems and data analytics in order to ensure effective implementation of the red flagged account (RFA) and early warning signals (EWS) framework suggested by the RBI, which would help in a better profiling of customers by analysing patterns of their transactions and rendering a near real time monitoring possible for banks. Also, we recommend that the Institute for Development and Research in Banking Technology (IDRBT) could consider incentivising development of relevant software for commercial banks at affordable costs. This is vital to enhance their monitoring of suspicious and fraudulent transactions within the branches of their banks.

- Regular disclosure of banking activities to RBI,

SEBI and other regulators should be made with consistent periodicity.

- It is necessary to train all bank personnel, not only auditors, about potential fraud risk factors. Bank personnel should be educated about common internal control weaknesses that create an opportunity for fraud to occur.

- Banks should have a strong internal rating agency, which evaluates big ticket projects before sanctioning loan. The rating agency should strictly evaluate the project on the basis of business model/plan of project without being influenced by brand name or credit worthiness of the parent company, considering current macroeconomic situation and exposure of the sector to the global economy. In case ratings of internal and external agencies are not similar then an investigation must be conducted to establish the causes for such differences. Also, bank should seek services of at least 2-3 independent auditors in evaluation of such projects so as to prevent chances of any possible collusion.

CONCLUSION

India's financial services sector has grown exponentially in the last decade. The incidents of frauds have also been on the rise. The study reveals that the number of cases of frauds have increased over the years. Banking frauds have long term effect on the health of the banks and the economy. As such the RBI and the Government must make sure that the banking system does not lose its robustness and the faith of common man due to unscrupulous businessmen and corrupt bank officials.

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Factors affecting marketing by social media influencer: A discussion on extensive literature.

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ABSTRACT

The digital space is growing ever than before. The recent covid 19 pandemic has just added fuel to fire. The new internet celebrities i.e. social media influencers has become more prevalent in the marketing arena owing to the growth of digital space. The social media influencers are replacing traditional word of mouth marketing and are sufficient to create necessary buzz around the brands, as they are considered to be the opinion leaders on the digital space. Most of the brand are now collaborating with these influencers and not hesitating to invest their money on them. However selecting the right influencer for the brand is a difficult task. It is more difficult now because a lot of new influencers are emerging. The marketer should select those influencers who can create value for the brand which is possible through establishment of brand credibility. The study aims to explore the variables that can add to brand credibility from influencer marketing perspective.

Keywords: Digital space, Social media influencers, Brand credibility

INTRODUCTION

Celebrity endorsement is one of the most commonly used marketing tools of organisations all around the world. Use of celebrities from different fields be it cinema, sports to promote products or services has always proved to be effective. But in the recent years with the advent of **new internet celebrity called social media influencers** and with their growing popularity, companies can be seen abandoning traditional celebrities and are preferring to market their product through these influencers (Veriman *et al*., 2017).

Social media influencers are the people who have built a sizeable amount of follower on social media platforms by proving themselves as a trusted tastemaker in one or several niche

(Veirman *et al*., 2017).They are regular people like us who have expertise in a specific area and have become popular by posting content regarding that particular area (Lou and Yuan., 2019). As they are regular people representing common masses, social media influencers enjoy a similar level of trust as people have on their friends (Swant, 2016). When businesses sell their product or services by means of promotion through these popular people on internet, it can be termed as influencer marketing (Ahmad,2018).Influencer Marketing can further be defined as a strategy whereby the opinion leaders on internet is used to promote brands (Noyan, 2017; Varamis, 2018; Tanwar *et al*; 2022). Influencer marketing is now being considered as "the next big thing" by most of the researchers (Agrawal,2016).From a survey

conducted by Linqia in 2018across a variety of industries, including CPG, Food & Beverage, Media, and Retail, it was found that 92% of the marketers found influencer marketing to be effective and it is growing to be an integral part of the marketing mix. Influencer marketing can drive actual incremental sales at a rate 11X traditional digital advertising. The impact of influencer marketing is more prominent in fashion and beauty industry. A study conducted by Vettese among 520 women on Facebook reveals that influencer marketing sways their purchase decision the most (Forbes, 2019). Consumers pay more attention to the photos and videos posted by the influencers than the TV commercial Ads as they are considered less credible.Thus, in order to establish connections with the customers, fashion and beauty brands are collaborating with social media influencers.

We could see researches being done on this subject "influencer marketing " in recent years. But most of these researches focuses on the impact of influencer marketing on the purchase intention taking credibility as a mediating factor (Lim *et al*.,2017;Sokolva *et al*., 2019;Müller *et al*.,2018;Veirman *et al*., 2017;Casaló *et al*., 2018). But how influencer marketing can add to **brand credibility** has not been fully explored yet. Brand credibility can help in building brand equity by indirectly addingconsumer value to the brand (Erdem and Swait,1998; Spry *et al*; 2011). The emergence of brand credibility concept can be attributed to brand Signalling theory according to which marketers use brands as signals (Erdem and Swait, 2002; ErdemansSwait, 2004).**Expertise and trustworthiness** are two important elements of brand credibility. A brand is considered credible if the brand have the ability (i.e. expertise) and willingness (i.e. trustworthiness)to consistently deliver what has been promoted (Erdem and Swait, 1998).This paper proposes to make study on extensive literatures to bring into focus various factors researchers have identified affecting the marketing by social media influencers.

Objectives: The objective of this paper is to review the literatures so as to find out factors premising research on social media influencers marketing. It is expected that the findings will help the scholars in design their researchin the field of influences marketing.

METHODOLOGY

As this paper is conceptual and intension is to highlight the various factors researchers have identified as crucial to influencers marketing, the scholar has undertaken extensive review of extant literatures. So, only secondary sourcesof information have been used.

Discussion: Extensive extant literature has been consulted to get insights into various factors that affect the markets. The common factors researchers have explored are discussed below.

(1) Source credibility-

Communicator's characteristics have a significant effect on the persuasiveness of the message. Credibility is a positive characteristic of a communicator that affects the receiver's acceptance of the message (Ohanian, 1990). According to Giffin (1967) credibility is a part of ethos of communicator and it can impact the effectiveness of message. The study conducted by Hovland (1953) is one of the earliest and pioneer researches to be conducted with an emphasis on source credibility in a communication process. Hovland (1953) defined source credibility as the sum total of two factors namely source trustworthiness and source expertise. However, in the landmark study conducted by Ohanian (1990), in order to develop a credibility scale, both the source credibility model provided by Hovland (1953) and source valence model provided by McGuire (1985) was merged.

In recent years' numerous studies (Teng *et al*., 2014; Fanoberova *et al*.,2016; Munnukka *et al*.,2014;Roy *et al*.,2013; Lou and Yuan, 2013; Reinkainen et al., 2020; Bhatt *et al*.,2020) have investigated the role of endorser's credibility in the persuasion process and its impact on consumer behavior. All these studies have adopted the Ohanian

(1990) scale of source credibility. There are three dimensions of source credibility- **trustworthiness, expertise and attractiveness**Ohanian (1990).

(i) Trustworthiness: Trust is the element of degrees of confidence in the trusted person or his communication (Giffin, 1967). Hovland (1953) defined trustworthiness as the degree of confidence in the communicator's intent to communicate the statements that he believes to be true. According to Erdogan (1999) trustworthiness refers to the honesty, integrity and believability of a person. Trustworthiness of an endorser in the communication process can influence the attitude of consumers (Bhatt *et at*., 2013)

Trustworthiness has a positive effect on the credibility of the influencer and it enhances the belief of the followers on the content provided by social media influencer promoting a brand (Lou and Yuan, 2018; Saima and Khan, 2020). Trust in the branded content can add to brand awareness (Lou and Yuan, 2018). For developing a long lasting consumer brand relationship trust is must (Morgan and Hunt, 1994). If credibility and trustworthiness is compromised, it might create distrust in the brand recommended by the influencer (Reinikainen *et al*; 2020).

(ii) Attractiveness: Attractiveness of a source is related to three factors- similarity, familiarity and likability. (McGuire, 1985). **Similarity** is a supposed resemblance between the source and the receiver with the communicator. **Familiarity** refers to the level of comfort that the receiver feels with the communicator and likability is the affection that is developed towards the communicator due to communicator's physical appearance and personal traits (Kiecker and Cowels, 2002). **Attractiveness** does not mean simply physical attractiveness, but includes any number of virtuous characteristics that consumers might perceive in a celebrity endorser. For example, intellectual skills, personality properties, lifestyles, or athletic prowess (Erdogan, 1999).

Apart from trustworthiness, **attractiveness and perceived similarity** are found to be important in enhancing trust in the branded content.

People feel similar to influencers which ultimately leads to the success of influencer marketing, but this is more relevant in case of beauty products (Schouten *et al*., 2019).

(iii) Expertise: Hovland (1953) states expertise as the extent to which a communicator is perceived to be source of valid assertions. Expertise may be judged on the basis of quantity of pertinent information, degree of ability or skill, or validity of judgment (Giffin, 1967). A source having knowledge, intelligence, maturity, and professional or social status, can be termed as an expert. A source with expertise is more persuasive than a source with less expertise (Kiecker and Cowels , 2002) . In the Ohanian's (1990) scale of source credibility five dimensions of expertise was used, namely- expert, knowledgeable, experienced, qualified and skilled.

However in most of the studies **expertise** is found to have no significant influence on the consumer purchase decisions (Ladhari *et al*., 2019, Lou and Yuan, 2018; Schouten et al; 2019).

(2) Para social relationship-

Para social relationship can be termed as the illusionary face to face and direct relationship between a media persona and a media user (Hurton and Wohl,1956;Jin,2018). Para social relationship may range from merely liking and having trust on the media persona, feeling similarity with him/her, desiring to have communication to para social love including romantic desire with the media persona (Tukachinsky,2010). These relationships can lead to a positive bonding between media persona and the audience (Rubin and Perse,1987). Such positive bonds results in the transfer of positive traits of the media persona or celebrities to the endorsed brand (Chung and Cho,2017). Para social interaction and para social relationship can enhance the cognitive and emotional engagement with the media content provided by the media persona and shift in the attitude of media users towards the message conveyed by the content (Libers and Schramm,2019). It has many characteristics of the real social relationships. The

human need for social affiliation is now fulfilled by most of the people from young generation by developing proximity and connection with the media figures (Hoffiner,1996).Para social relationship with the influencer attracts the followers towards the brand related information provided by the influencer and followers can evaluate the brand in a more objective and fair manner.Thus para social relationship can be used by firms to disseminate product information and also it is crucial for consumer's brand evaluation including value equity, relationship equity and brand equity (Yuan *et al*., 2019).Para social relationship plays a significant role in transferring trust from the follower to the brandpromoted by a particular influencer by reducing any apprehensions that a follower might have regarding the brand (Reinikainen *et al*.,2020).

(3) Advertising value-

Advertising value is the subjective evaluation of the relative worth or utility of advertising to consumers (Ducoffe,1951). The factors affecting online advertising value are informativeness, Entertainment and irritation. The way a consumer perceives the advertisement, influences their attitude towards the advertisement. The ability of an advertisement to provide resourceful and helpful information regarding the product to cause the a consumer to act in as positive way implies its informativeness (Ducoffe,1996). Out of all three factors the informative value of influencer generated contents positively affects credibility of theinfluencer and inturn affects their purchase intentions. Social media influencers regularly share contents on the social media platforms on the topics of their interest or areas where they have expertise. They are viewed as quality information and followers take purchase decisions depending on that. Thus brands should rely on informative content creators as a part of their collaboration (Lou and Yuan, 2018).The advertisers or promoters on the web also should focus on delivering more precise, concrete facts related to the products that they are endorsing ,so that consumer can take rational decision by evaluating various product alternatives (Burner, 2006; Zha et al., 2014).

Conclusion and implications-

The paper is an attempt to identify the factors that contributed to brand credibility in influencer marketing. Influencer marketing can prove to be an effective marketing strategy to reach that segment which very young and hard to reach provided that all the factors that can lead to its success are given due consideration. Going through previous literature, it has been identified that thecredibility factors such as attractiveness including similarity and trustworthiness has a significant influence on brand credibility. Besides that para social relationship with the influencer and informativeness value of advertising message created by the content creator on the internet are two important variables in transferring from the influencer to the brand that they are recommending. The ultimate goal of the marketers is to develop brand equity which can be done by establishing brand credibility. Brand equity helps a company to competitive advantage over its competitors. There are plenty of social media influencers but marketers must select and invest on those influencers who help the brand to establish brand credibility and generate revenues. Even though the study tried to shed light on the factors required for strengthening brand credibility in the context of influencer marketing by exploring the findings of the previous literature, more detailed studies needs to be conducted in this regard. Thus,future research involving survey among consumers to investigate their perspective in this regard will enhance credential.

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A study on management of household expenditure and savings-investment in select households in Guwahati City

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ABSTRACT

National savings and household savings-investment are one of the key factors that have direct relationship with economic growth of a nation. In India rural household prefer physical investment or economic investment. Urban Indian prefer to invest in the form of financial investment like share, mutual fund and fixed deposit savings etc. Researchers have revealed that urban households are willing to take more risk as compared to rural households. A total 150 households of Guwahati city are surveyed to understand the expenditure behaviour and savings-investment behaviour. It is found that income and educational status of the households head are important factors that influence the expenditure habit and savings-investment habit. Households prefer less risky saving-investment avenues rather than investment in stock market and mutual funds. Higher income households often keep a written or electronic record of monthly expenses and they have expenditure plans. They prefer savings in emergency fund out of excess disposable income. Most of the households have male members as Households head that also influence the expenditure and savings-investment habit. Number of dependent in every Households also influence savings-investment habit.

Keywords: Expenditure behaviour, Savings-investment habit, Household income, Educational status, Risk.

INTRODUCTION

Expenditure and savings are dependent variables of income. Income level determines the consumption expenditure and savings habits of every household. The categorical variables such as age of family head, education level, occupation and number of dependent family members are also work as factors that influence savings and spending habit of every household. Household expenditure consist of consumption expenditure on food and non-food items. Food expenditure increases up-to a point and after that it remains constant. Expenditure on non-food items increase if disposable income increases depending on many factors. Household debt and credit pattern also plays an important role in influencing the spending and saving habit of households. Economic and attitudinal both factors influence the spending and saving habit of consumers. But there are some factors which must take into account for the purpose of obtaining sufficient insight into consumer behaviour on spending and savings. Current and past incomes, current and past savings, presence or absence of regular saving plans, motives for saving, reasons for changing the amounts of saving, information on saving motives, holdings of liquid assets, attitudes toward liquid assets held, negative

savings, liquid asset holdings on new savings, Income expectations, price expectations and opinions about the general economic outlook are the variables that have influence on consumer behaviour (Katona & Likert, 1946).

Guwahati City is one of the largest metropolis in North-east India. The most common economic problem faced by the citizens of Guwahati is the hike in prices of essential commodities, vegetables, poultry, fish, petrol, diesel, transportation cost at a rapid speed. The prices of these commodities keep escalating at an inordinate rate because of which the households find it difficult in managing their expenditure out of limited and stable income. In another side the city is the educational hub of North-east Indian states. Therefore it is important to study the spending and saving habit of households in the city for understanding spending-saving behaviour of urban households.

LITERATURE REVIEW

Household income is the sum total of consumption expenditure and savings-investment. Under the head consumption expenditures, all items of food and non-food including expenditures on durables are included. Non-food items include clothing and footwear, medical care and health services, transport expenses, education, and household utensils and alcohols (Sethi & Pradhan, 2012). Engle's law observed the declination of relative percentage of income on food, when income increases (Engel, 1857; Houthakker, 1957; Ankar, 2011; Chai & Moneta, 2010; Perthel, 1975; Zimmerman, 1932). Spending of income on other areas of household expenditure increases with the increase of income. Consumption pattern of majority of Indian households depend on many factors like assets, level of education, occupation and demographic characteristics.

Household expenditure functions for food and consumer good, healthcare, education and durable goods can be estimated by using Engle's law (Parida et at., 2015; Working, 1943; Leser, 1963) where households have remittance income. Multinomial logit Model can be used to estimate household expenditure function for food and consumer goods, health care, education and durable goods. Migration from one state to another is driven by income distress in rural India and remittance plays an important role for determining spending behaviour of rural India. Households having higher income spend more income in educating other dependent members of the household to enable them to migrate in other countries for earning income (Oberai &Singh, 1980; Krishnaiah, 1997; Deshingkar et al., 2006; Samal, 2006; Awasthi, 2010). Remittance helps to meet the immediate consumption need and improve the socio-economic condition of migrant's family member at origin, reduce poverty, investment in home country or home state and have spill-over effect to other household (Mohanty et al., 2014). Remittance at international level strengthen foreign exchange reserve and indirectly contribute economic growth.

Indian household's income spending habit depends on factors like educational status of households, number of dependent family members, past and present income, financial knowledge, distance of financial institution from residential area.

Household behaviour deals with theories of spending (expenditure), savings behaviour, amount of income, influence of variables other than income on spending and savings, determinants of asset holdings, determinants of specific expenditures, management of household budget and decision making process (Ferber, 1962). Income has a positive impact on savings. Current income without differentiating the types of income has a positive impact on savings (Keynes, 1936; Friedman, 1957; Muradoglu et al., 1996).

In north-east India household spending and savings are influenced by many factors like income level due to their educational status, degree of financial inclusion, occupation, lack of saving knowledge, facilities available, etc. The investment level was strongly dependent with their occupation in the population. The Government employees were the most invested group according to most of the respondents and Businessmen, Private Employees and Housewives respectively

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rank second, third and fourth investing group of people (Wangkheimayum, 2014; Khatun, 2010; Nath, 2018).

OBJECTIVES OF THE STUDY
(1) To study the expenditure behaviour of households in Guwahati City.
(2) To study the savings-investment behaviour of households in Guwahati City.

RESEARCH METHODOLOGY

The present study is a descriptive research with a structured questionnaire followed by interview of 150 households in Guwahati city. Five point Likert scale is applied to prepare the questionnaire and to understand the expenditure-savings behaviour of the households. The popula-tion of the study consist of households of Guwahati City. Data are coded and analysed using MS excel and SPSS software. In addition to primary data from filed survey secondary data are also used from different journal papers, thesis, websites for doing and understanding the literature review and research gap respectively.

DATA ANALYSIS AND INTERPRETATION

Table 1 shows the demographic details of households. In this table frequency and percentage are included for the data. Gender is an important determinant who is the head of households in the studied area. It is found that 81 percent of the households are headed by senior male member in their family. Age wise it is found that majority (50 percent) of households head is age group between

Table1. Demographic Details of Respondents

Gender of respondents	No. of respondents	Percentage
Male	122	81.3
Female	28	18.7
Age	**No. of respondents**	**Percentage**
18 to 30 years	10	6.7
31 to 50 years	75	50.0
Above 50 years	65	43.3
Education level	**No. of respondents**	**Percentage**
Non-Graduate	54	36.0
Graduate	56	37.3
Above Graduate	40	26.7
Family Type	**No. of respondents**	**Percentage**
Nuclear	103	68.7
Joint Family	47	31.3
Occupation	**No. of respondents**	**Percentage**
Private Service	48	32.0
Government Service	29	19.3
Business	45	30.0
Others	28	18.7
Number of Dependents	**No. of respondents**	**Percentage**
One	14	9.3
Two	70	46.7
Three	25	16.7
More than three	41	27.3

Source: Field Survey by the researcher

30 to 50 years old, followed by 43.3 percent households head is above 50 years of age. It is found that majority (37.3 percent) of the urban household heads are graduate, followed by 36 percent are non-graduate and 26.7 percent are above graduate. 68.7 percent households are nuclear family households. Occupational status highlights that in Guwahati city majority (32 percent) of the household's primary occupation is private service, followed by 30 percent households have business income source, 19.3 percent household's primary occupation is government service and 18.7 depends on other source of income. It is found that majority of the household's (46.7 percent) have two dependent members in their family, followed by 27.3 percent households have more than three dependent members and 16.7 percent households have only two dependent member in their family.

Table 2 shows statistics on average monthly income, average monthly expenditure, monthly household debt repayment and monthly household savings-investment. It is found that the mean (average) monthly income of households is

10.84 which lies between Rs.30000 to Rs.32499, the mean monthly expenditure of households is 8.34 that lies between Rs.20000 to Rs.24999, the mean monthly debt repayment of households is 2.45 that lies between Rs.5000 to Rs.7499 and the mean monthly savings-investment of households is 2.44 that lies between Rs.5000 to Rs.7499. During filed survey, there are total 20 class intervals for average monthly income and average monthly expenditure each starting from "less than Rs.5000" and last class interval "Rs.55000 & above" and 21 class intervals for monthly household debt repayment and monthly household savings-investment each starting from "none", " less than Rs.5000", "Rs.5000 to Rs.7499" and last interval "Rs55000 & above". It is found that the maximum amount of monthly expenditure for the households lies between Rs.42500 to Rs.44999 and the maximum amount of monthly debt repayment of household's lies between Rs.40000 to Rs.42499. It is found that the maximum amount of monthly savings-investment of household's lies between Rs.17500 to Rs.19999.

Table 2. Statistics on Monthly Income, Expenditure, Debt and Savings-investment of the Households

	Monthly Income (Rupee in thousand)	Monthly Expenditure (Rupee in thousand)	Monthly Repayment of Debt (Rupee in thousand)	Monthly Savings-investment (Rupee in thousand)
N	150	150	150	150
Mean	10.84	8.34	2.45	2.44
Std. Deviation	5.412	3.610	2.347	2.038
Variance	29.290	13.031	5.511	4.154
Minimum	1	1	1	1
Maximum	20	16	16	8

Source: Field Survey by the researcher

Table 3. Household expenditure behaviour, attitude and behaviour

Statement on Expenditure behaviour	1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always					
	N	Mean	S.D.	Variance	Mini	Max
Pay all household bills on time	150	3.03	1.328	1.764	1	5
Keep a written or electronic record of monthly expenses.	150	3.25	1.336	1.784	1	5
Stay within budget or spending plan.	150	3.01	1.361	1.852	1	5
Save money from every pay check.	150	3.08	.959	.920	1	5
Save for a long term goal such as a car, education, home, etc.	150	2.55	1.144	1.309	1	5
Contribute money for a retirement plan/ scheme.	150	2.31	1.142	1.304	1	5
Buy bonds, stocks or mutual funds.	150	1.97	1.234	1.522	1	5
Buy household items.	150	2.85	.712	.507	2	4
Maintain an emergency savings fund.	150	2.75	1.342	1.801	1	5
Contribute an amount for adequate health insurance policy.	150	1.96	1.092	1.193	1	4
Contribute an amount for adequate property insurance like auto or home-owners insurance policy.	150	2.46	.939	.881	1	4
Contribute an amount for adequate life insurance policy.	150	2.77	.743	.552	1	4
Compare products at the time of purchasing it.	150	3.04	.962	.925	1	5
Compare prices of products at the time of purchasing it.	150	3.21	1.046	1.095	1	5
Searched for information about a big-ticket item before purchasing it	150	2.89	1.090	1.188	1	4

Source: Field Survey by the researcher

Table 3 shows the expenditure and savings-investment behavior of the urban households of Guwahati City. A total of five point Likert scale (1 = never, 2 = seldom, 3 = sometimes, 4 = often, 5 = always) based statements (Xiao & Dew, 2011) are included to understand the household's expenditure and savings-investment behavior. Expenditure behavior are analyzed from the statements, 'Pay all household bills on time', 'Keep a written or electronic record of monthly expenses', 'Stay within budget or spending plan' and 'Buy household items' with mean scores are found 3.03, 3.25, 3.01 and 2.85 respectively. It is found that 26.7 percent respondents often pay all household

bills on time followed by 24.7 percent respondents sometimes pay all household bills on time and 4.7 percent always pay all household bills on time. It is found that 26.6 percent respondents sometimes keep a written or electronic record of monthly expenses, followed by 23.3 percent often keep a written or electronic record of monthly expenses and 22 percent households always keep a written or electronic record of monthly expenses. 43.7 percent respondents sometimes buy household items, followed by 34 percent respondents seldom buy household items and 18.7 percent respondents often buy household items. Financial behaviour are analysed from the statements, 'Compare prod-

ucts at the time of purchasing it', 'Compare prices of products at the time of purchasing it' and 'Searched for information about a big-ticket item before purchasing it' and mean score are found as 3.04, 3.21 and 2.89 respectively. It is found that 50 percent respondents often compare prices of products at the time of purchasing it, 32 percent respondents often compare products at the time of purchasing it and 36.7 percent respondents often search for information about a big-ticket item before purchasing it. The savings- investment behaviour are studied with the statements, 'Save money from every pay check', 'Save for a long term goal such as a car, education, home, etc.', 'Contribute money for a retirement plan/scheme', 'Buy bonds, stocks or mutual funds', 'Maintain an emergency savings fund', 'Contribute an amount for adequate health insurance policy', 'Contribute an amount for adequate property insurance like auto or homeowners insurance policy' and 'Contribute an amount for adequate life insurance policy'. The mean score of response on the above statement are 3.08, 2.55, 2.31, 1.97, 2.75, 1.96, 2.46 and 2.77 respectively. 46 percent respondents sometimes save money from every pay check, 32 percent respondents sometimes save for a long term goal such as a car, education, home, etc. It is found that majority of the (55.3 percent) respondents never buy bonds, stocks or mutual funds. Most of them do not prefer high risk investment avenues. 28.7 percent respondents sometimes maintain an emergency savings fund, which means they have a positive attitude towards savings. Majority (49.3 percent) of the respondents never contribute an amount for adequate health insurance policy, which indicates that either they are not aware about the importance of health insurance policy or they prefer other investment options more than this. 63.3 percent respondents sometime contribute an amount for adequate property insurance like auto or homeowners insurance policy, whereas 62 percent respondents contribute an amount for adequate life insurance policy.

COLCUSION

Among the surveyed households of Guwahati city majority are nuclear family households with income from private service, govt. service and business income respectively. The educational status of most of the households head is non-graduate. The average monthly income of majority of the households are between Rs.15000 to Rs.17499 (8.7 percent), Rs.32500 to Rs.34999 (8.7 percent), Rs.12500 to Rs.14999 (8 percent), Rs.55000 & above (8 percent). It indicates that they have the capacity to save a minimum amount out of their monthly earnings. It is also important to mention that gender wise, majority of the household heads are male members and HH expenditure, savings-investment is influenced by the male member of the HHs. Higher income with stable sources of income HHs are willing to spend with planning and save/invest on regular basis. Income and education are overall important determinants of HHs spending, repayment habit of debt and savings-investment habit.

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Mudrayojna- A Performance Analysis 2016-2022 with Special Reference to North Eastern States

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ABSTRACT

Long term economic policies for a developing country like India play an important role not only in contributing to nation's GDP but also by providing employment to a large number of people. Small businesses in India are not in a position to contribute   effectively due to various constraints. Raising finance is one of the biggest problems for this sector. The scarcity of financial assistance and inadequate availability of credit facilities due to the weak credit worthiness of small businesses are the major causes of this problem. To remove the financial difficulties faced by micro and small business units the government of India launched a scheme on 8th April 2015 MUDRA to 'fund the unfunded'. The paper has made an attempt to review the financials of the MUDRA scheme for the period 2015-2022. Special reference has been given to the North Eastern states. The study is based on information collected from secondary sources.

Keywords: *MUDRA, Small Business, Financials*

INTRODUCTION

In a Developing country having large population like India, small businesses play an important role not only in contributing to nation GDP but also by providing employment to a large number of people. In India over 6000 products are manufactured by around 5.77 crore units and employ 460 million people in the country, of which 262 million people are self-employed. Micro Small and Medium Enterprises (MSME) contributes around 8per cent to GDP. The small businesses in the country are largely unorganized but employ a sizeable labour force. Small businesses are not in a position to play their role effectively due to various constraints. Raising finance is one of the biggest problems for this sector. The scarcity of financial assistance and inadequate availability of credit facilities due to the weak credit worthiness of small businesses are the major causes of this problem. To remove the financial difficulties faced by micro and small business units the government of India launched a scheme on 8th April 2015 called Micro Unit Development and Refinance Agency, or MUDRA to 'fund the unfunded'. MUDRA is still not a fully-fledged bank and is in its initial stages. It will provide its services to small entrepreneurs outside the service area of regular banks, by using last mile agents.

REVIEW OF LITERATURE

Londhe (2022)   measured and identified if the 'Pradhan Mantri Mudra Yojana' (PMMY) was

able to help and assist the targeted Bottom of Pyramid to achieve sustainable development by creating an inclusive, sustainable and value based entrepreneurial culture, in achieving economic success and financial security. A remarkable number of beneficiaries have been observed for shift to self-employment form previous jobs and status of unemployment.

Gupta and Sharma (2021) analysed Mudra Yojna and its impacton the Banking Sector. Banks take initiatives to promote the scheme as a result of which there is a year-on-year increase in the number of loan accounts created as well as loan amount sanctioned and loan amount disbursed. A percentage of the Mudra loans are turning to NPAs also as the borrowers are turning to be a defaulter. To cope with the NPAs and also to boost Banking Sector to intensively promote the scheme, GOI should take initiatives like the introduction of Collateral Security concept.

Poornima(2019) analyzed the MUDRA scheme and the products under the scheme. The researcher observed that f the procedural difficulties are removed then MUDRA scheme would definitely be a game changer in the MSME sector.

Ibrahim (2018) analyzed the performance of Micro Unit Development and Refinance Agency (MUDRA) Yojana, an initiative of Government of India to escalate the micro enterprises. The majority of the accounts holder and the beneficiaries of credit is General category but ST shows only meagre portion in both accounts opening and credit benefits. The majority of the accounts opened were in the 'Shishu' scheme, only meagre portion of accounts were opened in 'Tarun Scheme'. The study also found that there regional disparities in opening of MUDRA bank accounts, eastern region of the country have opened more accounts but the credit to the doesn't shows such proportion. The northern region of the country shows comparatively lesser participation in both creations of accounts as well as sourcing of credit.

Govindaraj and Gopalsamy (2020)stated the problems in recovery of Mudra loans provided by the NBFCs and defaults in it. Business failures, inefficiencies in lending practices, poor credit appraisal, willful default by borrowers and impaired cash flows are the major reasons in recovery of loans.

Ojha and Pandey (2022) studied how MUDRA has impact on Development of Entrepreneurship opportunity in East Singhbhum District of Jharkhand.Both government and private banks are playing leading role in acceleration of the MUDRA scheme in the district.

Bhosale (2022)highlighted the importance and the role of MUDRA bank towards the small business units. The reseracger observed that the scheme will contribute to the well-being of the individuals engaged in small scale industries which will positively affect the progress of the economy as a whole.

Laiju (2020) studied the features of Mudra Loan, its major advantages and limitations, whether it has helped in self employment and also the number of people who has availed it in the past years. Mudra indeed has promoted entrepreneurship especially among the youth who are the future brains of the nation and who can lead our country to a developed phase.

Girnara (2015) give information about what is mudra yojna, product and offering of mudra yojna, mission, vision and objective of mudra yojna, interest rate of mudra yojna, how to apply under mudra yojna, progress report ofvarious state in India relating to no. of sanctioned, total amount sanctioned, total amount distributed under mudra yojna, facts and figures relating to mudra yojna.

Agarwal and Dwivedi (2017) included the overview of PMMY, performance analysis of the scheme based on state, caste and category, SWOT analysis of the scheme and some recommendations.

Bhayana (2020) emphasized on the overview of Pradhan Mantri MUDRA Yojana in different states and overall performance by all the institutions for the year 2015-16 to 2018-19.

Mahajan (2019) studied and reviewed PMMY in the state of Maharashtra. It was found that MUDRA scheme has been fairly successful in the state of Maharashtra, but more need to be done for financial inclusion of all categories of people.

OBJECTIVES OF THE STUDY

1. To study the Prime Minnister MUDRA Yojna (PMMY) and its performance from 2015-2022
2. To study the distribution of the scheme in North Eastern States of India and interpret on regional balance of the Scheme.

METHODOLOGY

The study is based on secondary sources of data. The financial data were collected from research papers accessed from authentic websites including Mudra official site. For the observations and findings are analysed and presented table and facts were analyzed logically.

DESCRIPTION ABOUT MUDRA YOJNA

MUDRA (Micro Units Development and Refinance Agency Limited) Bank was formed in April 2015 by the Government of India's Union Budget. It aims to provide integrated financial support to the micro enterprises sector which includes small manufacturing units, food service units and small industries to name a few. The basic motive of establishing MUDRA is to extend the facility of institutional finance to small business entities involved in various trading, manufacturing and service activities. Along with MUDRA, the PMMY (Pradhan Mantri MUDRA Yojana) was also launched. Under the PMMY scheme, everyone from the non-farm income generating sector can seek loans up to Rs. 10 lakhs.

The following are some of the key features and characteristics of the Pradhan Mantri MUDRA Yojana:

MUDRA bank provides refinancing and credit support to institutions that promote small and micro enterprises. The products offered by MUDRA bank are -

- Micro credit scheme (MCS)
- Refinance for micro units
- Mahila Uddyami scheme for women entrepreneurs and
- Equipment Finance scheme

Refinance for micro units is given to commercial banks, regional rural banks, co-operative banks, micro finance institutions and non banking finance corporations. There are three types of loans offered under Refinance scheme. The loan is given on the basis of the stages of growth of enterprise (Table 1).

Table 1. Types of loans offered under Refinance scheme

Type of loan	Stage of enterprise	Amount of loan	Rate of Interest
Shishu	Starting stage Upto	Rs. 50,000	12%
Kishor	Mid stage	Rs. 50,000 to Rs. 5 Lakhs	14 to 17%
Tarun	Growth and development stage	Rs. 5 Lakhs to Rs.10 Lakhs	16%

Beneficiary-

Any businessperson or business who/which has not been a defaulter on any loan repayment previously is eligible to borrow under the PMMY (Pradhan Mantri MUDRA Yojana). Thus individual business owner, private limited companies, public sector companies, proprietary firms or any other legal business entity can apply for the Mudra loan.

Purpose of Loan assistance-

As MUDRA loan is a business loan, the loan amount cannot be used for personal needs. It is provided to small businesses that carry out specific activities in the manufacturing, services or trading sectors. Businesses can utilize the capital obtained from a MUDRA loan for marketing purposes, increasing the available working capital or for acquiring capital assets to grow the business. Maximum Tenure– As per existing rules of the PMMY, the maximum repayment period for a MUDRA loan can extend to 5 years, however, the repayment period can be shorter if the lender decides so while sanctioning the loan.

Objectives of the scheme-

To fulfill the main objective of "fund the unfunded",MUDRA has following important objectives.

1. Regulation of lender and borrower of microfinance and to provide stability by inclusive participation in micro-finance system and ensuring regulation

2. To cooperate in financing and lending activities of microfinance institutions (MFIs), and other lending agencies who make available finance to small traders, retailers, self-help groups and individuals.

3. For listing of all MFIs and to set up a performance level (performance rating) and system of preferential treatment for first time. This will help in assessment before taking loan and to reach that MFI which will meet the borrower's needs and whose oldest record is the most satisfactory. It will boost up the competitiveness of the MFIs.

4. To provide infrastructure guideline to borrowers by implementing them. Business crash can be avoided and appropriate measures can be taken timely. MUDRA will assist in making satisfactory procedure or guidelines to follow for recover the money owed in case of default.

5. Development of standard set of covenants regulating last mile lending to micro units, which in the future will be the strength of character of the micro-business.

6. Formulating and implementing a credit guarantee yojana for providing guarantees to the loan given to micro business units.

7. For monitoring of funds distributed and promoting right technology solutions for last mile.

8. To develop an effective system for last mile credit delivery to micro business units creating a good architecture under the scheme of Pradhan Mantri MUDRA Yojana (PMMY).

PERFORMANCE ANALYSIS

Performance Analysis is shown in Tables 2-5.

Table 2. Particulars about Shishu Schemes-2015-2022

Particulars	Shishu (Loans up to Rs. 50,000)							Total
	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-22	2015-2022
No. of Accounts	32401046	36497813	42669795	51507438	54490617	40180115	41721154	**299467978**
Loan Disbursed (Rs. Cr.)	62027.69	83891.88	104228.05	139651.55	162813.21	108637.24	123969.05	**785218.7**

Average loan per A/C (Rs.)& % increase / decrease	19143	22985 (20%)	24427 (6.27%)	27113 (11%)	29879 (10.20%)	27038 (-9.50%)	29714 (9.89%)	Average Rs. 25757
Loan out-standing (Rs. Cr.)	46811.38	60407.35	76655.45	102763.82		96172.17	127709.5	----

Table 3. Particulars about Kishore Schemes-2015-2022

Particulars (% of the total)	Kishore (Loans from Rs. 50,001to Rs. 5.00 Lakh)							Total
	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-22	2015-2022
No. of Accounts	2069461	2663502	4653874	6606009	6471873	9486160	11088206	**43039085**
Loan Disbursed (Rs. Cr.)	41073.28	51063.12	83197.09	99868	91427.07	127239.57	133389.24	**627257.4**
Average loan per A/C(Rs.)& % increase / decrease	198473	191714 (-3.40%)	178770 (-7.24%)	151178 (-15.43%)	141268 (-6.55%)	134132 (-5.05%)	120298 (-10.31%)	**159405**
Loan out-standing (Rs. Cr.)	36612.44	43925.22	73563.59	88651.68	82403.25	118042.95	118388.5	

Table 4. Particulars About Tarun Scheme-2015-2022

Particulars	Tarun (Loans from Rs. 5 lakh to Rs. 10 Lakh)							Total
	2015-16	2016-17	2017-18	2018-19	2019-2020	2020-21	2021-22	2015-2022
No. of Accounts	410417	539732	806924	1756871	1285116	1068771	986166	**6853997**
Loan Disbursed (Rs. Cr.)	29853.76	40357.13	59012.25	72291.84	75474.75	75877.66	74043.91	**426911.3**
Average loan per A/C(Rs.)& % increase / decrease	727400	747725 (2.79%)	731324 (-2.19%)	411481 (-43.73%)	587299 (42.72%)	709952 (20.88%)	750826 (5.75%)	**666572.4**
Loan out-standing (Rs. Cr.)	25869.05	33876.74	51894.23	68712.6	66646.09	70331.51	65608.46	

Table 5. Status MUDRA finance in North Eastern States 2015-2022

Sl. No	States	Shishu (Loans up to Rs. 50,000)		Kishore (Loans from Rs. 50,001 to Rs. 5.00 Lakh)		Tarun (Loans from Rs. 5 lakh to Rs. 10 Lakh)	
		No Of A/Cs	Disbursement Amt (Rs. Cr.)	No Of A/Cs	Disbursement Amt (Rs. Cr.)	No Of A/Cs	Disbursement Amt (Rs. Cr.)
		2015-2022	2015-2022	2015-2022	2015-2022	2015-2022	2015-2022
1	Arunachal Pradesh	56014	157.31	10223	230.60	5108	38.55
2	Assam	8145942	23337.69	1112712	13150.47	101409	5982.06
3	Manipur	344032	678.04	48717	710.02	6681	461.87
4	Meghalaya	162634	451.07	37288	662.93	9656	582.41
5	Mizoram	43301	172.97	39797	693.26	4448	310.17
6	Nagaland	60751	194.58	31445	497.34	5638	388.14
7	Sikkim	90031	238.96	252.16	418.51	6330	330.35
8	Tripura	1864128	5575.47	367964	4263.28	11527	795.53
9	**TOTAL (N.E.)**	**10766833**	**30806.09**	**1648398**	**20626.41**	**150797**	**8889.08**
10	**Share (%) to the total (India)**	**3.59**	**3.92**	**3.83**	**3.28**	**2.20**	**2.08**
11	**Average loan per A/C (Rs.)**		**28612**		**125130**		**589473**

Interpretation

1. Micro Units Development & Refinance Agency Limited (MUDRA) monitors the progress of Prime Minnister MUDRA Yojna (PMMY). The National Bank for Agriculture & Rural Development (NABARD) was also advised to closely monitor the progress of RRBs, as RRBs are under supervisory domain of NABARD.
2. Private Banks and MFIs are also partners of MUDRA.
3. The State Bank of India and its associate banks stands out among all the banks inlending under PMMY.
4. Among the Private Sector Banks, HDFC Bank tops the list. The RRBs are also playing a mojor role in proving assistance under the MUDRA scheme in the rural areas.
5. The loans were provided in highest inShishu (Rs.785218.7 Cr.) Category followed by Kishore (Rs. 627257.4 Cr) .and Tarun (Rs. 426911.3 Cr.) from 2016-2022category. Highest assistance in Shishu category hascoordinated MUDRA's primary objective of financial assistance to new small and marginal entrepreneurs.
6. However, the average loan provided under "Shishu" is Rs. 25757 and Rs. 28612N. E Statesis far below the maximum loan assistance of Rs.50, 000. In N.E States it is higher than the national average. This reveals that all loan applicants did not received
7. Rs.50,000.
8. In case of N.E states, Assam tops in the MUDRA Yojna. Tripura follows Assam. The other states also need more importance to have a regional balance and entrepreneurial growth

in the hill states of North Eastern Region of India.

9. The share of Account and loan disbursement in N.E states increased in the all categories during 2015-2022 is not encouraging. Government should focus more on N.E states as the states are not entrepreneurially rich traditionally.

10. Assistance should be increased in other categories also in the years to come as more finance will be required to a established business. But proper guidelines should be followed in provided the second term assistance or the banks will follow up with NPA.

11. It will be early to access the outstanding loan amount as it has been only 7 years of loan disbursement. But the Government should closely monitor the recovery status of the loan amounts for continuance of the scheme.

CONCLUSION

Due to PMMY there is a bigger change in the area of micro finance. This schemehas promoted competition in giving credit support to the weaker section, low income group and the unfunded population. Efforts are needed to invite more credit or loan disbursement. Financial inclusion through PMMY has increased the opportunities for credit requirement and refinance. If the plan is carry forwarded with proper and scientific monitoring, it shall work as a game changer financial inclusion initiative of Government of India and shall accelerate the economic growth rate of the nation.

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National Education Policy-2020: A Critical Study with Reference to Higher Education in India

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ABSTRACT

In accordance with the custom and traditions, countries acquire different education system and also attain various stages in their life cycle to make it fruitful in all schools, colleges and other higher educational institutes. Recently, the Government of India under committee chaired by Dr. K. Kasturirangan and this National Education Policy 2020 (NEP 2020)was approved by the Union Cabinet of India on 29 July 2020, sketched out the vision of India's new education system. The policyclarified that no one will be forced to study any particular language and that the medium of instruction will not be shifted from English to any regional language. Education in India is a concurrent list subject.The NEP 2020 is marching towards achieving such objective by making innovative policies to improve the quality, attractiveness, affordability, and increasing the supply by opening up the higher education for the private sector. By encouraging merit-based admissions with free-shipsand scholarships, merit and research based continuous performers as faculty members and strict monitoring of quality through biennial accreditation based on self-declaration of progress through technology-based monitoring, NEP2020 is expected to fulfill its objectives by 2030.

[Keywords: Accountability, Affordability, Implications, Multidisciplinary,National Education Policy2020]

INTRODUCTION

'Education is the manifestation of the perfection already in man' - Swami Vivekananda Education is the most fundamental thing to upgrade the national developmentAs youth represent the present and future of the nation, it is crucial to offer quality educational opportunities. In India, it is observed that a small proportion of students get enrolled in colleges due to their poor socio-economic conditions, inadequacy of teachers and dearth of modernization and innovative practices in higher educational institutions. The National Education Policy gives emphasis on the development ofcognitive abilities to each of the students, like – problem solving and critical thinking. Allstudents not only learn; but they also learn how to learn. The pedagogy must be holistic,discovery-based, flexible and learner-centered. The teachers are also playing a crucial role in the education system The New Education Policy aims at providing a platform to the teachers to help the students get better educational opportunities including the socially and physically disadvantaged category of students which in turn will reshape the future of the nation. The main aim of this new education policy is to give the high quality educational opportunities to all the students so that they can get

proper education. The National Education Policy of India 2020 (NEP 2020) was approved by the Union Cabinet of India on 29 July 2020 which outlines the vision of new education system of India.The new policy replaces the previous National Policy on Education of 1986. The policy is a comprehensive framework for elementary education to higher education as well as vocational training in both rural and urban India. The policy aims to transform India's education system by 2040.

OBJECTIVES OF THE STUDY

The present study is conducted with the following objectives:

- To understand the basic principles of NEP 2020.
- To distinguish between the NEP 1986 and NEP 2020.
- To identify the new innovation in National Education Policy 2020.
- To know the implications of NEP 2020 in Higher Education.
- To offer suggestions for improvement in the policy.

METHODOLOGY

The methodology used in this paper is descriptive and the data has been collected through secondary sources by taking help of draft NEP 2020, articles, websites and research papers. The Methodology used in this study also consists of simple discussion and arguments on National Education Policy 2020 where a few portion of NEP 2020 has been highlighted. It highlights the basic principles of this policy and tries to differentiate between the NEP 1986 and NEP 2020. An attempt has been made to provide an overview on the new inclusions of the policy; highlighting its implications and thereby offering some suggestions.

BASIC PRINCIPLES OF NATIONAL EDUCATION POLICY 2020:

The National Education Policy 2020 comprises of four parts and twenty-seven chapters, where, the government of India drafted various obstacles and situations that concern children education in the country. Initially, the draft starts with the introduction part encompassing fundamental requirement of the children, how to accomplish human potential, development of equality in the society, national development, quality education, scientific advancement, national integration and preservation of culture. It also illustrates goal 4 of the 2030 agenda adopted by India in 2030. Goal 4 is to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all by 2030. The policy also discusses the quickly changing global economy and employment opportunities that create criticality to the student in learning. India also aims to provide high-quality education by 2040. This policy is drafted by the chairperson of the National Education Policy Drafting Panel Mr. Krishnaswamy Kasturirangan. It states that this policy reforms the education system and teachers' recruitment and re-establishes a new system to make teachers the most respected and essential member of society. Then the policy describes the fundamental principles like identifying, recognizing, and developing the unique capabilities of every student, achieving basic foundation level in literature and numerals by 3rd grade, flexible learning, no difference between the departments, multi-disciplinary education system with equal importance to curriculum activities, emphasizing practical understanding, creativity, critical thinking and analysis, conceptual up-gradation, developing ethics and human values through constitutional preaching, the practical skill required to manage the life righteously, use of technology and so on. Then the Policy is classified into four parts as part1- school education, part 2- Higher education, part-3 professional education, and all other key areas, part-4 strengthening and financing various education boards, etc. Some of the basic principles of National Education Policy 2020are as follows:

- Learners are flexible to choose the subjects and are able to choose their own way along with their own interests and own talents.

- Students can choose any subjects from different streams as because there is no hard separation.
- This policy finds out the various capabilities of each student in academic as well as in non-academic areas.
- Facilitation of multidisciplinary studies so that the students are able to gain knowledge from different functional areas.
- Instead of rote-learning; new policy gives emphasis on conceptual understanding.
- In the teaching-learning process; the multilingualism and the power of the language must be raised.
- In this policy, main focus is put on critical thinking and innovative thinking.
- Instead of summative evaluation; the main focus is given on formative evaluation in a regular manner.
- The students can able to develop some life skills like – Teamwork, Communication, Co-operation and Resilience.
- In the teaching-learning process; the emphasis is given on maximum use of technology.
- The Constitutional values and ethics will be developed in students such as-respect for others, scientific temper, spirit of service, cleanliness, empathy, and respect for public property, liberty and responsibility.

DIFFERENT EDUCATIONAL STAGES

NEP 2020 Highlights Different Educational Stages: a range of stages of education are being highlighted as follows. This revised education policy enlarged the term of compulsory education from 6-14 years to 3-18 years. The government also intends to afford free education for economically backward students under this scheme. The new system consists of 12 years of schooling along with the 3 years of Anganwadi and pre-schooling. The new academic structure consists of the following classifications.

Foundation Stage: Foundational stage is for five years. In this stage the basic education is being provided and the education will be flexible, discovery-based, activity-based, play-based and multi-level. The emotional and cognitive level of a child must be continuously improved by the research.

Preparatory Stage: Preparatory stage is of three years which is activity-based, play-based and discovery based and the children gradually link up with normal classroom learning along with some textbooks. This stage focuses on introducing various subjects so that children can develop knowledge from them.

Middle School Stage: The middle school stage is for three yearsand this stage has given focus on the abstract concepts of all subjects such as arts, mathematics, sciences, humanities and social sciences and the technique of learning is experimental learning at all specialized subjects along with subject teachers having semester system.

Secondary stage: The secondary education stage is for four years with the subjects of multidisciplinary and the approach of curriculum will be always greater critical thinking, greater depth and greater flexibility. In this stage, there will be a semester system and each semester the students will study 5 to 6 subjects. At the end of class 10th and 12th the board exams will be held.

Under-graduation stage: The duration of under-graduation degrees will be either three/four years duration. After passing first year the students will get a Certificate, after passing second year a Diploma and after third year a Bachelor degree. Major and minor research projects are basically preferred in four year undergraduate degree programme.

Post-graduation Stage: The students who have four years B.A degree have one year M.A degree, three years B.A degree have two years M.A degree. In M.A degree there must be a research com-

ponent; so that the competence in the professional areas will increase and the students will prepare for a degree of research.

Research Stage: The least period of Ph.D.degree for a full-time and part-time is three to four years and in this stage, students will be allowed to pursue high quality research in any multidisciplinary subject. In Ph.D., course work in research or teaching pedagogyin context of respective subject domain must be provided. The M. Phil. program will be removed from the education structure and the introduction of the mother tongue medium of instruction in the system of education.

Lifelong learning: The new policy NEP 2020 opines for a lifelong learning so that all human beings are not deprived from having an experience, skills and knowledge in a society and have a comfortable life. It has believed that at any stage the education and research gives a satisfaction for a whole life.

Further, in addition to the above, it is also laid that the 360-degree holistic progress card will be introduced to evaluate the students as well as to keep track of the student's achievement and establishments. It is also proposed that National Curriculum Framework for Teacher Education 2021 will be formed and new degree qualifications for teachers will be introduced.

MAJOR CHANGES IN THE NEP 2020 POLICY:

Following 1968 and 1986 education policy, the NEP 2020 is the novel policy that aims to transformteachers' quality as well as students'. The NEP 2020 mostly aims at students' empowerment with universal knowledge. In this 2020 NEP policy, the government had substituted the 34 years old national education policy. There are 10 fresh key changes brought in the new policy as follows.

- The schooling starts from age 3 in the form of Anganwadi or kinder garden.
- The education structure had changed from 10+2 to 5+3+3+4.

- The differentiation and inflexibility between science, arts, and commerce had been removed.
- The schemes of internship and vocational education had been introduced with effect from class 6th onwards which will empower student to gain clarity and experience regarding the work environment as well helps them to improve their social skills as well as practical knowledge.
- The NEP 2020 had brought changes in board exam models also. Although, the class 10th and 12th board exam will continue, the model of the exam has been changed and the exam will not be focused on the syllabus but on the evaluation of the core subject knowledge.
- The NEP 2020 had brought back the four years undergraduate program system.
- The main reforms had been targeting to 50% of the gross enrollment ratio by 2035.
- The College fees will be fixed by the government and a separate committee will be organized to supervise the college fees and ensure that no colleges charged any fees above the cap fixed.
- The Common College Entrance Test will be conducted in all forms of the graduation program.

NEP 2020 AND HIGHER EDUCATION INSTITUTIONS:

In higher education, there were various controlling institutions like AICTE, UGC, MCI, etc. But as per NEP, these controlling institutions will be merged with Higher Education Commission of India (HECI) as a single controlling agency for Higher Education Institutions. The Higher Education Institutions are divided into two types – one is Multidisciplinary Universities (MU) and second is Multidisciplinary Autonomous Colleges (AC). By 2040 there will be more than 3,000 students. Presently, NAAC and NAB are the current Accreditation Institution, but NEP 2020 suggested that it

will be replaced by National Accreditation Council (NAC). There will be two types of Multidisciplinary Universities – one is Research intensive Universities and second is Teaching-intensive Universities. In Higher Education, along with vocational education the Gross Enrolment Ratio will be increased to 50% by 2035from 26.3 % in 2018. It is recommended that in the underserved regions, many higher education institutions shall be developed and established so that all students can access the education. It is expected that the Higher Education Institutions get more incentives from the government agencies. Regarding research activities, NEP suggested that in the undergraduate and postgraduate level, the research work must be includedalong with multidisciplinary and holistic approach of education and the pedagogy will mainly focus on the discussion, debate, presentation, communication, research and multidisciplinary thinking. There will be Academic Bank of Credit (ABC) for recording all the academic credits of all registered students.

In Higher Education Institutions, the curricular structure will be made more flexible and imaginative which enable creative combinations of disciplines for study. It suggested that the curriculum, assessment and pedagogy must be structured in a new way for increasing the experiences of the students. In Higher Education Institution, there must be encouragement for Online Distance Learning (ODL) and to help the financial needs of meritorious students; there must be increase in National Scholarship Portal. Scholarships to the students must be encouraged in private Higher Education Institutions. Presently, the end semester system has been going on, but this policy says that there will be continuous evaluation examination system by revising the Choice Based Credit System; and also there will be a Competency Based Credit System.

Additionally, each higher education Institutions must have centers for career counseling for all the students; so as to make them physically, emotionally and psychologically competent. The topic-centered clubs and some activities which are

to be organized by the students with the help of faculty in all Higher Education Institutions must support, develop and fund in the area of music, debate, sports, literature, poetry etc. The NEP 2020 opines that the process of learning will be made student-centered instead of teacher-centered where each Higher Education Institutions must focus on some innovations and research by setting up the Interdisciplinary Research Centers including humanities and social sciences research, Start-up incubation centers, Centre in frontier areas of research, technology development centers, Centre for Industry-academic linkage. The Bachelor degree of Four years with different options will be opened in Colleges and in accordance with the number of years spent in bachelor degree, the master's degree will be based on that. All higher education institutions must support and encourage the students who are belong form socio-economically disadvantaged backgrounds. Higher education institutions must have to provide some basic facilities and infrastructure such as labs, libraries, clean drinking water, blackboards, clean toilets, offices, proper teaching supplies, the space of classroom must be enough and each classroom must access the latest educational technology; so that the learning experiences of the students get better.

FEW POSITIVE FACETS OF NATIONAL EDUCATION POLICY 2020:
- Comprehensiveness: The NEP 2020 seeks to address the entire gamut of education from pre-school to doctoral studies, and from professional degrees to vocational training. In adopting a 5+3+3+4 model for school education starting at age 3, the New Education Policy recognizes the primacy of the formative years from ages 3 to 8 in shaping the child's future Early Childhood Education:
- Easy on Regulations: NEP 2020 makes a bold prescription to free schools, colleges and universities from periodic "inspections" and place them on the path of self-assessment and voluntary declaration
- The main goal of United Nations Sustainable

Development Goals is to give Quality Education to all students and so in NEP 2020, the private sector must give 20% free-sit and 30% scholarship to all meritorious students whobelong to economically disadvantages groups; so that they can get opportunities to study. This free education system will help to increase the Gross Enrolment Ratio (GER) at Higher Education level in the country.

- Higher Educational Institutions have freedom to do any kind of innovation in regard to curriculum, examination, courses, pedagogy and evaluation system; as the quality of education will also improve. If the institutions do not have anyfreedom, then the motivation and quality of faculty members and students get more affected.

- In Higher Education level; NEP 2020 replaces teacher-centric learning to student-centric learning. In teacher-centric, the teachers should decide about the curriculum, pedagogy, courses and evaluation system whereas in student-centric, students have right to choose their own subject for their studies and the students can also appear for competency-based evaluation according to their own speed of learning.

- NEP 2020 make over the Higher Education System from information centric to innovation or research centric. All higher education institutions must have the objective to create a new innovation or knowledge; so that all problems of the society can be solved easily.

- NEP 2020 gives emphasis on competency-based credit system, which will evaluate the skills of students along with their experience and knowledge and it also helps to find out the new problems on the areas of a study.

- It has been observed that many teachers who are upgrading their administrative positions forget their responsibility in research and publication related work. Professors who hold the administrative positions should also give their free time as a role model to young researchers who get motivated by seeing the

leaders so they can perform very well.

- The NEP 2020 gives more emphasis on the admissions of students, faculty selections and promotion according to merit-based. This policy say that the quality of higher education and research are only depend upon the faculty selections and promotion and the members of Board of Governors must be highly qualified.

- In NEP 2020, the productivity of a teacher will be based on research output. Since in higher education system research is a very important thing, so faculty members must have motives and experiences in research work so they can be a role model for their students. Their performance only depends on their research work and publication work.

- The objective of NEP 2020 is to solve the social status hierarchy which is related with vocational education and it is necessary to all education institutions to merge the vocational education programmes into mainstream education and will make sure that all children can learn at least one vocation.

- NEP is holisticpolicy which aims to eliminate problems of pedagogy, structural inequities, access asymmetries and rampant commercialization. The Policy proposes the creation of 'inclusion funds' to help socially and educationally disadvantaged children pursue education

SOME CONCERNS OF THE NATIONAL EDUCATION POLICY 2020:
Few of the concerns expressed about the NEP 2020 are as follows:

- The panel's report fails to address and include ideas based on contemporary global thinking such as emphasis on creativity, critical thinking, need for learning in a non-competitive and non-hierarchical ecosystem and discovering one's passion without any sense of fear.

- The suggestions of volunteer teachers, peer tutoring, rationalization of the system of

- schools and sharing of resources do not seem like long-term solutions.
- Delivering the changes proposed related to anganwadis may be complex despite the focus given to early childhood care and schooling.
- Lack of clarity in government strategies in regard topublic sector like municipal schools, state-run institutions, Kendriya-Vidyalaya, etc.
- The creation of a National Testing Agency (NTA) has generated skepticism. The NTA, though visualized to serve as a premier, expert, autonomous testing organization to conduct entrance examinations for admissions and fellowships in higher educational institutions may, in reality, lead to loss of autonomy among the universities and departments over admissions.
- The sharpest criticism of NEP 2020 is that it would lead to the privatization of higher education, as it has changed the affiliation system and proposed to grant autonomy to colleges after 15 years which will certainly open the doors to privatization.
- In the NEP 2020, language may be a negative factor as there is inadequate teacher - student ratio in India, thus introducing mother languages for each subject in academic institutes is a problem. Sometimes, finding a competent teacher becomes a problem and now another challenge comes with the introduction of the NEP 2020, which is bringing study material in mother languages.
- According to NEP 2020, students willing to complete their graduation have to study for four years while one can easily complete his/ her diploma degree in two years. This might encourage the pupil to leave the course midway.
- According to the NEP 2020, students of the private schools will be introduced to English at a much earlier age than the students of the Government schools. The academic

syllabus will be taught in the respective regional languages of the Government school students. This is one of the major new education policy drawbacks as this will increase the number of students uncomfortable in communicating in English thus widening the gap between sections of the societies.

SOMESUGGESTIONS FORWARDED TOWARDS NEP 2020 REGARDING HIGHER EDUCATION: In my view, thereis certain requirement of amendments in current educational policy. Considering the Educational Institution Amendment Act 2016 and education policies of many states, the amendments should be brought for the educational institutions and their provision of facilities to the students. Some recommendations are:

- Introducing online platform for conduct of classes and setting up cells for lodging complains in educational institutions.
- The education institutions license should be renewed every 3 years only after inspection and scrutiny made by the concerned department authorities.
- Education ombudsman must be appointed for every district to solve the disputes that arise regarding the education system and educational institutions.
- Every multidisciplinary institution must have at least five disciplines. The main objective of multidisciplinary institutions is to give multidisciplinary experience and choice. Some disciplines are as follows – Computer Science, Languages, Social Science, Basic Science, Education, Engineering, Medical Science, Dental science, Indology, Indian Medicines etc.
- In this policy, it is said that the Ph. D will be compulsory, so there will be a large requirement in Ph.D. degree and the demand for research guide will also increase. Therefore, all universities must reappoint the retired professors as research guides for assisting scholarsin Ph.D.programmes which will reduce dearth of

research guides.

- As per NEP, integrated B.Ed. course is compulsory for teaching in foundation, preparatory, middle and secondary school. Likewise, the Ph. D degree should be compulsory for getting a job for Assistant Professor in colleges and universities as per NEP 2020; because the research is going to be an important part in bachelor's degree as well as master's degree.

- In Higher Education institutions need for adopting technology-based training methods for imparting vocational, industry linked and skill-based courses exist. Moreover, provision for learning subjects through MOOCs platform must be provided.

- In all higher educational institutions, the IPR generation must be compulsory to avoid faculty obsolescence. So, it is very necessary for all faculties to publish at least two open access scholarly research papers and must have with copyright certificates from Government of India.

- In Higher Education levels, greater focus should be made on vocational education so that students may identify their individual areas of interest and engage in productive activities thereby creating self-reliance.

- It will be very helpful for the students if the publication of papers made compulsory intheir post-graduation courses. In under-graduate courses, the awareness which isrelated to IPR must be provided.It has observed that research-oriented activities are getting discouraged due to lack of financial help. So, it is very important to alluniversities to have their own publication unit in a proper or systematic way topublish high quality research work and sharing with global indexing agencies.

- Emphasis should be given on strict evaluation of the project or research work which wasfunded by National Research Foundation (NRF) by making research output basedcredit bank for all NRF members.

Few further steps maybe followed by all Higher Education Institutions to make NEP2020 more effective and successful:

- The curriculum should be designed more comprehensively.

- For pursuing higher education, all institution should provide fees to all financially deprived students.

- The process of admission should be more all-encompassing.

- No-discrimination and anti-harassment rules will be sternly enforced.

- Institutions on must develop degree courses and it will be taught in bilingual and in local Indian languages.

- There must be an appropriate counselling and mentoring programmes to deprived students.

- Proper care should be taken for divyangjan students.

- Institutions must develop an Institutional Development Action Plans;

CONCLUSION

The NEP 2020 came after 34 years and is all set to change the existing academic structure of India with the purpose of making it at par with the international standard of academics. The Government of India aims to set up the NEP by the year 2040. Till the targeted year, the key points of the plan are to be implemented one by one. The proposed reform by NEP 2020 will come into effect by the collaboration of the Central and the State Government. Subject wise committees will be set up by the GOI with both central and state-level ministries for discussing the implementation strategy. With the introduction of NEP 2020, many changes have been made and one of those is the discontinuation of the M. Phil course.

The new education policy proposes measures to recruit the very best and brightest to enter the teaching profession at all levels, by ensuring livelihood, respect, dignity, and autonomy, while also instilling in the system basic methods of quality control and accountability. It is

believed that by implementing these changes, the Indian academic system will be taken a step higher. With the view of the current education system and the stakeholder's expectation, it is believed that the NEP 2020 will bring a new revolution in the educational policy and also there is larger capacity to improve the rate of literate in India. This NEP 2020 also helps students from dropping out of education between the age of 3- 18. This may help students in pursuing a flexible system of education without any constraints. The NEP2020 will be the first policy that possesses various changes that benefits the students. The most admirable part of the policy is that their aim of goal4 making Indian students equipped with universal knowledge is the best part which will help the students to launch themselves in the international platforms. The outline of NEP is expected to revise the regulatory avatar of the Higher Education Commission of India ("HECI") being set up with a wide role in Indian higher education. The HECI is likely to have four verticals under its umbrella, such as (a) National Higher Education Regulatory Council, intended to be a single point regulator for the higher education sector; (b) National Accreditation Council, which will deal with accreditation of institutions; (c) Higher Education Grants Council, which will be tasked with carrying out funding and financing of higher education; and (d) General Education Council, the final vertical, is expected to have a more academic based-role, as it will structure expected learning outcomes for higher education programmes. Foreign universities coming into the country will also fall under the purview of this framework. While the Universities Grants Commission and the All- India Council for Technical Education have played a major role in this direction until now, questions pertaining to the role of the UGC and AICTE remain unanswered under the new policy. It is expected that NEP 2020 will opens up avenues for home-schooling and foreign universities alike, in India.

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Cowries and Forest Resources: Commercial and Cultural Transactions in Northeast India and Beyond (*c*. 5th -13th centuries CE)

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ABSTRACT

Northeast India, a physiographically land-locked area, fawning the easternmost part of India has culturally and commercially maintained close relationships with the Ganga Valley, Bhutan and Southeast Asia as early as the 5th century CE. While the riverine and overland trade network connections accorded the region its economic character, exotic items of trade such as cowries and forest resources were often peddled through these routes which demonstrated the global significance of the region of Northeast India as a part of the larger Southeast Asian, South Asian and the Indian Ocean context. This paper is an attempt to understand that Northeast India played an active and dynamic role for long-distance trade and has drawn connections between the neighbouring regions of Yunnan (South China), Bhamo (Northern Myanmar) and Bhutan for over half a millennium.

Keywords: Northeast India, Cowries, Forest Resources, Trade, Networks

INTRODUCTION

Northeast India in present day is the easternmost part of India which represents both a geographic and political administrative division of the country. Historically gleaned from literary, archaeological and epigraphic studies, this region has maintained close relationships with the Ganga Valley, Bhutan and Southeast Asia. Positioned within the girdle of the Eastern Himalayas, the Patkai, the Brahmaputra and the Barak plains; this land-locked area finally merges with the north Bengal region. Situated at the confluence of the Indo-Malayan, Indo-Chinese and Indian biogeographical realms, this region has emerged as an interaction zone among diverse cultures and civilisations.

Physiographically speaking, Northeast India is a land-locked area. The hydrography of the region has considerably influenced the settlement pattern and communication network. This land-locked region finds its only outlet to the sea through the Bengal delta; the delta being the only *a-samudrahimācala* (stretching from the Himalayas to the sea) region in the entire Indian-subcontinent. The interplay between the Himalayan forelands and the Bengal delta accentuated by the geography of the place provided feasible conditions for networks of communication (Chapman & Rudra, 2015: 2-4). In addition to the riverine networks of connectivity, the overland trade routes also have given the region its economic character. It is these networks which places Northeast India within the trade routes of Southwest Silk Route. The Southwest Silk route refers to a route network linking Southwest China (Sichuan and Yunnan), with Tibet, Southeast Asia and beyond. The Southwest Silk route included four main branches with numerous sub-branches. The first links Si-

chuan and Yunnan to India, via Burma. It is called the Road of Chwan-Dian-Mian-Yin (Sicuan Yunnan-Burma-India) (Yang, 2004: 281-322). These rubric of networks and communication patterns enhanced the role of Northeast India in transregional interactions.

This paper is a desideratum to work on the region of Northeast India with a particular focus to present almost half a millennial perspective of the commercial and cultural transactions on certain exotic items of trade such as cowries and forest resources (aloes wood, yak tails, musk deer and rhinoceros' horn) between 5th to the 13th centuries CE, bearing the chronological label, the 'early medieval' (Sharma, 2009). In that endeavour, it shall aim to demonstrate the global significance of the region of Northeast India as a part of the larger Southeast Asian, South Asian and the Indian Ocean context. The focus shall be to argue that Northeast India played an active and dynamic role for long-distance trade and has drawn connections between the neighbouring regions of Yunnan (South China), Bhamo (Northern Myanmar) and Bhutan for over half a millennium. We shall try to understand if these routes of communication constituted a network supplementing each other spatio-temporally. The interconnectedness of the historical region with its adjacent/contiguous area- sort of a connected history will be divulged into.

A region is a part of a given whole; the whole is often taken as a nation state. However, the period of research did not experience a nation state. So, the study of this historical region in relation to its neighbouring areas go beyond the parameters of a nation state. The aim is to trace certain possibilities of networks of connections, both through cultural networks and trade linkages. These networks which acted as arteries of commerce, facilitated the movement of man and material. To understand these networks, we shall study both stated and unstated linkages as gleaned from copper plate charters, geographies, literary texts and travelogues.

METHODOLOGY AND SOURCES

The most challenging task is the effective methodology of handling sources. The proposed paper will pay particular attention to multiple genres of sources. The methodology is to use the sources in terms of their temporal and spatial moorings; in a diachronic manner and not in a synchronic style. This aids us in identifying the forces of continuity and change thereby offering better explanations of the past. The use of diverse sources in a non-synchronic manner might leave an impression of a uniform, immutable past for half a millennium which was unlikely to have been static in terms of socio-economic, political and cultural experiences beyond dynastic shifts. The diversity of sources offer multiple images of the past in terms of the biases, perspectives and aims of respective authors. It is then that we can present the past as a complex entity and not as a descriptive narrative.

For the proposed paper inscriptional, field archaeological, textual, numismatic sources and travelogues will be utilized to demonstrate the vitality of studying these networks in order to construct a more comprehensive picture. This shall add a new dimension to Sino-Indian, Indo-Malayan and Indo-Burmese exchange and communication. The proposed research aims at looking into this region, as gleaned from the following variegated sources:

The cultural materials from the major archaeological excavation at Sekta burial site excavation in Manipur (c. 4th -5th centuries CE) will be analyzed. Extant inscriptions in this region assigned to the 6th -13th centuries CE records land grants which are legal documents issued by political authorities to record the perpetual gift of revenue-free landed property (agrahāra) to religious donees (individual, collective and institutional) to be maintained by functionaries and people in the locality. Replete with information on rural settlements, society and material culture, these records offer insights into the state and economy of early Northeast India.

Coins have often been analysed to study the linkages between spaces in a specific temporal context. Our numismatic sources for the period till 13th century CE come from a hoard discovered at Paglatek lying on the south bank of the Brahmaputra about 15 km to the west of Goalpara district. The same type of coins of the 7th and later centuries CE has been found in Bangladesh and Tripura. An alternative face of the monetary history of the region is the acceptance of cowrie shells as a medium of exchange. This will be one of the primary exotic items to be elaborately discussed in this work.

The importance of textual importance to study economic life is fairly established. Literary sources like Bāṇabhatta's *Harṣacarita* of the 7th century CE and the *Rāmacaritaṁ* of Sandhyākaranandin of the 12th century will be probed into. Travelogues and pilgrims' accounts have often hinted on the history of a region. Their observation has directly or indirectly reflected on the agrarian life, geography and topography, social and cultural life of the areas they visited. Some of the travelogues which shall be discussed are- the geographies of Sulaimān Al-Tājir (*Akhbār Al-Ṣīn Wa'l-Hind: An Account of China and India, A.D. 851*) and Ibn Khurdādhbih (*Al-Masālik wa'l-Mamālik: Roads and Kingdoms, A.D. 912*) and the lived experiences of Ibn Battuta (*Travels in Asia and Africa: 1325-1354*).

COWRIES

This brings us into our first section of discussion. A study of the commercial and exotic items of trade between these regions can yield details about the network of connectivity. This is the Northeast Indian trade and cultural connections with its neighbouring regions as illuminated from the presence of cowries. The commercial connections of the Northeast were through two ways. One was towards the east i.e., towards Myanmar and China and the other to the west of it i.e., towards Bengal.

Our first evidence comes from the *Harṣacarita,* a 7th century CE text by Bāṇabhatta

which lists black and white cowries gifted to Harṣavardhana of Kanauj by Bhāskaravarman of Kāmarūpa in the 7th century (Barpujari, 2007: 262). This is followed by the Tezpur rock inscription of Hajaravarmana of 829 CE which mentions *vuṭṭikā*. This term has been widely translated as cowries.

There could have been a slightly later notion of the Northeast India being in contact with the Bay of Bengal on one hand and Yunnan-Bhamo on the other hand. This is reflected from the evidences of cowries as found from contemporary Bengal. Sulaiman, [*Akhbār Al-Ṣīn Wa'l-Hind* (*An Account of China and India*) (A.D. 851)] stated that in the kingdom of Ruhmī which is the Pāla empire "trade is carried on by means of *kauris*, which are the current money of the country" (Elliot & Dowson, 1867: 5). The *Rāmacaritaṁ* written in the 12th century CE states that, "Madanapāla maintained his large army by cowries and daily bread" (Mukherjee, 1982: 68). Minhāj-ud-din Abū-Umar observed in the 13th century CE that in the country of Rae Lakhmanīah "as in the country of Kauri (shells) is the current money in place of silver" (Mukherjee, 1982: 68-69). Ibn Battuta [*Travels in Asia and Africa (1325-1354)*] observed that in Bangāla not long after the end of the rule of the family of Daśarathadeva in that area "the rates of local commodities are terms of dirham", but stated that the local people used cowrie shells in exchange of rice, used them as money (Mukherjee, 1982: 68-69). Further, in the words of the 14th century CE traveler, Ibn Battuta:

> *From these lands islands there are exports of fish which we have mentioned, coconuts, cloths and cotton turbans, as well as brass utensils, of which they have a great many, cowrie shells and qanbar…the inhabitants of these islands use cowrie shells as money. This is an animal which they gather in the sea and place in pits, where its flesh disappears, leaving its white shell. They are used for buying and selling at the rate of four hundred thousand shells for a gold dinar, but they often fall in value to twelve thousand for a dinar. They sell them in ex-*

change for rice to the people of Bengal, who used them instead of sand (as ballast) in their ships.These shells are used also by the negroes in their land; I saw them being sold at Malli and Gawgaw at the rate of 1,150 for a gold dinar. (Battuta, 1983: 243)

Cowries are clearly a marine product which was obviously procured from the sea coast of Bengal. The Assam cowrie hoards provide us the evidence of processing of these shells during their export through the Southern Silk Road. These were found in Amiyanagar, Hojai, Lanka, north Lakhimpur. The evidence of these hoards clearly is indicative of their export to China through Assam. The work of cutting cowrie shells was accomplished in Assam in the process of transport. They were either transported from the Maldives to the Bengal coast or Odisha. These were then sent through the Southern Silk route to China and Yunnan (Majumdar, 2014: 596).

Cowries are still valued by tribes inhabiting Northeast India. For instance, in Nagaland cowries are worn by tribal elders as a mark of their status. Bin Yang while describing the cowries in Yunnan cites Michele Pirazzoli-t' Serstevens that 'the most frequent cowry species found in Tien tombs are Cypraea annulus Lin. This seems to have been a special highly prized form of money, a statusmarker, and a certain form of prestige goods, accumulated as stores of value and used in intersocietal exchanges between elites, exclusively' (Yang, 2004: 306-07). Thus, based on this statement Bin Yang states that 'these cowries serve as strong evidence for the southwest silk route, or trade of luxuries between Yunnan and the Indian Ocean Zone' (Yang, 2004: 306-07).

Although beyond the scope of this paper, another significant prestige good which were sent deep into the Indian northeast through the 'cowrie trial' were the Indo-Pacific beads. This is clear from hundreds of Indo-Pacific beads (circular & tabular) excavated at the early historic site of Sekta in Manipur. The site of Sekta which flourished between 200 BCE to 600 CE was located at crucial crossroads of the traditional land routes.

These Indo-Pacific beads at Sekta are the same as those produced at Arikamedu (Gupta, 2018: 9). There is all likelihood that these beads might have moved through land and sea routes to India's northeast into Myanmar and thence to Southeast Asia.

FOREST RESOURCES

This brings us to the subsequent section of our discussion. One cannot overlook the melange of forest resources Northeast India has to offer. The circulation of these commercial and exotic items of trade between these regions can yield details about the network of connectivity. In this regard, the importance of two forest products of the Northeast, especially of Kāmarūpa: black aloes trees which made the woodland dark (*agaru*) and rhinoceros' horns is equally vital.

As reflected from the Paschimbhag copper plate of Śrīcandra of 930 CE, this charter states that the banks of the Brahmaputra were adorned with numerous black aloes trees which made the woodland dark (*kāl-aguru-śyāmalaḥ*) (Sircar, 1973: 27). This fact is also corroborated by the accounts of Arab geographers. The geography of Ibn Khurdādhbih of the 12th century CE was the first contemporary Persian account to have ascertained this linkage. It is interesting to note that Ibn Khurdādhbih never visited the Indian subcontinent and relied on the travel reports of voyagers and merchants. The author states that aloes wood was brought from the land of Kāmrūn (Kāmarūpa) through the Brahmaputra down the river to Samundar (Sonargaon on the east coast of the Bay of Bengal) (Ahmad, 1989: 5). The geographers mention the fine quality aloes wood from Kāmarūpa and rate it second to the wood of Multan.

Khurdādhbih's awareness of the rhinoceros' horn as a trade item with China is a testimony to the widespread popularity of this animal as a highly priced trade item (Ahmad, 1989: 6). The rhinoceros' horn was believed by the Chinese of possessing medicinal properties, an aphrodisiac. This gave this exotic item its overwhelming price.

Accounts of Sulaiman dated asearly as 851 CE is one of the earliest available Arabic accounts taking note of this fact. The merchant observed that girdles made of horn of rhinoceros, exported to China from Rahmi used to fetch 2,000 to 4,000 dirham each (Ahmad, 1989: 6).

The Arab geographers also mention about Yak tail as an important commodity of the kingdom of Dahum. Further, the Paschimbhag plate of 930 CE illuminates that Śrīcandra's force in the course of their conquest of the Kāmarūpa country (*Kāmarūpa vijaye*), entered the woodlands near the Lauhitya, which was covered by the clouds, had banana groves that were tawny owing to the ripening of the leaves or fruits and in which monkeys were roaming and had many plains on which drowsy yaks were ruminating leisurely *(romanthalasa baddhanidrā chāmari-samsevita prāntara Lohitasya vanasthali-parisaraḥ kāl-aguru-śyāmalaḥ)* (Sircar, 1973: 27). This no doubt indicates that the floral and faunal resources of the Northeast had an outlet to the Indian Ocean network through coastal Bengal, especially Samandar (Sonargaon on the east coast of the Bay of Bengal).

Northeast India's trans-regional role can be ascertained from a later source of a 19th century report by the British. Captain R.B. Pemberton in his *Report on the Eastern Frontier of British India* has mentioned the presence of 'four Meerwaree merchants from the eastern extremity of India' at Sadiya (Lahiri, 1990: 135). These merchants imported broadcloths, muslins, long cloths, coloured handkerchief, chintzes, and various other kinds of cloths, salt and opium,liquor, glass and crockery ware, tobacco, betel nut and rice for the troops. He further mentioned that these articles were bartered by the merchants with different surrounding tribes in the hills of Sadiya for gold dust and ivory, silver, amber, musk, *daos,* a few Burmese cloths and some small Chinese boxes and he had furthered that 'this trade is gradually extending across the mountains to the Hookong valley on the Burmese side of the pass.' Captain Pemberton goes on to discuss the lines of communication

with Burma. The most important route according to him is the extensive tract of the mountainous country near the 'Patkoee pass.' According to him it was through this tract that the Shans came to Assam in 1228 CE. It was through this route that the Burmese army came to Assam in 1818 CE and 1822 CE. This suggests a continued use of the route from Assam to Burma which as Pemberton has conformed 'presents facilities of transit, not offered in any part of the long chain of ranges south-east of Assam' (Pemberton, 1966: 66).

Contrary to this route was the route to Bengal. F. Hamilton states in his *An Account of Assam* that in the beginning of the 19th century CE the exports from Bengal to Assam marked of salt, pulses, ghee, sugar stone, beads, coral, jewels, cutlery and glassware, spices, paints, copper, red lead, English woolens, taffetas, Banaras silk cloth, satin, gold and silver cloth, shells and muslins amounted to Rs. 2,28,300. The exports from Assam to Bengal made of stic lac, Munga silk, Munga cloth, Manjistha, black pepper, long pepper, cotton with seed, ivory, bell metal vessels, mustard seeds, iron hoes, slaves amounted to Rs.1,30,900 (Wade, 1963: 46). This trade was conducted through the Brahmaputra and this trade goes back to the early medieval times. But the question which arises from this discussion is that, if there was trade and exchanges what items were exchanged and what was the medium of the exchange. However, our sources are silent about the items of exchange except some indirect inferences.

CONCLUSION

The trade and exchange in these luxury items illuminates the global importance and strategic location of Northeast India in the crucial crossroads of the traditional routes penetrating Yunnan, Bhamo and Bhutan. These exotic items got absorbed into the prevailing cultural milieu of the regions and became markers of power, status and hierarchy. Additionally, this trade in this region left significant marks on the regional societies and cross-

regional networks of communication. On careful examination of the available genre of literature, it can be argued the trade networks of connectivity played a significant role in the context of early medieval Northeast India. A close examination of the context and the contents of the sources clearly underline the global significance of the region of Northeast India as a part of the larger Southeast Asian, South Asian and the Indian Ocean context. These networks which enabled the sustained inter-actions of the Northeast India with adjacent areas resulted in remarkable cultural plurality and dispels any monolithic construction of the past. Frontier areas like the Northeast India demands to be freed from national and regional boundaries and barriers and studied in a wider context from a broader perspective. This global historical approach can fully explicate issues that have conventionally been confined only within the contours of national histories. This will make Andre Gunder Frank's plea for a 'world-system' history comprehensible.

ACKNOWLEDGEMENTS

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Performance Analysis of Pradhan Mantri Awaas Yojana - Gramin (PMAY-G) in Assam

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ABSTRACT

A proper housing facility helps people to improve their living standard. With the objectives of rural development and making the rural homeless people's life better, the Ministry of Rural Development in India introduced PMAY-G scheme. Under this scheme the Government of India construct houses for the rural houseless peoples. The study is completely based on secondary data and descriptive in nature. In this research paper the researchers try to explore the overall performance of the PMAY-G scheme in the north eastern state of Assam. The researcher found in his study that the performance of the scheme in Assam is not up to the mark as expected and committed under the scheme launched by the government.

Keywords: PMAY-G, House, Performance, Development, Rural, Assam.

INTRODUCTION

House is one of the essential needs of every human being after food and cloth in today's society to living a standard life and also for safety purpose. Like other north eastern states, in Assam majority of the people belongs to the rural areas. The rapid population growth creates a situation of shortage of proper houses in the both urban and rural areas. From time-to-time Government of India introduced many schemes for countering the problem of housing and aimed to provide affordable house to the needy and homeless people in the rural areas. With this objective   Government of India launched a comprehensive scheme called "Pradhan Mantri Awas Yojana – Gramin" on 1st August 2016 with a tag line "Housing for All" by 2022. The main purpose of this scheme is to provide affordable house to the poor and needy rural people.

The present paper aims at analyzing the performance of the Pradhan Mantri Awas Yojana – Gramin (PMAY – G) scheme in Assam.

REVIEW OF LITERATURE

Swathi and Vezhaventhan (2018) in their paper tries to highlight the way how Indian Government builds the houses in rural areas under PMAY-G scheme and also found that this scheme is very much helpful for the rural needy people. The study is mainly conducted in the rural areas of Tamilnadu and after implementation of this scheme, the rural people of Tamilnadu have been economically developed.

Khan (2019) states in his article that Pradhan Mantri Awas Yojana (PMAY) scheme provides the holistic understanding about the housing scheme and proper success of this scheme is fully dependent on the implementation process and procedure of this scheme.

Reddy, Ramesh and Siva Ram (2019) in their research report has mainly analysed the impact of

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Pradhan Mantri Awas Yojana – Gramin (PMAY-G) scheme in the state of Madhya Pradesh, Odisha and West Bengal. The report revealed that majority of the beneficiaries are satisfied and shows a positive response towards this scheme and in the state of West Bengal this scheme shows tremendous progress.

Sawant and Fulwari (2019) in their paper "Progress In Rural Housing In India In The Post Reforms Period" tries to examine the progress trend of the rural housing through the government programmes. The rural housing scheme Pradhan Mantri Awas Yojana – Gramin (PMAY-G) 'Housing for All' by 2022 has positive impact on the rural housing sector.

Saji (2020) in her paper entitled "A case study on Pradhan Mantri Awas Yojana in Mallapplly Block Panchayath, Pathanamthitta district, Kerala" shows that PMAY – G scheme has a positive impact on human development in the rural areas. The study also suggest some suggestions like effective formulation & execution of a sound land policy, yearly survey for identification of proper beneficiaries and regular inspections & monitoring of the scheme for the accomplishment of the objectives of the scheme.

Radha and Mary (2022) in their paper mainly tries to focus on the other schemes which are mainly related with the Pradhan Mantri Awas Yojana (PMAY) and from the last ten years how much number of houses constructed and total amount expenses for constructed those houses under this scheme. They give the details about state-wise and financial year-wise number of houses constructed under PMAY scheme in India.

OBJECTIVE OF THE STUDY:
The study is undertaken with the objective to explore the overall performance of PMAY-G in the state of Assam.

PRADHAN MANTRI AWAS YOJANA:
The PMAY provides housing for everyone until the country celebrates 75 years of independence in 2022. To achieve this goal, the central government launched the comprehensive mission Pradhan Mantri Awas Yojana – "**Housing for All (Urban)**". The mission aims to meet the housing needs of the urban poor, including slum dwellers, through the following program areas:
- In-situ Slum Redevelopment (ISSR)
- Credit Linked Subsidy Scheme (CLSS)
- Affordable Housing in Partnership (AHP)
- Beneficiary-led Individual House Construction/ Enhancement (BLC-N/ BLC-E)

We all dream of owning a home. Whether it's a small 1BHK or a bungalow, a home is the best financial security a person can have. It can provide a safe haven for you and your family, care for your children's financial future, and security for various types of loans when you need cash most. However, with property prices skyrocketing, there are some segments of society that can't even dream of owning a house. According to Prime Minister Narendra Modi, "The Pradhan Mantri Avas Yojana is an important step towards realizing the dreams of the poor." Let's take a look at the benefits of the Pradhan Mantri Awas Yojana – Home for All.

PRADHAN MANTRI AWAS YOJANA (PMAY) 2021 ELIGIBILITY CRITERIA:
If anyone matches the following conditions, she/he may be eligible for this scheme:
- You and your family are not permitted to own property in any region of the country.
- To be eligible for the PMAY scheme, your annual income must not exceed Rs. 18 lakhs.
- The benefits of PMAY cannot be used on a residence that has already been built.
- Your family should not have received any central support from the Indian government under any housing scheme.
- All statutory towns and towns announced after Census 2011 will be eligible for coverage under the system, according to Census 2011.
- If you are a senior person or have a disability, you will be granted priority for ground floor housing.

- If you are married and file a joint application, either you or your spouse may be eligible for the subsidy.

STUDY AREA

Assam is one of the major states in the entire north east region of India. In terms of population it is the largest north eastern state and while in terms of area it stands second. The total area of Assam is 78,438 km^2 (30,285 sq. miles). The state is surrounded by Bhutan and Arunachal Pradesh state in the north side; Nagaland, Arunachal Pradesh and Manipur in the east side; Meghalaya, Tripura, Mizoram and Bangladesh in the south side; and West Bengal in the west side.

As per 2011 census, the total population of Assam is 31,205,576 where 15,939,43 were males and rest 15,266,133 were females. The total population of Assam covers 2.58 percent of India's population as per the census data of 2011. The population density of Assam is 398 per square km which is higher than the national average of 382 per square km. According to 2011 census data, the total literacy rate of Assam is 72.19 percent where the male literacy rate is 77.85 percent and female literacy rate is 66.27 percent.

METHODOLOGY

The present paper is descriptive in nature and fully based on secondary sources of data. District and year wise report of Pradhan Mantri Awaas Yojana – Gramin (PMAY-G) scheme in Assam are evaluated to study the performance of the scheme in Assam. The secondary sources of data are mainly collected and compiled from various research papers, official websites of Ministry of Rural Development and PMAY – G, census report, articles, etc.

STATUS OF PMAY-G IN ASSAM

Assam is one of the most important states in the entire north eastern region. The most of the part of the north eastern state Assam is mainly comes under the rural area. The Ministry of Rural Development (MoRD) targeted 15,18,833 number of houses constructed at the end of the year 2022 but out of these only 10,74,884 number of houses are registered and 7,35,832 number of houses were sanctioned and out of which only 4,69,501 number of houses construction works were completed. As per the report of the Ministry of Rural Development (MoRD) only 46.52 percent number of houses sanctioned against total number of houses targeted and 29.68 percent number of houses were completed against total number of houses targeted. The total fund transferred to the beneficiaries account for the purpose of the construction of the houses against Pradhan Mantri Awas Yojana – Gramin (PMAY-G) scheme was Rs.7975.3 crore. Here, the table no 1 clearly depicts the present status of the Pradhan Mantri Awas Yojana – Gramin (PMAY - G) scheme in Assam.

DISTRICT AND YEAR WISE PERFORMANCE OF PMAY-G IN ASSAM

As per the report of Ministry of Rural Development (MoRD), the north eastern state of Assam comprises of 32 districts. The state Assam culturally and naturally is rich as compared to the other states of India. The following tables and figures highlight the performance of the PMAY-G in the various districts of Assam.

Table 1: Glimpse of PMAY-G scheme in Assam as on 08/03/2022

MoRD Target	Registered	Sanctioned	Completed	Fund transferred (in Cr.)	% of sanctioned against MoRD target	% of completion against MoRD target
1581833	1074884	735832	469501	7975.83	46.52	29.68

Source : Ministry of Rural Development (PMAY-G)

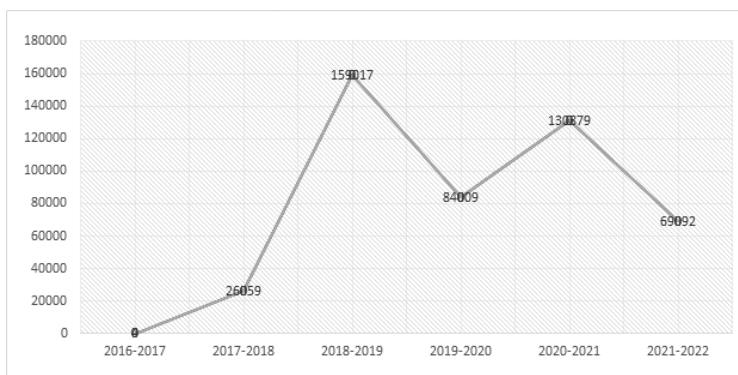**Table 2.** Total number of houses completed under PMAY-G in Assam

Sl. No	District Name	Total Houses completed in Financial Year (Percentage are shown in brackets)						Total
		2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	
1.	Baksa	0 (0)	310 (1.58)	7587 (33.63)	3044 (15.50)	6521 (33.21)	2175 (11.08)	19637 (100)
2.	Barpeta	0 (0)	1786 (6.99)	11224 (43.95)	4074 (15.95)	4706 (18.42)	3752 (14.69)	25542 (100)
3.	Biswanath	0 (0)	541 (6.51)	1711 (20.57)	1207 (14.51)	3516 (42.28)	1341 (16.13)	8316 (100)
4.	Bongaigaon	0 (0)	729 (9.38)	2766 (35.58)	1437 (18.49)	1256 (16.16)	1585 (20.39)	7773 (100)
5.	Cachar	0 (0)	192 (0.76)	10137 (40.32)	6153 (24.47)	5996 (23.85)	2664 (10.60)	25142 (100)
6.	Charaideo	0 (0)	338 (5.58)	637 (10.53)	1081 (17.85)	3349 (55.31)	650 (10.73)	6055 (100)
7.	Chirang	0 (0)	756 (9.28)	3415 (41.90)	1769 (21.70)	1290 (15.83)	920 (11.29)	8150 (100)
8.	Darrang	0 (0)	675 (5.11)	3728 (28.22)	2023 (15.32)	4560 (34.52)	2223 (16.83)	13209 (100)
9.	Dhemaji	0 (0)	2564 (10.08)	13574 (53.39)	2528 (9.94)	6281 (24.70)	480 (1.89)	25427 (100)
10.	Dhubri	0 (0)	382 (1.48)	8606 (33.42)	3086 (11.98)	6966 (27.04)	6718 (26.08)	25758 (100)
11.	Dibrugarh	0 (0)	413 (2.74)	2805 (18.62)	3915 (25.99)	6840 (45.41)	1090 (7.24)	15063 (100)
12.	Goalpara	0 (0)	2343 (13.28)	6973 (39.53)	2267 (12.85)	2862 (16.23)	3194 (18.11)	17639 (100)
13.	Golaghat	0 (0)	713 (4.49)	4009 (25.24)	2236 (14.08)	7678 (48.35)	1245 (7.84)	15881 (100)
14.	Hailakandi	0 (0)	95 (1.36)	3421 (48.85)	1227 (17.52)	1573 (22.46)	687 (9.81)	7003 (100)
15.	Hojai	0 (0)	272 (1.95)	2771 (19.83)	2301 (16.47)	4879 (34.92)	3749 (26.83)	13972 (100)
16.	Jorhat	0 (0)	419 (9.56)	1102 (25.15)	878 (20.04)	1690 (38.57)	293 (6.68)	4382 (100)
17.	Kamrup	0 (0)	3707 (15.20)	6429 (26.36)	7055 (28.92)	2864 (11.74)	4337 (17.78)	24392 (100)
18.	Kamrup (Metro)	0 (0)	285 (10.92)	1344 (51.51)	575 (22.04)	323 (12.38)	82 (3.15)	2609 (100)
19.	Karbi Anglong	0 (0)	153 (0.87)	6787 (38.80)	3450 (19.72)	5404 (30.89)	1699 (9.72)	17493 (100)
20.	Karimganj	0 (0)	177 (0.93)	7955 (42.01)	5515 (29.13)	4553 (24.05)	735 (3.88)	18935 (100)

21.	Kokrajhar	0	782	5627	1927	5051	2540	15927
		(0)	(4.91)	(35.33)	(12.10)	(31.71)	(15.95)	(100)
22.	Lakhimpur	0	697	13199	4228	4358	1160	23642
		(0)	(2.95)	(55.83)	(17.88)	(18.43)	(4.91)	(100)
23.	Majuli	3	300	1534	771	234	55	2897
		(0.10)	(10.36)	(52.95)	(26.61)	(8.08)	(1.90)	(100)
24.	Morigaon	0	2224	6436	1838	4713	7802	23013
		(0)	(9.66)	(27.97)	(7.99)	(20.48)	(33.90)	(100)
25.	Nagaon	0	728	7389	7049	9577	9497	34240
		(0)	(2.13)	(21.58)	(20.59)	(27.97)	(27.73)	(100)
26.	Nalbari	0	1064	2150	1536	2702	1604	9056
		(0)	(11.75)	(23.74)	(16.96)	(29.84)	(17.71)	(100)
27.	North Cachar Hills	0	37	3541	1702	1833	246	7359
		(0)	(0.50)	(48.12)	(23.13)	(24.91)	(3.34)	(100)
28.	Sivasagar	0	904	490	772	1626	186	3978
		(0)	(22.72)	(12.32)	(19.41)	(40.87)	(4.68)	(100)
29.	Sonitpur	0	884	2548	2531	5978	1472	13413
		(0)	(6.59)	(19)	(18.87)	(44.57)	(10.97)	(100)
30.	South Salmara-Mankachar	0	10	2854	1295	1213	2755	8127
		(0)	(0.12)	(35.12)	(15.93)	(14.93)	(33.90)	(100)
31.	Tinsukia	1	1067	3106	3110	7009	1259	15552
		(0.006)	(6.86)	(19.97)	(20)	(45.07)	(8.10)	(100)
32.	Udalguri	0	512	3162	1429	3487	897	9487
		(0)	(5.40)	(33.30)	(15.06)	(36.76)	(9.46)	(100)
	Total	**4**	**26059**	**159017**	**84009**	**130879**	**69092**	**469058**
		(0.00)	**(5.56)**	**(33.90)**	**(17.91)**	**(27.90)**	**(14.73)**	**(100)**

Source : Ministry of Rural Development (PMAY-G)

(Note – Percentages of each financial year are calculated based on the total number of houses constructed in each district)

Figure 1: Total number of completed houses under PMAY-G scheme in Assam

Source : Researchers work

Interpretation of Table-2

From the table 2, it is found that highest number of houses constructed under PMAY-G scheme is Nagaon district with 34,240 nos. and Dhubri district stands second position with 25,758 no. of houses. The lowest number of houses constructed is the district of Kamrup (Metro) with total 2,609 nos. under PMAY-G scheme. It is quite obvious that Nagaon district stands for first position because the district has the majority number of rural populations as compared to the other districts of Assam and Kamrup (Metro) stands lowest in number of constructed houses under this scheme, since the majority of the people belong to urban areas under this district and this scheme does not included beneficiaries from urban area. Again, if we see the table and figure, it is also found that the financial year 2018-2019 shows the highest number of houses and the financial year 2016-2017 shows the lowest number of houses constructed under this scheme.

Table 3. District and Year wise financial progress report of PMAY-G in Assam

(Figures are in Rs. Lakhs)

Sl. No	District Name	Utilization of funds						Total
		2016-2017	2017-2018	2018-2019	2019-2020	2020-2021	2021-2022	
1.	Baksa	257.06	7322.90	6199.12	9018.46	5228.02	3059.10	31084.6575
2.	Barpeta	68.575	11551.41	6166.875	6433.6025	9726.8275	28370.3875	62317.6775
3.	Biswanath	172.9	2532.79	1278.875	4034.5175	2696.07	1345.76	12060.9125
4.	Bongaigaon	331.825	2881.515	1454.31	2205.8075	2500.0625	5974.9625	15348.4825
5.	Cachar	192.4	6597.89	8695.245	13061.035	4369.69	8594.43	41510.69
6.	Charaideo	144.82	1062.23	249.665	4739.735	1939.8925	262.99	8399.3325
7.	Chirang	931.385	2799.29	2298.92	3325.0425	1552.07	2429.7325	13336.44
8.	Darrang	193.05	4811.17	1231.1	5845.6775	4769.1475	8605.22	25455.365
9.	Dhemaji	1392.95	13060.125	7241	9109.1325	2607.735	374.01	33784.9525
10.	Dhubri	185.25	5979.87	7187.57	6574.5225	10365.1275	2678.8475	32971.1875
11.	Dibrugarh	121.875	2485.665	1832.805	11365.9	3899.6425	1052.155	20758.0425
12.	Goalpara	637.65	923.93	3274.96	4816.0125	4664.1075	10752.6575	25069.3175
13.	Golaghat	610.025	4039.49	2471.235	8986.7375	5070.2925	1240.07	22417.85
14.	Hailakandi	000	1226.355	3756.675	2356.64	2097.4525	4564.235	14001.3575
15.	Hojai	168.675	2201.68	2518.425	7319.3575	5642.715	6834.7825	24685.635
16.	Jorhat	232.765	1102.335	689.26	2864.81	867.23	108.2575	5864.6575
17.	Kamrup	1417.845	6534.695	3376.62	10244.455	5670.9575	11206.2275	38450.8
18.	Kamrup (Metro)	271.05	1411.215	593.84	1052.9675	123.2075	68.4125	3520.6925
19.	Karbi Anglong	282.1	3803.085	8427.77	7110.285	3753.62	1203.0525	24579.9125
20.	Karimganj	000	5937.75	6462.885	9814.025	3511.365	5308.3875	31034.4125
21.	Kokrajhar	162.175	7018.7	2969.85	7106.4825	4585.035	5243.6475	27085.89
22.	Lakhimpur	226.525	9534.785	8624.46	9417.135	2937.025	3082.7875	33822.7175
23.	Majuli	330.85	1549.535	689.325	994.2725	173.355	28.925	3766.2625

24.	Morigaon	872.885	8756.345	2758.015	4530.4675	7869.095	16958.76	41745.5675
25.	Nagaon	305.175	5476.055	6867.51	16766.165	10713.17	18989.75	59117.825
26.	Nalbari	584.35	2636.335	1613.235	3154.32	3378.6025	4661.54	16028.3825
27.	North Cachar Hills	48.425	968.76	4859.595	3130.595	711.0675	96.525	9814.9675
28.	Sivasagar	289.64	1325.74	203.84	2827.955	660.465	53.3	5360.94
29.	Sonitpur	69.225	2812.095	1947.92	8712.21	4496.6675	2551.5425	20589.66
30.	South Salmara-Mankachar	11.05	1333.475	3726.775	1608.5875	3831.685	12164.6525	22676.225
31.	Tinsukia	410.8	2621.645	2766.985	10902.7425	4124.4775	1005.16	21831.81
32.	Udalguri	458.9	3206.32	2532.53	5239.0975	1870.5375	1992.9	15300.285
	Total	**11382.215**	**145845.18**	**114967.19**	**204668.75**	**126406.41**	**194363.1625**	**797632.9075**

Source : Ministry of Rural Development (PMAY-G)
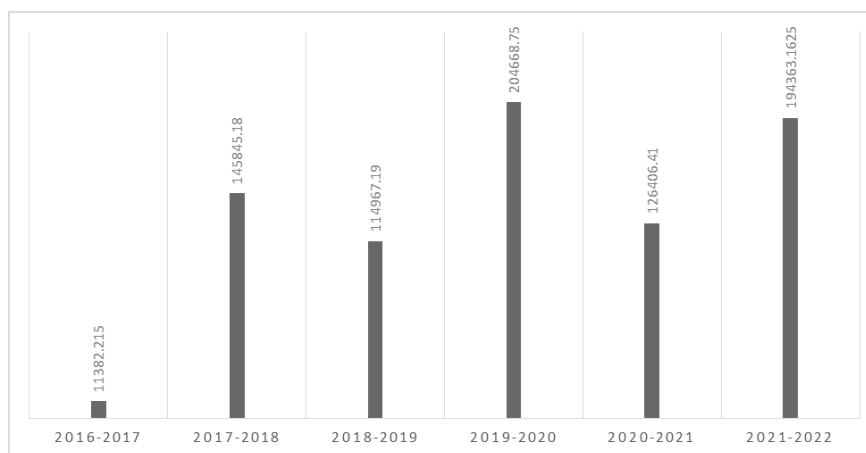
Figure 2. Financial year wise fund utilization under PMAY – G in Assam
Source : Researchers compilation

Interpretation of Table-3

The table 3 clearly depicts that highest utilization of funds under the Pradhan Mantri Awas Yojana – Gamin (PMAY – G) scheme has been done in the financial year 2019-20 with Rs. 2,04,668.75 lakh and the lowest utilization of funds has been done in the financial year 2016-17 with Rs. 11,382.215 lakh.

Again, it is also found from the table that out of all the districts in Assam Barpeta and Nagaon districts have utilized highest amount for the construction of houses under this scheme and Kamrup metro has utilized lowest amount for construction of houses. The reason behind is that Barpeta and Nagaon districts have majority areas under the rural status and major part of Kamrup metro district is under the urban area category.

FINDINGS

Some of the major findings of the present study are highlighted below –

(i) The Pradhan Mantri Awas Yojana - Gramin (PMAY-G) scheme is mainly beneficial for

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needy and poor people of rural area who are not able to afford their own home.

(ii) As per the report of Ministry of Rural Development, the total number of houses sanctioned under PMAY-G scheme in Assam is 7,35,832 and out of which only 4,69,501 number of houses construction has been completed.

(iii) The highest number of houses construction done in the financial year 2018 - 2019 under PMAY-G scheme is 1,59,017 and the lowest number of houses construction done in the financial year 2016 - 2017 under PMAY-G scheme is only 4.

(iv) In the state of Assam under PMAY-G scheme, the Nagaon district has the highest number of constructions completed houses which is 34,240 and Kamrup (Metro) district has the lowest number of constructions completed houses which is 2,609.

(v) In the state of Assam in terms of financial progress under PMAY-G scheme, the highest fund utilization done in the financial year 2019 - 2020 which is Rs. 2,04,668.75 lakh and lowest fund utilization done in the financial year 2016 - 2017 which is Rs. 11,382.215 lakh.

(vi) As per the report of Ministry of Rural Development, in the state of Assam the Barpeta district has utilized highest fund which is Rs. 62,317.68 lakh and Kamrup (Metro) district has utilized lowest which is Rs. 3,520.69 lakh for construction of houses under PMAY-G scheme.

CONCLUSION

The rapid population growth is the main reason behind the housing shortage in rural areas of India. Government of India always try to solve this problem so they introduced a number of housing programmes from time to time. The recently launched housing scheme "Pradhan Mantri Awas Yojana – Gramin (PMAY – G)" has drawn attention to the researcher in critically analyzing the programme. The researcher found in his study that the performance of the scheme in Assam is not up to the mark as expected and committed under the scheme launched by the government. The present status shows that the completed houses under this scheme is very much low as compared to the targeted houses by the government. So, there is still some gap in proper implementation of this scheme in Assam.

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