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Editorial

Scientific temper and social responsibility

The first issue of *Northeast Journal of Contemporary Research* (NeJCR) got over whelming responses from educationists, universities, colleges and well-wishers. Such support encourages us for strengthening our next publication in a more better way. In starting our journey for depicting current and new knowledge in a more determined way we ponder a while asking within- how such knowledge can be of societal utility. If the research, studies and project works are not aimed for societal needs and for meeting future societal aspirations then such studies will make increase the pages of literature, instead of adding to the progression of society. Such a dilemma engrosses us!

It is also evident that the output of new knowledge in our country cannot be considered satisfactory compared to countries like the USA, China, Australia and Great Britain. This is clearly stated in the section on Science and Technology in the Twelfth Five Year Plan (2012-2017). The report states that the full Time Equivalent R&D professionals in India have stagnated for long and we are ranked ninth in the world. In terms of share in world output of science papers in 2012 stood at around 3.6% compared to more than 14% for China. According to one estimate, in terms of scientific publications our position was 7th in the world in 2013.

Such a scenario of the country is no different for our states of North East India. However, considering high literacy rates in the region and increasing supports from the state and national governments, research output need to be augmented. In this context the objective of research ought to find the remedies for diverse and complex problems of the region, be it exploration/ conservation of diverse natural resources, preservation and planning for ethnic and cultural diversities, policy orientations for public health management and other so many areas which remain hitherto untouched.

Here lies the emphasis for social responsibility in pursuing research and its publications. The outlook of every researcher should be in creating some amount of, be it too small, new knowledge/ new ideas for social well being which entails two ways of benefit, apart from adding knowledge – it makes the time and energy worth spending as well as makes oneself happy!

I wish this second issue of volume-I will certainly be well received by the knowledge fraternity.

Joysankar Hazarika
Editor in chief & Principal
Darrang College

Science Section

SNP of ZFY gene in Yak (*Poephagus grunniens* L) and their F1 hybrid

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ABSTRACT

ZFY is a potential candidate gene known to influence fertility in yak and their hybrids. Genetic polymorphism and diversity study of ZFY gene in Yak (*Poephagus grunniens* L), yak hybrids and related bovines in Arunachal Pradesh has been attempted in this study. PCR based protocols, direct sequencing and bioinformatic tools have been adopted to find out SNPs within the species and variation across the species. With reference to standard template SNPs have been observed in position A76C, G272A & G428A. *In-silico* translation is performed which revealed nonsynonymous mutation which is of missense type substituting methionine for valine. Restriction digestion study is also performed with *Alu I*. Gene identity in yak and homology studies were also conducted following standard protocol

Key words : F1 hybrids, *in-silico*, Polymorphism, SNPs, , SSCP, Yak translation

INTRODUCTION

Understanding the molecular basis of fertility is of immense importance not only for the advancement of knowledge but has profound practical implication for genetic improvement of livestock, reproductive health care of human and domestic animals and wild-life conservation. Since ancient days fertility or lack of fertility aroused human curiosity and he tried to overcome it as per his existing knowledge and experience. Many domestic animals often face the problem of sterility which not only affects their propagation and population size but also livelihood of people. One such

domestic animal is Yak (*Poephagus gruenneins* L.) figure 2 which is often known as Ship of the plateaus and is one among the bovine family distinct from its wild predecessor i.e wild yak (*Bos mutus*). One possible candidate gene along with the other MSY/NRY gene (Male specific gene of Y Chromosome/ Non Recombining Region of Y Chromosome) associated with male fertility was detected in the short arm of the Y chromosome by Page *et al.*, 1987. This gene was reported to encode a Zinc Finger protein and hence named as Zinc Finger gene on Y chromosome with abbreviation ZFY.

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Initially this was projected as the master gene Testis Determining Factor (TDF) which was contradicted by others. Zinc finger proteins forms a big protein family and they are of great interest to molecular biologist since they regulate the expression of many genes and referred to as transcription factor. Genes for Zinc Finger Protein are a group of trans-acting element which synthesize the so called Zinc Finger Protein. They are also known as transcription factors because they modulate transcription by guiding the RNA polymerase to the promoter (cis-acting element) which is generally in upstream and in close physical proximity to the structural gene. The Zinc finger protein have a common DNA binding motif as finger like protrusions which consist of approximately 30 amino acids folds in two N-terminals β -strands and a C-terminal α -helix, surrounding a central zinc ion. This zinc ion is generally co-ordinated by four cysteine and/ or histidine residues. Such transcription factors (Zinc Finger Protein) generally have three or more finger like protrusions. Lau and Chan (1989) isolated and sequenced a testis specific ZFY c-DNA. The corresponding ZFY transcript encodes a protein that has 801 amino acids and a calculated molecular weight of 90.6 KD. When first detected ZFY was describes as 'Master' switch – a function attributed to TDF (Testis determining factor). The *zfy* gene is highly conserved in many species of mammals, and has been used as a marker for the Y chromosome in population studies of rodents and humans (Tucker and Lundrigan, 1993; Mukhopadhyay *et al.*, 2011) and as a sex-specific marker in wildlife studies (Okuyama *et al.*, 2014). Limited studies have been conducted with Indian yak and their hybrids. So the present study is conducted with an aim to study SNPs and variation of the

participating individuals of parental species, figure 1 (Yak $2n=60$, Tibetan Hill Cattle $2n=60$), hybrids ($2n=60$) and Back Crosses ($2n=60$) of ZFY gene.

MATERIALS AND METHODS

DNA from 124 individuals were isolated viz. from yak, indigenous hill cattle, F1 male hybrids and members from back crosses following high salt method as described by Montgomery and Sise (1990) with minor modification. The purity and concentration of DNA samples were checked by UV-VIS Spectroscopy. The optical density (OD) was checked at 260 nm and 280 nm in an UV spectrophotometer (Systronics-2202) and was found in between 1.7 to 1.9. The working solution was prepared by diluting the stock to 70 to 100 ng/ μ L for further PCR related work.

FP5'-GAAACCCAATTAAAATATAGAAGCA-3' & RF5' AGACCTGATTCCAGACAGTACCA-3' were used after Cathey *et al.*, 1998. The PCR (hot start PCR) reactions were carried with the following programme, initial denaturation at 95°C for 5 minutes, denaturation at 94°C for 30 sec, annealing 59°C for 45 seconds and extension at 72°C for 1 minute followed by a final extension of 10 minutes at 72°C. Number of cycle for the programme was 30. The PCR product is then electrophoresed in 1.5% agarose in constant 100V and variable mA for 45 to 60 mins with 1X TAE buffer followed by staining the gel with Ethidium Bromide. SSCP patterns were obtained by PCR amplicons were resolved in PAGE gel 12% non-denaturing Gel. 5 μ L of denaturing solution (95% formamide, 10mM NaOH, 20mM EDTA) and 5 μ L tracking dye was added to the samples (10 μ L PCR product). All samples were denatured in a thermo cycler at 95°C for 13 minutes.

Denatured PCR product was subjected to snap cooling by immediate transfer to ice to prevent renaturation of the denatured PCR product. The gel was run initially for 1 hour at 200 Volt and then at constant voltage of 375 volt for 10 hours. Thereafter the glass plates were removed and the gel was washed in double distilled water. Subsequently the gel was kept immersed in fixing solution (10% ethanol) for 9-10 hours to over night. The SSCP gels were stained after Sambrook and Russel (2001). Following which electrophoretic mobility and scoring the gel for their characteristic pattern was done.

Following scoring of SSCP gels, representative sample products giving unique SSCP patterns were custom sequenced to confirm the mobility shift in each pattern. Sequence data were analysed using Bio Edit software, Clustal W multiple alignments for detecting single nucleotide polymorphisms (SNPs) by comparing the observed sequence with AY079137. *In-silico* translation was done with the help of NCBI ORF finder and the best frame is selected with high precision. The selected ORF frame of each representative population (hybrids, back cross and parental species) were aligned with the help of Bio Edit (Sequence of NCBI ORF selected frames » translate or reverse translate permanent» ClustalW). The restriction digestion is done as per the manufacturer's instruction (Fermentas) and the reaction is inactivated at 64 °C for 20 mins after its recommended incubation at 37° C with optimum buffer and enzyme unit.

RESULTS & DISCUSSION

The observed ratio of OD 260 to OD 280 was found to be in between 1.7 to 1.9 which is regarded as good in quality for the isolated DNA. The size of the PCR amplicons was 589

bp. Five partial sequence were deposited with NCBI whose accession number are from GU075408.1- GU075416.1. Male yak, hill cattle and hybrids showed amplification in these ZFY regions whereas their female counterpart had partial or no amplification. BLAST analysis of ZFY (589 bp) also confirmed gene identity (figure 8) & the percent homology which is 99% (*Bos grunniens*), 98% (*Bos gaurus*), 97% (*Bos taurus*), 98% (*Bos indicus*), 98% (*Bos frontalis*), 98% (*Bos javanicus*), 96% (*Bubalus bubalis*), 99% (*Bison bison*). PCR-SSCP studies (figure 5) revealed five characteristic band pattern for ZFY fragment (589 bp) figure 3 a & b. SNP studies revealed that ZFY amplicon (589 bp), one transversion was observed at A76C and two transition was observed at position G272A & G428A both for hill cattle and hybrid (figure 6). The restriction digestion product of ZFY by *Alu I* (figure 4 a & b) reveals fragments of 589 bp, 500 bp, 400 bp, 380 bp, 350 bp, 220 bp, 180 bp, 150 bp & 75 bp. Yak, F1 hybrids and others showed districted band patterns. The *in-silico* translation (figure 7) result showed that for a change in the selected ORF (with NCBI ORF finder) in position G51A & A64G for hill cattle and F1 hybrid, there is a change in amino acid i.e. nonsynonymous change (missense mutation) where methionine (M, uncharged hydrophilic with side chain containing S atom) at position 22 is substituted by valine (V, uncharged hydrophobic with aliphatic side chain) for hill cattle and F1 hybrid. Since the substituted amino acid are of different nature, there is a like chance of change in the protein structure and therefore its function. The partial expression of ZFY in some yak females and F1 hybrids is found as par with the work of Lau and Chan (1989). Moreover expression analysis revealed that ZFY and ZFX

is differentially expressed in both adult and foetal human tissue and even in XX tissue there were ZFY expression which should not have occurred if ZFX is TDF (Lau and Chan (1989).

CONCLUSION

The present study revealed distinct SSCP patterns of individuals of parental species, hybrids and Back crosses. Three SNPs was observed in Hill cattle and F1 hybrid and *in-silico* translation was performed and significant change was observed at amino acid substitution

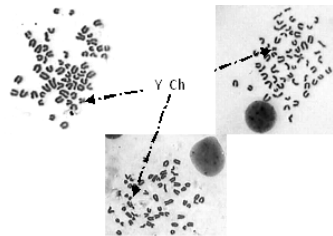


Figure 1: Presence of Y Chromosome. Starting from left Metaphase plate of Yak, Hill Cattle and F1 hybrid



Figure 2: Different types of Indian Yak, Starting from left, Common yak, Hairy forehead, Bare Back, Bisonian type and White Yak

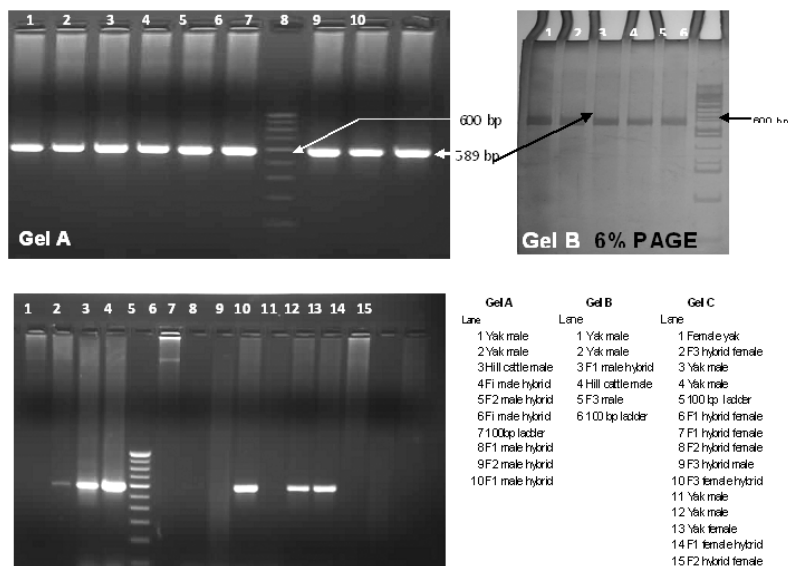


Figure 3 Agarose gel electrophoresis and PAGE of ZFY, 589 bp. Gel A represent agarose gel electrophoresis (1.5%) of male yak and male hybrid. Gel B is simple PAGE (6%) to confirm for the absence of any artifact or non specific band. Gel C (1.5 %) agarose represents the absence or partial presence of amplification in female yak and related female hybrids.

level. Restriction digestion of the amplicon of ZFY is also done and distinct type was observed with hill cattle and F1 hybrids.

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SNP of ZFY gene in Yak

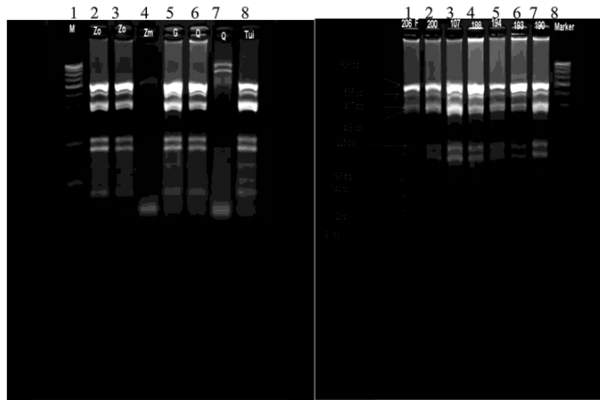


Figure 4a & b: Restriction Enzyme digestion (*Alu I*) of 589 bp ZFY fragment showed distinct features in some of the hybrids

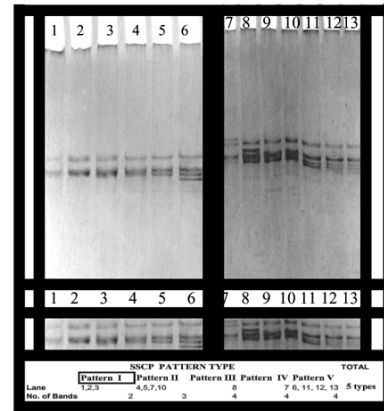


Figure 5: SSCP pattern of ZFY-1 589 bp.

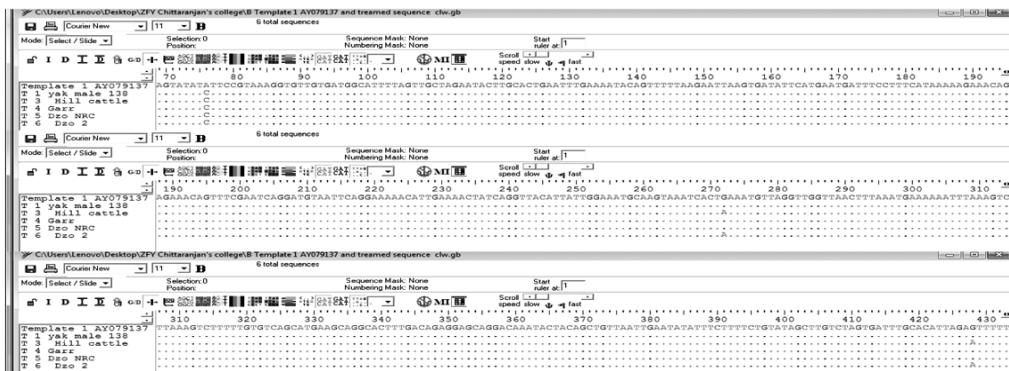


Figure 6: Clustal W results of the ZFY (589bp) fragments of yak, Fi hybrid, hill cattle showing mutation at position A76C (transversion), G272A (transition), G428A (transition).

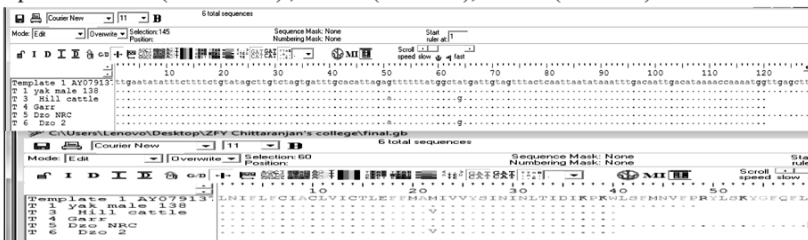


Figure 7: *In-silico* translation of 589bp ZFY amplicons of yak, hill cattle and their hybrids with the help of NCBI ORF finder.

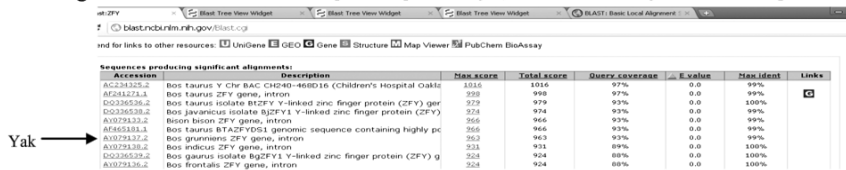


Figure 8: Gene Identity by BLAST analysis

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Texture analysis of Supercritical Fluid Extrusion (SCFX) Products and Comparison with Traditional Puffed Extrusion

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ABSTRACT

The compressive stress-strain sigmoidal relationship of extruded products is commonly examined to quantify the qualities associated with human sensory perception. The hardness of extruded products can be compared by examining the stress for multiple products at a given strain value. Brittleness—also called crunchiness, or crumbliness—can be evaluated by examining the jaggedness of the normalized stress-strain curve for a given product. In this experiment, fourteen extruded, SCFX products made in the Rizvi Lab (Department of Food Science, Cornell University) were analyzed and compared to six commercially available extruded, puffed products. There were three primary objectives in this experiment. The first objective is to analyze the textural characteristics and compare SCFX products with commercial samples. The next objective is to test the applicability of this sigmoid stress-strain model to SCFX product. Finally, the overall aim is to ensure that SCFX product will meet consumer demands. According to the measurements collected in this experiment, the extruded, puffed products produced by the Rizvi Lab do exhibit textural characteristics within the same range as the commercial products tested. The sigmoidal stress-strain model was found to be appropriate for 8 of the 14 lab products and 3 of the six commercial products; suggesting that this model is useful, but not globally applicable. The data suggests that the Rizvi Lab's extruded, puffed products will meet consumer expectations for hardness and crunchiness.

Key words : Extrusion, SCFX, texture analysis

INTRODUCTION

Traditional extrusion technology is now widely used in manufacturing a diverse range of food products including pasta, snacks, breakfast cereals, confectionary, texturized meat substitutes, infant food formulations, precooked beverage powders, and extruded crispbread

(Rizvi *et al.*, 1992). Supercritical fluid extrusion (SCFX) is a novel process combining extrusion and supercritical fluid technologies. SCFX utilizes supercritical carbon dioxide (SC-CO₂) as a viscosity-lowering plasticizer and expansion/foaming agent (Rizvi *et al.*, 1992). Traditional

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extrusion uses steam expansion as the driver for expanding or ‘puffing’ the extruded product; SCFX can operate below steam temperatures (Rizvi *et al.*, 1992). An important advantage SCFX has over traditional extrusion is that it allows for simultaneous expansion, flavoring, and reduction of viscosity (Rizvi *et al.*, 1992).

The textural characteristics of traditional extrusion products were analyzed and compared to SCFX products to determine what SCFX conditions generate product which texture profiles are consistent with commercial extruded products. Various researchers have put forth efforts to develop a quantitative model in order to compare the texture profiles of different extruded products (Hecke *et al.*, 1998; Fan *et al.*, 2013; Ding *et al.*, 2005; Chanvrier *et al.*, 2014). For our experiment, the texture of each product was characterized according to the compressive stress-strain relationship proposed by Nuebel and Peleg (Christoph *et al.*, 1993).

Six commercial products made with traditional extrusion techniques were analyzed and compared to fourteen SCFX products. Quantitative measurements of the stress-strain relationships for each product were made with a texture analyzer (Instron Universal Testing machine model 1122) to assess the hardness and brittleness/crunchiness of the products. A sigmoidal mathematical model was employed to interpret the stress-strain curves (Christoph *et al.*, 1993). The applicability of this sigmoidal model to the stress-strain relationships of a variety of spongy bakery products, popcorn and plastic foam was previously demonstrated (Peleg *et al.*, 1998; Swyngedau *et al.*, 1991; Anton *et al.*, 1993). The force required to achieve a certain deformation demonstrates the hardness of the extruded products. The ‘jaggedness’ of the stress-strain curve is a mani-

festation of the material crunchiness or brittleness of the puffed extrudate (Rohde *et al.*, 1993).

There were three primary objectives in this experiment. The first objective was to analyze the textural characteristics and compare SCFX products with commercial products. The next objective was to test the applicability of this sigmoid stress-strain model to SCFX product. Finally, the overall aim is to determine how to design SCFX products with specific texture profiles.

MATERIALS AND METHODS

Fourteen SCFX products were made by the Department of Food Science at Cornell University (Ithaca, NY) using a A pilot-scale Wenger TX-57 Magnum corotating, self-wiping, twin-screw extruder with a barrel diameter of 52 mm and length to diameter ratio (L/D) of 28.5:1 (Wenger Manufacturing, Sabetha, KS). The method used to create the SCFX products is described elsewhere (Rizvi *et al.*, 1995). Six traditional-extrusions, commercial products were purchased from a local supermarket. The names and the compositions of the products are given in the Table 1. The commercial products were removed from their packages and each product (commercial and SCFX) was stored at ambient temperature (22⁰c). Samples of each product were compressed in an Instron Universal Testing machine model 1122 at a speed of 10mm/min (Christoph *et al.*, 1995). For each trial, the sample was arranged in the specimen holder as one layer. The device created a chart representing the stress-strain relationship as the sample was compressed. The data from the stress-strain chart for each sample were read and manually input into Microsoft Office Excel to generate the charts

shown in this paper. The stress-strain data were then analyzed using JMP software to determine if the stress-strain relationship for each product fit the empirical mathematical model that was developed for the description of the sigmoidal stress-strain relationships of cellular solids (Eq. 1) (Swyngedau *et al.*, 1991). If the model does fit a given product, then the JMP software was used to determine the values of k_1 , k_2 , n_1 , and n_2 .

$$\text{Equation 1, } \sigma = k_1 \epsilon^{n_1} + k_2 \epsilon^{n_2}$$

Where σ is the engineering stress, ϵ is the engineering strain and k_1 , k_2 , n_1 , and n_2 are constants depending on the specific texture of the products.

For each sample which fit the sigmoidal model expressed in (Eq. 1), the complete data set of the stress-strain relationship was

used to calculate a normalized dimensionless stress $Y(\epsilon)$ using following transformation (Rohde *et al.*, Barrett *et al.*)

$$\text{Equation 2, } Y = \frac{\sigma(\epsilon) - \sigma^*(\epsilon)}{\sigma^*(\epsilon)}$$

Where σ^* is the set of theoretical, smooth stress values generated from (Eq. 1) corresponding to the measured strain values. Values for σ^* were produced after k_1 , k_2 , n_1 , and n_2 were obtained from the model using the JMP software. The jaggedness of different samples may be compared by examining the Y-strain curve (Christoph *et al.*, 1995). The validity of this Y value and its ability to express crunchiness or brittleness was one of the parameters being evaluated in this experiment.

Table 1. Source, name and description of the samples

Source of the Sample	Name	Description of the sample
SCFX Product (Department of Food Science, Cornell University, NY)	S1	F1 popples bad shape
	S2	F2 harder texture popples
	S3	F3 veggie puffs 150rpm 1% CO2
	S4	F1 Mexican Chocolate 150 rpm 1% CO2, 17.5% MC
	S5	F4 Grape Puffs 130 rpm 25% MC
	S6	F2 Savory Helium 1% CO2
	S7	F4 Grape Puff 1% CO2, 25% MC
	S8	Tomato Carrot 1005 IR
	S9	Broccoli 20% 1002
	S10	F1 MPC
	S11	Apple promace starch 70 %, 1% CO2, 100 rpm, 22.5% Mo
	S12	WPC5-8, WP 60%, Fiber 0%, 1800Ks
	S13	F4 Grape Puffed 130 rpm 17%MC
	S14	F4 Grape Puffs 25%MC 150 rpm 1% CO2
Commercial Product	S15	Gerber graduate yogurt melts
	S16	Cocoa puff whole grain
	S17	Gerber lil's crunchies garden tomato
	S18	Cheerios yogurt burst
	S19	Gerber graduates puffs peach whole grain
	S20	Kix crispy corn puff

For those products which did not fit the sigmoidal model (Eq. 1), the Y -strain curve could not be produced. Instead, only the hardness was quantified for these samples. The hardness of all samples was evaluated by comparing the stress value at 70% maximum strain, a higher stress value implied a higher degree of hardness (Katz *et al.*, 1981)

RESULTS AND DISCUSSION

Of the products analyzed in this experiment, 8 of the 14 lab samples and 3 of the 6 commercial products were found to fit the model (Eq. 1). These products are listed in table 2. Figure 1 represents both the empirical stress-strain curves and the smooth curves calculated

from the model (Eq. 1) for the lab products (Fig. 1a) and the commercial products (Fig. 1b). Figure 2 is a representation of the normalized and dimensionless stress $Y(\epsilon)$ plotted against strain for the lab products (Fig 2a) and the commercial products (Fig 2b). The $Y(\epsilon)$ -strain curves for lab products S5, S6, S7, S9, S13, and S14 were very similar so their $Y(\epsilon)$ values were averaged and collectively represented as SA in Figure 2a.

Table 2 shows the values of k_1 , k_2 , n_1 , n_2 , and stress values at 70% maximum strain for the products that did fit the empirical mathematical model given by equation 1.

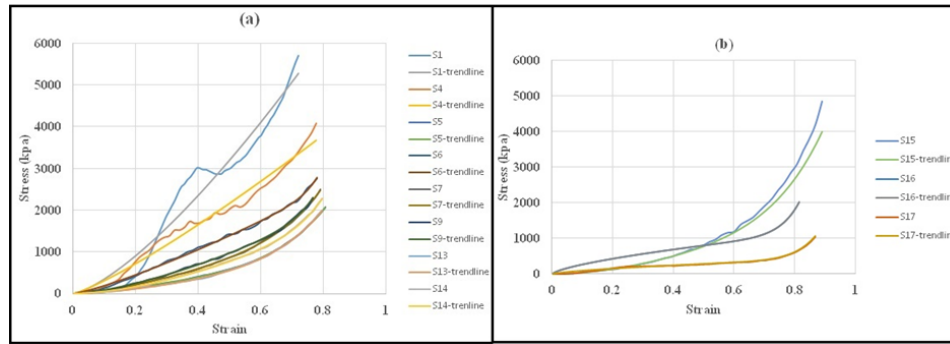


Figure 1. The typical stress-strain actual curves (σ) and trendline curves (σ^*) that fit the model (Equation 1) for, (a) SCFX samples S1, S4, S5, S6, S7, S9, S13, and S14, (b) Commercial samples S15, S16 and S17

Table 2. Shape characteristics of the stress-strain relationships for the samples that fit empirical mathematical model (equation 1).

Source of the Sample	Sample ID	k_1	n_1	k_2	n_2	Stress value for 70% Strain
SCFX (Department of Food Science, Cornell University, NY)	S1	8239.39	1.37	-25657546.07	3006.90	5325.6133
	S4	4970.48	1.20	13543.48	145.91	3181.5352
	S6	3273.79	1.23	25486.17	16.81	2178.6600
	S9	2703.44	1.48	10799.69	11.71	1770.5935
	S7	2305.52	1.48	4079.58	6.67	1715.2625
	S14	2410.80	1.65	5499.27	9.50	1535.4366
	S5	1234.27	1.29	3777.41	5.54	1327.9451
	S13	1467.39	1.58	3662.51	5.85	1286.4469
Commercially available	S15	2474.50	1.76	4133.50	6.40	1862.2695
	S16	1276.00	0.68	14227.00	13.52	1120.6038
	S17	451.50	0.67	4014.50	12.87	394.2337

The typical stress-strain curve of cellular solids has three linear regions connected by shoulders (Christoph *et al.*, 1995) but the stress-strain curves for our products show only two regions and a slight shoulder. These two regions represent the deformation of the original structure and the subsequent collapse of the cell walls, respectively. Small or absent shoulders indicate that the product's cell walls have low mechanical resistance over a considerable strain.

The degree of jaggedness and the trend of the curve SA correlates to the curve for commercial products S16 and S17. The normalized curves for S1 and S4 are to some extent smooth

with some small jaggedness; they follow the trend of the curve for S15. Thus, the crunchiness or crubleness or brittleness of the laboratory products is similar to the tested commercial products, as demonstrated in their respective stress-strain curves. Products with higher moisture contents tend to be less brittle and more plastic, the result being that their stress-strain relationships become much smoother. The jaggedness of the stress-strain relationship is mainly a manifestation of the particles' mechanical disintegration. The disappearance of jaggedness is indicative of the transformation of the compression mechanism from primarily dominated by fracture to plastic deformation and collapse of intact cell wall (Christoph *et al.*, 1995). The smooth nature of normalized curves of S1 and S4 suggests less mechanical disintegration of the particles (less fracturing); therefore, it is likely that these products had higher moisture contents and that the stress-strain relationships for their compressions were dominated by plastic deformation.

The stress value ($\sigma_{(\epsilon)}$ at 70% maximum strain for each product was used to compare the hardness of the products. Table 2 shows the lab products and commercial products in descending order of hardness.

The hardness of all the lab products except S1, S4 and S6 is comparable to the hardness of commercial products S15 and S16. Products S1 and S4 have a high degree of hardness and very smooth normalized stress ($Y(\epsilon)$)-strain curves. There may be a correlation between product hardness and the smoothness of its normalized stress-strain curve.

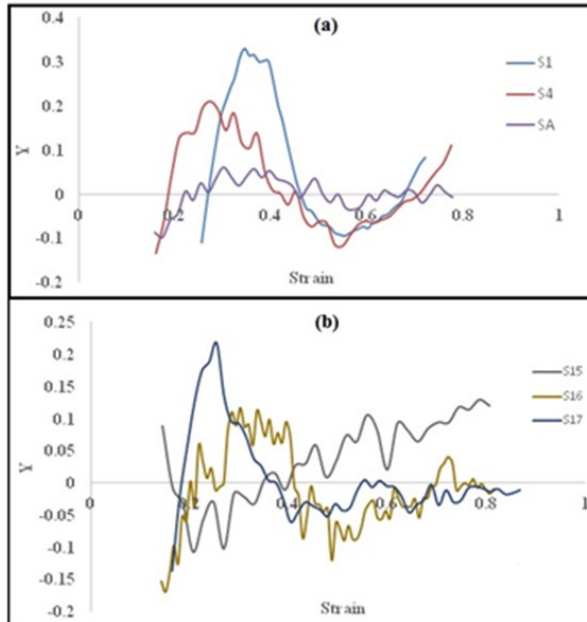


Figure 2: Normalized and dimensionless stress ($Y(\epsilon)$)-strain relationship for, (a) Samples from Rizvi Lab S1, S4, SA (the average of S5, S6, S7, S9, S13, and S14), (b) Commercial samples S15, S16 and S17.

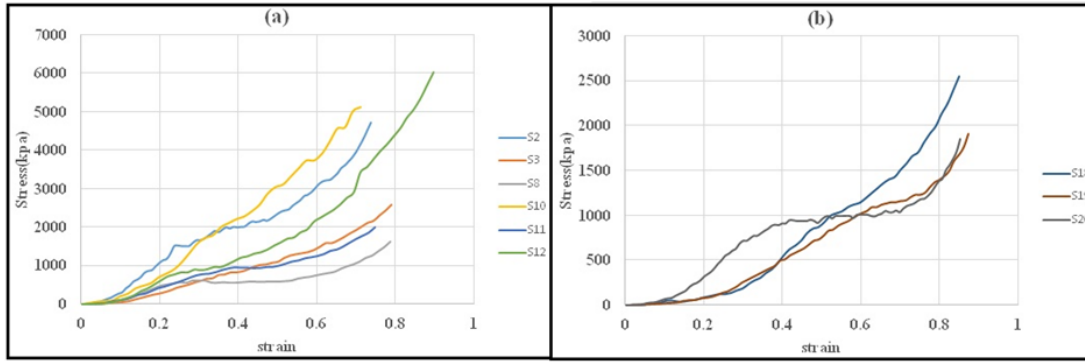


Figure 3. The typical stress-strain curves that do not fit the model (Equation 1) for, **(a)** SCFX samples S2, S3, S8, S10, S11 and S12, **(b)** Commercial samples S18, S19 and S20

Table 3. Shape characteristics of the stress-strain relationships for the samples that do not fit empirical mathematical model (equation 1). Strains 1 and 2 represent the ranges of the two linear portions of the sigmoidal curve respectively.

Source of the Sample	sample ID	Strain1	a1	r ²	Strain2	a2	r ²	Stress value for 70% Strain
SCFX sample (Department of Food Science, Cornell University, NY)	S10	0.13-0.26	5738.1	0.978	0.59-0.72	12162	0.9788	5014.3765
	S2	0.11-0.21	7692.2	0.9934	0.55-0.65	7105	0.9796	3942.3371
	S12	0.1-0.2	5023.2	0.9913	0.7-0.85	12130	0.9959	3164.2443
	S3	0.1-0.3	2857.6	0.9955	0.65-0.75	5783.1	0.9971	1922.7539
	S11	0.1-0.3	3367.3	0.9981	0.65-0.75	5766.6	0.9949	1687.5970
	S8	0.09-0.21	3766.6	0.9928	0.7- 0.8	6023.2	0.9844	1058.2063
Commercially available	S18	0.15-0.4	1630.7	0.9477	0.58-0.79	3823	0.9845	1576.9349
	S19	0.25-0.5	2495.8	0.9982	0.78-0.88	6173.4	0.9571	1161.9520
	S20	0.16-0.3	3889.7	0.994	0.76-0.85	6991.7	0.9735	1038.4571

The compressive stress-strain relationships of lab products S2, S3, S8, S10, S11, S12 and commercial products S18, S19 and S20 do not fit the model (Eq. 1) according to the JMP software analysis. Figure 3 shows the relationship between stress and strain for these products. The slopes of the linear parts of the stress-strain curves for these products were determined and are represented in the Table 3 as a_1 and a_2 . The value r^2 is the coefficient of

determination for the curves represented in Table 3. Slope a_1 represents the portion of compression dominated by elastic deformation while slope a_2 represents the portion dominated by cell wall collapse.

The comparative hardness of the products can be understood from the stress value at 70% maximum deformation. It is logical that the magnitude of slope a_1 for a given curve represents the elasticity of the product's super-

structure whereas the magnitude of slope a_2 for a given product represents the elasticity of its cell wall structure. A higher slope means more force is required to deform the product. All three regions of the stress-strain curve for all the samples except S3 and S10 are evident from Figure 3 (a, b). The highest stress, third region represents the densification of the collapsed cell walls.

The hardness at 70% deformation for products S3, S8 and S11 is in the same range as the hardness of commercial products S18, S19 and S20. The stress-strain curve for these products does not follow the sigmoidal model (Eq. 1) so the brittleness of these samples could not be characterized from the stress-strain curve. However, in the absence of the sigmoidal model, it may be possible to characterize the brittleness of these products based on the slopes of the a_1 and a_2 regions.

For all of the non-sigmoidal products (listed in table 3) except S2 the magnitude of slope a_2 is roughly twice that of slope a_1 . This indicates the extent of the difference between the elasticity of the product's superstructure and its cellular structure.

CONCLUSION

The methodology employed in this experiment has allowed for the assessment of the sigmoidal model itself. The sigmoid model for compressive stress-strain relationships has been shown to be applicable to most—but not all—of the products examined in this experiment. Failure of the model for some products suggests a need for further research to develop a broader understanding of the compression mechanism. The model only seems to fit for products which exhibit deformation mechanisms and/or textural characteristics similar to

those upon which the model is based.

The textural characteristics measured in this experiment (hardness, jaggedness) were chosen for their correlation with human perception of foods. The jaggedness and hardness of SCFX products and commercial products were found to be similar; thus, future commercial products with specific textural qualities can be produced using SCFX techniques.

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Rainfall trend and flood hazard vulnerability: a community based case study of parts of Kamrup Metro District, Assam

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ABSTRACT

Study of hazard vulnerability in various parts of the world is a growing field of research. It is a very intricately linked study in the field of disaster management, with very less amount of local level analysis. It is also an interesting field of research to interrelate the various intricately linked weather parameters with the changing hazard events in various parts of the world at global, regional and local level. At the same time, it is to be acknowledged that dearth of micro level data to justify the weather change and its likely impact on various hazard events in terms of their change is always a big challenge to overcome. From geographic standpoint the challenge is primarily to unfold, how the changing weather have affected the hazard events in terms of their nature and intensity over space in time dimension. This paper is a local level effort to enlighten the issue of existing flood hazard vulnerability of both urban and rural landscapes with special reference to Kamrup Metro District of Assam. Unfortunately the issue of vulnerability itself is a lesser addressed area of geographic research, at-least at local level in Assam. But study of vulnerability (degree of exposure) is a vital parameter to assess the various underlying characteristics of hazards, including their causes and effects on the existing landscape, so that a better disaster risk reduction strategy can be formulated for the time of disaster. The study is an attempt to highlight the rainfall trend of last 20 years, considering two observation stations of Borjhar and Chanmari at outskirts and core of the city respectively. The analysis is based on some secondary data and information generated from concerned government agencies, from which some relevant components are derived. In addition to that community based hazards calendar is prepared, based on field survey of randomly picked up villages and ward locations (rural and urban respectively) from among the affected places. It has been observed that among the rural vulnerable villages maximum percentage of respondents indicated hazards exposure especially in the month of July, where maximum average rainfall and rainy days are recorded, whereas the urban respondents have wider range of response in the hazard calendar.

Key words: disaster risk, Flood, hazard calendar, rainfall trend, vulnerability.

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INTRODUCTION

A global paradigm shift has been observed, in disaster related studies over the years, which is becoming more of a pro-active approach, coming away from its previous relief centric approach. The focus is now more on reduction of the involved risk element, rather than its management straightaway. With this new effort, identification of the type of hazard and assessment of its degree of vulnerability (level of exposure to hazard risk) is placed as key element, so that an effective risk reduction strategy (space and time bound) can be formulated. Another captivating area of this pro-active approach is involvement of all concerned stakeholders, especially the affected communities, who actually live with the hazards. With increasing global population on one hand and rising demand of natural resource on the other hand, the natural balance is coming under an unprecedented peril. In this dwindle, both natural and man-made hazards are rising like never before, with no any immediate respite. In this connection, study of hazard vulnerability can, not only give some fresh insights to the study of disaster management in specific, but also build up a general consciousness among the concerned stakeholders in totality. The paper has attempted to visualise the nature of temperature and rainfall pattern of the study region, with especial reference to community response towards occurrence of hazard events. Being a monsoon dominated region the community response is primarily concentrated within the rainfall season of May to September (5 months), to see the trend of hazard occurrence during that period.

Food victims perceive a much greater range of choices in dealing with flood hazard, than the state agents, who deal with it from outside. This is probably why indigenous knowledge application in dealing with the problem of the people can be more effective and meaningful (Mustafa, 2005).

Relevance of study:

Assam as a whole is lying in a belt of perennial flood, caused by its mighty river network of the Brahmaputra and the Barak and their rich network of tributaries. With its location in a tropical monsoon climate, with an average monthly rainfall of 278mm in a spell of just 5 months (May to September, IMD, Guwahati) and its giant sediment carrying river network in an abruptly falling angle, the state is bound to be perished by the perennial flood problem. Not only the river Brahmaputra, but many of its tributaries, especially that of the northern tributaries turns violent during the summer season, causing widespread displacement of people, loss of property, standing crops and even loss of life.

Hazard occurrence is directly related to various short terms weather affect and long term climatic controls, which are ever changing with time. As a result of this change effect, nature and intensity of hazard and their geographic confinement are also bound to change. Its growing attention is also attributed to the fact that it is a kind of interdisciplinary research, that brings together experts from a wide range of fields including climate science, development studies, disaster management, health, social science, policy development, economics so on and so forth. With ever expanding scope of bottom-up approach of disaster management and the paradigm shift from relief centric to response centric approach, community participation in disaster related issues are gaining momentum. In this context vulnerability assessment, involving the community, who actually live and fight with the concerned hazard become a central attraction, so that other necessary assessment related to immediate preparedness and long term mitigation options can be implemented in true spirit. The paper tries to unfold the issue of hazard vulnerability in the context of rainfall trend over a period of time. In this connection a community based hazard calendar is also tried

to be prepared, to see how community response are related with the rainfall trend of the study area.

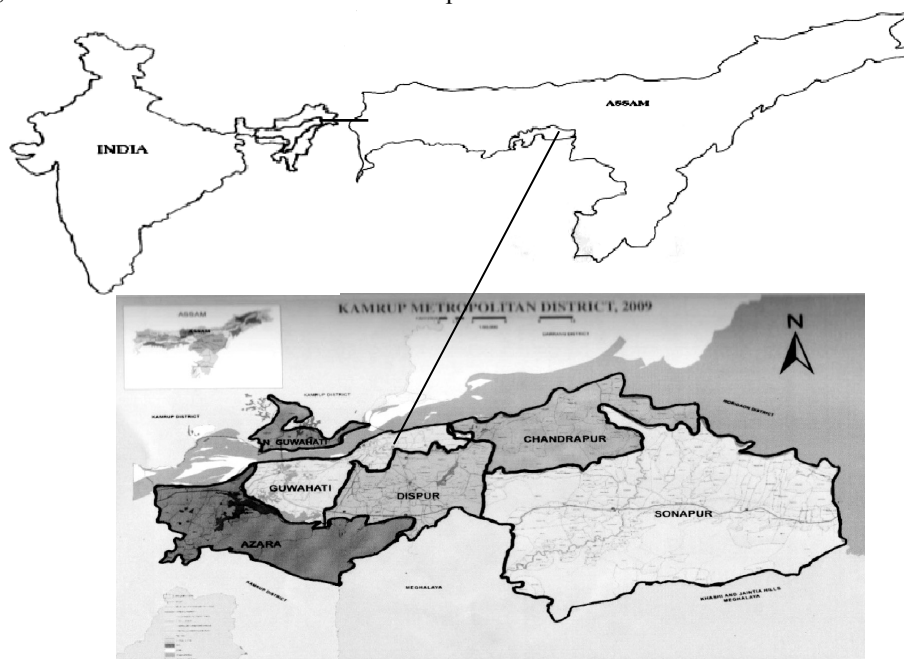
The issue of Hazarel Val: and adaptive capa has much to do with sl. Exploration of the local wisdom of those people, who outually live with such a system. The importane of formalizing a monitories network based on local knowl-edge, as apart of a broder adaptive management framework is highlighters many times by the community themselves. (Ogden and innes)

Study Area:

Ancient Assam was known an Prag-jyotis in early times and as kamrupa in late time. The Ahom Kingdom the east of Manas river came to be known as Assam or Asam, after the Ahom and the name Kamrupa has since then restricted to the present district of Kamrup beth Manas and the Baruadi (Rai let Baruak Bahadu—Early History of Kamrupa).

Kamrup Metro District is a newly created district of the state of Assam, since 2003, bifurcated from the earlier Kamrup

District. Geographical area of the district is 216.79 sq.km. It is bounded by Kamrup Rural district in three sides of west, north and south, part of Darrang district in north, state boundary of Meghalaya in south, and the district boundary of Morigaon in east. The extension is 25.43 - 26.51⁰ north latitude and 90.36 -92.12⁰ east longitude (NIC, Kamrup Metro). As the only metro of the region and the gateway to North-East, this part of Assam has gone through radical transformation in demographic and land use pattern over the years. Lying on the south bank of the mighty river Brahmaputra, the region originally belongs to swamp and low-lying landscape surrounded by hillocks on all side. With ever expanding population and expanded urbanization, the region have increasingly witnessed a vast environmental loss, reflected in various form of hazards viz. lost forest, especially on the hill slope and its aftermath like slope failure, hill soil erosion, etc. Urban flash flood is a rising environmental issue of the region, gaining momentum with



Map 1. Map of Study Area

changing land use pattern especially with filling up of the low lying belt, with expanding settlements. The district has witnessed both rural seasonal flood and the issue of urban flash flood. Flood vulnerability of Kamrup Metro District at village level is derived on GIS platform for two case study locations namely: Sonapur and Chandrapur revenue circle. Altogether nine villages (9) from two circles and six (6) urban flood affected locations are selected for case study to highlight community based responses towards hazard occurrence.

Objectives of the study:

The paper is an attempt to highlight the following objectives:

- 1) Identification of the geographical distribution of the flood vulnerable locations of the study area with special reference to two (2) circles having maximum flood vulnerable villages.
- 2) Average trend analysis of temperature-rainfall of the study area.
- 3) Comparative statistical analysis of rainfall trend from two observatory stations of Borjhar and Chandmari.
- 4) Projection of community based hazard calendar to see the relation between community response towards hazard occurrence and the general rainfall trend of the study area.

METHODOLOGY

Assessment of flood hazard vulnerability and rainfall trend analysis of Kamrup Metro district is based on secondary information, collected from concerned departments and reports etc. Based on the data other relevant derivatives are tried to be measured. In addition to that, assessment of community based hazard calendar is made on the basis of field study of selected case study area, covering both rural and urban locations.

The methodological steps are as follows:

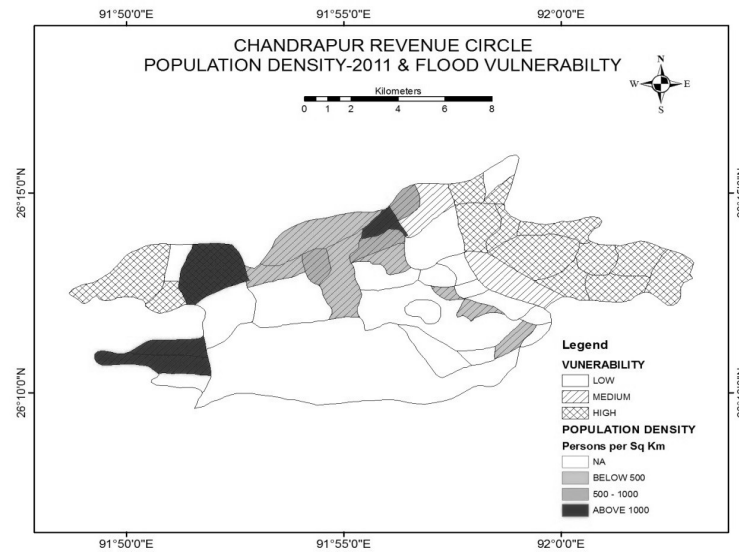
- Preparation of circle level base map, delineating the flood vulnerable zones in it.

- Average trend analysis of temperature and rainfall pattern of the study area in general.
- Trend analysis of rainfall of the study area for a specified time period of 2 decades (1991-2011), in 2 observatory stations.
- Preparation of hazard calendar based on community response in selected case study areas (9 villages from two revenue circles and 6 urban locations) to see how the community response towards hazard occurrence are related with that of trend of rainfall distribution in the study area.
- Development of various carto-statistical models for analysis of findings.

Circle-level flood vulnerability of Kamrup Metro District:

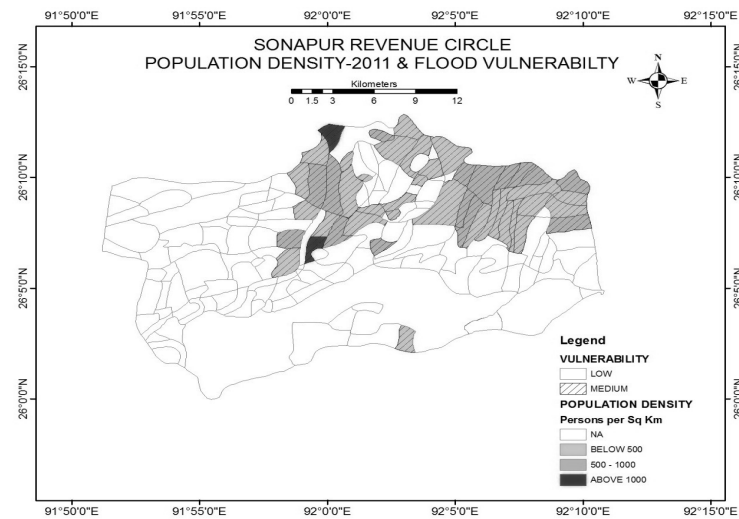
During the monsoon, flood hazard become a seasonal mayhem, especially in the low-lying belts of Assam. Like many other districts, lying along the valley of the mighty river Brahmaputra Kamrup Metro is also been affected by flood during the monsoon period (ASC, 2005). During last couple of decades urban flash flood is growing in terms of frequency, volume and spread, exposing the unplanned growth of the district. Among six (6) revenue circle of the district, the most flood affected are Chandrapur and Sonapur, followed by Azara, whereas few wards falling under Guwahati Municipality are affected by the problem of typical urban flash flood.

Among the circles, in Chandrapur 73% of the villages are identified as flood vulnerable. Out of total forty villages (District Census 1991) twenty nine (29) are identified as flood vulnerable. Looking at the flood vulnerability pattern (Map No: 2), it become clear that most of the affected villages are falling along the bank of Brahmaputra, and low lying belt in between kolong and Digaru.



Map 2. Vulnerability Pattern, Chandrapur Circle, Kamrup Metro District, Assam

On the other hand Sonapur with maximum number of villages also have maximum number of flood vulnerable villages. Out of 145 total villages, forty seven (47) are identified as flood vulnerable, representing 32.41% of the total villages. Looking at the flood vulnerability pattern of the circle (Map: No 3) one can see that most of the vulnerable villages are clustered in the north-east corner, along the bank of river Digaru and Kolong.



Map 3. Vulnerability Pattern, Sonapur Circle, Kamrup Metro District, Assam

The third most flood affected circle under the Kamrup Metro district is the Azara revenue circle, located west of the district. All together ten (10) villages of the circle are identified as flood vulnerable. The circle has 26 villages, affected partially or fully by flood water of river Brahmaputra. Out of that, four are fully affected by flood, falling under flood prone area, while six villages are partially submerged.

In addition to this three most flood affected circles, the other two circles namely North Guwahati Revenue Circle and Guwahati Revenue Circle also have pockets of partially affected flood areas. In North Guwahati, out of 39 villages, Amingaon is fully affected, whereas Tilingaon, Silagrang and North Guwahati are falling under partial flood affect. The Guwahati circle has area under Ulubari, Guwahati and Jalukbari. Parts of this circle are partially affected by problem of artificial flood. In addition to the rural seasonal flood, parts of

Kamrup Metro District, falling under Guwahati Municipal Corporation are also increasingly affected by the problem of urban flash flood, which is growing over the years. (Flood Management Plan, Kamrup 2007).

Average trend of temperature-rainfall of the study area:

The climate of Kamrup doesn't differ from rest of the districts of central Assam. It falls under subtropical monsoon climate, with semi dry summer and cold winter. It receives an annual rainfall of about 1500-2600 mm, with a high humidity of about 75%. Annual temperature ranged between 07-38.5 degree C. The average temperature (daily minimum-maximum), rainfall and rainy days of 30 years database (1951-80) as measured by Regional Meteorological Centre, under IMD, Borjhar, Guwahati is shown in Table:1 and illustrated separately by Fig: 1,2 & 3 respectively.

Table 1. Average temperature-rainfall pattern, Kamrup Metro District, Assam

Months	Average temperature (in °C)		Average Rain-fall (in mm)	Average number of rainy days
	Daily minimum	Daily maximum		
January	9.8	23.6	11.4	1.2
February	11.5	26.4	12.8	1.3
March	15.5	30.2	57.7	4.6
April	20.0	31.5	142.3	9.0
May	22.5	31.0	248.0	14.3
June	24.7	31.4	350.1	16.1
July	25.5	31.8	353.6	16.8
August	25.5	32.1	269.9	13.9
September	24.6	31.7	166.2	10.3
October	21.8	30.1	79.2	5.3
November	16.4	27.4	19.4	1.5
December	11.5	24.6	5.1	0.4

Source: Regional Meteorological Centre, Guwahati-1951-1980

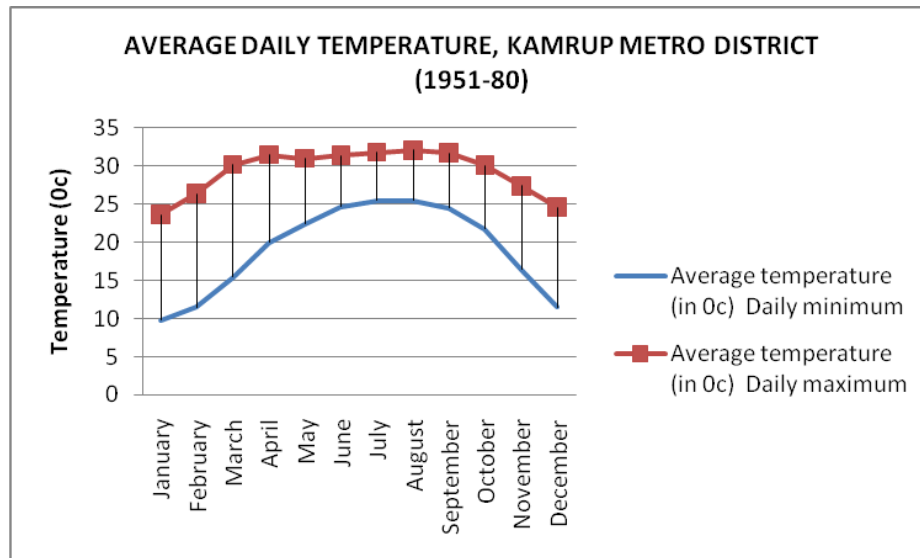


Figure 1. Average daily temperature (minimum-maximum), Kamrup Metro District

As shown in Fig: 1 during the winter season, the gap between minimum and maximum remains high. Minimum temperature is observed in the month of January 9.8°C , during which maximum remains more than double the minimum at 23.6°C . However with the advancing monsoon, during the summer season temperature continuously raised in the study area, that never falls below 30°C (March to September), indicating creation of low pressure in the region.

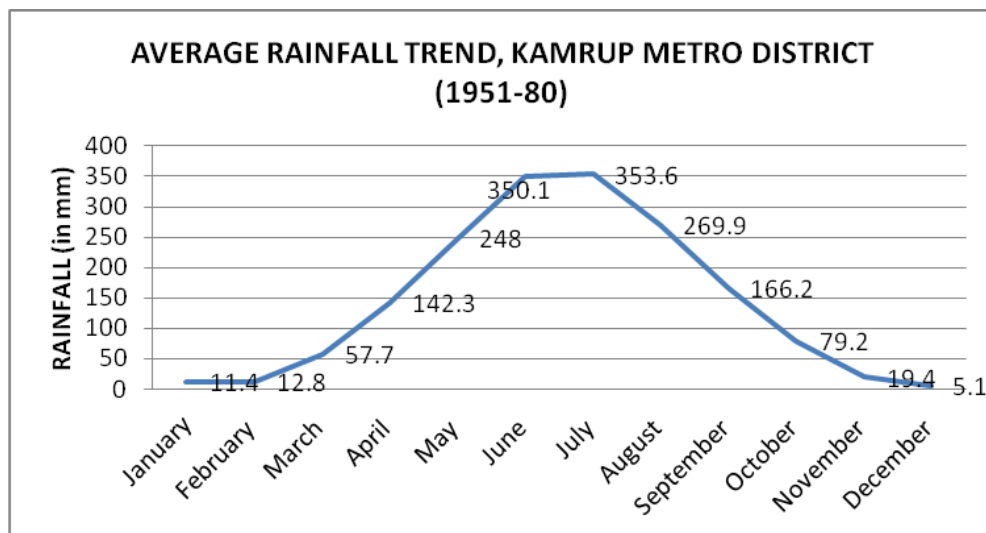


Figure 2. Average rainfall trend, Kamrup Metro District

The average rainfall trend of Kamrup Metro District during the observed time periods, have indicated a typical summer monsoon character of rainfall. From the month of April, with beginning of pre-monsoon phase till the month of August there is a continuous rise in rainfall, extended till the month of September. The rainfall trend is further supported by average number of rainy days during the same time period, represented by Fig: 3 Month of July, being the pick of the monsoon also have the highest number of average rainy days (16.8). Month from May to August have the highest numbers of rainy days in a calendar year.

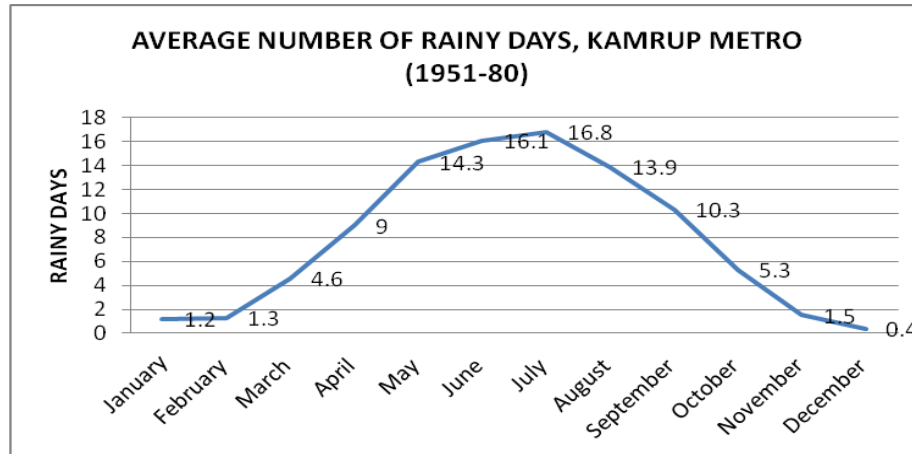


Figure 3. Average numbers of rainy days, Kamrup Metro District

Comparative statistics of rainfall of the study area:

Sufficient database on micro-level rainfall distribution pattern is required for effective rainfall analysis and projection of possible flood inundation. The official data are derived from the observation station of IMD at Borjhar airport, which is located at the western periphery of the city and in the office of the Chandmari Water Resource Department, located in the city centre. A comparative trend analysis of both the stations is presented in the following discussion, which will give us a general idea on hazard timing of the surrounding area of Guwahati metro. The analysis has covered 24 years of data (1991-2014) recorded in two stations of Borjhar and Chandmari.

Table 2. Total & Mean Rainfall (In mm), Guwahati Station at Borjhar Airport (1991-2011)

Data is derived from the original data generated at Borjhar Airport													
TIME PERIOD: 1991-2011													
(21YEARS)													
	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL MEAN
1991	19.7	7.9	54.3	130	520.7	206.8	222.6	347.2	177.2	312.3	0	11.7	2010.4 167.533
1992	9.9	32.7	19.3	103.1	270.9	414.1	367.1	373.4	185.9	55.3	7	16.5	1855.2 154.6
1993	76.1	61.3	83.3	102.5	319.6	487.3	343.7	378.7	242.8	24.8	0	0	2120.1 176.675
1994	19.4	30	121.3	156.4	170.9	350	199.8	315.8	28.2	149.1	6.7	0	1547.6 128.967

	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	MEAN
1995	10.4	13.5	41.3	132	156.9	426	580.3	362.6	371.6	30.2	37.9	3.7	2166.4	180.533
1996	10.2	31.3	36.3	28.5	447.4	207.6	329.6	183.1	121.2	164.5	0	0	1559.7	129.975
1997	14.3	20	30.1	171.9	208	219.1	212.6	212.5	224.2	12.1	3.3	29	1357.1	113.092
1998	0.5	12.2	103.2	149.1	140.8	164.4	260.8	284.3	213	192.5	7.1	0	1527.9	127.325
1999	0	0	13.2	25.8	360.9	292.7	348.5	384.6	189	129.8	44.3	0.9	1789.7	149.142
2000	4.6	22.8	45.3	220.2	366.9	365	201.2	373.3	159.5	43.2	1.7	0.6	1804.3	150.358
2001	2.1	16.4	19.4	257.2	302	343	240.3	177.4	205.4	185.6	14.8	0	1763.6	146.967
2002	14.6	4.5	85.8	276.6	214.7	396.2	295	182.3	113.6	31.7	54.5	0	1669.5	139.125
2003	6.2	48	120.6	249.3	166.5	543.2	333.9	231.1	159.4	182.8	21.4	12.6	2075	172.917
2004	10.7	8.4	10.9	551.5	126	205.1	391.6	65.1	89.8	354.4	3.7	0.6	1817.8	151.483
2005	16.6	3.8	150.6	134.2	284.5	104.6	175.1	803	78.1	126.9	0	1.4	1878.8	156.567
2006	0	11	18.1	201.3	290.3	153.7	247.2	162.7	88	119.9	15.9	6.7	1314.8	109.567
2007	0	96.1	29.8	286.6	96.2	294.2	284.5	122.4	315.9	118.7	32.2	0	1676.6	139.717
2008	35.3	3.5	124.2	153.6	108.5	319	273.2	249.6	101.9	97.4	8	5.2	1479.4	123.283
2009	4	0	43.6	65.6	143.2	118	388.3	325.2	180.7	196.3	7.3	6.7	1478.9	123.242
2010	0.4	0	50	369.7	356	468.6	309.1	213.2	252.8	121	1.8	2.2	2144.8	178.733
2011	14.6	23.4	53.6	26.5	132.7	231	190.9	388.1	227.2	7.2	0	1.5	1296.7	108.058

Source: IMD, Borjhar Airport

Table 3. Total & Mean Rainfall (In mm), Guwahti Station at Chandmari Water Resource Department (2005-2014)

Data is derived from original data generated at Chandmari Water Resource department														
TIME PERIOD: 2005-2014 (10 YEARS)														
YEAR	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEPT	OCT	NOV	DEC	TOTAL	MEAN
2005	22.9	0	93.4	229.1	272.5	87.2	195.3	391.2	85.6	141.5	5.6	0	1524.3	127.025
2006	0	3.8	0	197.1	160.8	148.3	167.9	89.6	63.4	60.9	22.3	0	914.1	76.175
2007	0	96.4	17.8	191	177.3	208.4	259.5	80.5	39.5	31	0	0	1101.4	91.7833
2008	0	0	0	0	136.5	348.8	167.4	302.6	192.4	88.9	12.7	0	1249.3	104.108
2009	0	0	41.1	43.3	114.3	109	280.9	235.6	65.4	42.38	0	0	931.98	77.665
2010	0	0	0	415.3	179.9	311	126.7	75.9	148.5	36.1	0	0	1293.4	107.783
2011	16.5	20.2	48.2	42.1	93.5	142.1	115.2	155.8	142.9	103.1	5	5	889.6	74.1333
2012	6.4	3.3	2.8	159.2	123.5	479.1	208.3	196.9	148.5	34.8	0	0	1362.8	113.567
2013	0	9.7	15.7	82.9	280.2	164.4	205.5	29.7	126.5	151.8	0	0	1066.4	88.8667
2014	5	20	6.9	16.2	199.4	332.6							580.1	48.3417

Source: Raingauge Station, Water Resource department, Chandmari

Based on the above two tables the spatial differences of monthly and mean rainfall at two separate stations of Borjhar and Chandmari are prepared in a series of Figures (Fig 4.1 to Fig 4.7 for monthly and Fig: 5 for annual) as indicated below. It has highlighted the differences of rainfall pattern from core to periphery of the metro (monthly and mean in mm)

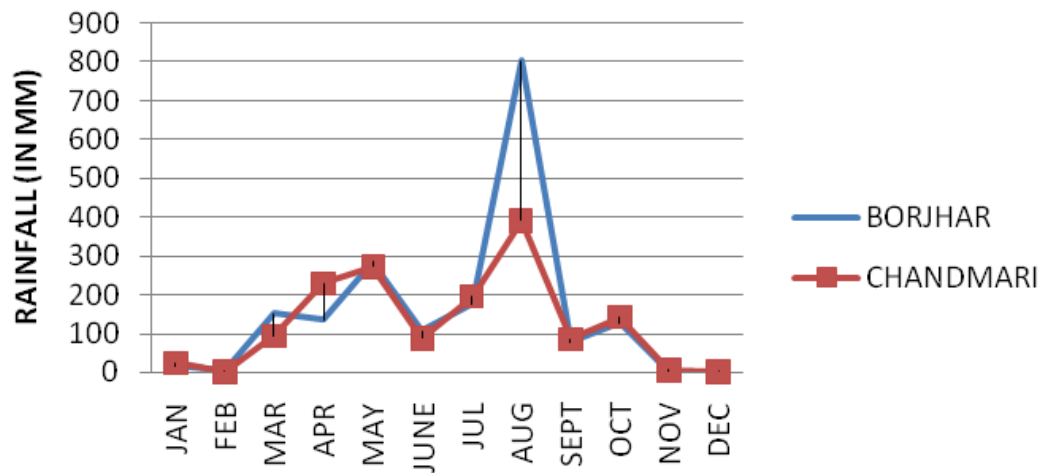


Figure 4.1. Total Rainfall Comparison, Kamrup Metro, 2005

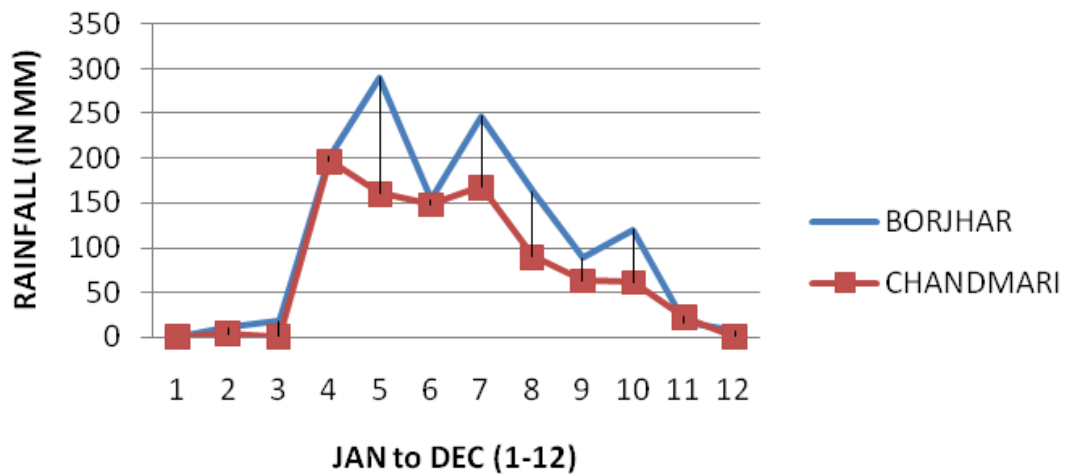


Figure 4.2. Total Rainfall Comparison, Kamrup Metro, 2006

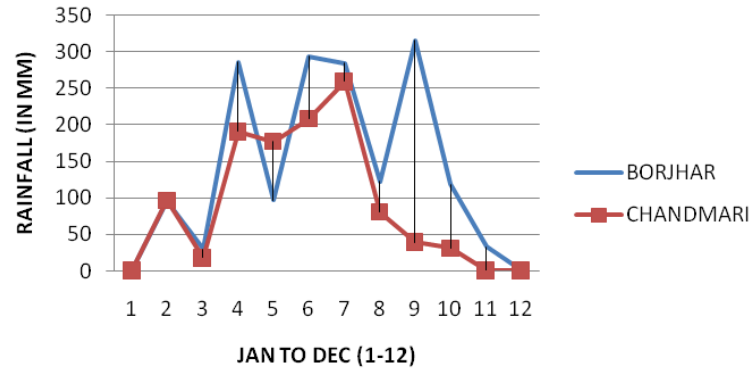


Figure 4.3. Total Rainfall Comparison, Kamrup Metro,

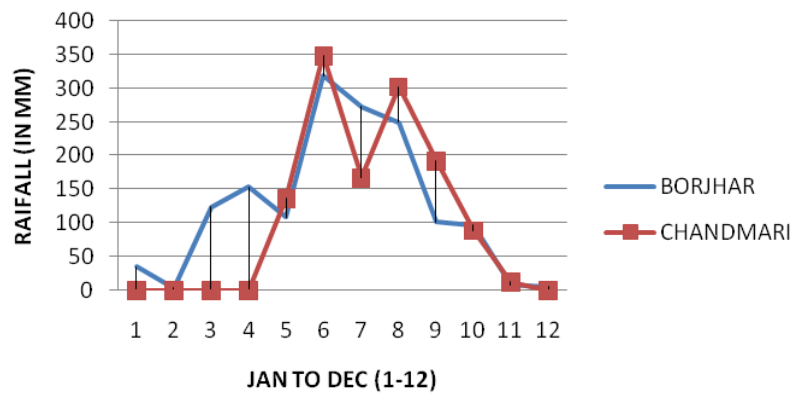


Figure 4.4. Total Rainfall Comparison, Kamrup Metro, 2008

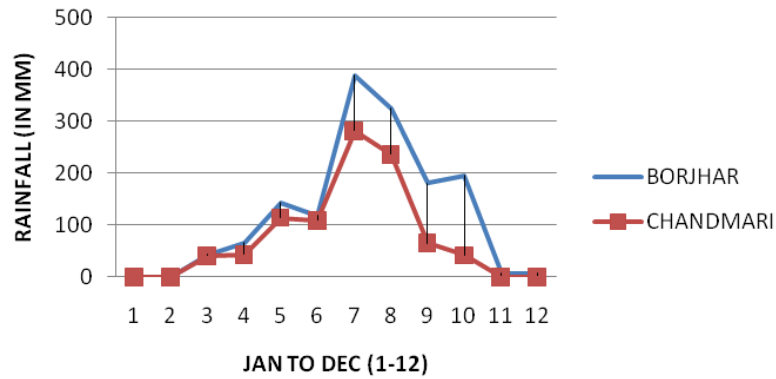


Figure 4.5. Total Rainfall Comparison, 2009

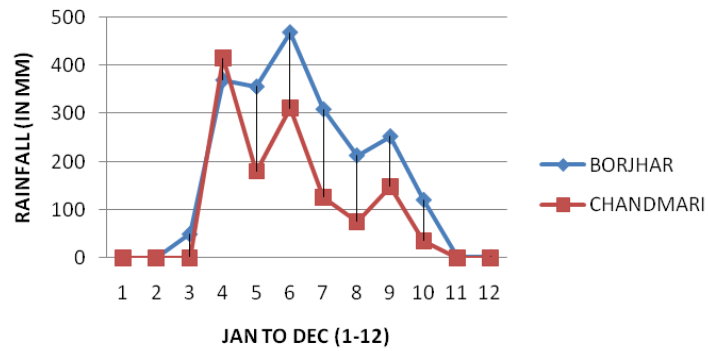


Figure 4.6. Total Rainfall Comparison, Kamrup Metro, 2010

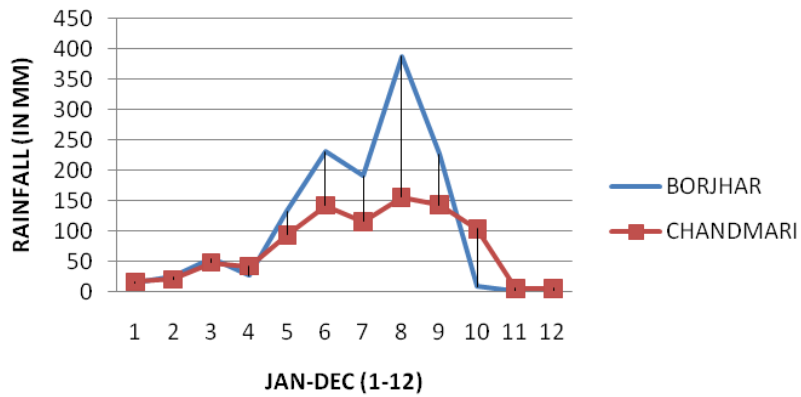


Figure 4.7. Total Rainfall Comparison, Kamrup Metro, 2011

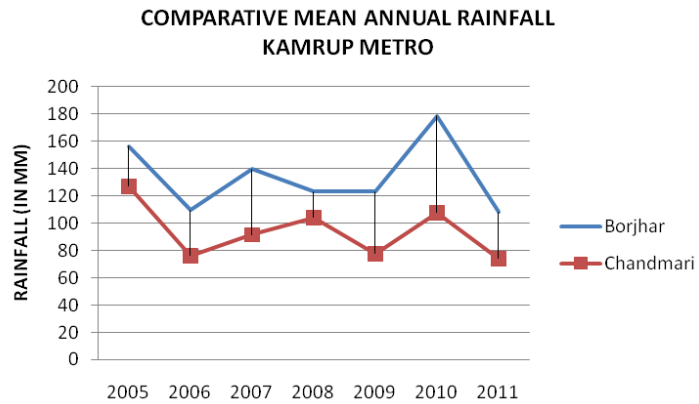


Figure 5. Comparative Mean Annual Rainfall (in mm), Borjhar & Chandmari Station

Community Based Hazard Calendar:

The community based hazard calendar is prepared during field study of selected flood vulnerable villages from two circles of Sonapur and Chandrapur and few urban locations frequently inundated by urban flash flood. All together 9 villages and 6 urban locations are

selected for the purpose to assess the community response regarding months of hazard occurrence during the 5 months period of monsoon (May to September), which is summarised in table: 4 (rural) and 5 (urban) and supported by their graphical trend in Fig: 6 and 7 respectively.

Table 4. Community based rural hazard Calendar

VILLAGES	(% of respondent)				
	May	June	July	August	September
RAJABARI	9.8	39.4	45.9	4.9	0
TATIMARA	0	11.1	61.1	22.2	5.6
UTTAR DIMORIA	14.3	21.4	64.3	0	0
KOLONGPARA	0	22.2	77.8	0	0
KASUTALI	0	17.6	82.4	0	0
DURUNG	5.9	29.4	58.8	5.9	0
MURKATA	5.7	28.6	57.1	8.6	0
AMARAPATHAR	8.7	21.7	65.3	4.3	0
SONAPURPATHAR	7.1	28.6	64.3	0	0

(Field observation of first 2 villages is from Chandrapur and the rest of 7 villages from Sonapur Circle)

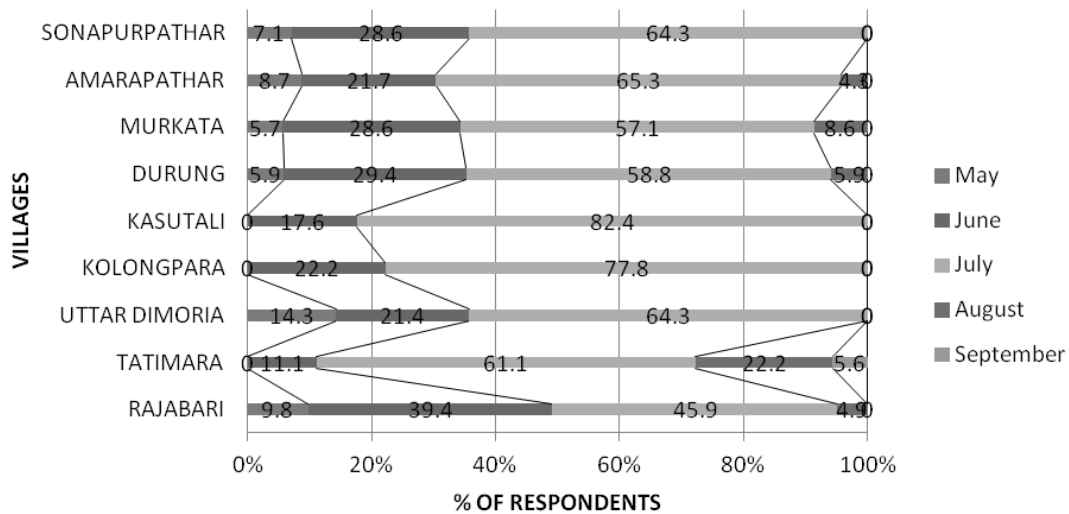
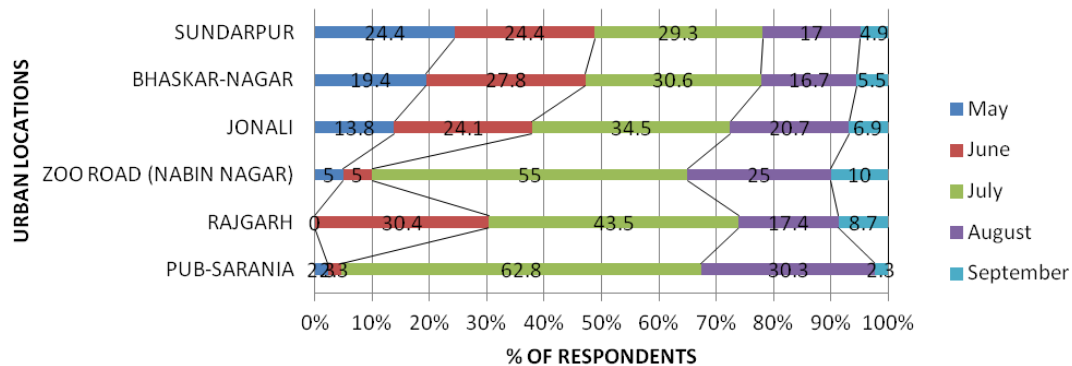
**Figure 6.** Rural Community Based Hazard Calendar, Kamrup Metro, Assam

Table 5. Community based urban hazard Calendar

(% of respondent)					
Urban locations	May	June	July	August	September
PUB-SARANIA	2.3	2.3	62.8	30.3	2.3
RAJGARH	0	30.4	43.5	17.4	8.7
ZOO ROAD (NABIN NAGAR)	5	5	55	25	10
JONALI	13.8	24.1	34.5	20.7	6.9
BHASKAR-NAGAR	19.4	27.8	30.6	16.7	5.5
SUNDARPUR	24.4	24.4	29.3	17	4.9

**Figure 7.** Urban Community Based Hazard Calendar, Kamrup Metro, Assam

CONCLUSION

In flood risk management, flood vulnerability assessment is a vital component. Its quantitative analysis require scientific study of many of the underlying component of physical, climatic, demographic and socio-economic background, which directly or indirectly affect the vulnerability status. This paper is an attempt to highlight the issue of vulnerability, in terms of geographical location, covering both urban and rural scenario of a district. The thrust of the paper is to visualise the general trend of a single component of seasonal rainfall of the study area and how it is related with the hazard calendar prepared from community response.

Certain observations have been made from the thrust of the study as follows:

* Flood vulnerability is a study of level of hazard exposure, which is location specific. Out of six revenue circles of the district, affected villages are mostly confined to two circles of Chandrapur and Sonapur.

* 30 years average trend of rainfall and rainy days (1951-80) of the study area have clear indication of their increasing trend during the monsoon season (May-to-September), which is highest in July in both cases (353.6 mm and 16.8 days respectively).

* Monthly and mean annual rainfall of the study area have indicated greater records at the out-skirt of the city (IMD, Borjhar Airport) than at the city core (Chandmari Water Resource Department). More observatories at micro level is required to get better rainfall picture for

pre-hazard preparedness.

* Community Based Hazard Calendar have shown maximum of respondents in the month of July in both rural and urban cases of the study area. The urban calendar have more spread-out % of respondents of the season, while the rural calendar is mostly confined to the month of July. It is indicative of hazard awareness of the community.

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Morphological and mitochondrial D-loop region based genetic characterization of two Synbranchid eels of genus *Monopterus*

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ABSTRACT

Two synbranchid species of genus *Monopterus* found in the Northeast India, *Monopterus cuchia* (Hamilton) and *Monopterus albus* (Zuiew) are analyzed in the present study for both morphological and genetic characterization. Morphological observation followed by sequencing and molecular characterization has been performed on the mitochondrial D-loop region to identify the molecular differences of *M. cuchia* and *M. albus*. The study has revealed several interesting morphological and genetic differences between *M. albus* from *M. cuchia*, which clarifies their genetic distinctness rather than species complex as suggested by earlier studies. There are minor morphological but well defined genetic diversity between *M. cuchia* and *Monopterus albus*.

Key words: D-loop, eels, *Monopterus*, morphology, phylogeny

INTRODUCTION

Freshwater habitats provide the occurrence of various species of freshwater eel – a fish bearing elongated snake-like structure. The freshwater air-breathing mud eel- *Monopterus cuchia* (Hamilton, 1822) and swamp eel- *Monopterus albus* (Zuiew, 1793), are tentatively identified as belonging to the synbranchid genus *Monopterus* (Collins *et al.*, 2002; Li *et al.*, 2007). They are regarded as species complex and require taxonomic revision (Dahanukar, 2010). Both *M. cuchia* and *M. albus* are economically important freshwater fishes, recorded

from India, Bangladesh, Nepal, Pakistan and Myanmar (Menon, 1999; Mirza and Alam, 2002; Zhou *et al.*, 2002).

Comparative examination of morphological characters is one of the traditional methods of distinguishing fish taxa and stocks (Hubbs and Lagler, 1947). The modern genetic analysis is helping the traditional morphometric observation for proper identification of organisms or species. The morphological analysis is essential in genetic identification of species to see the concordance of genetic data with

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morphological data to draw a proper conclusion on speciation. Although, the freshwater air-breathing mud eel- *Monopterusuchia* (Ham.) and swamp eel- *Monopterus albus* (Zuiew), are regarded as species complex (Dahanukar, 2010), this morphological and genetic aspects of these two species have not been so far reported together.

Systematic position of *Monopterus*:

Phylum-Chordata
 Class-Actinopterygii (ray finned fish)
 Order-Synbranchiformes
 Sub order-Synbranchioidei
 Family-Synbranchidae
 Genus-*Monopterus*
 Species- *M. cuchia*, *M. albus*

The development of DNA-based genetic markers has a revolutionary impact on animal genetics. It is theoretically possible to observe and exploit genetic variation in the entire genome of organisms with DNA markers. In recent years, mtDNA, because of its fast evolution i.e. 5 to 10 times faster than single copy nuclear genes (Avise, 2000), has been widely applied in systematics, population genetics and conservation biology of animals.

Although some research has investigated population differentiation in *M. albus* population using RAPD (Liu et al., 2005) and isozymes (Yang et al., 2005), yet, little is known about the genetic diversity of *M. albus* and *M. cuchia* in northeast India. According to IUCN (2014), Taxonomic investigation is needed to clarify confusion between *M. cuchia* and *M. albus* within India, which could impact upon the species. Therefore, in the present investigation, an attempt has been made to study the both morphological and genetic variation between *Monopterus cuchia* and *Monop-*

terus albus of Northeast India based on morphological observation and mitochondrial DNA (D-loop region) based genetic analysis. The study represents the first hand information generation that includes field data collection, sample collection and analyses including DNA isolation, PCR, sequencing of D-loop region followed by study of sequence-based molecular genetic variation between *M. cuchia* and *M. albus*.

MATERIALS AND METHODS

Sample collection

Field work was carried out during July, 2011 to June, 2014 in different parts of Assam and Manipur in Northeast India (GPS location 26°10'22.79'' - 27°39'32.79''N Latitude and 91°26'39.74'' - 96°15'39.84''E Longitude) (Table 1 and Figure 1). A total of 230 *Monopterus* individuals were sampled from their habitat for morphological observations. In the laboratory, each sample was measured for its body weight and standard body length. Length was measured to the nearest mm and weight to 0.1 g. Phenotypic variations were recorded and used for the analysis of molecular data. Most reliably measurable morphometric characters were considered for the study.

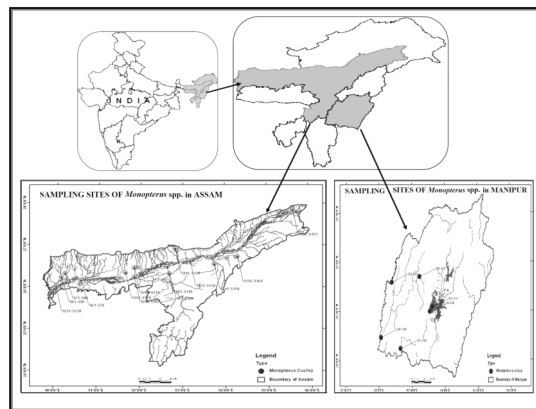


Figure 1. Map of study area showing the sampling sites.

Table 1. GPS coordinates of the sampling sites of *Monopterus cuchia* and *Monopterus albus*

Sampling area	Sampling Site(s)	Coordinates
Manipur	Loktak Lake	24.3°N, 93.5°E
	Ijei River, Longmai, Tamenglong	24.5°N, 93.4°E
	Tuivel River, Manipur	24.08°N , 93.2°E
	Wetlands, Hallawgaon, Sadiya, Tinsukia	27.50°N, 95.45°E
	Rice field, Mariani, Jorhat	27.52°N, 95.37°E
	Bhogdoi River, Jorhat	26.77°N, 94.22°E
	Kakodonga River, Golaghat	26.43°N, 94.3 °E
	Dhansiri River, Golaghat	26.35°N, 93.35°E
	Kolong River, Nagaon	26.36°N, 92.69°E
	Jia Bhorali River, Sonitpur	26.69°N, 92.87°E
Assam	Bishwanath Ghat, Sonitpur	26.66°N, 93.17°E
	Chandubi beel, Kamrup	25.51°N; 91.21° E
	Kulshi river, Kamrup	26.03°N; 91.26° E
	Rice field, Nalbari	26.14°N, 91.08°E
	Puthimari river, Kamrup	26.22°N, 91.4°E
	Rice field, Hajo, Kamrup	26.14°N, 91.32°E
	Wetland, Manikpur, Bangaigaon	26.45°N, 90.80°E
	Rice field, Bilaishipara, Dhubri	26.11°N, 90.16°E
	Rice field, Dhubri	26.01°N, 89.6°E
	Urpada Beel, Goalpara	26.06°N, 90.35°E
	Rice field, Dudhnoi, Goalpara	25.98°N, 90.79°E

DNA extraction, PCR amplification and sequencing of D-loop region:

Selected samples (6 each from *M. cuchia* and *M. albus*) were used simultaneously for genomic DNA extraction, sequencing of targeted regions of mitochondrial genome (D-Loop). DNA was isolated from the tissue using the Chloroforme-Octanol method (Salah and Iciar, 1997; Cabe *et al.*, 2007). The informative regions of D-loop region were PCR amplified using primer pairs F-TTCCAATGGAGG

GATGGTGC and R- AACCACCGAAAAG-CGAAAGC.

All PCR amplifications were carried out in 25 µL reaction volume, with 1.5 units of Taq DNA Polymerase (Bangalore Genei, Bangalore, India), 0.25 mM of dNTPs (Bangalore Genei), 2.0 mM of MgCl₂, 0.1 M (Sigma) of each primer and 20 ng of genomic DNA. The condition for amplification was an initial denaturation temperature 94 °C for 5 min, followed by 35 cycles of 94 °C denaturing

temperature for 50 sec , then by 45 sec at appropriate annealing temperature followed by extension temperature of 72°C for 90 sec and then by a final extension at 72°C for 10 min. The amplified PCR products were separated in 2% agarose gel by electrophoresis at 100 V. The results of electrophoresis was observed and recorded in the UVIDoc gel documentation system. Using the QIA quick PCR Purification kit (Qiagen), the amplified PCR products were purified. Sequencing of D-loop region was carried out in ABI PRISM® 377 DNA sequencer (at BioAxis DNA Research Centre, Hyderabad).

Sequence analysis

The sequences were simultaneously aligned using aligned using ClustalW 1.6 (Thompson *et al.*, 1994) integrated in software MEGA6 (Tamura *et al.*, 2013). The nucleotide sequence analyses were performed in the CLC Genomics Workbench 7.0.3 (CLC Bio, Hyderabad).



A.



B.

Figure 2. Photographs of A. *M.cuchia* collected from Assam, B. *M. albus* collected from Manipur

Morphological observation:

The major morphological similarities and differences of *M. cuchia* and *M. albus* have been listed in Table 2.

1. *M. cuchia* bears smooth, tiny cycloid scales embedded in the skin but *M. albus* is scale less.
2. *M. cuchia* is pale red in ventral side but *M. albus* has white, orange, light brown ventral side.
3. In *M. cuchia* mature females are larger than males but in *M. albus* males are larger than female.
4. Fin formula of *M. cuchia* is: D_{-very rudimentary}; P₁; V₂; A. and C. Absent .
5. Fin formula of *M. albus* is: D_{-vestigial}; P₀; V₀; A_{vestigial}. and C₀

Table 2. Morphological Characters of two *Monopterus* species

Character	<i>M. albus</i>	<i>M. cuchia</i>
Caudal fin	Absent	Absent
Gill slit	gill opening is confined to a single slit, which is ventral; narrow	gill opening is confined to a single slit, which is ventral; wide
Posterior nares	Between eyes	Between eyes
Soft tissue around upper jaw	Jaw-like flap over upper jaw	Jaw-like flap over upper jaw
Branchiostegal membrane	Attached to isthmus	Attached to isthmus
Branchiostegal rays	six	six
Holobranchs	Reduced or modified on first 3 arches. Absent from 4 th arch	Reduced or modified on first 3 arches. Absent from 4 th arch
Suprapharyngeal pouches	Present but incomplete	present
Scale	none	present on tail

The total length is highest (69.68±1.92) in *M. cuchia* females of population-2 and minimum in *Monopterus cuchia* males (42.93± 1.55) of the population-2. The total length of *M. cuchia* males ranged between 41 cm and 63cm. The total length of *M. cuchia* females ranged between 58-74 cm. However, the total length of *M. albus* males ranged between 51-67 cm and the females ranged between 40-52cm (Table 3). This data on total lengths on both sexes indicates that females are larger than males in *M. cuchia*. On the other hand males are larger than females in *M. albus*.

Table 3. Data on total length and weight between both sexes of *M. cuchia* and *M. albus* specimens from Assam and Manipur.

Species identified	Population code	N	Sex	Ns	Mean TL ± SD (cm)	t-statistics of TL	p value of TL	Mean weight ± SD (g)	t-statistics of weight	p value of weight
<i>M. albus</i>	1	50	M	23	62.91 ± 5.2 (51-67)	15.8744	< 0.0001	215.43 ± 30.5 (140-250)	8.9778	< 0.0001
			F	27	43.22 ± 3.13 (40-52)			142.62 ± 26.15 (75-195)		
<i>M. cuchia</i>	2	45	M	29	42.93 ± 1.55 (41-45)	-47.7949	< 0.0001	184.65 ± 57.27 (110-325)	-9.7745	< 0.0001
			F	16	69.68 ± 1.92 (67-73)			567.81 ± 150.92 (370-750)		
	3	40	M	21	56.33 ± 4.47 (51-63)	-12.2342	< 0.0001	237.61 ± 48.17 (200-450)	-9.456	< 0.0001
			F	19	69.53 ± 2.01 (66-74)			470.47 ± 97.07 (400-850)		
	4	95	M	56	55.37 ± 2.97 (52-63)	-12.9367	< 0.0001	152.76 ± 28.95 (125-350)	-15.1797	< 0.0001
			F	39	64.89 ± 3.87 (58-69)			252.82 ± 33.33 (210-450)		

M: Male; F: Female; SD = standard deviation; TL: Total Length; Ns: Sample size collected from a site. N: Total samples from each population; **P* < 0.05

Identification key of *Monopterus cuchia*:

The present study has confirmed the identified 150 *Monopterus cuchia* individuals

based on following keys- (i) Skin of branchial region of ventral side of head drawn into deep longitudinal folds; in gill arch skeleton, epibranch-

chial two short and wide-based, broadly triangular, epibranchial three a stout rod as robust as that of fourth arch, (ii) Teeth on palate and laterally on jaws uniserial; with 99 to 112 abdominal and 55 to 70 caudal vertebrae. A rudimentary dorsal fin originates a little anterior to vertical from anus. Dorsal fin is continuous with caudal fin.

Identification key of *Monopterus albus*: The present study has confirmed the identified 80 nos. of *Monopterus albus* individuals based on following keys- (i) Body robust, not whiplike; ventral gill opening triangular; 88 to 102 abdominal and 45 to 74 caudal vertebrae; epigeal. (ii) Without pelvic or pectoral fins; all other fins greatly reduced or not evident. Body

eel-like, to 70 cm (24 in) long, tapering at hind end to a point. Anguilliform body; no scales; no pectoral and pelvic fins; dorsal, caudal and anal fins confluent and reduced to a skin fold; gill openings merged into single slit underneath the head. Rice paddy eels are red to brown with a sprinkling of dark flecks across their backs; large mouths and small eyes.

PCR amplification and sequencing:

The DNA samples of purified PCR product gave ~ 600 bp D-loop regions, amplified in separate reaction set for each gene by using the specific primer pairs. The representative gel images for the PCR amplification profile for mitochondrial and nuclear genes are shown in Figure 3.

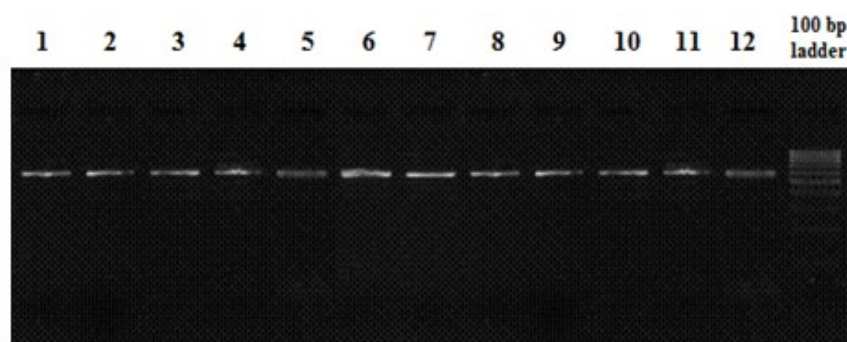


Figure 3. PCR amplification profile of D-loop region (~600 bp); Lane 1-6: *M. cuchia*, Lane 7-12: *M. albus*, 13. 100 base pair ladder (1kb).

Comparative sequence analysis D-loop region:

The D-Loop region sequence of the present study ranged from 610 (in both the *Monopterus* species) to 950 (in *Danio rerio*) nucleotide long and with molecular weights of 195.84 kDa (in *M. albus*), 195.95 kDa (in *M. cuchia*) and 304.272 kDa (in *Danio rerio*) respectively. The melting temperature was found to be 78.06 (in *Danio rerio*), 81.70 (in *M. cuchia*) and 82.04 (in *M. albus*) at 0.1M salt concentration (Table 4). The frequency of AT in D-loop region (cDNA) sequence ranged from 0.582 (in *M. albus*) to 0.679 (in *Danio rerio*).

On the other hand frequency of GC ranged from 0.321 (in *Danio rerio*) to 0.418 (in *M. albus*) (Table 4). The D-loop region was found to A:T rich (Table 4; Figure 4). The transition/ transversion frequency for the nucleotides of the D-loop region are- A=>T = 0.06, A=>C = 0.04, A=>G = 0.11, T=>A = 0.06, T=>C = 0.11, T=>G = 0.04, C=>A = 0.06, C=>T = 0.17, C=>G = 0.04, G=>A = 0.17, G=>T = 0.06, G=>C = 0.04. Multiple sequence alignment of D-loop region in *M. cuchia* and *M. albus* has been presented in Figure 5.

Table 3. Comparative Nucleotide sequence statistics of the D-loop region cDNA sequence *M. cuchia* *M. albus* and *Danio rerio*.

Statistical parameter	<i>M. cuchia</i>	<i>M. albus</i>	<i>Danio rerio</i>
Sequence source/GenBank Accession	This study	This study	AC024175
Length (bp)	610bp	610bp	950bp
MW in single stranded condition (kDa)	195.95 kDa	195.84 kDa	304.272 kDa
Melting temperature ($^{\circ}$ C) [salt] = 0.1M	81.70	82.04	78.06
Frequency of A + T	0.590	0.582	0.679
Frequency of C + G	0.410	0.418	0.321

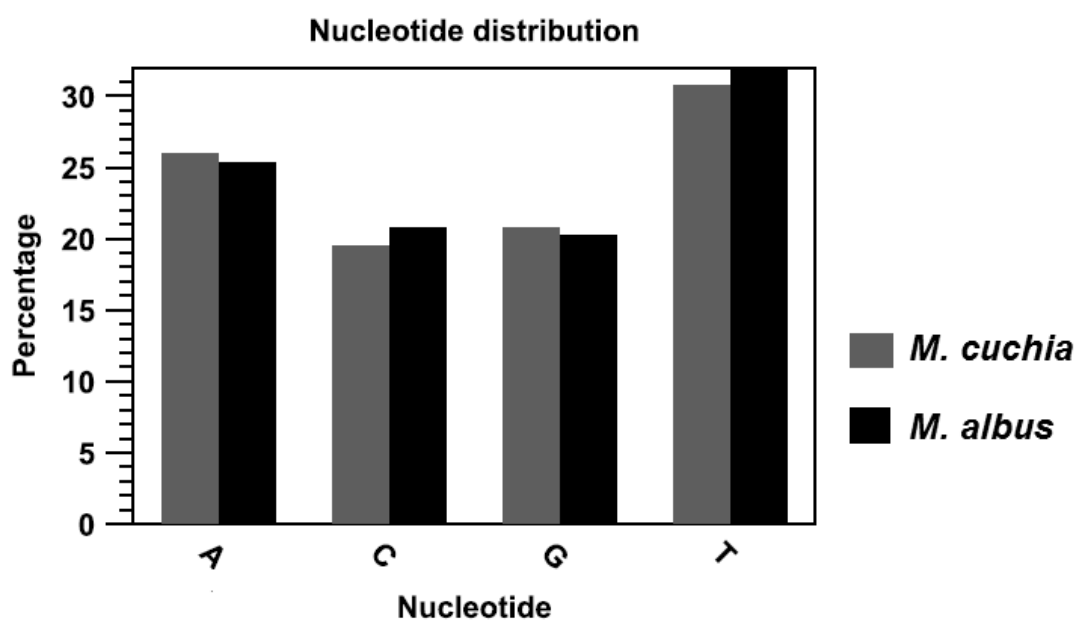


Figure 4. Comparative nucleotide composition (% in average) in the D-loop region cDNA sequence of *M. cuchia* and *M. albus*.

Morphological and mitochondrial

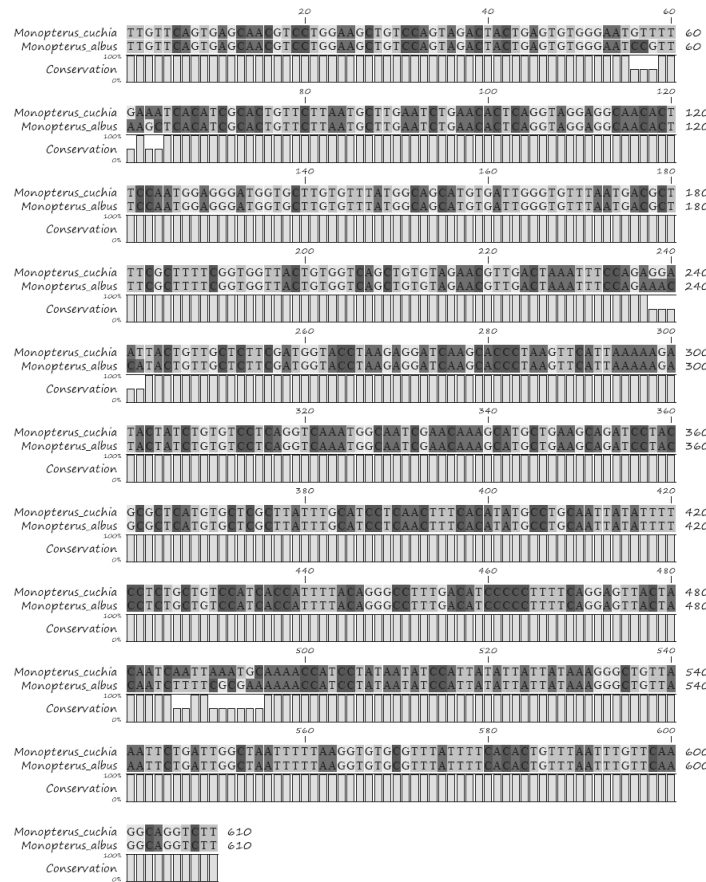


Figure 5. Multiple sequence alignment of D-loop region between *M. cuchia* and *M. albus*. The height of the bar diagram represent the level of conservation at each alignment position of respective amino acid(s).

Phylogeny of *Monopterus* based on D-loop sequence

The Maximum-likelihood model T92 has been used based on Modeltest (Posada and Crandall, 1998). Pair-wise distances (P-distance) of D-loop region have been depicted in the Table 5. The bootstrap consensus tree inferred from 1000 replicates was taken to represent the evolutionary history of the taxa analyzed (Felsenstein, 1985).

The Pair-wise distance of D-loop region sequences among the different eel species

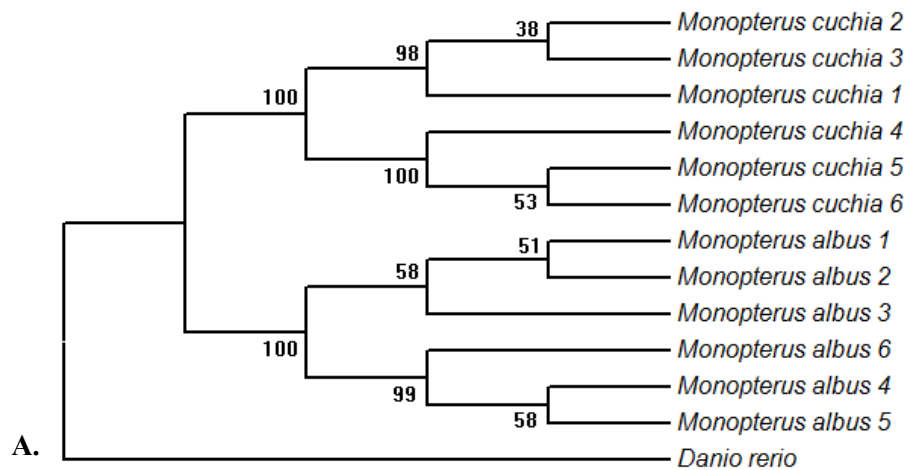
of the present study revealed genetic distance exist (0.013) within the *Monopterus cuchia* samples collected from lower Assam and upper Assam populations (Table 5). Between *Monopterus cuchia* and *Monopterus albus* samples, highest genetic distance (0.062) exists between *M. cuchia* 4,5,6 (upper Assam population) and *M. albus*-10,11,12 (Manipur) populations. The longest genetic distance (0.810) exists between the outgroup sequence *Danio rerio* and *M. cuchia* 4,5,6 (middle-upper Assam population) (Table 5).

Table 4. Estimates of Evolutionary Divergence between Sequences of D-loop region

		1	2	3	4	5	6	7	8	9	10	11	12	13
1	<i>Monopterusuchia 1</i>	-												
2	<i>Monopterusuchia 2</i>	0.000												
3	<i>Monopterusuchia 3</i>	0.000	0.000											
4	<i>Monopterusuchia 4</i>	0.013	0.013	0.013										
5	<i>Monopterusuchia 5</i>	0.013	0.013	0.013	0.000									
6	<i>Monopterusuchia 6</i>	0.013	0.013	0.013	0.000	0.000								
7	<i>Monopterus albus 1</i>	0.032	0.032	0.032	0.046	0.046	0.046							
8	<i>Monopterus albus 2</i>	0.032	0.032	0.032	0.046	0.046	0.046	0.000						
9	<i>Monopterus albus 3</i>	0.032	0.032	0.032	0.046	0.046	0.046	0.000	0.000					
10	<i>Monopterus albus 4</i>	0.048	0.048	0.048	0.062	0.062	0.062	0.015	0.015	0.015				
11	<i>Monopterus albus 5</i>	0.048	0.048	0.048	0.062	0.062	0.062	0.015	0.015	0.015	0.000			
12	<i>Monopterus albus 6</i>	0.048	0.048	0.048	0.062	0.062	0.062	0.015	0.015	0.015	0.000	0.000		
13	<i>Danio rerio</i>	0.789	0.789	0.789	0.810	0.810	0.810	0.790	0.790	0.790	0.804	0.804	0.804	-

The evolutionary history of *Monopterusuchia* and *Monopterus albus* based on D-loop region was inferred using the Maximum Parsimony method. Tree #1 out of 116 most parsimonious trees (length = 321) is shown (Figure 6). The consistency index is (0.980392), the retention index is (0.992308), and the composite index is 0.989216 (0.972851) for all sites and parsimony-informative sites (in parentheses). The percentage of replicate trees in which the associated taxa clustered together in

the bootstrap test (1000 replicates) are shown next to the branches (Felsenstein, 1985). The MP tree was obtained using the Close-Neighbor-Interchange algorithm (Nei and Kumar, 2000) with search level 1 in which the initial trees were obtained with the random addition of sequences (10 replicates). The analysis involved 13 nucleotide sequences. All positions containing gaps and missing data were eliminated. There were a total of 608 positions in the final dataset.



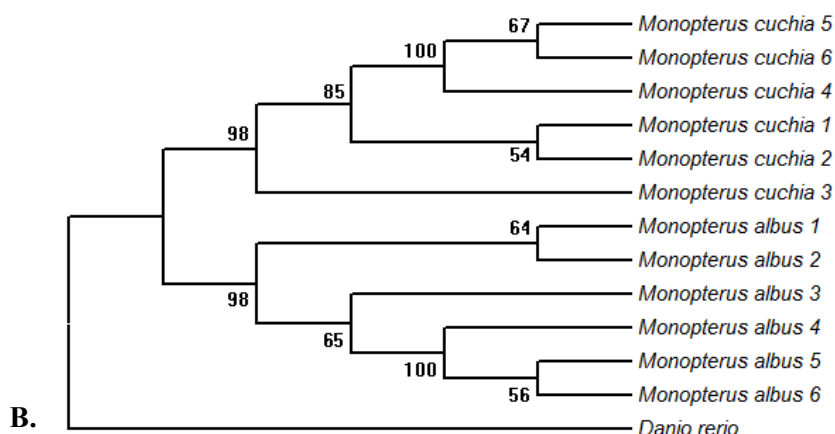


Figure 6. Molecular phylogenetic analysis of *Monopterus* based on D-loop sequence. A. Maximum Parsimony analysis; B. Maximum Likelihood method based on the Tamura 3-parameter model (Tamura, 1992). The percentage of replicate trees in which the associated taxa clustered together in the bootstrap test (1000 replicates) is shown next to the branches (Felsenstein, 1985).

The D-loop region based MP phylogenetic tree (Figure 6A) revealed that *M. cuchia* and *M. albus* are two separate sister groups (bootstrap support 100%). The ML tree (Figure 6B) revealed that *M. cuchia* and *M. albus* are phylogenetically distinct species (bootstrap separation 98%) having common ancestor. Both in *M. cuchia* and *M. albus* taxon in the tree showed sub-clades within the genus, indicating the possibility of existence of subspecies in each of the species (Figure 6). Within the *Monopterus cuchia* populations, the samples of lower Assam (*M. cuchia* 1-3) formed a distinct clade (bootstrap support 99%) from upper Assam population (*M. cuchia* 5-6) with bootstrap separation 100%, which indicates the possibility of existence of two subspecies in *Monopterus cuchia*. Within the genus *M. albus*, differences exist in evolutionary distance and two distinct sub-clades are observed in bootstrap value 100% (Figure 6A).

DISCUSSION

Morphometric study as well as its

variation plays an important role in physiological, evolutionary and ecological implication. *Monopterus albus* as well as *Monopterus cuchia* are almost certainly a species complex, and taxonomic identity of the eastern Himalaya needs to be validated (IUCN, 2014). The study has generated necessary information for the support of recognition of two *Monopterus* species based on morphology and mitochondrial genetic variation, which will provide the information about the systematics and natural history of this genus.

Monopterus is characterized by specializations of the dorsal gill arch skeleton; upper lip jowl-like, without a separate or swollen fold; gills, if present, reduced to single rows of filaments on the first three arches; gill membrane attached internally to the isthmus; and other modifications of the branchial circulatory system and skeleton (Rosen and Greenwood, 1976).

The process of sex reversal in synbranchids, on the other hand, has been

subject of a series of studies (Tao *et al.*, 1993; Ravaglia *et al.*, 1997). *Synbranchus marmoratus*, particularly, is known as a proto-gynous diandric fish (Lo Nostro and Guerrero, 1996), with two different kinds of males. Primary males develop directly as males while secondary males arise from the sex reversal of females (Sadovy and Shapiro, 1987; Lo Nostro and Guerrero, 1996).

The mitochondrial DNA control region, which includes the D-loop in vertebrates, is usually the fastest evolving region in the mitochondrial DNA of vertebrates and invertebrates and therefore more sensitive than protein loci as a marker to score intraspecific variations of many organisms (Avice, 2000). Direct sequencing of mtDNA D-loop (745 bp) and mtATPase6/8 (857 bp) regions was used to investigate genetic variation within common carp (*Cyprinus carpio*) and develop a global genealogy of common carp strains (Thai *et al.*, 2004).

In the present study, although, the morphological data did not very strongly supported distinctness between *M. albus* and *M. cuchia*, the molecular investigation, based on mitochondrial (D-loop region) clearly revealed that *M. cuchia* and *M. albus* are two distinct species. D-loop and COI gene based phylogenetic tree also revealed that both the species *M. cuchia* and *M. albus* might have two sub-species within each species. Efficient identification of the two Synbranchid eel species of the present study is critical for aquaculture management as well as for eel conservation (Dudu *et al.*, 2010). Thus, identification of *M. cuchia* and *M. albus* has been supported by molecular characterization in the present study instead of conventional methods (Huang, *et al.*, 2001).

The high bootstrap value in the D-loop

region based phylogenetic tree also supports that *M. cuchia* and *M. albus* are two separate species (bootstrap support 100%) (Figure 6). Within the *Monopterus cuchia* populations, lower Assam (*M. cuchia* 1-3) and upper Assam population (*M. cuchia* 5-6) showed evolutionary distinctness by forming two distinct sub-clade (bootstrap separation 100%). This clearly supports the finding of COI gene based phylogeny that there is higher possibility of existence of two subspecies in *Monopterus cuchia* (Figure 6). The *M. albus* also shows evolutionary distance by forming two distinct sub-clades and the bootstrap value 100% indicates the possibility of existence of two subspecies within this species (Figure 6).

The study revealed minor morphological but well defined genetic distinctness between *Monopterus cuchia* and *Monopterus albus*. The sequencing and molecular characterization has been performed on the mitochondrial D-loop region and COI genes to identify the molecular differences of *Monopterus cuchia* (Hamilton) and *Monopterus albus* (Zuiew). The study has revealed several interesting morphological and genetic differences between *M. albus* from *M. cuchia*, which clarifies their genetic distinctness rather than species complex as suggested by earlier studies.

The present study will certainly be helpful in understanding genetic variation between *M. cuchia* and *M. albus* and will clarify taxonomic uncertainties mentioned by earlier workers. (Dahanukar, 2010). Further, D-loop region based phylogenetic study showed genetic distinctness of *M. cuchia* and *M. albus* rather than a species complex.

CONCLUSION

The present study based on morphological observation and mitochondrial D-loop

region revealed that *M. cuchia* and *M. albus* are two distinct species. The D-loop region based phylogenetic tree revealed that both *M. cuchia* and *M. albus* might have two sub-species within each species. Further, phylogeographic study based on sampling in large geographic area along their distribution ranges will help to establish such sub-speciation. The present study will certainly be helpful in understanding genetic variation between *M. cuchia* and *M. albus* and will clarify taxonomic uncertainties mentioned by earlier workers. The study is useful in modern molecular biology and fish biotechnology in sequence analysis, characterization two synbranchid fishes of genus *Monopterus* found in Northeast India.

ACKNOWLEDGEMENT

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An evanescent field waves based fiber-optic temperature sensor

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ABSTRACT

An evanescent field wave absorption based fiber optic temperature sensor being presented in this work has the potential to detect temperature changes in a liquid to a good degree of precision as when compared to traditional temperature sensing devices. The amount of rays guided along the fiber probe is a result of the absorption of evanescent waves being produced at the core-cladding interface. Some of the important characteristics of the proposed sensor are that it utilizes inexpensive analyte, uses multimode optical fiber and exhibits a small response time. A millivolt range multimeter displays voltage output which is an indicator of the temperature of the liquid bath. An effort has also been carried out for the search of a suitable liquid which exhibits optimum sensitivity and better response regarding the proposed set-up. Moreover, it has also been studied regarding the suitable wavelength which gives a better response to the proposed sensor.

Key words: Evanescent wave, Optical fiber, temperature sensor

INTRODUCTION

Some traditional temperature sensors namely, thermometers, thermocouples, RTDs, PRTs do not meet recent demands for sensing temperature to a required degree of precision. Some laboratories and industries need a different kind of temperature sensor which fulfils the precision considerations as well as maintains a lower expenditure. These requirements are also followed by performance, size and reliability. Moreover, non expertise in temperature measurement in industries is also preferred. The proposed sensor based on evanescent wave absorption phenomena provides a way to measure temperature that meets the aforementioned requirements. The temperature sensor

designed using this phenomenon is susceptible to electromagnetic disturbances and is suitable at hazardous environments also (Gupta, 2006).

This paper illustrates an inexpensive temperature sensor designed using a step index multimode optical fiber in which a length of 3.3 cm about its middle portion has been stripped off the cladding, and is being substituted by a suitable liquid of known physical properties (Lee *et al.*, 2010). The absorption of evanescent waves depends upon the refractive index of the liquid. On the other hand, refractive index of a liquid also bears a relationship with temperature

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of the liquid bath. The probe being immersed in the liquid gives a way to measure the temperature of the liquid by knowing the output power at the receiving end of the fiber. The following section illustrates the probe characteristics and the measurement procedures.

DESIGN AND EXPERIMENT

If the field phase is real in an optical fiber, the propagating rays are real, whereas unreal part is the evanescent field which is the exponentially decaying part of the light. The real field are the guided rays that exist in the core while the rays outside the core are leaky rays (Betta and Pietrosanto, 2000; Gupta, 2006)

When a ray is incident at an angle (θ) greater than the critical angle for the interface separating the two media, then light is total internally reflected into the core, but has an evanescent wave in the surrounding medium. The penetration depth which is given by

$$d_p = \frac{\lambda}{2\pi(n_1^2 \sin^2 \theta - n_2^2)^{1/2}}$$

is associated with the electric field amplitude at the core-cladding interface given by $E = E_0 \exp(-zd_p)$ (Jianqing *et al.*, 2000; Messina *et al.*, 1996; Gupta, 2006)

This expression is dependent upon the length of the unclad portion 'z' and 'd_p' is a function of the refractive indices of the core, n_1 and that of the liquid, n_2 serving as the cladding. Considering that n_1 does not change owing to external parameters, but n_2 gives proportional change, it leads to change in the number of guided rays through the length of the fiber. One of the common external parameters bringing a change in refractive index of the liquid is temperature. Thus, the liquid when substituted for the plastic cladding at the probe length, an

increase in temperature would bring about more output power at the receiving end. The minimum output will occur when the refractive indices of the core equals to that of the liquid at the temperature T_{\min} . For rises in temperatures a gradual increase in the power output can be found, but is maximum upto a temperature, T_{\max} (Betta and Pietrosanto, 2000). Thus, a very suitable liquid will enhance the difference ($T_{\max} - T_{\min}$). In this work, three test liquids, viz. kerosene, distilled water, and glycerol are being investigated as the cladding substance separately to get a conclusion about their sensitivities and responses.

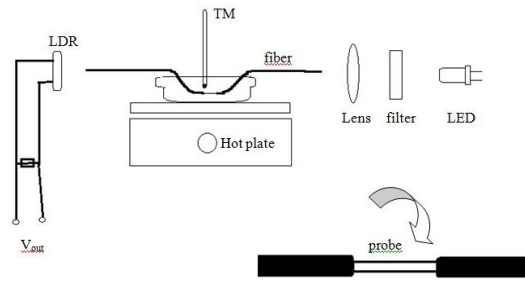


Figure 1. Experimental set-up

The multimode fiber is a PCS (plastic clad-silica) FT-600UMT ($n_1 = 1.457$, $n_2 = 1.368$, $NA = 0.37$) of dimensions 200/220 μm has been stripped to 3.3 cm of its cladding exposing the core[1]. A suitably shaped frame fixes the fiber to let the probe immersed into the liquid kept in a bowl that can be heated by the hot-plate. The hot plate is equipped with a temperature controller that has temperature calibrations to supply a suitable value. A laboratory thermometer is dipped into the same liquid at a vertical position to check the stability of the temperature of the bath.

The light source is a white LED (EVERGREEN ELECTRONICS) wherein the

final wavelength is determined using wavelength filters which have 20 nm spectral width bandpass characteristics. The rays are focussed into the fiber using a convex lens of short focal length. The filters being used in the experiment have wavelength specifications of 460nm, 540nm, 570nm, and 635nm.

The attenuated light at the output end of this fiber is fed to the surface of a light dependent resistor (LDR), CdSe coated having peak spectral response at 550nm; model NORP12 (RS components).

The output across the LDR using a megaohm resistor is displayed by a mV range digital multimeter whose voltage values are indicative of the temperature of the liquid bath for that particular instant. Having fixed the temperature at a particular value, the wavelengths are varied. Thus, the search for the suitable wavelength has also been made throughout the experiment.

It has been considered that white light of comparable brightness can significantly excite the fiber at the interface between the two media, and the related transducer gives the proportionate temperature relative to the output power.

In order to account the variation of output intensity with temperature changes, equal intervals of temperature are tuned by the controller, and at particular moment, the thermometer is held to show a stable value. Then, wavelength is varied (Kyuma *et al.*, 1982).

RESULTS

The output voltages across the LDR are tabulated for both temperatures as well as wavelength variations. Separate graphs are being plotted for all the three test liquids having

normalised voltage output along ordinate and temperature along abscissa (figures 2,3,4). To study the sensitivity of the sensor from the point of view of wavelength dependence, two extreme temperatures are considered, i.e. 30C and 80C for plotting normalised output vs wavelength graph [5] for all the three liquids (figures 5 and 6).

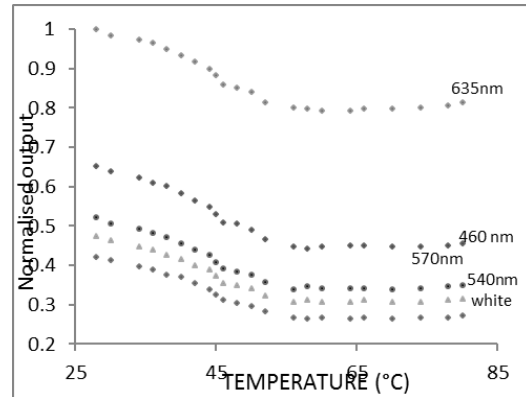


Figure 2. Normalised output vs. temperature for kerosene as the liquid medium for different wavelengths

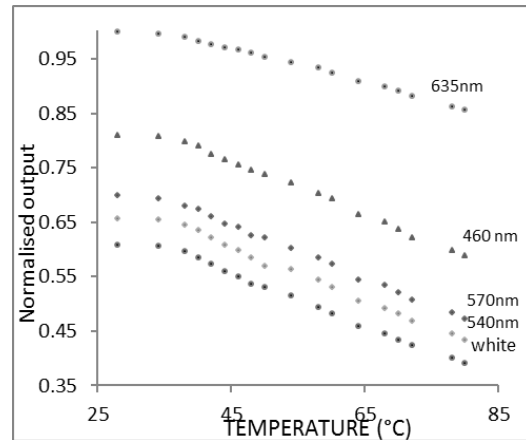


Figure 3. Normalised output vs. temperature for water as the liquid medium for different wavelengths

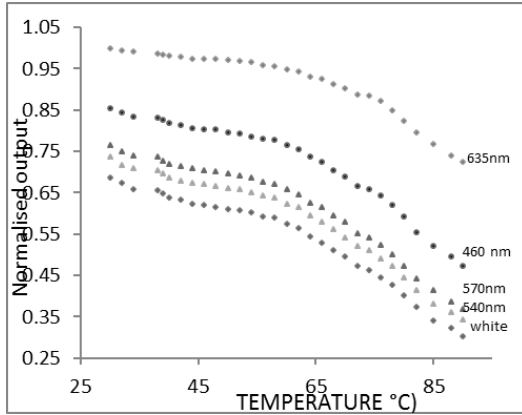


Figure 4. Normalised output vs. temperature for glycerol as the liquid medium for different wavelengths

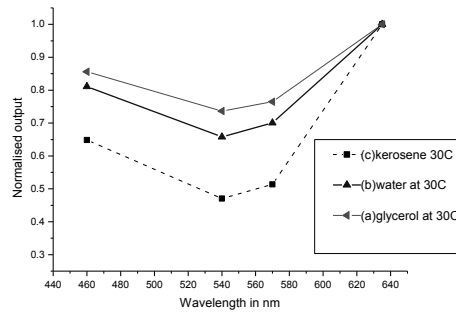


Figure 5. Normalised output vs. wavelength for all three liquids at 30°C

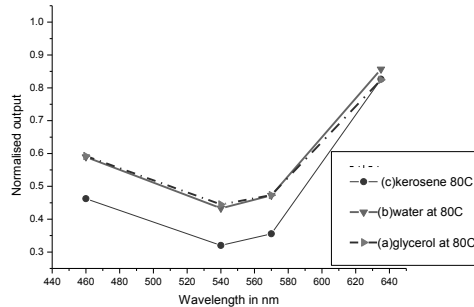


Figure 6. Normalised output vs. wavelength for all three liquids at 80°C

In this work, three different liquids have been tested, namely, kerosene, water and glycerol of their known refractive indices as well as temperature. The proposed set-up utilizing evanescent wave field absorption is found to exhibit good yield in terms of temperature change as well as wavelength change. The temperature change was incurred by heating element and monitored by a sensitive thermometer. Similarly, during the experiment, wavelength is tuned by deploying different filters of precise wavelengths.

So far, with different temperature variation with respect to testing liquid as kerosene, the highest transmittance is observed at the room temperature, i.e. at 28-30 degrees Celsius. After that, as the temperature rise, there is a sharp decline in the output until it reaches a value of 45°-50°C. After that, the output remains almost linear and saturated.

As of water, transmittance vs. temperature curve yields a consistently declining curve. Within the whole temperature range of 25°-80°C, a decreasing trend has been observed. However, compared to kerosene, water seems to be more responsive in the context of transmittance. The same yield has also been achieved in the case of glycerol. With temperature variation, a consistent decline in the transmittance has been seen. Comparing all the three liquids under observation, the maximum non-linearity in the output is contemplated in the case of kerosene whereas glycerol and water preferably exhibits less non-linearity.

Similarly, the plot of normalised output vs. wavelength exhibits a varying pattern. A large dependence of output with respect to wavelength can be observed. It is quite evident that the three different liquids

produce minimum output at the wavelength of 540nm whereas highest transmittance is achieved at 635 nm which is inclusive of all the experimental liquids. Noteworthy fact is that the output decreases with the increase in temperature. For example, glycerol shows higher contrast with respect to change in temperature.

Thus, with the current setup, the wavelength dependence of refractive index as well as temperature can be monitored. The key point in this set up is to select the optimal liquid which is more susceptible to changes in temperature as well as wavelength variation. In our current set up, exploiting the evanescent wave field, glycerol is found to reveal the highest sensitivity compared to water and kerosene. Although LDR is utilised as the receiver or detector, the set-up was also tested with photodiode and the same results were obtained. Apart from this, all the results have good degree of repeatability.

CONCLUSIONS

The experimental setup so designed for the purpose of sensing temperature utilizing evanescent field wave absorption phenomena has been investigated to an extent to provide a measure of the advantageous qualitative and quantitative parameters as compared to other types of temperature sensors available. The degree of accuracy, the utilisation of optical phenomena and using less expensive equipments are its noteworthy points. The repeatability and precision are found to agree every time from previous identical conditions. The liquids used here are very common and easily available, are non-volatile and harmless. The output voltages so obtained in each of the cases

throughout the experiment have been monitored by the use of a good precision digital multimeter. When interfaced to a PC using Data Acquisition System, the data could be maintained and stored digitally for further references.

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Entrepreneurship Development in North East India: A study on Initiatives taken by Indian Institute of Entrepreneurship (IIE)

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ABSTRACT

Entrepreneurs are the people who channelize various resources of production and starts new business establishments with their creative ideas. A country may be rich in resources but if it lacks entrepreneurs the resources remains underutilized and in turn the country lags behind in economic development. After the Kakinada experiment on entrepreneurship development training during the mid 1960s, the myth that entrepreneurs are born, no more holds good, rather it is well recognized now that the entrepreneurs can be created and nurtured through appropriate interventions. North Eastern Region of India has long been neglected in terms of both economic and social development. Richness of natural resources in this region displays a huge opportunity for investment and growth of enterprise in the region. For decades, this part of the country has been a black-hole for business and enterprising. Moreover, the region is suffering from ethnic violence for decades resulting in lack of opportunity for people to exercise their entrepreneurial spirit. The Indian Institute of Entrepreneurship (IIE) was established to carry out training, research and consultancy activities in small and micro enterprises focusing on entrepreneurship development. This paper aims to study the trend of the various entrepreneurship training programmes under IIE over last five years and to focus on the role played by IIE to develop awareness for entrepreneurship in North East India. The findings from the study indicates that there have been an increasing trend both in the number of programmes and number of participants under each program of IIE conducted over the years under the study and IIE has taken initiatives in all dimensions to promote entrepreneurship.

Key words: Entrepreneurs, (IIE), North East India.

INTRODUCTION

The term “entrepreneurship” comes from the French verb “entreprendre” and the German word “unternehmen”, both means to “undertake”. Bygrave and Hofer in 1891 defined the entrepreneurial process as, involving all the functions, activities, and actions associated with

perceiving of opportunities and creation of organizations to pursue them. Entrepreneurship is the process undertaken by the entrepreneurs to materialize his/her business interest, involving creativity and innovation that will go towards establishing his/her enterprise. It refers

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to the process of identifying opportunities in the market place, arranging the vital resources to pursue these opportunities and investing the resources to develop opportunities for long term gains. As said by A.H Cole, “Entrepreneurship is the purposeful activity of an individual or group of associated individuals, undertaken to initiate, maintain or organize, a profit oriented business unit for production or distribution of economic goods and service”.

The level of economic growth of a region to a larger extent depends on the level of entrepreneurial activities in a region. In the era of liberalisation, privatisation and globalisation along with ongoing IT revolution, capable entrepreneurs are making use of the opportunities emerging from the evolving scenario. However, a large segment of the population, particularly in the industrially backward areas, lags behind in taking advantage of these opportunities. Therefore, there is a need to provide skill development and entrepreneurship development training to such people in order to mainstream them in the ongoing process of economic growth. Entrepreneurship training and its awareness is thus one of the key elements for development of entrepreneurship.

To undertake this task on a structured manner, Government of India has set up three national-level Entrepreneurship Development Institutes (EDIs) which are as follows-

- The National Institute for Micro, Small and Medium Enterprises (NI-MSME), Hyderabad;
- The Indian Institute of Entrepreneurship (IIE), Guwahati and
- The National Institute for Entrepreneurship and Small Business Development (NIESBUD), Noida.

In addition to these, Entrepreneurship training programmes are also being conducted and organised by large number of Government and non-government agencies in India like-

- Entrepreneurship Development Institute Of India (EDII),
- Institute for Entrepreneurship Development (IED),
- Science and Technology Entrepreneurship Parks (STEPs),
- The Centre for Entrepreneurship Development (CED),
- Development Banks etc.

Entrepreneurial Development Programmes are meant to inculcate entrepreneurial traits into a person, imparting required knowledge, developing the technical, financial, marketing and managerial skill and building the entrepreneurial attitude.

In order to run the programmes efficiently, people in the societies are divided into different strata which is known as “targeted groups”. These groups are composed of technical and qualified persons, ex-servicemen, business executives, students, women entrepreneurs, SC and ST entrepreneurs etc.

The Indian Institute of Entrepreneurship (IIE) was set up at Guwahati in 1993 by the Ministry of Micro, Small and Medium Enterprises (earlier known as Ministry of Small Scale Industries), Government of India as an autonomous national institute. The institute’s activities are focused in the areas of stimulating, supporting and sustaining entrepreneurship development with special emphasis on North Eastern Region. The institute is constantly evolving in accordance with the emerging needs of the MSME sector. Since its establishment and up to

March 2014, the Institute has organized 4813 programmes with 1,68,867 participants.

Present Socio-Economic Condition prevailing in North East India

Today's North-East India is composed of eight sister states namely Assam, Arunachal Pradesh, Meghalaya, Manipur, Nagaland, Mizoram, Tripura and Sikkim. It is one of the most backward regions in the whole country. Its socio-economic condition reveals that though India has attained political freedom, yet it has not been able to gain freedom from wants, hunger, unemployment and exploitation. Growing insurgent activities, ethnic clashes, frequent violation of human rights coupled with mal-administration and corruptions are the common events in today's North-East India. Moreover, prevalence of socio taboos, superstitious belief, usage of traditional methods of production etc. are the prominent feature of the socio-economic life in NE India. It is characterized by low per capita income, poor rate of capital formation, heavy population pressure, lack of infrastructure, excessive dependence on agriculture and backward transport and communication system.

Statement of the Problem

Entrepreneurship is considered as backbone for economic development. It has been observed that the major factor which damages spirit of entrepreneurship is "societal pressure" that is respect for service class (Arun Kumar Jha, Director of IIE Guwahati & Director of NIESBUD). The North-eastern region will generate 2.6 million jobs, but the manpower supply will be 16.8 million persons till the year 2022 (Indian chamber of commerce in its report entitled India's North-East Diversifying Growth Opportunities), which itself gives

an impression of unemployment scenario in the region. The region is blessed with flora and fauna and forest resources which provide scope for tourism, bamboo industries, handloom industries, transportation industries etc. The emerging trend of e-commerce which requires technical know-how has added to this predicament, the educated youths of this region even after having academic qualifications could not relate their knowledge with entrepreneurial proficiency. Owing to this circumstance, it was felt necessary to study and analyse the trend of growth of entrepreneurship in the North Eastern part of this country.

Need of the study

Indian Institute of Entrepreneurship, Guwahati is a premier institute in North eastern India which works for promoting entrepreneurship. A necessity is felt to know the training programmes conduct by IIE with its growth. The number of trainees in different programmes indicates the interest of people at large in respective programmes. The particular programmes which are accompanied by larger numbers of trainees must be nurtured more and for others, having lesser number of trainees, measures of improving must be explored. In this context, out of three national-level Entrepreneurship Development Institutes (EDIs), the role played by Indian Institute of Entrepreneurship (IIE), Guwahati is highlighted.

Objectives of the study

- To study the trend of programmes conducted by Indian Institute of Entrepreneurship, Guwahati, over last five years.
- To study the trend of trainees participated in various training programmes

conducted by Indian Institute of Entrepreneurship, Guwahati, over last five years.

- To highlight the various initiatives taken by Indian Institute of Entrepreneurship, Guwahati, in promoting entrepreneurship in north eastern region of India.

METHODOLOGY

This research paper is in the form of a descriptive study. The present study is based on secondary data. The secondary data were collected from various published sources. Relevant data for five years (i.e., from 2009-10 to 2013-14) has been collected. The findings were discussed in the light of published literature. For identifying the trend in number of programmes and growth in number of participants' percentage is used. To know the various measures undertaken by IIE for promoting entrepreneurship a thorough review of literature is done. Average participants in each programmes is ascertained by dividing the number of trainees with the number of programmes to

grasp the per programme number of trainees.

OBSERVATION

Trend of Entrepreneurship Development Programmes conducted by Indian Institute of Entrepreneurship (IIE), Guwahati

As it is said "Entrepreneurship is catalyst for economic development", Indian Institute of Entrepreneurship (IIE), Guwahati, has taken such an endeavor to motivate, promote and nurture entrepreneurship so as to help in economic development of the region. The Indian Institute of Entrepreneurship (IIE), Guwahati, since inception, has conducted a good number of training programmes and various other events to perk up the entrepreneurial skill and motivate the youth to start their own business and become successful entrepreneur. In this context, it is noteworthy to study and analyse the growth/decline in the number of programmes conducted by the institute over the study period. Following table (Table 1) reveal the said trend.

Table 1. Trend of number of training programmes conducted by Indian Institute of Entrepreneurship, Guwahati, over last five years

PROGRAMMES/ FINANCIAL YEARS	2009-10	2010-11	2011-12	2012-13	2013-14
Entrepreneurship Development Programmes (EDP)	114	121	91	17	27
Growth Rate (%)		6.14	-24.79	-81.31	58.82
Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP)	11	350	625	1348	312
Growth Rate (%)		3081.81	78.57	115.68	-76.85
Management Development Programmes (MDP)	45	20	10	19	27
Growth Rate (%)		-55.56	-50	90	42.10
Others	127	65	89	77	135
Growth Rate (%)		-48.81	36.92	-13.48	75.32
Total	297	556	815	1461	501
Growth Rate (%)		87.20	46.58	79.26	-65.70

Source: Indian Institute of Entrepreneurship, Annual Reports (For the financial years 2009-10 to 2013-14).

It is observed from the table that initially in the year 2010-11 the no. of EDPs has increased by 6.14 % but then in two subsequent years it shows reducing trend of -24.79 % and -81.31% respectively. Lastly in 2013-14, 58.82% increase in the number of programmes can be seen.

In the case of Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP) initially a massive growth of 3081.81 % can be observed. In the subsequent two years 78.57 % and 115.68% growth can be seen. But lastly in the year 2013-2014 there was a decline of -76.85% in such programmes. It is worthy to mention here that these set of programmes are meant for inculcating skill into the participants and its growth shows the interest of the institute to conduct the same.

The analysis of Management Development Programmes (MDP) signifies that there is initial decline of -55.56% and -50% in the years 2010-11 and 2011-12 respectively. But later in the subsequent years, i.e 2012-13 and 2013-14 positive growth is observed in the no. of such programmes.

In the set of other programmes a decline of -48.81% is viewed in the year 2010-11, in 2011-12 these programmes increased to 36.92% again in the year 2012-13, -13.48% reduction is observed. In the year 2013-14, an increase of 75.32% is observed in the pro-

grammes.

Overall impression about the programmes is that the number of programmes is increasing though not in a uniform manner which indicates that the Indian Institute of Entrepreneurship is putting continuous effort in developing entrepreneurship in the region.

After observing the trend of increase/decline in the number of programmes conducted by Indian Institute of Entrepreneurship, (IIE), Guwahati, it is felt necessary to study the trend of participants who participated in such programmes.

Trend of participants under each training programme of Indian Institute of Entrepreneurship (IIE), Guwahati

The programmes conducted by the institute intend to promote entrepreneurship by way of stimulating entrepreneurial education among the mass of the North East Region. Since the success of the programmes conducted by the Indian Institute of Entrepreneurship (IIE), Guwahati depends upon the active participation of trainees, it is of great importance to analyse the growth/decline in the number of trainees participating in the programmes conducted by Indian Institute of Entrepreneurship (IIE), Guwahati. Table 2 highlights the trend of trainees who participated in the programmes conducted by the institute over the past five years.

Table 2: Trend of participants under each program of Indian Institute of Entrepreneurship over last five years

PROGRAMMES/ FINANCIAL YEARS	2009-10	2010-11	2011-12	2012-13	2013-14
Entrepreneurship Development Programmes (EDP)	3045	3246	2839	463	710
Growth Rate (%) -		7.19	-12.53	-83.69	53.34
Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP)	284	9393	17983	39575	9235
Growth Rate (%) -		3207.39	91.45	120.06	-76.66
Management Development Programmes (MDP)	1292	568	234	624	943
Growth Rate (%) -		-56.30	-58.80	166.67	51.12
Others	7403	3630	5528	3625	12471
Growth Rate (%) -		-50.97	52.29	-34.42	70.93
Total	12024	16837	26584	44287	23359
Growth Rate (%) -		40.03	57.89	66.59	-47.26

Source: Indian Institute of Entrepreneurship, Annual Reports (For the financial years 2009-10 to 2013-14).

It is observed from the table that the number of participants in EDPs increased by 7.19% in the year 2010-11, then for the next two subsequent years the growth is negative that are -12.53% and -83.69% respectively and in the year 2013-14 the growth has increased by 53.34%.

In Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP) in the year 2010-11 there is a huge increase in the number of participants that is 3207.39% and for the next two year also there is positive growth that are 91.45% and 120.06% respectively but in the year 2013-14 the growth is negative that is -76.66%.

In the case of number of participants in Management Development Programmes (MDP) for the year 2010-11 and 2011-12 there is negative growth of -56.30 and -58.80. In the year

2012-13 and 2013-14 the growth is positive which are 166.67 and 51.12 respectively.

In the others category of programmes, in the year 2010-11 the growth is negative which is -50.97%, in the year 2011-12 the growth is positive which is 52.29%, in the year 2012-13 the number of participants get reduced by -34.42% and in the year 2013-14 the increase is 70.93%.

Behind analyzing the trend of number of training programmes conducted by Indian Institute of Entrepreneurship, Guwahati, and trend of trainees participated in all those programmes. It is important here to ascertain the average trainees in each programmes separately so that a clear picture of the exact number of trainees participation in each of the various programmes could be figured out.

Table 3. Table showing average number of participants in each training programmes

PROGRAMMES/ FINANCIAL YEARS	2009-10	2010-11	2011-12	2012-13	2013-14
Entrepreneurship Development Programmes (EDP)	27	27	31	27	26
Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP)	26	27	29	29	30
Management Development Programmes (MDP)	29	29	23	43	35
Others	59	56	62	47	92

Source: Researcher's observation.

It can be observed that in Entrepreneurship Development Programmes (EDPs) the minimum average number of participants in each programme is 26 (2013-14) and the maximum average number of participants is 31 (2011-12).

For the Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP) the minimum average number of participants in each programme is 26 (2009-10) and the maximum average number of participants is 30 (2013-14).

For Management Development Programmes (MDP) the minimum average number of participants in each programme is 23 (2011-12) and the maximum average number of participants is 43 (2012-13).

And lastly, for the others category, the minimum average number of participants in each programme is 47(2012-13) and the maximum average number of participants is 92 (2013-14).

It can be seen that more or less around 28 trainees joins in each programmes under Entrepreneurship Development Programmes

(EDPs), Entrepreneurship and Skill Development Programmes (ESDP) & Skill Development Programmes (SDP). And in Management Development Programmes (MDP) 32 trainees joins in each programmes throughout the years and for other category of programmes 63 trainees joined the same.

Initiative taken by Indian Institute of Entrepreneurship, Guwahati, in promoting entrepreneurship in North Eastern Region of India

The promotion of entrepreneurship has been one of the sole focuses of the Institute. In order to promote new entrepreneurs, the Institute organizes buyer-seller meets, exhibitions, orientation program, etc. The Institute has been giving special thrust upon the upliftment of weaker sections of the society. The Institute organizes programmes for SC, ST and women folk of rural and tribal areas to promote livelihoods. The latest programmes undertaken by the Institute for employment generation are:

- The Regional Resource Centre (RRC) of the Indian Institute of Entrepreneurship (IIE), Guwahati has been organizing Buyer- Seller Meets for the cluster

artisans and units implemented by it since 2009. These Buyer- Seller Meets organized are humble attempts at giving a platform to the cluster artisans and household units to reach to a wider market cutting across spatial miles and segregated sectors has been working for Cluster Development with projects sponsored by a number of agencies like DC-MSME, DC-Handloom and KVIC.

- Cluster Conclave 2013 - Exhibition of Cluster products: In an effort to showcase the various products developed by cluster artisans so far and also to provide forward linkages for the same, the RRC on Cluster Development has organized one Exhibition of Cluster Products from North East India. The 10 days long Cluster Conclave and Exhibition was jointly organized by IIE and District Industries and Commerce Centre (DICC), Kamrup at Maniram Dewan Trade Centre, Guwahati from 27th December to 5th January, 2014. The programme was divided into two main parts; the physical part (look, touch, feel) and the business part (products, brand, packaging, target customers). But both the parts were blended together with the all encompassing concept of social touch to every ones lives. The initiative aimed to provide platform to the various clusters to understand the market needs and have a direct interaction with the buyers. A wide range of products from the clusters were displayed. It includes exquisite products of silk, various corporate gift items, jewellery, handicrafts, home furnishing items and textiles, food & fruits, etc.
- The Training Programme on Gemstone Cutting and Polishing, Design Diversification, Branding and Packaging was held at IIE, Guwahati from 2nd to 6th of September, 2013 for the artisans of Ranthali Jewellery Cluster, Nagaon. The main objectives of the programme was to provide basic knowledge about identification of Gemstones, training on Gemstone cutting & polishing, design diversification, branding & packaging of products.
- Science and Technology Entrepreneurship Development (STED) Project taken up by Indian Institute of Entrepreneurship in April, 2010 was completed in March, 2014. During the year 2013-14, the Institute trained 323 beneficiaries in Kamrup district of Assam and provided handholding support to them. Out of 323 beneficiaries, 55 have launched their units and generated jobs for 184 individuals.
- Orientation on Self-employment Group & Individual Enterprises: A concerted effort by all development agencies, departments and other bodies can result in generating self-employment avenues in the urban pockets. It would help in value addition of local resources fulfilling the service requirements of the urban households. Thus, promotion of self-employment in urban areas would not only aid in employment generation but also contribute to the economic growth and development of the region. It is in this direction that the Indian Institute of Entrepreneurship (IIE), under the aegis

of the Ministry of Housing and Urban Poverty Alleviation, Govt. of India, organized State level Training Programme on Orientation on Self employment Group & Individual Enterprises in four States of the Region. The training was conducted at Itanagar (Arunachal Pradesh); Agartala (Tripura); Shillong (Meghalaya) and Dimapur (Nagaland). A total number of 184 participants attended the programmes.

- Orientation Course for NSS Programme Officers: The Ministry of Youth Affairs & Sports, Govt. of India has granted “Empanelled Training Institute (ETI)” status to Indian Institute of Entrepreneurship (IIE), Guwahati for imparting regular training to NSS Programme Officers (PO) of North East India. In this context, Indian Institute of Entrepreneurship (IIE) Guwahati, organized 3 Orientation Courses for Programme Officers, National Service Scheme during the month of March, 2014. The programmes were sponsored by Ministry of Youth Affairs & Sports, Govt. of India. The rationale behind conducting these Orientation Courses for Programme Officers is to provide them necessary knowledge, skills and attitude required for effective implementation of NSS Programme.
- Rajiv Gandhi Udyami Mitra Yojana (RGUMY): Providing consultancy services to entrepreneurs is a part of IIE’s initiative for Self Employment. Handholding support for Enterprise Creation is provided to all those who approach the institute for support. The entire process of support in this direc-

tion has been generated through the Rajiv Gandhi Udyami Mitra Yojana (RGUMY). IIE along with its associates Udyami Mitras, has identified more than 35000 prospective Udyamis out of which 17700 were enrolled as Udyamis for providing handholding support. Out of them 8800 Udyamis could start their own Enterprises. IIE has also been organizing workshops on RGUMY at different locations of North Eastern Region to create awareness about the schemes available so that they can take the benefit of these schemes.

- New Initiatives: Sustainable Livelihood Promotion: Under the Centre for Sustainable Livelihood Promotion’s Corporate Social Responsibility Project, a Memorandum of Understanding was signed between Indian Institute of Entrepreneurship and Oil India Limited, Duliajan, Assam. As per the MOU, Oil India as a part of its Corporate Social Responsibility (CSR) has agreed to extend financial assistance for various activities viz. Entrepreneurship Education, Skill Development Training Programme, Livelihood clusters and Solar Solution Initiative for a period of 5 years in the Oil India operational areas. IIE, Guwahati has agreed to implement the above activities under the umbrella of a distinct entity named Centre for Sustainable Livelihood Promotion (CSLP). The Institute organized four Skill Development Programmes, two on Housekeeping and Hospitality Management and two on Gems Cutting and Jewellery Designing, for un-employed youths of Oil India operational districts

of Assam. One Orientation Programme for College Teachers was also organized so that the Teachers can motivate and guide the students for self employment. The Institute also organized two Entrepreneurship Awareness Programmes for College and School students in the Oil India operational areas. The Institute also started Baseline Survey to ascertain the scope and opportunities of socio-economic activities for sustainable growth in the ten identified Blocks of Tinsukia and Dibrugarh districts.

- **Nokrek (Chandigre) Honey Processing Cluster:** The state of Meghalaya, particularly Garo Hills is famous for honey. People have been hunting for bees and making honey in the traditional way and selling them as and when available. However the market is totally un-organized and there is hardly any physical data as to the total quantum of honey produced and sold. Till now the industry is cottage based without scientific extraction, proper bottling, labeling etc. A Diagnostic Study has been carried out by the Institute in 13 villages of West Garo Hills district in and around Nokrek Hills in Rongram Block of Meghalaya.
- **Wooden Furniture Cluster, Mairang, WestKhasi Hills:** The timber industry developed significantly during the 1960's with the establishment of mills. In order to fill the growing gap between domestic demand and supply, it has been importing increasing quantities of timber and timber products in recent years. Pyndengmiong is the village

located in Mairang Sub Division which has the Carpentry Cluster. Carpentry is the major occupation of the village which has been practiced from generation to generation. There are about 50 carpentry units in Mairang spread within 15 kms radius. However majority of them are located in Mairang town. All the carpentry units produce same type of products viz. wooden sofa set (without covers), dining table sets, almirahs, door and window frames, boxes etc. The institute carried out the Diagnostic Study of the Cluster.

CONCLUSION

The present study is an attempt to know the activities of the Indian Institute of Entrepreneurship, Guwahati, over the past five years. On the basis of number of programmes conducted under it and the number of participants who attended such programmes helps to examine how IIE, Guwahati have helped in generating employment through their various programmes. From the study it could be observed that although there is an increasing trend both in the number of programmes conducted and number of participants who attended such programmes still there remains a lacuna in some of the programmes where there is observed a fall in the number of programmes as well as number of participants under such programmes. Therefore, initiative must be taken to improve the number of programmes and lure more number of participants' especially job-seeking youths.

Suggestions:

From the present study the following measures can be undertaken to lure more people in general and especially job-seeking youths to

attain entrepreneurial training programmes-

- More number of 'Awareness programme' or 'People's education programme' may be planned for districts which are far away from state head quarter.
- The training programmes should lay hold of the benefits of new age media.
- Arrangement of finance to start new ventures for trainees.
- Entrepreneurship, as a subject should be incorporated in high school studies so that the students could be made passionate to start their own business without waiting for white collar jobs.

Scope for future study

- Study can be conducted to know the difference in pattern of training imparted for developing entrepreneurship in North-eastern states and other parts of the country.
- Study can be conducted to know the after training views of the participant to know whether their expectation is fulfilled by the Institute or not.
- Study to know different business opportunities, in the North-eastern states along with its training needs to develop requisite skills, can be done.

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The Concept of Enlightenment of Self in Isopanishad and Sri Aurobindo : A Comparative Assessment

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ABSTRACT

The concept of self has a rich tradition of being investigated psychologically from the time of the Vedas and Upanishads. The concept of self is prevalent everywhere both in Psychological thoughts. The Isopanishad, one of the best Upanishads declares that the true knowledge of self is necessary for the attainment of liberation. Isopanishad state that those who deny the self for the attainment of liberation are born again. Such people are ultimately involved in darkness. The self was regarded in the Isopanishad as lying beyond the mind. The idea that the self is transcendent is present in the Isopanishad. At the same time the Isopanishad states the self is imminent. When something is recognized as both transcendent and immanent then its nature turns out to be paradoxical. The nature of the self is described in Isopanishad as in-consistent, Puzzling, Odd, illogical etc. For Aurobindo, the self is Iswara, the Lord. Self is the cause to be born and die, increase and diminish, progress and change. Self enjoys both pleasure and pain, good and bad and also appears to be their victim. The Upanishad four mahavakyas or great sentences was also indicated in the Isopanishad ("Aham brahmasmi", "Tat tvam asi", "ayam atma brahma", "prajnanam brahma."). No definite description or accounts of the nature of the self has been given by the Isopanishad. One basic point to be emphasized in the Isopanishad is that the inner self is to be identified with the cosmic reality.

Key words : Enlightenment, Isopanishad, Philosophical, Sri Aurobindo

INTRODUCTION

The Philosophical ideas that are presented in the Isopanishad are as follows.... In Isopanishad the Self is said as within all and yet it transcends all. The Self is regarded to be one and it is stated to be the foundations of all existence. The Self is regarded to be the unifying factor of the Universe. It is stated that it is

omnipresent. All these descriptions clearly indicate that the writer of the Isopanishad identifies the Self with the reality itself. The Four and the fifth verse gives us an account of the Paradoxical nature of the Self. Some of the Paradoxes mentioned in the Isopanishad in this regard are – The Self does not move. Yet it is

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swifter than the mind, The Self remains standing. Others are in motion. Yet the others cannot reach the Self, The Self is declared to be imminent. At the same time it is declared to be transcendent. The fifth verse is translated by R.E. Hume as "It moves. It moves not. It is far and it is near. It is within all these, and it is outside of all these." By using a Paradoxical language the writer of this verse perhaps wanted to put forward the idea that language is incapable of expressing the nature of the Self (Atman). The Self is given contradictory ascriptions. Thereby the paradoxical nature of the Self is brought out. The Sixth verse also contains a very important Philosophical idea. It states that whoever sees all things in the Self, and the Self in all things does not keep himself separate from anyone. The great monistic ideal of Indian Philosophy is ultimately to be found here. The sixth verse contains thus a profound idea and this profound idea is further elaborated in seventh verse. The seventh verse states that one who has acquired a monistic vision who has realized the basic unity of the individual Self with the cosmic Self goes beyond all delusions and all sufferings.

For Aurobindo, Atman or self represents itself differently in the sevenfold movement of nature according to the dominant principle of the consciousness in the individual being. In the physical consciousness Atman becomes the material being. In the vital or nervous consciousness Atman becomes the vital or dynamic being. In the mental consciousness Atman becomes the mental being. In the supra-intellectual consciousness, dominated by the truth or causal Idea, Atman becomes the ideal being or great soul. In the consciousness proper to the Universal Beatitude, Atman becomes the all-blissful being or all-enjoying and all-

productive soul. In the consciousness proper to the infinite divine self awareness which is also the infinite all-conscious soul that is source and lord of the universe. In the consciousness proper to the state of pure divine existence Atman is *sat purusa*, the pure divine self.

In the four mahavakyas or great sentences indicated beautifully about the self as '*Spirit*', '*Consciousness*', '*Ultimate reality*' etc. In the *Brihadaranyaka* Upanishad 'Self' is regarded as the ultimate reality. In the *Chandogya* Upanishad 'self' is regarded as '*you*' who is the ultimate reality. In the *Mandukya* Upanishad 'self' is regarded as Brahman. In the *Aitareya* Upanishad 'self' is regarded as consciousness. The four mahavakyas are explained briefly in the following.

Aham Brahmasmi :

The first of the basic four is from *Brihadaranyaka* Upanishad (1. 4. 10) "*Aham Brahmasmi*", which means I am the Ultimate reality (The Brahman). In the Vedic literature (*Brihadaranyaka* 1.4.10) it is said I am Brahman as well as I am Spirit. This "I am", the sense of Self, also exists in the liberated stage of Self-realization. This sense of "I am" refers to ego, but when the sense of "I am" is applied to this false body it is false ego. When the sense of self is applied to reality, refers to real ego. "Brahman means who knows that 'I am not this body; I am the.... I am the.... I am in Spirit, Conscious, I am Soul, Spirit, Consciousness', one who knows perfectly well this understanding and the Science also, that 'I am qualitatively one with the Supreme Lord', *Aham Brahmasmi*. The Vedic mantra says, *Aham Brahmasmi*. That means 'I am Brahman. I am not this matter. I am Brahman.' So one who knows this Science, he is called Brahmana. And this doesn't matter who

is he and where he is born. That doesn't matter" (Bhagavad Gita 2.48-49, Lectures by Srila Prabhupada, New York, April 1, 1966). *Aham Brahmasmi* when it is stated as I am a spirit soul, not this body. The symptoms of the self-realized persons are given herein. It is said that one should understand that he is Brahman, Spirit and Soul. This Brahman conception of life is also in devotional service, as described in this verse. The pure devotees are transcendently situated on the Brahman platform, and they know everything about transcendental activities.

Tat Tvam Asi :

The second sentence of the basic four is from Chandogya Upanishad VI.8.7 "*Tat Tvam Asi*" which means that [tat] (is what) you [tvam] are [asi]. That refers to the Brahman, while you refer to the Atman, the individual soul or self within every human being. In this sentence the individual self is identified with the cosmic self. The sentence *Tat Tvam Asi* appeared in a conversation between the great sage Uddalaka Aruni and his son Svetaketu. Uddalaka attempted to explain the nature of the ultimate reality to his son Svetaketu. He pointed out that the ultimate reality is none other than the individual self. The content in which the sentence *Tat Tvam Asi* appeared may be briefly stated here. When Svetaketu came back home after completion of his studies, his father, the learned sage Uddalaka came to know that his son had not been taught about the ultimate reality. Uddalaka said that in the beginning pure existence (Sat) was without a second. It wished to become a manifold. Out of it the manifold world emerged. On being asked by son what that pure existence was. Uddalaka replied that pure existence is none other than the individual self. "You are that reality"- that was the reply of Uddalaka. The ultimate reality, Uddalaka

seemed to say, is imminent in everything, including the individual self. The absolute reality constitutes the being of the individual self and therefore Uddalaka identified the individual self with the cosmic self. The universal self is imminent in the individual self of Svetaketu and therefore Uddalaka identified the essence of Svetaketu with the ultimate reality itself.

Ayam Atma Brahma :

The third of the basic four is from Mandukya Upanishad 1.2: "*Ayam Atma Brahma*" which means this self is Brahma. This saying portrays the idea that the individual self is one and the same with the absolute. The concept *Ayam Atma Brahma* is explained with the wave and ocean. The waves and ocean is not considered as separated entity, similarly Atma and Brahman is the same. The aspirant can clearly understand this mahavakyas by taking up the example of the ocean and watching the vastness of the ocean. If a big wave starts to come ashore, and one concentrates on the wave, he can intently notice that the wave get absorbs in the crashing of the surf, and he can feel the salt spray. In that moment, the person is only aware of the vastness of this one wave. The ocean itself is forgotten during that time. The only idea then prevails is that the ocean and the wave is the same and the one. Atman refers to that pure, perfect, eternal spark of consciousness that is the deepest, central core of human being, while Brahman refers to the oneness of the real and unreal universe. It is like saying that atman is a wave, and Brahman is the ocean. The insight of *Ayam Atma Brahma* is that the wave and the ocean are one and the same.

Prajnanam Brahma :

The four of the basic four is from Aitareya Upanishad, III.3.13: "*Prajnanam*

Brahma” which means the ultimate reality is wisdom or consciousness. It is known as the swaroopā vakya, because it indicates the swaroopā or true nature of the ultimate reality. Brahman in this teaching means Truth, or Reality, or God or whatever we may choose to call it. The verse states that “whatever exists here, whether moving or un-moving, all is supported by consciousness. The basic (of the Universe) is consciousness. Consciousness is Brahman.” Brahman is the one consciousness in all manifested forms. As Gold remains gold alone, whether it is molded into coins, jewellery, idols or anything else, the universal consciousness remains the same, no matter in which form it is manifested. Whatever we see or know as this universe, as Gold and our-selves, is nothing but the play of this one consciousness. It is the light of consciousness that illumines everything, both within and without. Rig Veda proclaims ‘*Prajnanam Brahma*’ that is, prajnanam is Brahma; Prajnanam is awareness, consciousness, which is pervading the subtlest texture of the cosmos and is present and active everywhere, at all the places and all the time.

I am that I am :

“*I am that I am*” is a common English translation (King James Bible and others) of the response God used in the Bible when Moses asked for his name (Exodus 3:14). It is one of the most famous verses in the Torah. "Ehyeh asher ehyeh" is generally interpreted to mean "I am that I am", though it more literally translates as "I-shall-be that I-shall-be.". "Ehyeh" is a first-person singular verb, and can be understood as God saying that God is "in the process of being", a reference that could say, based on theological interpretation, that God exists in all times. Holladay defines "asher" as a relative particle, meaning anything from "that" to

"because" to "who." The Roman Catholic Church's interpretation has been summarized in the "Catechism of the Catholic Church". The interpretation is found in numbers 203-213. : In God "there is no variation or shadow due to change." God, who reveals his name as "I AM", reveals himself as the God who is always there, present to his people in order to save them. The divine name, "I Am" or "He Is", expresses God's faithfulness: despite the faithlessness of men's sin and the punishment it deserves, he keeps "steadfast love for thousands"... By giving his life to free us from sin, Jesus reveals that he himself bears the divine name: "When you have lifted up the Son of man, then you will realize that "I AM". Some religious groups believe that this phrase or at least the "I am" part of the phrase is an actual name of God, or to lesser degree the sole name of God. In the Hindu Advaita Vedanta, the "I am" is explained by teachers such as Sri Nisargadatta Maharaj as an abstraction in the mind of the Stateless State, of the Absolute, or the Supreme Reality, called Parabrahman. It is pure awareness, prior to thoughts, free from perceptions, associations and memories.

Indian and Western View's on Self and Sri Aurobindo:

According to Sankaracarya's analysis (whose commentary we have mainly followed in our explanations), Isopanishad lays down two paths for spiritual aspirations- one for the jnanins or those who are the exclusive adherents of the paths of knowledge, and the other for those who have not attained the necessary internal development needed to renounce desires and adopt that exalted way. A jnanins of that type is identical with a Sannyasin. He is absolved from the performance of all sacrificial rites. Repeated study of the Upanishad texts and reflection and

contemplation of the real nature of the Atman are the only activities that engage his attention. And as the first verse and the verses from the fourth to the eight (both included), which describe the nature of the Atman, are meant for him. The rest of the Upanishad has in view all other persons who are bound to the world by the desire to enjoy it. These men, who are attracted by the writings of the world, worship God as a Person with the aim of securing through His grace worldly happiness and spiritual bliss in the form of final emancipation from the round of births and deaths.

In the Visistadvaita Vedanta system, the individual self is regarded by Ramanuja as an attribute or mode of Brahman. It is to be noted here that for Ramanuja the individual self is the body of God. But he didn't thereby mean that the self is bodily in nature. For him 'self' is a spiritual substance. Being a spiritual substance it is absolutely real. The analogy light and luminosity is employed by him to explain the nature of the self. The self is a point of luminosity. The self is beyond creation and destruction. The self is subjected to earthly existence. But this earthly existence and all miseries that follow from it are incapable of affecting the essence of self. The individual self in its essence it is perfect and changeless. For Ramanuja self is the real knower, the real doer and the real enjoyer. Knowledge is regarded by him to be the essence of the soul. The individual soul is viewed as self conscious subject and a self luminous substance. The individual soul is freedom of will. God doesn't interfere in this aspect of the freedom of will. Ramanuja regarded God as the inner controller of the soul.

In the Dvaita Vedanta System, the individual selves are regarded by Madhva as an eternal and atomic. Consciousness and bliss

(ananda) are intrinsic to the selves. But the selves become associated with bodies due to their past karmas or action as a result. The self suffers from misery and pain. Freedom of will has been granted to every self by God. Therefore the self is responsible for its own state of existence.

In the Charvaka Philosophy, soul and body were not differentiated. To them, there is no separate existence of self other than body. Self-consciousness is an emergent property of the body itself. Body is perceptible, not soul. The existence of self after the decay of body is also not permissible. When I say "I am sleeping" then this "I" is nothing else but body, as 'Sleep' is used for symbolizing the rest of the body, not of the soul. Self is, in their tradition, as just body and nothing else. Conscious human body is regarded by the Charvaka as self. Hence all kinds of soul-consciousness are the sheer manifestations of the bodily consciousness. In this respect we can discover their strong similarity with that of the epiphenomenalism of the west where mind and mental parts are considered to be the epiphenomena of the physical components. Only physical parts are apprehended to be the phenomena and the mental components, as the inherent objects within the physical realm, has been known as epiphenomena.

When we look back to the west, we can discover the similar theory regarding self and body in that of William James. According to him, "No psychology.....can question the existence of personal selves". He admitted the possibility of various kinds of self, e.g. the material self, social self and the spiritual self. If we concentrate only towards his theory of material self, then we can certainly deduce that self=body. The body is the innermost part of the

material self in each of us; and the body as a whole seems more intimately ours than the rest. Without body no one can exist. Self has to be manifested within the bodily realm of an individual. Hence at least in the case of material self, William James too accepted the doctrine of equality between self and body. In our common sense point of view, we can immediately remove this dichotomy by calling that self is conscious and body is un-conscious, hence body should never stand for self. However, Sri Aurobindo's position is certainly much different from that. It is true that soul is supremely conscious, but body even is not at all un-conscious in its inherent nature. He explained his position in two ways as following-

First, by showing the presence of bodily consciousness and secondly, by rejecting the idea that matter must be un-conscious in nature. Let us start with the first standpoint. When our fingers are cut, then the mind can also feel the pain. The reason of it, as conceived by him, is that body has its own consciousness though in the dormant level. For that reason, body can influence the mind (as shown in the above example) and also body can do my things according to its own will, e.g. picking up a spoon or knife even when we are not conscious of it. By these two examples we can prove the existence of consciousness in matter. According to Sri Aurobindo, Consciousness is a fundamental thing which in the process of involution for fulfilling the Divine purpose of God (this Divine purpose is due to Sachchidananda's cosmic manifestation) takes the form of apparently un-conscious matter. So matter, in his theory, is nothing but a dormant form of Divine consciousness. From his *Life Divine* we ultimately derive this truth. Actually due to our ignorance we misunderstood the true nature of matter as

inconscient. For describing matter, Sri Aurobindo uses the term "sleep of consciousness" unless "suspension of consciousness" which is sufficient enough to prove the existence of consciousness even in the material level.

According to Rene Descartes, "I think, therefore I am" this cogito ergo sum thesis indicates towards drawing a conclusion such that self= mind. Here the word, 'I' stands for "Self". But this self can never be able to think, but mind. Thinking thus indicates towards the mind. Hence 'I think' this utterance could be true if and only if we accept that self is mind. In Kantian doctrine, we can't understand soul without understanding the mind. Consciousness is a unique feature of mind. Hence, without mental consciousness there is no such thing as self-consciousness. We can't experience self-consciousness, but mental consciousness. For him, self-consciousness simply implies having experience and recognizing that as one's own (mental consciousness). So, no difference between self and mind could be drawn in Kant's thesis.

However, in the opinion of David Hume, we find out that soul in nothing but just the Bundle of mental thoughts. We can't experience any such thing like soul, but only our mental states. We can identify the experience of our childhood due to the existence of such mental states remaining intact till now. In his book, "Treatise Concerning Human Nature" he clearly argued that there is no such thing as self even if we have strong belief in its favor. What we can experience is the continuous flow of perception that replaces one another in rapid succession. His thesis is known as the Bundle theory of Mind. This can also be claimed as the No-Self theory of Hume. When we consult the

Indian tradition, then we can discover a somewhat a similar theory with that of the Bundle theory of Hume is the Buddhist theory of Anatma-vada. According to them, there is no such thing as the eternal soul. The soul we see is just a mental flux and comprises of every little bit of mental experiences. Self is nothing but a succession of several mental states; we can't experience soul, but only that of these mental states. Hence soul stands to them nothing but a mental phenomenon.

From the point of view of Sri Aurobindo, all consciousness is not mental, soul consciousness remains in the highest position; and secondly, soul is not similar to mind. In the first interpretation, he shows us that consciousness is not at all mental. In the hierarchy of consciousness-level, mental consciousness is actually that type of consciousness which exists within the range of human knowledge.

We can discover a somewhat related theory in that Sartre. According to him, the consciousnesses can conceive of other objects but it can't conceive of other consciousness. Sartre in his book, "Transcendence of the Ego" mentioned that the consciousness can conceive of other egos, be it my ego, or be it the ego of another person.

But in Sri Aurobindo's notion self is not at all replaceable by ego. Ego is the cause of generating ahankara in every living creature. It is mainly responsible for every kind of authoritative feelings that gave birth of the false notion that only I am that person on the earth that can do it.

CONCLUSION

Now we can draw our conclusion on the basis of our above discussion. The Concept of Self is the Psychological thoughts. No one

can explain the nature of Self without Psychological thoughts. Where from this thoughts come, is it from our body or mind or other source? This was the biggest question in Isopanishad and that's why, it is explained as the true knowledge for the attainment of liberation. For Aurobindo, we born, grow and die at last. No one can get rid of it. Self is the cause for that. Self enjoys both pain and pleasure. Though, it is the natural process of nature but, for Aurobindo, the nature is within the Self. For Aurobindo, Self is Iswara. The uniqueness of Isopanishad and of Sri Aurobindo concept of self is truly amazing. None before Isopanishad and perhaps even after Sri Aurobindo, either of the Indian tradition or of the Western one, ever dare to think of self as inner being of the individual. The Isopanishad is known as the Upanishad that contains knowledge on bringing one closer to the Isa, supreme personality of Godhead (Isa+ Upanishad= Isopanishad), Krishna. The Isopanishad contains very profound scientific truths and the ultimate conclusion of the worship of the supreme personality of Godhead. On the other hand, no one other than Sri Aurobindo conceives self as the "inner-most being" and gives such a vivid description of its workings. The inmost being or psychic being, according to him, is the mere manifestation of the Brahman. In this way he beautifully draws a correlation of jivatman or psychic being with that of paramatman or God. Standing far beyond the reach of the ordinary mental consciousness of man, the psychic being or self is actually the individual expression of divinity hidden within each human being. And this is the true essence of his theory concerning human being.

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Worker's Participation in Trade Union Activities: A case study with special reference to Oil India Limited, Duliajan, Assam

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ABSTRACT

Trade union is an organization whose membership consists of workers and union leaders, united to protect and promote their common interests. The principal purposes of Trade Union are to (1) negotiate wages and working condition terms, (2) regulate relations between workers (its members) and the employer, (3) take collective action to enforce the terms of collective bargaining, (4) raise new demands on behalf of its members, and (5) help settle their grievances. The main intension of this study is to access the extent of participation of workers in trade union activities with special reference to Oil India Limited, Duliajan, Assam. The present study is based on primary data collected from selected 150 respondents working in Oil India Limited, Duliajan, Assam through purposive sampling technique and interview schedule. Following are some of the important findings of the study: (1) Worker's participation in trade union activities is satisfactory (2) Workers feel pride in trade union activities (3) There is cordial relationship between management and workers in trade union activities.

Key words: Problems and prospects, Trade Union Activities, Worker's participation,

INTRODUCTION

The idea of workers' participation arose in Europe, where collective bargaining has usually been at the branch or industry level; this often left a gap of employee representation at the enterprise or plant level, which became filled by bodies such as works councils, works committees, enterprise committees and so forth. Many developing countries have also adopted legislative initiatives with a view to having works councils or similar structures set up (e.g.,

Pakistan, Thailand, and Zimbabwe) as a means of promoting labour-management cooperation. The relationship of these bodies to trade unions and collective bargaining has been the subject of considerable legislation and negotiation. This is reflected in a provision of the ILO Workers' Representatives Convention, 1971 (No. 135), which states that where both trade union representatives and elected representatives exist in the same undertaking, measures shall be taken

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to ensure that the existence of those representatives is not used to undermine the position of the trade union.

The concept of workers participation in India dates back to 1920 when Mahatma Gandhi had suggested that both the workers and management should share in the prosperity of the business. Employer should not regards sole owner of mills and factory of which they may trustees. There should be a perfect relationship of friendship and cooperation among them. Capital and labour should be supplementary to each other. TISCO, Indian Aluminum work, Belur. The Delhi cloth and general mill ltd also introduced workers participation in management 1938. The Royal commissioner of labour (1929-31) recommended the formation of works committee which plays an useful part in Indian industrial system. Bombay Industrial Relation act 1946 (apply to textile industries in Maharashtra and Gujarat), and ID Act 1947. Royal commission also reported in general for work committee. The royal commission for labour also suggested that for cultivation of industrial harmony and avoiding misunderstanding and setting dispute. In the first five year plan it was suggested for constitution of joint committee for consultation at all level of management. ID ACT 1947, joint management council 1957, the industrial policy resolution 1948. The 2nd 5yr plan explained the philosophy of worker-management relationship outlined that a socialist society is built up not solely on monetary incentives but on idea of service to the society. The creation of industrial democracy is therefore a prerequisite in the establishment of a socialist society. For the successful implementation of the plan, increased association of labour with management is necessary. Govt. of India set up a specific study group to see the progress

and problem in working of worker's participation in May 1957. The recommendations of the study group were accepted by 15th Indian labour conference in July 1957.

'Workers Participation' is considered as a process by which workers participate in management functions of planning, to organizing and controlling with the objective of better results and satisfaction. The move to associate workers in decision-making process of management has gradually been gaining momentum in India with the introduction of democratic institutions and spread of literacy among workers.

SIGNIFICANCE OF THE STUDY

Trade union is an organization or a group that workers join so that they can have their interests and goals well represented. Today, we live in a world where workers have assumed great importance. The employers have started to realize the importance of workers. The employees too have started to form Trade Unions to protect their interests. Bosses around the world have recognized that the best way to resolve issues is by way of dialogue. The employees have realized that to protect them from exploitation, unity is very important. This is one of the reasons why trade unions have become so important today. The studies of trade unions are necessary because of their demanding role for workers growth and development such as- (a) Obtaining satisfactory rates of pay (b) Protecting workers jobs, as it has been shown that union members are less likely to be dismissed (c) Securing adequate work facilities (d) Ensuring satisfactory work conditions, this can include areas such as health and safety and equal opportunities (e) Negotiating bonuses for achieving targets and Negotiating employment conditions and job descriptions. Lack of support

of trade union or defective trade unionism causes poor industrial relation and which in turn produces highly disquieting effects on the economic life of the country. Lack of coordination in trade union adversely affects the tempo of work. Costs build up. Absenteeism and labor turnover increase. Plants discipline breaks down and both the quality and quantity of production suffer. Dynamic industrial situation calls for change more or less continuously. Methods have to be improved. Economics have to be introduced. New products have to be designed, produced and put in the market. Each of these tasks involves a whole chain of proper planning, organizing, directing, controlling and coordinating the trade union activities. Every man comes to the work place not only to earn a living. He wants to satisfy his social needs also. When he finds difficulty in satisfying these needs he feels frustrated. Poor Industrial Relations take a heavy toll in terms of human frustration. For adequate functioning of industrial relation, trade unionism is one of the most important criteria. Besides these, lack of adequate structure and functions of trade union organization is also a direct source of poor industrial relations resulting in inefficiency and labour unrest. Management is not sufficiently concerned to ascertain the causes of inefficiency and unrest following the laissez-faire policy, until it is faced with strikes and more serious unrest. Even with regard to methods of work, management does not bother to devise the best method but leaves it mainly to the subordinates to work it out for themselves. Contempt on the part of the employers towards the workers is another major cause. However the causes of ineffective functioning of a working environment and industrial relation due to defects in trade unionism are (a) An intolerant attitude of contempt towards the

workers on the part of management (b) Inadequate fixation of wage or wage structure; (c) Unhealthy working conditions; (d) Indiscipline; (e) Lack of human relations skill on the part of supervisors and other managers; (f) Desire on the part of the workers for higher bonus and the corresponding desire of the employers to give as little as possible; (g) Inappropriate introduction of automation without providing the right climate; (h) Unduly heavy workloads; (i) Inadequate welfare facilities; (j) Dispute on sharing the gains of productivity; (k) Unfair labour practices, like victimization (l) Retrenchment, dismissals and lock-outs on the part of management and strikes on the part of the workers; (m) Inter-union rivalries; and (n) General economic and political environment, such as rising prices, strikes by others, and general indiscipline having their effect on the employees' attitudes.

In Oil India Ltd. (OIL), the environment of trade unionism have coming across simultaneously since the establishment of the company (1959). In 1962 the Indian Oil Workers Union (IOWU), Assam has been registered under the Indian Trade Union Act. On the other hand several other trade unions like Oil India Employees Union (OIEU), Assam Petroleum Mozdoor Union (AMPU) etc. have been playing significant role in Oil India Limited.

This particular oil industry is chosen because it is one of the largest organization and in one of the most profitable oil industry of Assam. Now a days OIL has been considered a Novaratna Public Sector Undertaking Company of India. It is very necessary to know in which way trade unionism have been moving. Because, as we know trade unions generally protect and promote the interest of wage earner. We believe that without knowing about the

trade unions no one can study about worker's problems. Apart from that it will be helpful for us to know about the work culture, workers employer's relations and other aspects of workers and management. So, a sociological study is very significant to find out the hidden truths which are associated with the trade unions.

OBJECTIVES OF THE STUDY

The following are the objectives of this study:

1. To ascertain workers level of involvement in the decision making process of their work places;
2. To establish the general attitude of workers towards worker participation in management Decision making.
3. To suggest some practical approaches for effective participation of workers in trade union activities

METHODOLOGY

For this study, Survey Method is applied. This study is based on primary data source where the researcher conducted interviews for collecting necessary information from the respondents. Total 150 respondents are selected as the sample of the present study through purposive sampling and interview schedule working in Oil India Limited, Duliajan, Assam. Out of which 63 samples are regular workers and 87 workers selected who are working in contractual basis.

RESULTS & DISCUSSION

The following data analyzed on percentage basis showing the clear picture on workers participation in trade union activities. The following tables shows systematically the extent of participation in different dimensions.

Table 1. Percentage of Degree of Support of Workers satisfactory Participation by the Management

	Don't Support	Indifference	Support	Total No of Managers interviewed	Percentage of Support	Percentage of Don't of Support	Percentage of Indifference
Managerial Support	3	1	26	30	10%	3.33%	86.66%

On the basis of the above mentioned data of the table, it can be said that 86.66% of managers involved in trade union activities support their workers to participate equally with them, where 10% from that managerial group do not support in workers involvement in such activities. Interestingly, 3.33% of managers having indifference attitude regarding workers participation in trade union activities. This highlights that majority of the managers have positive attitude towards workers participation in trade unionism.

Table 2. Percentage of Workers Participating regularly or irregularly in Trade Union Activities

Total Regular Workers participated in trade union activities Surveyed	Total contractual Workers participated in trade union activities Surveyed	Total Workers (both contractual and regular workers) participated in trade union activities Surveyed	Percentage of Regular Workers participated in trade union activities Surveyed	Percentage of Contractual Workers participated in trade union activities Surveyed
87	63	150	58%	42%

The above mentioned data indicates that 58% of regular workers are participating in trade union activities whereas 42% of contractual workers are participating in trade union activities. This means the involvement of regular workers are more than contractual workers in union activities.

Table 3. Percentage of Workers having Regular or Irregular Trade Union Membership for Trade Union Activities

Surveyed Permanent Workers having trade union Membership	Surveyed Contractual Workers having trade union membership	Total number of Surveyed Workers (both Permanent and Contractual) Having trade union membership	Percentage of Surveyed permanent Workers having trade union Membership	Percentage of Surveyed Contractual Workers having trade union membership
55	42	97	56.70%	43.29%

Similarly, it was also observed that only 43.29% of contractual workers have trade union membership than the permanent workers having trade union membership (56.70%). This shows us a picture of better involvement of permanent workers than contractual workers in trade union activities.

Table 4. Percentage of the extent of Workers Participation in Trade Union Activities on the basis of Some Variables

Variables	Low/ Negligible Involvement	Average Involvement	High Involvement	Total Respondents Involved	Percentage of Low/Negligible Involvement	Percentage of Average Involvement	Percentage of High Involvement
AGE:							
20-30 Years	2	22	93	117	1.70%	18.80%	79.48%
31- 40 Years	4	5	11	20	20%	25%	55%
41-50 Years	1	2	3	6	16.66%	33.33%	50%
51- Above	2	2	3	7	28.57%	28.57%	42.85%
Total - 150							
SEX:							
Male	12	36	55	103	11.65%	34.95%	53.39%
Female	11	09	27	47	23.40%	19.14%	57.44%
Total- 150							

Contd....

LENGTH OF SERVICE:

Less than 1 year	4	0	31	37	10.81%	0%	83.37%
1 to 3 Years	10	1	33	44	22.72%	2.27%	75%
More than 3 Years	8	2	59	69	11.59%	2.89%	85.50%

Total- 150**EDUCATION**

Illiterate	1	3	0	4	25%	75%	0%
School Drop Outs	2	5	0	7	28.57%	71.42%	0%
Primary	1	9	0	10	10%	90%	0%
Secondary	4	8	0	12	33.33%	66.66%	0%
Higher Secondary	7	12	0	19	36.84%	63.15%	0%
Graduation	12	12	12	36	33.33%	33.33%	33.33%
Post Graduation	21	16	25	62	33.87%	25.80%	40.32%

Total- 150**NATURE OF EMPLOYMENT**

Irregular	2	4	57	63	3.17%	6.34%	90.47%
Regular	4	1	82	87	4.59%	1.14%	94.25%

Total- 150

The above mentioned table shows the distinct picture of workers involvement in union activities in different dimensions. If we compare the picture in a combined form, then it will be observed that percentage of high involvement is comparatively better in every dimension than percentage of low and average involvement of workers in union activities. If we notice some interesting figures, we will get that 79.48% of workers showing high involvement in union activities having the age group between 20-30 years. Again 83.37% of workers showing high involvement in union activities with only one year of service experience and 85.50% of workers showing more involvement in union activities having 3 years of working experience. This

clearly shows that for participation in union activities, experience matters. Similarly in case of sex dimension, the involvement of female (57.44%) is better than male (53.39%). Level of education is also a factor of effective workers participation in union activities where except graduate and post graduate worker, others have zero involvement in union activities due to lack of knowledge and experience. In nature of employment, it was also observed that the nature of involvement of regular workers (94.25%) is better than the irregular workers (90.47%). Although the difference is negligible. Both regular and irregular workers having strong motivation for high level involvement in union activities.

Table 5. Percentage of Workers Involvement in Decision Making Process

Frequency of Involvement	Total Number	Percentage of Involvement
Not at all	5	3.33%
Occasionally	17	11.33%
Often	128	85.33%
Total	150	

From this study, it was also observed that majority of the workers are participating often in decision making process (85.33%). Only 3.33% of workers are not all involved in decision making process. This highlights that the level of participation is satisfactory.

Table 6. Opinion of Workers in the following areas related with Trade Union Activities

Areas Related with Trade Union Activities	'YES' Group	'NO' Group	Total Respondents (Both from 'Yes' and 'No' Group)	Percentage of 'YES' Group	Percentage of 'NO' Group
Any practical seminar, workshop or training course attended on workers participation in trade union activities	85	65	150	56.66%	43.33%
on line training is better than face to face training for workers participation in management	51	99	150	34%	66%
Equal treatment from the management irrespective of caste, colour, creed, sex and social status.	103	47	150	68.66%	31.33%
Having a cordial relationship between workers and managers	115	35	150	76.66%	23.33%
Having a cordial relationship between senior level managers with junior level managers	125	25	150	83.33%	16.66%
New developments in trade unionism must be accepted by the workers although it may increase their work load.	114	36	150	76%	24%

Table 6 showing the workers opinion. 66% of union workers prefer face to face training than online training on trade union management. 76.66% of workers said that they are having cordinal relationship between workers and managers. Interestingly, 83.33% of workers said about positive cordial level relationship between junior level managers with their senior level managers. This shows a healthy environment and good working condition of trade union workers.

SUGGESTIONS OF SOME PRACTICAL APPROACHES FOR EFFECTIVE PARTICIPATION OF WORKERS IN UNION ACTIVITIES:

For effective functioning of trade union activities, both managers and the workers must share a good working conditions. Some practical approaches can be adopted like (a) Both parties should have a genuine faith in the system and in each other and be willing to work together. It should be based on mutual trust (b) Participation should be real (c) The issues related to increase in production and productivity, evaluation of costs, development of personnel, and expansion of markets should also be brought under the jurisdiction of the participating bodies. (d) Congenial work environment (e) Well defined roles (f) Faith in the efficacy of the scheme (g) Wide publicity (h) Should be evolutionary (i) Free flow of information throughout the enterprise (j) Decisions taken by different participatory forums must be sincerely carried out in the stipulated time Participation must work as complementary body to help collective bargaining and so on.

CONCLUSION

We believe that workers' participation in management and decision-making processes

in enterprise or plant levels has good impacts in several issues including the improvement in working conditions. We feel that the demand for participation in management is to be raised in order to bring about transparency in managerial activities and decision-making process, which will enhance a fair sharing of gains. It will strengthen workers' psychology as labour investors of equal status and will produce positive results in terms of higher and higher productivity. However, these possibilities depend on attitudinal changes in employers and effective workers' education. Only then can industrial democracy and labour-management cooperation be pushed to a new height towards desirable horizon. Proper planning, organizing, directing, controlling and coordinating at all levels of management is necessary for effective workers participation in union activities. Then only we can think about improved level of workers participation in union activities.

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The Dimaraji Movement: A Movement of Ethnic Identity of the Dimasa of North East India

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ABSTRACT

The North – East India is an India in miniature with diverse colourful groups of population belonging to different races and groups with their distinctive society and culture. It gave shelter to streams of human waves carrying with them distinct culture and trends of civilizations. Austro – Asiatic, Negritos, Dravidian, Alpine, Indo- Mongolians Tibeto-Burmese and Aryans have penetrated North East India at different points of time. Assam, a constituent state of North East India is the sentinel of the region and the gateway to the North Eastern States.

Key words : Dimaraji movement, Dimara, Ethnic identity, NE India

INTRODUCTION

Most of the communities of North East India, in the pre-colonial period, were not conscious about their ethnic identities. Their world was confined to their family, clan, kinsmen and the villages. During colonial administration, the communities started developing the concept of ethno tribal identity. Different groups on the basis of ethnicity, region, religion, language, culture, caste, race etc started thinking of improving their social, economic, and political status on the one hand and to retain their traditions and relative prestige on the other. All these issues involve competition, conflict and struggle for political power.

The concept of ethnicity, ethnic group and ethnic identity is a product of the second half of the twentieth century. The concept of

ethnicity appeared for the first time in *Webster's Third New International Dictionary* in 1961. B. Pakem mentions ethnicity in the following words:

“... the term ethnicity is also not free from being misunderstood. So far the term tribe was used to denote a group of people with common tradition and culture. But of late the term seems to be value loaded. Besides even within the same tribe we may sometimes encounter certain uncommon traits which may form the basis of an ethnic social organism with its accompanying characteristic ethnicity” (Pakem, 1990).

The phenomenon of assertion of ethnic identity has become a serious challenge to National Integration in India. Many ethnic groups of North East India are also heading for asser-

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tion of ethnic identity and in so doing they are looking back into their past to strengthen their cause. The case of the Dimasa is also not an exception.

METHODOLOGY

The main purpose of this paper is to throw some lights on the history of identity movements of the Dimasa of Assam in India. The analysis is based on secondary sources of information, personal observation together with informal talks with the elderly people and the functionaries' of the organizations and associations of the Dimasa.

OBSERVATION

The Dimasa is a community which belongs to the Tibeto-Burman linguistic group of the Indo-Mongoloid family. They are spread over Dima Hasao, Karbi Anglong, Cachar and Nowgaon district of Assam, Dhansiri valley of Dimapur in Nagaland and a small section of them in Meghalaya. There is a lot of controversy regarding the origin of the word Dimasa. The term DIMASA is better interpreted as **DIMANI B'SA – DIMA B'SA – DIMASA, 'Sons of the great river'** (Nunisa Motilal in Bhuyan 1993:72). Here **Di** meaning Water, **Ma** meaning Big and **Sa** meaning children in Dimasa Dialect. However, the Dimasa are usually represented by those from the Dima Hasao in all spheres and particularly social life as the district is considered their homeland. The Dimasa living in Dima Hasao and Karbi-Anglong and Nagaland are specified as Schedule Tribe (Hills) and those in Nagaon district and Barak Valley are specified as Schedule Tribe (Plains).

The Dimasa had their own religions practices but the process of Hinduisation started when their capital was at Maibang. However with the acceptance of Hinduism as their religious faith during the reign of King Krish-

nachandra, the general Dimasa people were Hindused. But, they are still performing some of their religious rites in their own way which are sharply different from that of Varna Hindu people.

The Dimasa, one of the earliest known inhabitants of the Brahmaputra valley (Gait, 1922) have a long historical past to strengthen their cause for ethnic identity. The authentic historical period of these people started from the eleventh century when their supremacy extended from the Dikhou to the Kallang river embracing the whole tract of surrounding the Dhansiri river. The Dimasas ruled this vast tract with Dimapur as their capital (Mishra P. S. in Pakem, 1991). They shifted their capital to Maibang in North Cachar Hills in mid sixteenth century. The Dimasa kingdom during this period included North Cachar Hills and the greater part of Nagaon district. Finally, the Dimasas shifted their capital to Khaspur in the plains of Cachar district in 1750. It is seen that after shifting royal seat to Khaspur, the conversion to Hinduism followed. Coming under the Brahminical influence, the last Heramba Kings became worshippers of Ranachandi, the Hindu goddess of war. Generally speaking, the Dimasa consider themselves to be Hindu though they have their traditional Gods and Goddesses and even to this day liberal practices of Animism. The Dimasa Society is known for its conservatism and loyalty to its own religion and in their unique way it has so far stubbornly resisted the attempts for conversion to Christianity ever since the days of the British Raj.

The British annexed Southern part of the Kachari Kingdom, i.e. the plains valley of Barak, to the East India Company's territory on 14th August 1832 by a Proclamation. The hills Division was finally annexed by the British in 1854 on the death of Senapati Tularam the

Dimasa Chieftain who holds sway over that area. Accordingly, in early 1854, the status of Sub-Division under the direction of the Government of Bengal, Lieutenant H.S. Biver immediately resumed the administration of the tract and granted pensions to several members of Senapati's family aggregating to Rs. 1002 (Rupees one thousand and Two only) annually, beside rent-free grants in the village of Mohung Dijua on the understanding that these would be resumed upon the death of the respective holders. Thus the whole of the Heramba Kingdom came under the Government of East India Company and the British Paramountcy in the Cachar became the *fait accompli*". (Bhattacharjee, 1977)

But the British acted very treacherously after the annexation of the territory. They did not tag the Northern (Hills Division) with Southern part but unscrupulously annexed the hilly territory to the Assam district of Nowgong. Between 1832 and 1881 distribution and redistribution of old Dimasa territory took place and in 1881 North Cachar Hills was made a subdivision of Cachar. Subsequently in 1866, the remaining territory had been sliced away and distributed among the neighbouring districts of Nowgong and present Naga Hills. Thus, while the parts of the Diyung valley and the Kopili Valley had been given to the district of Nowgong and large portion was joined with the newly created district of Naga Hills. The rest formed the territory of the North Cachar Hills comprising exclusively the hilly region.

Since the annexation of the Heramba Kingdom by the British administration there gradually followed several changes in the administration. The British Government of India started dividing of the great Heramba Kingdom into divisions, divisions into districts, districts into sub-divisions for their administrative conveniences. The province of Assam was

divided into divisions Surma Valley, Brahmaputra Valley etc. The Cachar and Sylhet district were under the Surma Valley. The Cachar district was divided into three Sub-divisions- Silchar, Hailakandi and Haflong. The North Cachar Hills Sub- Division, was at first created in 1853 with headquarters at Asaloo. But when the Naga Hills district was created in 1866, the North Cachar Hills Sub-division was closed. The territories of Tularam's Country when annexed were cut into several pieces and distributed to the neighbouring districts of Nowgong, Sibsagar and Naga Hills. The North Cachar Hills Sub-division was again created in 1880 with its headquarter at Gunjung and it was later shifted to Haflong in 1898. The Karimganj subdivision of Sylhet district was transferred to the Cachar on the partition of Bengal retaining Sylhet with the present Bangladesh. Thus, the great Heramba Kingdom of Govinda Chandra and Tularam were divided into several districts and sub-divisions. With the distributions of the land, the aboriginal ruling Dimasa people were also divided as the least minority everywhere.

The land settlement procedure of the British Government was very liberal and encouraging for the new comer settlers in Cachar. The Government allotted lands as much as one could occupy at different rates for different terms. Even the practice of offering of waste lands at progressive rates with rent-free terms had also been in vogue in Cachar. The land of Cachar being very fertile and suitable for agriculture also attracted the people. Thus the fertile soil and the liberal land allotment procedure of the Government immediately attracted the landless outsiders of the neighbouring areas in large numbers and settled. The opening of Tea and Rubber plantation industries in Cachar was another cause of influx of outsiders there. The Government also imported thousands of tea

labourers from outside the district and state for plantation purposes. It had, outnumbered the aboriginal Dimasa losing their every rights and benefits like political autonomy, economic development, development of language and culture and heritage, etc. The illiterate and minority Dimasa being unable to adjust themselves with the latest administration and developments which brought fast 'growth of population, towns and civic lifestyles, left their earlier homes and hearths and started settlement in the remote and dense forest areas. The Indian Independence movement under the leadership of Mahatma Gandhi, the world war etc. also brought several changes and in turn affected the Dimasa politically, Socially, Territorially and Economically.

After India's independence too there developed several changes in Assam. In 1951, a new district was created in the name of 'United Mikir' and North Cachar Hills. The Mikir Hills District was formed by curving out some territories of land from the district of Nagaon and Sib-sagar. The North Cachar Hills Sub-Division was separated from Cachar and tagging it with Mikir Hills formed into a district. The Naga Hills

district of Assam was separated from Assam and formed into a separate state of Nagaland in 1963. The Dimapur area of Assam, the capital of ancient Heramba Kingdom was also leased out to Nagaland. It was only in 1971 that North Cachar Hills (now known as Dima Hasao) was made a full-fledged district of Assam with its headquarters at Haflong with one autonomous District Council. The Mikir hills later renamed 'Karbi Anglong district. Barring the district of North Cachar Hills, the population of Dimasa people turned out as the least minority in all the remaining district of Cachar, Nowgong, Karimganj, Hailakandi and Karbi Anglong of Assam and Dimapur district of Nagaland. What is the most saddening is that the Dimasa of same language, culture, and religion are classified by different names and scheduled by different names in the census of India. The Dimasa today are known in government records by different names in different districts and states. The following table depicts the nomenclature of the Dimasa group of people in different parts of NE India and their population. (Table-1).

Table 1. Dimasa population in different parts of North East India

Nomenclature in different District/State	Male	Female	Total	Sex Ratio
Dimasa, Dima Hasao, Assam	33,330	31,551	64,881	947
Dimasa, Karbi Anglong, Assam	23,546	22,549	46,095	958
Barmans, Cachar, Assam	5,414	5,494	10,908	1,015
Barmans, Karimganj, Assam	961	877	1,838	913
Tangmi or Rukhini Barmans, Hailakandi As	389	344	733	884
Hojai, Kamrup, Assam	6	3	9	500
Hojai, Marigaon, Assam	67	74	141	1,104
Hojai, Nagaon, Assam	850	865	1,715	1,018
Hojai, Lakhimpur, Assam	9	8	17	889
Kachari, Nagaland.	3,917	3,890	7,807	993
Dimasa, Meghalaya.	311	242	553	778
Total Dimasa population	68,800	65,897	1,34,697	958

Source: Census of India, 2001.

Thus the Dimasas have completely lost the identity and oneness of the community though they belonged to the same language and culture. It has harmed their society in many ways. So, the administrative procedures so reformed and enforced for the protection, growth and peace of the tribals do hardly work at all. The Tribal Belts and Blocks, their Rules and Regulations framed for the protection of tribal interest could never work perfectly. Even the two autonomous districts of Assam with more autonomy powers are seemed to want something more because it could not fully serve the interest of the tribals and their districts. The demand for Autonomous State under the Article 244 (A) & (B) of the Indian Constitution, therefore soon followed.

All these tribes mentioned in the above table actually belong to same community. i.e. Dimasas. Recognition of Dimasa community by different names in different districts and states as mentioned above has further created troubles, misunderstandings, and disintegrations within the Dimasa society. The whole Dimasa community should be recognized by one name viz. Dimasas.

The Dimasas have also another complaint that till date the Dimasa people have never been provided with the opportunity to send a member-representative from their community either to the House of State Assembly or to the Parliament from any constituency of the districts of any state other than Dima Hasao to ventilate their problems and grievances for remedies. But the non-tribals who migrated to their ancestral homeland and formed majority in population have been freely enjoying such benefits and all other economic rights and facilities ever since the British rule. The Dima Hasao has now been spared with only one seat in the State Assembly of Assam. No Dimasa people of other districts either of the State of Nagaland or of

Assam has been provided with such opportunities. The re-organization of districts and states has resulted in dividing the Dimasas from their own ancestral homeland. The identity, integrity, language and culture of the Dimasa people are thereby threatened.

Until 1961, the Dimasas were treated as a sub-tribe of the Kachari tribes. In the 1961 census, however, they were classified as a separate tribe. Before the introduction of the District Council, the Dimasas were more or less unaware of the national political situation. At the dawn of independence the world of the average Dimasa was confined to the boundaries of their respective villages. Repeated migrations had already made the community isolated and conservative. The people who were once the ruling power of a large tract of Assam had confined themselves in their shells and the Dimasas living in isolated pockets had severed all contacts with the greater world. But though living in isolation, the Dimasas had a vague sense of pan-Dimasa identity. (Mishra P. S. in Pakem, 1990).

Since the last part of the 19th century, the Dimasa people living in the plains have, however, been facing the problem of land alienation in alarming magnitude. Large-scale migration from East Bengal (erstwhile East Pakistan, now Bangladesh), Nepal as well as from the mainland India and their settlement in Dimasa areas has adversely affected the economy of the Dimasa people. The migration of the outsiders has changed not only the demography of the region but also has dislocated socio-economic and political scenario. In addition the non-tribal traders, businessmen and moneylenders grabbed large areas of land of the Dimasa people exploiting their honesty and simplicity.

Under the circumstances stated above, the Dimasas of the North East India have started organizing themselves into a single community and movements for single identity followed. In

order to protect and promote the cultural identity of the community 'Dimasa Jalairaoi Hosom' was formed in 1972. It is a non-political cultural organisation with its headquarters at Haflong. Since its inception it has been demanding the preservation of Dimasa historical monuments and the adoption of Dimasa language at the primary level in N.C. Hills. Dimasa historical monuments of Dimapur and Maibong are in a deplorable condition and the educated Dimasa youths are very agitated on this point (Mishra P. S. in Pakem 1990). In 1978, the District Council gave some new settlements to a few non-tribals which caused resentment among the Dimasa. In its annual general meeting on 24-6-79 'Dimasa Jalairaoi Hosom' passed a resolution urging upon the authority to stop giving undesirable settlement to outsiders.

Dimasa National Organisation was given birth in 1979. The organization in the first resolution in its first general session held on 11. 03. 1979 passed a resolution demanding the preservation of ancient relics and monuments of the Kachari kings lying in various places of Assam and other parts of North Eastern States especially at Dimapur, Maibong and Khaspur. The executive committee of this organization consists of Dimasas belonging to the plains and the hills. Important Dimasa personalities like Sri Nandamohan Barman (President), Sri Brojendra Langthasa (General Secretary) were connected with this organization and this was the first attempt to unite all the Dimasa living in different areas under a common umbrella. Dimasa lawyers like Sri Anil Kumar Barman of Cachar, the then Minister of Assam Sri Sonaram Thaosen of N.C. Hills and the delegates from Nagaland pledged to work for a cultural and social unification of all the Dimasa (Mishra P. S. in Pakem, 1990).

The Dimasa of Cachar District formed 'Nikil Cachar Haidimba Barman Samity' in

December 31, 1945 at Bijoypur, in the present Borkhola Constituency. It is the oldest organization of the Dimasa community, not only in Barak Valley but also among the other Dimasa organizations in Assam. Nikhil Cachar Haidimba Barman Samiti, put forward a political demand in 1980 for the reorganization of the Dimasa speaking areas of the North East. This organization believes in the concept of greater Dimasa nationality and opines that the existence of the Dimasa will be in danger unless all the Dimasa are brought under a single administrative unit. Consequently, basing upon geographical facts and historical evidence, the organisation demands that in addition to the then N.C. Hills and the major part of Barak Valley, the southern part of Nagaon district including Howraghat, Jamunamukh, Dabaka, Lanka, Hojai, Namti, Jogijan and the area from Dimapur to Dhansiri should be included in the proposed administrative unit.

With a view to safeguard the greater interest of the Dimasa people, some of the educated Dimasa youths organized themselves to form a students' union in the name and style of Dimasa Students' Union (DSU) in 1952. The DSU was instrumental in overseeing the overall interest of the Dimasa people since its inception, particularly the welfare and safeguard of education, socio-culture and socio-economic situations of the Dimasa people.

The Dimasa Sanskriti Parishad (DSP) was born in the year 1975 in Cachar with a view to reawaken the cultural identity and social and political consciousness of Dimasa people.

All Dimasa Students' Union (ADSU) is a democratic, non-political and social umbrella organization of all students' community belonging to Dimasas. Earlier it was known as All Dimasa Students' Federation which followed a federal pattern but since 8th of January 1991, it was rechristened as All Dimasa Students' Union (ADSU) unifying all the

federal bodies belonging to them in different places like in Nagaland, Nagaon, Karbi Anglong, Dima Hasao and Cachar. The ADSU has been demanding for creation of a separate full-fledged state '**Dimaraji**' by incorporating all the territories that were included in the ancient Dimasa Kachari Kingdom so as to enable them to enjoy all constitutional rights and privileges to bring all round developments. The ADSU and the Dimaraji Revival Demand Committee (DRDC) jointly submitted a memorandum to Shri P.V. Narasimha Rao, the then Hon'ble Prime Minister of India, in 1996, demanding a separate homeland for the Dimasa. The ADSU, apart from safeguarding the common interest of the Dimasa community as a whole has launched a democratic political movement on 30 April 2003 staging a demonstration at Jantar Mantra, New Delhi demanding Dimaraji.

Dima Halim Daogah (DHD) is an offshoot of the erstwhile Dimasa National Security Force (DNSF), which had surrendered en masse in 1995, except for its self-styled Commander-in-Chief Jewel Garlosa, who subsequently launched the DHD. The emergence of this militant outfit can be ascribed partly to the no-responsive attitude of the government to the constitutional agitation path followed by the Dimasa and partly to the politics of expediency of the dominant class. Its declared objective is to create a separate State of 'Dimaraji' for the Dimasa and the indigenous People, comprising Dima Hasao, Dimasa dominated areas of Barak valley and Karbi Anglong districts of Assam and parts of Dimapur district in Nagaland. On June 24, 2004, Dilip Nunisa, commander-in-chief of the organization and the head of the outfit's armed wing, the Dima National Army, took over the command of DHD by ousting its President Jewel Garlosa on charges of anti-DHD activity. Nunisa, in a press statement, said that Garlosa has already formed a separate outfit on March 31, 2003, named 'The Black Widows', which also has a private army.

A ceasefire agreement was signed between the DHD leadership and the Union Government on January 1, 2003 and the agreement has been periodically extended. On September 23, 2004 a six-member DHD delegation led by 'Chairman' Dilip Nunisa met Union home minister Shivraj Patil in New Delhi and submitted a memorandum demanding a separate homeland for the Dimasa People. However, the tardy progress of the negotiation process has disappointed the DHD leadership, which, Dilip Nunisa termed as "intentional procrastination".

After submission of the memorandum of the D.H.D. on 23.09.2004 to the Hon'ble Home Minister of India, many things happened to the Dimasa people which need to be mentioned. The D.H.D. had entered into a Ceasefire agreement with the Govt. of India on 1.1.2003 and by the time the said memorandum was submitted there had hands full with an ethnic clash with the Hmars which spread over the Dima Hasao and Cachar district continuing for several months and causing extensive destruction of life and property on both sides. Close to its heels, came the infamous split in the D.H.D. leadership. Joel Gorlosa, the founder president/chairman of the organization was replaced by Dilip Nunisa as the chairman of the organization. Gorlosa was lying low for some time but since one year or so, he has emerged with a new outfit and has made his presence felt. About the same there had another ethnic clash with the Karbi in the Karbi Anglong district. The clash continued for several months and many precious lives and huge amount of properties on both sides were lost.

The other faction led by Jewel Garlosa came to be known as DHD (Jewel) and came in national and international news for its violent activities. The DHD (Jewel) has surrendered and signed a ceasefire agreement with the government of India on October 2, 2009.

What is more painful is the fratricidal feud between the two factions of the D.H.D.

which had been going on. Many incidents of killing and counter killing among the cadres of both factions were reported frequently. All endeavours to resolve this intense hostility have ended in failure. This divided house on the other hand, has opened the door wide to a number of other militant outfits of local and outside origin to operate in the Dimasa areas.

However, in the recent Dima Hasao Autonomous Council election, both the factions of DHD participated in the democratic process and contested as independent candidate in a few constituencies and got elected as Member of the Autonomous Council. But as both the factions have not contested in sufficient seats for forming the Executive Body of the council, they are not in a position to make decision for the development of the Dimasa in particular and the Dima Hasao district in general.

CONCLUSION

It can be said that although the assertion of 'Dimaraji' is a post independence entity, it is having a long historical reality. It is the result of growth of consciousness among the Dimasa as to their marginalisation in different parts of the region in the name of administrative divisions and re-divisions at various points of time. This has led to a unique and complicated situation. At present the demand for "Dimaraji" creates a rift not only between the different ethnic groups but also between Dimasa themselves causing uncertainty and tension in the Dimasa populated regions of the North east India. Now, it is the turn of Government to bring about a solution to the demand of "Dimaraji" considering the very history of indigenusness of the Dimasa and the possible tension that may arise among the other indigenous ethnic communities in the region. In doing so the interests of all sections of people must be protected and guaranteed. The policy of inclusive development may be fruitful for the solu-

tion of the problems of the Dimasa viewing the present heterogeneity of the region where "Dimaraji" is projected by the Dimasa.

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- SNP of ZFY gene in Yak (*Poephagus grunniens* L) and their F1 hybrid
Sandeep Das 1
- Texture analysis of Supercritical Fluid Extrusion (SCFX) Products and
Comparison with Traditional Puffed Extrusion
Simanta Hazarika and Syed S. H. Rizvi 7
- Rainfall trend and flood hazard vulnerability: a community based case study
of parts of Kamrup Metro District, Assam
Satyendra Hazarika and B.C. Kalita 15
- Morphological and mitochondrial D-loop region based genetic characteriza-
tion of two Synbranchid eels of genus *Monopterus*
Papari Devi and D.K. Sharma 30
- An evanescent field waves based fiber-optic temperature sensor
Prasenjit Paul 43

Humanities & Social Science Section

- Entrepreneurship Development in North East India: A study on Initiatives
taken by Indian Institute of Entrepreneurship (IIE)
Arijeet Das 49
- The Concept of Enlightenment of Self in Isopanishad and Sri Aurobindo- A
Comparative Assessment
Bijoy Kumar Das 60
- Worker's Participation in Trade Union Activities: a case study with special
reference to Oil India Limited, Duliajan, Assam
Arun Roy 68
- The Dimaraji Movement: A Movement of Ethnic Identity of the Dimasa of
North East India
Dadul Borah 77