Modified Pre-regularization and its Application in Renormalization Problems of Quantum Chromodynamics (QCD)

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Abstract

It is well known that in Quantum Field Theory (QFT) the interactions of elementary particles can be studied through Gauge theory. The modern approach to study the problems of QFT is to quantize a theory by Feynman Path Integral Method. The problem arises when we quantize a theory some of the symmetries of the Lagrangian may be lost. This problem can be recovered through renormalization. Again after quantization we have to deal with Feynman integrals which are divergent in most cases of loop integrals. Then our main task is to regularize these divergent integrals. Pre-regularization is one of the best prescriptions among other regularization prescriptions such as Dimensional Regularization, Pauli–Villars Regularization etc. which was proposed by me with some other Canadian researchers in 1985. It preserves all the underlying symmetries of the Lagrangian. But this prescription is also inadequate to calculate β-function, number of plausible fermion families in the theory and some other cases.

To overcome these problems, recently, we have proposed a modified version of the pre-regularization which is called "Modified Pre-regularization" Prescription. In this method initially we use pre-regularization and after calculation we introduce a parameter for defining the poles which can be used to calculate β-function and other properties of the theory. This modified pre-regularization Method is now a general prescription which can be applied in any problem of quantum field theory. In the present form it is also easy to compare the result with other regularization methods. Here also the Ward identities are controlled by finite surface terms like pre-regularization.

In this paper we have used this prescription in studying a QCD problem in particular in evaluating the Flavour-Changing one-loop Electromagnetic Vertex in non-linear R_ξ -gauge. This is a very important problem, because its contribution in CKM matrix is crucial. We find that not only the proof of renormalization of a theory but also to find the contribution of the finite part is much easier in this prescription.

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Introduction

Renormalization of any Gauge theory is essential. To find the dynamics of the particles and the values of the physical quantities one has to quantize a theory. The most fundamental problem in quantization of field theory is to study the underlying symmetries; that mean the symmetries, which exist classically, should uphold after quantization. Quantum Electrodynamics (QED) [1] is a well established Abelian gauge theory to study electromagnetic interactions. Gross and wilezek [2], Politzer [3] and Weinberg [4] showed that QCD is a gauge theory to study strong interactions phenomena. The problem of renormalization in QED, Yang-Mills theory and QCD can be studied perturbatively through the use of regularization method. That means when we consider radiative corrections in any Lagrangian then we have to evaluate loop diagrams which are not always finite. Then the problem of divergences can be consistently studied by the use of proper regularization method. Among various regularization methods Dimensional Regularization [5] and Pauli-Villar Regularization [6] prescription are most popular one, but even those are not suitable to apply in all problems.

To overcome most of the difficulties in 1985 we have proposed a prescription, called '**Pre-regularization**' [7]. This is an extremely convenient method to study loop diagrams and hence renormalization of quantum field theory. We have applied this prescription in many problems to prove the renormalization of the corresponding theory [8, 9, 10]. It gives us exact poles for divergent loop integrals. But it is also not sufficient to apply for evaluating β**-function** and some other interesting features of gauge theory with the existing form of the prescription. To incorporate these features recently, we have proposed a modified form of the pre-regularization which is called "Modified Pre-regularization" [11]. We have seen that the results obtained by this modified form can be easily compared with the results of other methods. In this framework, the ultraviolet content of the model is displayed in terms of momentum loop integrals order by order in perturbation theory for any Feynman diagrams. After integration the pole terms are represented by a parameter which approaches to exact poles in the limit. In this method also like pre-regularization, the Ward-Slavnov-Taylors identities [12] are controlled by finite surface terms.

The advantage of this method is that here we can study the problem exactly in the same dimension as we are interested in. This means we can carry out not only the γ –matrices algebra but also the γ_5-algebra in four dimensions and we do not have to adopt any ad-hoc rules such as going to higher dimensions, trace cyclicity and so on.

To illustrate the new method recently in papers [11, 13] we have clearly demonstrated how the modified form of pre-regularization can be applied to study the renormalization problem and the calculation of β-function in QED, in Yang-

Mills theory and in QCD. There we have explained the advantage of using modified form of pre-regularization than that of others. The main advantage of this prescription is that one can study the problem in physical dimension and the calculations are simpler than that of other methods.

In this paper we have used this prescription in studying a QCD problem in particular in evaluating the Flavour-Changing one-loop Electromagnetic Vertex in non-linear R_ξ -gauge. The purpose of studying this problem is mainly to get an idea about many unresolved questions of the most successful theory i.e. the standard model [14]. Presently the most striking way to search for new physics is to observe experimentally rare or forbidden processes such as $b \to s\gamma$. This is also the flavour changing electromagnetic vertex [15]. It is also interesting to note that to evaluate this type of decay processes is simpler in non-linear R_ξ -gauge, which was first introduced by Fujikawa [16].

Pre-regularization and Modified Pre-regularization Method

I have already mentioned that the Pre-regularization and Modified Pre-regularization method is described in ref [11, 13] but for completeness I have again describing the prescription here.

The basic idea of pre-regularization [7] involves parametrizing the ambiguities inherent within Feynman loop integrals. These ambiguities arise because propagators are not functions, but rather are distributions, and the product of two distributions is not well defined. Without violating momentum conservation, it is possible to add an arbitrary momentum-shift parameter s to a given loop momentum k .These shift parameter are then determined by requiring that the Ward identities of the theory in question be upheld. The basic steps of the procedure are:

1) To a given order of perturbation theory, write down all Feynman integrals in *d*-dimensional integrals, where *d* is the exact (integer) dimensional of space-time of the problem in consideration. For example if we consider (3+1) dimensional space time, then *d* is 4. Write each independent loop momentum as $(k+s)_i$, where k_i^μ is the variable of integration of the i-th loop, and s_i^μ is the arbitrary momentum shift parameter (consistent with momentum conservation at each vertex) reflecting the arbitrariness in assigning internal loop momenta. Then each integral will be of the form

$$I = \int d^d k_1 .... \int d^d k_n \times F(k_1 + s_1, .., k_n + s_n; p_1, p_2 ....; m_1, m_2 ...) \quad (1)$$

where k_j, p_j^μ and m_j are internal, external momenta and particle masses respectively. *F* is a function which is determined form the Feynman rules; in general it is a Lorentz tensor.

2) Combine the terms occurring in the denominator of (1) using standard Feynman parameter techniques, and then shift the variables of integration keeping track of the surface terms [7], so that

$$I = \int d^d k_1' .... \int d^d k_n' \int_0^1 dx_1 ... \int_0^1 dx_n \tilde{F}(k_1'^2, ..., k_n'^2; x_1, ..., x_n; p_1, p_2, ...; m_1, m_2 .....)$$

$$+ S(s_1, ..., s_n; p_1, p_2, ...; m_1, m_2 .....) \qquad (2)$$

Here the $x_i's$ are Feynman parameters and by definition, the function $\tilde{F}$ contains no momentum shift parameters s_i. Most important point here is that when we shift the variable of integration we have to keep track of appropriate surface terms.

3) The shift parameters s_i^μ occurring in the surface terms that generate s are now expanded so that $s_i^\mu = \alpha_{ij} p_j^\mu$ (3)

where α_{ij} are parameters and p_j^μ are external momenta.

The divergences in the integrals over $k_i'^\mu$ in equation (2) are now parameterized using any convenient method and the parameters α_{ij} in equation (3) are determined by demanding that *I* satisfy any relevant Ward identities. It is not necessary to redefine the original theory (such as by extending its dimensionality from *d* to *n*).

4) After evaluating the momentum integrals we get pole terms of the form

$\Gamma(0)$, $\Gamma(-1)$ and so on.

To replace the poles introduce a parameter ε in the following way:

$$\Gamma(0) = \Gamma(\frac{\varepsilon}{2}) \ , \ \Gamma(-1) = -\Gamma(\frac{\varepsilon}{2}) \text{ and so on} \qquad (4)$$

where, $\frac{\varepsilon}{2} = 2 - \frac{d}{2}$ in four dimensions, d is the number of dimensions.

Hence $d \to 4$, then $\frac{\varepsilon}{2} \to 0$.

This implies that our result is now parameter dependent that allows us to calculate the β**-function** and other important properties of the theory. Hence now we are able to compare our results with other regularization methods.

Modified Pre-regularization in QCD Problem

In this section we want to evaluate the Flavour-Changing one-loop Electromagnetic Vertex in non-linear R_ξ-gauge using our new prescription. This is a very interesting

problem in QCD, because it contributes to Cabibbo-Kobayashi-Maskawa (CKM) mixing matrix which characteristics the three generations of quarks. The loop diagrams comes from the QCD Lagrangian [2]
The QCD Lagrangian can be written in the following form

$$L_{QCD} = -\frac{1}{4} G^a_{\mu\nu} G^a_{\mu\nu} + \sum_k^m \hat{q}_k (i\gamma^\mu D_\mu - m_k) q_k \qquad (5)$$

Where, $G^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu + g\, f^{abc} A^b_\mu A^c_\nu$ (6)

$$D_\mu q_k = (\partial_\mu - igA_\mu) q_k \qquad (7)$$

$$A_\mu = \sum_{a=1}^{\infty} A^a_\mu t^a = \sum_{a=1}^{8} A^a_\mu \frac{\lambda^a}{2} \qquad (8)$$

Here A^a_μ is the colour gauge field similar to the iso-spin gauge field in the original Yang-Mills theory and g is the strong interaction coupling constant, k is the flavour index $k = 1, 2, 3, ..., n_f$ (number of quark flavour). That is, $q_k : u, d, s, c, b, ...$.

The λ's are the Gell-Mann matrices that satisfy the $SU(3)_c$ commutation relations

$$\left[\frac{\lambda_a}{2}, \frac{\lambda_b}{2}\right] = if^{abc} \frac{\lambda_c}{2} \qquad (9)$$

And the normalization condition

$$tr(\lambda^a \lambda^b) = 2\delta^{ab} \qquad (10)$$

We have to add a gauge fixing term in the above QCD Lagrangian. The gauge fixing Lagrangian in non-linear R_ξ-gauge is

$$-\mathcal{L}_G = \frac{1}{2\alpha}(\partial_\mu A^\mu)^2 + \frac{1}{2\eta}(\partial_\mu Z^\mu + \eta M_z \chi)^2$$

$$+ \frac{1}{\xi}[(\partial_\mu - igA^3_\mu) W^{\mu+} - i\xi M_w S^+]^2 \qquad (11)$$

Where A^3_μ can be expressed in terms of A_μ and Z_μ

$$A^3_\mu = A_\mu Sin\theta_w - Z_\mu Cos\theta_w \qquad (12)$$

In this gauge for electromagnetic vertex the relevant Feynman diagrams arises have shows in fig-1 and the Feynman rules are given in fig-2 according to ref. [14].
Using the Pre-regularization prescription as described in section-2 and the Feynman rules of fig-2 we can evaluate the one-loop diagrams of fig-1. The contribution for fig-1a is:

$$\Lambda_{a\mu} = \frac{e_w g^2}{2}\int \frac{d^4q}{(2\pi)^4}\frac{1}{D_1}\gamma_\alpha L\{(\not{q}+\not{p}+\not{s}_1)+m\}\gamma_\beta L$$

$$\times[g_{\alpha\beta}(2q+k+s_1)_\mu - 2g_{\beta\mu}k_\alpha + g_{\mu\alpha}k_\beta] \qquad (13)$$

Where,

$$D_1 = [(q+p+s_1)^2 - m^2][(q+k+s_1)^2 - M_w^2][(q+s_1)^2 - M_w^2] \qquad (14)$$

Here, according to the pre-regularization we have added s_1 for fig-1a in the usual momentum routing. The most important feature here is that we can perform the γ – matrices algebra and the integrals exactly in four-dimensions.
Taking the W-I and performing all other tricks we get

$$-k^\mu \Lambda_{a\mu} = 2e_w g^2 \int_0^1 dx \int_0^{1-x} dy \int \frac{d^4q}{(2\pi)^4}\frac{1}{(q^2-c)^3} N_1 L \qquad (15)$$

Where, $N_1 = \frac{1}{2}\not{k}q^2 - \{2xp.k - (1-2y)k^2\}\{(1-x)\not{p} - y\not{k}\}$ (16i)

$$c = M_w^2(1-x) + m^2 x + p^2 x(x-1) + k^2 y(y-1) + 2p.kxy \qquad (16ii)$$

After doing all the tedious γ – algebra and performing the integrations we get

$$-k^\mu \Lambda_{a\mu} = \frac{ie_w g^2}{32\pi^2}\Gamma(0)\not{k}L + \Lambda^1_{a\mu} \qquad (17)$$

Where, $\Lambda^1_{a\mu}$ = Finite part

$$= \frac{ie_w g^2}{16\pi^2}\int_0^1 dx \int_0^{1-x} dy \frac{1}{c}[\{2xp.k - (1-2y)k^2\}.\{(1-x)\not{p} - y\not{k}\}]L \qquad (18i)$$

Using the same procedure for other diagrams in fig-1 we get

$$\Lambda_{b\mu} = \frac{-e_s g^2}{2M_w^2}\int \frac{d^4q}{(2\pi)^4}\frac{1}{D_2}[(m_j L - mR)\{(\not{q}+\not{p}+\not{s}_2)+m\}$$

$$.(-mL + m_i R)\{(2q+k+2s_2)_\mu] \qquad (19)$$

Where,

$$D_2 = [(q+p+s_2)^2 - m^2][(q+k+s_2)^2 - M_w^2][(q+s_2)^2 - M_w^2] \quad (19i)$$

$$\Lambda_{c\mu} = \frac{e_q g^2}{2}\int \frac{d^4q}{(2\pi)^4}\frac{1}{(q+s_3)^2 - M_w^2}\gamma_i L \frac{1}{(\not q + \not p + \not s_3) - m}\gamma_\mu$$

$$\cdot\frac{1}{(\not q + \not p - \not k + \not s_3) - m}\gamma_i L \quad (20)$$

And

$$\Lambda_{d\mu} = \frac{-e_q g^2}{2M_w^2}\int \frac{d^4q}{(2\pi)^4}\frac{1}{(q+s_4)^2 - M_w^2}(m_j L - mR)\frac{1}{(\not q + \not p + \not s_4) - m}\gamma_\mu$$

$$\cdot\frac{1}{(\not q + \not p - \not k + \not s_4) - m}(-mL + m_i R) \quad (21)$$

Since the integral (19) is similar to that of (13) we can apply the same procedure for $\Lambda_{b\mu}$ and get

$$-k^\mu \Lambda_{b\mu} = \frac{ie_s g^2}{64\pi^2 M_w^2}\not k(m^2 L + m_i m_j R)\Gamma(0) + \Lambda_{b\mu}^2 \quad (22)$$

Where,

$$\Lambda_{b\mu}^2 = \text{Finite part} = \frac{ie_s g^2}{32\pi^2 M_w^2}\int_0^1 dx \int_0^{1-x} dy \frac{1}{c}[m^2\{(1-2y)k^2 - 2xp.k\})$$

$$\times(m_j L + m_i R) - \{(1-2y)k^2 - 2xp.k\}\times\{(1-x)\not p - y\not k\}(m^2 L + m_i m_j R)] \quad (23)$$

where c is defined in (16ii).

For diagrams 1c and 1d that is for expressions (20) and (21) it is better to apply another type of trick for taking W-I which separates the integrals into two parts and give raise to simpler integrals. In this procedure if we apply the W-I in (20) and (21) we get:

$$-k^\mu \Lambda_{c\mu} = \frac{e_q g^2}{2}\int \frac{d^4q}{(2\pi)^4}\frac{1}{(q+s_3)^2 - M_w^2}\gamma_i L(E_1 - E_2)\gamma_i L \quad (24)$$

Where, $E_1 = \dfrac{(\not q + \not p + \not s_3) + m}{(q+p+s_3)^2 - m^2}$, $E_2 = \dfrac{(\not q + \not p + \not s_3 - \not k) + m}{(q+p+s_3-k)^2 - m^2}$ (24i)

And

$$-k^{\mu}\Lambda_{d\mu} = \frac{e_q g^2}{2M_w^2}\int \frac{d^4q}{(2\pi)^4}(m_i L - mR)(E_1' - E_2')(mL - m_i R) \quad (25)$$

$$E_1' = \frac{(\not{q} + \not{p} + \not{s}_4) + m}{(q + p + s_4)^2 - m^2}\,,\; E_2' = \frac{(\not{q} + \not{p} + \not{s}_4 - \not{k}) + m}{(q + p + s_4 - k)^2 - m^2} \quad (25i)$$

After going through a tedious algebra and performing the integrals we came up with a very simple result:

$$-k^{\mu}\Lambda_{c\mu} = \frac{-ie_q g^2}{64\pi^2}[2\Gamma(0) + 1]\not{k}L \quad (26)$$

And $$-k^{\mu}\Lambda_{d\mu} = \frac{-ie_q g^2}{128\pi^2 M_w^2}[2\Gamma(0) + 1]\not{k}(m^2 L - m_i m_j R) \quad (27)$$

Combining the results (17), (22), (26), and (27) we get the total contributions for the W-I of electromagnetic vertex:

$$-k^{\mu}\Lambda_{\mu} = \frac{ig^2}{64\pi^2}[2(e_w - e_q)\not{k}L + \frac{1}{M_w^2}(e_s - e_q)\not{k}$$
$$(m^2 L - m_i m_j R)]\Gamma(0) + \Lambda^1_{a\mu} + \Lambda^2_{b\mu} + \Lambda^3_{c\mu} + \Lambda^4_{d\mu} \quad (28)$$

Where, $\Lambda^1_{a\mu}$, $\Lambda^2_{b\mu}$ defined before and

$$\Lambda^3_{c\mu} = -\frac{ie_q g^2}{64\pi^2}\not{k}L \quad (29)$$

$$\Lambda^4_{d\mu} = -\frac{ie_q g^2}{128\pi^2}\not{k}(m^2 L + m_i m_j R) \quad (30)$$

$\Lambda^1_{a\mu}, \Lambda^2_{b\mu}, \Lambda^3_{c\mu}, \Lambda^4_{d\mu}$ are finite parts.

Equation (28) is the final result for flavour changing electromagnetic vertex of one-loop diagrams after imposing Ward identity. Here we see that there is a pole term which has to be removed for renormalization. To do this let us now use Modified Pre-regularization method. This means that we have to replace $\Gamma(0)$ by $\Gamma(0) = \Gamma(\frac{\varepsilon}{2})$.

$$-k^{\mu}\Lambda_{\mu} = \frac{ig^2}{64\pi^2}[2(e_w - e_q)\not{k}L + \frac{1}{M_w^2}(e_s - e_q)\not{k}\,(m^2 L - m_i m_j R)]\,\Gamma(\frac{\varepsilon}{2}) + \Lambda^1_{a\mu} + \Lambda^2_{b\mu} + \Lambda^3_{c\mu} + \Lambda^4_{d\mu} \qquad (31)$$

Now if we expand $\Gamma(\frac{\varepsilon}{2})$ in terms of $\frac{\varepsilon}{2}$ and Eulerian - γ function we get terms which goes to infinity for $\frac{\varepsilon}{2} \to 0$. That means we get pole terms, so for renormalization we have to add a counter Lagrangian in (5) which give us same contribution as in the pole part of (31) with opposite sign. That means the divergent part will now absorbed by the redefinition of charge and mass of the particles involved in the Lagrangian. Hence the Lagrangian is now renormalized and we are left with finite parts which are easily calculable.

Conclusions

The result in (31) is very attractive because of its simple structure of the divergences and also the finite parts, which is in contrast with refs. [14, 15, 16]. This better result is only because we have used "Pre-regularization" and "Modified Pre-regularization" prescription. From this calculation it is transparent that the renormalization of any theory is so easy and also the finite parts are so simple to evaluate with this new prescription. From the finite part we can evaluate the form factors, which will give us better description of the underlying physics of the decay process.

Feynman Diagrams

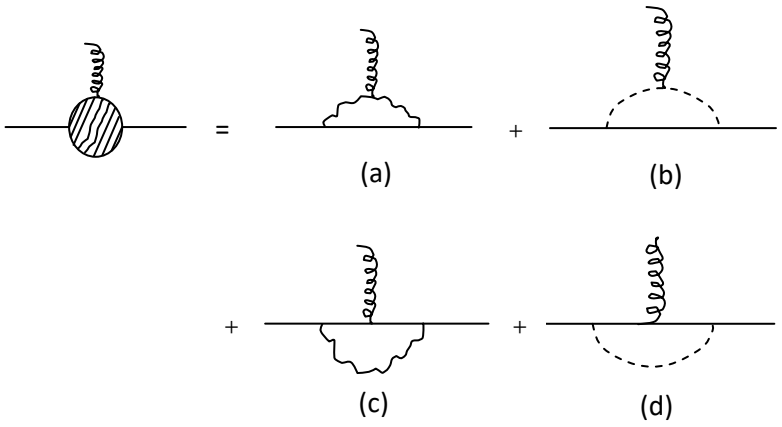
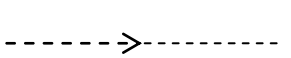


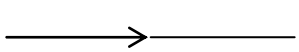
Fig-1: The one-loop Feynman diagrams that contribute to the proper vertex.

Feynman Rules in R_ξ -gauge

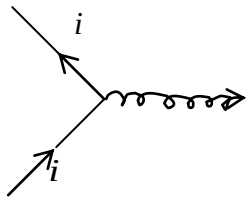
Propagator:

$\Delta_w^{\mu\nu}(p)$  $= \dfrac{-ig^{\mu\nu}}{P^2 - M_w^2}$

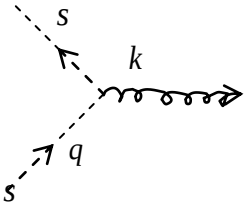
$\Delta_s(p)$  $= \dfrac{i}{P^2 - M_w^2}$

$S_F(p)$  $= \dfrac{i}{p - m}$

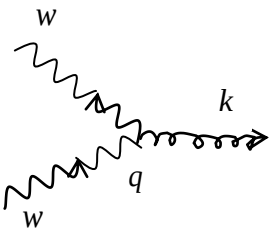
Vertices:



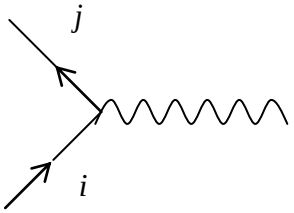
$A_\mu = ie_i \bar{u}_i \gamma_\mu u_i$



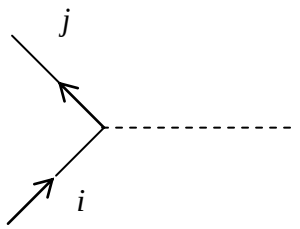
$A_\mu = ie_s (2q - k)_\mu$



$A_\mu = -ie_w [g_{\alpha\beta}(2q - k)_\mu + 2g_{\beta\mu}k_\alpha - 2g_{\alpha\mu}k_\beta]$



$W_\mu = -i\dfrac{g}{\sqrt{2}} \bar{u}_j \gamma_\mu L u_i$



$$S = \frac{ig\sqrt{2}}{M_w}\bar{u}_j I_3^j (m_j L - m_i R) u_i$$

$$L = \frac{1-\gamma_5}{2},\ R = \frac{1+\gamma_5}{2}$$

Fig-2: Solid line represents quarks, short wavy line is for electromagnetic field, and large wavy line is for W -meson and the dashed line is for scalar field.

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Transition to Chaotic and Unstable Exponent in Duffing-van Der Pol Oscillator

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Abstract

In real physical phenomena governed by dissipative non-linear dynamical systems, an interesting & strange long time behavior appears relating to their solutions. In these systems, in general approximate solutions are obvious to accept other than some special cases. Most of the non- linear oscillating systems include complex behavior such as strange attractors & chaotic output that our knowledge cannot explain all the possible complex dynamics. Recently very complicated behavior known as chaos of the dynamical systems is an important part of the research field. In this paper, an attempt has been made to investigate the chaotic and unstable behavior in the mixed type of Duffing and Van der pol oscillator. For observing chaos and instability, an analytical solution of this mixed type of equation has been performed. It has been found that chaos and instability exit for some particular parameter values which have been shown graphically.

Introduction

Recently attention has been devoted to intrinsically non-linear effects which arise for somewhat larger near resonant perturbation. In order to understand the effects of periodic perturbation on a sub critical bifurcation S.T Vohra , L.Fabiny and K. Wiesenfeld [1] used the augmented form

$$\dot{x} = \mu x + x^3 + \varepsilon \cos \delta t \qquad (1)$$

where, $\varepsilon = 0$ represents the unperturbed system (1) and ε is proportional to the strength of the near resonant perturbation and δ is proportional to the detuning frequency. The authors were able to demonstrate experimentally that near resonant perturbations tend to induce subcritical bifurcation which is in contrast to the effect observed in super critical bifurcation. Using a normal form analysis they derived a generic scaling law relating to the magnitude of the destabilizing shift μ to the perturbation amplitude ε and the detuning frequency δ . The predictions were in excellent agreement with their experiments.

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You-Huang Kao & Shing-Sen Wang [2] investigated the injection locking and chaotic transition in Van der pol oscillator with a non-linear restoring force term via electronic circuit. The equation of motion in Duffing and Van der pol oscillators are

$$\ddot{x} + \mu\dot{x} + (\alpha - \lambda x^2)x = F\sin\omega t \qquad (2)$$

and

$$\ddot{x} + \mu(x^2 + g)\dot{x} + \alpha x = F\sin\omega t \qquad (3)$$

Equation (2) has the non-linear restoring force $(\alpha - \lambda x^2)x$ and the linear damping term. Equation (3) has the non-linear damping term $\mu(x^2 + g)\dot{x}$ and linear restoring force αx and can also contain free running solution or relaxation oscillation depending on the sign of 'g' factor in the damping term. The chaotic dynamics in Duffing oscillator involves period doubling route to chaos, intermittency and crisis event [3,4]. Its bifurcation structure reveals as shallow-tailed shapes among the resonant regions [5,6] The dynamical behavior in VDP oscillator have also been by several researchers. The regular case with small coefficient μ has been studied analytically with the averaging and topological methods [6,7]. The bifurcation in self oscillation systems were investigated with their potential application for the VDP oscillator containing non-linear restoring force. The dynamical behavior of the locking transients and chaotic transition were focused upon. Three varieties of the capture process from quasi-periodic to locked state clarified as intermittency catastrophe, blue-sky catastrophe and inverse Hopf bifurcation. They concluded that for the existence of non-linear restoring force and damping term, the most eminent behaviors observed in VDP and Duffing oscillator were the intermittency catastrophe, the blue-sky catastrophe and the complicated bifurcation of sub harmonic regions.

In non-linear dissipative systems, if every initial states close enough to equilibrium leads to state which continue permanently to be closed, called the equilibrium is stable. But if a system in some way disturbed, will its subsequent behavior differ from its undisturbed behavior, variation produce large changes in the operating conditions would be described unstable. The non-linear dynamics in forced system have described a substantial amount of attention since the prediction of the scaling constant of routes to unstable exponent.

The mixed type of Duffing and VDP oscillator is

$$\ddot{x} + \varepsilon(x^2 + g)\dot{x} + \alpha x - \lambda x^3 = F\sin\omega t \qquad (4)$$

Two types of local and global bifurcations are involved in transition process which can be classified according to the topological change of attractors [8]. In the local bifurcation of co dimension-one with only

one control parameter variation, there are saddle-node, pitchfork, flip and Hopf bifurcation and have the Floquet multiplier passing the unit circle from +1, +1 ,-1 and the complex number respectively. The global bifurcations are associated with the topological change of the invariant of the manifolds of a saddle point. Two types of blue-sky catastrophe and intermittent catastrophe are often encountered. The former is the global bifurcation proper, which is the qualitative change of invariant manifold topology. The later is the hybrid type in which the bifurcation is a local bifurcation of the catastrophe variety repercussions are determined by global structure of invariant manifolds and this is referred to local and global bifurcations. The local and global bifurcation in equation (4) is extensively examined by the authors [1]. Also they investigated the complicated behavior at a high μ value and high excitation similar to the VDP system, the highly damped case with $\mu < 1$ is focused to signify the role of non-linear restoring force on a chaotic dynamics. In this paper an analytical solution of equation (4) has been performed to investigate the chaotic and unstable exponent.

Analytical solution of Duffing and VDP oscillator

A linear system arise in connection with non-linear systems which are in some sense close to linear. In such cases certain characteristics of their solutions notably stability properties may follow those of the approximately linear systems. In order to match the form of the theory of linear systems, it has been expressed equation (4) in the form

$$\dot{X} = \begin{pmatrix} \dot{x} \\ \dot{y} \end{pmatrix} = \begin{pmatrix} y \\ -\varepsilon(x^2 + g)\dot{x} - \alpha x + \gamma x^3 + F\sin\omega t \end{pmatrix}$$

$$= \begin{pmatrix} y \\ -\varepsilon(x^2 + g)y - \alpha x + \gamma x^3 + F\sin\omega t \end{pmatrix} \qquad (5)$$

and put approximately $x^* = a\cos\omega t$; $y^* = -a\omega\sin\omega t$. To obtain the variant equation, define

$\underline{\xi} = (\xi, \eta)^t$ *by* $\underline{\xi} = \underline{X} - \underline{X}^*$, *where* $\underline{X}^* = (x^*, y^*)$,

$\underline{X} = \underline{\xi} + \underline{X}^*$, *then* $\dot{\underline{X}} = \dot{\underline{\xi}} + \dot{\underline{X}}$, *and* $\eta = y - y^*$, *or,* $y = \eta + y^*$ *then* $\dot{y} = \dot{\eta} + \dot{y}^*$

Substituting x and y in eqn (5)

$$\dot{x} = y, \dot{\xi} + \dot{\underline{x}}^* = \eta + y^* \qquad (6)$$

$$and\ \dot{y} = -\varepsilon y(x^2 + g) - \alpha x + \lambda x^3 + F\sin\omega t$$

$$\ddot{\eta} + \ddot{y}^* = -\varepsilon y^* \{(\xi + x^*)^2 + g\} - \alpha(\xi + x^*) + \gamma(\xi + x^*)^3 + F\sin\omega t$$

$$= \varepsilon a\varepsilon \sin\varepsilon t\{\xi^2 + 2\xi x^* + x^{*2} + g\} - \alpha(\xi + x^*) + \gamma(\xi^3 + 3\xi^2 x^* + 3\xi x^{*2} + x^{*3}) + F\sin\omega t \quad (7)$$

By neglecting the powers of ξ higher than first and considering the fact that x^* and y^* satisfy eqn. (5), the systems (6) and (7) reduces to $\dot{\xi} = \eta$ (8)

Since $\dot{x}^* = \dot{y}$ and

$$\dot{\eta} + \dot{y}^* = \varepsilon a\omega\sin\omega t(x^{*2} + g\} + 2\varepsilon a\omega\sin\omega t.\xi x^* - \alpha\xi - \alpha x^* + 3\xi\gamma x^{*2} + \gamma x^{*3} + F\sin\omega t$$

$$= \{-\varepsilon y^*(x^{*2} + g) - \alpha x^* + \gamma x^{*3} + F\sin\omega t\} + 2\varepsilon\xi x^* a\omega\sin\omega t - \alpha\xi + 3\gamma x^{*2}$$

$$= \dot{y}^* + 2x^*\varepsilon\xi a\omega\sin\omega t - \alpha\xi + 3\xi\gamma x^{*2}$$

$$\therefore \dot{\eta} = 2x^*\varepsilon\xi a\omega\sin\omega t - \alpha\xi + 3\xi\gamma x^{*2} \quad (9)$$

From (8)

$$\ddot{\xi} = \dot{\eta}$$

$$= 2x^*\varepsilon\xi a\omega\sin\omega t - \alpha\xi + 3\xi\gamma x^{*2}$$

$$\ddot{\xi} + \xi(-2x^*\varepsilon\xi a\omega\sin\omega t - 3\xi\gamma x^{*2} = 0$$

$$\ddot{\xi} + \xi\{\alpha - 2\varepsilon a^2\omega\cos\omega t\sin\omega t - 3\gamma a^2\cos^2\omega t\} = 0$$

$$\ddot{\xi} + \xi\{\alpha - 2\varepsilon a^2\omega\cos\omega t\sin\omega t - \frac{3}{2}\gamma a^2(1 + \cos 2\omega t\} = 0$$

$$\ddot{\xi} + \xi\{\alpha - 2\varepsilon a^2\cos\frac{\tau}{2}\sin\frac{\tau}{2} - \frac{3}{2}\gamma a^2(1 + \cos\tau) = 0, where\ \tau = 2\omega t$$

$$\ddot{\xi} + \xi\{(\alpha - \frac{3}{2}\gamma a^2) - \varepsilon a^2\omega\sin\tau - \frac{3}{2}\gamma a^2\cos\tau\} = 0 \quad (10)$$

$$put\ \alpha - \frac{3}{2}\gamma a^2 = l,\ \varepsilon\omega a^2 = m,\ \frac{3}{2}\gamma a = n$$

then from eqn. (10)

$$\ddot{\xi} + (l + m\sin\tau + n\cos\tau)\xi = 0 \quad (11)$$

Equation (11) is almost similar to Matheu's equation [$\ddot{x} + (\alpha + \beta\cos\tau)x = 0$] with an addition of oscillation term m sin τ. Again eqn. (11) can be expressed as

$$\ddot{\xi} + (l + m\sin\tau + n\cos\tau)\xi = 0$$

$$\begin{pmatrix}\dot{\xi}\\ \dot{\eta}\end{pmatrix} = \begin{pmatrix}0 & 1\\ -l - m\sin\tau - n\cos\tau & 0\end{pmatrix}\begin{pmatrix}\xi\\ \eta\end{pmatrix}$$

This is the form of $\dot{\underline{X}} = p(t)\underline{X}$, where p(t) is periodic with minimal period T, i,e T is the positive smallest number for which p(t+T) = p(t); $-\infty < t < \infty$.

so $$p(t) = \begin{pmatrix} 0 & 1 \\ -l - m\sin\tau - n\cos\tau & 0 \end{pmatrix} \qquad (12)$$

Theorem1.1 : If $E = (e_{ij})$ is non-singular and E has n distinct eigen values μ_i i=1, 2 …..n, then $\dot{\underline{X}} = p(t)\underline{X}$, has n linearly independent normal solution of the form $X_i = \underline{P}_i(t)e^{\rho_i t}$ where ρ_i are the characteristic exponents corresponding to μ_i and $\underline{P}_i(t)$ are the functions with period T [9].

Theorem1.2: For the regular system $\dot{\underline{X}} = A(t)\underline{X}$, the zero solution (and hence all solutions) are stable on $t > t_0$; t_0 arbitrary, if and only if every solution is bounded. If A is constant and every solution is bounded, the solutions are uniformly stable [9].

Theorem1.3: For the system $\dot{\underline{X}} = p(t)\underline{X}$, where p(t) has the principal period T, let the characteristic numbers of the system be μ_1, μ_2 ……..…..μ_n, then μ_1, μ_2 ...…....μ_n = $\exp(\int_0^T tr\{p(s)\}ds)$, a repeated characteristic number being counted according to its multiplicity [9].

The general structure of the solution is determined by the above theorem 1.1, whilst the question of the stability of the solution can be decided through the theorem 1.2 by the boundedness or otherwise of the solution for given values of the parameters l , m , n. In eqn. (12) tr{p(t)} = 0. Then by the theorem 1.3,

$$\mu_1\mu_2\mu_3 = e^0 = 1. \qquad (13)$$

where μ_1, μ_2, μ_3 are the characteristic numbers of p(t). Therefore, they are the solutions of a cubic equation with real coefficients, which has the form

$$\mu^3 + \phi(l,m,n)\mu^2 + \phi(lm, mn, \ln)\mu + 1 = 0 \qquad (14)$$

$$put\ \mu = z - \frac{\phi}{3}\ in\ eqn.(14)$$

$$(z - \frac{\phi}{3})^3 + \phi(z - \frac{\phi}{3})^2 + \phi(z - \frac{\phi}{3}) + 1 = 0$$

$$z^3 + Hz + G = 0 \qquad (15)$$

$where\ H = \phi - \frac{\phi^2}{3}; G = 1 - \frac{\phi^2}{3} - \frac{4}{27}\phi^3$

$put\ z = g^{\frac{1}{3}} + k^{\frac{1}{3}},$

$z^3 = g + k + 3(gk)^{\frac{1}{3}}(g^{\frac{1}{3}} + k^{\frac{1}{3}})$

$z^3 - 3(gk)^{\frac{1}{3}} z - (g + k) = 0$ (16)

comparing (15) *and* (16)

$H = -3(gk)^{\frac{1}{3}}\ ;\ G = -(g + k)$

so g, k *are the roots of* $f^2 - \{-(g + k)\} f + gk = 0$

$$f^2 + Gf - \frac{1}{27}H^3 = 0$$

$$27 f^2 + Gf - H^3 = 0$$

$$f = -\frac{1}{2}G \pm \frac{\sqrt{27}}{54}\sqrt{27G^2 + 4H^3} \qquad (17)$$

Now

$$27G^3 + 4H^3$$

$$= 27(1 - \frac{\phi^2}{3} - \frac{4}{27}\phi^3)^2 + 4(\phi - \frac{\phi^2}{3})^3$$

$$= \frac{1}{27}(729 + 16\phi^6 + 72\phi^5 + 93\phi^4 - 288\phi^3 - 378\phi^2)$$

$$= \frac{1}{27}(729 + \delta);$$

where $\delta = 16\phi^6 + 72\phi^5 + 93\phi^4 - 288\phi^3 - 378\phi^2$;

Now from (17)

$$\mu^3 = f = -\frac{1}{2}G \pm \frac{1}{54}\sqrt{729 + \delta}$$

$$\mu = [-\frac{1}{2}G \pm \frac{1}{54}\sqrt{729 + \delta}]^{\frac{1}{3}} \qquad (18)$$

Case I : Characteristic numbers will be complex if δ< -729. we have ρ_1= -iυ , υ is real. The general solution is of the form $\xi(t) = c_1 e^{i\upsilon t} p_1(\tau) + c_2 e^{-i\upsilon t} p_2(\tau)$

$$\therefore x(t) - x^*(t) = \xi(t)$$

$$x(t) = a\cos\omega t + \xi(t)$$

$$where\ \dot{x}^* = y^* = -a\omega\sin\omega t$$

$$x^* = -\int a\omega\sin\omega t dt = a\cos\omega t.$$

Case II: Characteristic numbers will be real, different when $\delta \geq 0$, $\delta > -729$, i,e $\delta \in (-729, \infty)$. The corresponding characteristic exponents are real and have the form $\rho_1 = \sigma > 0$ and $\rho_2 = -\sigma < 0$. The general solution is of the form (by theorem 1.1),

$$\xi(t) = c_3 e^{\sigma t} p_3(\tau) + c_4 e^{-\sigma t} p_4(\tau)$$

$$\therefore x(t) - x^*(t) = \xi(t)$$

$$x(t) = a\cos\omega t + c_3 e^{\sigma t} p_3(\tau) + c_4 e^{-\sigma t} p_4(\tau) \qquad (19)$$

Where, c_3 and c_4 are constants.

Now $p(t) = \begin{pmatrix} 0 & 1 \\ -l - m\sin\tau - n\cos\tau & 0 \end{pmatrix}$

$p(\tau+T) = \begin{pmatrix} 0 & 1 \\ -l - m\sin(\tau+T) - n\cos(\tau+T) & 0 \end{pmatrix}$

Since $p(\tau+T) = p(T)$

$$\therefore \begin{pmatrix} 0 & 1 \\ -l - m\sin\tau - n\cos\tau & 0 \end{pmatrix}$$

$$= \begin{pmatrix} 0 & 1 \\ -l - m\sin(\tau+T) - n\cos(\tau+T) & 0 \end{pmatrix}$$

$$-l - m\sin\tau - n\cos\tau = -l - m\sin(\tau+T) - n\cos(\tau+T)$$

$$m[\sin(\tau+T) - \sin\tau] = n[\cos\tau - \cos(\tau+T)]$$

$$\frac{m}{n}\cos(\tau + \frac{T}{2}) = \sin(\tau + \frac{T}{2})$$

$$\tan(\tau + \frac{T}{2}) = \frac{m}{n} = \tan(\beta + \tau) \qquad [say]$$

$$\tau + \frac{T}{2} = r\pi + \beta + \tau$$

$$T = 2r\pi + 2\beta$$

$$\therefore\ p_1(\tau) = \tan(r\pi + \beta),\ p_2(\tau) = -\tan(r\pi + \beta)$$

$$\sigma = \rho_1 = \frac{1}{T\ Log\mu} = \frac{1}{(2r\pi + 2\beta - 4\omega t).Log\mu}$$

$$\rho_2 = -\frac{1}{(2r\pi + 2\beta - 4\omega t).Log\mu}$$

Hence

$$x(t) = a\cos\omega t + \tan(r\pi + \beta)[c_3 \exp(\frac{t}{T.Log\mu}).\tan(r\pi + \beta) - c_4 \exp(-\frac{t}{T.Log\mu})] \quad (20)$$

where T = 2(rπ+β –2 ω t)

Now applying boundary conditions

$x(t_0) = x^* = 0$ at $t = t_0 = 0$

$x(t_1) = a\cos\omega t$ at $t_1 > 0,\ 0 < a < 1$,

$$0 = 0.5 + \tan(r\pi + \beta)(c_3 - c_4 c_3 - c_4 = 0.5\cot(r\pi + \beta) \quad (21)$$

$$when\ \ a = 0.5$$

$$Let\ \ t = t_1 > 0;\ say\ t_1 = 10$$

$$0 = \tan(r\pi + \beta)\{c_3 e^{\frac{20}{T\log\mu}} - c_4 e^{\frac{-20}{T\log\mu}}\}$$

$$\therefore c_3 = c_4 e^{\frac{-20}{T\log\mu}}$$

From (21),

$$c_4(1 - e^{\frac{-20}{T\log\mu}}) = 0.5\cot(r\pi + \beta)$$

$$c_4 = 0.5\left\{\frac{e^{\frac{20}{T\log\mu}}.\cot(r\pi + \beta)}{e^{\frac{20}{T\log\mu}} - 1}\right\}$$

Hence from (20), the solution becomes

$$x(t) = a\cos\omega t + 0.5\left\{\frac{e^{\frac{20}{T\log\mu}} - e^{\frac{20-t}{T\log\mu}}}{e^{\frac{20}{T\log\mu}} - 1}\right\}$$

Supposing φ = 1 , G(g,k) = .51852 , where g , k are the functions of (α , ε ,γ), also assuming β(α , ε ,γ) = 0.5 (constant), we prepare the following table.

Table

ω	δ	μ(α , ε ,γ),	Fig.
0.4	-530	0.12548	1
,,	0	0.62221	2
0.5	0	0.62221	3
0.6	-530	0.12548	4
,,	0	0.62221	5
0.7	-530	0.12548	6
,,	0	0.62221	7
0.8	-530	0.12548	8
,,	0	0.62221	9
0.9	-530	0.12548	10
,,	0	0.62221	11
0.7	0	0.62221	12

Conclusion

When δ < 0, supposing δ = – 530, μ = 0.12548 then for ω = 0.6 and 0.8, it has been got almost periodic response in fig. 4 & 8 and an unstable region 0 < t < 25 for ω = 0.4 and 0.7 in fig. 1 & 6. Also for δ = 0 and μ = 0.62221, unstable region still existed for ω = 0.4, 0.5, 0.6, 0.7 and 0.8 in fig. 2, 3, 5, 7 and 9. But when δ = –530, μ = 0.12548 and ω = 0.9, response has become irregular which is known as chaotic in fig. 10. Chaotic response also has been existed for ω = 0.9 and δ = 0, μ = 0.62221 in fig. 11 and an isolated (distinct) point has been found in fig.12 for δ = 0, μ = 0.62221 and ω = 0.7 for a wind range of x label. The sudden change in the shape of the trajectories from regular to unstable and then in irregular response for slight change of parameter values mean complicated behavior which we call chaotic.

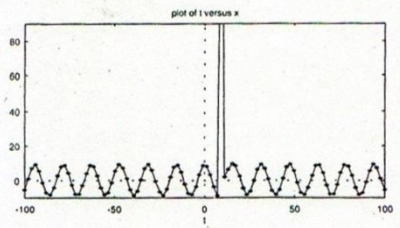

fig. 1 $\delta < 0$, $\mu = 0.12548$, $\omega = 0.4$

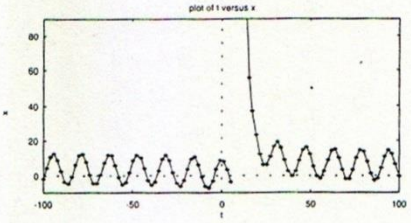

fig. 2 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.4$

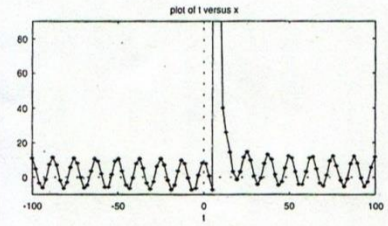

fig. 3 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.5$

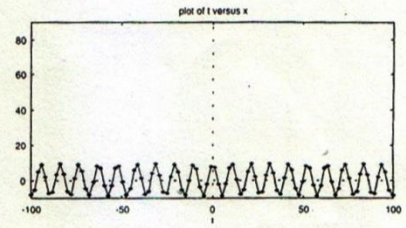

fig. 4 $\delta < 0$, $\mu = 0.12548$, $\omega = 0.6$

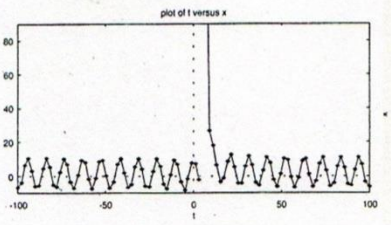

fig. 5 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.6$

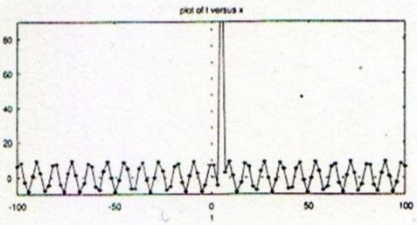

fig. 6 $\delta < 0$, $\mu = 0.12548$, $\omega = 0.7$

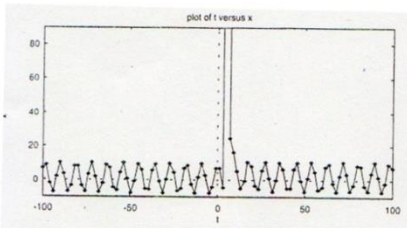

fig. 7 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.7$

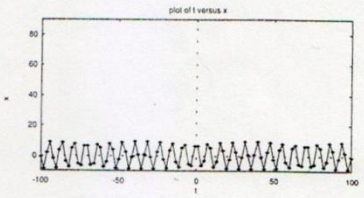

fig. 8 $\delta < 0$, $\mu = 0.12548$, $\omega = 0.8$

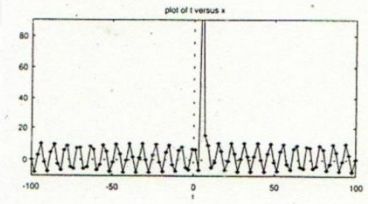

fig. 9 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.8$

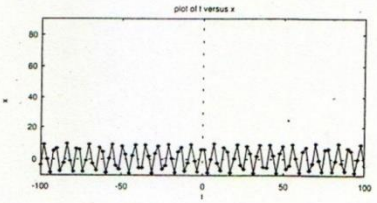

fig. 10 $\delta < 0$, $\mu = 0.12548$, $\omega = 0.9$

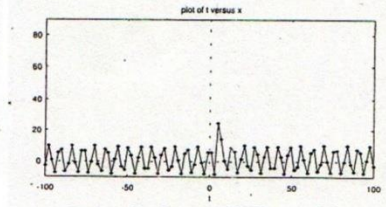

fig. 11 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.9$

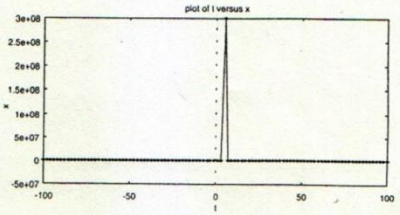

fig. 12 $\delta = 0$, $\mu = 0.62221$, $\omega = 0.7$

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Relationship Between Tropical Rainfall and Convective Available Potential Energy (CAPE)

Choudhury Md. Mukammel Wahid

Abstract

Monthly mean convective mass was calculated from 16 locations. Convective mass is the amount of mass in the boundary layer, which is able to take part in deep convection due to its positive convective available potential energy. It is found that high convective mass is associated with high rainfall rates while low convective mass is associated with low rainfall rates. The correlation coefficient between convective mass and sea surface temperature (SST) is higher in subtropical locations than in tropical locations. The seasonal variation of convective mass is similar to that of SST in subtropical locations while in the tropics the sites with the largest differences between maximum and minimum SST's follow the seasonal cycle of SST. It is found that convective mass is somewhat a better predictor of tropical rainfall than SST. This is valid particularly in the regions where a seasonal variation of SST is present and SST in that location crosses the 27.5^{0}C threshold SST for deep convection. Convective mass is useful for predicting long-term average rainfall in tropics.

Keywords: Convective mass, boundary layer, CAPE, SST,

Introduction

Atmospheric convection is the transfer of heat by the actual movement of heated air and moisture. Moist atmospheric convection and its influence on climate variability are very important to study (Emanuel 1994). It links small scale turbulent motions to global circulations through cloud formation and precipitation. Deep convection transports heat and moisture from the ocean via the atmospheric boundary layer. The latent heat released in the upper atmosphere by organized convective systems has a profound effect on global circulation.

It is very difficult to treat theoretically the initiation, formation, location and the timing of convection. (Holton et al. 2001). This is because many atmospheric processes are involved in influencing both the vertical thermodynamic structure of the atmosphere and the initiation of convection.

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The relationship between SST and deep convection has been studied in a variety of contexts by many researchers (Lau and Bony, 1995). One important aspect of SST and convection is that generally deep convection occurs more frequently as SST increases with a sharp increase in convection when SST exceeds 270C - 280C. (Waliser and Graham, 1993). Betts and Ridgway, 1989 suggest that the surface temperature approximates the value at which the vertical stability of the tropical troposphere is sufficiently reduced to allow the onset of large-scale moist convection.

Another important feature of SST and convection is the reduction of convection with SST higher than 300C. Waliser and Graham, (1993) suggest that very warm SST may only occur under conditions of diminished convections, which indicates that convection acts to limit SST's. Del Genio and Kovari (2002) found that storms occur frequently at SST 28 0C and with strong upward 500 mb mean vertical velocity.

Tompkins (2001) observed a maximum SST of 320C and found that the primary mechanism by which cold pools organize tropical deep convection in low wind shear conditions which is principally thermodynamic and not dynamic. Tompkins and Craig (1999) found convection is very insensitive to changing SST in the absence of larger scale flow.

Convective available potential energy (CAPE) is frequently regarded as an indicator of the potential intensity of deep convection (Donner and Phillips, 2003). It is the amount of energy an air parcel would have if lifted a certain distance vertically through the atmosphere. It is an indicator of atmospheric instability as it is related to the positive buoyancy of an air parcel. During daytime the bottom layer of atmosphere receives heat from the sun and moves upward as warmer air is lighter. This vertical motion develops clouds from convection which can lead to thunderstorms and precipitation. Generally CAPE is represented on a sounding diagram by the area enclosed between ambient temperature and the path of the air parcel.

Zawadzki et al (1981) found that CAPE is highly correlated with maximum convective rainfall rates on both hourly and daily time scales. The observed values of CAPE differ significantly between days with convective activity and days with no such activity Lopez et al. (2001). Monkam (2002) found that rainfall and CAPE are very well correlated around the Inter Tropical Convergence Zone (ITCZ). The ITCZ and orographic effects influence both CAPE and rainfall.

In this work monthly mean convective mass was calculated using data from 12 tropical weather stations (Figure 1). The purpose of this research is to explore the correlation between Convective Available Potential Energy and variation of rainfall at various tropical locations.

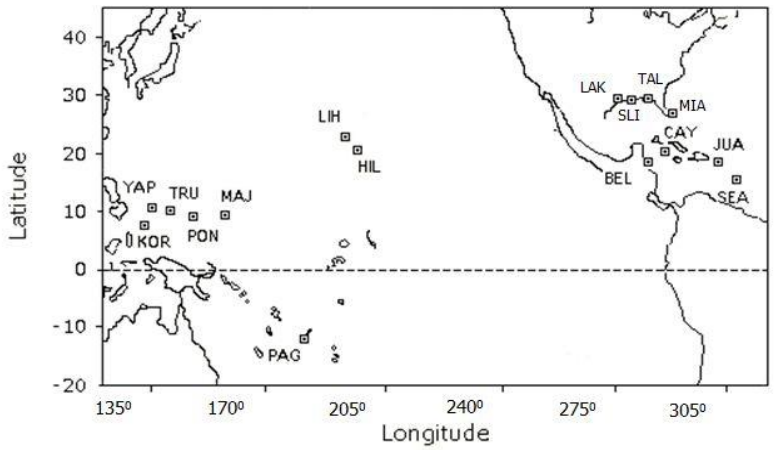

Figure 1: Location map of 16 tropical weather stations.

Data and Procedure

We used the Radiosonde data obtained from The Stratospheric Processes and Their Role in Climate (SPARC) data center. It consists of high-resolution 6-second data recorded by the National Weather Service (NWS) operational upper-air observing system. Upper-air observations are made twice daily at 00 UTC and 12 UTC, respectively. Monthly mean rainfall data were obtained for a grid of 2.5^0X2.5^0 from the Global Precipitation Climatology Project (GPCP) version 2 Combined Precipitation Data (Huffman et. al 1997). SST data were obtained from the global 1^0X1^0 monthly mean SSTs (Reynolds et al. 2002).

Calculation of CAPE and CIN

The potential energy available to a particular air parcel displaced from its current position to its level of neutral buoyancy is called Convective Available Potential Energy (CAPE).

$$\text{CAPE} = -R_d \int_{p_{LFC}}^{p_{LNB}} (T_{vp} - T_{vs})\, d\, ln(p)$$

where, T_{vs} – virtual temperature

T_{vp} – virtual temperature of the displaced air parcel

R_d – gas constant for dry air

LNB – Level of neutral buoyancy

LFC – Level of free convection

The virtual temperature is defined as,

$$T_v = T(1+0.608*w_v)$$

Where, T is the temperature and w_v is the water vapor mixing ratio.

LFC and LNB were calculated in terms of virtual temperature. CAPE and CIN were obtained by integrating the work done by the buoyancy force from LFC to LNB.

Calculation of Convective Mass

For calculating convective mass the atmospheric boundary layer between 1020 – 700 mb is divided into 32 pressure intervals each spanning 10 mb. For each level the fraction of air parcels with the sum CAPE and CIN positive is calculated. The fraction is then multiplied by the layer depth (10 mb) to obtain convective mass for that particular layer. All the contributions from individual layers are added to give convective mass in the boundary layer. (Folkins & Brown, 2003)

Results and Discussion

To understand the relationship between rainfall and convective mass we analyzed three years of radiosonde data. The monthly mean value of SST, rainfall, and convective mass show a good correlation among them. These results are delineated below.

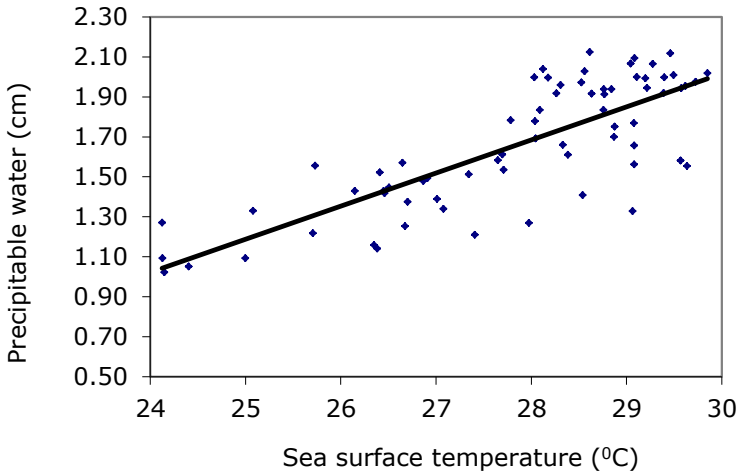

Figure 3. Boundary layer precipitable water and sea surface temperature.

Figure 3 shows the mean monthly precipitable water for boundary layer (1020 – 700 mb) against the corresponding SST values for 12 tropical locations. Precipitable water in the atmospheric boundary layer increases with SST very slowly (slow compared to increase in rainfall with SST). As SST increases from 24^0C to 30^0C precipitable water increase from about 1 cm to 2 cm. This is just a two fold increase, unlike rainfall which increases 4 to 5 times as SST increases from 24^0C to 30^0C.

Convective Mass and SST

Figure 4 shows the scatter plot of mean monthly convective mass versus SST in the study area. These values of convective mass were calculated for the parcels for which the sum of CAPE and CIN is positive. Since CAPE is much larger than CIN, it does not change much if we assume CAPE to be positive. Convective mass increases with SST rather slowly for SST up to 27^0C and then the maximum values of convective mass occur for SST 29^0C. No stations were found to have SST's higher than 30^0C.

As SST increases from 24^0C to 27.5^0C thermodynamics play an important role in initiating convection. (HOW) Above 27.5^0C dynamics come into play.

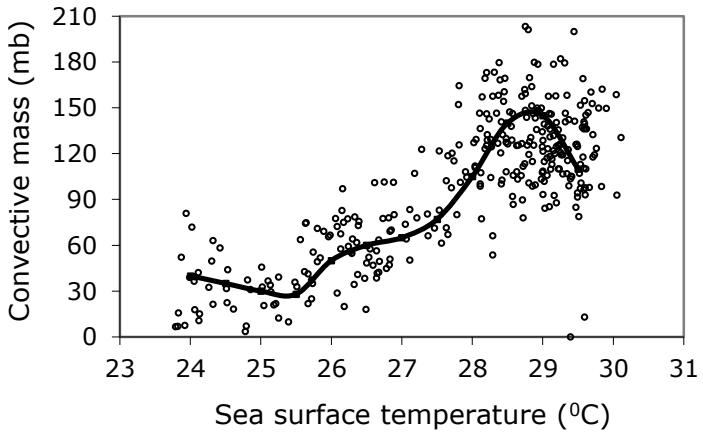

Fig. 4. Scatter plot of mean monthly convective mass and SST (from 1999-2001); solid line shows mean convective mass.

Model results support this idea; in the tropical atmosphere where the temperature profile is a moist adiabat, convection is found to be very insensitive to changing SST in the absence of large-scale flow (Tompkins and Craig, 1988). Convection is not found to decrease under the influence of strong large-scale ascending motion but increases monotonically with SST even at higher than 29.5^0C (Lau and Wu, 1996). Convection has an influence on large scale environment so that it contains itself. (Ramanathn and Collins, 1991).

Convective Mass and Rainfall

Figure 5 shows the dependence of rainfall on mean monthly convective mass at 12 tropical locations. It is evident from the graph that for almost all data points there is

a positive correlation between convective mass and rainfall. The value of the correlation coefficient was found as 0.52. If the monthly mean convective mass is

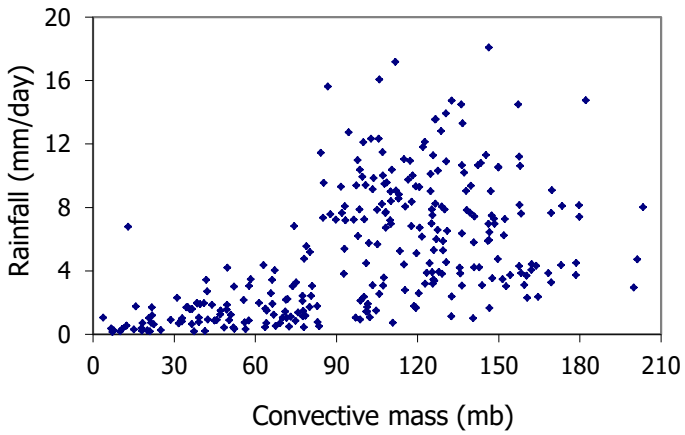

Fig. 5. Mean monthly rainfall versus convective mass for 12 data locations for the period 1999-2001.

less than 84 mb we get less rainfall and rainfall values do not exceed 7 mm/day. When convective mass exceeds 84 mb the rainfall rate is highly variable from 1 to 18 mm/day. This particular threshold (84 mb) to obtain large rainfall rates indicates that thermodynamics is a necessary but not sufficient condition for rainfall in tropics.

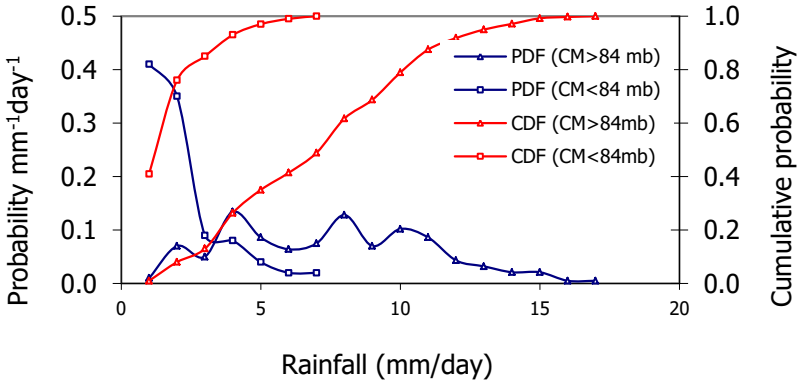

Fig. 6. Probability distribution function (PDF) and cumulative distribution function (CDF) of monthly mean rainfall were plotted for two different cases, i) when convective mass is less than 84 mb and ii) when convective mass is larger than 84 mb.

Figure 6 shows the probability distribution functions (pdf) and cumulative distribution functions (cdf) of rainfall for the two cases: i) when convective mass is less than 84 mb, ii) when the convective mass is larger than 84 mb. When the convective mass is less than 84 mb, the probability of obtaining rainfall amount less than 4 mm is 90%. When the convective mass is more than 84 mb, the probability of obtaining rainfall amount up to 14 mm is 90%. The CDF (when convective mass > 84 mb) is roughly linear for rainfall up to 12 mm, this means that there is almost equal probability of obtaining that amount of rainfall once convective mass is greater than 84 mb.

Correlation coefficients

For 12 locations correlation coefficients were calculated for the pairs, rainfall - convective mass and SST - rainfall separately. They are shown in table 1.

Table: 1. Correlation coefficients between monthly mean SST, Convective mass and rainfall in 12 tropical data sites.

	Name	Code	Location	Correlation coefficient.		
				CM- rain	CM-SST	SST-rain
1	Belize	BEL	17.53N, -88.30	+ 0.67	+0.84	+ 0.78
2	Cayman Island	CAY	19.30N, -81.37	+ 0.59	+0.90	+ 0.50
3	Hilo	HIL	19.72N, -155.07	+ 0.13	+0.52	+ 0.03
4	San Juan	JUA	18.43N, -66.00	+ 0.53	+0.92	+ 0.60
5	Koror	KOR	07.33N, 134.48	+ 0.15	-0.05	− 0.22
6	Lihue	LIH	21.98N, -159.35	+ 0.38	+0.83	− 0.16
7	Majuro	MAJ	07.08N, 171.38	+ 0.18	+0.84	+ 0.35
8	Pago Pago	PAG	14.33S, -170.72	+ 0.46	+0.38	+ 0.38
9	Ponape Island	PON	06.97N, 158.22	− 0.21	-0.26	− 0.03
10	Seawell	SEA	13.07N, -59.50	+ 0.65	+0.94	+ 0.63
11	Truk	TRU	07.47N, 151.85	+ 0.12	-0.28	− 0.35
12	Yap Island	YAP	09.48N, 138.08	+ 0.20	+0.86	+ 0.20

From Table 1 it is evident that there is a wide range of correlation coefficients (convective mass-rainfall) from 0.67 at Belize to only 0.12 at TRU. There is a very weak correlation between rainfall and convective mass in Ponape Island where the value of 'r' is –0.21. From the values of SST it can be seen that if SST is always higher or always lower than the 27.5^0C threshold, a lower correlation between rainfall and convective mass is expected. According to the SST values the data sites can be divided into different categories with SST's high, below or crossing the threshold SST. The three regions show three kinds of relationship between rainfall - SST and convective mass – SST.

Table 2.: Data sites grouped according to the SST value of that site.

Co-relation	Location	Comment
High	BEL, CAY, JUA and SEA	SST crosses 27.5^0C threshold
Medium	HIL and LIH.	SST always below 27.5^0C
Low	KOR, MAJ, PAG, PON, TRU & YAP.	SST always above 27.5^0C.

Table 2. shows three groups of location based on their annual variation in SST.
Figure 7. show the plots for the mean seasonal variation of convective mass and sea surface temperature for first group of locations which have high correlation coefficient between convective mass and rainfall.

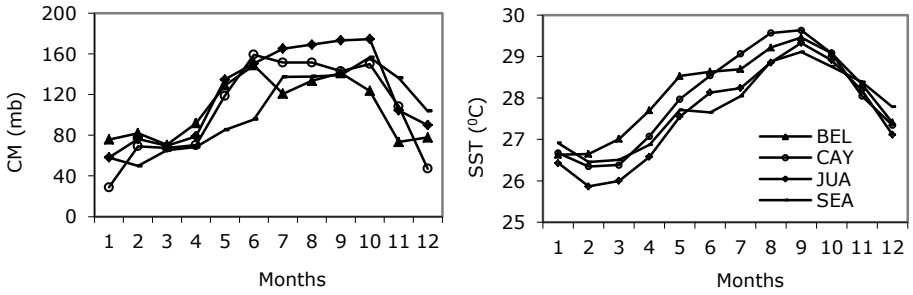

Fig.7. Annual variation of mean convective mass (mb) and SST (^{0}C) for group 1

Group #1 consists of Belize, Cayman Island, San Juan and Seawell (BEL, CAY, JUA and SEA). Figure 7 shows that these sites have lower convective mass from December through April and higher convective mass from May to October. This is due to hot summer and cooler winter in northern hemisphere. The seasonal variations of convective mass at these locations are very similar to that of SST. SST

increases during the summer and decreases during the winter. Seasonal variation of SST together with atmospheric temperature drives the seasonal variation of convective mass in these locations. SST in that location crosses the 27.5^0C threshold for deep convection, which leads to a good correlation among convective mass, rainfall and SST.

Figure 8 shows the seasonal variation of convective mass and SST at Lihue (LIH), Hilo (HIL). These two locations were grouped into group #2 (Table 2). The common feature of the seasonal variation of SST's in these sites is that SST does not change very much from month to month.

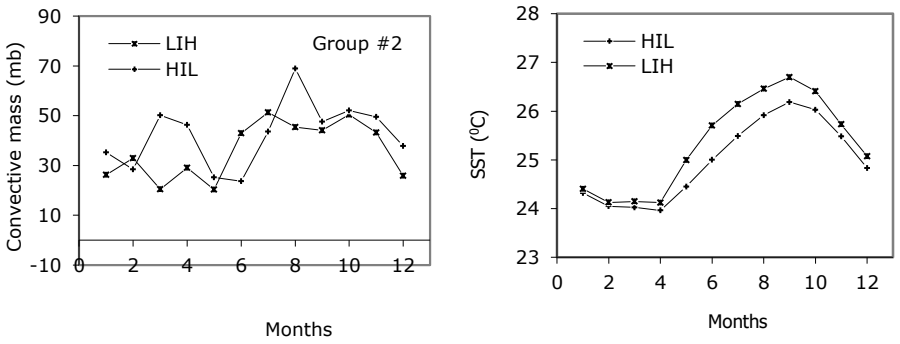

Fig.8. Annual variation of mean convective mass (mb) and SST (^{0}C) for group 2.

In Hilo and Lihue SST does not cross the 27.5^0C threshold. At Lihue (LIH), minimum convective mass occurs in March and May, while the minimum SST occurs in April. Maximum convective mass occurs at LIH in September and October, which is the same as SST. At Pago Pago maximum SST occurs in the month of April, while the minimum SST occurs in August and September, as expected in the southern hemisphere. The seasonal variation of convective mass at this location shows two maxima, one in May the other in November. There is a decrease in convective mass from November to July and then it increases until October. Convective mass follows the variation in SST at Pago Pago.

Figure 9. shows that there is not much SST variation in group # 3 sites. Convective mass is always high because SST is always above the 27.5^0C threshold for deep convection. There appears a monthly variation in convective mass at Koror, Truk and Yap. At these three locations, convective mass increases and decreases after every two months.

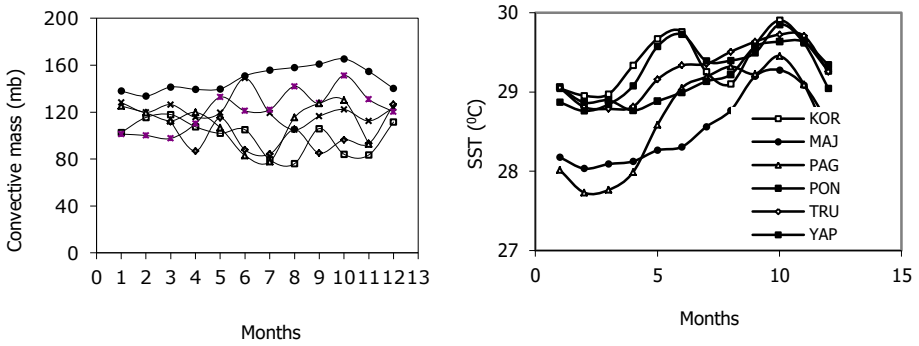

Fig. 9. Mean monthly Convective Mass-SST plot for group#3.

Figure 10 shows that in all 12 locations, the correlation between convective mass and rainfall is positive except one location (Ponape), while the correlation between SST and rainfall is positive for 8 locations and is negative for the rest. A strong correlation exists between these two variables (convective mass and rainfall) at Belize (BEL), Cayman (CAY), San Juan (JUA), Pago Pago (PAG) and Seawell (SEA), while this relationship is weaker at Koror (KOR), Majuro (MAJ) and Truk (TRU)

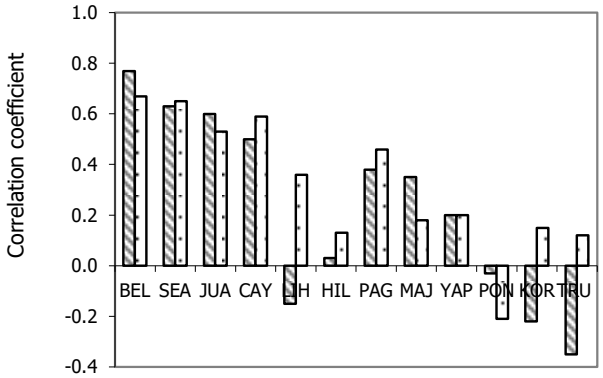

Fig.10. Correlation coefficients ('r') between rainfall—SST and convective mass—SST with the difference between monthly maximum and minimum SST.

Figure 10. shows the correlation coefficients ('r') between rainfall—SST and convective mass—SST and the difference between the monthly mean maximum and minimum sea surface temperature at a particular location. The correlation between these two variables increases as the difference between maximum and minimum SST increases. When the difference is about 2.5^0C to 3.5^0C between summer time

SST and wintertime SST, the correlation is stronger; while for lower SST differences the correlation is much weaker.

Generally the larger SST, the higher the value of the correlation coefficient. Both sites with SST's always below 27.5^0C are located in Hawaii. Most of the sites with SST's always above the 27.5^0C threshold SST are located in the Western Pacific Warm Pool

Conclusion

In this work the idea of convective mass is used to study the relationship between convection and rainfall in tropical areas. The seasonal and spatial variation of convective mass and the correlation between convective mass, rainfall and sea surface temperature are also studied.

Rainfall and sea surface temperature

From the analysis it is found that rainfall rises sharply as SST increases from 28^0C to 29^0C, reaching a maximum value for SSTs of 29^0C to 29.5^0C and then declines (Figure 3.1) It can be shown that the increase in atmospheric boundary layer precipitable water with SST is slow compared to the increase which does not support a 4 to 5 times increase in rainfall as SST increases from 24^0C to 30^0C. The increase in rainfall with SST therefore cannot be explained from the availability of boundary layer moisture only.

Convective mass, rainfall and SST

Monthly mean convective mass and rainfall are highly correlated in the tropics. The value of the correlation coefficient between convective mass and rainfall was 0.52 for the study period 1999 to 2001. The variation of convective mass with SST is similar to that of rainfall with SST. There is a positive correlation between convective mass and rainfall at the 12 tropical sites. High convective mass is associated with high rainfall while low convective mass is associated with little rainfall.

A strong correlation exists between convective mass and rainfall at Belize, Cayman, San Juan, Pago Pago and Seawell. This correlation is weaker at Koror, Lihue and Truk. The correlations between Rainfall - SST and Convective mass - SST increase as the difference between maximum and minimum SST increases. The correlation is stronger when there is a large seasonal variation in SST and where SST's crosses the 27.5^0C threshold for deep convection. The correlation is weaker for small seasonal variations in SST.

It is found that the correlation between rainfall - SST and convective mass – SST at any station improves if the difference between maximum and minimum SST increases (Figure 10.). The relationship is roughly linear. When the difference is

about 2.5^0C to 3.5^0C between summer SST and winter SST, the correlation is stronger; while for smaller SST differences although the correlation exists, it is weak. A big difference between summer and winter SST is expected if the SST's crosses 27.5^0C. Generally, larger seasonal variations in SST give rise to higher correlation coefficients.

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Consumers' Attitude Towards Packaging and Labeling of Products: A Study on Sylhet

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Abstract

Packaging and labeling play a vital role in consumers' purchase decision. The objective of this study is to identify the consumers' attitude towards packaging and labeling and their perception about various components of packaging and labeling. This is a primary research, and data have been collected through questionnaire. For analysis purpose SPSS software has been used. 200 respondents were selected based on the convenience as well as judgment sampling techniques. It was found in the study that most of the consumers pay attention to various components (colorful, eye-catching, informative, user-friendly, eco-friendly, recyclable, price etc.) of packages and labels in making their purchase decision.

Key words: Purchase decision, Consumer, Packaging, Labeling, and Attitude

Introduction

In recent competitive marketing environment, packaging and labeling are used as marketing tools. Packaging may attract customers, facilitate easy handling, reduce cost, and protect environment. A label may provide adequate product information to the customers which influence their purchase decision. The label and package also serve as a secondary communication medium. When a product moves from one place to another, its package and label diffuse brand and product information. This study examines the consumers' attitude towards packaging and labeling of product.

The package and label may be termed as the face of any product because a customer initially perceives the package or label before he purchases or consumes the product. Kotler and Keller (2006) defined packaging as activities of designing and producing the container for a product. Package might include three levels of material: primary (bottle for a cosmetic) secondary (carton) and shipping package product. The label may be a simple tag attached to the product or an elaborately designed graphics that is part of the package (Kotler and Keller, 2006).

Packaging plays multi-dimensional roles. It provides information about the product and company, a method to communicate with consumers and protects the quality of a product (Butkeviciene, *et al*., 2008).

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Packaging is a part of a product whereas labeling is the part of packaging, which actually provides information about the ingredients of the product, product quality, taste and color, dates of manufacturing and expiry, price, sales tax, customer care, contact number and company profile. Information about the products stimulates the consumers to buy products. Therefore, labeling is the main source that provides information at the nick time of purchase. Sometimes consumers purchase products unintentionally. Unintentional purchases are called impulse buying. Labeling motivates and stimulates the consumers to make impulse buying (Sharma, H.K., 2012).

Packaging and labeling are the first thing that customers observe before making their purchase decision. That is why taking packaging and labeling decision is very crucial for any company. Many marketing scholars describe packaging as the fifth "P" of marketing mix. Packaging is now generally regarded as an indispensable part of our modern life style and the way business is organized and a physical object, typically a product, is offered for sale.

Literature review

A large number of research studies have been conducted for measuring consumers' attitude towards packaging and labeling. A few important studies are briefly reviewed below:

Packaging performs multi-dimensional functions. It offers information about the products and organization, a procedure to communicate with consumers and protect the quality of products (Silayoi & Speece, 2007).

According to Rita Kuvykaite (2009), packaging and labeling promote self-service and change consumers' lifestyle with ultimate effect on consumer choice. For an increase in impulse buying, labeling acts as a communicating medium to the customers.

Hari Govind and Deepak Jain (2012) state that packaging has a significant position in marketing communications, particularly from the point of sales, and could be treated as one of the most important persuading factors in consumers' purchase decision.

Staniewska et. al. (2008) found that consumers focus mostly on the product's shelf-life/ minimum durability period, the producer's trademark which is often identified with the specific brand as well as information on the product's ingredients and nutritive value. The consumers' tendency to make impulse purchases is confirmed by an observation that the buyers' attention is frequently drawn to packaging design that is often identified with product quality.

Ampuero and Vila (2006), investigated the need to understand consumer's perceptions in order to correctly design product packing and to achieve the desired position in the minds of consumers. The results showed that the consumers exhibited harmonious perceptions towards product-packaging strategies.

Abdalkrim and AL-Hrezat (2013) studied the consumers' perception of product quality at the point of purchase. The study comprises some key independent variables viz; protection of products and consumers, promotion of products, facilitation of storage, use, and convenience of products, facilitation of recycling and reducing environmental damage. The dependent variable is consumer's perception of

product quality at the point of purchase. It was found that all the independent variables had a significant effect on consumers' perception of product quality at the point of purchase.

Ahmed, Parmar and Amin (2014) examined the role of packaging on consumer's buying behavior in their study. It has been observed in the study that the packaging is the most important factor. It is further concluded that the packaging elements like its color, packaging material, design of wrapper and innovation are more important factors when consumers make any buying decision. Finally, it has also been concluded that the packaging is one of the most important and powerful factors which influence consumer's purchase decision.

Saeed et. al. (2013) explored the impact of labeling on consumer buying behavior. The results have shown that consumers purchase more quantity of the products after looking at a well-labeled product. Therefore, labeling influences the consumer buying behavior. But there are some other factors that also influence the consumer buying behavior.

Ezekiel, Anyadighibe and Samuel (2014) studied the relationship between package color, labeling, and quality of packaging material and consumer choice of cosmetic products. Their results from the test of hypotheses revealed that there is a significant relationship between the package color and consumer choice of cosmetic products. There is a significant relationship between the labeling and consumer choice of cosmetic products. There is also a significant relationship between the quality of the package materials and the consumer choice of cosmetic products.

Objectives of the Study

The main objective of the study is to explore the attitudes of consumers towards packaging and labeling. More specifically, the objectives are:

- To find out the consumers' attitude towards the packaging and labeling of product.
- To indentify the consumers' perception of eco-friendly packaging and labeling.
- To explore the variation in attitude formation about the packaging and labeling of product based on respondents' gender.
- To determine the consumers' preference level of high quality packaging.

Research Hypotheses

The following hypotheses were stated in a null form:

$H_0$1: There is no influence of gender in paying first attention to eye catching and colorful packaging.

$H_0$2: There is no influence of gender in preference of comfortable packaging and container.

$H_0$3: There is no influence of gender in purchasing of product whose packages or containers are re-usable.

$H_0$4: There is no influence of gender in consumers' avoidance of environment unfriendly packaging, labeling and containers.

$H_0$5: There is no influence of gender in consumers' feeling of risk in purchasing products with sealed package or container.

Methodology of the study

The study adopted exploratory and survey research designs**.** The data were collected from different areas of Sylhet from January to March 2014. The sample size was 200 and sampling method adopted was a combination of judgmental and simple random sampling techniques. The instrument used for data collection was a questionnaire developed to assess the attitude of consumers towards packaging and labeling of products. A five point scale of Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) Strongly Disagree (1) were used to measure the responses of the respondents. Chi-square test and descriptive statistics were used for data analysis.

The reliability was tested using Cronbach's Alpha. The Cronbach's Alpha coefficient of 0.763 indicated a high reliability of the instrument.

Data analysis and findings

Table-1: Demographic information of the respondents

			Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Valid	Male	132	66.0	66.0	66.0
		Female	68	34.0	34.0	100.0
		Total	200	100.0	100.0	
Age of respondents	Valid	15- 20 years	16	8.0	8.0	8.0
		21-25 years	52	26.0	26.0	34.0
		26-30 years	64	32.0	32.0	66.0
		30-35 years	36	18.0	18.0	84.0
		36-40 years	20	10.0	10.0	94.0
		Above 40 years	12	6.0	6.0	100.0
		Total	200	100.0	100.0	
Monthly family income	Valid	Less than TK. 10,000	12	6.0	6.0	6.0
		Above TK. 10,000-20,000	60	30.0	30.0	36.0
		Above TK. 20,000- 30,000	76	38.0	38.0	74.0
		Above TK. 30,000-40,000	32	16.0	16.0	90.0
		Above TK. 40,000-50,000	16	8.0	8.0	98.0
		Above TK. 50,000	4	2.0	2.0	100.0
		Total	200	100.0	100.0	
Marital status of the respondents	Valid	Single	84	42.0	42.0	42.0
		Married	116	58.0	58.0	100.0
		Total	200	100.0	100.0	
Education level of the respondents	Valid	SSC	52	26.0	28.3	28.3
		HSC	40	20.0	21.7	50.0
		Honors	44	22.0	23.9	73.9
		Masters	16	8.0	8.7	82.6
		Others	32	16.0	17.4	100.0
		Total	184	92.0	100.0	
	Missing	System	16	8.0		
		Total	200	100.0		
Occupation of the respondents	Valid	Business	72	36.0	36.0	36.0
		Service	24	12.0	12.0	48.0
		Student	52	26.0	26.0	74.0
		House wife	36	18.0	18.0	92.0
		Others	16	8.0	8.0	100
		Total	200	100.0	100.0	

Table-2: Consumers' attitudes toward eye-catching and colorful packages

		When I go for shopping, I pay first attention to those products that have eye-catching and colorful packages.				
			Disagree	Neither agree nor disagree	Agree	Strongly agree	Total
Gender	Male	Count	8	16	64	44	132
		% Within gender	6.1%	12.1%	48.5%	33.3%	100.0%
	Female	Count	12	16	28	12	68
		% Within gender	17.6%	23.5%	41.2%	17.6%	100.0%
Total		Count	20	32	92	56	200
		% Within gender	10.0%	16.0%	46.0%	28.0%	100.0%

Respondents were asked whether they paid their first attention to the products that have colorful and eye-catching packaging. From table 2 we can find that 28% of the respondents strongly agreed with this statement and 46% were agreed. Among the male respondents, 33.3% strongly agreed that they paid first attention to products with eye catching and colorful packaging whereas only 17.6% of female espondents were strongly agreed. 17.6% of the female respondents were disagreed with the statement whereas only 6.1% of the male disagreed. So, It can be concluded that male consumers pay more attention to colorful and eye catching packaging than female customers.

Table-3: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	14.141	3	.003
N of Valid Cases	200		

Table 3, shows the Chi-square test result, where the P value is .003, which is significant at 5% level of significance. So we can reject the null hypothesis **($H_0$1)** and can conclude that gender has an influence in paying attention to eye catching and colorful packaging.

Table-4: Consumers' attitude toward comfortable packaging or container.

		I select those products that have comfortable packaging or container.				
			Disagree	**Neither agree nor disagree**	**Agree**	**Strongly agree**	**Total**
Gender	Male	Count	12	20	64	36	132
		% Within gender	9.1%	15.2%	48.5%	27.3%	100%
	Female	Count	4	12	40	12	68
		% Within gender	5.9%	17.6%	58.8%	17.6%	100%
Total		Count	16	32	104	48	200
		% Within gender	8.0%	16.0%	52.0%	24.0%	100%

Table 4 shows consumers' preference of comfortable packaging and containers. It was found that 52% of the respondents agreed and 24% were strongly agreed with the statement that they prefer products which have comfortable packaging and containers. 75.8% of the male respondents showed positive attitudes toward comfortable packaging and containers wheras 76.1% of the female respondent's positive approach. It can be stated up that preference of comfortable package and container does not vary much with gender.

Table-5: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.407	3	.333
N of Valid Cases	200		

Table 5, shows the Chi square result. The p value was found .333, which is statistically insignificant at 5% level of significance. So the null hypothesis **($H_0$2)** is accepted, i.e. consumers' preference of comfortable packaging and containers do not depend on their gender.

Table-6: Consumers' attitudes toward re-usable or re-cyclable

		If the package or container of any product is reusable or recyclable, I prefer those products.					
			Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**	**Total**
Gender	Male	Count	4	12	8	68	40	132
		% Within gender	3.0%	9.1%	6.1%	51.5%	30.3%	100%
	Female	Count	0	8	12	36	12	68
		% Within gender	.0%	11.8%	17.6%	52.9%	17.6%	100%
Total		Count	4	20	20	104	52	200
		% Within gender	2.0%	10.0%	10.0%	52.0%	26.0%	100%

There are some products (such as, cold drinks, mineral water etc.) whose packages or container may be reused. The researchers tried to investigate whether there is any influence of reusable product package or container in consumers' decision making. It was found that only 12% respondents showed negative attitude. Reusable packages or containers have a positive influence on customer buying decisions.

Table-7: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.189	4	.025
N of Valid Cases	200		

Table 7 shows the Chi square result. The p value was found .025, which is statistically significant at 5% level of significance. So the researchers failed to accept the null hypothesis **($H_0$3)**. It can be concluded that gender is a dominating factor in customers' purchase decision of product whose packages and containers are reusable.

Table-8: Consumers' attitudes toward environment friendly packaging, labeling and containers

		I avoid those products that are not using environment friendly packaging, labeling and containers.					
		Strongly disagree	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**	**Total**
Gender Male	Count	8	28	40	20	36	132
	% Within gender	6.1%	21.2%	30.3%	15.2%	27.3%	100%
Female	Count	8	16	20	16	8	68
	% Within gender	11.8%	23.5%	29.4%	23.5%	11.8%	100%
Total	Count	16	44	60	36	44	200
	% Within gender	8.0%	22.0%	30.0%	18%	22.0%	100%

Table shows the customers' attitude toward environment-friendly packaging, labeling and containers. About 40% to the total respondents have the same opinion that they will avoid environment unfriendly packaging, labeling and containers and 30% respondents took neutral position. Among the 132 male respondents, 42.5% stated that they would not purchase products whose packages, containers or labels are harmful for the environment where as the percentage of female respondents in such situation is 35.3%.

Table-9: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.603	4	.072
N of Valid Cases	200		

Table 9 shows the Chi square result. The p value was found .072, which is statistically not significant at 5% level of significance. So the null hypothesis **($H_0$4)** is not rejected. That means the age of the customers has no influence on their perception of environment friendly packages, labels and containers.

Table-10: Consumers' attitude toward sealed packages or containers

		I feel risk in purchasing a product, the package or container of which is sealed.				
		Disagree	**Neither agree nor disagree**	**Agree**	**Strongly agree**	**Total**
Gender Male	Count	4	28	60	40	132
	% Within gender	3.0%	21.2%	45.5%	30.3%	100%
Female	Count	4	8	36	20	68
	% Within gender	5.9%	11.8%	52.9%	29.4%	100%
Total	Count	8	36	96	60	200
	% Within gender	4.0%	18.0%	48.0%	30.%	100%

There are some products whose package or container is sealed. So the customers cannot make a close assessment of the product attributes. The respondents were asked whether they felt risky in purchasing sealed products. Table -10 shows that 48% agreed and 30% strongly agreed with the statement. 18% respondents took neutral positions. Only 4% respondents disagreed with the statement. So it can be concluded that customers feel risk in buying sealed products.

Table-11: Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.674(a)	3	.299
N of Valid Cases	200		

The p value of chi square test was found .299 in table-11 which is statistically insignificant at 5% level of significance. So the null hypothesis **($H_0$5)** is accepted. There is no influence of gender in customers' feeling of risk in purchasing products with sealed package or container.

Table-12: High-quality packaging and informative labeling are essential part of any quality product.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	2.0	2.0	2.0
	Disagree	12	6.0	6.0	8.0
	Neither agree nor disagree	28	14.0	14.0	22.0
	Agree	84	42.0	42.0	64.0
	Strongly agree	72	36.0	36.0	100.0
	Total	200	100.0	100.0	

Respondents were asked about their perception of high quality packaging and informative labeling. Whether these are essential part of any product or not? Respondents were asked to give their answer in a five point Likert Scale where value 1 assigned for strongly disagree, 2 for disagree, 3 for neither agree nor disagree, 4 for agree and value 5 for strongly agree. Table 12, shows that 42% of the respondents agreed and 36% strongly agreed with this statement. Only 2% strongly disagreed and 6% disagreed with this statement. So it can be concluded that majority of the customers believe that high quality packaging and informative labeling are essential part of any quality product.

Table-13: High quality packaging may increase the price of the product

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	4	2.0	2.0	2.0
	Disagree	8	4.0	4.0	6.0
	Neither agree nor disagree	12	6.0	6.0	12.0
	Agree	72	36.0	36.0	48.0
	Strongly agree	104	52.0	52.0	100.0
	Total	200	100.0	100.0	

This study also tries to investigate into the customer's perception about the impact of high quality package on the price of the products. It was found that 52% of the respondents strongly agreed and 36% agreed with the statement that high quality package or container increases the products' price, whereas only 4% disagreed and 2% strongly disagreed.

Conclusion and scope for future research

There are many factors that influence consumers' attitude formation towards any product and their purchase decision. Packaging and labeling are two of them. These two elements create the first impression aboutthe products to the customers. This study investigates into the consumers' attitude towards various elements of packaging and labeling, such as, attractive color and design, informative descriptions, user friendliness, eco-friendliness, recyclability, cost worthiness and so on. It was found that these factors of packaging and labeling have massive influence on consumers' attitude formation about any product. For future research the results of this study may be used. In our study, we only analyze which factors influence/attract most for a products packaging and labeling. Further research may be conducted on eco-friendly packaging. Research can also be carried on issues like information about products on packages and labels. The consumers have a right to be informed about a product, especially the ingredients used in a particular product. Future research can also be conducted in costs during products; packaging because about 52% respondents are concerned about costly or highly decorative packaging. According to the consumers, it influences greatly products; price.

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Quality of Work Life and Life Balance of Tea Workers in Bangladesh

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Abstract

Tea industry is recognized as a labor-intensive organization; so the quality of work life of tea workers has significant impact on the smooth operations of tea industry. The main purpose of this study is to explore the tea workers' prevailing quality of work life depending on their demographic and work related variables and come up with some issues that make their life balance at work place. The researchers have used a highly structured questionnaire to collect primary data. The questionnaire has two parts, namely, demographic information, such as, age, education, gender as well as quality of work life-related factors, such as, wage, rations, medical facilities, accommodation, education facilities and job security etc. Data analysis and interpretation of results have done by demographic and descriptive approach, ANOVA, Turkey's Post Hoc ANOVA, Test of Homogeneity of variance and multiple regression analysis model. The study shows that tea plantation workers are not happy at all about their work life but they make a life balance by availing themselves of some fringe benefits like life-long job, flexible work schedule, autonomy in decision, free accommodation and so on.

Key Words: Tea Workers; Quality of Work Life (QWL); Life Balance; Life Satisfaction; Job Security.

Introduction

Quality of work life (QWL) refers to the favorable or unfavorable feelings of employees about the total job environments. QWL program is the way through which organizations confirm their responsibilities to the employees by enriching jobs and creating favorable working conditions that bring well-being for both organization's people and its economic health. Successful organizations provide and support different facilities to their people for better quality of their working life which make a balance between work and social/family life. QWL program is very essential for labor-intensive organizations where production system largely depends on physical labor. The tea industry in Bangladesh is still labor-based.

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Before explaining QWL of tea workers in Bangladesh, the researchers consider it appropriate to say something on tea industry and tea workers of Bangladesh because the origin and development of Tea industry and Tea workers in Bangladesh are totally different from that of other labor-intensive industries.

Bangladesh is ranked 10th among the ten largest tea-producing and exporting countries in the world. In the year 2000, the country's tea production was 1.80% of the 2,939.91 million kg produced world-wide (Bangladesh Tea Board, 2009). At present, the total number of tea estates is 163 and the total number of tea factories is 114. The total garden area is 115,629.76 hectares (www.teaboard.gov.bd). Most of the tea estates in Bangladesh are located in the north-eastern region of Bangladesh, namely, Maulvibazar, Habiganj, Sylhet and Brahmanbaria districts.

There are a few tea estates in Panchagarh, Nilphamari and Chittagong districts.

The British government in 1854 compelled the tea workers to migrate from different states of India (Uttar Pradesh, Bihar and Orissa) to Bangladesh. The deprived poor people who first arrived signed a four-year working contract that eventually obliged them to remain in the tea gardens for generation to generation. That was the beginning of hard labor and erosion of cultural identity that never came to an end. Due to their illiteracy and ignorance, they did not know what the deed they had signed contained. This unawareness and ignorance led them to a life full of sufferings for generations (Bangladesh Tea Board Bulletin, 2009). The workers get medical service from the concerned tea garden authorities. Moreover, the garden authorities provide educational and recreational facilities to the workers and their children. A century later, they still find themselves as poor, illiterate and separated from general civil society. In Tea gardens, each worker's family is a working unit. All these families live together. They all belong to one particular group, their weddings take place within their own community and they seldom shift from one tea garden to another. Everyone in a family works in the concerned tea garden and takes part in the family's earning. Besides remuneration, they are also supplied with daily necessaries at reduced prices. The workers get medical service from the concerned tea garden authorities.

Their poor housing conditions, low wages, long working hours, social discrimination, and existing restriction on free movement deprive them of many basic human needs and rights (Maslow, 1943) that every human being must have for personal and societal progress. These conditions make sure that the successors of tea workers can do nothing else but become tea workers. Deprivation, exploitation and isolation make the tea workers' lives inhumane.

The researchers could know about the sad condition of workers in tea gardens through various reports and direct observation. The workers are even afraid of telling people about their sorrows. It seems that the garden-owners are neither eager to upgrade the living standard of the workers nor interested to educate the workers because if the workers become educated, they may overcome their inherited mentality regarding their sub-human circumstances in the tea gardens which may have adverse effects on tea production as supposed by them.

Review of Literature

Quality of Work Life (QWL) is such a concept that not only encompasses one area of work life like job satisfaction but also incorporates a hierarchy of perception, such as, life satisfaction factors and general feelings of well-being of employees (Danna and Griffin, 1999). More recently, work related stress and the relationship between work and non-work life domains have also been identified as factors that conceptually are included in QWL (Loscocco and Roschelle, 1991). At the same time, QWL is conceptually similar to well-being of employees but differ from job satisfaction which solely represents the workplace domain (Lawler, 1982). QWL is the environment at work place provided to the people in the job. QWL programs enforce employers of the organization to provide congenial working environment where organization's people can perform excellent jobs along with avoiding job dissatisfaction and meeting organizations' economic health needs. It is also viewed as an approach to motivating people by satisfying not only their economic needs but also their socio- psychological wants. At earlier times, quality of work-life indicated only job enrichment but, at present, it means the level of employee happiness and satisfaction with one's career in the organization along with improving work system. Even though, the outcome of QWL is similar to all organizations, the components of QWL might vary between organization to organization, group to group and individual to individual (Taylor 1979, Bearfield 2003, Ellis & Pompli 2002, Subramaniam & Saravanan 2010). Hackman and Oldham (1976) considered some psychological growth need factors like skill variety, task identity, task significance, autonomy and feedback as relevant to the consideration of quality of work life program. They suggested that if these needs have to be properly addressed, the employees are to experience high quality of work life. Taylor (1979) pragmatically identified the essential components of quality of working life as basic extrinsic job factors of wages, hours and working conditions and the intrinsic job notions of the nature of the work itself. Besides these intrinsic and extrinsic factors (Herzberg et al., 1959), Taylor added a few additional factors for quality of work life, such as, individual power, employee participation in the management, fairness and equity, social support, use of one's present skills, self-development, social relevance of the work or product and so on. Warr et al. (1979) also supported Taylor QWL components but added life satisfaction, happiness and self-related anxiety for QWL. In their research works, they found moderate correlation between total job satisfaction and total life satisfaction and happiness. Mirvis and Lawler (1984) suggested that safe work environment, equitable and satisfactory wages, equal employment opportunities and opportunities for career advancement are also responsible for QWL whereas Baba and Jamal (1991) described totally different aspects of quality of working life indicating job satisfaction, job involvement, work role ambiguity, work role conflict, work role overload, job stress, organizational commitment and turn-over intentions.

A valid measure of quality of working life can be used as a basis for effective interventions of getting excellent work (Edwards et al., 2009). To retain good talented people in the organization, it is important to maintain a high quality of work life in the organization. The scenario of QWL of tea plantation workers in Bangladesh is very disgraceful.

Gain (2009) showed that the Bangladeshi tea workers are deprived in all respects as compared to Indian tea workers. He gave more emphasis on wages and found that Bangladeshi tea workers got only BDT 48 per day whereas Indian tea workers earned RS 53.90. A famous photo journalist named Salman Saeed (2009) of Bangladesh Tea Board found in his survey that Tea workers mostly depend solely on the companies for their medical treatment, housing and schooling etc. They do not have any choice about their life and living facilities. Francis Rolt (1991), a British journalist, mentioned that tea gardens are managed like an extreme hierarchy and the managers live like gods -distant, unapproachable, and incomprehensible. Some even begin to believe that they are gods in the sense that they can do exactly what they like. Furthermore, a British writer named Dan Jones in 1986, depicted the actual scenario of tea workers' life by describing that the tea garden managers have anything upto a dozen laborers as their personal and domestic servants. They are even made to tie the managers' shoe laces to remind them that they are under managerial control and that they are bound to do whatever they are asked (Gain, 2009).

From the above review of literature, it is apparent that quality of work life is attributable to a number of factors and tea workers live in very terrible conditions. So the researchers think that it is a matter of further research to ascertain to what degree the tea plantation workers are enjoying quality of work life in their working place at present and how they balance their life with the prevailing quality of work life situation in the tea gardens.

Objectives of Study

The main purpose of this study is to explore the prevailing scenario of the quality work life of tea workers and identify the practices that help them to make work life balance in the tea garden. The specific objectives of this study are:

1. To know the present status of QWL in the tea gardens.
2. To sort out demographic effects on QWL program.
3. To find out the impact of existing practices on QWL program.
4. To find out the work life variables having significant effect on QWL program that helps the tea workers to make work-life balance in the tea gardens.

Based on literature review and the above objectives, the following hypotheses are developed:

Hypothesis, H_o1: There is no effect of respondents' demographic characteristics on QWL relevant variables.

Hypothesis, H_o2: There is no variation in the mean score of selected eleven (11) factors on tea workers' quality work life.

Hypothesis, H_o3: QWL factors have no cumulative effect on overall tea workers' quality of work-life.

Methodology of the study

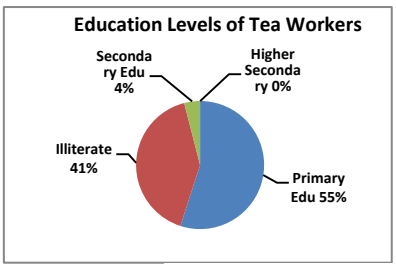
This research is an exploratory and conclusive type of research designed to explore or search through a problem or situation to provide insights and understanding of a problem (Malhotra & Das, 2010). This design was chosen on the ground that it is appropriate to formulate problems precisely and establish hypothesis about the problem. Both secondary and primary sources of information have used in this study. Secondary sources, such as, books, printed and online version journal articles and official websites of Bangladesh Tea Board were used to develop theoretical framework. Primary information was sought to assess the opinions of tea workers to explore the existing quality of work life situation in the tea gardens. The research was conducted on 100 respondents by following convenient sampling technique from five different Tea Estates of Sylhet and Moulvibazar Districts by direct interviews during the month of December 2013 to January 2014. The researchers used a structured questionnaire in both Bangla and English languages to collect the data. The questionnaire had two parts. Part one included demographic information, such as, age, education, gender and wage level. The second part of the questionnaire included some specific factors having relevance to quality of work life. Responses were measured on a 5-point Likert Scale ranging from 1=Strongly Disagree to 5= Strongly Agree. However, 130 questionnaires showing a response rate of 76.92% and the reliability (Cronbach's Alpha) of the responses was 52%. Since there were 11 independent variables, we did check multi-collinearity problem (see Appendix-A). Data analysis was done with the use of MS Excel-2007 and SPSS 17.5 version software. Statistical methods like demographic analysis, descriptive statistics, one-way ANOVA, Turkey's Post Hoc ANOVA, Test of Homogeneity of variance, and OLS multiple regression analysis are used to analyze the data and to make implication and conclusion.

Analysis and Findings

The researchers involved in this study conducted demographic analysis, descriptive analysis, ANOVA test and multiple regression analysis by using MS Excel 2007 and SPSS 11.5 for analyzing data, formalizing results and drawing implications and conclusions.

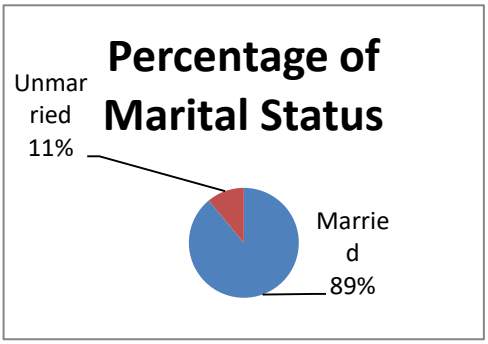
Demographic Information Analysis

Figure-1: Education Level of Tea Workers



Education is important for awareness of all people. Individuals want to lead a better life, and more importantly in a work place, education is a must. The figure shows the current educational condition of tea workers in the gardens. Here, out of 100 respondents, 55% entered into the primary level, 4% entered into the secondary level. 41% people could not read and write. Therefore, they do not know well about their rights and duties. There is only one primary school in every garden where there is always shortage of teachers and no high school. So, some of the tea workers have entered the job at best with primary education. No education is a familiar phenomenon.

Figure-2: Marital Status



89% tea workers are married and 11% unmarried. Most of the tea workers get married at an early age that might be 15 years for male and 12 years for female. We got the information during face to face interview. Child marriage is thus a very common affair in their society. As they face marriage at very young age, they fight for livelihood instead of education and personal development.

Figure-3: Gender classification

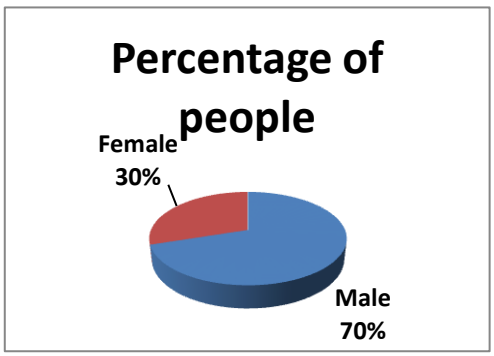
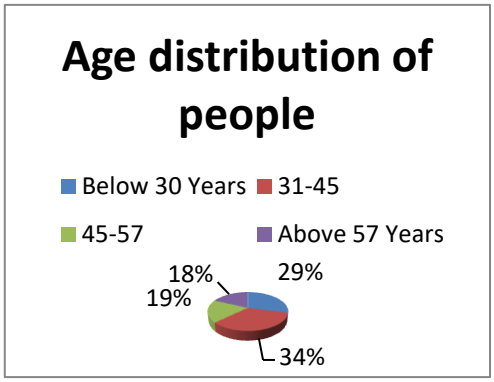


Figure 3 shows that of the total respondents in the sample study, 70% are male while 30% are female. But during the survey, we have observed about equal percentage of male and female workers work in the tea gardens. Here it may be mentioned that all the members (age above 12 years) of tea workers' families work in the gardens.

Figure-4: Age Distribution



The Figure shows that of the 100 respondents, 34% people belong to the age group of 31-45 years, 29% people below 30 years, 19% of people at the age level of 45-57 years and only 18% at the age of 57 years or above. In the gardens, middle-aged tea workers were more vigilant and a few workers were found old because their retirement age is 60 years.

During the survey, we have found equal earning of all tea workers which is 69 taka per day. So, this distribution is not worth mentioning in this study.

Descriptive Statistics of Tea workers QWL variables

Table No. 01: Descriptive Analysis

	Wages	Foods Facilities	Decisions	Compensation Facilities	Training	Education Facilities	Health Care Facilities	Accommodation Facilities	Working Schedule	Relationship With Supervisors	Job Security	Quality Work Life Satisfaction
Mean	1.54	1.85	1.69	2.18	2.25	2.38	2.93	3.19	3.87	4.09	4.16	1.94
SD	0.55	0.64	0.96	0.79	0.91	0.77	0.95	0.91	0.76	0.71	0.92	0.87
Sample Variance	0.31	0.41	0.92	0.63	0.83	0.60	0.91	0.84	0.57	0.50	0.86	0.76

Wages Facility

The people who earn high wages can afford better life than those who earn a lower wage. Minimum wage set at a reasonable level ensures that all workers earn enough to pay for the basic needs, such as, food, health care, education etc. The main purpose of good wage is to attract, retain, and motivate productive people in the organization. The table indicates workers' mental attachment to the existing wages as 1.540 (out of 5-point scale). That means the wages of tea workers are perceived very low and they are dissatisfied at their current wages. The Standard Deviation and Sample Variance of wages is very low which indicates that almost every tea worker has showed a variation in their opinions. The tea workers were found very dissatisfied at the quality of work life in existing wages system. The tea workers only get taka 67 per day which is not enough to fulfill their basic needs for survival. So, they are struggling for themselves and their families.

Food Facilities

Food is a key element in maintaining our overall physical well being. It is the basic need of human life. The table shows the mean value of food facilities 1.850 (which is below the average in a 5-point rating scale) indicates that the tea workers did not afford to purchase required food, and their employer provided food less than their necessity. Standard Deviation and Sample Variance also verify that workers were dissatisfied with the food provided. During the survey, the researchers have found that each worker was provided only 3 kg rice per week as a ration which is not sufficient for themselves and their family to survive nowadays comfortably.

Decision Making

Connecting employees in the decision-making process not only empowers them to contribute to the attainment of the goal of the organization but also saves the organization's time and money, increases productivity and reduces cost. In the table, it is found that tea workers have very little or no voice in organizational decisions concerning tea workers (mean value 1.69 is below average).

Job security

Job security is employees' assurance or confidence that they will keep their current job. It also affects workers' performance and commitment. The descriptive statistics in the table illustrate that the mean of job security is 4.160 which indicates that the job of tea workers is secured.They believed that entering into the job means they have to remain in the tea gardens until they go to retirement.

The tea workers were also not happy with their compensation facilities, training provided by the employer, education facilities and health care system provided in the tea gardens. But reverse scenario was also found; majority of the tea workers were happy with their accommodation facilities, working schedule (flexible work time) and relationship with supervisors (mean value of these practices are more than average in a 5-point scale).

Finally, they were asked whether they were happy and satisfied in overall terms with working in the tea estates. The perceived observation on quality of work life of tea workers is almost unsatisfactory but they are here because they have no other alternative means that they can think of.

One –way ANOVA Analysis: Comparison of Demographic Information in relation to Dependent Variables (QWL)

Hypothesis-1:

H_o1: There is no effect of respondents' demographic characteristics on QWL relevant variables.

H_a1: Respondents' surface level demographic characteristics have some on QWL relevant variables.

Table No. 02: One –way ANOVA Analysis

Variable	Results	Wage facility	Food facility	Education facility	Health facility	Accommodation facility	Compensation management	Participation in Decision	Working schedule	Relationship with supervisor	Training facility	Job security
Gender	F Value	0.1	1.42	2.52	2.51	3.43	0.03	0.37	0.07	0.494	0.35	0.035
	Sig. (P)	0.76	0.24	0.12	0.12	.067*	0.87	0.54	0.8	0.484	0.55	0.852
Age	F Value	1.69	0.47	0.32	0.22	0.39	1.25	0.73	0.13	0.945	1.62	0.285
	Sig. (P)	0.17	0.71	0.81	0.88	0.76	0.3	0.54	0.94	0.422	0.19	0.836
Income	F Value	1.69	0.47	0.32	0.22	0.39	1.25	0.73	0.13	0.945	1.62	0.285
	Sig. (P)	0.17	0.71	0.81	0.88	0.76	0.3	0.54	0.94	0.422	0.19	0.836
Marital Status	F Value	1.24	0.45	0.56	1.17	0.53	0.17	0.22	1.04	0.204	0.37	2.153
	Sig. (P)	0.27	0.5	0.46	0.28	0.47	0.68	0.64	0.31	0.653	0.54	0.146
Educati on	F Value	0.56	1.02	1.52	2.3	2.2	0.13	2.7	0.52	3.369	0.16	3.476
	Sig. (P)	0.57	0.37	0.22	0.11	0.12	0.88	0.07	0.6	.038**	0.86	.035**

Note: Mean value in F-distribution is significantly different at ** p < 0.05, * p < 0.10 Level of significance.

The above ANOVA table represents hypothesis Ho-1, that reflects whether there is any effect of tea workers' surface level (Robbins, 2014) demographic characteristics on tea workers' quality of work life relevant variables.

First of all, let us take a look at data in terms of gender. Out of 12 work life related factors, only one factor is statistically significant because its p value is below significant level at 10%. It indicates there is a significant difference between male and female with regard to accommodation facilities. In terms of education, only two factors, namely, relation with supervisors and job security have been found to be significant because these p values are less than significant level at 5%. However,

remaining three demographic variables (Age, Income and Marital Status) may have shown some differences among 11 work life related factors but these are not statistically significant.

Implication

In general, tea workers work all day long in the gardens. Their working environment and infra-structural facilities must be comfortable and relaxed enough to make the whole day workable. It is desirable to build adequate accommodation facilities to make them more productive. Male and female workers have shown differences (table no. 1) in accommodation facilities. So, it is suggested to provide gender-based accommodation.

Nature of supervision and connection with supervisors are not same for all workers. Workers at different education levels (self education v/s secondary education) demand different levels of supervision as shown in Appendix-B (Turkey's Post Hoc ANOVA).

Job security for quality of work life also differs in education levels, especially for primary and secondary educated workers (Appendix-B). The more educated workers may find options other than plucking tea or working at the gardens. Illiterate workers do not differ in thinking job securities because they have no alternative way other than tea gardens. So, to retain educated workers, the authorities should provide quality of work life at their work places.

Hypothesis-2

H_o2: There is no variation in the mean score of selected eleven (11) factors on tea workers' quality work life. That is,

$$H_o: \mu_1 = \mu_2 = \mu_3 = \ldots\ldots\ldots\ldots = \mu_{11}$$

H_α: at least one mean is different.

Table No. 02: ANOVA Table

Source of Variation	**SS**	**df**	**MS**	**F**	**P-value**
Between Groups	937.2291	10	93.7291	138.88**	.000
Within Groups	734.89	1089	0.67483		
Total	1672.119	99			

** **The Table value of F for *d.f.* 10, 1089 at α=.05 is 1.927**

Both the f-value and p value reject the perceived null hypothesis. So, the mean scores (at least one mean) of 11 quality of work life relevant factors have shown variability regarding quality of work life satisfaction. The tests of homogeneity of variance (Appendix-C) point out which factor responses show variability in quality of work life satisfaction. Two variables explain no variance in the response of the respondents (compensation management p=0.141 and training facility p=0.053). Again as per Appendix-A, wages structure (p=0.274) and working schedule (p=0.212) do not differ in relation to quality of work life satisfaction. And the other nine factors have shown differences with quality of work life satisfaction.

Implication

Mean score of quality of work life satisfaction is 1.9, i.e., tea workers do not enjoy their quality of work life. But still now, all are working in the gardens. As per test of homogeneity of variance, respondents were more consistent on compensation management and training system. The mean value of these two variables is less than average (averaging two or less on a five-point scale) and the remaining nine quality of work life relevant variables differ from the mean score (1.94) of quality of work life satisfaction. So, it may be assumed that these factors are somewhat responsible to keep the tea workers in the garden.

Multiple Regression Analysis

Hypothesis-3

H_o3: QWL factors have no cumulative effect on overall tea workers' quality work life.

H_a3: QWL factors have joint effect on overall tea workers' quality work life.

Table No. 03: Summary Output of Multiple Regression Analysis	
Multiple R	0.588255 (a)
R Square	0.346044
Adjusted R Square	0.264299
Standard Error	0.749737
Observations	100

ANOVA table

	df	SS	MS	F	Significance F
Regression	11	26.17476	2.379523	4.233236	4.91E-05
Residual	88	49.46524	0.562105		
Total	99	75.64			

The regression model establishes the reason of developing hypothesis $H_0$3. Both the P value and critical F value failure to reject the null hypothesis at 1% level of significance. This means that the organizational internal practices have some joint effect on determining tea workers' quality of work life. This model also explains that the selected quality of work life factors (mainly 4 factors as indicated by **) describe about 34.60% of variance in determining overall tea workers quality of work life satisfaction.

Implication:

Though the variables explain only 34.60% of variance, this is not due to the limited (11) variables. In the regression model, the difference between R^2 and adjusted R^2 is very close. This may happen because of respondents' lack of education, awareness and insincerity. This statement is also proved by the test of homogeneity of variance in the respondents' response. So, in order to understand and appreciate the quality of work life, tea workers must be given minimum education and supervisory support to make them more social and interactive with surrounding local community.

Table No.04: Regression Coefficients (a) Analysis:

	Un-standardized Coefficients		Standardized Co-efficients	t-test	Sig.
	B	Std. Error	Beta		
(Constant)	.593	.875		.678	.500
Wage Structure	.009	.143	.006	.063	.950
Food facility	-.083	.135	-.061	-.619	.538
Education facility	.042	.122	.037	.343	.732
Health facility	.125	.097	.136	1.290	.200
Accommodation facility	.034	.097	.035	.349	.728
Compensation management	-.119	.129	-.108	-.918	.361
Decision taking	.433	.110	.476	3.933	.000**
Working schedule	.265	.124	.230	2.127	.036**
Relationship with supervisor	-.068	.124	-.055	-.547	.586
Training facility	.223	.096	.233	2.313	.023**
Job security	-.194	.097	-.206	-2.01	.047**

Regression effect is significant at ** p < 0.05, * p < 0.10, b. Dependent Variable: Quality of Work Life

Tea gardens' facilities and internal practices have illustrated different regression coefficients with overall quality of work life of tea workers. In the regression coefficient table, four practices proved significant (indicated by **) impact in determining QWL satisfaction and its balance.

Implication

Quality of work life of tea workers can be boosted by emphasizing on (a) autonomy in decision making about their personal and work life (p=0.000); (b) providing training facilities for getting higher productivity and more income (p=0.023); (c) maintaining flexible work schedule (p=0.036) as the tea workers generally worked all day long with all family members at a time in the garden; and (d) tea workers mainly work in the garden due to the job security (p=0.047), because most of them are not well versed with anything other than plucking tea leaves. These four practices help them make a balance to work in the tea garden.

Limitation faced by researchers

Limitation faced by researchers in conducting the survey and research may include:

1. Most of the tea workers are afraid to provide information about their garden and superiors.
2. There was not enough previous research in this field in Bangladesh.
3. Tea workers have little idea of quality of work life.

Conclusion

The sustainable development of tea industry is essential not only for earning local and foreign currencies but also for maintaining environmental balance. Bangladesh is a tropical country experiencing common natural disasters, and the present global warming rate is alarming which can be reduced to a large extent through tree plantation, and tea industry can play a very effective role in this regard. The

ultimate role players behind the existence and growth of the tea industry are the tea workers. As the tea industry is labor-intensive, the quality of work life (QWL) of tea workers affects the smooth continuation of that industry. The tea workers are too much dependent on the companies for food, medicine, accommodation and education etc. They do not have choices about their life and amenities. They lead socially isolated life in the garden. They cannot afford the basic needs like cloth, shelter, medical facilities, food etc, and even the consumption of tea that they produce. They still remain socially excluded, low paid, overwhelmingly illiterate, deprived and disconnected with the other people. Tea workers in the gardens are not happy due to low wages, insufficient food facilities, no voice concerning their decision, lack of education facilities, limited or no training and lack of compensation facilities. In spite of these shortcomings, tea workers stay there because of life time employment security, friendly relations with supervisors, flexible working schedule and accommodation facility for all. Tea workers of different demographic characteristics have perceived similar views about quality of work life variables except education. About all the tea workers held similar opinions on two practices, viz; compensation and training system, which were graded below satisfaction level. Four predictor variables, such as, autonomy in personal and work decisions, working schedule, training facility and job security explain 34.60% of variance in the quality of work life and these four practices help them make a balance of their lives to work in the tea gardens.

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Appendix-A (Multi-collinearity Diagnosis)

Multi-collinearity Problems Statistics

There were eleven significantly interrelated independent variables (see table no. 06). We examined here the risk of multi-collinearity among these variables. According to the collinearity statistics (variance inflation factor "maximum 1.944" and tolerance 'minimum 0.514' were found) and multiple correlation value (maximum value 0.172), the multicollinearity was not a problem (Miles and Shevlin, 2001)

Model(Coefficients)	*Collinearity Statistics*	
	Tolerance	VIF
Food facility	.773	1.294
Education facility	.651	1.536
Health facility	.679	1.472
Accommodation facility	.729	1.372
Compensation management	.538	1.859
Decision taking	.514	1.944
Working schedule	.641	1.559
Relationship with supervisor	.732	1.367
Training facility	.734	1.362
Job security	.706	1.416
Food facility	.773	1.294

a. Dependent Variable: Wage Structure (Maximum VIF indicator variable as taken dependent variable)

Appendix-B

Post Hoc Anova: Tukey HSD : Multiple Comparisons

Dependent Variable	(A) Education level	(B) Education level	Mean Difference (A-B)	Std. Error	Sig.
Relationship with supervisor	Self Education	Primary education	.1164	.14310	.696
		Secondary education	.9405(*)	.36397	.030
	Primary education	Self Education	-.1164	.14310	.696
		Secondary education	.8241	.36043	.063
	Secondary education	Self Education	-.9405(*)	.36397	.030
		Primary education	-.8241	.36043	.063
Job security	Self Education	Primary education	-.3095	.18652	.226
		Secondary education	.7738	.47439	.238
	Primary education	Self Education	.3095	.18652	.226
		Secondary education	1.0833(*)	.46979	.050
	Secondary education	Self Education	-.7738	.47439	.238
		Primary education	-1.0833(*)	.46979	.050

* The mean difference is significant at the .05 level.

Appendix-C

Test of Homogeneity of Variances

Independent Variables	Levene Statistic	df1	df2	Sig.
Wage Structure	10.883	4	95	.000
Food facility	3.390	4	95	.012
Education facility	4.075	4	95	.004
Health facility	4.107	4	95	.004
Accommodation facility	4.031	4	95	.005
Compensation management	1.774	4	95	.141
Decision taking	6.823	4	95	.000
Working schedule	3.855	4	95	.006
Relationship with supervisor	7.307	4	95	.000
Training facility	2.423	4	95	.053
Job security	3.522	4	95	.010

Appendix- D

ANOVA		Sum of Squares	Df	Mean Square	F	Sig.
Wage Structure	Between Groups	1.604	4	.401	1.30	.274
	Within Groups	29.236	95	.308		
	Total	30.840	99			
Food facility	Between Groups	4.114	4	1.02	2.66	.037
	Within Groups	36.636	95	.386		
	Total	40.750	99			
Education facility	Between Groups	11.900	4	2.97	5.93	.000
	Within Groups	47.660	95	.502		
	Total	59.560	99			
Health facility	Between Groups	15.585	4	3.89	4.94	.001
	Within Groups	74.925	95	.789		
	Total	90.510	99			
Accommodation facility	Between Groups	13.317	4	3.32	4.51	.002
	Within Groups	70.073	95	.738		
	Total	83.390	99			
Compensation management	Between Groups	10.666	4	2.66	4.86	.001
	Within Groups	52.094	95	.548		
	Total	62.760	99			
Decision taking	Between Groups	24.983	4	6.24	8.93	.000
	Within Groups	66.407	95	.699		
	Total	91.390	99			
Working schedule	Between Groups	3.378	4	.844	1.48	.212
	Within Groups	53.932	95	.568		
	Total	57.310	99			
Relationship with supervisor	Between Groups	4.959	4	1.24	2.60	.041
	Within Groups	45.231	95	.476		
	Total	50.190	99			
Training facility	Between Groups	14.240	4	3.56	4.93	.001
	Within Groups	68.510	95	.721		
	Total	82.750	99			
Job security	Between Groups	16.457	4	4.11	5.66	.000
	Within Groups	68.983	95	.726		
	Total	85.440	99			

Money, Income and Causality: An Empirical Evidence From Bangladesh

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Abstract

This paper applies VAR approach to Granger causality testing to investigate relationship between monetary base, money and income in Bangladesh. It uses two trivariate systems. System A includes monetary aggregates m0, m1 and m2 showing causality link within monetary sector. System B includes m1, m2 and y showing monetary transmission channel to real sector. Granger causality Wald test results show that base money does not Granger cause money stock of either m1 or m2 and presence of causality from m1 or m2 to m0 is significant only in bivariate system. In money-income channel there are evidences of unidirectional causality from money to income indicating that money stock contains information explaining the fluctuations in income. These results give a signal to policymakers that although money does have influences on income, monetary authority has no significant control over the monetary aggregates.

Introduction

There has beena continuing debateamong macroeconomists over the issue of the determination of money supply. Main theme of the debate is whether money supply is exogenously determined outside the model or it is endogenous within the system (Bernanke and Blinder, 1988, Moore, 1989, Romer and Romer, 1990, Palley, 1994, Foster, 1994, Huang, 2004). Two schools are influential in this debate: Orthodox monetaryschool emphasises on stability of money multiplier and insists that money supply can be managed by the central bank through base money.Post Keynesian school, on the other hand, believes in the role of bank lending and argues that moneyis determined by the activities of economic agents. The role of central bank here is to accommodate or facilitate the demand for monetary aggregates (Kaldor and Trevithick, 1981).Orthodox monetary theorists believe that total supply of bank deposits is governed by the quantity of reserve supplied by the central bank. Since reserve money or base money is assumed to maintain a stablefraction of money stock (m = M/B), it creates a multiple amount of deposits which in turn creates loanable funds. Thus change in money stock (ΔM) or loan (ΔL) is assumed to be caused by change in monetary base (ΔB) created by the monetary authority. This reserve - money causality explains exogenous nature of money supplyas central bank determine monetary base. In contrast, post Keynesian economists, believe that changes in money is determined by the changes in the demand for loan by private sector which create the deposits that in turn causes change in monetary base (ΔB). This money - reserve causality explains endogenous nature of money as central bank has no role in determining the money supply except for accommodating or adjusting the reserve or policy rates.

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Proponents of monetaristschool also explainexogenous money using causality running from money to prices or output through Fisher Identity MV ≡ PY. They believe that money demand (1/V) is stable and money can cause prices (P) or nominal income (PY) resulting macroeconomic fluctuations (Palley, 1994, 2002). Post Keynesian economists on the other hand believe that money is the effect rather than cause as firms desire to finance their expected increase in income by demanding loan that increases money supply. Thus causality must run from output to money (Lavoie, 2005).

In the literature, there is a volume of empirical studies investigating the relationship between macroeconomic variables using causality test developed by Granger (1969), Sims (1972) and others. Among these studies there are a number of investigations in search of causal links between money, income and prices for different countries (Sims 1972, Williams, Goodhart and Gowland 1976, Hsiao 1979,Bernanke and Blinder 1988,Moore 1989, Boudjellaba, Dufour and Roy 1994). Following these studies current paper is an attempt toinvestigate Bangladesh data on money and income. It aims at finding any causal link or transmission channel that may suggest monetary policy implications for Bangladesh economy. The paper is organised as follows. Section II illustrates theoretical issues and empirical evidence of causality in money income space. Basic concepts in causality and exogeneity provide background information of the paper. Section III explains data and econometric methodology of the investigation. Section IV presents the empirical results of the study and Section V concludes the study with policy recommendations. In Annexure I place unit root tests for the variables of interest and bivariate VAR results of the study.

Theoretical issues and empirical evidence

Monetarists argue that money is exogenously determined by the monetary authority and thus money supply curve is vertical in interest-money space. In macroeconomics literature, monetary school is commonly known as *Verticalist.*However, there are divisions among post Keynesian economists on the issue of monetary endogeneity. For the sake of simplicity this paper will focus on*Monetarist approach* and two influential post Keynesian approaches: 1) *Horizontalist or Accommodationist, and 2) Structuralist.*

Multiplier approach to money supply

In their multiplier model of money supply, Brunner and Meltzer (1964) argue that reserve money is exogenous since it is the liability of the central bankadjustable through its assets. It is assumed that if money multiplier is stable, money supply is also exogenous since monetary authority could control the money expansion or contraction by keeping reserve money at consistentlevel. Money multiplier model is summarized in Brunner-Meltzer identity:

(1) $M \equiv m\ B$

Where, M is money supply, B is monetary base or reserve money and m is money multiplier. Monetary base B is net liabilities of the central bank defined as sum of currency held by non-bank public (C)and reserve held by banks (R). Given the

definition of the money supply M as currency held by the non-bank public (C)plus deposits of the banking system (D), related identities are:

(2) $M = C + D$

(3) $B = C + R$

$M/H = (C+D) / (C+R)$

$m = (C/D + 1) / (C/D + R/D)$

(4) $m = (c_d + 1) / (c_d + r_d)$

Where, $c_d$is currency-deposit ratio and $r_d$is the reserve-deposit ratio. When $r_d$isdecomposed into required reserve ratio,r_r= RR/D and excess reserve ratio,r_e= RR/D multiplier equation turns to

$m = (c_d + 1) / (c_d + r_r + r_e)$

(5) $m = f (i, i_d, r_r, c_d, \sigma)$

Money multiplier is a function of interest rates (i), discount rates (i_d), required reserve ratio (r_R), currency-deposit ratio and the variability of deposit flows (σ). It increases with the level of market interest rates, decreases with the discount rates, required reserve ratio, and currency-deposit ratio. Movements in the multiplier largely reflect the behaviour of the public through c_d, banks and financial institutions through excess reserve-deposit ratio (r_e) and monetary authority through required reserve-deposit ratio (r_r). Since money supply (M) moves with an amount multiple of reserve money or monetary base (B) monetary authority can affect money supply through three routes: B, controlled primarily through open market operations, discount rates i_d, and required reserve ratio r_r. Thus monetary base is exogenously determined by the central bank. If money multiplier is reasonably stable or constant, exogenous B can channel exogenous money in the economy indicating the direction of causality running from reserve to money

Since 1980s,Kaldor (1982), Moore (1988) and other post Keynesians have been claiming that money supplyis determined by the asset and liability management decisions of the commercial banks, the portfolio decisions of the non-bank public and the demand for bank loans. Central bank can influenceneither of the two components of money multiplier ($c_d$andr_r)and thus deliberately fails to maintain its stability in a liberalized financial system (Palley 1994, Jha and Rath 2002). The core of endogenous theory is that causality runs from bank lending to bank deposits, instead of the traditional notion of‘deposits create loans’.

Transmission mechanism and causality

For the analysis of transmission mechanismsI consider two very simple and well known identities:

(6) Brunner-Meltzer Identity: $M \equiv m B$

(7) Fisher Identity: $MV \equiv PY$

Where M = money supply, m = money multiplier B = Base money or reserve money, 1/V is demand for money and PY is the nominal income.

In monetaristtrans mission mechanism, central bank influences the quantity of money by adjusting its reserves. A decrease in money supply increases real interest rates that raises firm’s cost of capital. Higher cost of capital induces lower bank

lending (L) that decreases investmentand aggregate output or income (PY). In opposite direction, economic activities rise by an increase in money supply. In this mechanism banks are assumed to be passive as their loanable funds depend on central bank's actions on reserve money that influence deposits. Money supply is assumed to be independent of loan demand. Thus bank lending (L) should fail to Granger-cause both m and B. From banking sector balance sheet identity, changes in the money supply, arising from changes in either m or B, do cause changes in bank lending. Consequently, both m and B should Granger-cause L. Direction of causality runs from m or B to M to L and from M to PY both in unidirectional way suggesting that money is exogenous (Palley 1994).By contrast Post Keynesian emphasises on the fact that when banks provide loans new deposits are created which affect reserves and money supply. Thus direction of causality runs from loan to deposit to money through reserve instead of opposite what monetarists argue for (Kaldor 1982 andMoore, 1988)

In post Keynesian transmission mechanism, the*accommodationists* argue that changes in money supply depend on demand for bank lending. Central bank determines the level of interest rates and commercial banks fully accommodate loan demand at any rate of interest. Thus any change in bank loan creates new deposits and demand for reserves. Central bank accommodates the reserves fully through a passive increase in B which is responsible for the horizontal money supply curve. This model is consistent with L Granger-causing B and B does not Granger-cause L as lending is not reserve constrained (Moore, 1985). There is unidirectional causality from bank loans to monetary base and money supply. This approach also asserts that changes in the expected income lead to changes in demand for bank loan. This results in changes in deposits and hence money supply. However, changes in the volume of loans and money supply imply changes in economic growth influencing income in the next period. Thus there is bidirectional causality between money (M) and nominal income (PY) indicating that money is endogenous. In oppose to full accommodation, post Keynesians*structuralist*insist that central banks only partially accommodate the demand for reserves. Their transmission channel incorporates accommodationist views of causality from bank loans to the monetary base and the monetarist approach to causality from base money (B) and money multiplier (m) to total bank loans (L). In addition to Accommodationists' idea, structuralists argue that increased lending induces liability transformations that cause an increase in money multiplier through its components: currency/deposit ratio (c_d) and reserve/deposit ratio (r_d). Hence there are potential bidirectional causalities between L and m, and L and B in this mixed model. The structuralists share accommodationist views on the relation between income and broad money supply (Palley, 1994). Causality hypotheses of different schools of thought can be summarised in the following table (1).

Table 1: Monetary schools of thought: A comparison of causality hypotheses

Exogenous money	Post Keynesian endogenous money	
Monetarist	Accommodationist	Structuralist
$B \rightarrow M$ $M \rightarrow L$ $M \rightarrow PY$	$L \rightarrow B$ $L \rightarrow M$ $M \leftrightarrow PY$	$L \leftrightarrow B$ $L \leftrightarrow m$ $M \leftrightarrow PY$

M = Money supply, B = Reserve money or Base money, L = Bank lending, m = money multiplier and PY = nominal GDP, → Unidirectional and ↔ Bidirectional causality

Evidence of exogenous money

Sims was the pioneer in money income causality studies with his 1972 paper on post war US data. His investigation started with the question: is there any statistical evidence of exogenous money?The post war data revealed that causality was unidirectional from money to income. Feedback relation was rejected as he found no causality from income to money.Thus he concluded that money should be treated as exogenous in the regression of GNP on money (Sims, 1972). In their earlier study Bernanke and Blinder (1988) applied simple regression technique in US monthly aggregate data spanning from 1953 to 1985. Later, they ran VAR using monthly aggregate data from 1959 to 1989. In both studies they found that contractionary monetary policy was followed by a decrease in the volume of aggregate bank lending (Bernanke and Blinder, 1992). Romer and Romer (1990) obtained similar findings using dummy variables drawn from the minutes of the Federal Open Market Committee. They argued that M1 tends to drop faster than bank credit in the wake of contractionary monetary policy, and that bank credit growth lags behind money growth.Ford, et al (2003) analysed monthly data Japan 1965-1999 data using VAR estimation and found the evidence that bank lending was affected by the monetary policy prior to 1984 but there was no evidence of it after 1985 indicating that. Japanese money supply was exogenous before 1984 turning to endogeneity in 1985 afterwards. There were differences in methodologies and proxies used for monetarypolicy stance but most of the empirical evidence concluded that small and undercapitalised banks were more affected by a change in monetary policy than average banks.

Evidence of endogenous money

Williams, Goodhart and Gowland (1976) applied Sims methods in UK data and found results different from Sims (1972). They concluded that some UK evidences are unidirectional running from GNP to money and some of them are also unidirectional from money to GNP. Over all, there was bidirectional causality between money and income which supported the Post Keynesian view of Money endogeneity. Hsiao (1979) studied on Canadian money and income data and found that between M1 and GNP there was a bidirectional relationship but M2 and GNP showed unidirectional from income to money. Chikara (1982) found bidirectional causality between money and both nominal and real income in Japanese data. He obtained feedback relations between GDP deflator and money in the fixed exchange rate regime: 1955 - 1964. In the flexible exchange rate regime: 1971-1980 there was unidirectional causality running from GNP to money and weak bidirectional

causality between Money and GNP deflator. Later on, some of the Post Keynesian economists have explained monetary endogeneity through a channel that showsloans cause deposits which in turn cause moneysupply. Their causality analysis remains within the monetary sector while other Post Keynesians include real sector showing that there are unidirectional or bidirectional causality from nominal income to money supply. Kaldor (1982) was one of the earliest PK economists who investigated the money supply endogeneity. He used OLS method to analyse UK data for sample period of 1966-1979. He found that UK money supply was determined by the demand for bank lending. Moore(1989) found unidirectional causality from bank lending to monetaryaggregates and from monetary aggregates to the monetary base. He argued that when firms intended to finance their working capital and wage bill for increased activity the demand for loan increased which stimulated money supply implying that US monetary aggregates were endogenous. Palley (1994) applied Granger-causality test on1973-1990 US monthly data for analysingthree approaches to money supplydetermination: 1) Money multiplier approach to money supply (the pure portfolioapproach), 2) Accommodationist approach (pure loandemand) and 3) Structuralist approach (the mixed portfolioloandemand approach). He concluded that money is endogenous in favour of the structuralists approach. Boudjellaba et al (1992) applied ARMA technique to causality between monetary aggregates (M1, M2) and GDP using Canadian dataset used by Hsiao (1979). They developed necessary and sufficient conditions for Granger causality in ARMA time series and found unidirectional causality from monetary aggregates to income. Later on, they modified testing techniques and obtained bidirectional causality between money and income. They also found feedback between money and interest rates (Boudjellaba et al (1994).

Basic concepts in causality and exogeneity

Grangernon-causality and Sims strict exogeneity: IfX and Y are nonstationary stochastic processes, Y does not Granger cause X when immediate future of X is independent of or orthogonal to past and current values of y conditional on past and current values of x.

(8) $x_{t+t} \perp Y^{t}_{-\infty} \mid X^{t}_{-\infty}$ for any t

On the other hand, X is strictly exogenous to Y in Sims sense if current y is independent of or orthogonal to future values of x conditional on past and current values of x and any past of Y.

(9) $X^{\infty}_{t+1} \perp y_t \mid [\, X^{t}_{-\infty}\, Y_{t-1}\,]$ for any t

Florens and Mouchart(1982) and Bouissou et al (1986) argued that the idea of past and current values of Y affecting some values except for immediate future of X limitsthe concept of Granger non-causality from being sufficiently strong and thus they proposed for Global definition of non-causality:

(10) $X^{\infty}_{t+1} \perp Y^{t}_{-\infty} \mid X^{t}_{-\infty}$ for any t

i.e. whole future of X orthogonal to past and current values of y conditional on past and current values of x.

Let the joint distribution of y_t and x_t be expressed as

(11) $F(y_t, x_t \mid \lambda_t) = F_c(y_t \mid x_t, \lambda_{1t})\, F_m(x_t \mid \lambda_{2t})$

Where F_c and F_m are conditional y_t on x_t and marginal density of $x_t$respectively. λ_ts are parameters. Engle, Hendry and Richard (1983) and Engle and Hendry (1993)

defined x_t as **weakly exogenous**for a set of parameters of interest θ if 1) θ is a function of λ_{1t} alone and 2) $\lambda_{1t}$and λ_{2t} are variation free i.e. perfect knowledge of λ_{2t} could not improve the estimate of λ_{1t} when both are constant. When y_t fails to Granger Cause x_t then x_t is **strongly exogenous** for θ. Finally, x_t is saidto be**super exogenous** for θ when λ_1 is invariant to λ_2 i.e.changes in $\lambda_2$do not imply change inλ_1**.**

In a simple bivariate VAR (1) describing x and y, y does not Grangercause x if the coefficient matrixΦ are lower triangular i.e. $\Phi_{12} = 0$.

(12)
$$\begin{bmatrix} x_t \\ y_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix} + \begin{bmatrix} \Phi_{11} & \Phi_{12} \\ \Phi_{21} & \Phi_{22} \end{bmatrix} \begin{bmatrix} x_{t-1} \\ y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

Hamilton (1994) proposed a simplified version of Granger-Sims causality which consider a linear projection of y_t on past, present and future of x's expressed in following equation.

(13)
$$y_t = c + \sum_{j=0}^{\infty} b_j x_{t-j} \sum_{j=1}^{\infty} d_j x_{t+j} + \eta_t$$

Where E ($\eta_t x_\tau$) = 0 for $\forall$ t and τ. y fails to granger cause x if and only if $d_j = 0$ for j= 1, 2.....

Econometric methodology

This paper aims primarily at testing causality between monetary base (B) and money supply (M) in the monetary sector in Bangladesh. Its ultimate goal is to identify monetary links to real sectorof this country through money - income causality testing. I call monetary base - money causality test **System A**and money - income causality test **System B**. For the sake of simplicity, Iuse Vector Auto regression (VAR) approach to Granger non-causality testing instead of co integration based testing like Error Correction Model (ECM). ECM is less relevant in System Abecause of insignificant evidences of co integrating relations. For consistency and uniformity prefer VAR to Vector Error Correction models (VECM) for non-causality testing in both models. More accurate and parsimonious model likeVector Autoregressive Moving Average (VARMA)are beyond the scope of this paper. I keep this as future research agenda.

I consider unconstrained VAR to test Granger causality or exogeneity of variable under consideration expressed in following equation. The test involves examining upper or lower block triangularity of auto regressive operator.

(14)
$$Y_t = \alpha + \sum_{i=1}^{p} \psi_t Y_{t-i} + u_t$$

Where Y is a vector of r random variables and u_t is r x 1 vector of white noise innovations.In the analysis of causality I assume two systems of Y_t = [m2, m1, m0]′

for monetary sector and Y_t = [m2, m1, y]′ for the economy where m0, m1, m2 and y are log of monetary base, narrow money, broad money and nominal GDP respectively. I consider bivariate VARs *Y*: [m2, m0]′,[m1, m0]′ [m1, y]′ and [m2, y]′ to cross check the results obtained in the trivariate systems. Bivariate results are placed in the annexure.

In data analysis I find no cointegrated equations for system [m2, m1, m0]′ but there are one or two cointegrating relations in the system [m1, m2, y]′ and thus I suspect any cointegration of unknown form. In order to control unknown form of cointegration we use excess-lag technique developed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). Their technique (hereafter TYDL)involves a VAR augmented with extra lag determined by the maximal order of integration. This is applicable irrespective of the integration and cointegration properties of the system.They use Wald statistic for testing the significance of the p parameter(s) while estimating VAR ($p + d_{max}$) where p is the lag length of VAR and $d_{max}$is the maximal order of integration in the system.

Basic steps in TYDLprocedure:

a) Test each of the time series to determine the order of integration using stationarity test such as Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) or Kwiatkowski-Phillips-Schmidt-Shin (KPSS). ADF and PP test for null of unit root or non-stationarity can be cross-checked by KPSS which test null of stationarity. Now, determine the maximal order of integration $d_{max}$for the group of series. In our cases d_{max} =1.
b) Set up VAR irrespective of the orders of integration and determine the maximum lag length (p) using information criteria such as Akaike Information Criteria (AIC), Schwarz Information Criteria (SIC).Make sure that VAR is stable and free from serial correlation in the residuals. Increase p if needed.
c) If two or more series have same orders of integration then see if they are cointegrated using test such as Johansen methods. This test is used for cross-checking the validity of the causality test using VAR. If two or more series are cointegrated then there must be granger causality between them either uni- or bidirectional (Granger, 1969). But reverse may not be true
d) Set up VAR model adding extra d_{max} lag in each of the equations in the system.
e) Test for Granger causality using standard Wald test for parameter significance for p lags but not for the extrad_{max}.There is a trick in avoiding d_{max} in Wald test using statistical package. Just put extra lag in exogenous variable list along with constant and report lag length p. Wald test statistics will be asymptotically distributed in χ^2 with p degrees of freedom under the null.
f) Rejection of null implies the rejection of Granger Non-causality i.e. there is an evidence of Granger causality.

Data description

This paper uses yearly money and income data of Bangladesh obtained from International Monetary Fund publication *International Financial Statistics (IFS)*. The data ranges 1972-2012. I do not use monthly or quarterly data for the analysis as income data is available only yearly.There is a common practice of converting annual to more frequent monthly or quarterly to increase the number of observation.

Using Monte Carlo estimation Hakkio and Rush (1991) show that there is no power gain in cointegration test with small sample data when converted into high frequency data.I perform some testsin system A where monthly and quarterly data are available and find that results are identical to yearly data. Moreover, VAR with monthly data shows instability with serial correlation problems in residuals.Thus, I avoid using monthly and quarterly data even thought it would risk insufficient number of observations. This is one of the major limitations of this paper. This limitations might be addressed in future research when Bangladesh economy would experience more data realization.

In system A,I use three variables M0, M1 and M2 in their logarithmic form m0, m1 and m2. M0 or reserve moneyorbase money(hereafter m0)is the monetary liability of the central bank which is composed of reserves of banking sectors held by the central banks (R) and currency held by the non-bank public (C). The central bank of Bangladesh (hereafter Bangladesh Bank or BB) uses this money as its policy instrument for monetary targeting. M1 or narrow money (hereafter m1) is the sum of currency held by the non-bank public (C) and demanddeposits or checkable deposits held by banks. M2 or broad money (hereafter m2) is M1 plus time deposits held by the banks. Bangladesh Bank uses M2 as an intermediate target to achieve ultimate target of price stability. In system B three variables M1, M2 and Nominal GDP in their logarithmic form m1, m2 and y. Nominal GDP (y hereafter) is the GDP at current market prices.

Findings

System A: monetary base – money causality in trivariate VAR

In VAR system A, we insert three random variables in vector Y in equation (14) such as m0, m1 and m2. Central idea behind this system is to look at the effectiveness of BB's policy instrument m0. If m0 do Granger causes m1 or m2 then monetary targeting can be used effectively stabilizing price or enhancing growth.

Table A1: VAR residual serial correlation LM Tests for system A

Null Hypothesis: No Serial Correlation at lag order h

lags	LM Static	p values
1	12.30402	0.1967
2	11.11662	0.2678
3	8.131476	0.5210
4	11.27281	0.2575
5	8.163895	0.5177
6	10.00131	0.3504
7	4.008011	0.9109
8	10.43809	0.3162
9	6.712238	0.6671
10	6.401192	0.6992

P values from chi-square with 9 df

Unit root test result (Annexure 1) shows that all variable in this system are integrated of order I(1) and d_{max} is 1. Using VAR lag order selection criteria

(Annexure 2) we see that maximum lag length in all criteria is p = 1 but we use p = 2 to control for residual serial correlation and the stability of the VAR (table A1). Finally I use extra lag d_{max} =1 for TYDL procedure.

Table A2: VARestimates for system A

	m0	**m1**	**m2**
m0 (-1)	0.263641	-0.148678	-0.173958
	(0.20257)	(0.20648)	(0.13267)
	[1.30146]	[-0.72006]	[-1.31119]
m0 (-2)	-0.244578	-0.070833	0.044217
	(0.21874)	(0.22296)	(0.14326)
	[-1.11813]	[-0.31770]	[0.30865]
m1 (-1)	0.319383	1.043465	0.132475
	(0.33004)	(0.33641)	(0.21616)
	[0.96770]	[3.10180]	[0.61287]
m1 (-2)	-0.182218	0.054956	-0.083061
	(0.51219)	(0.52206)	(0.33545)
	[-0.35577]	[0.10527]	[-0.24761]
m2 (-1)	0.701118	0.666330	1.329847
	(0.51331)	(0.52321)	(0.33619)
	[1.36587]	[1.27353]	[3.95567]
m2 (-2)	-0.577014	-1.171313	-0.546407
	(0.79438)	(0.80970)	(0.52027)
	[-0.72637]	[-1.44660]	[-1.05024]
C	-0.972843	-0.239449	-0.100253
	(0.24970)	(0.25452)	(0.16354)
	[-3.89601]	[-0.94080]	[-0.61302]
m2 (-3)	-0.340826	-0.201788	-0.206765
	(0.20751)	(0.21151)	(0.13591)
	[-1.64243]	[-0.95401]	[-1.52137]
m1 (-3)	0.174429	-0.111896	0.203991
	(0.33990)	(0.34646)	(0.22261)
	[0.51318]	[-0.32297]	[0.91635]
m2 (-3)	0.830828	0.900079	0.313714
	(0.51988)	(0.52991)	(0.34049)
	[1.59811]	[1.69856]	[0.92136]
R-squared	0.997935	0.997317	0.999244
Adj. R-squared	0.997247	0.996422	0.998992
F-statistic	1449.807	1114.956	3964.672
Log likelihood	47.02241	46.31568	62.68151
Akaike Information Criteria (AIC)	-2.001211	-1.963010	-2.847649
Schwarz Information Criteria (SIC)	-1.565828	-1.527626	-2.412266

m0, m1 and m2 represent log of M0, M1 and M2 respectively. Standard errors in ( ) and t-statistics in [ ]

VAR Granger causality Wald tests (Table A3) were conducted for testing causality between m0, m1, and m2. System Arepresents monetary data for sample period 1972 - 2012. In this model, null hypothesis of no causality from m0 to m1 and from m0 to m2 is rejected meaning that base money (m0) does not Granger cause either m1 or m2. On the other hand, m1 or m2 does not cause m0 separately. However, m1 and m2 together do Granger cause m0 which reflects post Keynesian idea that base money is not an effective instrument to determine money supply. From Table A3 we see that there is no causality between m1 and m2 in either direction. This is because the growth rate of time deposits is faster than the demand deposits which make m1 less informative in explaining m2. No feedback between m1 and m2 marks question on how do m1 and m2 cause m0 together.

Table A3: VAR Granger causality / Block exogeneity Wald tests for system A
Null Hypothesis: No Granger causality

Excluded	Dependent variable					
	m0		m1		m2	
	χ^2 (df)	p values	χ^2 (df)	p values	χ^2 (df)	p values
m0			0.954 (2)	0.621	1.774 (2)	0.4119
m1	1.360 (2)	0.507			0.517 (2)	0.772
m2	2.251 (2)	0.3245	2.128 (2)	03451		
all	13.210 (4)	0.011	3.806 (4)	0.433	2.001 (4)	0.736
Causality variables	Causality directions					
m0, m1	m1 → /m0		m0 → /m1			
m0, m2	m2 → /m0				m0 → /m2	
m1, m2			m2 → /m1		m1 → /m2	
m0, m1, m2	m1, m2→ m0					

m0, m1 and m2 represent log of M0, M1 and M2 respectively. → is the direction of causality and →/ is non-causality.

The results obtained in bivariate system A1: Y = [m0, m1]′ and A2: Y = [m0, m1]′ show that there is an evidence of unidirectional causality from m1 or m2 to m0 (Annexure 3).These findings have two policy implications: first, central bank has no

control over money supply using its monetary base in the sample period. Secondly, joint unidirectional causality running from m1 and m2 to m0 indicates that central bank monetary policy is less effective in targeting monetary aggregates.

System B: money - income causality in trivariate VAR

In VAR system B, we insert three random variables in vector Y in equation (14) such as m1, m2 and m3. Central idea behind this system is to look at the effectiveness of BB's monetary policy on real sector. If m1 or m2 do Granger causes y then monetary targeting can be used effectively in stabilizing the economy.

Table B1: VAR residual serial correlation LM tests for system B
Null Hypothesis: No Serial Correlation at lag order h

lags	LM Static	p value
1	15.13155	0.0874
2	9.623549	0.3818
3	6.103751	0.7295
4	3.702577	0.9299
5	7.741383	0.5604
6	4.091176	0.9053
7	8.746368	0.4610
8	16.70526	0.0535
9	6.033284	0.7366
10	9.824999	0.3648

P values from chi-square with 9 df

Unit root test result (Annexure 1) shows that all variable in this system are integrated of order I(1) except for y which is I(0) in ADF unit root test but I(1) in KPSS stationarity test. As explained in methodology we take ADF test result for decision and KPSS result for cross check. Again d_{max} is 1. Using VAR lag order selection criteria (Annexure 2) we see that maximum lag length in all criteria is p = 1 except for AIC which shows p = 5. We use p = 2 to control for residual serial correlation and the stability of the VAR (Table B1). We do not apply TYDL because of instability and serial correlation appears when the procedure applied in VAR.

Table B2: VAR estimates for system B

	m1	**m2**	**y**
m1 (-1)	1.018465	-0.005131	0.360921
	(0.29404)	(0.19165)	(0.29353)
	[3.46368]	[-0.02677]	[1.22960]
m1 (-2)	-0.095736	0.177316	-0.641198
	(0.29946)	(0.19518)	(0.29894)
	[-0.31970]	[0.90846]	[-2.14494]
m2 (-1)	0.380604	1.284150	-0.097044
	(0.45187)	(0.29453)	(0.45109)
	[0.84228]	[4.36005]	[-0.21513]
m2 (-2)	-0.380890	-0.481105	0.827120
	(0.44740)	(0.29161)	(0.44662)
	[-0.85134]	[-1.64983]	[1.85197]
m2 (-1)	-0.046938	-0.028629	0.412756
	(0.17049)	(0.11112)	(0.17019)
	[-0.27532]	[-0.25764]	[2.42528]
m2 (-2)	0.121619	0.092815	-0.060164
	(0.11234)	(0.07322)	(0.11215)
	[1.08258]	[1.26755]	[-0.53647]
C	-0.086099	0.013537	1.746989
	(0.27768)	(0.18099)	(0.27719)
	[-0.31007]	[0.07480]	[6.30247]
R-squared	0.997232	0.999203	0.997044
Adj. R-squared	0.996696	0.999048	0.996472
F-statistic	1861.367	6475.144	1742.612
Log likelihood	45.87778	62.14312	45.94413
Akaike Information Criteria (AIC)	-2.046199	-2.902269	-2.049691
Schwarz Information Criteria (SIC)	-1.744538	-2.600609	-1.748031

m1,m2 and y represent log of M1, M2 and Nominal GDP respectively. Standard errors in ( ) & t-statistics in [ ]

Table B3: VAR Granger causality / Block exogeneity Wald tests for system B
Null Hypothesis: No Granger causality

Excluded	Dependent variable					
	m1		m2		**y**	
	χ^2 (df)	p-value	χ^2 (df)	p-value	χ^2 (df)	p-value
m1	-	-	2.950 (2)	0.2288	5.9916 (2)	0.0500
m2	0.744 (2)	0.6894	-	-	20.037 (2)	0.0000
y	2.235 (2)	0.3271	3.344 (2)	0.1879	-	-
all	4.460 (4)	0.3473	4.936 (4)	0.2939	44.050 (4)	0.0000
Causality variables	Causality directions					
m1, m2	m2 →/m1		m1 →/ m2			
m1, y	y →/ m1				m1 → y	
m2, y			y →/ m2		m2 → y	
m1, m2, y					m1, m2→ y	

m1 m2 and y represent log of M1, M2 and Nominal GDP respectively. → is the direction causality and →/ is non-causality.

I run VAR Granger Causality/Block Exogeneity Wald Tests for system B to detectany causality between M1, M2 and Nominal GDP. The Wald test suggests that one cannot reject the null of no causality between y and m1 and y and m2 meaning that there is no evidence that GDP causes either m1 or m2 or both. Hover, there is an evidence of causality from m1 and m2 to GDP separately. As there is no evidence of feedback relationship between m1 and m2 joint causality from m1 and m2 to GDP is ambiguous.I also conduct Wald test for Granger causality between M1 and GDP and M2 and GDP in bivariate VAR systems B1 and B2 and obtained identical results for direction of causality m1, m2 and y. Both models are presented in the appendix 3. Unidirectional causality from M to PY indicates that although money supply is post Keynesian in monetary sector it follows monetarist transmission channel in affecting output.

Conclusion

This paper investigates causal two relations: between monetary base and money supply between and money stock and nominal GDP in Bangladesh using annual data from 1972 to 2012. It employs VAR approach to Granger causality test. The first causality test uses monetary aggregates data m0, m1 and m2 to find out whether monetary base is an effective tool in the hand of Bangladesh Bank as a monetary policy instrument. If monetary base Granger causes money supply then BB has the ability to target money stock to influence economic growth. Monetary targeting is then effective tool for monetary policy. If monetary base does not granger cause

money stock then targeting money is a useless exercise. In the Second causality test,I use income and monetary aggregates data to investigate any causality link between money supply and nominal income through monetary transmission mechanism. The objective of the test is to identify if money has any influence in the real sector. No causality from m0 to m1 or m2 rejects the monetarist view of money supply. However, unidirectional causality from money to income indicates the potential transmission channel from monetary sector to real economy which supports the monetarist view of money. Targeting money using either monetary base or interest rates could maintain the desired growth in the economy.But policy effectiveness is redundant when there policy instrument (m0) contains no information in explaining money supply. Ambiguous causality in both sector means that there is a missing links in transmission channel: m0→/m→y i.e. monetary authority has no influence in affecting income. This signals an important implication for policy makers in Bangladesh. Although money stock has influence in income the monetary policy has insignificant effect on real economy.

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Annexure 1
Unit root and cointegration test

Unit root test

Variables	ADF[1]		KPSS[2]		Oder of Integration
	Level	First difference	Level	First difference	
m0					
Constant	-0.0739	-5.978[a]	0.775 [a]	0.102	I(1)
Constant and trend	-2.040	-5.890 [a]	0.145 [c]	0.103	I(1)
m1					
Constant	-0.150	-4.573 [a]	0.779 [a]	0.105	I(1)
Constant and trend	-2.892	-4.493 [a]	0.101[c]	0.098	I(1)
m2					
Constant	-0.398	-3.946 [a]	0.776 [a]	1.148	I(1)
Constant and trend	-1.797	-3.902 [a]	0.149 [b]	0.130	I(1)
y					
Constant	-3.369 [a]	-5.476 [a]	0.7834 [a]	0.499	I(0)
Constant and trend	-5.411 [a]	-5.560 [a]	0.225 [a]	0.134	I(0)

a, b and cindicaterejection of null hypothesis at 1%, 5 % and 10% level of significance

1 Augmented Dicky-Fuller t- statistic based on MacKinnon (1992) one sided p-value. ADF H_0: unit root

2 Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1) LM statistic, KPSS H_0: Stationary (no unit root)

Cointegrationtest
Cointegration tests for system A
Cointegration Rank Test with Trace Statistic

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p values
None	0.000693	0.025794	29.79707	1.0000
At most 1	4.01E-06	0.000148	15.49471	1.0000
At most 2	1.30E-10	4.79E-09	3.841466	0.9999

* denotes rejection of the hypothesis at the 0.05 level in MacKinnon-Haug-Michelis (1999) p-values

Trace test indicates no cointegration at the 0.05 level
Cointegration Rank Test with Maximum Eigenvalue Statistic

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	p values
None	0.000693	0.025646	21.13162	1.0000
At most 1	4.01E-06	0.000148	14.26460	1.0000
At most 2	1.30E-10	4.79E-09	3.841466	0.9999

* denotes rejection of the hypothesis at the 0.05 level in MacKinnon-Haug-Michelis (1999) p-values.
Max-eigenvalue test indicates no cointegration at the 0.05 level

Cointegration tests for system B
Cointegration rank test with trace statistic

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	p values
None *	0.709813	61.47191	29.79707	0.0000
At most 1 *	0.327662	15.69437	15.49471	0.0467
At most 2	0.026812	1.005576	3.841466	0.3160

* denotes rejection of the hypothesis at the 0.05 level in MacKinnon-Haug-Michelis (1999) p-values

Trace test indicates 2 cointegrating equations(s) at the 0.05 level
Cointegration rank test with maximum eigenvalue statistic

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	p values
None *	0.709813	45.77753	21.13162	0.0000
At most 1 *	0.327662	14.68880	14.26460	0.0428
At most 2	0.026812	1.005576	3.841466	0.3160

* denotes rejection of the hypothesis at the 0.05 level in MacKinnon-Haug-Michelis (1999) p-values.

Max-eigenvalue test indicates 2 cointegrating equations(s) at the 0.05 level

Annexure2
VAR lag order selection criteria

Lag order Selection criteria for system A

Endogenous variables: **m0, m1, m2**
Exogenous variables: **C**

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	14.06343	NA	0.000101	-0.691464	-0.554052	-0.645916
1	144.0394	227.4579 *	5.25e-08*	-8.252462*	-7.702811*	-8.070268*
2	149.0663	7.854577	6.85e-08	-8.004145	-7.042256	-7.685306
3	155.6437	9.043889	8.32e-08	-7.852731	-6.478603	-7.397246
4	163.3234	9.119681	9.84e-08	-7.770214	-5.983848	-7.178084
5	175.0208	11.69736	9.62e-08	-7.938799	-5.740195	-7.210024

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error AIC: Akaike information criterion
SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Lag order Selection criteria for system A1

Endogenous variables: **m0, m1**
Exogenous variables: **C**

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	-27.98817	NA	0.022338	1.874261	1.965869	1.904626
1	73.04653	183.1254*	5.20e-05*	-4.190408*	-3.915583*	-4.099311*
2	74.52412	2.493432	6.11e-05	-4.032757	-3.574715	-3.880929
3	77.94267	5.341481	6.39e-05	-3.996417	-3.355157	-3.783857
4	78.83760	1.286470	7.89e-05	-3.802350	-2.977874	-3.529060
5	79.84369	1.320494	9.78e-05	-3.615231	-2.607537	-3.281209

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error AIC: Akaike information criterion
SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Lag order selection criteria for system A2

Endogenous variables: **m0, m2**
Exogenous variables: **C**

Lag	Log L	LR	FPE	AIC	SIC	HQ
0	-14.99776	NA	0.009919	1.062360	1.153968	1.092726
1	90.27666	190.8099*	1.77e-05*	-5.267291*	-4.992466*	-5.176194*
2	94.11655	6.479812	1.80e-05	-5.257284	-4.799242	-5.105456
3	96.59802	3.877291	1.99e-05	-5.162376	-4.521117	-4.949817
4	97.90245	1.875122	2.40e-05	-4.993903	-4.169427	-4.720612
5	99.15522	1.644264	2.93e-05	-4.822201	-3.814508	-4.488179

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error AIC: Akaike information criterion
SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Lag order selection criteria for system B

Endogenous variables: **m1, m2, y**

Exogenous variables: **C**

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	-2.533630	NA	0.000275	0.316207	0.449523	0.362228
1	162.8347	292.9382*	3.64e-08*	-8.619126	-8.085863*	-8.435044*
2	170.0530	11.54925	4.08e-08	-8.517313	-7.584105	-8.195170
3	180.3055	14.64651	3.92e-08	-8.588888	-7.255732	-8.128683
4	188.4593	10.25044	4.39e-08	-8.540531	-6.807429	-7.942265
5	199.2263	11.68983	4.41e-08	-8.641500*	-6.508451	-7.905172

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error AIC: Akaike information criterion

SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Lag order selection criteria for system B1

Endogenous variables: **m1, y**

Exogenous variables: **C**

Lag	LogL	LR	FPE	AIC	SIC	HQ
0	-38.90201	NA	0.044186	2.556375	2.647984	2.586741
1	83.69791	222.2124*	2.67e-05*	-4.856120*	-4.581294*	-4.765023*
2	85.30974	2.719955	3.11e-05	-4.706859	-4.248816	-4.555030
3	87.54232	3.488403	3.51e-05	-4.596395	-3.955135	-4.383835
4	88.76679	1.760175	4.24e-05	-4.422924	-3.598448	-4.149633
5	89.92862	1.524907	5.21e-05	-4.245539	-3.237845	-3.911517

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error AIC: Akaike information criterion
SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Lag order selection criteria for system B2

Endogenous variables: **m2, y**
Exogenous variables: **C**

Lag	Log L	LR	FPE	AIC	SIC	HQ
0	-37.02309	NA	0.031878	2.229891	2.318768	2.260571
1	105.4492	260.5207	1.17e-05	-5.682809	-5.416178*	-5.590768*
2	106.8494	2.400445	1.36e-05	-5.534253	-5.089868	-5.380851
3	114.3214	11.95521 *	1.12e-05*	-5.732653*	-5.110514	-5.517891
4	114.5152	0.287958	1.41e-05	-5.515157	-4.715264	-5.239034
5	119.2381	6.477048	1.38e-05	-5.556463	-4.578815	-5.218979

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error AIC: Akaike information criterion
SIC: Schwarz information criterion HQ: Hannan-Quinn information criterion

Annexure 3
Bivariate VARs in System A and B

System A1: Monetary Base - Money (M0 - M1) in bivariate VAR

Table A1.3: VAR Granger causality / Block exogeneity Wald tests for system A1

Null Hypothesis: No Granger Causality

Excluded	Dependent variable			
	m0		m1	
	χ^2 (df)	p values	χ^2 (df)	p values
m0			0.4741 (2)	0.789
m1	5.645 (2)	0.059		
Causality decisions	m1→ m0		m0 → /m1	

m1 and y represent log of M1 and Nominal GDP respectively.

VAR Granger Causality/Block Exogeneity Wald tests for system A1 shows that one cannot reject the null hypothesis of no causality from M0 to M1 meaning that M0 does not Granger cause M1. But M1 do Granger causes M0.

System A2: Monetary base - money (M0 – M2) in bivariate VAR
Table A2.3: VAR Granger causality / Block exogeneity Wald tests for system A2

Null Hypothesis: no Granger causality

Excluded	Dependent Variable			
	m0		m2	
	χ^2 (df)	p values	χ^2 (df)	p values
m0			1.367 (2)	0.505
m2	14.129 (2)	0.0009		
Causality decisions	m2→ m0		m0 → /m2	

m1 and y represent log of M1 and Nominal GDP respectively.

For Model A2 we cannot reject the null hypotheses of no causality from M0 to M2 meaning that M0 does not Granger cause M2. But M2 do Granger causes M0.

System B1: Money – income causality (M1 – GDP) in bivariate VAR
Table B1.3: VAR Granger causality / Block exogeneity Wald tests for system B1
Null Hypothesis: No Granger Causality

Excluded	Dependent variable			
	m1		y	
	χ^2 (df)	p values	χ^2 (df)	p values
m1			15.526 (2)	0.0004
y	3.863 (2)	0.1449		
Causality decisions	y →/ m1		m1 → y	

m1 and y represent log of M1 and Nominal GDP respectively.

VAR Granger causality/Block exogeneity Wald tests for system B1 shows that one can reject the null hypothesis of no causality from GDP to M1 meaning that GDP does not Granger cause M1. But M1 do Granger causes GDP.

System B2: Money – income causality (M2 – GDP) in bivariate VAR
Table B2.3: VAR Granger causality / Block exogeneity Wald tests for system B2
Null Hypothesis: No Granger Causality

Excluded	Dependent variable			
	m2		y	
	χ^2 (df)	p values	χ^2 (df)	p values
m2			33.952 (2)	0.0000
y	1.931 (2)	0.3807		
Causality decisions	y →/ m2		m2 → y	

m2 and y represent log of M2 and Nominal GDP respectively.

For System B2one can reject the null hypotheses of no causality from GDP to M2 meaning that GDP does not Granger cause M2. But M2 do Granger causes GDP.

Impact of Macro Economic Variables on the Financial Perfomance of Listed Companies in Bangladesh

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Abstract

There is an imperfection of leaning in the current empirical studies of the impact of macro-economic variables, such as, inflation, GDP, interest rate and exchange rate on the financial performance of the listed companies in Dhaka Stock Exchange (DSE). Most of the recent studies are carried on to show the impact of inflation, GDP, interest rate and exchange rate on the listed private and govt. banks in Bangladesh. Impact of macro-economic variables of financial performance varies industry to industry. Panel corrected standard error estimates on Prais–Winsten regression is used to determine the impact of macro-economic variables, such as, inflation, GDP, interest rate and exchange rate on the financial performance of the 81 listed companies from 2008 to 2012 in Dhaka Stock Exchange (DSE) of Bangladesh. The results found from the research put forward highly significant effect of macroeconomic variable especially interest rate, GDP and exchange rate on firm level performance suggesting that performance of a firm doesn't remain on itself rather it's a comprehensive outcome of macroeconomic policy.

***Key terms**: Inflation rate, Interest rate, GDP fluctuations and Exchange rate.*

Introduction

The economic condition of a country largely affects the financial performance of the companies in a country. If the economy runs well, then all general shareholders and investors of a particular company expect that the company might perform well with growth in wealth. The performance of the economy is measured by the sustainability of the macroeconomic conditions, such as, inflation, interest, GDP, exchange rate, CPI and stock market index. The expectation of shareholders and investors of a particular company in the micro and macro stage of an economy is that all macro-economic variables might be stable with sustainable business growth.

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Statement of the problem

There exists a significant relationship between macro-economic variables and profitability of a firm. The macro-economic fluctuations affecting the financial performance of a company include commodity price, supply of money, inflation, interest rate, GDP, exchange rate, political risk, oil price, deficit budget, deficit trade, consumer price index, employment rate, stock price and real wage (Menike, 2006). The Bangladesh economy has been attributed with the variations of macro-economic factors, such as, inflation, interest rate, GDP and exchange rate. The main focus of the professional investors and shareholders is such kind of fluctuations in macro-economic conditions. However, there are a lot of studies on the impact of macro-economic variables on the performance of the banking industry. There is an imperfection of knowledge in the current empirical studies resulting the impact of macro-economic variables, such as, inflation, GDP, interest rate and exchange rate on the financial performance of the listed companies in Dhaka Stock Exchange (DSE). But this study is very essential since manufacturing companies play a major role to achieve the vision 2021 in Bangladesh.

Olweny and Omondi (2011) investigated to determine the effect of macro-economic fluctuation on the stock market performance. This research shows that inflation, GDP, interest rate and exchange rate affect the variability of stock price significantly. It is also assumed by this research that all macro-economic variables affect the financial performance of the listed manufacturing companies in the same way. It may be mentioned that although all industries are affected by the macro-economic variables, the effects vary among the industries in terms of nature and range. In another research, Ongore and Kusa (2013) found that the financial performance of listed commercial banks is affected by the bank- specific factors.

In Bangladesh, the manufacturing industry faces challenges for high production cost, decrease in effective demand of consumers and insufficient government support. The effect of macro-economic variations on the financial performance of the listed companies in Dhaka Stock Exchange (DSE) is not justified adequately. Therefore, there is knowledge gap on the pattern and level of effect of the macro-economic variables on the financial performance of the listed companies in DSE. This research is designed to determine the effects of macro-economic fluctuations on the financial performance of the listed companies in DSE.

Objective of the Research

General Objective

The general objective of this research is to analyze the effect of inflation, GDP, interest rate and exchange rate on financial performance of some companies listed in the DSE.

Specific Objectives.

The specific objectives of this research are as follows:

1. To evaluate the effects of inflation rate fluctuation on the financial performance of the listed companies in Bangladesh.
2. To measure the effects of interest rate variation on the financial performance of the listed companies.
3. To analyze the effects of GDP fluctuation on the financial performance of the companies.
4. To ascertain the effects of foreign exchange rate fluctuations on the financial performance of the companies.

Literature Review

The selected literature deals with the profitability of the companies as a function of internal and external variables. This study concentrates on macro-economic variables. The external determinants are the factors that reflect the legal and economic environment in which a company operates, and affects company's performance. The main components of these macro-economic factors are inflation rate, real gross domestic product (GDP), real rate of interest and exchange rate. The following studies support the results of this paper. The recent studies carried out indicate the significant relationship between inflation rate, real interest rate, GDP and exchange rate and the profitability of a company. Moreover, multi-factor model has been developed to show the variation in security return, and the current literature shows a number of factors as responsible for variation in security returns (Chen et al. 2005). These variables include money supply, exchange rates, trade deficits, goods price, political risks, the trade sector, real activity, interest rates, domestic consumption, oil prices, budget deficits, rate of unemployment, imports and indices of regional stock market and real wage (Menike, 2006). Theoretical literature review includes the details of selected macro-economic variables. These are discussed sequentially. **The inflation** rate means the change in price level over a period of time in an economy. The change in price level has a significant effect on purchasing power of money and the cost of production of the commodity. The nominal rate of interest in an economy is composed of inflation rate and real interest rate. Therefore, the nominal rate will synthesize with the variations in inflation rate. **The interest** is an act of income. Ngugi (2001) argued that interest is the rental paid for money. The rate expected by lenders is called interest rate. According to Cowley (2007), interest rate is the rent that a borrower pays to the lenders for the use of borrowed fund. Excessive variations in interest rate significantly threat the capital base and earnings of the firm and increase the operating expenses. Variations in the rate of interest also affect the asset value, value of liabilities and the value of future cash flows today. World economy is experiencing cyclic variations in a boom and a recession period. In a boom situation the credit demand is very high compared to that in a recession period (Athanosoglou et al 2005). When there is a decreasing trend in GDP growth rate, the credit demand decreases which adversely affects the financial performance of a firm. On the other hand, when there is an increasing trend in GDP growth rate the credit demand also increases which positively affects the financial performance of a firm (Ongore and Kusa 2013). Exchange rate fluctuations occur due to the frequent changes in supply and demand for a foreign currency. These variations create foreign exchange risk for the companies. Normally

companies are experiencing three types of foreign exchange risk: economic, transaction and translation exposure (Eiteman et al., 2006).

Mamatzakis and Remoundos (2003) evaluated data of 17 Greek commercial banks from the year 1989 to 2000. Using a structure-conduct-performance framework, they found no significant linkage of CPI and real interest rate with ROA and ROE of banks. John et al (2008) analyzed the effect of interest rate on the stock return of banks of Australia during the years 1990 -2005. In their study, they found that the stock return was positively affected by the interest rate. By using feasible generalized least square (FGLS) method Wong et al (2006) proved that GDP and inflation have a noticeable impact on asset returns. Menike (2006) examined the effect of interest rate, GDP fluctuation, exchange rate and inflation rate on stock prices in the stock market of Sri Lanka from the years 1991-2002. The results indicated that most of the companies reported a higher R^2 which justifies higher explanatory power of exchange rate, interest rate, inflation rate and GDP fluctuation variables in explaining stock price variability. In the line of the results found in the developed as well as emerging market researches, inflation and exchange rate respond mainly negatively to stock prices in the Colombo Stock Exchange (CSE). The negative effect of Treasury bill rate implied that whenever the interest rate on Treasury securities rise, investors like to liquidate stocks causing stock prices to fall. However, lagged money supply variables appeared to have a strong prediction of movements of stock prices while stocks did not provide effective hedge against inflation especially in Manufacturing and Trading sector in the CSE. Working on Indonesian banking industry of Anwar and Herwany (2006) showed significant relation of economic growth, inflation rate and real interest rate with ROA at 1% level but not with ROE. Sufian and Chong (2008) studied performance of banks in the Philippines. Results of linear regression reveal the insignificant positive impact of GDP on ROA but negative impact of inflation. Using fixed effects estimation technique, Davydenko (2011) proved that both GDP and Inflation have a positive contribution to ROA of Ukrainian banks. Likewise, Damena (2011) performed comparative analysis using 10 years balance sheet data of seven leading Ethiopian commercial banks and it confirms significant association of GDP, inflation and interest rate with earnings. In the above the research, there is a knowledge gap in the macro-economic impacts on the profitability of listed companies in Dhaka Stock Exchange in Bangladesh. The studies carried in other countries are not applicable in Bangladesh due to various economic environments. The effects of all macroeconomic variables are unique to every industry. Although macro-economic variables affect all industries of an economy, the nature and spread of these effects vary from industry to industry. Thus this research is carried to determine the macro-economic impacts on the financial performance of the listed companies in Dhaka Stock Exchange.

Methodology and Sources of Data

Manufacturing and service oriented companies listed on Dhaka Stock Exchange are used in the sample of this study. This study covers 81 listed companies on Dhaka Stock Exchange from 2008 through 2012. Secondary annual balanced panel data of selected companies for 5 years (2008-2012) have been used. The source of

macroeconomic data for this study is World Bank Publication (WDI, 2012). For calculation of financial ratios, data are obtained from unconsolidated annual financial statements of banks. Where stand alone statements were not available, consolidated financial statements have been used. In order to examine the external factors that affect the profitability of listed companies in Bangladesh, the technique of Descriptive statistics, Prais-Winsten regression (Wooldridge 2008), correlated panels corrected standard errors have been used.

Table 1 provides the details of dependent variables and Table 2 shows the details of independent variables.

Table-1. Dependent Variables and Their Assessment

Variable	Variable Name	Assessment
ROA	Return on Assets	Net Income/Total Assets
ROE	Return on Equity	Net Income/ Shareholder's Equity
EM	Equity Multiplier	Total Assets/ Shareholder's Equity
* After-Tax Net Income is used to calculate ROA and ROE ratio		

ROA measures the profit earned per Taka of assets and reflects the efficiency of Companies' management to earn profits using financial and real resources. ROE ratio reflects the effectiveness of Companies' management to transform every unit of shareholder's equity into profit. Equity multiplier measures the amount of assets in Taka that an institution supports with one Taka of shareholders' equity (Accounting dictionary, 2012). It is considered a measure of profitability as it has a multiplier effect on ROA to determine the Companies' ROE (Grier, 2007). It shows financial leverage. It raises the shareholders' return if earnings are positive (Financial leverage, 2012; Stock research pro, 2009). However, some studies (Almazari, 2012; Naïmy, 2005) utilize equity multiplier in DuPont system of financial analysis of companies' data.

Table-2. Independent Variables and Their Assessment

Variable	Variables Nam	Assessment	Hypothesize relationship with profitability
INF	Inflation Rate	Annual % change in consumer Price	+/-
GDP	Real Gross Domestic Product	Annual growth rate of economy	+/-
INT	Real Interest Rate	Lending rate adjusted to inflation	+/-
ER	Annual exchange rate	Average annual exchange rate	+/-
*Inflation rate, Real interest rate and Real GDP are taken in percent form. *Real interest rates was calculated using average lending rate for a year adjusted with inflation			

Pooled Ordinary least squares (POLS) regression equation used for empirical analysis is as follows:

$$Y\,it = \beta_0 + \beta_1 X_1 it + \beta_2 X_2\,it + \beta_3 X_3\,it + \beta_4 X_4\,it + e_{it} \text{----------} 1$$

Where; Y it = ROA, ROE and EM, X_1it = Inflation Rate, X_2 it = Real Interest Rate, X_3 it = Real Gross Domestic Product, X_4 it = Real Exchange Rate, β_0 = Value of x-intercept which is constant, β_1, β_2, β_3& β_4 = Proportionate change in dependent variable due to independent variables, i = 1 to 81 Companies, t = 2008 -2012, e = Error term.

The study proceeds to follow panel corrected standard error methodology developed by Beck and Kartz (1995, 1996). Since panel data model very often suffer from nonsperical errors that is any or all of the followings

Contemporous Correlation
Panel heterosedasticity
Serial Correlation,

It is highly recommended by Beck and Kartz (1995, 1996) to use PCSE method to improve inferences regarding the complexity of error structures in panel data model. Ordinary least square (OLS) with incorrect standard errors resulting from nonsperical errors would not be the Best Linear Unbiased Estimators (BLUE). Generalized least square (GLS) takes into account all problems of errors and adjust them to produce correct standard errors and becomes BLUE. But true variance-covariance matrix (Ω) to weight the data is unknown in real problem made a narrower applicability of GLS techniques. Therefore, researcher's preferred Feasible Generalized least square (FGLS) technique where estimated variance-covariance matrix is used.

Beck and Katz (1995) identified incorrect standard errors in application of FGLS model in panel data. It is well regarded that FGLS requires large observation to provide precise standard error. FGLS often provides brash standard errors unable to fully adjust complex error structure.

Beck and Katz (1995, 1996) demonstrate the ability of PCSEs to generate more reliable standard errors than FGLS method through Monte Carlo studies. To take into all complexity of error, we use PCSEs with specifying autocorrelation with panel-specific coefficients of correlation denoting the parameter β are estimated by Prais–Winsten (otherwise no autocorrelation has been specified, the parameters of β are estimated in OLS). When autocorrelation with panel-specific coefficients of correlation is specified each panel-level ρ_i is computed from the residuals of an OLS regression across all panels.

The most common autocorrelated error process is the first-order autoregressive process. Under this assumption, the linear regression model can be written as

$$Y_t = \alpha + \beta X_t + u_t$$

where the errors satisfy

$$u_t = \rho\, u_{t-1} + e_{it}$$

and the e_t has been independently as well as identically distributed as N (0; σ^2).

When autocorrelation with a common coefficient of correlation is specified, the common correlation coefficient is computed as

$$p_i = \frac{p_1 + p_2 + ... + p_m}{p_m}$$

Where ρ is estimated coefficient for autocorrelation for panel i and m is the number of panels.

Then in calculating PCSEs, we have Ω, an NT*NT block diagonal matrix with ∑ and N*N matrix of contemporaneous correlation along the diagonal. OLS residuals, denoted $e_{i,t}$, for unit i at time t are used to estimate the elements of ∑.

$$\sum_{i\ j} = \frac{\sum_{t=1}^{T} e_{i,t}\ e_{j,t}}{T}$$

Now the standard errors of the coefficients are computed using the square roots of diagonal elements of

$(X'\ X)^{-1} X'\ \Omega X\ (X'\ X)^{-1}$

Then X denotes the NT * NT matrix of stacked vector of explanatory variable, $X_{i,t}$.

Data Analysis and its Interpretation

Descriptive statistics of data accumulated for this study are given in table 3. Summary statistics have been computed using the Excel data analysis tool.

Table-3. Descriptive Statistics for Variables Included in the Study

	ROA	ROE	EM	INF	GDP	INT	ER
Mean	5.613	16.035	1.586	8.346	6.180	5.714	91.160
Median	3.711	8.600	1.791	8.780	6.200	4.850	91.300
Maximum	91.405	626.811	79.170	10.330	6.700	9.070	97.700
Minimum	-21.810	-775.681	-276.072	5.530	5.700	2.970	86.000
Std. Dev.	8.604	69.148	15.641	1.580	0.319	2.231	3.814
Skewness	2.935	0.332	-13.230	-0.725	0.182	0.334	0.495
Kurtosis	28.510	72.249	249.765	2.535	2.446	1.610	2.419
Observations	405	405	405	405	405	405	405

Table 3 shows that the average return on assets of listed for companies in the past 5 years was about 6%, where as the ROE was 16%. ROE between 15% -20% is considered acceptable (Fraker, 2006). Also the selected companies under this study vary due to their size and level of establishment. The average EM ratio of selected companies was about 2% in the study periods. The Table also shows that the average consumer price inflation rate of Bangladesh has been 8.34% during this period. In case of interest rate, in 5 years, banks have been charging around 6% rate of real interest. On an average, the growth rate of Bangladesh's economy is 6.18% during 2008-2012.

Results of Model 1

Below is the regression equation for first model which shows the three external factors influencing ROA. Table 5 gives the details of empirical results of model 1.

$ROA = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 GDP + \beta_4 ER + €$ ----------2

Table 4. Empirical Findings Where Dependent Variable: ROA

Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)

	Panel-corrected					
ROA	Coefficient	Std. Error	Z	P>[Z]	[95% confidence interval]	
INF	0.059	0.14	0.42	0.68	-0.220	0.339
INT	0.051	0.12	0.41	0.68	-0.191	0.292
GDP	1.32	0.43	1.58	0.113	-0.313	2.95
ER	0.123	0.036	3.40	0.001	0.052	0.194
Const.	-14.24	7.94	-1.79	0.073	-29.81	1.334
RHOS	0.55	0.79	.280	0.667	0.373	0.676
Wild chi^2 (4) : 42.6						
Prob > Chi^2 : 0.000						

The value of regression table 4 reflects about 42.6 as wild chi^2 presenting contribution of macroeconomic variables (inflation, real interest rate, GDP and real exchange rate). Similarly inflation, real interest rate, GDP and real exchange rate have positive impacts on the financial performance of the listed companies.

Among these macro-economic variables inflation, real interest rate and GDP have negligible imfact and only the exchange rate has a very significant positive contribution to the financial performance of the listed companies.

Results of Model 2

The regression results of second model which computes the effect of independent variables on ROE are given in Table 6.

$ROE = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 GDP + \beta_4 ER + €$ ----------3

Table 5. Empirical Findings Where Dependent Variable: ROE

Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)

ROE	Panel-corrected Coefficient	Std. Error	Z	P>[Z]	[95% confidence interval]	
INF	5.268	2.361	-2.23	0.026	-9.896	-0.640
INT	11.665	1.781	6.55	0.000	8.174	15.155
GDP	80.665	13.304	6.06	0.000	54.590	106.739
ER	2.010	0.563	3.57	0.000	0.0907	3.113
Const.	-686.599	122.03	-5.63	0.000	-925.78	-447.416
RHOS	-0.209	0.622	0.709	-0.089	0.600	-0.322
Wild chi^2 (4) : 88.63 Prob > Chi^2 : 0.000						

In the above Table 5 the Wald ch² value is around 88 .63 which shows a very significant contribution of selected macroeconomic variables to the ROE of the listed companies. Among all the macro-economic variables real interest rate, GDP and exchange rate have positive impact on ROE of the companies and only inflation has a negative impact on ROE of the companies.

In the table, P values of all macro-economic variables are less than 0.05 which means all macro-economic variables affect ROE of the companies significantly.

Results of Model 3

The regression results of third model incorporating EM are reported in table 7. The regression equation for third model is given as follows.

$EM = \beta_0 + \beta_1 INF + \beta_2 INT + \beta_3 GDP + \beta_4 ER + €$ ----------4

Table-6. Empirical Findings Where Dependent Variable: EM

Prais-Winsten regression, correlated panels corrected standard errors (PCSEs)

EM	Panel-corrected Coefficient	Std. Error	Z	P>[Z]	[95% confident interval]	
INF	-4.289	0.442	-9.71	0.000	-5.154	-3.423
INT	-0.916	0.229	-3.98	0.000	-1.366	-0.465
GDP	11.828	2.185	5.41	0.000	7.546	16.11
ER	-0.626	0.0797	-7.85	0.000	-0.782	-0.469
Const.	26.56	16.99	1.56	0.119	-6.785	59.83
RHOS	0.256	-0.388	0.463	-0.604	-0.454	-0.723
Wald chi^2 (4) : 149.55 Prob > Chi^2 : 0.000						

In Table 6 above, the Wald chi^2 value is around 149.55 which show a very significant contribution of selected macro-economic variables to the EM of the companies. There is a significant negative relationship of inflation, real interest rate and exchange rate with EM and a positive relationship of GDP with the EM of the companies. In the above table, the p values of all macroeconomic variables are less than 0.05 which indicates that all factors affect the EM of the companies very significantly. Moreover, the relationship of inflation, real interest rate and exchange rate with EM is negatively significant and the relationship of GDP with the EM of the companies is positively significant.

Summary of Findings and Recommendations

Summary of Findings

This research is carried out to determine the macro-economic impacts on the financial performance of the listed companies in Dhaka Stock Exchange. The effect of four macro- economic factors viz on: Interest rates, inflation, GDP and exchange rate fluctuations were considered on the manufacturing sector. Inflation, real interest rate, GDP and real exchange rate have positive impacts on the financial performance of the listed companies. Among these macro-economic variables, inflation, real interest rate and GDP have a very negligible and only the exchange rate has a very significant positive contribution to the financial performance of the companies. Among all the macro-economic variables real interest rate, GDP and exchange rate have positive impact on ROE of the selected companies and only inflation has a negative impact on ROE of the companies. P values of all macro-economic variables are less than 0.05 which means all macro-economic variables affect ROE of the companies significantly. There is a significant negative relationship of inflation, real interest rate and exchange rate with EM and a positive relationship of GDP with the EM of the companies. In the above table, the p values of all macroeconomic variables are less than 0.05 which indicates that all factors affect the EM of the companies very significantly. Moreover, the relationship of inflation, real interest rate and exchange rate with EM is negatively significant and the relationship of GDP with the EM of the companies is positively significant.

Recommendations

Manufacturing, construction and agriculture are the vital sectors of Bangladesh economy. If the macro-economic factors adversely affect the financial performance of these sectors, the overall economy will also be adversely affected. So the government of Bangladesh should take necessary steps and policies to protect the manufacturing, construction and agriculture sectors because of their vast contribution to the economy. The government can patronize the central body, Bangladesh Bank to formulate and apply the policies to control the effects of accelerated variations of the macro-economic factors and their impacts on the financial performance of the key sectors.

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Legal Status of International Human Rights Instruments in the Domestic Legal System of South Asian Countries

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Abstract

The success of international Human Rights instruments mostly depends on the implementation in the national level. Because of the doctrine of state sovereignty, only nation state can implement these documents in their domestic level. The status of Human Rights treaties differs from country to country, region to region. This paper has tried to focus only South Asian Region. Almost all the South Asian countries are the signatory State Party of most of the core International Human Rights Instruments. This paper has tried to find out the legal status of these Human Rights Instrument in the national legal system of the South Asian countries. An effort has been taken by this paper to elucidate the position of judiciary as regards the incorporation of Human Rights conventions in the domestic legal system of South Asian countries.

Initial Remarks

The concept of Human Rights is as old as human being and originated with human species. It can be said that in the field of legal paradigm the notion of Human Rights is materialised in the international instruments by world community that is the best invention of human kind. Human rights are those rights, which are indispensable for human lives to exist in the planet. All human rights—civil, cultural, economic, political and social—are recognized as a universal, indivisible and interdependent body of rights, as originally foreseen in the 1948 Universal Declaration of Human Rights (United Nations Handbook, 2005). The national integration of international Human Rights norms and standards has taken place over many decades since the adoption of the UDHR in 1948 and the progressive ratification of an increasing number of multilateral Conventions (Goonesekere, 2013). Treaty monitoring bodies have in progress reviews of State Party reports called for harmonization of domestic law and policy with State obligations under treaties (Goonesekere, 2013). However, direct incorporation of international Human Rights treaties or any other treaties is common in civil law countries but rare in common law countries. Because maximum civil law countries follow monism doctrine, on the other hand common law countries follow dualism system. In the latter, the prevailing practice is not to make a treaty itself part of the national legal framework, but rather to amend existing legislation (UNICEF, 2007). In these cases, new laws are adopted as needed in order to ensure that the rights, principles and obligations contained in the

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treaty also form part of national law (UNICEF, 2007). The parliaments of common law countries can adopt laws that incorporate Human Rights treaties into national law – the Human Rights Act 1998 that makes the European Convention for the Protection of Human Rights and Fundamental Rights enforceable in the United Kingdom, is a leading example – but such laws remain rare (UNICEF, 2007). The position of South Asian countries regarding the legal status of Human Rights treaties is not making any difference as regard of application of Human Rights treaties. This paper has tried to examine the legal status of International Human Rights Instruments in the domestic legal System of South Asian countries. An attempt has been taken by this paper to analyse the position of International Human Rights Instruments in the municipal laws of SAARC countries as compared with public international law. Another important aspect of this paper is to find out the national implementation of International Human Rights Instruments and the role of Judiciary in the respective countries of South Asia.

General Overview on the Status of International Human Rights Instruments at National Level

The basic law of a country is critical in ensuring that State Party obligations under treaties are not merely inspirational political commitments, but create procedure for ensuring accountability to the beneficiaries of rights under international instruments (Goonesekere, 2013). There are only two ways through which states can comply with their legal international obligations as contained in treaties: firstly, by observing or respecting their national laws (constitution or statute law) which are consistent with international norms; and secondly, by making those international norms or obligations part of the national legal or political order, that is, they become domesticated (Bangamwabo, 2008). As international treaties usually say little about how States Parties have to implement their international legal obligations within their domestic legal orders, the starting point for figuring out how international law is integrated into and applied within a national legal order is – in most instances – the national constitution (Neudorfer & Wernig 2010). Post independence National Constitutions in developing countries of Non-European regions have adopted the practice of including Bills of Rights in their basic law that deals with the system of governance (Goonesekere, 2013). South Asian countries are not the exceptions. All of the South Asian Countries have already adopted a list of Fundamental Human Rights in their respective constitutions that are enforceable by the court of law to form the basic international Human Rights Instrument. The international Human Rights system seeks to persuade or put pressure on member states to meet their international obligations under Human Rights Instruments that they have ratified or to which they have acceded (Bangamwabo, 2008). Two different constitutional approaches exist: the transformation approach, following the theory of dualism on the one hand and the incorporation approach, following the theory of monism on the

other hand (Neudorfer & Wernig 2010). Monist view is that there is no distinction between international law and domestic law. If any monist country enters into any international treaty or convention, this treaty will be enforceable in the domestic legal system of that country. However, in case of dualism, international treaty or convention will not be applicable in the domestic legal system of these countries; the national implementing legislation will be must. To the dualist, international law cannot claim supremacy within the domestic legal system, although it is supreme in the international legal system (Bangamwabo, 2008). Therefore, the legal status of International Human Rights Instruments is same as like as national legislation in the monist countries. However, the problem arises in case of dualist countries. Almost all the South Asian countries follow dualist approach regard to implementation of any international treaty or convention. Therefore, the International Human Rights treaties also do not automatically become part of domestic legal system in the South Asian countries. Thus, it is necessary to analyse the legal status of International Human Rights Instruments in the domestic legal system of South Asian countries under the following heads.

The position of Afghanistan regarding the Legal Status of Human Rights Treaties in its Domestic Legal System

Before examining the status of international Human Rights Instrument in the domestic legal system of Afghanistan we have to know what the domestic legal system in Afghanistan is; what the status of international law in the municipal law of Afghanistan etc. Like many other developing countries, Afghanistan's official law, i.e. the formal legal system established under the provisions of a constitution, does not represent the *de facto* norms that govern the lives of the majority of the population (Lau, 2003). In Afghanistan, the system of domestic law includes the Constitution of Afghanistan (which also incorporates Islamic law through Article 3), state codes, state laws, decrees, and regulations (Afghanistan Legal Education Project, 2011). It is unclear as regards the status of international law or the international Human Rights treaties of which Afghanistan is a State Party. The National Assembly has the power to ratify international treaties and agreements, as well as abrogate Afghanistan's membership in them (Afg. Const. Art. 90, s 5). The Supreme Court has the power to review international treaties and covenants for compliance with the domestic laws and to interpret them in accordance with the law, but only at the request of the Government or courts (Afg. Const. Art. 121). On the other hand, The Supreme Court also has the power to decide cases in accordance with the provision of the law, which may include the power to resolve conflicts between governing international and domestic laws (Afg. Const. Art. 120). The Constitution of Afghanistan gives the power to the President over signing bilateral and international treaties (Afg. Const. Art. 64, s 17). However still it is confusing that which system Afghanistan is following in respect of the incorporation of

international law into the national legal system: dualism or monism. We know that there are some countries, which are neither strictly dualists nor strictly monists. Conversely, Afghanistan's approach to reconciling international law and treaties with Afghanistan's domestic legal system is still unclear because neither the Supreme Court of Afghanistan nor the Independent Commission for the Supervision of the Implementation of the Constitution has ruled on the issue (Afghanistan Legal Education Project, 2011). In case of International Human Rights Instrument, what the position of Afghanistan is required to examine or what the status of these documents in the domestic legal system of Afghanistan is. In the preamble of the constitution of Afghanistan, it said that we the people of Afghanistan observing the United Nations Charter as well as the Universal Declaration of Human Rights have, herein, approved this constitution. Now if we read between the lines of these words we can find some interpretation. According to one possible interpretation of this language, the members of the Loya Jirga intended the people of Afghanistan to be bound by the United Nations Charter and the Universal Declaration of Human Rights (Afghanistan Legal Education Project, 2011). This suggests that they are therefore binding as part of the domestic law of Afghanistan (Afghanistan Legal Education Project, 2011). Academics have long debated whether constitutional preambles are binding and, for that matter, whether preambles should be considered part of the constitution at all (Afghanistan Legal Education Project, 2011). Although the preamble of the constitution is ratified just the same as the body of the constitution but it is separated from the body, and therefore might not contain binding normative law (Afghanistan Legal Education Project, 2011). According to the Article 7 of the Constitution of Afghanistan, the state shall abide by the UN Charter, international treaties, international conventions that Afghanistan has signed, and the Universal Declaration of Human Rights. So it seems that Article 7 has incorporated the United Nations Charter, inter-state agreements, international treaties to which Afghanistan has joined, and the Universal Declaration of Human Rights into the domestic legal system of Afghanistan. Because here it is said, "Afghanistan the state shall abide" which means the state is bound to follow the international instrument as, said in the Article. On the other hand, another interpretation is that this article said about the State, which is bound by these documents not the domestic legal order of Afghanistan. This is also very much confusing that whether under this Article the international Human Rights Instruments can be enforceable by the court of law or not. We know that Constitution is the Supreme law of the land where the supremacy of the constitution exists. Therefore, in a sense under this Article the State is bound to follow this does not mean that the court of law cannot take into consideration of the provisions. However, The Afghan Constitution contains several important protections for international Human Rights that are recognized by the various international Human Rights Instruments. Undeniably, the Constitutional spirit regarding the UN Charter

and its guarantee to observe international Human Rights is incomparable in the history of Afghanistan. It is affirmed by Article 6 of the constitution that the state is obliged to create a prosperous and progressive society based on social justice, protection of human dignity, protection of human rights, realization of democracy, and to ensure national unity and equality among all ethnic groups and tribes and also Article 7 states further that the state shall abide by the UN Charter, international treaties, international conventions that Afghanistan has signed, and the Universal Declaration of Human Rights. Thus, this constitutional provision is apparently obligating Afghanistan to respect its treaty obligations under international law. Mandana Knust Rassekh Afshar conducts a case study that *Abdul Rahman* accused of rejecting Islam and converting to Christianity 16 years ago when he was working for a Christian relief organisation in neighbouring Pakistan as a medical aid officer caring for Afghan refugees. When he returned to Afghanistan to settle a custody battle for his daughters, he was arrested after his family denounced him to the police, accusing him of becoming a Christian. In an interview with the Associated Press, the competent judge stated, "We are not against any particular religion in the world. Conversely, in Afghanistan, this sort of thing is against the law. It is an attack on Islam ... The prosecutor is asking for the death penalty". Nevertheless, *Abdul Rahman* avowed himself a Christian when questioned by the competent judge. High-ranking state officials and dignitaries called for his release, reminding Afghanistan of its duty under international Human Rights law to respect the freedom of religion. Afghanistan's judiciary was vexed by the external intervention, recalling that it was a sovereign and independent nation. Finally, the indictment was rejected on procedural grounds and *Abdul Rahman* was released (Afsar, 2007). This writer also said that as regards the recourse to Islamic Jurisprudence, Article 7 of the Constitution must also be considered (Afsar, 2007). Article 7 stipulates that Afghanistan has an obligation to abide by the Charter of the United Nations, the treaties and conventions it has ratified, and the Universal Declaration of Human Rights (Afsar, 2007).

However Afghanistan has ratified many of the world's most important and far reaching Human Rights treaties, including the International Covenant on Economic, Social and Cultural Rights (ICESCR); International Covenant on Civil and Political Rights (ICCPR); Convention Against Torture and Other Cruel or Degrading Treatment; International Convention on Elimination of all Forms of Racial Discrimination (CERD); and the Convention on the Rights of the Child (CRC) (Afghanistan Legal Education Project, 2011). By ratifying these treaties, Afghanistan has agreed to recognize and uphold a broad range of human rights, including the rights in the treaties (Afghanistan Legal Education Project, 2011). Afghanistan is not only bound in its international obligations to its treaty partners, but it is also constitutionally obliged to its own citizens to abide by the obligations it

willingly accepted and to enforce under domestic law the rights contained therein (Afsar, 2007).

Legal Status of Human Rights Treaties in the Domestic Legal System in Bangladesh

As like other common law countries, Bangladesh follows dualistic approach as regards the ratification and incorporation of international treaty within the domestic law (Ashraful, 2014). There is no clear provision regarding the application of international law in the domestic legal system and the constitution, which is the supreme law of the land, also silent regarding the implication of treaty or convention. Therefore, in case of legal status of International Human Rights documents also remain unclear more specifically there is no direct applicability of International Human Rights Instruments in the Municipal Legal System. The constitution of Bangladesh contains only two main provisions regarding the international law; one of them Article 25 and another is Article 145A. But Article 25 of the constitution simply refers to the promotion of international peace, security and solidarity in accordance with the basic principle of international law. So this Article said Bangladesh will follow the basic principles of international law in case of promotion of international peace and security and solidarity but not obligate the country to follow these basic principles and it means that if any contradiction arises between International law and Municipal law the Municipal law shall prevail. On the other hand this Article is the guiding Principle of State Policy which is not enforceable by the court of law. Article 145A of the constitution provides that all treaties with foreign countries shall be submitted to the President, who shall cause them to be laid before parliament, provided that any such treaty connected with national security shall be laid in a secret session of parliament." This provision of the constitution provides one kind of obligation to present treaty before the parliament only for discussion not for ratification. So no international treaty including Human Rights treaty will be directly applicable in the domestic legal system of Bangladesh.

The parliament of Bangladesh has no power under the constitution to modify or repeal any treaty but can implement any treaty including Human Rights treaty by enacting legislation regarding the particular treaty into domestic law. Courts in Bangladesh cannot enforce treaties even if ratified by the state whether it is Human Rights treaty or any other kind of treaty. The question arose before the Supreme Court of Bangladesh in the case of *Chaudhury and Kendra vs. Bangladesh and others* that whether forced marriage is permissible under the domestic law of Bangladesh and conflicted with Bangladesh's international obligations under Human Rights treaties that Bangladesh has ratified or acceded to, particularly regarding the rights of women. In this case, the Court referred the Article 16 of the UDHR under which every man and women of full age have the right to marry.

However, the Court expressed its restrictive view that the international conventions or treaties or any other instruments do not have applicability in the domestic legal system unless incorporated in legislation. Yet the court does utilize international Human Rights Instruments as an aid to interpretation of the provisions of Part III of the constitution, particularly to determine the right to life and the right to liberty, but not to enumerate within the Constitution. In the case of *Ershad vs. Bangladesh and others* that although universal Human Rights norms, whether given in the UDHR or in the Covenants, are not directly enforceable in national courts they are enforceable by domestic courts if such norms are incorporated into the domestic law. *B B Roy Chowdhury J* expressed his opinion in the paragraph 3 of this case that

> "*Although universal human rights norms, whether given in the UDHR or in the Covenants, are not directly enforceable in national courts, they are enforceable by domestic courts if such norms are incorporated into the domestic law. However, national courts should not ignore the international obligations, which a country undertakes. National courts should draw upon the principles incorporated in the international instruments if the domestic laws are ambiguous or absent. Where the domestic laws are clear, but inconsistent with the international obligations of the state concerned, the national courts will be obliged to respect national law. The universal norms of freedom of leaving the country and returning have been recognised in Article 36 of the Constitution, and there was full application of Article 13 of the UDHR to the fact of this case.*"

The application of the International Human Rights Instruments including UDHR, ICCPR, ICESCR, CEDAW in the municipal legal system has been clarified by the Supreme Court of Bangladesh in *BNWLA vs. Government of Bangladesh* that it has now been settled by several decisions of this subcontinent that when there is a gap in the municipal law in addressing any issue, the courts may take recourse to international conventions and protocols on that issue for the purpose of formulating effective directives and guidelines to be followed by all concerned until the national legislature enacts laws in this regard. In the case of *Tayazuddin and another v Bangladesh* it was held that the Government is responsible for ensuring a free and fair trial not only to the accused but also to the victim of a crime. In essence, the fair trial of the accused also implies that the victim must be able to give evidence without fear and insecurity. In support of this judgment, the court had recourse to the universal Human Rights norm of the right to life, liberty and security of a person. Article 32 of the Constitution, 1972 states that no person shall be deprived of life or personal liberty saves in accordance with law. Article 3 of the Universal Declaration of Human Rights, Resolution 217A (III); UN Doc A/810 91, UN General Assembly, 1948 ('UDHR') provides for the right to life, liberty and security of a person. Articles 27, 31 and 32 of the Constitution impose a duty and obligation

on the state to protect and safeguard a citizen of the Republic and ensure his security. In another case, the court found that Bangladesh is a State Party to the international Convention of the Rights of Child, 1989; the treaty is binding on Bangladesh (*Zahida Ahmed (Liza) vs. Syed Noor Uddin Ahmed and another*). However, the courts would not enforce international Human Rights treaties, even if ratified by Bangladesh, unless these were incorporated in municipal laws, but they would have looked into the ICCPR while interpreting the provisions of the constitution to determine the right to life, liberty and other rights. Although the Constitution of Bangladesh is the Supreme law of the land does not contain any express provision as to the application of international Human Rights treaties in the domestic legal system. In some situation court has tried to identify the status of treaty under the constitution and made some clarifications which have been discussed above. It is identified that the status of all treaties are not same particularly to some Human Rights treaties and conventions (Ashraful, 2014). However, the status of Human Rights treaties in the domestic law still remains in many cases unclear. It can be concluded that except to the extent that a treaty becomes incorporated into the laws of Bangladesh by an Act of Parliament, the Courts have no power to enforce the treaty rights and obligations at the behest of sovereign government or at the behest of a private individual.

Legal Status of Human Rights Treaties in the Domestic Legal System in India

International treaties including international Human Rights Instruments do not automatically become part of the domestic law in India. India follows the dualistic theory for the implementation of international law in the national level like other South Asian countries. It has need of the legislation to make by the Parliament for the operation of international law in India.

According to the Constitution of India, the state shall endeavour to foster respect for International Law and Treaty obligations in the dealings of organized people with one another (Ind. Const. Art. 51). Article 51 has relied upon by Courts to hold that various International Covenants, Treaties etc., particularly those to which India is a party or signatory, become part of domestic law as far as there is no conflict between the two. It is pertinent to mention that article 51 enshrines one of the Fundamental Principles of State policy (DPSP), embodied in Part IV of the Constitution (Agarwal, 2010). The directive principles, according to Article 37, are not enforceable through the court of law, nevertheless they are fundamental in the governance of the country and there is a no obligatory duty on the part of the State to apply these principles in making of laws (Agarwal, 2010).

In *Unnikrishnan v. State of Andhra Pradesh* the Supreme Court of India has utilized Article 51(c), which merely required the State to foster respect for international law and treaty obligations, for the purpose of protecting Human Rights and bringing about a social order which did away with inequality and extended justice to the

extent of the powers of the Supreme Court. Article 253 gives the power to enact laws implementing treaties, conventions etc. to the parliament. According to the Article, parliament has power to make any law for the whole or any part of the territory of India for implementing treaty, agreement or convention with any other country or countries or any decision made by any international conference, association or other body. However, it is important to mention here that all treaties are non-self-executing and hence domestic legislation is required to execute any treaty (Ashraful, 2014).

The traditional view held by Basu on one hand who advances the view that no treaties which have not been implemented by legislation are binding on the municipal courts, relying on Article 253 of the Constitution (Kadoliya, 2007). On the other hand, Alexandrowicz contends that not all treaties must be implemented by legislation. He cites several cases as authority for assuming that certain treaties only, such as treaties affecting private rights, must be enacted by legislation to become enforceable (Kadoliya, 2007).

In this respect, Indian judiciary, though not empowered to make legislations, has interpreted India's obligations under international law into the constitutional provisions relating to implementation of international law in pronouncing its decision in a case concerning issues of international law (Agarwal, 2010). Through "judicial activism", the Indian judiciary has played a proactive role in implementing India's international obligations under International treaties, especially in the field of Human Rights and environmental law (Agarwal, 2010). In *Jolly George Verghese & Anr vs the Bank of Cochin* it was contended that from the perspective of international law the question posed is whether it is right to enforce a contractual liability by imprisoning a debtor in the teeth of Art.11 of the International Covenant on Civil and Political Rights. It is also argued that the International Covenants on Civil and Political Rights are part of the law of the land and have to be respected by the Municipal Courts. However, it was held that

> "*The remedy for breaches of International Law in general is not to be found in the law courts of the State because International Law of per se or proprio vigore has not the force or authority of civil law, till under its inspirational impact actual legislation is undertaken. In short, the basic human rights enshrined in the International Covenants above referred to, may at best inform judicial institutions and inspire legislative action within member-States; but apart from such deep reverence, remedial action at the instance of an aggrieved individual is beyond the area of judicial authority"*

In 1997, in the case of *Vishakha and Others vs. State of Rajasthan*, the Supreme Court, in a landmark judgement, referred to the importance of international norms, particularly CEDAW, in providing guidelines for protecting the rights of women (Saksena, 2007). However, the Supreme Court observed in this case that

> *"In the absence of domestic law occupying the field to formulate effective measures to check the evil of sexual harassment of working women at all work places, the contents of International Conventions and norms are significant for the purpose of interpretation of the guarantee of gender equality, right to work with human dignity in Articles 14, 15, 19(1)(g) and 21 of the Constitution and the safeguards against sexual harassment implicit therein. Any international convention not inconsistent with the fundamental rights and in harmony with its spirit must be read into those provisions to enlarge the meaning and content thereof, to promote the object of the Constitutional guarantee".*

Thus, in absence of specific domestic legislation enacted by the Parliament, the India's international obligations are not enforceable in Indian courts (Agarwal, 2010). However, a perusal of the jurisprudence shows that a pro-active role is being played by Indian judiciary in implementing India's international obligations under International treaties, especially in the field of Human Rights and environmental law (Agarwal, 2010). Thus, Indian judiciary through "judicial activism" fills up of the gaps in the municipal law of India and International law, thereby playing an important role in the implementation of international law in India (Agarwal, 2010).

Legal Status of Human Rights Treaties in the Domestic Legal System in Nepal

Domestication of international instruments, broadly speaking, is a process of giving effect to the provisions enumerated in the instruments to which the state is a party at the national arena (National Human Rights Commission, 2007). Human rights are incorporated as fundamental rights in Nepali Laws. Nepal has acceded many basic International Human Rights Instruments and placed them in its legal system. In Nepal there is a treaty Act relating to the ratification, accession or adoption of international treaty or agreement beside the constitutional provision, which is the exception of SAARC countries because none of the SAARC countries have treaty Act or legislation as like Nepal (Ashraful, 2014). The Interim Constitution, 2063 BS (2007) is considered to the most progressive among all the constitutions promulgated in Nepal to date in terms of the provisions related to Human Rights (Centre for Constitutional Dialogue, 2009, p. 4).

Laws inconsistent with the Interim Constitution including its Human Rights provisions, are declared "void", and therefore without force or effect (Interim Constitution of Nepal, art. 164(2)). Article 156 of the interim Constitution of Nepal provides the provisions relating to the ratification of, accession to, acceptance of or

approval of, treaty or agreement. According to the Article 156(1) the ratification of, accession to, acceptance of or approval of treaties or agreements to which the State of Nepal or the Government of Nepal is to become a party shall be as determined by the law. On the one hand, the Nepal Treaties Act 1990 explicitly provides a guarantee for the enforcement of the Convention or treaty to which Nepal is a party. According to the section 9 of the Act in case of any provision of a treaty to which the Kingdom of Nepal has become a party following its ratification, accession, acceptance or approval by the Parliament, contradicts with the provisions of current laws, the latter shall be held invalid to the extent of such contradiction for the purpose of that treaty, and the provisions of the treaty shall be applicable in that connection as law of Nepal. In Nepal, according to the Section 9 of the Treaty Act, 2047 BS (1991), all ratified treaties become the laws of Nepal (Centre for Constitutional Dialogue, 2009, p. 3). In Nepal, there has been dominance of both monistic and dualistic schools of thoughts (National Human Rights Commission, 2007). *Rajendra Thapalia vs. General Manager(personnel) T.R. Bhatta*, which is the first case relating to sexual harassment at the work place in Nepal. In this case, the learned judge has proficiently examine the facts, interpreted the constitution, and applied international instruments on Human Rights including the CEDAW, to conclude that the appellant had actually harassed his co-worker. It was held that in the absence of any direct law to address the issue, the court recorded that as Nepal is one of the signatories to CEDAW, the Treaty Act is as good as Nepali law and to support their view, two other Supreme Court cases (Reena Bajracharya and Meera Dhungana, on behalf of FWLD) that had interpreted that "CEDAW is operational like [any other] Nepali law" were cited. (USAID, Bangladesh, 2007 p. 352 / 353)

Legal Status of Human Rights Treaties in the Domestic Legal System in other South Asian Countries

Customary international law and Human Rights treaties ratified by Sri Lanka have no status in national law; they must be transformed into domestic law before the courts or competent authorities can apply them. Even so, the Courts of Sri Lanka have referred to them in their judgements. (Country Report of Srilnaka, 2013).

As like as other South Asian countries, Pakistan is a state party to the core international Human Rights Instruments. However, these are not directly applicable in the domestic legal system of Pakistan as Pakistan follows the doctrine of dualism in case of application of international law in the national legal order. The applicability of Human Rights treaties or conventions in domestic legal order of Pakistan depends on the matter, which determines the act of state required for their municipal application.

Bhutan has acceded to very few International Humanitarian and Human Rights law treaties (Geneva Academy of International Humanitarian Law and Human Rights, 2014). In Bhutan, there is also no direct application of International Human Rights treaties. It is required to be ratified by the parliament of Bhutan. According to Article 10(25) of the Constitution of the Kingdom of Bhutan all International

Conventions, Covenants, Treaties, Protocols and Agreements duly acceded to by the Government hereafter, shall be deemed to be the law of the Kingdom only upon ratification by Parliament unless it is inconsistent with this Constitution. Therefore, the international Human Rights conventions or treaties, which are acceded by the Kingdom of Bhutan, shall be the law of the land if the Parliament of Bhutan ratifies these.

The Maldives has ratified many of the major international Human Rights law and humanitarian law treaties, including the Rome Statute of the International Criminal Court (Geneva Academy of International Humanitarian Law and Human Rights, 2014). According to the Article 93 of the Constitution of the Republic of Maldives, 2008 provides that treaties entered into by the Executive in the name of the State with foreign states and international organizations shall be approved by the People's Majlis, and shall come into force only in accordance with the decision of the People's Majlis. Therefore, in Maldives same as other SAARC countries the human rights treaties are not directly applicable. These have to be approved by the parliament of Maldives for the domestic application.

Concluding Remarks

When a Constitution incorporates a procedure of enforcement in courts of law, this institution becomes a major actor in bringing international Human Rights into domestic law (Goonesekere, 2013). In countries which adopt a dualist approach to international law, as in Common law countries, traditionally courts adopt a conservative role in regard to creating jurisprudence on treaty incorporation (Goonesekere, 2013). The South Asian Countries are not exception in this regards. The Human Rights treaties or conventions have no direct application in the domestic legal system in this region. However, the judiciaries of these countries are most proactive to implication of the international Human Rights Instrument in the court of laws through the various interpretations of their national laws. Therefore, experience shows that even in the absence of clear provisions regarding the direct application of international human rights treaties or conventions, the courts of law of this region are trying to play an advanced task in incorporating international human rights norms in national law through the various remarkable judgments. On the other hand, if we analyse the landmark judgments of the South Asian countries' Judiciary it can be concluded by saying that they are making empowerment to individuals and other civil society groups including NGOs to bring a court case and make stronger Human Rights implementation in the national level. However, almost all the South Asian countries are following the dualist approach of international law for the implementation of Human Rights treaties or conventions with some variations. While the status of all the treaties are same in the domestic level, the court of these respective countries are giving special emphasis on the Human Rights treaties in case of explanation of fundamental rights enshrined in the constitutions (Ashraful, 2014).

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Minority Protection under Companies Act, 1994: Towards Certainty

Md. Abdul Wahab

Abstract

Protection of minority interest is sine qua non for establishing Shareholders' Democracy in Company governance. Shareholders are the real owners of the company. Technically, they hold a participation interest in its capital, composed of relatively small unites called 'Shares'. The rights accruing from each share are in principle the same for all shareholders. Conflict of interest between the minority and majority shareholders of company is a common phenomenon till the date. A bonafide and appropriate equilibrium of the rights between majority and minority shareholders is eminent necessity to root out minority oppression and the smooth and pleasant functioning of the company. Section 233 of the Companies Act, 1994 has been incorporated in establishing bid to establish the rights of the minority shareholders so that the democratic values shall be upheld in the company governance. But it is not so get-at-able to protect the minority shareholders under section 233 rather uncertainty in wording of the section puts the interest of the minority shareholders at stake. Nevertheless in Bangladesh the higher judiciary plays a vital role to driving down the dark of the said section. The objective of this article is to bring out the operation of section 233 of the Companies Act, 1994 through a bundle of precedents of the Higher Judiciary of Bangladesh and abroad. This also aims to draw a picturesque description of how is minority protection achieving certainty in our legal arena.

Keywords: Company Act, Minority Protection, Prejudicial Action, Oppression, Shareholders' Democracy.

Prologue

Company is unique business establishments where, as in democratic norm, a few of the owners control, manage and oversee the operation of the company. They are vested with the responsibility to safeguard the interest of the shareholders in general and the larger majority in particular. Conflict of interest among the shareholders is very visible and it seems to be inbuilt in the genome of the company. Despite this intrinsic flaw in the very structural fabric of company, it still survives and optimistically shall continue to be as a universally established business body. In order to ensure corporate governance in the company and guard the clash of interest, different mechanisms have been devised. In Bangladesh *inter alia* section 233 of the Companies Act 1994 (hereinafter referred the "CA") has been incorporated with an eye to uphold the interest of minority shareholders.

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This article is particularly designed to draw the picture as to what roles are played by our Supreme Judiciary to protect the rights of minority shareholders. It also brings out the certainty of existing provisions of CA which is expected to define and enforce the rights of minority shareholders. It also emphasizes on the precedents that are in place for obtaining redress by higher judiciary in case of violation of minority shareholders rights.

This write up closely considers the roles and aspects of the higher courts in interpreting the relevant provisions of the Companies Act, 1994 with a view to protecting minority interest. Secondary sources of information have been taken into consideration for accomplishing the study. The references have been adopted from Companies Act, several texts on company laws, reputed law journals, research reports, financial newspapers, internet and especially from the legal decisions of the Supreme Court of Bangladesh and abroad.

Law of Minority Protection

Inter alia section 233 of the CA read with section 195(a) and (b) contain the provision as to minority protection. Section 233 holds that any member or debenture holder of a company satisfying the benchmark of section 192 can bring an action individually or jointly (1) if the affairs of the company are being conducted in a manner prejudicial to one or more members of its members or debenture holders or in disregard of his or their interest, (2) the company is acting or is likely to act in a manner which discriminated or likely to discriminate the interest of any member or debenture holder, (3) any resolution has been passed or is likely to be passed which discriminates or is likely to discriminate the interest of one or more of the members of debenture holder (Companies Act, 1994:Section 233).

Who are Minors?

Section 195(a) and (b) set benchmark of minority shareholders. To proceed under section 233 an applicant must satisfy the court that (s)he/ they hold(s) one-tenth of the shares issued in case the company has a share capital and in case the company does not have a share capital (s)he/they comprise(s) not less than one-fifth of the number of persons registered as members (Companies Act, 1994:Section 195(a)and(b)). Unlike in Australia, England and many other Western jurisdictions, only the members or debenture holders satisfying the conditions as specified in section 195 can apply under section 233.

This section itself seems to discriminate among members of the company. Because, none but those having shares as specified in section 195 can proceed under section 233 to avail the protection. Does it mean that members having less than the benchmark are left beyond the shadow of section 233 protection? However, this detracts from the main rationale behind the section, namely to protect the minority shareholders whatever their shareholdings may be. It is illogical to say that minority has no right to protect itself unless it is at least 10% minority (Zahir, 2005:184). However there are ample counter arguments supporting the benchmark. A threshold is certainly required to prevent persons with very small stakes in a company from holding the company and larger investors to ransom by bringing vexatious actions in

court (Sobhan and Werner, 2003:38). The benchmark seems to be intended to avoid unnecessary litigation. Lowering the 10% floor for minority shareholders would open a floodgate of actions(Sobhan and Werner, 2003:123). In Bangladesh actions under section 233 are often brought before the court, although a large number of these actions are ultimately found to be vexatious or not covered under the section.

Action by Representative of the Deceased Shareholder

Despite the language of the section being clear as to the fact that the applicant shall be a member or debenture holder of the company, a representative of deceased member can bring action under this section subject to the fact that the name of the representative is entered in the share registrar. In *Re Jermyn Street Turkish Baths Ltd.* Pennycuick J. held that even without registration as members, the personal representatives of a deceased member had to be regarded as members of a company for the purposes of an application to protect the minority shareholders rights (*Re Jermyn Street Turkish Baths Ltd., 1970*).

Whether Majority can Bring Action under this Section

The right to apply under section 233 is apparently confined to those members or debenture holders having one-tenth of the share capital and not less than one-fifth of the number of persons registered as members in the company. However the stance of different courts still remains divergent in this respect. The Calcutta High Court in *Ramashankar Prasad vs. Sindhri Iron Foundry (P) Ltd* held that majority can apply for relief under this section (*Ramashankar Prasad vs. Sindhri Iron Foundry (P) Ltd., 1966*). However, High Court Division in *Moksudur Rahman vs. Bashati Property Development Ltd.* came into a conclusion stark different from that of Calcutta High Court. It held that unless the applicants are minority shareholders, i.e., less than fifty percent, they have no right to apply for protection under this section (*Moksudur Rahman vs. Bashati Property Development Ltd., 1997*). In another case High Court Division refused an action point blank brought before the court by directors having 50% stake in a company. In *Moksudur Rahman and another vs. Bashati Property Development Ltd. and others* it was held that "section 233 of the Companies Act is meant for protecting the interest of the minority members of the company. In the instant case, out of four Directors of the Company the petitioners are two Directors and they hold 50% of the shares of the Company. Consequently the petitioners cannot be regarded as minority shareholders and as such they are not entitled to invoke the jurisdiction of the Court under section 233 of the Companies Act"(*Moksudur Rahman and another vs. Bashati Property Development Ltd. and others, 1997*). However Indian High Courts in a couple of cases held that any member or members having obtained the consent in writing of the requisite number of members may apply. In *Jadavlal Dutt vs. Hooghly Ink Company Ltd.* and several other cases it was held that:

"The right to apply is not confined in an oppressed minority of the shareholders alone. An oppressed majority also may apply"(*Jadavlal Dutt vs. Hooghly Ink Company Ltd., 1982*).

In *Maharastra Power Development Corpn. Ltd vs. Dabhol Power Co. Ltd.* the court took the view that:

"Where this requirement is satisfied, it would be immaterial whether the oppression is being spelt out to a majority block by a minority block or by a one minority group to another minority group (*Maharastra Power Development Corpn. Ltd. vs Dabhol Power Co. Ltd., 2003*).

A petition is not liable to be struck out as showing no reasonable cause of action only because the petitioner happens to be a majority shareholder (*Re Baltic Real Estate Ltd., 1993*).

Oppression is the very fundamental requirement to proceed under this section. To avail the protection, the shareholders have to satisfy two core requirements; *Firstly*, oppression by a part of the shareholders against the others; and *Secondly*, the threshold provided by section 195. Nowhere in the section it is stated that only minority shareholders having less than 50% stake in the company can proceed under this section. Despite the caption of the section 233 states that "Power of the court to give direction for protecting the interest of the minority", In fact the caption is not to be deemed as law. It seems that satisfying the minimum 10% threshold any part of the shareholders can proceed against others subject to the fact that the oppression or prejudicial action or omission has been done to the other part of the shareholder.

Whether a Director Can Apply under this Section

Section 233 of CA holds that a member or debenture holder can proceed under this section subject to the satisfaction of the conditions as stipulated in section-195. Nowhere in the section it is provided that a director can bring action under this section. So the moot point is whether a director can file action under this provision. Different case laws establish the fact that a director can bring action if he is affected by the oppressive action of the majority as a member. In the Scottish case of *Elder v. Elder and Watson* it was decided that "relief under the section will only be granted if the petitioner is complaining of oppression towards him *qua member* and not in the character of director or employee of the company" (*Elder vs. Elder and Watson, 1952*). When a shareholder's rights as a director are affected an application under this section is maintainable (*In Re Albert Davit Limited,1964*). However in Bangladesh the High Court Division categorically provided that "the section specifically protects the interest of the minority shareholder(s) when prejudiced and discriminated against, it does not protect the interest of a director however prejudiced and discriminated by the way the company is conducted" (*ASM Shamsul Islam Rashedi vs. Satellite Fishing Ltd. and Others, 2002*).

Prejudicial- Meaning

Section 233 does not define the term 'prejudicial'. It is an umbrella concept incorporating actions and omissions which affect or likely to affect the interest of the minority shareholders. Oppression or prejudicial actions or omissions may take different forms. It was held by Arden J. that the jurisdiction under section 459 [corresponding to section 233 of Companies Act 1994] has an elastic quality which enables the court to mould the concept of unfair prejudice according to the circumstances of the case"(*Macro (Ipswich) Ltd.,1994*). The expropriation of the rights of the minority shareholders occurs when family-member stakeholders take fund-related decisions to their own benefit, divert cash to inefficient projects and

lend funds to relatives and friends rather than returning the money in the form of dividends to the minority shareholders. Other expropriation can take place in the forms of profit reallocation, asset misuse, transfer pricing, selling below the market price any department or part of the firm to other firms that the majority shareholders own or acquisition of any other firm that the majority shareholders own. The majority shareholders treat the company as their own and act accordingly to the detriment of other shareholders (*Siddiqui, 2013*).

Prejudice includes cases where the value of his shareholding in the company has been seriously diminished or at least seriously jeopardized by reason of a course of conduct on the part of those persons who have had *de facto* control of the company (*In Re Bovey Hotel Ventures Ltd., 1981*). *In Shanti Prasad v. Kalinga Tubes Ltd***.** It was held that:

"It must be further shown that the conduct of the majority share-holders was oppressive to the minority as members and this requires that events have to be considered not in isolation but as a part of a consecutive story. There must be continuous acts on the part of the majority share-holders, continuing up to the date of petition, showing that the affairs of the company were being conducted in a manner oppressive to some part of the members. The conduct must be burdensome, harsh and wrongful and mere lack of confidence between the majority share-holders and the minority share-holders would not be enough unless the lack of confidence springs from oppression of a minority by a majority in the management of the company's affairs, and such oppression must involve at least an element of lack of probity or fair dealing to a member in the matter of his proprietary rights as a share-holders. It is in the light of these principles that we have to consider the facts in this case with reference to section 397 [*Corresponding to section 233 under CA 1994*]" (*Shanti Prasad vs. Kalinga Tubes Ltd., 1965*).

In *Ramashankar Prasad vs. Sindri Iron Foundry (P) Ltd*. the court held that:

A petition under section 397 (*Corresponding to section 233 under CA 1994*) would be maintainable even if the oppression was of a short duration and of a singular conduct it its effects persisted indefinitely (*Ramashankar Prashad vs Sindri Iron Foundry (P) Ltd., 1966*).

A lack of probity and fair dealing in the affairs of a company to the prejudice of some portions of its members constitutes oppression and is subject to interference of the court (*Elder vs Elder and Watson1952*).

(i) Non-Declaration of Dividend / Fewer Dividends

Non-declaration of dividend is itself does not constitute oppression unless it is proved that the minority is discriminated. However a policy of low dividend payments can amount to unfair prejudice under the Companies Act (*In Re, A company, 1990*). Non-declaration of dividend except without a reasonable cause affords justified ground to bring action under this section. In a Bangladeshi case the court held that "section 233 enables a member to obtain a remedy where a company with sufficient profit persistently refuses to pay dividends or the member is excluded

from the profit after he is no longer a director (*Mrs. Homera Ahmed and others v. Nahar Shipping Lines Ltd. And others, 2002*).

(ii) Legitimate Expectation

Joining in a company a member can legitimately expect that (S)he will continue to participate in the management and all benefits accruing from the company. So his/her exclusion from the management and benefits may go against his/her legitimate expectation and affords an actionable claim to be brought before the court. Peter Gibson J. in *Re Ringtower Holdings PLC* held that "If management participation was a legitimate expectation then its demise could found an unfairly prejudicial petition"(*In Re Ringtower Holdings PLC, 1989*). However the legitimate expectation must be in relation with affairs of the company. So deprivation of shareholder's legitimate expectations was regarded as unfair prejudice (*Soul D Harrison & Sons Plc, 1995*).

(iii) Misappropriation

Misappropriation is a very common allegation generally made against the majority shareholders. Minority shareholder can petition the Court for relief if there has been fundamental breach of the rules and where the majority endeavoring directly or indirectly to appropriate to themselves money, property or advantages which belonged to the company (*Syed Al Nesar Ahmed vs. Nafisa Choudhury and others, 2001*).

(iv) Breach of Fiduciary Duty

A remedy under section 233 can be given only if the directors have acted in breach of the duty or if the company has breached any of its articles or any relevant agreement (*Nahar Shipping Lines Ltd. and another vs. Homera Ahmed and others, 2004*).

Test of Oppression

Oppression and unfairness shall visibly and objectively be proved to the satisfaction of the court. An unfounded complain as to oppression and prejudicial act shall be liable to be rejected. The test of unfairness is objective –there is no need to show any conscience knowledge on the part of the controller that it was unfair, or any other evidence of bad faith. It would be a question of whether a reasonable bystander would regard it as unfairly prejudicial (*In Re Bovey Hotel Ventures Ltd., 1981*).

Remedies Available

The court has been armed with ample discretion to decide the case as each particular situation requires. Section 233 specifically provides that if invasion on the interest of the shareholder or debenture holder is substantiated the court may make any order as prayed for or any other orders as the court deems fit including a direction to cancel or modify any resolution of transaction or to regulate the conduct of the affairs of the company in future or to amend any provision of the memorandum and articles of association of the company (*Companies Act 1994: Section 233(3)*).

However, the company shall not, without leave of the Court, make any amendment therein or take any action which is inconsistent with the direction contained in the order made under section 233(3) (*Companies Act, 1994:Section 233(4)*). A company shall inform the Registrar in writing of the order of the court and send him a copy thereof within fourteen days from the making of an order under section 233. If the company fails to comply with the obligation under this sub-section, it shall be liable to a fine not exceeding one thousand taka (*Companies Act, 1994:Section 233(5)*).

The Court can make any just order beyond the relief sought for, to bring the affairs of the company to its right track to safeguard the interest of the minority shareholders. Professor Pennington held that this power includes appointing a receiver to manage the company's affairs temporarily and such orders that alter the voting and other rights of classes of members (*Pennington, 1995:903*). *In Scottish Co-operative Society Ltd. vs Meyer* the court held that where as a result of oppression company has been brought to a stage where it has to be wound up, wronged shareholders are still entitled to the remedy, i.e., by making oppressor buy their shares at a fair price (*Scotish Co-operative Society Ltd. Vs. Meyer, 1959*). However, the company shall not, without leave of the Court, make any amendment therein or take any action which is inconsistent with the direction contained in the order made under section 233(3). In case of any deadlock in the management of company the majority shareholders are offered to buy out the shares of minority shareholders' share at fair market value. Majority shareholders against whom allegations of oppression have been made can be given first option to purchase shares (*KL Ahuja vs SK Ahuja, 1983*).

Concluding Remarks

Upholding of shareholders' democracy is one of the fundamental aims of corporate governance. Law should provide enough space for minority shareholders to redress all the grievance they suffer by the powerful majorities the concept of 'Prejudice' shall extend to mean all sorts of mismanagement. Section 233 of the CA is silent as to the fact that whether any action or omission of the company that goes against public interest would amount to prejudice. The term prejudice should be clarified enough to include mismanagement and public interest issue with great precision. All Shareholders of the same series of a class should be treated equally and should have effective means of redress. Shareholders are generally not aware of their legal rights and duties. Moreover, general shareholders do not pay attention on issues of performance, business strategy, future business plans, disclosures and processes that could give them a greater voice in the policy decisions of a company. In fact, there is very little awareness about shareholders' rights and responsibilities. Shareholders' activism is still an illusion in Bangladesh (Hossain, 2005). Liberty is the price of eternal vigilance. Law is not enough to shield the interest of the minority shareholders unless they themselves are pro-active and aware of their rights and responsibilities.

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A Critical Study on the Existing Laws of the Forest Resources in Bangladesh

S.M.Mamun-Bin-Alam

Abstract

Forestry is a gift of nature. It has various contributions to the welfare of mankind; in fact without forestry no human civilization can be imagined. In Bangladesh, forest land covers approximately 2.52 million hectare. Therefore, in this densely populated country, the multiple uses of forest resources are very rampant. Forests also play the vital role to protect the watersheds, the hydraulic structure and the coastal areas from natural disasters. The contribution of forest in defending the environment from pollution and its efficiency towards the bio-diversity are numerous. Moreover, the participatory social forestry contributes greatly to the rural poverty eradication. Apart from that, many people are directly benefited from forestry-related activities e.g. working in wood based industry; saw milling, furniture making and establishing private nursery etc. Besides this, the Sundarbans, the largest mangrove forest of the world, is used as the habitat of millions of people who exclusively depend on the forest resources for their livelihood. Keeping the fundamental notion of preserving the resource, although Bangladesh government has passed various Laws and Policies, I think, these policies can be made more feasible to meet the current demand. The main objective of this study is to analyze the existing Laws and Policies regarding the forest resources and provide possible suggestions to make them effective enough to protect the forest resource of Bangladesh.

Key words: Forest Resources, Forest policy, Laws on Forest Resources.

Introduction

Bangladesh is situated in the north eastern part of the South Asian region. The country covers an area of 1, 47,570 sq. km and bounded by India and Myanmar. Forestry is an integral part of this country. It has various contributions towards the welfare of mankind. The multiple uses of forest resources have been familiar to its inhabitants since the advent of Bangladesh. The Forestry sector is contributing greatly to the development of Bangladesh. But if a country wants to get proper benefit from this sector then a sustainable policy is highly required. Complying with the reality, Bangladesh government has passed different laws and policies. But the actual result of these policies is far end. It is very common news to the citizen of Bangladesh that the forest sector is decreasing day by day. Now it is a burning question about the actual outcome of such laws and policies. Government can pass laws but actual enforcement of such laws belongs to the people and the executive authority. The ultimate protection of our valuable resource cannot be possible unless the proper integrated action is ensured by the all sectors concerned.

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Objectives of the Study

Bangladesh is a land of the abundance of natural resources. Forestry being the most important component maintains the Biodiversity of this vast region. Keeping this reality in mind, Bangladesh has passed several Laws and Policies. The main objective of this study is to find out and analyze the Laws and Policies regarding the forest resources. Other objective of this study is to provide possible suggestion for the betterment of these Laws and Policies which can eventually protect this important resource in Bangladesh.

Methodology and Data Sources

To conduct this research I have used the analytical method. Moreover, Primary & Secondary sources of data have been used in different places. The references have been used from several books, journals, research report, act, newspaper & internet.

Definition of Forest

Forestry generally refers to the areas of land covered with trees. However, while it is true that forest landscapes are dominated by trees, in reality these ecosystems are far more complex than they may first appear (Wildscreen ARKive, 2003). Forests are the house of world's terrestrial biodiversity, from birds and mammals to amphibians and invertebrates. Being the host of different species forests are playing the vital role for all the living species. There are many different types of forest around the world, with temperature, rainfall and soil composition all determining which type will grow in a particular area (Wildscreen ARKive, 2003).

Brief Overview of Forest Resources of Bangladesh

From the very beginning, Bangladesh is the land of forest resources. Various forest areas make the country as a distinctive feature. Considering the location and unique feature of the forestry, forest resources of Bangladesh are divided in four kinds of forests which are Mangrove forest, Tropical evergreen and semi-evergreen forests, Tropical moist deciduous Forests and Village Forests**.**

Mangrove Forest

Mangrove forest is the main forest resource of Bangladesh. The largest unique tract of mangrove forest is situated in the Sundarbans. It consists of a total of 6,01,700 hectare which is 4.07% of total land mass of the country and 40% of total forest land. The Sundarbans harbours 334 species of trees, shrubs and epyphites and 269 species of wild animals. World renowned Royal Bengal Tiger is the magnificent animal of the Sundarbans. (Department of forest,2011) The Sundarbans is declared as the World Heritage Site where the three wildlife sanctuaries viz. Sundarban East, Sundarban West and Sundarban South wildlife sanctuaries are located. Considering the distinct separate features of this forest it may be classified into two kinds viz. Natural Mangrove Forests and Mangrove Plantation. Natural Mangrove Forests are

those which grow naturally. Basically the Sundarbans is the main hub of natural mangrove forest. Sundari is the most important tree species in this forest. Sundri is distributed over 73% of the reserve **(**Department of forest, 2011). Gewa (Excoecaria agallocha), Baen (*Avecinnia offcecinalis*), Passur (*Xylocarpur mekongensis*), Keora (*Sonneratia apetala*) etc are also the vital tree species in this area. Apart from that there are some other non-wood forest products like Golpata (*Nypa fruticans*), honey, wax, fish, crab etc which are also of high value. The Sundarbans is also a heavenly habitat of a number of wildlife. Among them some mammals are The Royal Bengal Tiger (*Panthera tigris tigris*), Gangetic Dolphin (Platanista gangetica), Monkey (*Macaca mulatta*), Indian Fishing cat (Felis viverrina), Indian Otter (*Lutra perspicillata*), Spotted Deer (*Axis axis*) etc. Reptiles like Estuarine Crocodile (*Crocodylus porosus*), Monitor Lizard (*Varanus salvator*), Rock Python (*Python molurus*) and Green Turtle (*Chelonia mydas*) etc. are found in the Sundarbans. ***(***Department of forest,2011 ***)***

Mangrove Afforested Forest or Mangrove Plantation is created under the guidance of Bangladesh Government through the unique tree plantation programme. It is basically situated in the southern coastal frontier. During 1960-61, Government undertook afforestation programme along the shore land of coastal districts. This initiative got momentum from 1980-81 with the aid of development partners and afforestation programs are extended over foreshore islands, embankments and along the open coasts ***(***Department of forest,2011) The present net area of mangrove plantation is 132,000 hectare.

Tropical Evergreen and Semi-evergreen Forests

Tropical evergreen and semi evergreen forests are basically seen in Chittagong, Coxe's Bazar, Chittagong Hill Tracts and Sylhet region. The total area of this forest is 6,70,000 hectare which is 4.54% of total landmass of the country and 44% of national forest land. Depending on topography, soil and climate these areas are categorized as i) Tropical wet evergreen forests and ii) Tropical semi-evergreen forests (Department of forest, 2011). These forests are abundant with numerous plant and animal species. Some important flora are Garjan (*Dipterocarpus spp*.), Chapalish (*Artocarpus chaplasha*), Telsur (*Hopea odorata*), Tali (*Palaquium polyanthrum*), Kamdeb (*Callophyllum polyanthum*), Uriam (*Mangifera sylvatica*), Jarul (*Legarstromia speciosa*), Civit (*Swintonia floribunda*), Toon (*Cedrela toona*), Bandorhola (*Duabanga grandiflora*) etc. (Department of forest, 2011) From 1871, these forests are brought under plantation programme.

Tropical Moist Deciduous Forests

The Central and the northern districts of the country's forest land are known as

Tropical Moist Deciduous Forests. Total area covering the forest is about 1,20,000 hectare. This forest is intermingled with the neighbouring settlements and fragmented into smaller patches (Department of forest, 2011) **.** Sal (*Shorea robusta*) is the main species in this forest. Apart from that there are other species like Koroi (Albizzia procera), Azuli (Dillenia pentagyna), Sonalu (Cassia fistula), Bohera (Terminalia belerica), Haritaki (Terminalia chebula), Kanchan (Bauhinia acuminata), Jarul (Lagerstroemia speciosa), Jam (Syzygium spp) etc (Department of forest, 2011). Recently under the social forestry initiatives participatory forestry programme are implemented here.

Village Forests

This kind of forest is basically seen in the rural areas of the country. Tree coverage in the village forests are 2, 70,000 hectare which acts as the source of a remarkable portion of national demand of forest produces (Department of forest,2011) .

Why Forests so Important?

Forest is the most important part for Biodiversity. As well as being home to countless plants, animals and fungi, forests are extremely important to human wellbeing, providing vital ecological, economic, social and health benefits (Wildscreen ARKive,2003).People around the world depend on forests for their livelihoods, for Oxygen and prevention from flood and soil erosion. Forest also protects the earth from the grave impact of climate change. Through the process of photosynthesis, trees and other plants produce life-giving oxygen, while also playing a role in battling climate change by acting as sinks for carbon dioxide (Wildscreen ARKive, 2003)**.** The volume of carbon stored within forests is greater than the amount of carbon in the atmosphere. Forests also stabilize the soil, prevent soil erosion and help to regulate the potentially devastating impacts of storms and floods. Forests also protect our rivers. Human populations living far from these habitats depend upon them, as they are vital in supplying the water for almost 50 percent of the world's largest cities (Wildscreen ARKive,2003). The role of forest in supplying the raw materials is great. We use for all sorts of day-to-day products, such as paper, packaging and construction timber and medicines from forest plants. Aside from the more obvious physical benefits of these diverse habitats, forests harbour great cultural and aesthetic value, and also contribute to the nature-based tourism industry (Wildscreen ARKive,2003) .

Overview of Forest Policies in Bangladesh

The first outline of the policy for forest conservation was laid down in 1858 during the reign of Lord Dalhousie. Subsequently, the amended Forest Policy laid in 1894. The focal points of this policy were the role of forest in the conservation of soil, climate, watershed and prevention of erosion, siltation, flood, cyclone etc. However, preference on agricultural use of land over forestry practice remained unchanged. Hence, clearing of forest for agricultural use of land continued unabated and unchanged even after enactment of the policy (Hassan, 2001). In 1945 two countries devolved from Indian Subcontinent named as India & Pakistan. During the

Pakistan period new forest policy was formulated in 1955. It basically dealt with the issues related to the West Pakistan forest and thus forest in the East Pakistan region was totally neglected. At that time the exploitation of the natural resources was extensive. On the contrary, any step for its conservation, development and management was ignored. Consequently, a Forest Product Laboratory was set in Chittagong and Paper Mill at Chandroghona during the mid-fifties for increased extraction and utilization of forest products at commercial scales (Hassan, 2001) . However The Forest Policy, 1955 was revised in 1962. But the discrimination regarding Bangladeshi forestry was unchanged. This policy also failed to support all round growth perspectives of forest and failed to recognize the need oriented forestry research, development and utilization. Hence, degradation of forest in Bangladesh continued (Hassan, 2001).

In 1971 Bangladesh became a sovereign country. The Forest Policy for the independent country was framed in 1979. But due to lack of sincere intention of Government of Bangladesh and capability of Forest Department it remained dormant for a long time as an office document. After1972 a rapid change in the socio-economic condition ultimately results in grave exhaustion of the forest resources in Bangladesh. In addition price hike of the fossil fuel in the international market, closure of the Suez Canal and economic isolation of Bangladesh from the world community accelerated rapid exhaustion resources in Bangladesh including the forest resources (Hassan, 2001). According to the UNCED (Rio Conference 1992) The Forest Policy, formulated in 1962 is inadequate in its operation. It termed forest as multi functional, multi dimensional and renewable biological resource production unit with multiple use potentials. From this guiding view of Rio Conference, the policy makers were inspired. They ultimately realized the need for an absolute study for framing a 20-year Forestry Master Plan to combat the environment and ecological degradation. The Forestry Master Plan was published accordingly in 1993. The National Forest Policy, 1994 subsequently enacted by Ministry of Environment & Forest in light of the recommendations of Forestry Master Plan(Hassan, 2001).

The salient features of the National Forest Policy, 1994 are notable. Which are (i) By 2015, raising of forest covered area to 20 percent (ii) ensuring participation of Forest Department, NGOs and private individuals in forestry related activities. (iii) Strengthening efficiency of Forest Department, Bangladesh Forest Research Institute (BFRI), (iv) Ensure entrepreneurship development to deal with research development and utilization of forest resources, (v) Redevelopment of Forest Department, Bangladesh Forest Research Institute and other forestry related organizations.

General Inspection on Forest Policy

Forest policies are evolving over the years in keeping pace with the changing

circumstances and needs of the time. The first policy recognized the importance of the reserve forests. However, the1894 Forest Policy shifted its focus to revenue earning and framing of rules to that end, based on which, 1927 Forest Act came into being (Alam, 2009:158). The 1955 Forest Policy also focused on yield and it was much influential in the later stages too. The community people are often the most appropriate managers and regulators of forest uses. The importance of people's participation for ensuring the sustainable forest management goals has been stressed by many authors from different parts of the world (Alam, 2009:158) **.**It is now the most highlighted issue that social forestry can ensure sustenance of forestry in developing countries which targets to ensure economic, ecological, and social benefits to the people. People's attitude towards forest is highly influenced and affected by the policy regime (Alam, 2009:158). But it was not much conspicuous to the policy maker & the citizen of Bangladesh. Ultimately it created the uncertainty to the citizen of Bangladesh. So the past policies influenced the negative attitude to the citizens on forestland use in Bangladesh. This is why the Forest Policy (1979) clearly laid down the participatory approach to be followed in government-owned forestland and plantations on marginal land (Alam, 2009:158,159). It is highly remarkable that Forest Policy, 1994 is unique for its some distinctive feature. It enshrines elements of sustainability that are catering the needs of today and tomorrow. There are some provisions in this policy where it emphasized the creation of employment opportunities, poverty alleviation, and augmenting national income through forestry (Alam, 2009:159).

Policies bring no benefits to forestry or communities unless they are implemented properly. In developing countries like Bangladesh, policies are often very well formulated – sometimes with foreign assistance – but are not properly implemented because of interference by influential interest groups such as local political leaders and social elites (Alam, 2009:160). The directives to increase afforestation in the villages have no practical application. About 0.27 M ha homestead agro forests of Bangladesh, representing 10.5% of the total forestlands are claimed to supply more than 60 percent of various forest products in the country. But there is no program targeted to provide technical or financial support to improve the productivity of this important agroforestry system (Alam,2009:160) .

Another way the policy declared that forestland will be used for afforestation only. But aggressive conversion of forestlands into non-forest use is very common in many of the forest areas. Examples of such conversion can be observed across the tropical deciduous Sal (Shorea robusta) forests of Bangladesh. Poor implementation of existing laws has completely failed to save forestland and its resources (Alam, 2009:160). Apart from that, serious weakness in the policy is that the policy is neither sufficiently backed up with legislative provisions, nor is it followed up by programme and strategy development, action plans. For instance, the 1994 forest policy encourages people's participation in forestry activities, but the Forestry Act, however, was only amended in 2000 to accommodate social forestry (Alam, 2009:160).

In addition, frequently forest policy conflicts with the other policies formulated by different authority. The recent land-use policy, for instance, does not support forest policy sufficiently. The serious and continuing demand for agricultural land is a

major constraint for expanding forest cover. Forestland that does not have the legal status of reserved forests is highly susceptible to conversion (Alam, 2009:160). Although the existing Forest Policy targets to increase forest cover, but there is no reality in different parts of the country. This indicates that there is no coordination among the concerned government agencies. Corruption in forestry sector is believed to additionally contribute to the observed problems. Lack of appropriate collaboration between and among different implementation agencies is also obstructing effective implementation of forest policy directives in a number of ways (Alam, 2009:161).

Legislation in Bangladesh Touching the Forest Resources and Their Evaluation

Constitution is the supreme Law of our country. It empowers the government to make laws and regulation. In the Constitution of Bangladesh there are several articles with implications on the authority, control and management of environmental resources. And as the supreme law of the land, it empowers the courts or the judiciary to enforce the judicial implementation of different laws and regulations. In addition to Constitution, Bangladesh has many acts and international conventions that affect her forest resources.

State Acquisition and Tenancy (SAT) Act, 1950

Prior to SAT Act, 1950, absolute power of possession of land belonged to the Landlords (Zamidars). The tenants were under the control of Landlords. SAT Act brought a revolutionary change in this regard. This Act abolished the landlord system and vested all the land in the constitution (State). It provided title of the land to its tillers and set limits on extent and kinds of private land holding. The Act allowed for retention of the homesteads and agricultural lands, up to a specified limit but did not entitle a tenant to retain forested lands (Bangladesh Country Report, 2000). During the period, many people illegally cleared their forests and erected settlements arbitrarily so that government cannot claim that land. For this reason tremendous impact of such heinous activity became rampant. Much forest land disappeared from the record. For the protection of this kind of forest the government acquired private forest lands under the SAT Act and termed them as "acquired forests". Under the SAT Act, the government has also acquired full ownership of many of "vested forests" (under Private Forest Act) and reserved them (Bangladesh Country Report,2000).

The Acquisition of Wasteland Act, 1950

Under this Act the government can acquire private lands that have not been cultivated during last five years, for any public purposes including afforestation. The government has not applied this law widely to acquire lands for forestry purposes, since under the Private Forest Act, 1959 the Government has the alternative of temporarily vesting lands lying idle for more than three years and not paying outright for the title to the land (Bangladesh Country Report,2000) .

Saw-mill (License) Rules, 2012

It is one of the most important legislations about forest resources of Bangladesh. This act particularly focuses on one specific kind of establishment termed as Saw-mill. The parent act of these rules is the Forest Act, 1927. Under this rule no saw-mill can be established without any valid license. The validity period of such license will be for one year however after the expiry of said period the license may be renewed. The most important feature of this rule is that no saw-mill can be established within 10km of the protected forest determined by the Forest Act, 1927. Apart from that all the owners of saw-mill will mandatorily be preserve buying & selling account of wood & other forest resources. Executive magistrate or forest officer or Sub-Inspector of police may at any time conduct inspection in any saw-mill. The rules basically formulated for proper application of Forest Act, 1927. If the all the rules properly applied then it may be a key weapon for the protection of the forest resource.

Brick Burning Control (Amendment) Act, 2013

In Bangladesh Brick making is one of the major domestic industries. This industry basically depends on fuel wood and a huge number of fuel woods were used to run this industry. The indiscriminate use of fuel wood created a grave impact on the forest resource of Bangladesh. So the Government passed Act as The Brick Burning Control (Amendment) Act, 2013. The supremacy of this Act has been granted under section 3 of this Act. Under this Act no brick field can be established without the express permission of Deputy Commissioner. This act also imposed restriction on cutting hill for making any brick. Apart from that the use of forest wood in any brick making procedure is totally banned. The detail procedure of obtaining license, renewal of license & validity period of license has been clearly described in this Act. Although the use of fuel wood is totally banned in brick field, the fuel wood is now commonly used as fuel for brick making. Currently, there is no substitute for fuel wood as a source of energy in brick making. Under such circumstances, the ultimate object of this Act is not finding its destination.

Forest Act, 1927

The ultimate root of The Forest Act of 1927 is in the Indian Forest Act, 1878. The Forest Act grants the government several basic powers, largely for conservation and protection of government forests, and limited powers for private forests (Bangladesh Country Report, 2000).The ultimate power of implementation of the Forest Act is on the Forest department. The Act, however, does not specify any sort of institutional structure for the forest or other land holding agencies. It also does not set out any specific policy direction for managing the forests (Bangladesh Country Report, 2000). Most of the forest lands are under the management of forest department. Such departments usually declare lands as reserved and protected forests. The actual figures for the total area of reserved or protected forest are not consistent. Under the Forest Act the government may establish village forests by assigning parts of reserved forest to particular villages for their use (Bangladesh Country Report, 2000). However, the actual application of this provision has never been evidenced in Bangladesh. It is highly noticeable that the Act empowers the

government to regulate the felling, extraction, and transport of forest produce in the country. But it is a matter of regret that, under current social conditions and existing institutional structure, the forest department finds it difficult to enforce many of the provision of the Forest Act.

The Environment Court Act 2010

This is the unique weapon for enforcing the Environmental Laws in Bangladesh. In 2010 this act has been passed in parliament. Under this act environment court will be established at every district & more than one court may be established if required at the districts. This act exclusively formulated the function of special magistrate court regarding disposal of complaints. Under this act a deadline of 180 days has been determined, within this time special magistrates have to complete the proceedings. The director general of environment or anyone empowered by him can file the case directly in the special magistrate's court The Act also allows the director general of environment or anybody directed by him to enter any place at any time to conduct searches and collect evidence. From the unique feature of this Act it is clear that for the speedy disposal of environmental suit or proceeding, this Act can play a vital role. If proper application of this act can be ensured it will not only be protect the forest resource but also protect the other valuable resources in Bangladesh.

Bangladesh Environment Conservation Act, 1995

In Bangladesh environmental laws are in an embryonic stage. So a new legislation was highly required for environmental resources. For this reason the government enacted a good legislation named as the Bangladesh Environment Conservation Act, 1995. This Act has directed the welfare of the forests and other natural resources in the country as its fundamental notion. According to the Act, the Government shall establish a Department, which shall be called as the Department of Environment. This department is headed by a director general. The fundamental responsibility of this authority is to identify the zones in the country, which are environmentally in critical condition & formulate such regulation which are very effective for the betterment of those zones. For the proper application of this act the government also passed the rule named as Bangladesh Environment Conservation Rules, 1997.This rule provides the detail guidelines for companies so that those can run smoothly without causing any environmental hazard. From the close inspection of this Act it is clearly assumed that this Act is a watchdog not only for the forest resources but also for the all natural resources of Bangladesh.

Local Government Institutions Dealing With Forest Resources in Bangladesh

The Constitution of Bangladesh has established a unitary government system for the republic. But for ensuring the uniform development in the whole country the constitution also recognized the Local Government system. Under this system the government has formulated guidelines to many of its local governments and institutions to plant trees. The ultimate purpose of these guidelines is to develop and support the forest resources. For example, at district level, the Paurashava Act, 2009 empowers the local administration to plan, develop and support forest resources and

trees. Similar powers have been given at the city level to City Corporations. At village level, the Union Parishads Act, 2009 entrusts the Union Parishads with the responsibility to create and develop for various sectors including forests. Some highlighted development corporations have been entrusted with remarkable authorities regarding forests. For example, the Agricultural Development Corporation has the authority to undertake afforestation, restrict clearing of land and cutting of trees, developing forests and penalize for destroying trees on Corporation land (Bangladesh Country Report,2000) . Similarly, function of Bangladesh Water Development Board is also mentionable. It has the authority to undertake watershed management, prohibit clearing of land, and regulate activities such as tree planting on embankments within its territorial zone.

Recommendation on Existing Policy & Legislation

In Bangladesh various forestry related laws & forest policies have been formulated considering the needs of gradual adjustments of circumstances over the decades. Major focus is now more on people than on the forest itself and this is how the forest policy is now 'pro-people' (Alam, 2009:163). It is now the principal policy goal to ensure local people's participation for creation, conservation and management of forest. But poor implementation of most policy directives due to lack of adequate institutional capacity, legislative backup and law enforcement has been a major area of concern (Alam, 2009:163). However, there are some remarkable achievements despite various constraints to policy implementation. Afforestation has been carried out substantially in the marginal, fallow and unproductive lands to increase forest cover of the country (Alam, 2009:163). Social forestry has become a major key factor to involve local people in the forest management activities. The concerned authority has been identified denuded and encroached government forestland and brought under the afforestation program with people's participation using the benefit-sharing approach. Hence, it can now be concluded that the policy & laws are contained many positive features but considering the existing circumstances those need to be reviewed and amended. In the revision & amendment procedure of this existing policy & laws the followings may be considered:

- Existing policy & laws are in traditional top-down approach. These need to be amended. If the policy & laws are formulated in bottom-up approach then it will effectively ensure the participation of grassroots people in policy formulation stream.

- Most of the forest resources in Bangladesh are situated in far remote areas. Existing situations in all the areas are not the same. So Forest policy & laws should be flexible enough to adopt the local situation so that the forest management can be planned taking into consideration existing local realities.

- Existing forest policy & laws do not say anything about the livelihood of poor people. So poor people are reluctant to implement such policy & laws. If there are provisions for incentives, for example free seedlings or cash payments to the poor people then it can make policy implementation more effectively and ensure the security of the livelihood of the poor people.

- Existing forest policy & laws do not take into account about climate change. It can gravely impact the implementation of such policy & laws. So forest policy & laws should contain some provision which can comply with the climate change in Bangladesh. In this regard special interest may be given on adaptation of forests especially mangroves forest.

- Every effective forest policy & law contains the provision on the role of the NGO. The existing policy also contains provision on the participation of the NGO. But how the NGOs will participate & what will be the role is not clearly mentioned in the policy or any other Laws. So the role of the NGOs in protecting the forest and afforesting the degraded and denuded areas is not satisfactory. Only few NGOs have shown some interest in protecting the natural forests but there activity is much limited to the specific region. So for the effective participation of NGOs policy & laws should be amended.

- Laws & policies can be effectively applied when an effective social movement can be materialized. No existing laws & policy contains any provision which can encourage the social movement on forestry. But such social movement is common in the neighboring countries. So laws & policy to be amended considering vital issue of social movement on forestry.

- Enforcement of Laws & policies largely depends on creating awareness to the mass people. But mass people especially people who live in the root level have no idea about the forest policy & forestry related laws. So, for ensuring people's participation at different stages of the planned activities the laws need to be disclosed in full details to the public. In this regard mass publicity of the laws & policies may be conducted all over the country.

- The environment policy said that the Ecotourism will be encouraged, bearing in mind the carrying capacity of the forest and the environment. But no specific law has been passed in parliament to foster the sound ecotourism. So actual goal of this policy is in vanishing point. In this regard government should formulate law or policy specifically focusing on ecotourism in Bangladesh.

Concluding Remark

Human beings and forests are intimately connected to each other from the very beginning of human history. And the relationship of people with forests is much more intimate and reciprocal. If we cannot make a framework in which forests and people can live together, one or the other will certainly be destroyed. This warning appropriately applies to Bangladesh. Government alone will not be able to preserve the forest resource. Government can formulate laws and policies but actual power belongs to the citizens. If the Government and people can march hand in hand then it will be very simple to preserve this resource. For that reason active participation of all the sectors is highly needed.

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A Legal Analysis of the Presidential Prerogative of Mercy in Bangladesh

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Abstract

The Presidential mercy is the common prerogative of every country in the world. It is treated as the last shelter of justice. This power has been exercised from the beginning of modern civilization. It is a discretionary power of the president. As a result, the president exercises an unbridled power to pardon a convicted in any situation. That is why it sometimes raises controversy; as the presidents misuse their power in the name of prerogative. There are many countries where this power is being used following some guidelines and specific conditions, but it is being manipulated arbitrarily in Bangladesh. It is the moral liability and duty of a government to execute clemency maintaining neutrality and good conscience, but hardly these things are followed in Bangladesh. Day by day the number of clemency is increasing and every clemency is breeding new controversy. This article has pointed out the present condition of presidential clemency, its pitfalls and way to overcome it in Bangladesh.

Key words: *Prerogative, clemency, mercy, commutation, reprieve, respite, rule of law, suo moto.*

Introduction

The prerogative of mercy is exercised almost in every country. It is an extraordinary judicial power which is exercised by the head of the state. Somewhere it is treated as divine power which is delegated from the Almighty. Now it is used to avoid the miscarriage of justice. The 16th US President, Abraham Lincoln has rightly quoted "I have always found that mercy bears richer fruits than strict justice". In common sense prerogative of mercy means the special power to grant pardons, reprieves and respites, and to remit, suspend or commute by the president or the monarch of any sentence passed by any court, tribunal or other authority. This power is ensured by the constitution of the land. It may be exercised either before or after the conviction and need not wait for the verdict of the court (***Attorney General of Trinidad and Tobago v. Philli*, *1994***). That is why the president has an unrestrained power to exercise this prerogative. The constitution of Bangladesh through its Article 49 offers the President of the Republic to exercise this authority, but this Article has not provided with any specific guidelines. As a result this consecrated power is being desecrated repeatedly in the hands of different governments of this State for their personal and political gain. The history of pardon in Bangladesh bears testimony to that all the pardons took place considering only political ground and affiliation. This presidential clemency started in Bangladesh from the tenure of Hussain Muhammad Ershad. After that, less or more all the governments have exercised it.

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But present government has surpassed all the records of the formers. The number of their mercy is five times more than the total number of the former governments. This attitude has generated a widespread criticism among the people of all walks. In Bangladesh it takes a huge time to dispose of a judgment, as it is related to investigation, inquiry, report, record, evidence and so other processes. But before exercising prerogative of mercy these things are hardly assayed. Though a lot of people are applying for presidential clemency every year, only the political supported persons are getting the boon of this system. Hence it is now considered as a gift of political loyalty. The door of clemency is open only for the government party supporting persons. But it is not the main tenet of the system, rather the clemency should be exercised only for the justice's sake. This power should be exercised only in that case when the convicted person's right to get proper judgment is denied. This should be granted to only those who deserve it, irrespective of political view, religion, race, caste, sex, color or society.

Objective

The main objective of the research is to find out the present conditions of prerogative of mercy in Bangladesh. However, the research will attempt to achieve the following objectives:

i. To analyze the meaning and significance of prerogative of mercy;
ii. To point out the exercise of this power at present time;
iii. To assess the socio-political impact for its indiscriminate implementation; and
iv. To make a conclusion recommending some suggestions.

Methodology

The study is analytical in its nature. The study is based on various kinds of primary and secondary sources of data which are collected from concerned books, websites, law journals, research papers, records, case law, opinions of intellectuals etc. The study is carried out relying on these documents by systematic method of exploration, analyzing and conceptualization. In this research it has been tried to discuss a comparative study relating to practice of prerogative power in various countries, for the purpose of finding out weak points of this system in Bangladesh.

Meaning

In common idiom, to pardon means to forgive a person of his or her offence. The term 'pardon' has been defined as an act of grace, proceeding from the power entrusted with the execution of the law, which exempts the individual on whom it is bestowed upon, from the punishment the law inflicts for a crime he has committed. It affects both the punishment prescribed for the offence and the guilt of the offender. In other words, grant of pardon wipes off the guilt of accused and brings him to the original position of innocence as if he had never committed the offence for which he was prosecuted. The power to grant pardons and reprieves in the United Kingdom is known as the Royal prerogative of mercy where the monarch could turn around any sentence given to an individual. The word prerogative actually comes from the Latin term *"prærogativa"* or *"prærogativus"* which means "special right, previous choice or election." When it was initially introduced, there was no limitation on the power given to the king. However, Under Bangladesh

Constitution, the President has been given the power to grant pardons, reprieves, respites or remissions of punishment or to suspend, remit or commute the sentence. Granting of pardon may be of two kinds. Absolute or unconditional- an unconditional pardon wipes out both the conviction and sentence and restores all civil rights of the individual concerned as if he had never been convicted of the offence (***R. v. Foster, 1985***). Conditional- when the grant of pardon is conditional, the protection provided by the pardon is not available until the condition is complied with and pardon becomes valueless due to non-compliance with a condition to which it is subject (***Attorney General of Trinidad and Tobago v. Phillí, 1994***) and the pardoned person may be made to suffer the punishment he was originally sentenced (Islam, Mahmudul, 2002: 324). Prerogative of mercy in Bangladesh indicates pardons, reprieves, respites, remission, suspension or commutation of a punishment. These words bear distinctive definition and procedure. According to Cambridge Advanced Learner's Dictionary the word prerogative means something which some people are able or allowed to do or have, but which is not possible or allowed for everyone (Cambridge Dictionary, 2008). According to Oxford Advanced Learner's Dictionary the word prerogative means a right or advantage belonging to a particular person or group because of their importance or social position (Oxford Dictionary, 2005). And it defines mercy, a kind or forgiving attitude towards somebody that you have power to harm or right to punish (Oxford Dictionary, 2005). Clemency means the forgiveness of a crime or the cancellation (in whole or in part) of the penalty associated with it. It is a general concept that encompasses several related procedures: pardoning, commutation, remission and reprieves. The word pardon is the forgiveness of a crime and the cancellation of the relevant penalty; it is usually granted by the head of State or by acts of the parliament or a religious authority. Pardons are sometimes offered to persons who are wrongfully convicted or claimed that they have been wrongfully convicted. Some believe accepting such a pardon implicitly constitutes an admission of guilt as a pardon does not set aside the conviction, so in some cases the offer is refused. Clemency plays a very important role when capital punishment is applied. A reprieve is the temporary postponement of punishment, often with a view to a pardon or other review of the sentence. Commutation is substituting the penalty for a crime with the penalty for another, whilst still remaining guilty of the original crime. Remission is complete or partial cancellation of the penalty, whilst still being considered guilty of said crime (i.e. reduced penalty). The Crown's use of the pardon power to ensure that justice was administered with mercy was one of the great advantages of monarchy over any other kind of government, because it softened the rigors of the general law (Blackstone 1769). So, purpose of granting pardon may be- a. To help in saving an innocent person from being punished due to miscarriage of justice or in cases of doubtful conviction; b. To provide an incentive for the convict to behave himself in the prison institution and thus, to help considerably in solving the issue of prison discipline; c. To grant liberty to an offender is better than sentencing of an innocent person; and d. To correct possible judicial errors, for no human system of judicial administration can be free from imperfections.

Origin and Development

In ancient Rome, a process known as *'Adeia'* facilitated a democratic pardon for individuals, such as athletes, orators and other powerful figures, who were successful in obtaining the approval of at least 6000 citizens by way of secret ballot. The linking of punishment and pardon are at least as old as the Code of Hammurabi, where the prescription of harsh penalties was balanced by rules to limit vengeance and specify mitigating circumstances (Rai, 2014:1). Although the source of this power to pardon was not an executive privilege, it is not difficult to see the similarities in the ancient concept of *'Adeia'* and the contemporary practice of pardon, which also often takes into consideration factors such as the public opinion in relation to the individual sought to be pardoned. The modern pardon comes from the English realm. The first known General Pardon in England was issued during the celebrations at the coronation of king Edward III in 1327. During the reign of King Charles II between the years 1660–85, impeachment sentence was removed from the pardoning power. This change in the rule is followed even today.

In the late years of the 18th century, when the initial set of laws was developed for the constitution of the US, the founders did not include the power of pardoning. As a matter of fact, it was not accepted by many. For example, George Mason who was an important backer to the Virginia Plan thought that this power was a grave mistake if given to just a single head. Americans, who considered the rule of King George III as tyrannical, agreed with him. However, Alexander Hamilton thought that the pardoning of a king was a very important tool for governance. He was able to convince the makers of the constitution to include the power of presidential pardon. He believed that it would be very useful in some critical situations to save national crisis. This has proved very useful at a later date several times. For example, President George Washington used this power during the revolt of 1794 by the farmers when taxes were levied by the US government on the corn crops. When the revolting farmers were pardoned for rebelling, the situation was quietly brought under control without further damage. The concept of pardon as enshrined in the Indian Constitution can most realistically be said to be derived from the British tradition of granting mercy. Consequently this power is exercised in Bangladesh. Military ruler HM Ershad was the first President to exercise this constitutional authority in 1987.

Legal Basis

Pardon corrects possible judicial errors, as no human system of judicial administration can be free from miscarriage of justice. It may substantially help in saving an innocent person from being punished due to wrongful conviction. The philosophy underlying the pardon power is that every civilized country recognizes pardoning power as an act of grace and humanity in proper cases, without such a power a country would be most imperfect and deficient in its political morality. Almost every country in the world exercises the power of pardon. It is considered as necessary for the peace and good governance. Article 49 of the Constitution of Bangladesh provides-"The President shall have power to grant pardons, reprieves and respites and to remit, suspend or commute any sentence passed by any court, tribunal or other authority. Article 72(1) and 161 of Indian Constitution ensure this

power for the President and the Governor respectively. Everywhere it is exercised by the head of the state. They are given almost unfettered power in this regard. Since this power flows from the Constitution, it can't be modified, abridged or diminished by the Parliament **(*State of Punjab v. Jogindar Singh, 1990*)**. In Bangladesh, the President exercises this power on the advice of Prime Minister. The President may exercise the power either before or after conviction and need not wait for the verdict of the court (Islam, Mahmudul, 2002: 324).

Clemency in International Sphere

Though almost every country of the world exercises the power of clemency, procedure of it varies from country to country. Somewhere it is being practiced maintaining legal norms and propriety, somewhere there is a lack of proper rules and regulation, which is paving the way of misusing this sacred power. Different countries execute this power maintaining different rules and procedures as below.

In the United Kingdom, the power to grant pardons and reprieves is known as the royal prerogative of mercy. It was traditionally in the absolute power of the monarch to pardon an individual for a crime. Today the sovereign only grants pardons upon the advice of her cabinet: currently they are the Secretary of the State for Justice, for England and Wales, the first Minister of Scotland or Secretary of State for Northern Ireland. It is the standard policy of the government to only grant pardons to those who are considered "morally" innocent of the offence. Pardons are generally no longer issued prior to a conviction, but only after the conviction. The use of the Royal prerogative of mercy is now a rare occurrence, provided that the Criminal Case Review and the Scottish Criminal Cases Review Commission are now avenues to statutory remedies against miscarriages of justice.

In the USA, all federal pardon petitions are addressed to the President, who grants or denies the request. Typically, applications for pardons are referred for review and non-binding recommendation by the Office of the Pardon Attorney, an official of the United States Department of Justice. The percentage of pardons and reprieves granted varies from administration to administration (fewer pardons have been granted since World War II). The Justice Department requires that anyone who requests for a pardon has to wait five years after conviction. A presidential pardon may be granted at any time; however, the pardoned person need not yet have been convicted or even formally charged with a crime. Clemency may also be granted without the filing of a formal request and even if the intended recipient has no desire to be pardoned. In the overwhelming majority of cases, however, the Office of the Pardon Attorney will consider only petitions from persons who have completed their sentences and, in addition, have demonstrated their ability to lead a responsible and productive life for a significant period after conviction or release from confinement. The pardon power of the President extends only to offences cognizable under federal law. However, the Governors of most of the 50 states have the power to grant pardons or reprieves for offences under state criminal law. In other states, that power is committed to an appointed agency or to a board and the Governor in some hybrid arrangement (in some states the agency is merged with that of the parole board, as in the Oklahoma Pardon and Parole Board).

In Chile, the institution of pardon is regulated in the Criminal Code which deals with the extinction of criminal liability. The President is the Head of the State; in this capacity, he has the discretionary power to grant particular pardons. He is not obliged to seek opinion or approval from other authorities, although, the granting of pardons is limited by the norms of law and its regulations which forbid particular pardons for those convicted of a crime of terrorism.

Article 72 (1) of the Indian Constitution refers "The President shall have the power to grant pardons, reprieves, respites or remissions of punishment or to suspend, remit or commute the sentence of any person convicted of any offence—(a) in all cases where the punishment or sentence is by a Court Martial; (b) in all cases where the punishment or sentence is for an offence against any law relating to a matter to which the executive power of the Union extends; (c) in all cases where the sentence is a sentence of death and the Article 161 refers power of the Governor to grant pardons, etc. and to suspend, remit or commute sentences in certain cases." However, it is important to note that India has a unitary legal system and there is no separate body of state law. All crimes are crimes against the Union of India. Therefore, a convention has developed that the Governor's powers is exercised for only minor offenses, while requests for pardons and reprieves for major offences committed in the union territories are sent to the President. Both the President and the Governor are bound by the advice of their respective Councils of Ministers and hence the exercise of this power is of an executive character. So, judgments dealing with Article 72 have simultaneously dealt with Article 161 and vice-versa (Islam, Md. Minhazul, 2012: 265). It is therefore subject to judicial review as held by the Supreme Court of India in the case of ***Maru Ram v. Union of India (1980)***. It was subsequently confirmed by the Supreme Court in case of ***Kehar Singh v. State of India (1988)***. And the Supreme Court also confirmed, clemency is subject to judicial review and that it cannot be dispensed with as a privilege or act of grace ***(Epuru Sudhakar & Anr. v. Govt. of A.P. & ors, 2006)***. The court made this observation while quashing the decision of the then the Governor of Andhra Pradesh, Shushil Kumar Shinde in commuting the sentence of a convicted Congress activist.

In South Africa Under section 84(2j) of the Constitution of the Republic of South Africa, 1996 (Act 108 of 1996), the President is responsible for pardoning or reprieving offenders. This power of the President is only exercised in highly exceptional cases. To pardon a person is to forgive a person for his/her deeds. Pardon is only granted for minor offences after a period of 10 years has elapsed since the relevant conviction. For many serious offences (for example if the relevant court viewed the offence in such a serious light that direct imprisonment was imposed) pardon will not be granted even if more than 10 years have elapsed since the conviction.

In Canada the Parole Board of Canada (PBC) is the federal agency, responsible for making pardon decisions under the Criminal Records Act (CRA). Under the CRA, the PBC can issue, grant, deny and revoke pardons. The criminal record is not erased, but it is kept separate and apart from other (non-pardoned) criminal records.

Processing of pardons by the National Parole Board generally takes on average 60 days for a summary offence and 180 days for an indictable offence.

Bangladesh Perspective

Presidential clemency is also reserved in Bangladesh Constitution. Article 49 of this Constitution provides- "The President shall have power to grant pardons, reprieves and respites and to remit, suspend or commute any sentence passed by any court, tribunal or other authority." This power is reserved to avoid any miscarriage of justice. But there is no specific guideline in our Constitution. As a result, every government is using this power as per its whim and caprice and day by day the tendency to use this power is increasing. In Bangladesh, the power of the presidential clemency is being used in an unrestrained way. After the independence of Bangladesh 25 convicted offenders have been pardoned totally. All of them were exempted on the ground of political nepotism. The number of clemency under different governments is shown in the table below:

	Year	Incumbent President	Ruling Party	Number of Clemency
1	1987	HM Ershad	Jatiya Party	01
2	2005	Prof. Dr. Iajuddin Ahmed	Bangladesh Nationalist Party	02
3	2008	Prof. Dr. Iajuddin Ahmed	Caretaker Government	01
4	2009	Md. Zillur Rahman	Bangladesh Awami League	01
5	2010	Md. Zillur Rahman	Bangladesh Awami League	18
6	2011	Md. Zillur Rahman	Bangladesh Awami League	02

Source:http://newagebd.com/newspaper1/archive_details.php?date=2012-02-28&nid=51887 (accessed on 16-07-13)

Military ruler HM Ershad was the first to exercise the power entrusted upon the President. In 1987 he showed clemency to his party cadre Azam Khan, who was convicted for killing Awami League leader Moyezuddin Ahmed of Gazipur. During 2005 in the tenure of BNP led government, two people, including Sweden expatriate Mohiuddin Jhintu, were given clemency. Jhintu was sentenced to death penalty by a martial law court during the regime of HM Ershad for killing in a political clash with Ershad's student organisation. He was absconded abroad. According to the press reports, Jhintu maintained close liaison with the incumbents of Home Ministry and Law Ministry and managed to have them channeled the process for presidential clemency (Islam, Md. Minhazul. 2012: 259). After having the process ready, he came to Bangladesh on January 3 and surrendered before January 12, 2005. His pardon raised a great deal of controversy at that time. Later Fakhruddin Ahmed led Caretaker Government also granted clemency to a convict sentenced to death penalty in 2008. After the Awami League had assumed office, one was given

clemency in 2009, 18 in 2010 and 2 in 2011. The ruling Awami League has been highly criticized for having 18 people pardoned by the President at the same time. They were convicted of killing a nephew of former deputy minister Ruhul Quddus Talukder in Natore. Former President Zillur Rahman pardoned them as the government considered the murder case a "false one", plotted to destroy the whole Awami League leadership in Natore. Among the 21 people who were forgiven during the present government, HM Biplab, son of Awami League leader Abu Taher of Lakshmipur, was prominent. On 5th September 2000 he killed a Shibir activist Mohsin then on 18th September 2000 he abducted and hacked to death Advocate Nurul Islam, the then organizing secretary of the Lakshmipur BNP. Again in October 2001 he killed a BNP activist Kamal in his house in front of his parents. Biplab was awarded life imprisonment for the murder of Mohsin and Kamal in separate trial and death penalty in Nurul Islam killing. He was convicted in absentia in these three cases, after being on the run for more than ten years; he surrendered before a court on April 6th 2011. His capital punishment in advocate Nurul Islam murder case was pardoned on July 4, 2011. Surprisingly the President being further lenient on the same Biplab reduced his life sentence in each of two murder cases to 10-year imprisonment at the end of 2011. Lawmakers, politicians, lawyers, rights activists and the intelligentsia reacted sharply to the presidential clemency to convicted killer AHM Biplab for the second time within seven months (News Age BD).

Evaluation

It is mentioned previously that there is no specific guideline in Bangladesh Constitution about the way of exercising this power. The tradition of clemency is not developed in a right way in the short history of Independence of Bangladesh. All the prerogatives those have been given till the date are completely politically biased. This makes the citizen anxious about the existence of the rule of law. The recent presidential clemency to Biplab undermines the government's self-professed commitment to the rule of law and the dignity of the presidential office. Now it is clear that the President is to act according to the wish of the government and he cannot apply his individual discretion. One of wonders whether one has ever heard of another instance, anywhere else in the world, where the same person, has been granted presidential pardon twice in seven months, once to save his life, and then to reduce his sentence. A convicted person has the right to beg clemency and the supreme authority has power to grant it but the matter of concern is all the clemencies have been granted just on the base of political affinity with the ruling parties. But it is now being used complete adversely for saving the nearest and dearest criminals of powerful politicians. Surely a person who has been convicted in multiple cases of murder, cannot qualify as a 'good' man, and should automatically forfeit the right to any special consideration. While being kind to the killers, the authority should consider the grief of the family members of the murder victims and the question of justice and rule of law.

Though there is no bar in granting clemency, it is the sacred duty to execute this power with optimum caution and neutrality, which a government is always committed to maintain. It is true this power is an administrative one but it is to be handled more judiciously to uphold the dignity of the office. The conscious

community of the land is raising voice to be more fair and neutral in using this power. After the pardoning of 18 persons (in a year) in 2010, being concerned the Asian Human Rights Commission claimed that the President was just playing the same cards as his predecessors had and his successors would, with no sense of justice and humanity.

The High Court Division in a verdict in April 2012 said that the powers of the President to pardon, suspend or remit sentences of any convict should be exercised fairly and on unbiased relevant principles. The court pronounced the verdict in a case involving presidential clemency to a fugitive convict. It is well settled that the court cannot direct the President and the government in exercising their powers according to Article 49 of the constitution and section 401 of the Code of Criminal Procedure, 1898. The judgment provides, "but the action of the President or the government, as the case may be, must be based on some rational, reasonable, fair and relevant principle which is non-discriminatory and it must not be guided by any extraneous or irrelevant considerations." Possibly it is high time for the government to think about the matter to avoid controversy, criticism and misuse of power, the court observed.

It is the standard policy of the government to only grant pardons to those who are considered "morally" innocent of the offence, who may have been wrongly convicted by a misapplication of law. Wholesale pardon will increase the rate of crime in the society. The countries which are successful to ensure the rule of law in their land, they handle this power much more cautiously. In UK, USA this power is exercised rarely as it is very sensitive and public opinion may go adverse if it is executed unscrupulously. They have strong commission, which examines the merit and demerit of it with extensive cautions, then they submit their observation report, and the clemency mostly depends upon it. Even in our neighboring country India, day by day the way of misusing this power is shrinking as the court is empowered to review it. There are some leading cases which have ensured power to review the presidential clemency in that country. One of the earliest cases was ***G. Krishta Goud and J Bhoomaiah v. State of Andhra Pradesh***. In this case though the court rejected to review the decision of the presidential clemency, it sounded a note of caution and stated that the court would intervene where there were absolute arbitrary and mala-fide execution of public power. This parameter for judicial review was reiterated again in ***Maru Ram v. Union of India and others*** where the Supreme Court further asserted that the courts would intervene in cases where political *vendetta* or party favoritism was evident or where capricious or irrelevant criteria like religion, caste and race had affected the decision making process. Such *mala-fide* and extraneous factors vitiate the exercise of pardon power and should be checked through judiciary. In the case ***Epuru Sudhakar & another***, it was held by the Supreme Court that it is a well-set principle that a limited judicial review of exercise of clemency powers is available to the Supreme Court and High Courts. Granting of clemency by the President or the Governor can be challenged on the following grounds: i. The order has been passed without application of mind; ii. The order is *mala-fide*; iii. The order has been passed on extraneous or wholly irrelevant considerations; iv. Relevant material has been kept out of consideration. v. The order suffers from arbitrariness.

Now, it is a well settled principle that power under Articles 72 and 161of India is subject to judicial review. The court made this observation while quashing the decision of the then Governor of Andhra Pradesh, Shushil Kumar Shinde in commuting the sentence of a convicted Congress activist. So the court will take no action over it but if the pardon appears to be based on *mala-fide* or extraneous considerations, it can set aside the decision of the President or the Governor.

Presidential clemency is considered as the safety valve in exceptional cases where judiciary fails to deliver a morally acceptable result. But it is also necessary to ensure check and balance in the arena of presidential clemency. If it is not checked properly it will reap biased authority. Lord Acton has rightly quoted "power tends to corrupt and absolute power corrupts absolutely". Thus, if there is no existence of scrutinizing body to review this power, it will be misused absolutely and the main goal of this will turn into a great debacle. Where the judiciary has to take a lot of time to determine the offenders and offences for a single case, the president pardons them without following any standard procedure. The judgment was not fair, it did not follow the proper procedure of criminal justice, it was executed to fulfill the political *vendetta* etc. can't be the excuses of a pardon without any reasonable explanation or proof. To tackle this political disaster the article should be amended, and the review system in Bangladesh should be established.

K.C. Davis gave seven principles of rule of law, among these one of the important principles is the "judicial review of administrative actions." Hence if the review system against the arbitrary clemency is introduced that might not be *ultra vires*. Moreover as per Article 27 of Bangladesh constitution: "All citizens are equal before law and are entitled to equal protection of law". In this circumstance the power to clemency goes against the fundamental right in some cases as all men are not equally treated to grant clemency. The Judiciary may make a mistake to deliver its justice. So it is necessary to reserve a safe guard, but the justice or fair judgment should not be bothered in the name of so called safeguard. If the verdict is given maintaining the proper neutrality then administrative body should not intervene there. This will destroy the object of justice in lieu of reserving it.

Recommendations

In this condition, the unrestrained power of the presidential clemency is needed to be restrained for the sake of justice. The following recommendations may be made to bring this under positive control:

- An effective scrutinizing commission should be formed, which will be presided over by a Session Judge or a Supreme Court Judge and its other members may be criminologist and some others who are experts in criminal laws. The commission will verify the applications and check every aspects of pardoning systematically and recommend who deserves pardon and who does not deserve.
- The habitual offenders or those who are convicted of more than once should not be shown any mercy.
- None should be pardoned more than once.
- Since the Prime Minister advises the President in granting pardon, the Prime Minister should be more alert, lest a stigmatized offender gets the opportunity of being pardoned.

- Article 49 of constitution may be amended including sufficient specific guidelines for granting clemency.
- The parliament should enact the provisions empowering the judiciary with review jurisdiction against arbitrary clemency of the authority. If this house is indifferent to establish the judicial review then the judiciary itself should exercise the *suo moto* review power against the whimsical pardon.
- Provisions may be provided in the Constitution so that conscious citizens may raise voice against the misuse of this power. And
- Most of the grounds of clemency should be conditional and not of absolute.

Conclusion

In fine, it may be said that clemency has its own significance. It is the last shelter of judicial mistake. The necessity of granting mercy can't be denied. That is why almost every country exercises this power. But it must be kept in mind that this power is exercised for justice and not for injustice. So this power is to be exercised very cautiously and fairly. To maintain fairness an active scrutinizing commission should be established to assess the exercise of the power. The arbitrary use of this power gives some temporary interest or facility to a ruling party but it hampers the rightful application of justice. Citizens always keep their eyes upon the government activities; so if the government authority carries any malpractice in exercising justice, it will ultimately be remained to the government. All people irrespective of caste, sex, colour, religion, political belief and locality hate the miscreants and expect their punishment but if they are pardoned in lieu of punishment, this will tarnish the image of the party. Leniency should be shown to that persons who deserve it but it should never be shown to a socially detested person. It is a universal truth that if criminals are pardoned, crime will increase, respect to law will be declined and justice will be buried. The rationale of the pardon power has been rightly and wisely enunciated by Justice Holmes of the United States Supreme Court in the case of *Biddle v. Perovich* in following words: "A pardon in our days is not a private act of grace from an individual happening to possess power. It is a part of the constitutional scheme. When granted, it is the determination of the ultimate authority that the public welfare will be better served by inflicting less than what the judgment fixed". Lastly, the pardoning authority must keep in mind that this power is delegated by the citizens for their greater interest and the authority has no right to use it for the personal interest at all.

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