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*Mewar University*  

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*Knowledge to Wisdom*

*Mewar University*

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# CHAIRPERSON'S MESSAGE

Extend cordial greetings to the academic community on this occasion of Deepavali. The festival of light brings zeal in our endeavours. We worship Ganesha and Lakshmi, the supreme bestower of auspiciousness and prosperity, respectively. Without inculcating the wisdom of Ganesha, one cannot hope to bring *aishwarya* in one's hearths and home. The wisdom springs forth from the insight. Wisdom is always intuitive and not sophistry. But, in recent decades, there is a persistent attempt to identify intellectual sophistry with higher wisdom. The result has not been satisfactory for the world at large. While the natural sciences have been exploring the native wisdoms to build a roadmap for the future research, humanities have been at logger-head with native wisdom, particularly in country like India. Wisdom has been replaced by reproduction of Western debates into desi- titled tomes.

With the shift in gravity of global power configuration towards Asia, it is becoming necessary to bring out fusion of Asian and western wisdom. Indian scholars ought to rise to this occasion to provide thought leadership to mankind. In fact, it is time for non-western paradigms to seek space in the emerging global wisdom pool. Since its inception, the Journal of Indian Research has been in the forefront to put forth the non-western knowledge traditions in the contemporary context. In the current issue, we have papers from many scholars who question the framework of western education system or western representation of their colonies as 'static' entities and offering their own narratives which are forceful and scholarly.

I also take this opportunity to request the government bodies promoting research and indigenous thinking to extend financial support to the nascent venture like Journal of Indian Research which can make it sustainable on a long-term basis. In fact, the JIR is becoming a flag-bearer of South Asian scholarship. The next SAARC Summit is to be held in Nepal in the coming weeks (Nov.22-27). I would request the SAARC nations to generate a common pool for promoting South Asian scholarship. The financial body can sponsor research which utilizes non-western paradigm and should also support publication activities.

The Editorial team of the JIR deserves accolades for bringing out another issue in time with meticulous work. I wish the institutions and readers a pleasant reading experience!



**Dr. Ashok Kumar Gadiya**

Last month I was invited to attend a lecture by Professor S.N. Balgangadhara of Ghent University, Belgium. He spoke on ‘Being Hindu’ for almost an hour. There was nothing that he said to really address the idea of ‘Being Hindu’. In fact, following the principle of *apoha* (negation) enunciated by the famous medieval Buddhist critical realist Acharya Dignaga, he spoke on “what is not Being a Hindu”. The message was lost amidst bombastic statements flowing through his flamboyant personality. But his message was stern: “Indian culture is to be deliberated in the language of the twenty-first century, as the new generation is not interested in the gibberish stories of the colonizers in the name of Indology.”

But, what should be the mode of non-Indological narrative? Professor Balgangadhar proclaimed: “Scientific language”. For him, science is universal and the language adopted for understanding physical universe ought to be deployed to understand the epiphenomena of human mind, our culture. The whole gamut of his thought is fallacious. If indigenous thought-mentors have to shed the cloak of Indology, they ought to drop the epistemic baggage of the west that produced such positivist knowledge traditions. Not only the mode of inquiry, but even the gestures of enquiries, the object of inquiry, the framework of inquiry has to be based upon non-western pedestal.

While the discussion was in full-swing, a brilliant young scholar, Priyadarshi Dutta raised a valid point. It is only subsequent to the advent of Indology that the convention of speaking while standing on two legs was borrowed by Indians. The idea pierced like an illuminating streak.

In Asian tradition, teaching is always imparted while sitting cross-legged on the floor. Our sages (ऋषि) composed the treatises while sitting cross-legged. Buddha, Nagarjuna, Dignaga, Abhinavagupta, Vyasa, Valmiki are the greatest masters of this soil. None of them taught while standing. India’s own vibrant tradition of debate brings in the image of sitting opponents on floor. Our singers would sing in similar posture. In fact, Gandhiji adopted this traditional method of conveying thoughts and was much more effective as compared to the modernist leaders groomed in standing genre of public speaking.

This tradition of teaching while sitting on floor is prevalent across Asia. Chinese sages, Japanese monks and Muslim fakirs adopted this habit. Is there any correlation between thinking/speaking while sitting cross-legged and Asian mode of inquiry and language? Is cross-legged sitting posture conducive to developing *ontology of closure* in which everything is beaded in the cyclical perspective? Do that make Asians less prone to pursuing the politics of expansionsim? Similarly, is there a correlation between thinking/speaking while standing and the mode of inquiry? Is the different paradigm of thinking merely a byproduct of our physical postures and gestures? Does sitting cross-legged bring a sense of harmony and balance in our thought and action? Does standing with wide-open legs induce a mode of activating quest for *ontology of expanse*? Does the root of imperialism and linearity paradigm lie in the standing posture prevalent in the West?

There are clear differences between position of caring in Asia and the West. While in India, mothers hold the baby in the couching position, it is convenient in the west to carry and care for the baby in the standing position. Across Asia, traditionally people eat while sitting on the floor, but we are witnessing the influx of buffet system in which people partake meals in standing position. Sitting and serenity appear correlated. It is not a surprise that in Tantric Buddhism, which investigates the mind with as much discreetness as feasible, even the Bodhisattva is depicted sitting in *yab-yum* position with his consort, *Vajra Varahi*. If Asian tradition of thinking emphasizes contemplation and intuition, such thinking has foundation in the sitting position.

Martin Heidegger, the German philosopher was engrossed with understanding gesture and thinking in Asian tradition. With the sophisticated brain imaging techniques, one can fathom how mind responds in different postures and gestures. What region of brain gets more stimulation with change in postures? Hopefully, in coming days we can have synthetic study of such features under the new discipline like Cognitive Neuro-physio-science.

But in a programme where the best of ‘Hindu Minds’ congregated to discover ‘Hinduness’, serious intervention made by Priyadarshi Dutta was scoffed at. What is Being Hindu? At least, not being a standing preacher. Our

discourses of *sanatan parampara* are still carried through the sitting *mudra*. If something is to be seen as essential, then the art of sitting cross-legged must be counted as the most tangible phenomena. But, with the change in the government, there is little movement towards new posture. In fact, the new government is focusing more on standing and less on rediscovering “old postures in new system”. The Ministry of External Affairs has directed its spokesman to address the media in standing position using podium. This mirrors the spokesperson of the western governments.

Our wisdom-masters conveyed the most profound teachings through mere gestures. We excelled in embodiment of thoughts. But thinking beyond reason has since been forfeited and has given place to the primacy of reason, that too, of only western variant. Image of divinities with folded legs and folded fingers (*mudra*) have enthralled our civilization for millennia. In fact, our thinking is rooted in the orientation of condensation and miniaturization. The Sutras would convey manifold meanings to a listener. The Sutras could be condensed into few-line shorter *dharanis*. Finally, *dharanis* could be condensed further into mantras, mantras into mere phoneme, thence further compressed into *nada*, bindu, and finally complete silence. Deepest wisdom would be communicated through wordless silence.

Similar compression technique of thinking is ubiquitous in the *extremity* of the Orient, in Japan. Japanese culture revolves around the concept of reduction/compression-the *Chijimi*. Japan traditionally gained the Mastery of the Miniature (*Chijimi shikoo no Nihonjin*). The Japanese fan (*sensu*) can be folded up. *Origami*, the art of folding the papers, is highly evolved in Japanese culture. *Kimono* is the folded clothes, *Futon* is the foldable mattress, *Byobu* is the folding screen and so on. Japanese excel in growing dwarf plants (*bonsai*), and creating miniature gardens (*hakoniwa*). *Haiku* and *tanaka* poetic forms are examples of this compression in literature. Similarly, *Zen koan* is the prime example of compression of consciousness itself.

It is not a surprise that Japan dominates the post-industrial new technology where focus has shifted from building mega-structures to creating miniature machines. May it be little cameras, small watches, mobile handsets, computers, laptops; the Japanese have excelled in the new technology due to the cultural bedrock of compression.

What is required today is an epistemic rupture and to pave way for other modes of knowing. We must sit down and start recollecting our ancient wisdom in compressed forms. Peddling sophistry and polemics devoid of any wisdom is surely a way of *Being Not a Hindu*. But, this necessitates change in postures and gestures. The radical break can only come from the top. What if our top political leadership starts speaking while sitting on a podium (not on chair but on the spread mat) following the footsteps of Gandhiji! What if our cabinet meetings are held with the ministers sitting on a carpet!

The current issue of the Journal of Indian Research focuses on this theme of non-western mode of knowledge. The cover of the Journal carry the image of seven Asian masters of wisdom (*saptarishis*, सप्तर्षि), all in sitting position forming a chakra around the book of wisdom. We hope to rejuvenate the debate over western and non-western modes of knowing and enrich our understanding better. I would also like to take this opportunity to extend my heartiest greetings to all the contributors for putting faith in the visions of this nascent journal!

– **Niraj Kumar**

## THE SCIENCE OF MEDICINE AND SURGERY: A PRIME CONCERN IN THE *MILINDA-PANHA*

Krishna Kumar Mandal\*

### ABSTRACT

*This paper is an attempt to explore the medicinal and surgical concern of the Milinda-panha, a text of the 1<sup>st</sup> century AD which describes the debate between King Milinda and the Buddhist monk Nagasena. Nagasena compares nirvana with medicine. The elaborate description about various diseases, diagnosis and their treatment can be found in the text. But, these categories need psycho-analytical and semiological analysis for grasping the proper meaning of words Milinda-panha, despite its canonical nature, provides interesting insights into the medicine as its core context, the method of surgery, the anatomical and physiological details of human body, diagnosis, the importance of diet control in disease management and the prestige enjoyed by the medicine men in the contemporary society. But at the same time it also hints at the ongoing conflict between the forces of science and superstition. The causative status assigned to karma for disease and acceptance of the curative powers of charms and rituals in the face of rational traditions of diagnosis reflects the milieu of increasing Brahmanical orthodoxy.*

**Keywords:** Buddhaghosha, Charak, dosha, gabbham, Humor, karma, Medicine, Milinda, Nagasena, nirvana, samskara, shilpa, yamaka-salaka.

### INTRODUCTION

By the sixth century BC, medical knowledge largely became an exclusive domain of ascetic wanderers. It was however codified only in the Buddhist *samgha* because of the institutionalization of the Buddhist order. There was a shift from this magico-religious system to empirico-rational medicine.<sup>1</sup> To a great extent this empirico-rational system incorporated and adopted the knowledge of medicine as developed in the Buddhist order.<sup>2</sup> Articulation of proper medical treatment for the members of the Buddhist order is echoed in entire section of the *Mahavagga* of *Vinay Pitaka*. Bearing the title *bhesajjaka*, the contents underline the remarkable strides, the science of medicine made in Buddhist India. Unmistakably this stage is called *yukti-vyapasraya bhesaja* which is defined as ‘therapeutic system based on substances as diets and drugs.’<sup>3</sup> That the knowledge of medical science enjoyed centrality in the Buddhist philosophy and that the Buddha presumably followed the model of this science to formulate his views which indirectly find a reflection in the *Milinda-panha*,<sup>4</sup> a text of the 1<sup>st</sup> century AD. The text not only persistently draws on the analogy of surgeon and physician curing the sick while explaining the teaching of the Buddha, but also equates these healing agents and surgical skills.

This paper is an attempt to explore the medicinal and surgical concern of the *Milinda-panha*. It needs psycho-analytical and semiological analysis for grasping the genuine meaning of words.<sup>5</sup>

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The *Milinda-panha* reflects its familiarity with both the treatment of disease and the nature of medicine. It specifically provides that a physician should give his decoction to the patient only at a time when illness has set in, and never before that.<sup>6</sup> before starting the treatment, the doctor should know the age of his patient,<sup>7</sup> obviously because the body condition changes with age and this fact needs to be carefully considered while prescribing medicine. An able physician never acts in hurry, when he visits a patient suffering from a complication of diseases, he ponders over the line of treatment to be followed and type of drugs to be used.<sup>8</sup> The treatment of fever is mentioned.<sup>9</sup> In the cases of poisoning, it is medicine that is projected as the only refuge of the tormented,<sup>10</sup> an antidote to whatever poison may have been imported through bites or contact or by eating or drinking.<sup>11</sup>

The core context of the text is medicine. Elaborating upon the artistic and scientific acquisitions of King Milinda, it includes medicine in the text of nineteen *shilpas*.<sup>12</sup> The reference to the Buddha as the supreme healer and physician<sup>13</sup> vindicates the unreserved acceptance of the science in the Buddhist circles. The Buddhist preference for rationality may also explain the enthusiastic preference for this branch of knowledge. Medicine has been mentioned more than sixty times in the text. References indicate that *nirvana* is compared to medicine. Responding to a query of Milinda, Nagasena say: “As medicine, O King, is the refuge of beings tormented by poison, so *nirvana* the refuge of being tormented with the poison of evil disposition .... And again, O King, as medicine puts an end to diseases, so does *nirvana* put an end to grief .... And again O King, as *nirvana* is ambrosia, so also is medicine ambrosia.”<sup>14</sup> This enthusiasm for medicine is further explicated in the description of the Buddha’s bazaars of antidote, medicine and ambrosia. Describing the antidote bazaar of the Buddha, Nagasena says : “Certain drugs .... have been made known by the Blessed one; drugs by which Blessed one delivers the whole world of gold and men from the poison of evil dispositions. And what are these drugs? The Four Noble Truths made known by the Blessed one .... And whatever hears this doctrine .... are set quite free from rebirth, .... old age .... death, .... grief, lamentation, pain, sorrow and despair.”<sup>15</sup> The analogy is further elaborated in terms of medicine<sup>16</sup> and ambrosia<sup>17</sup> bazaars of the Buddha.”

Nagasena has repetitively used the analogy of medicine not without a close familiarity with it. He is clear about the purpose of medicine, i.e. to end the diseases.<sup>18</sup> He is equally clear about the direct equation between health and medicine.<sup>19</sup> He refers to five kinds of drugs made from medicinal herbs<sup>20</sup> and adds that a medicinal herb by exceeding power of its nature will utterly kill pain and put an end to disease.<sup>21</sup> He also knows that hundred of such magical drugs are found in the Himalayas.<sup>22</sup> The medicine included nasty, sharp and scarifying drugs and evil-smelling decoctions.<sup>23</sup> The medicine, however, had its limitations. Nagasena says that no medicine can prolong the life of one whose allotted period has come to an end.<sup>24</sup> This attitude of pessimistic fatalism was bound to constrain a physician.

The *Milinda-panha* suggests the importance of diet control in disease management. Nagasena speaks of the need of “self-control as regards the stomach” and adoption of the “practice of restraint in the matter of eating.”<sup>25</sup> Taking right food and getting proper sleep are essential ingredients of good health.<sup>26</sup> To regain energy, even a sick monk was allowed to consume broth.<sup>27</sup> Repeated references to ambrosia<sup>28</sup> apparently articulate this concern. Dietics assume greater significance in the context of the administration of purgatives and emetics.<sup>29</sup> A purge is to be administered only after the patient has been made to drink oil for four or five days in order to strengthen him and to soften his body.<sup>30</sup> As the ancient Indian physicians believed that purgation weakened the body, this was followed up by giving a tonic to the patient.<sup>31</sup> Obviously a person afflicted with a serious disease is to visit only that physician who is expert in diagnosis and has the knowledge of an efficacious and lasting method of cure.<sup>32</sup> Thus, factors in the wider social environment that affect the longevity and health of individuals which are properly denoted as social determinants of health.

The *Milinda-panha* sets a very high standard for a practicing medicine man and makes a clear distinction between the physician (*vejja/vaidya*) and the surgeon (*sallakatta*). The text refers to the physician twenty times while surgeon is mentioned ten times and there are two co-references of physician and surgeon. For Nagasena, a medicine man has to be well-versed in his lore. The text refers to some renowned teachers of the subject, a fact that vindicates the continuation of a strong tradition of this science in early India. The teachers including Narada, Dhanvantary, Agnivesha, Kapila, Kandaraggisama, Atul and Pubba Kakkayana, are credited with thoroughly investigating the rise of disease along with its cause, nature, progress, cure, treatment and management. Each of them is further credited with having “composed his treatise en block, taking time by the forelock, and painting out that in such and

such body, such and such a disease would arise”.<sup>33</sup> Thus a physician so trained is a true follower of the sages of old, “one who carries (in his memory) the ancient traditions and verses a practical man, skilled in diagnosis and master of an efficacious and lasting system of treatment, who had collected a medicine able to cure every disease . . .”<sup>34</sup>

Highlighting the characteristics of a physician, the *Milinda-panha* states “that surgeon who is able to extract the dart the most quickly, and allay the disease, is considered the cleverest.”<sup>35</sup> Surgical instruments as well as methodology have been located. The text indicates *salaka* as a kind of surgical instrument used for different curing purposes. *Salaka* is of two kinds — one is used to put collyrium with both ends and other is a surgical instrument with dual ends and is not used for ointing eyes. The text narrates that if a man is suffering from *medoganthi* (abscess of fat) and unable to bear the pain; a surgeon is called, who after hearing patient’s history takes a sharp instrument (*tikhinam-sattha kam*) namely, *yamaka-salaka*, keeps it in the fire, mixes alkaline and pungent salt and cuts a part of skin with this dual-rod (*yamaka-salaka*) and opens it and makes a space to pour the mixture in it.<sup>36</sup> Nagasena gives a detailed procedure of opening an abscess of wound treated with *yamaka-salaka*. Accordingly a skillful surgeon observes the wound filled with pus, giving bad odour. He cuts it very deep till the hollow inside is filled with blood. He then applies, on the mouth of the wound, a strong alkaline substance and allows it to foment. As it turns soft by use of strong alkaline or pungent salt and bitter medicines, he then opens it with a thin bar of *yamaka-salaka* and burns the wound with ends of the *salaka*, then applies ointment on it and allows it to heal; with this therapy he cures the patient.<sup>37</sup> A possible reference to eye-transplantation underlines the presence of such skilled ophthalmic surgeon in the contemporary society.<sup>38</sup>

The text is remarkably conversant with the anatomical and physiological details of human body. It mentions about bodily hairs, the nails, the skin, the flesh, the nerves, the bones, the marrow, the brain, the heart, the kidney, the liver, the abdomen, the spleen, the lungs, the larger intestine, the smaller intestine, the stomach, the faeces, the bile, the phlegm, the pus, the blood, the sweat, the fat, the tears, the serum, the saliva, the mucus, the oil that lubricates the joints and the urine.<sup>39</sup> It also refers to thirty two kinds of organic matter in a human body and five constituent elements of being.<sup>40</sup> It also details the following ten qualities inherent in the body : cold and heat, hunger and thirst, the necessity of voiding excreta, fatigue and sleepiness, old age, disease and death.<sup>41</sup> References to ten qualities inherent in the body and the admission that the Buddha fell sick after taking his last meal, not because of the pork which was tender and good for digestion but because of his old age,<sup>42</sup> articulates a perception of the varied condition of human body. Similarly, the knowledge about five constituent elements of being underscores the perception about interaction between environmental matter and body matter as the sole determinant of everything about the body, including health and disease. As everything in nature as well as in man is made of matter in its five forms, the therapeutic principle, put in more general terms, means that if there is excess of body-matter in some particular form resulting from the wrong absorption of environmental matter, a physician has to prescribe as drug or diet, certain specific substances which, when transformed within the body raises the affected body-matter to the desired level.<sup>43</sup> The theory of morbid matter or *dosha* and of their excess in the body causing diseases are issues known to both *Vinay Pitaka*<sup>44</sup> and *Milinda-panha*.<sup>45</sup>

As regards the views on science of medicine and surgery, the Buddhist approach seems to be based on practical experiments, especially psychopathological. Their narrations about disease and its treatment are given on the basis of an investigation, i.e. diagnosis though in a short and condensed form, they are very informative; so diagnosis is very important for physician and surgeon. In this context, the *Milinda-panha* underlines diagnosis as a criterion of an expert physician. “O King that a man afflicted with dire disease should visit a physician skilled in diagnosis”<sup>46</sup> . . . . That a physician, a true follower of the sages of old, one who carries (in memory) the ancient traditions and verses, a practical man, skilled in diagnosis, and master of an efficacious and lasting system of treatment, who had collected (from medicinal herbs) a medicine able to cure every disease, were to have announced.”<sup>47</sup>

This is attested by Nagasena’s analysis of the various facets of dream, an exercise having a distinct diagnostic significance. The following six causes for dream have been enumerated : windy humor, bilious humor, phlegmatic humor, influence of a god, influence of own habits, and in the way of prognostication.<sup>48</sup> Nagasena is apparently silent about the medical context of the dream but Charaka is explicit on this point; for making a proper diagnosis that the physician is asked to enquire also about the dreams of the patient.<sup>49</sup> Obviously by learning about the kind of dream a person was seeing, the physician could have made a better diagnosis by relating it with its specific cause. This

emphasis on diagnosis, both in terms of observation and inference, is decidedly the result of an advanced and critical outlook. Despite the rational approach to diagnosis, Nagasena does concede ground to superstition by accepting divine will and prognostication as possible causes for dream. This unnatural truce between reason and orthodoxy becomes more marked in his discussion on death. He talks about death at the appointed time and death out of time. The first category included death due to *karma*, journeying activity and old-age, even a death in the womb is a death at appointed time.<sup>50</sup> The second category includes death due to hunger, thirst, snake bite, poisoning, fire, drowning and wound of a dart.<sup>51</sup> But even such death are described as the result of the negative *karma* accrued in previous births,<sup>52</sup> though Nagasena asserts that “it is only death by the working of *karma* that is death at due season, all the rest are cases of death out of due season.”<sup>53</sup> At the same time, he keeps on repeating the rational explanation for the death of a person.<sup>54</sup> The scientific explanation has been repeated nine times.

The text reflects high regards for the physician and surgeon. It narrates : “A doctor or surgeon first procures for himself a teacher, either by payment of a fee or by the performance of service, and then thoroughly trains himself in holding lancet, in cutting, making or piercing with it, in extracting darts, in cleansing wounds, in causing them to dry up, in the application of ointment, in the administration of emetics and purges and oily enemas, and only when he has thus gone through training, served his apprenticeship, made himself skilful, does he visit the sick to heal them.”<sup>55</sup> Nagasena praises saying “O King! a skilful physician with his surgical instruments and medicine can make a dreadful disease very small.”<sup>56</sup> Nagasena while discussing on ‘*Nibbana*’ with Milinda compares it with medicine. He opines, “Medicine (*agada*) has three qualities e.g. (i) medicine cures a person from poison, (ii) it cures disease, and medicine is like a nectar. Truly speaking, *Nibbana* to a Buddhist monk is an ultimate realization and is esteemed very high.”<sup>57</sup> This reveals the great respect that people had for this profession. More passages like these may be cited from the text where the great esteem with which the physician and surgeon are viewed in early Buddhism is already obvious. Unfortunately, surgery was later on looked down upon as a low art. This tendency is evident in the *Milinda-panha*. It is said, “A physician who ignoring the cause of disease immediately picks up an instrument is not a skilful physician.” Similarly I-Tsing gives a list of eight sections of medical science but surgery has no place in that detailed list.<sup>58</sup> This indicates that surgery in ancient India from 300 AD to 700 AD was heading towards decline.

The text also addresses the gender issue with a view to bring parity in basic medical care. In Pali literature, there is no proper term that can be assigned to women’s diseases. At the same time one can not expect information about disease of women in an ascetical literature like Pali-Tripitaka. However the fact is that the Buddhist *samgha* had accommodated a separate wing of nuns and perhaps, therefore, we do not get an important record of disease of women, along with their remedies. There are exceptional references. Buddhaghosa has elaborately commented on barren woman in *Vanjhaitthivathu*. A woman who is called barren-woman has a womb that lacks in producing a fruit or is a result of bad fructification. Having no protective element in the womb, woman is unable to hold the fetus. Since there is no protective element in the uterus that could protect *gabbham* and sadly it is destroyed. Nagasena agrees, “woman becomes barren owing to these major defects (*atidosena vanjha hati*).”<sup>59</sup> Further the *Milinda-panha*<sup>60</sup> offers the four methods of conception such as (a) oviparous creation (*andaja*), (b) viviparous creation (*jabalu*), (c) moisture sprung (*samsadeja*) and, (d) spontaneous (*apapattika*) creation. It further narrates<sup>61</sup> sometimes conception takes place on account of one’s act (*kammavasena*) or on account of one’s womb (*yonivasena*) or on account of family traditions (*kulavasena*) and on account of begging or praying (*ayacanasena*) to Devaputta. The text gives a simile of a river. It narrates that a river recedes in the great ocean and it becomes big, similarly a fetus starts increasing with nourishment that he gets from a mother.<sup>62</sup> Nagasena referring to a simile of a pregnant woman, states : “A pregnant woman, when her fetus is not in proper position (*mulhagabha*) goes to a physician for check-up. There she shows her private part which otherwise is considered as very personal and not to be shown to any one.”<sup>63</sup> This small but important reference indicates the medical treatment available to a pregnant woman in ancient India.

The text highlights the causes for the rise of suffering. Referring to two kinds of pain, bodily and mental,<sup>64</sup> and one hundred and eight kinds of sensation,<sup>65</sup> Nagasena elaborates eight causes for the rise of suffering. Superabundance of mind and of bile and of phlegm, the union of these humors, variations in temperature, the avoidance of dissimilarities, external agency and *karma*. From each of those there are some sufferings that arise, and these are the eight causes by which many beings suffer pain.”<sup>66</sup> From the perspective of rationality, this raises a significant question: How can the fundamental assumptions of the physicians be synchronized with the law of

*karma*? Nagasena faces this problem squarely while the early Indian medical compilations have virtually ignored it.

Despite assigning a causal status to *karma*, he asserts, “And therein whosoever maintains that it is *karma* that injures beings, and besides it there is no other reason for pain, his proposition is false.”<sup>67</sup> But is this stand in tune with the fundamental teachings of the Buddha? It has to be remembered that the *samskaras*, which according to the formula of causal sequence explaining the origin of suffering are shown as the immediately preceding cause of the present existence, do represent the accumulated karmic effects left in a being before his rebirth.<sup>68</sup> Milinda articulates a similar view when he argues that all seven kinds of pain ultimately have their origin in *karma*.<sup>69</sup> But defending rational therapeutics, Nagasena replies, “If, O King, all diseases were really derived from *karma* then there would be no characteristic marks by which they could be distinguished one from the other. When the man is disturbed, it is so in one or other of ten ways — by cold, or by heat, or by hunger, or by thirst, or by over eating or by standing too long, or by over exertion, or by walking too fast, or by medical treatment, or as the result of *karma*. Of these ten, nine do not act in a past life or in a future life, but in one’s present existence . . . . So what arises as the fruit of *karma* is much less than that which arises from other causes. And the ignorant go too far when they say that every pain is produced as the fruit of *karma*.”<sup>70</sup> To buttress his argument against the omnipotence of *karma*, he adds, “. . . . when food is not digested, that must be due either to a defect in the stomach, or to the badness of the food.”<sup>71</sup> Ultimately he brings the Buddha in his defence by citing the prose *Sutta*, Moliya Sivaka of the *Samyutta Nikāya* wherein the Master says, “There are certain pains which arise in the world, Sivaka, from bilious humor . . . (or) from the phlegmatic humor or from the windy humor, or from the union of the three, or from variation in temperature, or from avoidance of dissimilarity, or from external action, or as the result of *karma*. In each case you should know for a certainty which those are, for it is a matter of common knowledge which they are. But these *sramanas* or brahmanas who are of the opinion or the view that whatever pleasure, or pain, or indifferent sensation, any man may experience, that is always due to a previous act— they go beyond common knowledge. And therein do I say they are wrong,”<sup>72</sup> This is manifestation of rational approach. Despite this scientific approach, the Buddhist tradition did concede some space to the law of *karma* in the rational domain of medical science. This was decidedly a sort of compromise affected with the growing orthodoxy in an attempt to save the science, as Debiprasad Chattopadhyaya puts it, by offering ransoms to counter-ideology.<sup>73</sup>

Similarly, the text locates in the context of treatment of snake bite; the cult of magic that overwhelms the tradition of rationality. A person bitten by a snake is cured by the repetition of a powerful charm compelling the poisonous snake to approach and suck the poison back again.<sup>74</sup> Nevertheless Nagasena refers to charms for curing snake-bite, he very much knows about the use of antidotes as well as application of lotion above or below the bitten spot as curatives.<sup>75</sup> This concession to superstition, apparently dichotomous, is aimed at keeping secure the rational foundations of medical science. The realization that one is afflicted by paralysis when all the humors of the body are affected,<sup>76</sup> however underlines the rational outlook. Quite possibly, aspects of magico-religious healing, originating with the *atharvans*, were also preserved by the *samana / sramana* groups and, through them, were transmitted into the early Buddhist and Ayurvedic medical traditions. Specific knowledge of individual religious techniques may have varied but the underlying precepts of magical and religious healing were maintained and incorporated into the general corpora of the emerging medical literature.

Thus the *Milinda-panha*, despite its canonical nature, provides interesting insights into the medicine as its core context, the method of surgery, the anatomical and physiological details of human body, diagnosis, the importance of diet control in disease management and the prestige enjoyed by the medicine men in the contemporary society. But at the same time it also hints at the ongoing conflict between the forces of science and superstition. The causative status assigned to *karma* for disease and acceptance of the curative powers of charms and rituals in the face of rational tradition of diagnosis reflects the milieu of increasing brahmanical orthodoxy.

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## FROM SULTANATE PERIOD TILL DATE: AN ESTIMATE OF ROLE AND STATUS OF MUSLIM WOMEN IN INDIA

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### ABSTRACT

*Ever since the evolution of Islam and advent of Muslim rule in the Indian subcontinent, Muslim women have played a convincing role in shaping up the history of our country. Whether they be the erstwhile royalty or the common women, they have actively participated in the political as well as socio-cultural sphere of the country. However there have been few scholarly attempts to bring to light the concerns, trials and tribulations endured by them in this long journey, especially the common women. The Quran mentions that both men and women are equal and they both are created from nafs wahidah (a single soul). Thus, in textual Islam women have been accorded a very high status. The present paper aims to put forward socio-economic and legal standing of Muslim women within a historical framework commencing with the inception of Muslim rule in India till date besides outlining their contributions, successes and failures as also the challenges that they face.*

**Keywords:** British Raj, Islam, Mughals, Muslim Women, Purdah, Shari'a feminism, Sultanate.

### INTRODUCTION

India houses one of the largest Muslim populations in the world next only to Indonesia and Pakistan. Thus it becomes imperative to assess the condition as well as role of the women of India's largest religious minority community after six decades of independence. There has been a persistent confusion about Muslim women's status and rights. The confusion arises due to the significant differences regarding the status and rights of Muslim women in textual Islam, in Islamic history and tradition and in Islam in practice at present (Ali, 2000). Our Constitution gives equal rights to all its citizens irrespective of caste, creed, sex, language or religion. This has naturally helped Muslim women like women of other communities improve their condition after independence but still a long road lays ahead. Though Islamic feminism has not emerged in India, it is on its way (Ali, 2002)

### Coming of Islam & Women during Sultanate age

Trade relations existed between Arabia and the Indian sub-continent since ancient times. Newly Islamized Arabs were Islam's first contact with India. In the 8th century, Sindh was conquered by an Arab army led by Muhammad Bin Qasim (E&D, 1871). While the 10th century witnessed Mahmud of Ghazni invading India followed by Muhammad Ghori which eventually led to the formation of the Delhi Sultanate. Muslim rule lasted for almost eight centuries, leaving an indelible impression on the history, culture, politics and administration of India. Iltutmish became the Sultan of Delhi in 1211 AD. He appointed his daughter Raziya, Sultan of Delhi, instead of his sons. Raziya was

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the only woman to ascend to the throne of Delhi by popular consent. Her reign and accession gains significance considering it took place in a society with rigid and fixed gender roles. She was an able ruler, although she was resented by some men. As a historian observes, 'She was endowed with all the qualities befitting a king, but she was not born of the right sex, and so, in the estimation of men, all these virtues were worthless.' (Thapar, 1966). Thus we see that India had a female ruler during the Sultanate period but it was more of an exception than usual practice. The common women remained absent from public life. This is one of the reasons for the lack of information on Muslim women's social history during this period. Another reason being the practice of purdah.

In this period, the *ulema* (Muslim theologian) interpreted Qura'nic verses and the *Shari'a*. The *ulema's* position on women was based on the orthodox Islamic tradition considering women as *fitna* (potential disorder). Accordingly; it became necessary to regulate men-women social interaction, which led to control over female sexuality, and female seclusion from public space(s). The *Ulema* also favored women's education but it was to be strictly religious (i.e. the Qur'an), furthering family values and morality among women (Kazi, 1999). For nearly two hundred years of Delhi Sultanate, condition of women remained more or less the same. In 1526 AD, the last of the Lodis were defeated in the battle of Panipat by Babur, marking the end of the Delhi Sultanate and beginning of the Mughal rule in India.

### Status of Muslim Women in Mughal Period

Babur founded the Mughal dynasty in India. The real might of Mughal rule in India, spanning nearly two centuries and seven rulers, ended in 1712 AD with the death of Bahadurshah First, though the last titular Mughal emperor ruled till 1857 AD. Like the Sultanate period, during this period also the absence of Muslim women from public life and the prevalence of *purdah* led to scarcity of information on Muslim women's social history. *Purdah* was a unique feature of Muslim women's lives in this time – particularly of Muslim elite, though not being followed by the working class. The ideology of *purdah* (female seclusion) came from consideration of women as *fitna*. *Purdah* later became synonymous with female 'respectability' among upper-class women (Lal, 1988). The practice of *purdah*, along with societal ideas which saw women as primarily wives and mothers, prevented female education. Thus education among Muslim women remained largely restricted to religious lore. Although *maktabs* (primary schools) had both girls and boys as students, girls were completely absent from *madarsas* (high schools/colleges). Only the affluent ones could afford private education, girls' education remained confined to memorizing the Qura'n and learning Persian or Urdu. Though many women in the Mughal royal family received private education. For example, Babar's daughter, Gulbadan Begum, wrote Humayun's biography called the *Humayun Namah* (Begum, 1988). Emperor Jahangir's wife Nur Jahan was a poetess and wrote verses under pen name 'Makhfi'. Jahanara, daughter of Shah Jahan was both a poet and a biographer. Zeb-un-Nissa, Emperor Aurangzeb's eldest daughter, was an eminent theologian and poet.

Thus it becomes clear that the period witnessed the rise of many female literary figures but one noticeable factor is the total absence of common women from this list. Not just in the literary field, even on the socio-political front, women played a prominent part though from veiled quarters (i.e. Harem). The period saw many influential women wielding great power from behind the veil. Hamida Bano Begum, Maham Anga, Bakhtunnisa, Salima Sultana, Nurjahan, Mumtaz Mahal, Jahan Ara, Roshan Ara, Zebunnisa, Zeenatunnisa to name just a few. Nur Jahan's (Sundaresan, 2003) name deserves special mention as she remains the only queen in the history of Muslim India, and one of the only two in the entire Muslim history, whose name was struck on the coin alongside that of the emperor. Historians have accused Nur Jahan of being cunning and power-hungry. What male historians tend to forget is that without Nur Jahan, the reign of Jahangir couldn't have lasted as long as it did (Findly, 2000). Outside the Mughal realm too we have a female hero in Chand Bibi, who defended Ahmednagar against the mighty Mughal forces of Akbar.

In actual practice, the Mughal society was essentially patriarchal where women held subordinate position to men. Men retained the right to unilateral divorce. Divorce could be given orally or in writing – without any witness. Husbands were liable to pay maintenance to the divorced wife. The practice of *khula* (a woman's right to seek divorce) was prevalent, subject to the husband's willingness to do so. Polygamy was the norm in the Mughal royalty

(Nath, 2005). Muslim women in polygamous marriages lived with their co-wives and other female relations in the royal harem, away from the public eye. Socially, condition of Muslim women was very similar to other Indian women in terms of the general lack of female education and autonomy (Lal,2005).

### **Condition of Muslim Women-From Coming of British upto Uprising of 1857**

The loss of imperial power led to a general decline of Muslims. The demise of Persian affected women's education adversely. Within the new colonial settings, Muslims felt marginalized. However a few privileged women, educated by private tutors, were able to breach conventions though they should be seen as exceptions rather than the rule. In the absence of a male heir, Sikander Begum (1819–68), Shah Jahan Begum (1838–1901) and Sultan Jahan Begum (1858–1930) ruled the princely state of Bhopal. (Khan, 2000)

The condition of Muslim women before independence was not very different from that of women belonging to other communities. Differences were rooted in caste, class and region, rather than religion. Practice of *Purdah* was common to all communities, but varied across regions and communities. Upper class Muslim women denounced the practice of *purdah* and called for participation in the freedom struggle both before and after the uprising in 1857. Invaluable contribution Muslim ladies made to the freedom struggle hasn't been credited properly. The list of Muslim women who participated in the freedom struggle is long and not subject to any particular class only. From queens to commoners, women from all walks of life enthusiastically participated in the revolt of 1857. It is estimated that about 225 Muslim women committed their lives to the Revolt but their role in the freedom movement has not been properly acknowledged by the historians.(Barnes,2007).

Begum Hazrat Mahal, the wife of Nawab Wajid Ali Shah, took charge of the affairs of the state, after her husband was exiled to Calcutta (Hibbert, 1980). She worked closely with other leaders of the first war of Indian independence. Bi Amma (Abadi Begum), the mother of Shoukat Ali and Mohammad Ali also played a vital role in the independence struggle. She was hailed by Mahatma Gandhi himself. Mrs. Zubaida Daoodi and Amjadi Begum played active role in the independence struggle so did Zulekha Begum (wife of Maulana Abul Kalam Azad). Sadat Bano Kichlew, wife of Dr. Saifuddin Kichlew was well versed in Urdu and Persian and compiled many patriotic poems and articles to encourage people and became chairperson of 'Swaraj Ashram'. Nishat un Nisa Begum represented Congress Subject Committee in 1921 with Begum Khursheed Khwaja. Mrs Khwaja established Hamidiya Girls Secondary School in Allahabad in 1930. Razia Khatoon was arrested and sent to Kalapani where she breathed her last.(Anjum,2011).

The history of freedom movement is replete with such incidents when Muslim women came out of their homes and took part in the struggle against the British. How can one forget Asghari Begum of Thana Bhawan, Muzaffarnagar, who bravely fought against the British and was burnt alive when defeated. Similar were the heroics of Habiba and Rahimi (Muzaffarnagar) who obstructed the advance of English forces, were caught and hanged. Zehida Khatoon Sherwani, wrote patriotic poems to encourage freedom fighters. Muneera Begum, Amina Qureshi, Fatima Qureshi, Amina Tyabji (wife of Abbas Tyabji), Rehana Tyabji (daughter of Abbas Tyabji), Begum Sakina Luqmani (daughter of Badruddin Taybji) and many others participated in the freedom struggle and made rich contribution in various ways. Some of them were imprisoned, fined and suffered for freedom movement and made undeniable contribution to the freedom struggle.

### **Status and Role of Muslim Women (1857-1947)**

Even after the failure of the Revolt of 1857, the Muslim women were part of the freedom movement in one way or the other. This period also marked the growth of modern thinking and western education which in turn led to social reform and women's rights movements in Indian society. In the Islamic context, modernists argued for reform in Muslim law, and a greater public role for Muslim women based on the principle of equal rights.

One peculiar feature of early 20<sup>th</sup> century was the emergence of Islamist view of women. It placed women strictly within the home, endorsed *purdah* and idealized domesticity. Despite societal pressures and prevailing orthodoxy, Muslim women at the start of the twentieth century successfully emerged from the isolation of traditional roles to claim a greater role in public affairs. In 1906, a separate school for girls called '*Purdahnashin Madarsa*' was

founded by Sheikh Abdullah and his wife Wahid Jahan Begum, the Begum of Bhopal also founded a girls' school in 1914. Thus opening up doors of education for women. (Lateef, 1990)

The women's movement teamed up with the nationalist leadership to attain pro-women legislation. In 1937, the *Shariat Act* was passed by the central legislature. The main aim of this Act was to secure uniformity of laws for all Muslims in British India. A little later the *Dissolution of Muslim Marriages Bill* (1939) was passed; it specified the grounds under which a Muslim woman was entitled to obtain a decree for the dissolution of her marriage. Both the bills generated public awareness for women's issues.

Although one big limitation of the women's movement was that its leadership remained restricted to upper class women (Caton, 1930). The early twentieth century also witnessed the establishment of 'purdah clubs' across India. Thus providing common platform to Muslim women to share their views which was previously not possible for them because of their confinement at home.

The period witnessed many strong and vocal female voices. The Begum of Bhopal, one of the pioneers of women's education was against the *purdah*. In 1929, she publicly removed her veil while presiding over the session of the All India Women's Conference. Thus, making a strong statement against it. In the 1946 elections, Begum Shahnawaz and Begum Shaista Ikramullah were elected to the Central Constituent Assembly.

Success of the women's movement in bringing about social and legal reform led to the demand for the enfranchisement of Indian women. By 1921, it became possible for women to be elected to central and state legislatures. An important feature of women's movement at this time was Hindu-Muslim unity. Begum Shahnawaz appealed to Hindu and Muslim women to work together for the benefit of all Indian women and opposed the idea of separate electorates based on communal lines. (Shahnawaz, 2002)

Although orthodox ideas dominated among the Muslims, liberal voices were also there in the form of two movements viz. the Aligarh and the Ahmadiya movements. Both positively effected slow but steady emancipation of Muslim women (Ghadially, 1989). Women also organized various Muslim Women's Organisation in different parts of the country called Anjuma-e-Khawateen-e-Islam. The All India Muslim Ladies Conference was founded in Lahore in 1907. Women participated actively in movements like Anjuman Khwateen-e-Islam, Haqooq-e-Niswan, Rahbar-e-Niswaan and the Khilafat movement.

### **Status of Muslim women in India-1947 till date**

With the partition of India in 1947 and exit of the Muslim League from the socio-political scene of the country, the political influence of the *ulema* and other conservatives increased. In the absence of a national or visionary leadership, the cause of Muslim women was taken up mostly by conservative Muslims claiming to represent the community.

While civil and criminal laws in post-independent India are secular, personal laws (i.e. laws covering family relations, marriage, divorce, inheritance, custody rights, etc.) fall in the domain of religious law. Accordingly, Muslim women came under the purview of Muslim Personal (Family) Law. In the recent times, we have seen keen debate being undertaken about Islam and women's rights. The roots of such discourse can be traced back to the time of its evolution. Muslim jurists compiled the Islamic law or the *Shari'a* during the ninth and the tenth centuries well after the death of the Prophet Mohammed. While the basis of the *Shari'a* is the Qura'n, believed to be the word of God; over a long period of time it has also been subject to human reasoning and interpretation. Four different schools of Islamic law originated due to interpretational differences among the Islamic jurists viz., Hanafi, Shafi, Maliki and Hanbali. (Gillaume, 1990)

All laws are unanimous on the fundamental dogmas, but differ on their interpretation. Jurisprudential difference among the followers of different schools of law has led to differing legal positions for women. (Mernissi, 1987). The variety of interpretations show that the *Shari'a* has been subject to human reasoning and interpretation at different historical periods, as per the political, social, economic and cultural conditions of the place in question (Hughes, 1988). Thus it becomes imperative to relook at the many century- old laws with a contemporary perspective as they can't be expected to work in the twenty-first century without modification when social, political and cultural conditions

differ considerably from those of seventh century Arabia.

India consists of one of the largest Muslim populations in the world next only to Indonesia and Pakistan. Thus the improvement in Muslim women's condition will positively affect overall condition of women in general and of the society at large. Education could be a handy weapon to eradicate economic misery of the Muslim women because financial dependency on their male relations is the main reason for their low status. After independence, women's education made considerable progress in India. The number of girl's schools and colleges increased. As a result, today Muslim women are seen coming out of their *purdah* and sharing greater responsibilities in national reconstruction.

There are socio-economic reasons for comparative backwardness of Muslim women. Mostly, Muslims are artisans and self-employed thus with a limited knowledge of the world around them. Then, we have those Muslims who live in villages and work as agricultural labourers and follow other such pursuits. They are found to be even more conservative. These sections of society do not know what is written in Qur'an or hadith, much less what are problems with hadith or different schools of law but at the same time we have positive signs also with an educated middle class emerging among Indian Muslims- though still short in numbers – which understands the need of changing times and wants to keep pace with it.

Islamic feminism has not come to India yet. Slowly it is gaining currency. Some Muslim women NGOs have come together and formed Bharatiya Muslim Mahila Morcha. Another healthy change is that the parents' attitude towards girl's education has changed significantly during the last two decades. They are not as hostile to it as earlier they used to be. Today the Muslim community can boast of many women achievers from different walks of life who have carved a niche for themselves in the so called men's world. Some of them can be listed: Najma Shaikh, Prof. Sakina Hasan, Begum Akhtar, Shabana Azmi, Ismat Chughtai, Kurtul-en-Haider, Najama Heptulla, Mohasina Kidwai, Justice Fatima Bibi, Shahnaz Hussain, Nafeesa Ali, Farah Khan, Zoya Akhtar, Sania Mirza etc. This is not an exhaustive list by any standards. Today Muslim women are trying to come out of conservatism by getting themselves educated, participating in societal tasks, earning through occupying gainful employment and thus becoming self-reliant (Menon, 1981)

## CONCLUSION

The main concern of pre-independence women's movements was to eradicate illiteracy and to bring Muslim women out of the four walls of their house thus making them a direct participant of the freedom struggle. The women were yet to question the male hegemony and their subservient status to men. While the post- independence women's movement stressed on gender equality and highlighted the oppressive nature of the existing patriarchal structure.

In more than six decades of India's independence, the condition of women in the country and Muslim women in particular has registered improvement. Yet it's only the beginning of a long journey. Education especially Qur'anic literacy for the women and by the women is an urgent need of the hour. It is for Islamic feminist to revisit Qur'an and reinterpret it in appropriate context of women's rights.

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# WESTERN IDEALS AND APPROACHES ABOUT INCLUSION RELEVANT TO SOUTHERN AFRICA DEVELOPMENT COMMUNITY (SADC) COUNTRIES: AN ANALYSIS

Albert Tembo\*

## ABSTRACT

*Some western literature on inclusion of children with disabilities can be modified for the SADC countries, provided regional cultures and traditions are taken into account and appropriate support plans and structure are put in place within those countries. Children with disabilities in most of the SADC countries do not have an opportunity to access formal education, and deprived of inclusive school setting. Experience in countries like Zambia and England while implementing inclusion for children with disabilities, suggest that lack of qualified human and financial resources is a major constraint in enabling these children. Most of the SADC countries have failed to plan and meet the needs to accommodate such educational components as human development, adequate teaching and learning resources, adequate accessible classrooms, adequate infrastructure and research, to mitigate the degrading condition for children with disability. Major impediment in spreading inclusive education in these countries could be attributed to the Western literature that is delinked from the culture, traditions and customs of the people in those countries. Culture and customs are part of the life style of the people and should be incorporated in whatever project is being implemented in their countries.*

*This paper discusses an account of the rise of inclusive education, the comparisons between western and indigenous education, relevance of Western literature on marketing inclusive education in developing countries, and finally suggests how inclusive education can be marketed and promoted in the SADC countries taking into account the culture and traditions of the people in the countries concerned.*

**Keywords:** African knowledge system, children with disabilities, *Education for All*, inclusive education, Jomtien Declaration (1990), meaning system, Salamanca Statement of Action (1994), social participation

## INTRODUCTION

The educational paradigm emanating from western countries can be marketed to SADC regional countries through generating proper discourse. But what should be done is to assess how to wholesomely promote inclusive education in the SADC region taking into consideration cultures, traditions and norms of the people. Most of the SADC governments' social services including education are run by various donor funding countries and agencies. It is not surprising to find how critical developing countries are in receiving assistance from persons who may have little or no knowledge about the situation in developing countries. The ideal situation could be that human resources from western world to developing countries should have inculcated upto date professional knowledge and information about the country concerned. The Western professionals should also bear in mind that professionals in developing countries are equal partner in the development, process and reform of educational system and that they

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have special knowledge and skills about their countries' systems and needs.

It is quite difficult to propose possible promotion and modification of western ideas about inclusion without acknowledging the African cultural and traditional situation. General reference is made to the experience of whole of African and the SADC region as the countries seem to have similar culture with minimal differences.

## **BASIC IDEAS OF INCLUSIVE EDUCATION**

Cursory glance at background is very important for understanding the history of inclusion. Although inclusive education movement is now an international phenomenon, it has its origin in the West (*Dyson & Forlin, 1999*). The basic ideas of inclusion can be found in many international policy documents including The Declaration of Human Rights (1948) which stipulated the rights of all people including children; and The Convention on the Rights of Children (1989). The latter one imposed a series of duties that are owed to the children by parents/guardians. Then, there are The Jomtien Declaration on Education for All (1990), that outlined the rights of a child to a full circle of primary education; The Standard Rules on the Equalisation of Opportunities for Persons with Disabilities (1993), which stated that the educational authorities are responsible for the education of all persons with disabilities in an inclusive setting and ; the Salamanca Statement of Action (1994), that stipulated that schools should accommodate all children regardless of their physical, intellectual, social, emotional, linguistic or other conditions.

*Baehr & Gordenker* (1992) point out that the most positive results on the United Nations covenants and charters on the protection of human rights including the rights on education lies in the influence on law and practice in the international community.

Inclusive education is viewed by UNESCO (1999) as a process of accommodating all children in general education classroom regardless of their physical, intellectual, social and emotional, linguistic or other conditions. Today, there seems to be a growing international realisation that inclusive education should be the approach in responding to the diversity needs of all pupils in the general education classrooms and reducing exclusion from and within education in order to afford all pupils basic human right to education, right to equal opportunities and right of social participation (*Kristensen & Kristensen, 2002*).

*Ainscow* (1995) underscored that for inclusive education to be successful in responding to all pupils, schools have to don the primary role. The education system must be structured in such a way that it can accommodate a diversity of pupils. When education fails to provide services for its consumers, and accommodate such diversity that pupils are excluded or have to drop out, schools fail their role in the society. Support Services should move away from only focusing on individual pupils to support educators and the system. This will ensure the recognition and appropriate response to the needs of all pupils, and thereby promote effective learning. In order to make it happen, there must be the ability to address diversity, remove and prevent barriers to learning and development, and this must be structured into the system and be an integrated part of its development (*Lazarus, 1997*).

It is crucial that the support system can provide continuous and competent advice to both teachers and learners in order to ensure that quality education takes place (*Kristensen & Kristensen, 2002*). The teachers' attitudes and understanding of inclusive education is crucial. Teachers must be empowered with training which gives them the tools to teach all pupils in the same learning environment, and understand the diversity of all children's needs. The training of teachers in the methods that cut across abilities is therefore vital. In most SADC countries, teacher training curriculums have components of special education.

Western countries seem to understand the movement towards inclusion as not only a change of the special needs education structure, but as a change of the whole educational system.

## **WESTERN VERSUS AFRICAN INDIGENOUS FORMS OF EDUCATION**

Following the political independence of many SADC countries as well as other developing countries, the states adopted and tried to develop a western type of education in order to fulfil the needs of nation- building and political socialisation of the individuals: new, modern individuals, who could give legitimacy to their states, had to be

created. These individuals were socialised to adopt moral western ideals and attitudes and forms of work, becoming in this way rational and universal individuals. These “Western” schools are according to *Hopper* (1994, p.43) not only “products of an increasingly questionable form of modernisation, but they are also constructs whose very existence has emanated from an alien culture”. He goes on to claim that schools have been organised as systems of control that socialise the whole person into a new way of life.

By adopting the western type of schooling, politicians expected it to erode the traditional forms of organisations existing in their countries, such as kinship groups, which were considered hindrance to economic development. Moreover this kind of education was supposed to lead to the establishment of modern organisations. According to *Daun* (1992a), it led instead to, among other things, a weakening of parenthood which affected the traditional age group system and stratification.

*Daun* (1994) characterises the meaning systems which dominate the world of schooling as follows:

- They do represent realities that have not been, are not and will not be experienced by the pupils;
- The content of the meanings is de-contextual, universal and standardised; and
- These meaning systems create cultural items that to some extent are alien to the larger cultures in which they function.

Western values and practices are believed to be universal and applicable world-wide in a standardised way. The system of knowledge is then de-contextual since it is not relevant to the society it addresses. It is moreover fragmentary and technical in the sense that its main purpose is to impart technical and cognitive skills to pupils. Constant technical innovation is viewed as the only way to solve the problems in the world. In my opinion, it seems African environment and cultural aspects of everyday life are not considered in schools.

As mentioned before, the western type of schooling is part of an alien culture that was introduced in Africa by missionaries and explorers during the colonial time. It was introduced neglecting the existing traditional or indigenous culture of the continent. After independence, many African states including the SADC countries, continued to develop the education systems without considering their local cultures. On the contrary, the traditional structures of production and collective activities for socialisation of children have been regarded by the states as a threat to the national unity.

The African knowledge system differs a great deal from the modern one. It is highly contextual and based upon direct experience. It has a “moral dimension implying that particular judgements are found in cultural values and norms” (*Daun*, 1992). The education of an individual is seen as being much more than knowledge and skills. It also includes moral values and attitudes and focuses on the development of the individual as a whole inside the community. Its major concern is the social and cultural integration of the individual. In this way education is a lifelong process. But in the case of the literacy programme, the time for its duration was very limited and the top-down programmes disregarded the availability of the learners and to what extent they did achieve their own objectives.

The western paradigm of education often sees education as an investment, a process in which profitable results only become visible after years, usually in work situation. This future-oriented and progress-oriented perspective of schooling defines the individual as the central unit of action. It stresses individual development and socialisation. The individual is expected to be competitive and strive for success. This perspective is contrary to the traditional values of solidarity and supremacy of collective interests over the individual ones. For example, the kind of tests used in school emphasises individualism and can be quite embarrassing if the individual fail to prove that s/he has learned. It seems that a failure may in some way affect the learner’s self-confidence.

Another characteristic of a modern education is that it is segmented and age- fixed. Schooling extends in a way the duration of childhood since it requires that the child should be in school for at least seven years starting at the age of seven. This is the case of many African countries where seven years of schooling were made compulsory.

The life of a modern individual is hence different compared to that of a traditional individual (*Benincasa*, 1994). A child’s entrance into ‘real life’ is postponed by staying in school. Children in African society become adults at an early stage as they have to help in domestic work and strive for survival. In the case of girls they are expected to

behave as any other adult women as soon as they undergo the initiation rites or get married. They learn everything they need to, from the adults surrounding them. The relationship between adults and children is central in the socialisation process.

Western schooling values the written word as compared to oral literacy in their attempt to make people literate. This ideal is contrary to traditional society where oral literacy functions to give people a sense of their history and culture. In traditional Africa “people link history, narratives and folklore to learning processes that are imparted in day to day contacts between an older and a young generation. It is a part of an essence of life that engenders coherence in societal relations, not just a change skill for unknown occupations” (Odora, 1992).

Nagel (1994) observes that modern schooling claim “to be run according to objective truths carrying their own validity claims particularly demanding rational behaviour and economic and human efficiency”. There are certainly confrontations between Western and African education approaches where explanations for things which happen in people’s lives are mythological. As Nagel continues “the value of modern educational systems are often in conflict with African values where elders and males are the guardians of knowledge and wisdom” She contends that “these two worlds are incompatible and that the interpretation of meaning within these worlds are part of the quality problematic in education”.

Kisanji (1998) has underscored that “education in Africa was based on strong family ties, the value of human person, co-existence and survival”. Therefore African children were educated informally in a natural environment where they not only received responses and explanations about all the problems encountered, but were also given time to experience and internalised the new things they have learnt, before carrying out the functions themselves. For example, taking care of goats, fetching water, counting and in some cases reading. Customary education was available and accessible to all community members during all waking hours. Children with severe and profound physical and intellectual disabilities were also catered for to the best of their abilities (Kisanji, 1998), although many children with severe disabilities did not survive, and some were hidden from the members of community. All educational content and practice were based within the community and no child was sent to another community for education.

## RELEVANCE OF WESTERN LITERATURE IN MARKETING OF INCLUSIVE EDUCATION

In general, the term ‘literature’ has acquired a number of quite, often contradictory, meanings. I personally understand the term literature as a way of communication, expressing one’s feelings, transmission of customs, beliefs and values of the people. The western literature therefore displays western values. It is a conduit of communication used to preach, spread and marketing these values to the rest of the world. Unfortunately, I view this as one way traffic messaging. The marketing does not carry out research or involve recipients of the messages to verify acceptability of the values. Neither do the originators of the literature get much opportunity to learn about the confounding factors or barriers that make their values unacceptable or immiscible with the other cultures. On the other hand the other professionals from the developing countries have had an opportunity to study the western cultures and values and therefore can pre- identify areas of difficulties of being assimilated.

There is a lot of literature available on inclusive education in the Western World. Unfortunately, this literature is based on the situation present in the western world where it is derived from. This literature does not however, fit squarely into the developing countries’ jigsaw puzzle because of various confounding factors. The terminologies used either do not grasp the actual meaning or weight that would have been expressed through the local languages, neither do they extract confident answers as there is always some suspicion about the ultimate use of the answers given against the community involved. A foreign language in Africa may appear to be highly associated with colonialism and harsh conditions and treatment that went with it.

As a matter of fact, literacy, or rather education, in view of many in the western world, is just to be able to read and write and uphold the western thinking and values. This means that respect for developing world’s values, in this case African values, are ignored as far as literacy is concerned. This seems to cause stigma in the steadfast African people who would then wish to give false impression to researchers. In fact, research devices seem to be aimed at further undermining the African customs and values even if it is an African interviewing in a foreign language

since the interviewer is still seen as a messenger of the colonialists. In such scenario, there is need for an African to interview Africans in own languages.

In some African culture, serious disabilities still seem to be dealt with summarily at the time of birth. Those who have chance of surviving through harsh condemnation may never be exposed to a normal life in the community. Often they are hidden away from the community as parents think they may be seen as bad omen and viewed as shame by some families (Piling, 1973). Equally, they are not taken to school to learn. Worse still, is when the child is a female. She would be kept under strict seclusion so that people would not take advantage of her impairment and ultimately abuse her sexually.

Disabled children as stated earlier on are not regarded as assets who could contribute to the economy of the family and that of the nation at large (Mwape & Tembo, 1999). Usually, some families prioritise the allocation of the limited available resources to only viable investments. One of such investment are promising intelligent children. In this respect, children with disabilities would never get a chance of being given financial resources to go to school as they are viewed as incompetent.

The present political arena together with United Nations initiatives is quite favourable in providing greater chances for girl and disabled child education. This is a blessing in disguise for inclusive education in Africa as people are made aware of the importance of educating such children so that they too can contribute wisely to the development of their societies and the nation as a whole.

On the other hand, an absence of data from African culture makes the task to adjust the strategies difficult. Until such data is made available, the western literature appears as the only alternative for any tangible planning to improve education in the African continent. To gather data in Africa in the proper perspective should be viewed as a stepping stone towards establishing non-western educational paradigm in African setting.

Although most African countries have accepted to educate all children into the general education classrooms, sufficient educational provision for children with severe and profound disabilities are lacking. The road to inclusion is a long journey and process, although experience does indicate that children with disabilities do fit well in the general education classrooms. But still there is need for more research especially on the nature and problems of effective implementation of inclusive education.

## **CONCLUSIONS AND RECOMMENDATIONS**

### **CONCLUSIONS**

This paper was set to explore the relevance of Western literature in marketing inclusive education in the developing countries. It is often stated that the concept of inclusive education and debate originated in the West (Dyson & Forlin, 1999) and most of the countries of the world including some developing countries were among the signatories to this initiative. Although its genesis is in the West, the concept has managed to spread to other parts of the world to deliver its intended message and emergence of an encouraging trend that encompasses educational provision for children with disabilities into the general education classrooms.

### **RECOMMENDATION**

Various arguments have been presented in favour or against Western literature marketing inclusive education in developing countries. The following recommendations are suggested based upon summarizing the debate on inclusive education:

- Research conducted in developing countries by professionals from the West should seek the participation of local professional who understand peoples' culture, traditions and customs;
- At the moment projects are being carried out in the SADC countries which focus on how well inclusive education can be implemented and promoted in the region. Teacher education and teachers must undertake to make inclusive quality education possible in the prevalent context of SADC. There is urgent need to develop

strategies and methods of teaching that can make inclusive education successful;

- SADC countries are striving to achieve *Education for All*, but children with severe learning disabilities are at present not being covered. This is due to lack of adequate environmental conditions, sufficient educational resources, empowerment of general education teachers with methods that cut across diverse needs of pupils, high teacher/pupil ration and long distances between home and school, although in some countries itinerant programmes have been introduced where teachers teach pupils with severe and profound learning disabilities who can not be brought to school, two or three times per week in their own home territory;
- Undoubtedly, the western literature though lacks some element of culture of the SADC countries, Jomtien (1990) and Salamanca Statement (1994) have been a great inspiration for the development towards inclusive education;
- The development and promotion of inclusive education is due to influence of Danish, Finnish, Swedish, and Irish technical and financial aids;
- In most of the SADC countries despite the difficulties they encounter, there is persistent use of western literature on inclusive education to lay ground for their own inclusion. Implementation of inclusive education can only succeed if county's cultures, educational structure, training possibilities, economy and political situation are taken into consideration. All the stakeholders have to participate in the development of plans and implementation in order to seek ownership and commitment;
- Politicians, administrators, and professionals at the implementation stage, must be empowered with knowledge about inclusion for children with disabilities into the general education classrooms settings. Above all, there must be political will to carry out inclusive education successfully. Many SADC countries have shown interest in the theoretical dimensions of education for children with disabilities by developing policies. But due to lack of knowledge and commitment from the leaders, successful implementation has eluded in most of the countries;
- Many SADC countries have a desperate need for technical and financial aid, from countries of the north. It should therefore be a condition for western countries never to assist the education sector without covering all pupils in an inclusive setting. It is not enough to place all children in the general education classrooms and let the class teacher have full responsibility for their education. It is vital that a country which opt to introduce inclusive education agenda, establishes well-structured support system. A system ought to be based upon theoretical understanding and proper institutions that can meet diverse needs of children in an inclusive setting. It is the quality of the support system which will determine how far we can get and how much we can achieve with inclusive education in the SADC region.

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# DEVELOPMENT OF FRONT END AND STATISTICAL MODEL FOR A HINDI SPEECH RECOGNIZER : A PRACTICAL APPROACH

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## ABSTRACT

*This paper describes the different approaches for the development of front end and statistical model for Hindi Speech Recognizer. The front end includes the preprocessing of speech signal such as capturing of raw speech signal, its digitization and converting it into Mel Frequency Cepstral Co-efficient(MFCC) vectors followed by Vector Quantization(VQ) step for the purpose of reducing the quantity of data which is to be used for the development of statistical model such as Hidden Markov Model (HMM) designated by parameter  $\lambda = [ A, B, \pi ]$ . A tutorial approach has been adopted in this paper for finding out various parameters such as MFCC vectors and Transition matrix (A), Observation symbol probability distribution (B), Initial state distribution ( $\pi$ ), Number of distinct observation symbols (M), Number of states (N) which are to be used for development of a statistical model at various stages of the development of this paper.*

**Keywords:** HMM, MFCC, speech recognition, Transition matrix, vocalization, VQ.

## INTRODUCTION

A speech recognition is an inter-disciplinary subject involving signal processing acoustics, linguistic, computer science, communication and information theory. A Hindi Speech recognition system involves capturing the speech, converting speech into coded vectors development of a statistical model (HMM Model) and the accuracy of recognition of a word is mainly dependent on various factors such as vocabulary size, language, stress condition, noise condition, vocalizations and the type of HMM parameters such as number of States, number of symbols in a particular State [1]. The performance of *Automatic Speech Recognition System* (ASR) can be measured by measuring accuracy and the accuracy of a speech recognition system is defined by the *Word Error Rate* (WER). For developing speech recognition system, the speaker's pitch, tone etc., utterance speed, accents, dialects are taken into account, also the type of microphone, environmental conditions, temperature, humidity, noisy condition, stress conditions are taken into account for designing the ASR[2]. Speech recognition finds applications in health care, fire fighter aircrafts, helicopters, spacecraft exploration, real time speech processing, vehicle navigation, transcriptions, Mobile Telephony[2]. Future projected applications in detecting Parkinson's disease from the voice samples or an algorithm to be developed for interrupting the people who speak loudly and to detect the lies of a person on phone conversation. The Signal modeling techniques gives an idea how speech samples can be used to generate observation sequence. The *Mel Frequency Cepstral Coefficients* (MFCC) represents the best approximation of the

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human ear. The human ear is more sensitive to higher frequencies [3]. A review on Speech recognition techniques concludes that the *Mel Frequency Cepstral Coefficients* are widely used for developing the front end of a Speech Recognizer [4]. This paper is divided in two parts (1) Front End Development; and (2) Statistical Modeling.

**FRONT END DEVELOPMENT**

The Front End involves the preprocessing stage which involves the calculation of MFCC parameters. It includes the recording of speech signal, digitizing the speech signal, converting into speech vectors(MFCC vectors). These parameters are widely used because they give best approximation of human ear. The Mel frequency scale is having linear frequency spacing below 1 KHz and has a logarithmic spacing above 1 KHz. The human ear has sound perception like a Mel Scale that is logarithmic above 1 KHz & linear below 1 KHz. That is why the MFCC parameterization is widely used for the purpose of recognition of speech [4],[9].The Mel Frequency Cepstral Coefficients can be found out by using the two available Tool Boxes (1) MATLAB Tool Box; and (2) HTK Tool Box . The Algorithm used for finding MFCC is described in this paper.

**MFCC CALCULATION USING MATLAB TOOL BOX: THE ALGORITHM**

**STEP 1: PRE-EMPHASIZING THE RAW SPEECH**

The raw speech signal is processed through a pre-emphasis filter for boosting the amplitude values at higher frequencies. The speech signal is spectrally flattened for the purpose of reducing finite precision effects by passing the digitized sound through an FIR filter of first order whose transfer function is given below:

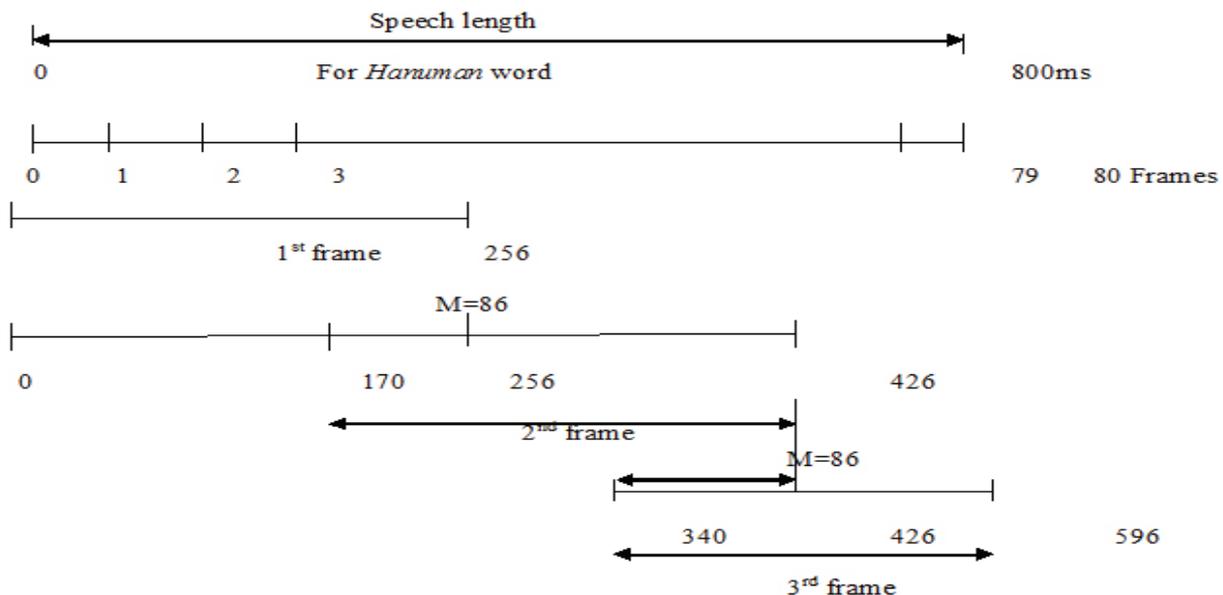
$$H(z) = 1 - a^{-1} \text{ where } 0.9 \leq a \leq 1.0$$

**STEP 2: ENFRAMING THE SIGNAL**

The output of the pre-emphasis FIR filter is segmented into number of frames having length of ‘N’ samples and overlapping of M samples. This process is called *enframing* or blocking.

Sampling Frequency Rate selected is 8000 samples/sec & Speech length recorded for word *Hanuman* is 800 ms .If Segmented into frame size of 10ms the total number of frames will be 80 and if the frame size N is 256 samples, then overlapping number of Frame M will be N/3 samples i.e. 86 sample values approximately. **Figure 1** describe the segmentation procedure of Speech signal for word *Hanuman*.

**Figure 1:Enframing**



**STEP 3: WINDOWING**

The segmented frames are convolved with hamming window to reduce the signal discontinuities at starting and ending of each frame. The convolved signal Y is given by the *formula*:

$Y_{(n)} = X(n) \otimes W(n)$  where X is the segmented input signal speech or frames and W is the Hamming window.

$$w(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right), \quad 0 \leq n \leq N-1$$

The window duration chosen is 16 ms. N is the no. of sample values.

**STEP 4: FFT CALCULATION**

The Fast Fourier Transform (FFT) is applied to each windowed frame for the purpose of finding the magnitude spectrum of the speech samples. The FFT is calculated by the *formula*:

$$X_n = \sum_{k=0}^{N-1} x_k e^{-2\pi jkn/N}, \quad n = 0,1,2,\dots,N-1$$

**STEP 5: MEL FREQUENCY TRANSFORMATION**

The Mel frequency transformation is achieved by passing each FFT samples through a bank of triangular band pass filters which are linearly placed for frequencies up to 1000 Hz. In this range, the bandwidth remains constant as a function of frequency 'f' and is close to logarithmic value above 1000 Hz where the bandwidth varies exponentially as a function of frequency 'f'.

The Mel Scale is given by the *formula*:

$$F_{mel} = 2595 * \log_{10} \text{ Hz}$$

**STEP 6 : MFCC PARAMETERS CALCULATION**

The logarithm of the output of the band pass filter is calculated to get the log mel spectrum. Finally the discrete cosine transformation is performed to get the Mel frequency Cepstral coefficients:

$$\tilde{c}_n = \sum_{k=1}^K (\log \tilde{S}_k) \cos\left[n\left(k - \frac{1}{2}\right)\frac{\pi}{K}\right], \quad n = 1,2,\dots,K$$

Where  $n$  is the no. of MFCC and  $K$  is number of Mel frequency band filters.

The MFCC Vectors can be calculated by executing the command *melcepst* in MATLAB prompt which implements the above algorithm MFCC=*melcepst*(S,Fs,'e0dD'). It includes log energy, 0th Cepstral coefficient and velocity & acceleration coefficients.

MFCC= *melcepst* (S, Fs, W, NC, P, N, INC, FL, FH);

Fs=8000; W='M'; NC=12; P=floor (3\*log(Fs)); N=pow2(floor(log2(0.03\*Fs)));

INC=N/2; FL=0; FH=0.5;

S: Speech signal, Fs: Sampling frequency, W: Hamming window, NC: Number of Cepstral Coefficients, P: Number of filters in the filter bank, N: Length of frames in samples, INC: Frame increment, FH: High end of highest filter, FL: Low End of lowest filter.

The dimension of MFCC feature vector is 26 if delta coefficients or velocity coefficients are included and it is 39 dimension if delta-delta or acceleration coefficients are used. However the dimensionality of feature vectors can be reduced by focusing on principal components of speech vectors into small number of features so that quantity of data may be reduced. Data reduction techniques are available to reduce the dimensionality of MFCC feature vectors [6], [7]. The MFCC vectors for word *Hanuman* is given in **Table 1**

**Table 1:** 12-Dimensional MFCC Speech vectors for word *Hanuman* having 41 frames and 800ms speech length

MFCC/ Frame	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
1	-1.731	-1.849	-0.638	0.093	0.292	0.244	-0.179	-0.893	0.247	-0.265	-0.780	0.028
2	-1.581	-2.718	-0.951	-0.811	0.740	-1.664	-0.393	-1.336	0.042	-0.322	-0.616	-0.136
3	-1.115	-4.039	-0.631	-1.443	0.589	-0.917	0.053	-0.974	0.238	-0.598	-0.961	-0.162
4	-3.004	-3.932	-0.676	-0.887	0.915	-1.262	0.180	-1.478	0.412	-0.811	-1.974	-0.483
5	-1.534	-4.394	-0.578	-0.302	0.837	-0.478	0.441	-1.019	0.789	0.137	-1.296	-0.574
6	-2.554	-4.392	-1.043	0.400	1.444	0.056	0.774	-0.949	0.343	-0.057	-1.811	-0.987
7	-1.976	-3.982	-1.428	0.324	0.525	0.022	-0.053	-1.338	0.829	0.238	-0.545	-0.548
8	-1.531	-4.317	-1.257	-0.167	0.462	-0.029	0.024	-1.411	0.054	0.263	-1.093	-0.935
9	-2.321	-3.246	-1.991	-1.304	1.486	-0.130	-0.414	-1.773	-0.410	0.042	-1.524	-0.609
10	-0.607	-4.238	-1.037	-1.157	1.037	-0.131	0.746	-1.331	-0.577	0.056	-1.285	-0.331
11	2.353	-2.978	-1.130	-1.921	-0.274	-0.845	-0.126	-0.584	-0.016	-0.012	-1.038	-0.281
12	3.181	-2.709	-0.720	-2.603	-0.080	-1.958	-0.696	-0.965	-0.092	0.050	-0.628	0.116
13	1.763	-2.883	0.023	-1.298	0.698	-1.159	0.287	-1.461	-0.021	0.673	-0.493	0.057
14	1.276	-3.613	0.362	-0.445	1.409	-1.047	0.369	-1.117	-0.356	0.027	-1.132	-0.480
15	0.990	-3.885	-0.039	-0.638	1.285	-1.417	-0.275	-0.950	0.584	-0.180	-1.354	-0.798
16	0.862	-4.592	-0.563	-0.408	1.148	-1.333	1.025	-0.754	0.428	-0.106	-0.854	0.409
17	0.895	-3.523	0.687	-0.451	1.575	-0.698	0.117	-1.264	-0.089	-0.552	-1.312	-0.160
18	1.595	-3.146	0.650	-0.148	1.043	-1.262	0.777	-1.362	-0.068	0.236	-1.465	-0.181
19	0.954	-3.731	1.051	-0.194	1.385	-1.076	0.855	-1.791	0.080	0.115	-0.703	0.006
20	-0.031	-4.811	0.037	-0.562	1.621	-0.955	0.350	-0.315	1.169	0.719	-1.242	0.046
21	0.818	-3.192	1.240	-0.565	1.336	-1.434	0.452	-0.974	-0.009	0.880	-0.636	0.020
22	-0.044	-3.579	0.371	0.488	1.594	-1.124	-0.708	-1.225	0.493	0.227	-0.657	0.558
23	0.907	-4.136	-0.226	-0.126	0.906	-1.787	-0.401	-0.824	0.460	0.042	-1.130	-0.568
24	-0.451	-2.913	-0.559	0.228	-0.444	-0.503	-0.147	-0.718	0.219	-0.242	-1.564	-0.520
25	-0.213	-1.797	-1.709	-1.994	-1.474	-0.799	-0.610	-0.320	0.008	-0.205	-0.498	-0.749
26	3.668	-2.054	-3.019	-2.056	-0.421	-0.562	-0.219	-1.408	0.505	0.284	-1.540	-0.301
27	4.301	-1.898	-2.679	-2.213	-0.406	0.173	0.042	-0.602	0.473	0.334	-1.213	-0.524
28	4.516	-2.736	-3.152	-2.073	-1.086	-0.340	0.193	0.037	0.347	-0.336	-1.140	-0.228
29	5.502	-2.042	-3.079	-2.270	-0.575	0.009	1.108	-0.218	0.568	0.649	-1.102	-0.788
30	4.455	-1.680	-3.113	-2.350	-0.668	0.135	0.778	-0.491	0.185	0.296	-1.307	-0.608
31	4.534	-2.138	-2.601	-3.067	-1.246	0.080	0.839	-0.723	0.117	-0.228	-0.958	-0.461
32	3.986	-2.675	-3.263	-2.967	-0.742	0.127	1.055	-0.279	0.755	0.214	-0.814	-0.165
33	3.873	-2.385	-3.156	-2.962	-0.839	0.270	0.750	-0.486	0.476	-0.488	-1.112	-0.841
34	3.781	-2.865	-2.998	-3.324	-0.695	-0.831	0.261	-1.404	0.031	-0.139	-0.850	-0.040
35	4.678	-2.507	-3.236	-2.729	-0.113	-0.392	0.999	-1.174	0.199	0.040	-1.043	-0.556
36	2.795	-2.244	-1.666	-2.551	-0.806	-0.215	1.575	-0.128	0.641	0.210	-0.950	-0.262
37	2.431	-2.245	-1.789	-1.316	0.579	0.143	1.312	-0.175	1.173	0.397	-1.059	-0.075
38	2.775	-2.314	-2.551	-1.432	0.465	-0.100	1.758	-0.448	0.481	0.009	-0.924	-0.708
39	3.683	-2.149	-3.060	-2.279	-0.300	0.288	1.109	-0.396	0.281	-0.450	-1.719	-0.762
40	2.347	-1.643	-2.174	-1.073	0.440	-0.246	0.787	0.082	0.388	-1.066	-1.031	-1.454
41	1.015	-1.372	-2.717	-2.297	-1.406	-1.324	0.082	0.355	0.710	-0.720	-1.069	-0.123

## MFCC CALCULATION USING HTK

The Mel frequency Cepstral coefficients can be calculated by using another speech processing tool box such as HTK. The H copy command is used for finding the MFCC parameters. The command used is as follows:

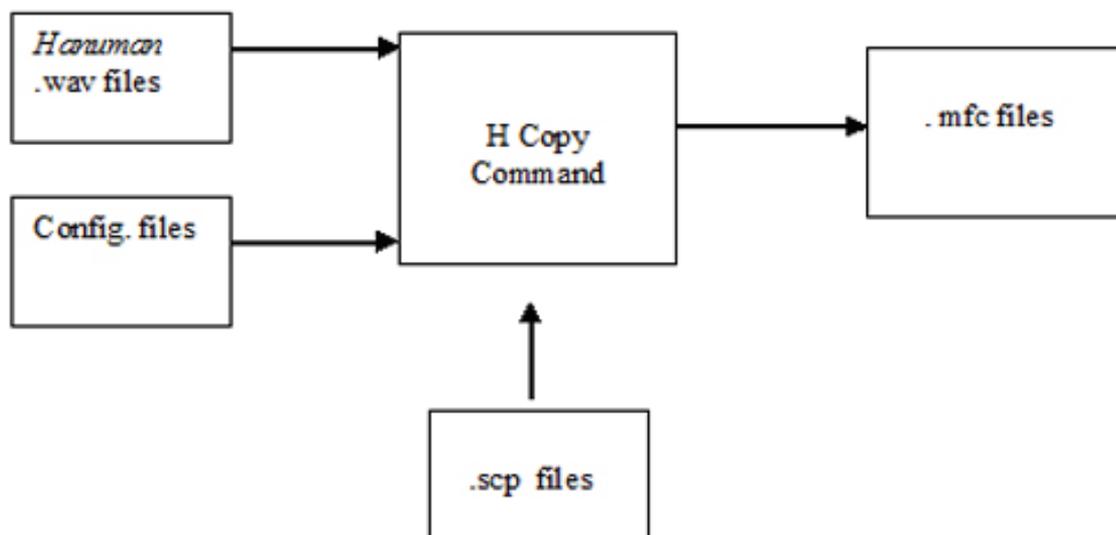
### H COPY – T1 – C CONFIG. TEXT – S H COPY.SCP

By executing this command in the DOS prompt the .wav files are read by HTK and are converted into MFCC parameters into output script files according to the specifications given in the configuration file. A configuration file which is text file is created [8].

```
# Coding parameters
Target Kind = MFCC - 0
Target Rate = 100000.0
Save Compressed = T
Save with CRC = T
Window size = 250000.0
Use hamming = T
Preemcoef = 0.97
Numchans = 26
Ceplifter = 22
Numceps = 07
Enormalise = F
```

The configuration files are stored in the notepad as a text files and in the same folder where H copy command is stored. **Figure 2** given below describes the procedure to obtain the MFCC parameters using HTK tool kit for word *Hanuman* .Wav files.

**Figure 2:**MFCC parameters using HTK tool kit



## STATISTICAL MODELING STAGE

A statistical model such as Hidden Markov Model (HMM) is developed. A HMM is widely used in speech recognition. The development of this model is based on two assumptions that the speech signal is a random process and the estimation of parameters of a stochastic process can be done easily [9],[10]. A Markov Model is defined by the parameter

$$\lambda = [A, B, \pi]$$

(a) **STATE TRANSITION PROBABILITIES (A)**: 'A' represents state transition probability distribution

$A = \{ a_{ij} \}$ , where

$$a_{ij} = P [ q_{t+1} = j / q_t = i ] \quad 1 \leq i, j \leq N$$

(b) **STATES (N)** : N represents number of States. There are two ways to estimate N. (1) On the basis of phoneme, phones or syllables; and (2) States which represent temporal frames. The individual states are labeled as  $\{1,2,3,\dots,N\}$  and state at time  $t$  is designated as  $q_t$ .

(c) **OBSERVATION SYMBOL PROBABILITY DISTRIBUTION (B)**: 'B' represents the Observation symbol probability distribution

$B = \{ b_j(k) \}$  in which

$$b_j(k) = P [ O_t = V_k / q_t = j ] \quad ; \quad 1 \leq k \leq M$$

It defines the symbol distribution in the states  $j = 1, 2, \dots, N$ .

(d) **OBSERVATION SYMBOLS (M)**: 'M' represents the number of observation symbols. The Observation symbols are the physical outcome of the system which is to be modeled. Here we have used  $M=32$  as observation symbols.  $m=1,2,3,4,5,6,\dots,32(M)$ .

(e) **INITIAL STATE DISTRIBUTION ( $\Pi$ )** :  $\pi$  represents initial state distribution.

$\Pi = \{ \pi_i \}$  in which  $\pi_i = P [ q_1 = i ]$  ,  $1 \leq i \leq N$

A complete HMM is developed when the specification of two model parameters N and M and Observation Symbols and specification of three set of probability measures A, B,  $\pi$  is given. A HMM is represented as  $\lambda = [A, B, \pi]$ . The probability measure for observation sequence is given by  $P(O/\lambda)$ . There are three main issues with HMM which must be resolved in order to develop a statistical model for the speech recognition system [9],[11].

### 2.1 PROBLEM NO. 1 AND ITS SOLUTION

For a given observation sequence  $O = (O_1, O_2, \dots, O_T)$  and the model parameter  $\lambda = [A, B, \pi]$ , the probability of observation sequence  $P(O/\lambda)$  for a given model is to be calculated. The solution to the Problem 1

can be obtained from the Forward & Backward algorithm. It gives us an opportunity to select the best model among various other models which describe the observation sequence which were produced by this model.

The MATLAB Command such as *hmmgenerate* and *hmmdecode* are used to find the solution to the Problem 1. The *hmmgenerate* does the following functions: (1) It generates the random sequences of States; and (2) It generate random sequence of emission symbols. The *hmmdecode* gives out following : (1) Posterior state probabilities; (2) Logarithm of the probability of sequence; and (3) Forward & Backward probabilities scaled by a factor 'S'.

The probability of observation sequence can be found out by the formulae:

$$P(O/\lambda) = \sum_{i=1}^N \alpha T(i)$$

Where  $\alpha T$  is a forward variable & T is the number of observations in one state (i).

## 2.2 PROBLEM NO. 2 AND ITS SOLUTION

For a given observation sequence  $O = (O_1, O_2, \dots, O_T)$ , one has to calculate the optimal state sequence. The solution to the Problem 2 can be obtained from the *viterbi* algorithm. The Solution 2 tells about the hidden states of any word. The *hmmviterbi* and *hmmgenerate* MATLAB Commands can be used to find the solution to Problem 2. The *hmmviterbi* gives the optimal state sequence.

## 2.3 PROBLEM NO. 3 AND ITS SOLUTION

In order to maximize the probability of Observation Sequence  $P(O/\lambda)$ , the given model parameters  $\lambda = [A, B, \pi]$  will be adjusted. The solution to the Problem 3 can be obtained from *Baum and Welch algorithm* which is used to re-estimate the model parameters. The Solution 3 tells about the optimization of the model parameters which best describes the observation sequence.

The *hmmtrain* and *hmmgenerate* MATLAB commands are used to find out the solution to Problem3. The *hmmtrain* re-estimates the transition and emission probabilities of the HMM model using the *Baum & Welch algorithm*. The *hmmestimate* is used to calculate the maximum likelihood estimate of transition & emission probabilities.

## 3. MODEL DEVELOPMENT

Here we have assumed number of States = 6 and the HMM Model selected is left right *Bakis Model*

For a word *Hanuman*, a HMM can be developed in the following manner :

1. Record a word *Hanuman* in .wav file format using MATLAB platform.
2. Find out the MFCC parameters for the above word.
3. Record many utterances of the above word. Here we have taken  $K = 5$  utterances.
4. Find the number of Observation Symbols in each state. Here we have taken 6 states. Find out the  $b_j(k)$  that is observation symbol probability distribution.

### 3.1 Calculation of $b_j(k)$

The whole word speech waveform is coded into the MFCC vectors. It is divided into 6 states *i.e.* roughly a frame of 10 – 15 ms is chosen as one state. The minimum and maximum value of the MFCC vectors is found out and then the whole range is partitioned and each partition is allotted a quantized value which is prescribed by a

codebook. The index of codebook gives the number of symbols that are produced after quantization. Then a matrix of distribution of observation symbols in each state can be easily calculated.

The vector quantized values of data or index values of codebook called as Symbols is shown in Symbol distribution matrix.

The symbols are  $k=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32$ . The Symbol distribution matrix for word *Hanuman* is given in **Table 2**.

**Table 2:** Quantized Symbol values of 41 frames for word *Hanuman* distributed across 6 states

State/ Frame	1	2	3	4	5	6	1	2	3	4	5	6
1	5	2	16	19	17	9	5	2	16	19	17	9
2	18	28	19	11	27	24	18	28	19	11	27	24
3	12	20	5	16	22	7	12	20	5	16	22	7
4	20	30	6	32	11	26	20	30	6	32	11	26
5	15	9	5	3	13	12	15	9	5	3	13	12
6	21	28	7	2	32	5	21	28	7	2	32	5
7	21	8	12	3	4	16	21	8	12	3	4	16
8	10	21	14	13	2	6	10	21	14	13	2	6
9	18	25	18	24	4	1	18	25	18	24	4	1
10	32	7	22	30	18	15	32	7	22	30	18	15
11	3	19	19	18	25	18	3	19	19	18	25	18
12	13	29	16	28	30	29	13	29	16	28	30	29
13	3	1	13	24	17	16	3	1	13	24	17	16
14	21	30	32	12	25	27	21	30	32	12	25	27
15	5	19	5	19	16	11	5	19	5	19	16	11
16	13	31	2	32	6	29	13	31	2	32	6	29
17	11	10	5	4	13	24	11	10	5	4	13	24
18	20	29	17	2	31	8	20	29	17	2	31	8
19	23	5	15	3	6	15	23	5	15	3	6	15
20	14	23	19	12	4	3	14	23	19	12	4	3
21	23	23	7	25	10	1	23	23	7	25	10	1
22	31	13	27	28	26	10	31	13	27	28	26	10
23	3	21	25	16	18	26	3	21	25	16	18	26
24	22	21	6	27	29	31	22	21	6	27	29	31
25	8	1	18	16	23	23	8	1	18	16	23	23
26	28	22	32	10	26	28	28	22	32	10	26	28
27	9	15	5	12	10	11	9	15	5	12	10	11
28	25	31	3	32	11	26	25	31	3	32	11	26
29	7	11	4	3	7	21	7	11	4	3	7	21
30	21	26	17	2	30	5	21	26	17	2	30	5
31	28	18	24	1	7	11	28	18	24	1	7	11
32	16	30	23	14	3	5	16	30	23	14	3	5
33	23	28	14	12	4	1	23	28	14	12	4	1
34	30	9	27	25	7	7	30	9	27	25	7	7
35	1	23	26	7	8	25	1	23	26	7	8	25

36	26	29	9	22	23	27	26	29	9	22	23	27
37	17	2	16	20	26	22	17	2	16	20	26	22
38	31	30	32	12	28	21	31	30	32	12	28	21
38	10	15	3	21	13	8	10	15	3	21	13	8
40	5	2	16	19	17	9	5	2	16	19	17	9
41	18	28	19	11	27	24	18	28	19	11	27	24

Observation symbol probability distribution or emission matrix  $b_j(k)$  for word *Hanuman* can be calculated using the formulae:

$$b_j(k)=$$

The output symbol probability distribution is defined by the Emission matrix as given in **Table 3**. Here the output symbols are the code vectors defined by codebooks.

**Table 3:** Thirty-two Output Symbol/Code vectors probability distribution or emission matrix in 6 States for *Hanuman*

Symbol/Code Vector	State1	State2	State3	State4	State5	State6
1	0.082474	0.019802	0.070707	0.009901	0.011364	0.0001
2	0.0001	0.039604	0.010101	0.069307	0.056818	0.009804
3	0.030928	0.019802	0.010101	0.019802	0.079545	0.039216
4	0.010309	0.009901	0.010101	0.039604	0.056818	0.058824
5	0.020619	0.009901	0.020202	0.059406	0.045455	0.029412
6	0.030928	0.079208	0.020202	0.029703	0.0001	0.029412
7	0.061856	0.049505	0.010101	0.039604	0.0001	0.019608
8	0.061856	0.039604	0.020202	0.019802	0.022727	0.019608
9	0.051546	0.009901	0.060606	0.019802	0.022727	0.029412
10	0.051546	0.029703	0.010101	0.019802	0.034091	0.039216
11	0.020619	0.029703	0.030303	0.029703	0.068182	0.019608
12	0.041237	0.049505	0.020202	0.029703	0.0001	0.039216
13	0.020619	0.019802	0.070707	0.019802	0.0001	0.04902
14	0.030928	0.049505	0.020202	0.029703	0.022727	0.039216
15	0.0001	0.049505	0.0001	0.069307	0.034091	0.029412
16	0.041237	0.0001	0.070707	0.0001	0.022727	0.04902
17	0.0001	0.019802	0.040404	0.039604	0.045455	0.04902
18	0.041237	0.019802	0.0001	0.039604	0.011364	0.068627
19	0.0001	0.049505	0.040404	0.059406	0.022727	0.019608
20	0.0001	0.029703	0.030303	0.059406	0.011364	0.04902
21	0.051546	0.039604	0.010101	0.049505	0.011364	0.019608
22	0.041237	0.019802	0.050505	0.009901	0.056818	0.019608
23	0.0001	0.069307	0.0001	0.039604	0.056818	0.019608
24	0.041237	0.029703	0.030303	0.019802	0.056818	0.009804
25	0.020619	0.029703	0.0001	0.069307	0.034091	0.039216
26	0.030928	0.039604	0.040404	0.019802	0.011364	0.039216
27	0.041237	0.029703	0.030303	0.009901	0.068182	0.019608

28	0.041237	0.029703	0.070707	0.0001	0.011364	0.029412
29	0.020619	0.049505	0.080808	0.0001	0.034091	0.0001
30	0.041237	0.019802	0.080808	0.0001	0.011364	0.039216
31	0.072165	0.019802	0.040404	0.009901	0.011364	0.029412
32	0.0001	0.0001	0.0001	0.069307	0.068182	0.04902

3.2. The State transition probability distribution matrix ‘A’ for a Left right *Bakis model* is given below

$$A = \{ a_{ij} \} \quad 1 \leq i \leq 6$$

$$1 \leq j \leq 6$$

$$A = \begin{pmatrix} a_{11} & a_{12} & a_{13} & 0 & 0 & 0 \\ 0 & a_{22} & a_{23} & a_{24} & 0 & 0 \\ 0 & 0 & a_{33} & a_{34} & a_{35} & 0 \\ 0 & 0 & 0 & a_{44} & a_{45} & a_{46} \\ 0 & 0 & 0 & 0 & a_{55} & a_{56} \\ 0 & 0 & 0 & 0 & 0 & a_{66} \end{pmatrix}$$

The state transition table is obtained for word *Hanuman* is given below:

0.989691	0.010309	0	0	0	0
0	0.990099	0.009901	0	0	0
0	0	0.989899	0.010101	0	0
0	0	0	0.990099	0.009901	0
0	0	0	0	0.988636	0.011364
0	0	0	0	0	1

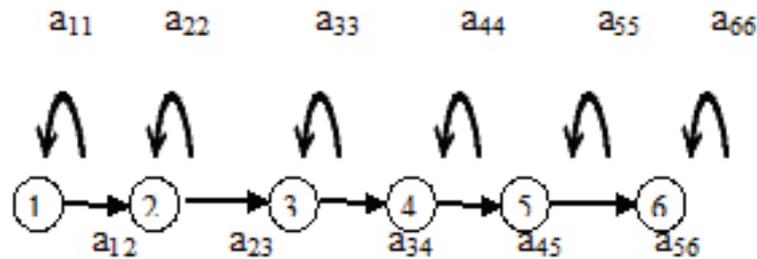
On comparing the above state transition tables we get the values as under that are used to draw the HMM used in speech recognition system.. Commonly a Left right *Bakis model* is drawn using these values.

3.3. The initial State distribution is given as below

$$\Pi_i = [ 1, 0, 0, 0, 0, 0 ]$$

The statistical HMM model for word *Hanuman* is developed and is expressed by parameters  $\lambda = [ A, B, \pi ]$ . The HMM model for word *Hanuman* is drawn in **Figure 3**.The model selected is Left right *Bakis model* showing the state transition probabilities.

**Figure 3:** HMM Model for *Hanuman*



## RESULTS & CONCLUSIONS

This paper can be used as a tutorial paper for the development of statistical model and Front end of a Hindi Speech Recognizer. The parameters such as MFCC, & HMM parameters  $\lambda$ , A, B,  $\pi$ , M, N can be easily used to develop a statistical model. These parameters can be used further to compare and investigate into Hindi speech recognition aspects.

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# WATER RESOURCE MANAGEMENT IN THE KANDI AREA OF PUNJAB: DESCRIPTION OF STATE POLICIES

*Rajni Bala\**

## ABSTRACT

*Punjab has 10% of the total geographical area of Shivalik foothills known as Kandi area. Out of it, only 20% area is under cultivation for irrigation purpose and this area is one of the most backward areas of the state. Most of the population of this area depends on agriculture. Here, water plays an important role in boosting the agricultural economy. Punjab state government and central government have put various efforts for the economic and social upliftment of this area in the last decades. This paper will concentrate upon various water issues and water policies and strategies adopted by the governments to sustain this area's economy. This paper will also explore the role of local community in this management.*

**Keywords:** Canal, Check Dams, Community, Kandi Area, Kandi Watershed and Area Development Project (KWADP), micro-lift irrigation, Public Tubewells, Small Dams, water harvesting, Watershed Management, Water Projects.

## INTRODUCTION

Water resources are limited and it is essential for mankind to be judicious in use of these resources. Agriculture is the main occupation of most of the people living in different states in India. Punjab's economy is basically based on agriculture and divided into three zones. Every zone has its own specialty and ecological issues. Out of the three zones, Kandi area is one of the most backward due to various geological reasons. This area covers 10% of the total geographical area of the state.<sup>1</sup> However, the average rainfall in this area varies from 1000 mm to 1200 mm but despite this, only 20% of the cultivated area is under assured irrigation.<sup>2</sup> Shortage of water for irrigation purposes is the main problem of the cultivation in hilly part of the state. As a result, especially during the current decade, overexploitation of water resource has adversely affected the soil productivity. There is a growing concern about the sustainability of today's agricultural breakthrough (*Kumar et.al, 2007*). Shortage of water and its management was the major challenge for the state government before a few decades. Thence, various schemes were initiated by the state government with the help of the central government and also with the help of local users in this region for proper water utilization.

### Demography of Kandi Area of Punjab

Kandi region consists of all areas in Punjab that is lying to the east of Derabassi, Chandigarh, Ropar, Balachaur, Hoshiarpur and Mukerian road. This area has spread over 22 blocks in 5 districts and most blocks of these districts contains both Kandi and non-Kandi area. Punjab government has notified the entire Kandi area as backward area

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because most of the population of this part depends on agriculture or as agricultural labourers. Size of landholding is very small and fragmented that is merely 1-2 ha. The area faces severe problem of soil and water due to highly erratic distribution of rainfall and frequent droughts. The agriculture is mostly rainfed due to lack of irrigation water. There is also general shortage of drinking water, fodder and fuel. Industries have not yet been established at major scale and the few industrial units established to take advantage of subsidies in backward areas are concentrated mostly near Ropar and in few villages of Nawanshaher district. It is assumed by the policy makers that the scope of agro-based industries and plantation may be helpful for boosting the socio-economic condition of the area. Landholding size is very small and most of the farmers have small landholding i.e. (1-2 ha) or marginal land holdings. Literacy rate amongst the women is very low. It is a fact that the marketing and transportation facilities have played a major role for general development but these facilities are still inadequate in the remote areas of the Kandi area<sup>3</sup>.

## Discussion and Results

### Water Resource Management in This area

- Public Tubewells
- Canal and Small Dams
- Watershed Management

#### (1) Public Tubewells for Groundwater Irrigation and Water User Associations

In 1970, Punjab State Tubewell Corporation (now known as Punjab Water Resource Management and Development Corporation- PWRMDC) was established to obtain the main objective of utilization of groundwater resources in this area. The corporation was meant to provide more irrigation facilities to the farmers through installation of deep tubewells for the development of this area. In order to further boost agricultural production, the work of lining of watercourses was also entrusted to the corporation by the government in the year 1974-75 under various schemes with finance available from NABARD and World Bank.<sup>4</sup> Presently, four hundred twenty two tubewells which were installed by the World Bank are in operation under this circle. These tubewells are functioning under the charge of Operations and Maintenance Division of Punjab State Tubewell Corporation Limited. Out of 420 tubewells, 364 tubewells fall in district Hoshiarpur - 233 tubewell in Kandi area and 131 tubewells in non- Kandi area.<sup>5</sup> In *Kandi* area, farmers formed Water User Association for proper water distribution among all water users, as per rules. To mitigate the sufferings & hardships of poor peasantry of backward *Kandi* area, it was proposed to install 70 deep tubewells. Under NABARD Scheme, 280 tubewells with properly designed underground distribution system was provided in different blocks of the area to create an additional irrigation potential of 8750 hectares approximately.

At present, Punjab Government has also sanctioned 280 new tube wells for Kandi and sub-mountain area to tackle the perennial irrigation water shortage problems in these pockets. While presiding over a meeting of irrigation department, Deputy Chief Minister Sukhbir Badal approved Rs. 108 crore to be spent for the purpose in the area. He summed up the water needs in following statement:

*“We have got a comprehensive study done on irrigation requirement of the area and as per findings of that study, 280 spots have been identified where there is an immediate requirement of digging deep tubewells. Our Government is fully committed to develop agriculture and encourage diversification in the Kandi area to bring development of this area at par with developed areas of the State. 65-year-old minor irrigation network needs immediate revitalization to ensure water to the farmers at the tail ends. Since last 65 years, Centre has not sanctioned a single penny for rehabilitation and maintenance of canal network. Due to lack of maintenance, the whole of canal network has become silted and choked with weeds, reducing the capacity of canal less than 50 per cent. In future, Irrigation Department while tendering these projects should make the construction agency accountable for maintaining that system for next 15 years”<sup>6</sup>*

Further he instructed the Irrigation Department to immediately tender out digging of 280 tubewells and as per availability of digging rigs in the market, it was decided that 140 deep tubewells be handed over to farmer community. He asked the Secretary (Irrigation) to redraft the tender documents incorporating this clause, in which construction agency would conduct annual maintenance of the canal system, desilting besides deweeding the whole system. He said that tender should also incorporate the clause making construction agency accountable for ensuring supply of water at tail end of the system besides monitoring the usage of Canal Water at different points. The department was also asked to put up a comprehensive plan for total canal system.<sup>7</sup>

## (2) Small Dams and Canal Project

Most of the agriculture land in Kandi area of Punjab is *barani* i.e. dependent on rains. The requirement of water for Rabi and Kharif crops cannot be met because most of the rainfall occurs in 2½ months only. Average agriculture yield has been 700 Kg/Hectare against State's 4500 Kg/Hectare. Further, Kandi area is traversed by numerous small and big seasonal streams called *choes* and is prone to flashy floods. About 40% of this rain water gets wasted in floods, which causes considerable damages to the crops & village *abadies* and makes the land infertile.<sup>8</sup>

Kandi Area Development Administration is primarily responsible for the development of the Kandi area for attenuation of floods and for providing irrigation facilities to the Kandi area which otherwise has been starved of assured irrigation, besides, repair/maintenance and running of already completed Canal/Dams in the region. Total 71621 hectares of land is proposed to be brought under command of Kandi canal and low dams, out of which 35640 hectare (50%) has already been brought under command of canals & low dam's networks.

The project of extension and improvement of irrigation on Shah Nehar canal system on which Kandi canal is a major component was originally envisaged to provide and improve irrigation in Shivalik foothills. This project was completed in two stages

(1) *Kandi Canal Stage-1 which is Talwara to Hoshiarpur*: The construction of this project was taken up during 5<sup>th</sup> Five Year Plan in 1978 with state funds and also was funded by the World Bank

(2) *Punjab Drainage Project Phase II in 1989*: This stage of canal provides irrigation to an area of 22594ha and gives benefits to 215 villages of Hoshiarpur district. The development of irrigation potential has boosted the agriculture production and brought overall socio- economic upliftment in the Kandi area which was already lying starved of assured irrigation. Boosting in agricultural production and good return of their produce have also increased the prices of land in this area and attracted the industrialist for making investment here.<sup>9</sup>

To obtain the purpose, thirty-six sites for constructions of dams were identified and out of these, 25 sites fall in Hoshiarpur district. At present, Dholbaha, Janauri and Maili have been completed in the Ist phase. In second phase programme of World Bank (from 1990-91 to 1995-96 and extended up to July 1998) ,13 dams were to be constructed. Out of which 6 dams have been completed and one dam is under construction. Patiari Dam is going to be taken up very soon and the investigation of Thana Dam has also been completed. The investigation of other four dams is being carried out. With the construction of these dams, large area has been benefitted, visualized in the projects such as flood protection and provision of irrigation facilities and recharging of groundwater etc. Salient features of dams along with benefits<sup>10</sup> are given in **Box 1**.

### **Box 1:** Salient Features of Dams constructed with assistance of the World Bank

- |  |
|--|
| <p><b>1. Dholbaha Dam:</b> This dam will reclaim 2326 ha of land and save 16200 ha of land from floods and also help in producing 7000 tonnes of food grains per year.</p>   |
| <p><b>2. Janauri Dam:</b> This dam started in March, 1989. The stored water in the reservoir and tubewells 1 irrigate 492 ha and 221 ha , respectively and expected return of Rs. 40.05 lacs on improvement in cropping pattern, development of fisheries, recharge of ground water and flood control. Irrigation potential of 433 ha has been created for irrigation from dam and 100 ha by 3 deep tubewells.</p> |

<p><b>3. Maili Dam:</b> This dam is located 1.5 km U/S of Maili village and 10 km from Mahilpur. This has provided irrigation facilities to 914 ha of land and has given relief to people from flood havoc and indirect benefit by recharge of ground water and development of fisheries.</p>
<p><b>4. Damsal Dam (Mehangrowal Watershed):</b> It is located near village Damsal at a distance of 20 km from Hoshiarpur town. It has provided irrigation to 1920 ha and has saved 2400 ha of land from floods.</p>
<p><b>5. Chohal Dam:</b> This dam was constructed with the help of the World Bank. It has provided irrigation facility to approximately 900 ha. This dam is located 0.5 km on the upper east side of village Chohal. Villages namely Baroti, Saleran, Bhagowal, Chohal, Adamwal, Sainchan and Thathal have been saved from the fury of floods and with its help, a number of development schemes have been implemented such as fish farming , irrigation and recharging of ground water.</p>
<p><b>6. Saleran Dam:</b> It is located about 15 km from Hoshiarpur city. This has provided irrigation facilities to 365 ha of land and has given relief to people from flood havoc and indirect benefits by recharge of ground water and development of fisheries etc.</p>
<p><b>7. Patiari:</b> The proposed Patiari Dam site is on Patiari Khad and is 5.00 km distant from village Kharan tehsil in Hoshiarpur district. The dam site is about 22.00 km from Hoshiarpur. It will irrigate 730 ha of land of village Dalewal, Patiari, Kharkan and Mehlanwali.</p>
<p><b>8. Thana Dam:</b> Thana Dam is proposed to be constructed on Khawaja Khad about 2.5 km distant from village Manhota, in the district of Hoshiarpur. This will provide irrigation to an area of 1160 ha.</p>
<p><b>Source:</b> Development Stories, <a href="http://hoshiarpur.nic.in/html/development_stories.htm">http://hoshiarpur.nic.in/html/development_stories.htm</a></p>

### (3) Rainwater Harvesting in Punjab

The Kandi belt faces the problems of degraded soil, water and lack of other natural resources. There are 21 major and 120 minor watersheds in the area, which is networked by a large number of rivulets carrying fast currents of rain water along with the sediments of the upper reaches and soils of the lower catchments and depositing all this on the plain cultivable lands. Recognizing the sparse development of Kandi area, the state government initiated two ambitious development projects, Kandi Watershed and Area Development Project (KWADP) during the period 1979-80 to 1987-88 and Integrated Watershed Development Project (Hills) [IWDP (Hills)] during 1990-98, financed by the World Bank. Under these projects, irrigation was the major component for the development of this area and the construction of micro irrigation structures was one of the aspects of irrigation component.<sup>11</sup>

In mid-eighties, the watershed projects were launched in a massive way in Haryana and Punjab as a replication of Sukhomajri model. In Punjab, Soil Conservation Department and the Irrigation Department initiated the works in mid-eighties. Later on, the World Bank assisted first phase of integrated watershed development projects which was initiated in 1990 for five years but extended up to 1997. The major works were undertaken initially by Soil Conservation Department, which constructed 66 earthen dams, and 33 Makkowal type. Water harvesting structures under the Watershed Management Programmes have become highly important for not only reversing the trend of deteriorating quantity & quality of ground water but also to prevent further soil degradation. Watershed Development shall play a big role not only in improving the state of soil & water resources thereby improving production of food grains but shall also help in socio-economic development & ecological development of the project area.<sup>12</sup>

The Department of Soil and Water Conservation constructed three types of micro irrigation structures namely,

small dams, lift irrigation structures and the Makowal type structures, depending upon the availability of water at site. After completion, these structures were entrusted to local farmers through constituting water management/water users committees of farmers of the village for independent use and distribution of water; collection of water charges and repair and maintenance of these structures.<sup>13</sup> A brief overview of these rain water harvesting structures would highlight the efforts made by the government in mitigating the crisis in the region:

- **Earthen and Masonary Check Dams:** The department has constructed about 90 earthen harvesting structures and 11 stone masonry/brick masonry structures in Ropar, Nawanshar and Hoshiarpur Districts where the geology varies from light textured to medium textured soils with clay bands. The masonry structures have mostly been constructed in Dhar and Dunera blocks of Gurdaspur district where the hills are composed of conglomerates and shales. The good earth as a fill material is often not available near the sites.
- **Makkowal type water Harvesting:** The Makkowal type water harvesting structures got its name from a remote village in district Hoshiarpur where this type of structure was constructed first, about 25 years ago. In this type of structure, the hill seepage and the base flow is tapped in the higher hill reaches and is delivered to the command area by gravity through a network of pipelines. In village Makkowal, the great socio-economic transformation was witnessed with this project. For decades, in the whole village consisting of about 200 hamlets, the only source of water for human and cattle drinking and other household chores was a 200 ft deep open well. With the construction of this water harvesting structure, water was carried by laying a 200 meter long pipeline from the hills to the village pond. Water was made available in the village for human and cattle and also for providing irrigation to about 100 acres. The excellence of the project was widely appreciated and later on replicated at about 110 other places in the Kandi region. The command area in this type of projects varied from 10 ha to 100 ha and in a few cases even more than 200 ha. The availability of water in this type of structures is assured for 8-9 months in a year.
- **Micro Lift Irrigation Projects:** These types of structures have been constructed where the command area is at a higher level than the water source. The projects include the development of the water source through percolation wells and then lifting to centrifugal pumps to irrigate the command area. The average Command Area for such projects is 50 ha. About 60 such structures have been constructed, the majority of them in hilly areas of Gurdaspur district.<sup>14</sup>

Most of the watershed management projects emphasized top-down planning with technically oriented objectives such as erosion control, and afforestation. The importance of local involvement in the planning process was crucial to ensure that socio-cultural dimensions were considered in projects designs. However these projects were technical but not successful without community involvement.<sup>15</sup> The participation of local people and government agencies have demonstrated that infertile and degraded areas can be conveniently converted into fertile and cultivable areas with their joint efforts and scientific acumen. Continuation of watershed management programmes in the remaining area is necessary for increasing crop productivity. Besides capturing rain, water sheds can meet the growing demand for irrigation in lean periods.<sup>16</sup>

S.S. Saini in his report described structure and functioning of Water User committees in this project. Each of the rainwater harvesting structures was used to be technically approved by a State Level Technical Committee .A Water Users' Society on each Water Harvesting Structure was formed and registered under the Societies Act. The detailed Byelaws of the Water Users' Society were got approved from the State Government. The Executive body of the Society, that controlled the Managing Committee, was constituted of 11 members elected by a simple majority. In the Byelaws, the functions of the Executive body were clearly defined. The maintenance of Water Harvesting Structure, protection of forests in catchment areas and equitable distribution of the benefits were the key responsibilities of the Society. The capacity of the Society and its members for maintenance & management of the assets created was built up through Orientation Trainings for the community mobilization. The community has been participating in the water harvesting projects right from the beginning when the work of water harvesting was started in the state 20 years ago. The functions and duties of these committees included supervision of the execution of work of water harvesting structure, sharing the harvested water, collection of user charges and maintenance of structure. The societies actively participated in the protection of catchment areas. However, there was no beneficiary share towards the cost of the structure and therefore, with the passage of the time, the interest of those societies was reduced where

the availability of water became unassured. The society remained more active in case of Makkowal and micro lift-irrigation projects since the availability of water is assured for most part of the year in these types of structures. With the passage of time, the community was motivated to share the cost in the shape of labour and with material and transport also. All projects completed with some contribution by the beneficiaries are functioning & sustaining better than the projects completed without their contribution. It has also been observed that the community is more active in Makkowal type and micro lift-irrigation projects than the earthen and masonry type projects since the last 10 years the Runoff Yield during the monsoons is only 30% of the designed norms. There is not enough water for irrigation. Another observation is that the smaller groups manage water harvesting structures in a better way than the larger groups due to the social divisions in the bigger groups. With the training and skill enhancement, component being focused during last few years for the management of water harvesting structures, the quality participation of the community members has improved. The water resource structure can be useful, effective and sustainable with the active involvement of the community. The sustainability directly depends upon the capacity of the community in the post-project operation and maintenance.<sup>17</sup>

## CONCLUSION

The experience from water management in *Kandi area* clearly points that local community must be involved for proper water management. For example, for getting the project of public tubewells in one village, it is compulsory that command area farmers should sign on the affidavit that they all are the members of Water User association and will properly manage water related issues at local level. Similar requirement should be made mandatory for small dams and canal water delivery in this area.

Watershed programmes are beneficial in this area, but there are detriments that has caused the failure of this in some parts of this region which were reported by Water Users Committee, inter-alia, (i) Wrong selection of site and direction of channels leads to less availability of water at site; (ii) Poor quality/undersize of pipes leads to breakage of pipes; (iii) Lack of follow up action by the concerned department after the completion/ entrusting of structures to Water Users Management Committees; and (iv) Poor recovery of water charges from farmers, leading to shortage of funds for maintenance/repairs.<sup>18</sup> It is of paramount interest to motivate local farmers to take immediate steps for better water management in this area.

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# HABITAT USE AND CONSERVATION OF MARSH CROCODILE (*CROCODILUS PALUSTRIS*, LESSON, 1831) IN BEESHAZARI LAKE COMPLEX, NEPAL

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Paras Mani Acharya\*\*

## ABSTRACT

*The marsh crocodiles *Crocodilus palustris*, Lesson, 1831 mainly inhabit the Beeshazari and associated lakes, whereas the gharials thrive in the boundary rivers such as Rapti and Buddhi Rapti. Many of the marshes and swamps listed in the Ramsar Site are seasonal, therefore during the dry season the crocodiles disperse to large water bodies such as Beeshazari, Satrahazari, canals and rivers. Some marsh crocodiles co-exist with gharials in the Rapti and Buddhi Rapti rivers. These rivers provide the additional habits for the gharials due to their connection with the Narayani River which supports largest number of gharials in Nepal. Crocodiles in Beeshazari Lake Complex are under pressures from loss of habitat due to encroachment by alien invasive species; high fishing pressure in the rivers; pollution of water bodies due to littering and eutrophication; unregulated visitors pressure; and inadequate awareness. No systematic studies pertaining to dispersal, habitat requirements, breeding and ecology of mugger crocodile in Chitwan National Park exist. Lack of these information have hindered the conservation and management of these threatened aquatic reptiles. This paper focuses in assessing the status and habitat ecology of marsh mugger in the Beeshazari Lake Complex.*

**Keywords:** alien invasive species, Beeshazari Lake Complex, Chitwan National Park, gharial, habitat, marsh crocodile, Ramsar site

## INTRODUCTION

The crocodiles are important species of aquatic system that play an important role as indicators of healthy wetlands and rivers that maintain environmental integrity of the area. The crocodiles are considered the top predators in the aquatic systems. There are 22 species of crocodiles found in the world, out of which, 2 species namely gharial (*Gavialis gangeticus*) and marsh crocodile (*Crocodilus palustris*) are found in the rivers, lakes and fresh water marshes, swamps and irrigation canals of Nepal (Rajbhandari & Acharya, 2013). The marsh *Crocodilus palustris* is listed in the Vulnerable and Appendix 1 of CITES. The marsh crocodile was widely distributed in Nepal (Andrews & McEashern, 1994). Their habitat range included most of the Terai, the West and East Rapti, the Narayani and Kosi River systems. In the Karnali, Narayani and Babai, they co-exist with the gharial. Currently, the mugger (marsh crocodile) is found in the fragmented populations primarily in the protected areas, such as Suklaphanta Wildlife Reserve, Bardia and Chitwan National Parks which contain the wild populations (IUCN, 1998). The Mahakali and

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Bahunne Rivers adjacent to Suklaphanta represent suitable habitats and are contiguous with areas in Uttar Pradesh where an effective rehabilitation program is in operation.

The mugger is a medium-sized crocodile (maximum length: 4-5 m), and has the broadest snout of any living member of the genus *Crocodylus*. It has a wide range of distribution within the Indian Sub-continent including Nepal. In India and Sri Lanka, marsh crocodiles are adapted well to reservoirs, irrigation canals and man made ponds, and in some areas may even be found in coastal saltwater lagoons (Whitaker, 1987; Whitaker and Whitaker, 1989). In some areas of northern India and Nepal, marsh populations co-exist with the gharials, but the two species tend to be partitioned by habitats. Where found together with the gharials, the marsh crocodiles tend to bask in the midstream, on rocks or muddy banks (Groombridge, 1982). During winter, they usually spend the day basking on the rocky, sandy and clay banks with mouth open to control the heat. The marsh crocodiles inhabit in the burrows, generally made on the bank of lakes, rivers, at the foot of trees or below rocks. The food comprises mainly fish, but they predate any other animals.

The current threats to marsh populations are principally, rapid agricultural and industrial development, habitat destruction, drawing in the fish nets, egg predation by people, and the use of crocodile parts for medicinal purposes (Whitaker, 1987; Whitaker, 1989; Groombridge, 1982). A survey in Nepal by McEachern (1994) indicate that the marsh crocodile is now restricted to isolated populations, primarily in protected habitats. Small numbers of individuals are known or suspected from Mahakali, Nala, Karnali, Babai, Rapti, Narayani and Kosi River systems. Alienation of habitat by river disruption and damming, and mortality in fisheries are major problems in protecting these vulnerable species.

## STUDY AREA

The Beeshazari Lake Complex is situated between Latitude 27° 37' 14" N – 27° 36' 34" N and Longitude 84° 08' 22" E - 84° 25' 04" E towards the north side and Latitude 27° 39' 07" N - 27° 37' 26" and Longitude 84° 27' 07' 00" E – 84° 25' 20" E towards the southern side (BPP, 1995) (Fig. 1). The Beeshazari and associated lakes (Ramsar Site) lies within the buffer zone of the Chitwan National Park (World Heritage Site) within the Chitwan district of Nepal (Fig. 2). The study area is located 7.2 km south from the east-west highway following Khageri canal with an altitude of 293 m from the sea level. The lake complex covers an area of 3200 ha including the mosaics of diverse habitats of open water bodies, marshes, swamps, grasslands and forests (RCB, 2003). The Beeshazari Lake has a maximum depth of 5 m and average depth of 3 m. The lake covers an area of 100 ha of open water body only representing the second largest lake in the terai region (IUCN, 1998). The Beeshazari Lake falls in the subtropical climatic regime and dominated by summer monsoon climate. The Khageri, Budhi Rapti and Rapti are the principal natural drainage of the area. The lake area lies within the Siwaliks or Sub- Himalayan geological belt of Nepal Himalaya. As the Beeshazari lake area represents a structural valley, the hard rock geology of the area is covered by the quaternary deposits comprising mostly of alluvial and co-alluvial deposits.

The Beeshazari lake basin is rich in biodiversity represented by 131 species of plants that comprise 32 trees, 64 shrubs and 99 aquatic plants (IUCN, 1998). All freshwater lakes are surrounded by mixed deciduous forest in which Sal (*Shorea robusta*) and Asna (*Terminalia alata*) are the most dominant trees with thick lianas and undergrowth. Jamun (*Syzigium cumini*) is mostly found on the shores of the lake. Barandabhar forest which bears Beeshazari Lake Complex that adjoins the Chitwan National Park in the south has over 22 mammals, 274 species of birds, 17 species of fishes and 13 species of reptiles (Yonzon, 2000). It owes a great importance to provide an excellent habitat as a water hole and corridor for globally threatened and endangered wildlife species, including the critically endangered *Gyps bengalensis*, endangered *Panthers tigris*, *Rhinoceros unicornis*, *Gavialis gangeticus*, Vulnerable *Lutrogale perspicillata*, *Melurus ursinus*, *Crocodylus palustris*, *Leptoptilus javanicus*, *Aythya nyroca* and *Haileetus leucoryphus* (RCB, 2003).

Figure 1: Beeshazari Lake Complex ( a Ramsar site)

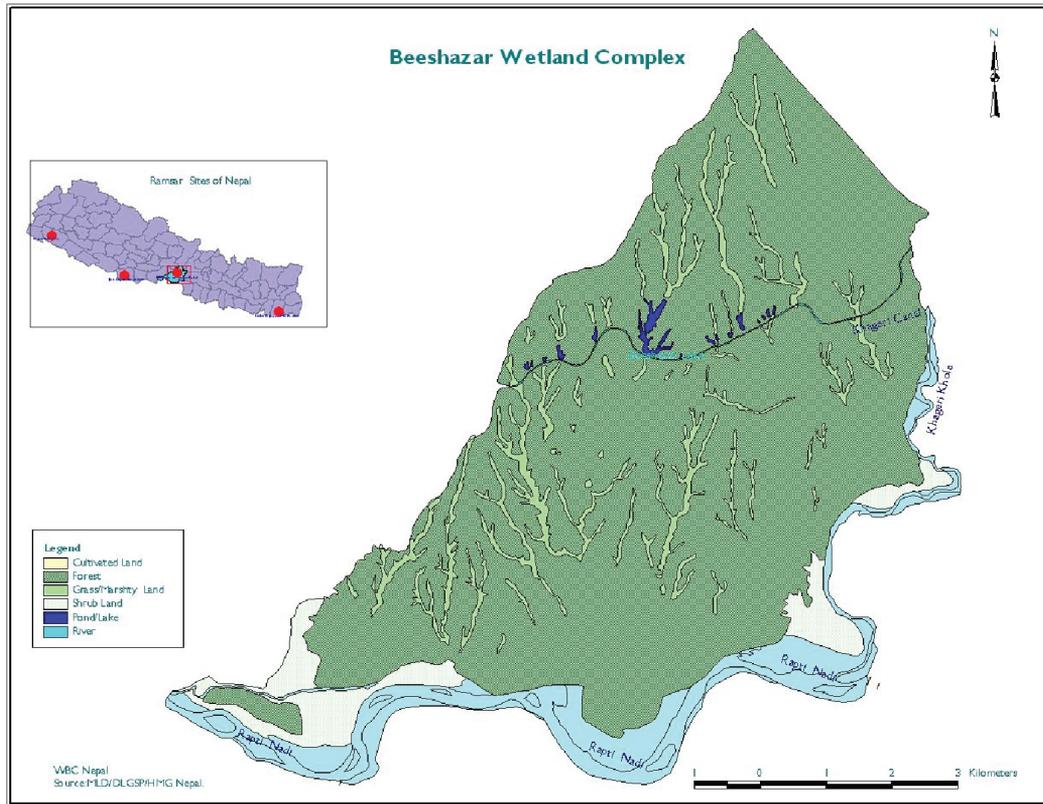
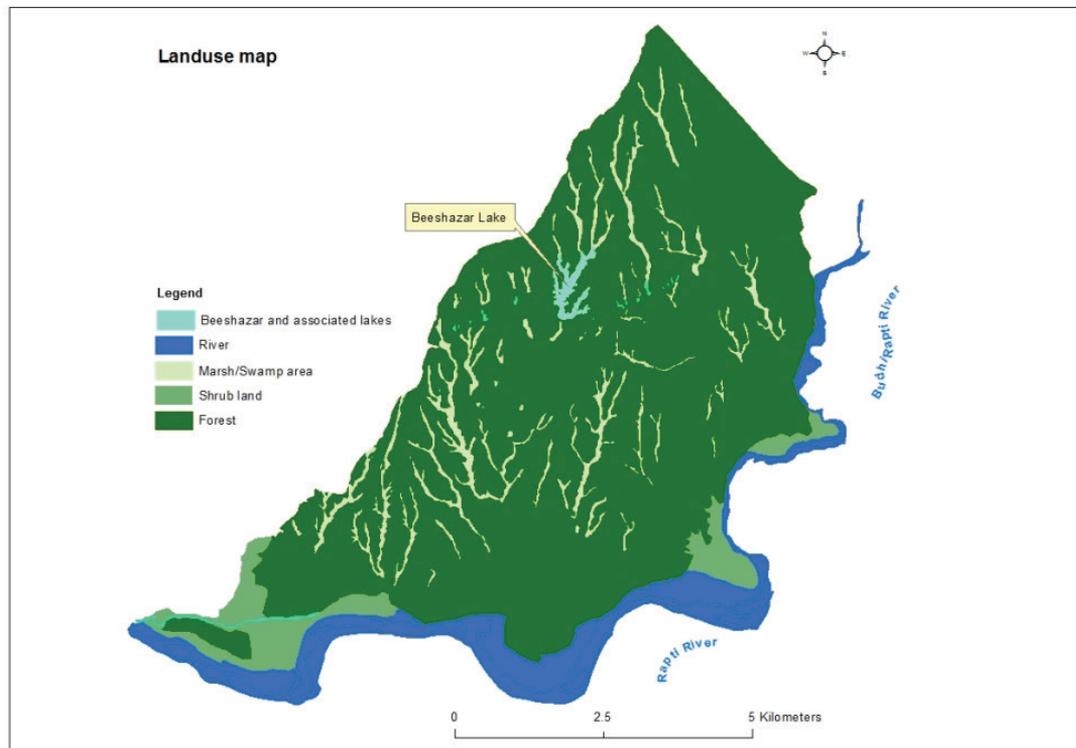


Figure 2: Landuse map of Beeshazari Lake Complex



## MATERIALS AND METHODS

A survey was conducted during the month of January 2011 to investigate the status and distribution of marsh crocodile in Beeshazari Lake, Ramsar Site. The survey was done by walking through the trails along the banks covering all the shallow water courses that extend from the main water body of the lake. The crocodiles were observed by the Olympus binoculars. The size of the crocodiles and the habitat type used were noted. The locations of the sighted crocodiles and the habitat features were recorded by Garmin GPS.

In the Rapti and Budhhi Rapti Rivers, the survey was carried out by using wooden boats. The crocodiles were counted by two experienced observers on both river banks. The survey covered a distance of approximately 15 km from Sauraha to Belsar area. The GPS points of the observed crocodiles were recorded. The habitat features such as river width, depth and substrate type were also noted. On the basis of these observations, the crocodiles sighted and counted were assigned to general size and age classes according to classification system developed by Rodgers (1991). Accordingly, the hatchling as < 50 cm, yearling/juvenile as 50 - 120 cm, sub adult as 120 - 180 cm, adult as >180 cm, and eyes only for very far or difficult to estimate, were classified.

## RESULTS AND DISCUSSION

### Habitat utilization of crocodiles

#### Beeshazari Lake

The marsh crocodiles recorded in Beeshazari Lake and around Khageri canal mostly selected muddy and grassy banks, and the floating mats of *Leersia hexandra*, *Cyperus sps.* with *Mikania* and *Eichornia* covered areas close to open water course. They normally preferred these areas for basking activity.

The seasonal and permanent wetlands of Beeshazari Lake Complex are severely effected by the extensive growth of the weeds such as *Leersia hexandra*, *Cyperus sps.*, *Ipomoea carnea fistulosa*, *Eichornia crassipes* etc. thereby reducing the water level resulting in the loss of habitats of the marsh crocodiles. The Beeshazari Lake is the largest water body of the Bharandabhar forest corridor. All of the five branches of this lake are undergoing gradual conversion of marsh and swamps into floating mats of vegetation. This will ultimately result into seral stage of grasslands.

The size of crocodiles observed in these habitats vary between 1.5 - 4.5 m ( $2.544 \pm 0.826$ , N=16) (Table 1).

**Table 1** : Observation of marsh crocodiles in Beeshazari Lake

S. No.	Latitude	Longitude	No.	Size m	Habitat
1	27.62030918	84.47041539	8	1.5-2.0, 2.5-3.0, 3.0-3.5, 3.0-3.5, 3.0-3.5, 3.5-4.0, 3.5-4.0, 4.0-4.5	muddy/open water
2	27.61912021	84.45298573	2	2.75-3.0, 3.5-4.0	mats of <i>Leersia</i> /open water
3	27.61446523	84.44316499	1	3.5-4.0	open water/ <i>Eichhornia</i>
4	27.61501526	84.43800350	2	3.0-3.5, 4.0-4.5	mats of floating island
5	27.61494233	84.43894143	1	2.5-3.0	Grassy
6	27.61500151	84.43795941	2	3.0-3.5, 2.0-2.5	Grassy
7	27.61847883	84.43377944	1	1.5-2.0	Muddy
8	27.61424990	84.42425164	1	1.82-2.0	water edge
Mean				2.544	
±SD				0.826	

**Khageri Canal**

The sizes of crocodiles observed in these habitats vary between 1.25 - 3.0 m ( $1.96 \pm 0.417$ , N=19) (**Table 2**).

**Table 2** : Observation of marsh crocodiles around Khageri canal

S. No.	Latitude (°N)	Longitude (°E)	No.	Size ( m)	Habitat
1	27.63136592	84.47773665	1	1.82-2.0	water edge
2	27.62030918	84.47041539	1	1.25-1.50	muddy/grassy
3	27.61792755	84.45298573	4	2.0-2.5, 2.0-2.5, 1.25-1.50, 1.25-1.50	open water/Leersia
4	27.61482633	84.43795555	1	1.25-1.50	irrigation canal
5	27.61501526	84.43800350	4	1.5-2.0, 1.8-2.0, 1.8-2.0, 1.5-2.0	Muddy
6	27.61494233	84.43894143	2	1.5-2.0, 2.0-2.5	open water
7	27.61500151	84.43795941	1	2.0-2.5	Muddy
8	27.61424990	84.42425164	1	2.5-3.0	Grassy
9	27.61297141	84.42058666	2	2.0-2.5, 2.5-3.0	muddy/grassy
10	27.61401982	84.42476520	1	2.0-2.5	grassy/Mikania
11	27.61041225	84.41704597	1	1.5-2.0	grassy/muddy
Mean				1.96	
±SD				0.417	

**Rapti River**

In Rapti River, the marsh crocodiles usually preferred habitats that varied from grassy, muddy, sandy, rocky and on the dead logs and woody debris. The sizes of the marsh crocodiles vary between 0.5 - 3.0 m ( $1.64 \pm 0.657$ , N=9) Water depth is 0.76 - 2.74 m deep ( $1.405 \pm 0.725$ , N=8) and the water channel is 45.72 - 91.44 m wide ( $63.82 \pm 22.84$ , N=8) (**Table 3**).

**Table 3:** Survey results of marsh crocodiles in Rapti River

S. N.	Latitude (°N)	Longitude (°E)	No.	Size (m)	Depth (m)	River width (m)	Habitat
1	27.57055856	84.46512750	1	2.5-3.0	2.43	60.96	grassy/muddy
2	27.56465066	84.45957667	1	1.0-1.5	0.91	76.2	muddy/dead logs
3	27.56466047	84.45940501	1	0.5-1.0	0.91	45.72	muddy/debris
4	27.56852947	84.44265244	2	0.5-1.0, 2.0-2.5	2.74	22.86	muddy/dead logs
5	27.56679098	84.43876625	1	1.5-2.0	0.76	91.44	grassy / sandy
6	27.55317986	84.42928774	1	1.5-2.0	1.21	76.2	open water/ muddy
7	27.56967754	84.39681835	1	1.0-1.5	1.52	91.44	rocky
8	27.56946674	84.39486939	1	2.0-2.5	0.76	45.72	Sandy
Mean				1.64	1.405	63.82 22.84	
±SD				0.657	0.725		

### Buddhi Rapti River

In Buddhi Rapti River, the marsh crocodiles were found on the muddy sand and Sachharum bank, dead log and pebbles.

The sizes of marsh crocodiles are 0.15 - 4.0 m ( $2.083 \pm 0.65$ , N=18), the water depth is 0.60 - 3.65 m deep ( $0.95 \pm 0.32$ , N=13), the water channel is 30.48 - 53.34 m wide ( $27.845 \pm 4.51$ , N=13) (**Table 4**).

**Table 4:** Survey results of marsh crocodiles in Budhi Rapti River

S.N.	Latitude (°N)	Longitude (°E)	No.	Size (m)	Depth (m)	River width (m)	Habitat
1	27.59484831	84.47591267	2	2.5-3.0, 1.0-1.5	1.52	45.72	Sandy
2	27.59465394	84.47578199	2	0.5-1.0, 2.5-3.0	1.21	53.34	muddy/grassy
3	27.59484831	84.47591267	2	1.0-1.5, 0.5-1.0	0.60	53.34	Muddy
4	27.59465394	84.47578199	1	0.15	0.45	53.34	Muddy
5	27.59241035	84.47372432	1	2.5-3.0	2.13	45.72	Muddy/sandy
6	27.59403468	84.46954317	1	1.0-1.5	3.04	53.34	Muddy/sandy
7	27.59405396	84.46943815	1	1.5-2.0	2.43	45.72	Grassy
8	27.59359689	84.46899491	2	2.75-3.0, 2.0-2.5	1.21	45.72	Pebbles
9	27.59339590	84.46849938	1	2.0-2.5	3.65	53.34	grassy/sandy
10	27.59265929	84.46789236	1	1.5-2.0	0.60	45.72	pebbles/muddy
11	27.59150133	84.46698871	1	2.5-3.0	1.21	45.72	wood debris
12	27.59117126	84.46677287	1	3.5-4.0	1.21	53.34	Grassy/muddy
13	27.59008991	84.46642368	2	2.0-2.5, 2.5-3.0	1.52	30.48	dead logs
Mean ±SD				2.083 0.65	0.95 0.32	27.845 4.51	

### Age classes of crocodiles

In Beeshazari Lake, a total number of 36 marsh crocodiles were recorded including 6 juveniles, 16 sub-adults, and 14 adults. In Rapti River 9 crocodiles were recorded including 2 hatchlings, 4 juveniles, 2 sub-adults and 1 adult. In Budhi Rapti River, a total of 17 crocodiles were recorded including 4 hatchlings, 6 juveniles, 6 sub-adults and 1 adult (**Table 5**).

**Table 5:** Marsh crocodile counts and their age classes in the Beeshazari Ramsar Site, 2011

River/Location of sightings	Hatchlings	Juveniles	Sub-adults	Adults (M.F)	Totals
Beeshazari Lake	0	6	16	14	36
Rapti River	2	4	2	1	9
Budhhi Rapti River	4	6	6	1	17
<b>Grand Total</b>	<b>6</b>	<b>16</b>	<b>24</b>	<b>16</b>	<b>62</b>

This study recorded a large congregation of marsh crocodiles in Beeshazari Lake and its associated wetlands due to the presence of suitable habitat conditions such as marshy and swampy wetland habitats with perennial sources of water and availability of prey resource base. During the summer, many of the seasonal wetlands viz. freshwater marshes and swamps become dry and therefore, the crocodiles move to the permanent water sources such as Beeshazari Lake, Satrahazari lake and Khageri irrigation canal.

In the rivers of the Ramsar Site (Rapti and Budhhi Rapti), the marsh crocodiles prefer to bask mostly on the muddy and grassy river banks along with the presence of dead logs or wood debris. Few of the crocodiles use the rocky substrate for basking. A marsh crocodile survey by *Bhatt et al.* (2012) recorded four adult marsh crocodiles basking on sandy and muddy bank of Rani Tal, Suklaphanta Wildlife Reserve, but it differs in the selection of habitat use where the lake basin is characterized by the muddy substrate..

During the flood waters in the Rapti and Budhhi Rapti Rivers, the crocodiles move to the adjoining marshes and swamps to avoid the unfavorable condition.

The marsh crocodiles were found basking at the edge of rivers having shallow depth that ranged from 0.45 - 3.65.

**Figure 3:** Marsh crocodile basking in the sun, Rapti river, Chitwan National Park



**Figure 4:** Gharial on the bank of Rapti river, Chitwan National Park



The crocodiles in Beeshazari Lake are severely threatened by loss of habitats and degradation due to extensive encroachment of open water surface by alien invasive species, thereby limiting the available habitats. The absence of proper management of irrigation barrage to regulate the flow of water in canal and lake and use of the overflow of/over drained water from the lake basin have accelerated the loss of wetland functions. Lowering of water level in Beeshazari Lake while there is low volume of water in the canal by seepage into the irrigation canal affect the habitat of waterfalls and other wetland dependent fauna.

Deforestation, overgrazing and human disturbances in the Khageri sub-watershed have increased the soil erosion thereby increasing siltation in rivers, canals, and lake systems. These have led to subsistence of the lake bottom (*WBC, 2007*). The water recharging channels in the catchment area of Beeshazari and Satrahazari lakes are almost covered with weeds, which may perturb ecological functions of aquatic system. The hydrological regime of Beeshazari Lake is not maintained and well functioning due to the inappropriate design of inlets and outlets, lack of IEE on water management (groundwater recharge, precipitation input, water balance and free circulation) which may lead to anoxic condition with low level of dissolved oxygen in water (*WBC, 2007*). Eutrophication, the invasion of the alien species responsible for the degradation of these lakes through habitat modifications and lowering the concentration of dissolved oxygen in water was the major threats to the Beeshazari Lake Complex. An integrated approach from scientific and social aspects is required for the wide use of these wetlands resources and the conservation of these resources from the existing and potential threats (*Bhattarai & Acharya, 2007*). All of these factors have contributed to declining water quality and therefore, affecting the aquatic life including the marsh crocodiles (*DBN, 2007; Acharya & Rajbhandari, 2012*).

Some conservation measures like awareness, waste collection and lake cleaning is being done in Chitwan National Park with support from TAL/WWF and Buffer Zone institutions, but due to lack of strict enforcement of laws in Park and Buffer Zone and inadequate awareness, the littoral habitats of Beeshazari is being polluted.

High use of trails by the local people for collection of resources in core and buffer areas of Beeshazari Lake have created disturbances to crocodiles that can obstruct their feeding, breeding and dispersal.

The Beeshazari Lake Complex is an attractive tourist site. The number of visitors, both national and foreigner who visit here is getting crowded day by day. This overcrowding has adverse effects over the activities of mugger crocodiles.

The Charara-Belsar stretch of Rapti River is highly influenced by human disturbances (*Acharya & Rajbhandari, 2012*). The suitable habitats of gharial and mugger crocodiles are being tremendously used for fishing purposes. This overfishing may cause the scarcity of food to the crocodiles.

The Government of Nepal formulated the Site Management Plan of Beeshazari and associated lakes to contribute conservation and wise use of Beeshazari wetlands and their resources for achieving sustainable development (*CNP, 2010*). This plan identifies seven strategic level actions and four actions at the site level. However, it does not specifically address the conservation problems and their management interventions to the conservation of wetland dependent fauna like the marsh crocodile, turtles, fishes, rhinoceros and the tiger.

The implementation of conservation programs should necessarily be under the umbrella of the Chitwan National Park to avoid duplication of the activities.

## CONCLUSION

The Beeshazari Lake Complex provides suitable habitat for the marsh crocodiles, but is being threatened by habitat loss and human disturbances. The Chitwan National Park should adopt appropriate habitat and species conservation measures of the Chitwan National Park Management Plan and Site Management Plan of Beeshazari and associated lakes to maintain the long term conservation of marsh crocodiles in the Ramsar site with the improvement and restoration of their habitats.

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# THE ROLE OF BIOGAS FOR ENVIRONMENTAL SUSTAINABILITY IN NEPAL: USERS' PERSPECTIVE

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## ABSTRACT

*Environmental sustainability is an important ingredient of sustainable development. Sustainable development is the positive change in a pattern of resources use in such a way that present needs can be met without destroying the chance for the future generations to meet their needs. Furthermore, renewable energy as an essential ingredient of environment comes from resources which are continually replenished. Renewable energy technologies such as biogas, solar and micro-hydro are widely promoted in Nepal. In this study, only biogas has been considered. The paper examines role of biogas for environmental sustainability in Nepal based on a case study of Niglihawa VDC of Kapilvastu district. The users' perspectives of sixteen out of twenty two biogas users have been collected by using structured questionnaire. It was found that there was 2.4 tons reduction of greenhouse gas emission annually per household as per CDM methodology. Biogas contributes for protecting environment in relation to forest conservation as 87 percent respondents agree that deforestation affects environment negatively while the rest are neutral. The results may vary in other area and/or sector of Nepal and beyond.*

**Keywords:** Biogas, Environmental Sustainability, Users' Perspective

## INTRODUCTION

Development consists of the process of economic and social transformation that is based on complex cultural and environmental factors and their interactions. Sustainable development is a pattern of resources use that aims to meet human needs while preserving the environment (*Wikipedia, Sustainable Development*). As early as 1970s, 'sustainability' was employed to describe an economy in equilibrium with basic ecological support systems. The term 'sustainable development' rose to significance after it was used by the Brundtland Commission in its 1987 report *Our Common Future*. In the report, the commission coined what has become the most often-quoted definition of sustainable development: "development meets the needs of the present without compromising the ability of the future generations to meet their own needs."

Sustainable development ought to be efficient with resources and carefully planned to deliver both immediate and long-term benefits for people as well as planet. The sustainable development ties together concern for the carrying capacity of natural systems with the social and the carrying capacity of natural systems with the social and economic challenges faced by humanity.

The concept of sustainable development has in the past most often been broken out into three constituent domains: *environmental sustainability*, *economic sustainability* and *social sustainability*. The United Nations 2005 World Summit Outcome Document refers to the "interdependent and mutually reinforcing pillars" of sustainable development as economic development, social development, and environmental protection (*Wikipedia*: 14 Jan

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2014). This paper focuses on only a single pillar viz. environmental sustainability.

Environmental sustainability is the process of making sure current processes of interaction with the environment are pursued with the idea of keeping the environment as pristine as naturally possible, based on ideal-seeking behavior. Thus, environmental sustainability demands that society designs activities to meet human needs while indefinitely preserving the life support systems of the planet. This, for example, entails using water sustainably, only utilizing renewable energy, and sustainable material supplies (e.g. harvesting wood from forests at a rate that maintains the biomass and biodiversity).

Furthermore, energy is an essential ingredient of socio-environmental development and economic growth (Goldemberg, 1996). Renewable energy is energy that comes from resources which are continually replenished such as sunlight, wind, rain, tides, waves and geothermal heat (Wikipedia: 28 Feb 2013). About 16 percent of global energy consumption comes from renewable resources, with 10 percent of all energy from traditional biomass, mainly used for heating, and 3.4 percent from hydroelectricity. New renewable energy (small hydro, modern biomass, wind, solar, geothermal, and bio-fuels) accounted for another 3 percent and are growing very rapidly. The share of renewable energy in electricity is around 19 percent, with 16 percent of electricity coming from hydroelectricity and 3 percent from new renewable (Wikipedia: 28 Feb 2013). Reliable and sustainable supply of energy is the basic needs of the people for meaningful life including cooking, lighting and economic activities.

Moreover, fuel crisis exists in the supply of traditional sources of energy (firewood). Increasing population pressure creates demand for fuel wood from forest. In most part of the country, fuel wood is now being used faster than it can be replenished by natural growth or re-plantation. This demand for wood, coupled with commercial exploitation of trees for construction, pulping and other uses, mean that the forests are being destroyed at an alarming high rate. As a result, people lose out in two ways: not only cannot they develop, because of high cost of petroleum fuel, but also their traditional life-style is threatened as fuel wood is becoming less available day by day.

In such circumstances, Nepal has very high potential to exploit the renewable energy; however, it has not been exploited to the fullest. The energy sector of Nepal is characterized by a very heavy reliance on traditional resources that contribute to more than 85 percent of the total energy consumption (AEPCC, 2012, p. 1). Renewable energy technologies such as biogas, solar and micro-hydro are widely promoted in Nepal. We are focusing merely on biogas for this study.

Biogas can contribute in environmental sustainability. It can play vital role for reduction of greenhouse gas emission, and forest conservation. It helps improve in health and sanitation through providing clean energy and smokeless kitchen that is directly associated with children and women's health and environment. Health and environment along with friendly surroundings contribute for better enterprise integration.

Nepal has over a half-century history of promoting domestic biogas. The history of biogas in Nepal goes back to 1955 AD when the biogas technology was first introduced at St. Xavier School, Godawari, Lalitpur by late Father B.R. Saubolle. Thereafter, Government of Nepal (GoN) started biogas program mainly as the technology for high quality organic manure production and with potential to reduce fire wood consumption in the Fiscal Year (FY) 1974/75. In order to expedite the progress rate towards achieving the biogas potential of Nepal, Biogas Support Program (BSP) was launched in 1992. The biogas program came under the umbrella of Alternative Energy Promotion Center (AEPCC) in 1996. As the result, biogas plant installation was rapidly increased after the end of nineties.

## REVIEW OF LITERATURE

There are several studies conducted in the area of biogas and environmental sustainability. Sigdel and Das (1990) show the forest conservation and economic benefits from the biogas while Keier (1993) study protection of environment. These studies support to analyze environment protection through using biogas.

Similarly, White (2005) studies the role of biogas as cleaner and efficient energy for agriculture development. Ghimire (2006) concludes improvement in health and sanitation situation and how social status was raised. Sharma (2010) finds how the agricultural production increased after installation of biogas plants. It was also found that women were highly benefited by the biogas plant and that the overall energy, environmental and economic condition

had been improved. *Timsina* (2008) studies the nature of time saving after installation of biogas from firewood collection, cooking activities and washing utensils. These studies reveal the role of biogas in protecting environment and cultural development.

*Bhandari* (2010) finds positive impact of biogas on social, economic, environmental, educational, and health aspects and many other benefits for the users. Comparatively, women had experienced much improvement in their health status after the installation of biogas plants than men. Biogas has made it easy for cooking and maintaining clean environment and increase social prestige. *Arthur, Baidoo and Antwi* (2011) find biogas as very successful and a very reliable and clean source of energy. Proper management of biogas programs can help reduce greenhouse gas emissions which may be affecting climate change. A study by *Yadav* (2012a) deals with the role of biogas for sustainable development and concluded that biogas plays a vital role in mitigating climate change and improving quality of life in Nepal. Likewise, *Adhikary* (2012) deals with green economy in pursuance of sustainable development in Nepal. Various studies conducted in Nepal either focus on technical aspects or environmental aspects of biogas and less on sociological aspects. The applicability of these facts is yet to be seen in the context of Nepal. In this context, a sociological study of biogas for environmental sustainability is considerable for investigation.

## DATA AND METHODS

This study consists of descriptive-cum-analytical research design. There are primary and secondary data. The secondary data have been collected from the database of Biogas Sector partnership-Nepal (BSP-Nepal) for the period of 1992/93 to 2012/13. The primary data has been collected by using structured questionnaire to get opinion of biogas users. All relevant research issues were translated into questions for field survey 2013. The survey was conducted at Ward Number 6 of Niglihawa VDC, Kapilvastu district of Nepal.

The study has employed multi-stage sampling. Kapilvastu District and Ward number 6 of Niglihawa VDC was selected based on judgmental sampling. The primary rationale behind the selection of this study area is proximity with the forest that makes easier to get genuine information on reduction of deforestation. The secondary rationale is the rampant use of both dung cake and firewood before installation of biogas plants by the users. However, the Simple Random Sampling (SRS) method has been employed to determine study unit for the study. Sixteen out of twenty two biogas users have been selected randomly for the study by applying lottery method.

## EMPIRICAL RESULTS

The role of biogas for environmental sustainability in the case of Nepal has been determined through examining its relation to reduction of pollution and forest conservation in the study of sample ward.

### Respondents Mix

The study has collected biogas users' opinion through field survey in the year 2013. The respondents mix is given in **Table 1**.

The age of respondents vary between 22 to 55 years old. The average family size of the respondents is 9.06. Fourteen out of 16 respondents have 6 m<sup>3</sup> biogas plants while one has 8 m<sup>3</sup> and rest another one has 4 m<sup>3</sup> biogas plant. Likewise, 15 plants out of 16 selected plants are 5 years old while one plant is more than 10 years old. The respondents consist of 14 male and 2 female.

**Table 1:** Respondents Mix

Basis	Data					
<b>Gender</b>	<b>Male</b>	<b>Female</b>	<b>Total</b>	<b>Remarks</b>		
	14	2	16			
<b>Occupation</b>	<b>Farmer</b>	<b>Student</b>	<b>Trader</b>	<b>Politician</b>	<b>Cook</b>	<b>Total</b>
	8	4	2	1	1	16
<b>Education</b>	<b>10+2</b>	<b>SLC</b>	<b>Barely Literate</b>	<b>Illiterate</b>	<b>Total</b>	<b>Remarks</b>
	4	6	4	2	16	

**Source:** Field survey 2013

The Respondents' occupations are dominated by that of farmer (50%), student (25 %) and trader (12.5%), politician (6.25 %) and cook (6.25 %). The education mix of the respondents include: 10+2 (25 %), SLC (37.50 %), barely literate (25 %) and rest (12.50%) are illiterate.

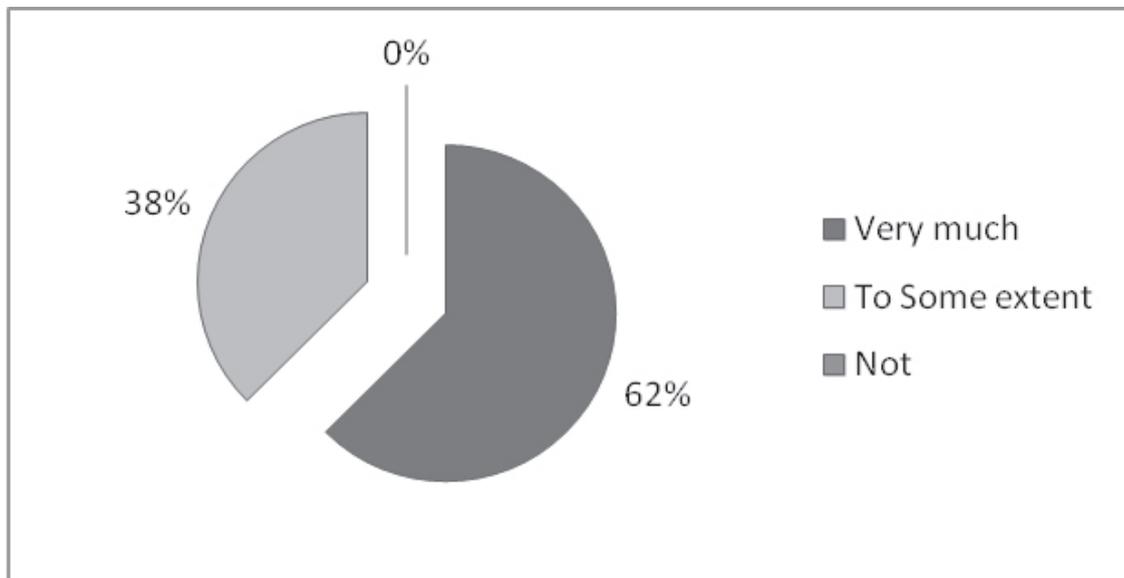
### Biogas in Relation to Pollution Reduction

Energy plays indispensable role in running the wheels of the economy of any country and more importantly in the lives and livelihoods of its people. Moreover, greenhouse gas emission reduced from the decrease in the use of fuel wood, agriculture residues, dung cake, and kerosene consumption.

In the survey, *fifteen* out of sixteen respondents believe that it reduces both in-door and out-door pollution while only one respondent think that it does not reduce them.

Additionally, 15 out of 16 respondents think biogas does not generate bad smell in the kitchen while rest one has expressed it generates bad smell. On the other hand, all respondents have toilet. Fifteen out of sixteen toilets constructed together with biogas and only one constructed beforehand. Likewise, fifteen out of sixteen toilets are connected with biogas plants. The owner of a biogas plant that is not connected with toilet believes that cooking with the gas produced from human waste is not safe and hygienic. However the owner has agreed that it can be connected now. It means that biogas plays role to improve health and sanitation by enforcing to build toilet and also connect with biogas plants. Similarly, 10 out of 16 respondents have felt the decrease in the indoor smoke very much and to some extent respectively after biogas plant installation as shown in **Figure 1**.

**Figure 1:** Responses on Decrease in the Indoor Smoke



**Source:** Field survey 2013

There are 290,902 biogas plants installed in Nepal from Fiscal Year 1992/93 to 2012/13 (*BSP-Nepal*). Out of these, 95 percent plants are operational as per Biogas User Survey. Accordingly, 276,357 households have access to clean renewable energy. The extrapolation of the sample study will indicate that biogas can play a great role in improving health and hygiene providing clean energy, smokeless kitchen and toilet connection in 167,356 households that directly affects children and women's health and hygiene.

UN Summit on global warming termed as the Earth Summit took place in Rio de Janerio, Brazil in 1992 (UN Department of Public Information , 1997). The Summit formulated and adopted the UN Framework Convention

on Climate Change (UNFCCC), which established principles and objectives but there was no specific target or obligations. Nepal ratified the Convention in 1995 as a party to the UNFCCC. In the follow up, the Conference of the Parties (CoP) of the UNFCCC that was held in Kyoto, Japan in 1997, drafted and adopted Kyoto Protocol. This treaty of UNFCCC sets specific targets and actions for the Annex I and Non-Annex I parties (*UN Department of Public Information, 1997*). The Kyoto Protocol in 1997 had the following 3 streams to meet the targets and legal obligations:

- Joint Implementation (JI) of Projects in an Annex I Country;
- Emission Trading among Annex I Parties; and
- Clean Development Mechanism (CDM).

Under the Clean Development Mechanism (CDM), the reduction of emission from projects in developing countries can be traded with Annex I countries to meet their targets. Nepal signed the instrument of accession to the Protocol and became a party in September 2005.

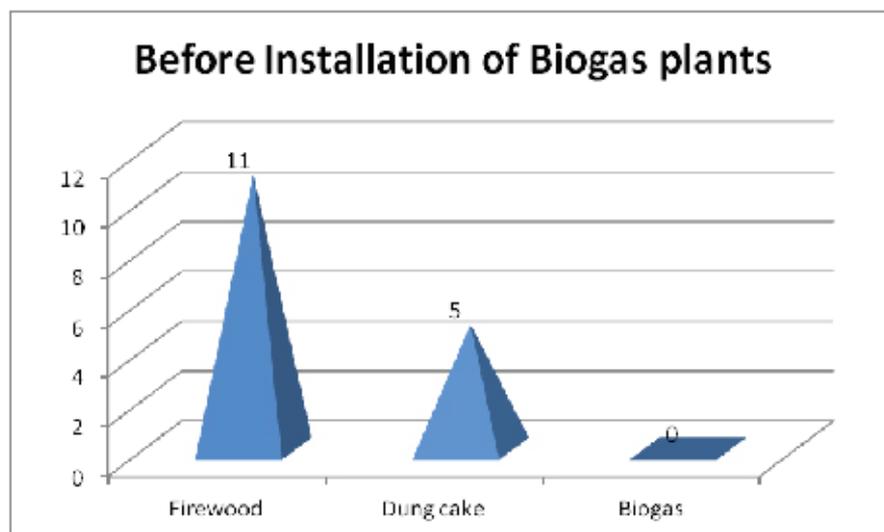
Biogas project has been registered with the CDM board as the first project of Nepal. There is 2.4 tons reduction of greenhouse gas emission annually per household as per CDM methodology (*BSP-Nepal, 2012*). 59,968 plants have been registered with CDM board till the end of FY 2012/13 (*BSP-Nepal, 2012*). Thus, biogas plays role for protecting environment through reduction in pollution and greenhouse gas emission that leads to environmental sustainability.

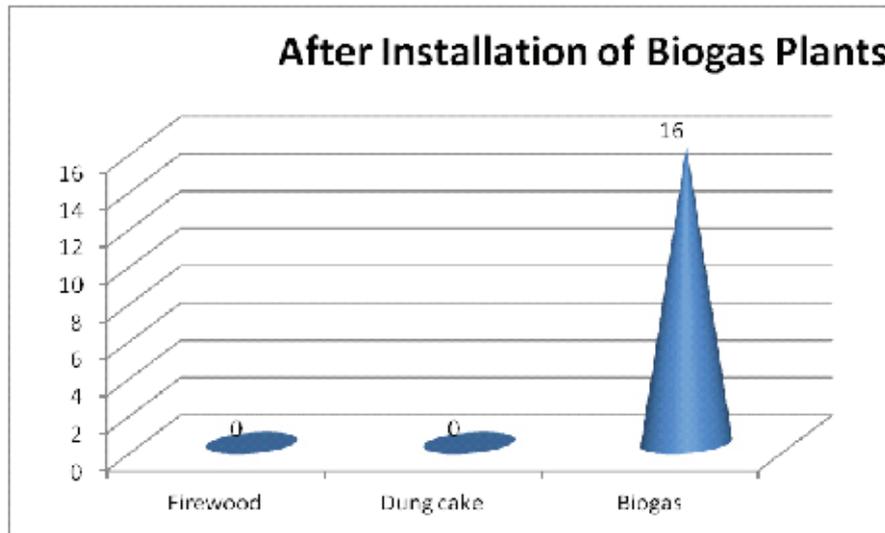
### Biogas in Relation to Forest Conservation

Biogas is an important medium in relation to forest conservation. The decrease in fuel wood consumption due to its substitution by biogas stoves has threshold benefits. *Firstly*, at individual level it incurs financial gains to the households as they can save some money which would otherwise be spent in purchasing the fuel wood or spending time for the same. Similarly, the substitution of fuel wood by biogas also saves time and effort required on fuel wood collection, which in some cases could even be many hours of daily work. *Secondly*, at national level the decrease in the use of fuel wood contributes to some extent in reducing the prevailing high rate of deforestation of the country.

The primary survey shows that all respondents use biogas for cooking and one respondent has also used for lighting. The respondents used either firewood or dung cake for cooking before installation of biogas plant as given in **Figure 2**. Eleven out of sixteen respondents used firewood for cooking while five respondents had used dung cake for cooking before installation of biogas.

**Figure 2:** Status of Cooking Fuel before and after Installation of Biogas Plants

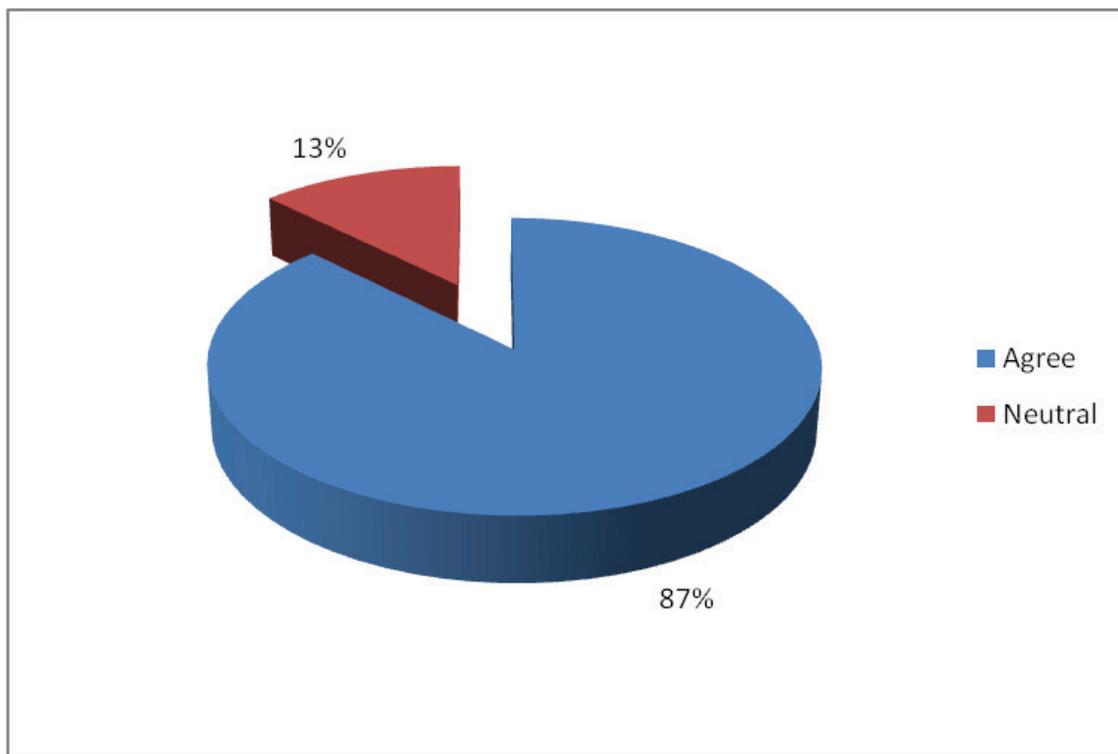




Source: Field survey 2013

In addition, all respondents think that the installation of biogas plant has saved the other fossil fuel. It contributes to reduce deforestation after installation of biogas. Furthermore, 14 out of 16 respondents agree that deforestation affects environment negatively while the rest two respondents are neutral in this regard as indicated in **Figure 3**.

**Figure 3:** Responses on Deforestation Affects Environment



Source: Field survey 2013

Biogas plays a dynamic role to reduce deforestation by reducing fuel wood. Hence, biogas contributes in protecting environment through forest conservation. Nationally, there are 1.25 trees protected per year per plant as per Biogas User Survey (*BSP-Nepal*, 2012). In total, 345,446 trees have been protected per year that enhance greenery and protect environment as well.

## CONCLUSION

The study suggests the vital role of biogas for environmental sustainability by determining its role for protecting environment. Based on the analysis, the results revealed three conclusions. At *first*, biogas plays an important role to reduce the both indoor and outdoor pollution through reducing smokes in kitchen and outdoor. Fifteen out of sixteen respondents believes that it reduce both pollution while only one respondent think that it does not reduce them. *Second*, biogas project has been registered with the CDM board as the *first* project of Nepal. There is 2.4 tons reduction of greenhouse gas emission annually per household as per CDM methodology. 59,968 plants have registered with CDM board till the end of FY 2012/13. *Finally*, biogas contributes for protecting environment in relation to forest conservation. The results may be varied in other area and/or sector of Nepal and beyond.

There are several avenues for future research in the area of the role of biogas for environmental sustainability. *First*, extension of the present study is to use a combination of qualitative and quantitative information extracted from primary and secondary sources of data. A *second* avenue of research is to conduct a case study by taking a benchmark before installation of biogas and changes after installation of biogas to get possibly more concrete results. A *third* research avenue is to make study by adding additional variables that are related to environmental sustainability to get greater insight into the results. A *fourth* research avenue is the comparative study of two areas on the role of biogas for environmental sustainability. A *final* avenue of research is to survey the opinions of stakeholders including biogas users on the role of biogas for environmental sustainability in Nepal.

## ACKNOWLEDGEMENTS

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# AGROFORESTRY PLANTATION ELEVATES POVERTY: A SOCIOLOGICAL STUDY ON CHEPANGS OF CENTRAL NEPAL

Raju Chetry\*

## ABSTRACT

*Chepangs are backward and an indigenous nationality of Nepal. They were using traditional way of agriculture farming called khoriya- kheti commonly known as shifting cultivation. After the intervention of some development agencies in Makwanpur, agroforestry plantation was started with an increasing trend. As a result of agro- forestry product sale, some improvement in terms of income among Chepangs has been reported by various organizations. This study is based on secondary data compiled through five Village Development Committees (VDCs) of Makwanpur district. The main objective of this study is to analyze the situation of agro- forestry plantation, level of Chepang participation and to discuss various reasons behind poverty alleviation among Chepangs. The study concludes that almost more than half of the Chepang community members are now involved in agroforestry plantation. Banana and broom grass plantation has found favors due to the market demands. Agroforestry plantation has visible impact over increase in income and mitigating the poverty.*

**Keywords:** Agroforestry, Chepangs, indigenous, khoriya- kheti, Plantation, Poverty.

## INTRODUCTION

Agroforestry is defined as a land-use system in which woody perennials (trees, shrubs, palms, bamboos) are deliberately used on the same land management unit as agricultural crops (woody or not), animals or both, either in some form of spatial arrangement or temporal sequence (Sanched, 1995). Agroforestry farming practices provide multiple benefits including high productivity and additional income while maintaining soil health (Kang, 1984). Chepangs, one of the most isolated tribal community among 59 indigenous nationalities of Nepal, have practiced shifting cultivation or *khoriya kheti* for centuries. The Chepangs people are regarded as the most marginalized and resource poor group in Nepal. (MDI, 2008). Forest is also an important source of cash income among Chepangs (Piya et al., 2011). Much changes has taken place in the traditional economic structure of the Chepangs as a result of a long period of interaction with non-tribal people. They are now selling their products in the markets, responsible factors for the modernization. Certain gradual changes are visible in the Chepangs' region with construction of roads, growth of marketing centers, establishment of educational institution and introduction of the Praja (Chepang) Development Programme (Gurung, 1990). Agroforestry offers many benefits for agricultural producers and society at large (Baets, 2007). Results of the farm income analysis showed that agroforestry system provided higher gross benefit than Khoriya farming (Khadka, 2010). Similarly, once they started benefiting from the agroforestry project activities, local people stopped entering the Chitwan National Park and the Parsa Wildlife reserve to illegally gather wild fruits, roots and non-timber forest products.

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Thus, the project intervention has indirectly contributed to biodiversity conservation in the protected areas (*Federico and Bhuju, 2009*). Agroforestry offers many benefits for agricultural producers and society at large. While not a silver bullet, agroforestry with its multiple environmental and economic benefits can help the agriculture and forestry sectors (*Baets, 2007*).

## CHEPANG AND AGROFORESTRY

In north-western Makwanpur, shifting cultivation is observed mostly in rugged terrain on steep slopes and stony red soils in the sloping uplands. The system functioned well while the population pressure on the land was low and the livelihood of the shifting cultivators were based on subsistence (*Federico and Bhuju, 2009*). Around 43 per cent Chepangs of north-western part of Makwanpur are engaged in agroforestry plantation (*Institute, 2008; CCDN, 2012*). Around 1015 households are engaged in agroforestry plantation (*NCA, 2013*).

We can observe from various published and unpublished records that agroforestry intervention within the Chepangs community brought some strengthening of economy especially on the part of income. Income from the latest agroforestry product also made an important contribution in overall income.

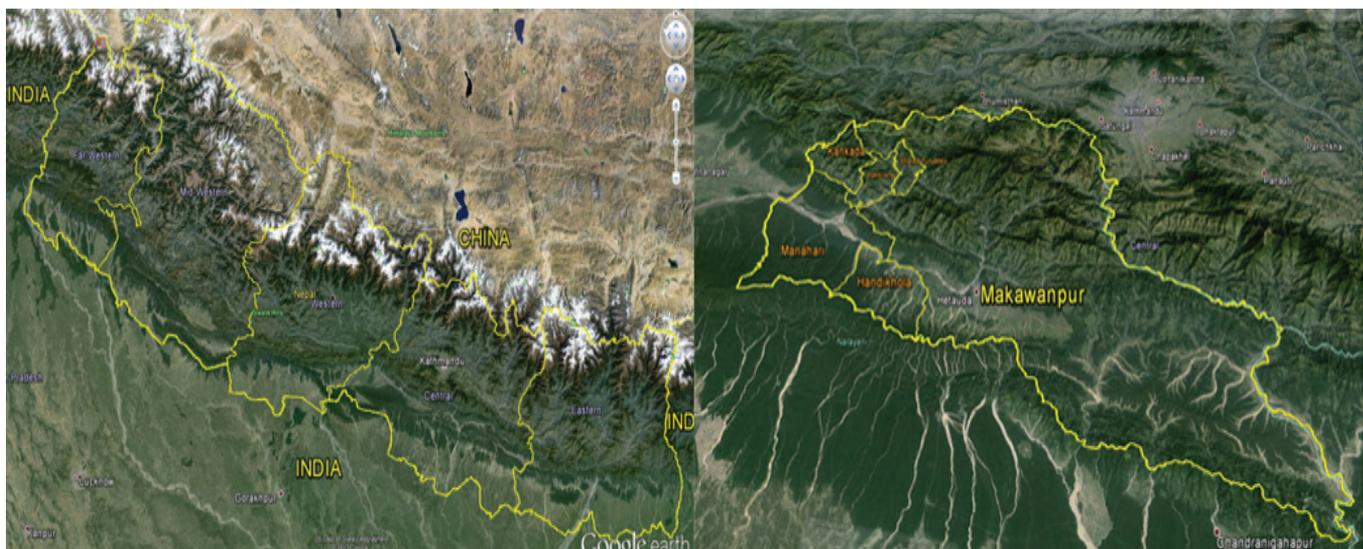
## OBJECTIVES OF THE STUDY

The present study intends to address the main objective i.e. to analyze the situation of agroforestry plantation with a situation of Chepangs participation and to show the reason behind poverty alleviation in five village development committee (VDC) of north-western part of Makwanpur district after implementing agroforestry.

## AREA OF STUDY

Makwanpur district comes in Central Development Region of Nepal. It covers an area of 2426 Sq. km. Five Village Development Committees (Manahari, Handikhola, Raksirang, Kankada and Bharta Punyadevi) towards north-western part of Makwanpur were selected for this project where the Chepangs are in majority. These are the major VDCs where shifting cultivation is dominant among Chepang community. There are total of 10,040 household, and total population of the five VDCs is 56,980 (CBS, 2012).

**Image 1:** Satellite Image of Makwanpur District, Nepal



(Source: Google Earth, 2013 edited image)

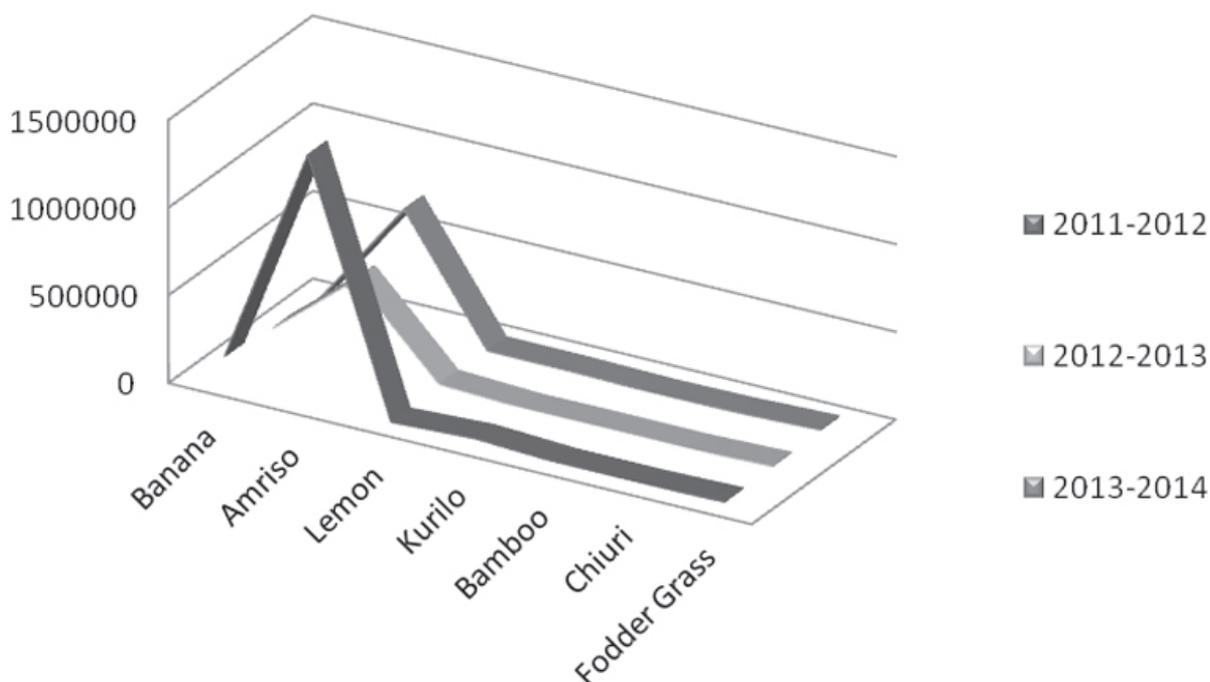
**DATA METHODOLOGY**

The study was undertaken to analyze the agroforestry plantation impact on five VDCs of North-western Makwanpur district of Nepal. The macro aspect of this study was based on published and unpublished work on the subject in journals, books, as well as report from different concerned organization working in the field. Secondary information was obtained from various organizations such as Manahari Development Institute (MDI), Center for Community Development of Nepal (CCDN), District Forest Office (DFO), District Agricultural Development Organization (DADO) and District Education Office (DEO). Furthermore, data from Small Area Estimation by National Planning commission (NPC) and World Food Programme(WFP) were used for poverty estimation. In addition, consultation with local media (*Hetauda Sandesh*) and local businessmen of Manahari market were consulted. The record of last three years from this organization was selected for the year 2011-2012, 2012-2013 and 2013-2014. A market price of agroforestry product was obtained from local businessmen of Manahari market in order to tally the farm gate comparative price of agroforestry product. Similarly, adequate and authentic data of production were obtained from statistical report and in-depth discussion with DADO and DFO.

**FINDINGS**

After the consultation and compilation of adequate data we found that data obtained by the Manahari Development Institute (MDI) was well supported in case of plantation of banana, amriso (*Broom grass*), pineapple, lemon, kurilo(*Asparagus racemosus*), bamboo (*Thysanolaena maxima*) and fodder grass within five VDCs. Data obtained from District Forest Office (DFO) was supported in case of tejpat(Bay leaves),amriso and lemon within two VDCs (Kankada and Raksirang only). On the other hand, CCDN which had supported two VDCs with *chuiiri* plantation only, did not have adequate data.

**Figure 1:** Comparison of Agroforestry Spices (number) of last three years.



**Table 1:** Plantation situation of five VDCs supported by MDI

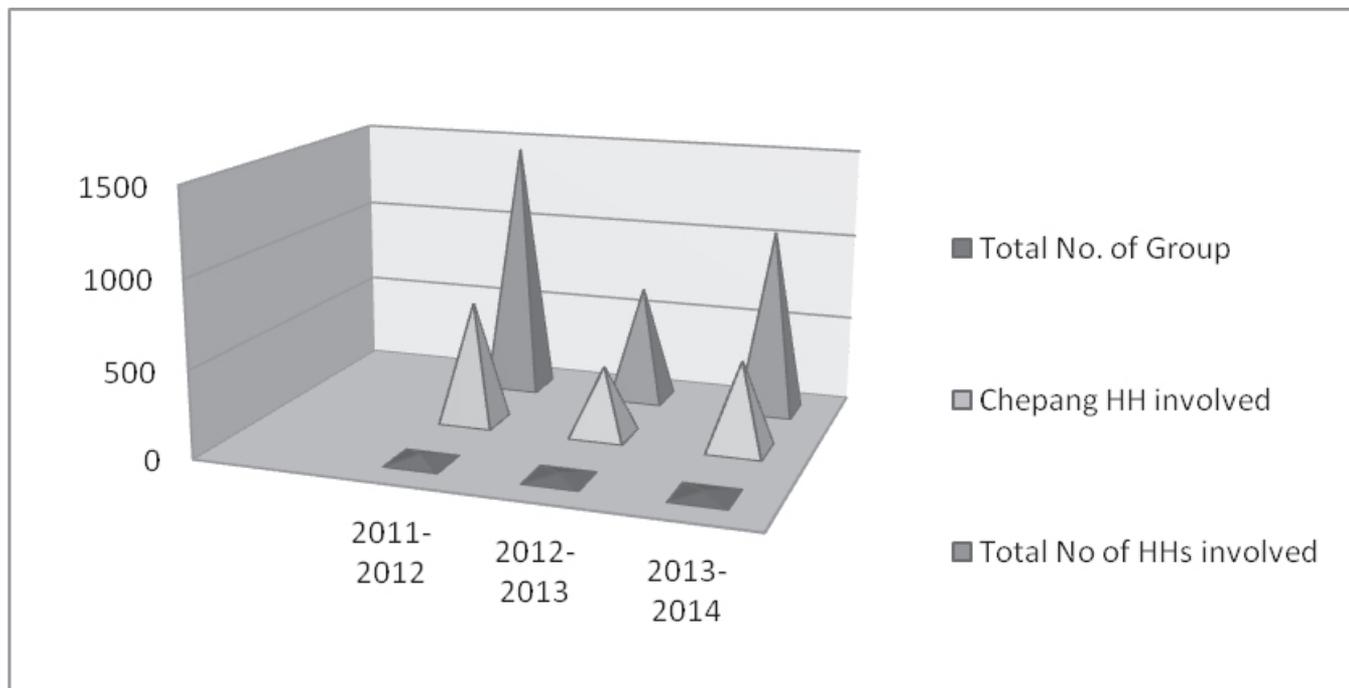
Year	Total No. of Group	Chepang HH involved	Total No of HHs involved	Plant Species(Number)						
				Banana	Amriso	Lemon	Kurilo	Bamboo	Chiuri	Fodder Grass
2011-2012	46	697	1466	149626	1413868	4364	26291	2040	0	8918
2012-2013	29	397	669	110062	502771	21585	0	2000	0	12900
2013-2014	29	508	1068	90103	705186	12805	11130	1633	6200	21391
<b>Plantation Sitatutaion of Agroforestry (2011-2012)</b>										
Name of VDC	Total No. of Group	Chepang HH involved	Total No of HHs involved	Plant Species(Number)						
				Banana	Amriso	Lemon	Kurilo	Bamboo	Chiuri	Fodder Grass
Raksirang	9	218	401	36068	285692	1394				
Kankanda	18	141	359	65369	523955		9231			
Eharta	9	211	367	30873	600306	1775	13640			
Handikhola	6	91	156	12151	2445	1195		2040		
Manahari	4	36	183	5165	1470		3420			8918
<b>Total</b>	<b>46</b>	<b>697</b>	<b>1466</b>	<b>149626</b>	<b>1413868</b>	<b>4364</b>	<b>26291</b>	<b>2040</b>	<b>0</b>	<b>8918</b>
<b>Plantation Sitatutaion of Agroforestry (2012-2013)</b>										
Name of VDC	Total No. of Group	Chepang HH involved	Total No of HHs involved	Plant Species(Number)						
				Banana	Amriso	Lemon	Kurilo	Bamboo	Chiuri	Fodder Grass
Raksirang	6	154	163	38228	81500	4500				4200
Kankanda	7	162	183	33990	92100	4200				
Eharta	8	58	173	15500	77850	8200				8700
Handikhola	5	14	96	11360	250200	4335		2000		
Manahari	3	9	54	10984	1121	350				
<b>Total</b>	<b>29</b>	<b>397</b>	<b>669</b>	<b>110062</b>	<b>502771</b>	<b>21585</b>	<b>0</b>	<b>2000</b>	<b>0</b>	<b>12900</b>
<b>Plantation Sitatutaion of Agroforestry (2013-2014)</b>										
Name of VDC	Total No. of Group	Chepang HH involved	Total No of HHs involved	Plant Species(Number)						
				Banana	Amriso	Lemon	Kurilo	Bamboo	Chiuri	Fodder Grass
Raksirang	3	148	191	28650	128330	1300				
Kankanda	7	118	293	17300	343400	800			6200	
Eharta	10	127	310	7200	196200	6885				10315
Handikhola	6	91	156	18053	37256	3820	0	1633		
Manahari	3	24	118	18900	0	0	11130	0		11076
<b>Total</b>	<b>29</b>	<b>508</b>	<b>1068</b>	<b>90103</b>	<b>705186</b>	<b>12805</b>	<b>11130</b>	<b>1633</b>	<b>6200</b>	<b>21391</b>

(Source: MDI)

According to data, a total of 3203 HH were supported within 104 Users Committee (UC) by MDI within a period of three years, where the participation of Chepangs is 1602 HH (50 per cent). Similarly the participation of Chepangs HH was 48 per cent in 2011, 59 per cent in 2012 and 48 per cent in 2013 year, respectively.

**Figure 1**, obtained from **Table 1** reveals that, amriso plantation is higher than banana and pineapple. As per the trend, production in the year 2011-2012 was higher due to continued support to MDI by World Food Programme (WFP) under the PRRO(Protected Relief and Reconciliation Programme) which stipulated mandatory rice support to beneficiaries on behalf of plantation . Similarly in the year 2012-2013, overall trend of plantation deteriorated due to absence of support from any agency in this area, only little effort of MDI could be made possible. Finally, in the year 2013-2014, there is increasing trend due to demands and effectiveness reported by the MDI. Furthermore, District Forest Office(DFO) started providing support from 2012 to the current year 2014, according to which, a total of 188 HH were benefited from 30 different Users Committee in Raksirng VDC, among which Chepangs participation was as high as 80 per cent, Similarly, in case of Kankada VDC, a total of 633 HH were benefited from 94 UC in Kankada VDC between the same period, among which Chepangs participation reached 80 per cent, in both VDCs. DFO supported tejpat and broom grass, Lemon(only in Raksirnag). The DFO data was found inadequate due to less coverage(only 2 VDC and limited beneficiary compared to those supported by the MDI). Similarly, Center for Community Development Of Nepal (CCDN) supported plantation of Churi in both Kankada and Raksirang VDCs; 200 HH of Raksirang were benefited through 10 different UC where Chepangs participation was 50 per cent. Similarly 400 HHs were supported through 50 different Users Committee (UC) among which 35 per cent Chepangs participation was recorded. Churi was the only plant which was supported by CCDN from the fiscal year 2011-2012. The VDC coverage and data was not adequate by CCDN for comparing for the last few years.

**Figure 2:** Target HH vs. Chepangs Participation



Analyzing **Figure 2 Table 1**, reflects the level of participation of Chepangs. According to the available data, 48 per cent Chepangs participated in agroforestry plantation programme by MDI in the year 2011-2012. Thence, the figure rose to 59 per cent Chepangs participation in the year 2012-2013 and finally came down to 48 per cent in the year 2013-2014. Overall the trend shows that the flow of first year and current year is same whereas the plantation flow picked in year 2012-13. It was due to continuous support of some donors to MDI.

Some trend of school enrolment figure and participation of indigenous groups and Chepangs groups within the study area as per the data compiled by the District Education Office (DEO), is reproduced below:

**Table 2:** Comparative literacy situation of five VDCs and participation of Indigenous and Chepang\*

Sl. No	Name of VDC	Total enrolment		
		2011-2012	2012-2013	2013-2014
1	Manahari	5754	5386	5201
2	Raksirang	1919	1815	1700
3	Kankada	2409	2268	1709
4	Handikhola	4986	4821	4832
5	Bharta	1059	992	1066
	<b>Total</b>	<b>16127</b>	<b>15292</b>	<b>14508</b>
<b>Enrolment of Indigenous Students</b>				
Sl. No	Name f VDC	Total enrolment		
		2011-2012	2012-2013	2013-2014
1	Manahari	3661	3516	3375
2	Raksirang	1755	1641	1546
3	Kankada	2269	2161	1626
4	Handikhola	3338	3109	2633
5	Bharta	1018	949	1009
	Total	12041	11376	10189

(Source: DEO, 2014)

#### Enrolment of Chepang Students

Sl. No	Name f VDC	Total enrolment		
		2011-2012	2012-2013	2013-2014
1	Manahari	1472	1406	1350
2	Raksirang	1141	1067	1005
3	Kankada	1588	1513	1138
4	Handikhola	661	622	527
5	Bharta	510	475	505
	Total	5372	5083	4525

(Source:MDI, DEO)

(\*Details of students from Class I to up to Class X is included only)

The data reveals that the overall enrolments situation between 2011 to 2014 is gradually decreasing year after year due to low population growth caused by outward migration of youth for earning. As per data in **Table 2**, the Chepangs students constituted 33.31 per cent of total student enrolment in the year 2011-2012, 33.26 per cent in 2012-2013 years and 31.18 per cent in 2013-2014 which is quite significant. There was no drastic downsizing of enrolment. This shows that children of household are not involved in agroforestry activity.

**Table 3:** Market price comparison of agroforestry product of last three years.

Agroforestry Product	Average price of year 2011-2012	Average price of year 2012-2013	Average price of year 2013-2014
Banana(Per 100 Pc)/	90	100	110
Pineapple(Kg)	15	23	30
Amriso(Kg)	65	70	75
Amriso(Per bundle)	30	36	48

(Market Survey, 2014)

Data shows the market price (farm gate only) comparison of last three years, according to which, farm gate price of agroforestry product is increasing year after year due to increase in demand. The data in the **Table-1** and **3** reveals that amriso and banana are sought more for plantation within the study area whose market value is increasing year after year, which indicates that agroforestry product brings price level due to demands. Since the production data from market was inadequate due to open market system and overall sold production was not available but it was reported that the sale of agro forestry products were frequent in nearest Manahari market.

**Table 4:** Estimation of agroforestry area and its product of year 2013-2014.

Name of VDC	Total cultivable land (ha)	Area used for Agroforestry (ha)	Area of Banana cultivation (ha)	Area of Broom grass Cultivation (ha)
Raksirang	1545	274	110	151
Kankada	600	220	77	121
Manahari	1170	312	62	94
Bharta Punyadevi	654	207	41	104
Handikhola	1440	400	203	88
<b>Total</b>	<b>5409</b>	<b>1413</b>	<b>493</b>	<b>558</b>

(Source: DADO, 2014)

The data reflects that 26.12 per cent land was used for agroforestry plantation. Banana covers 35 per cent area and broom grass 39 per cent area. According to the District Agricultural Development Office report, the overall yield (productivity) of banana for this year(2013- 2014) is 9.4Mt/ha. That means, estimated production of banana would be 9634.2MT which is Nrs 63.58 million (1 kg banana=6.6Rs/kg). If we compare **Table1** and **Table 4**, we will find that each HH might earn approximately 59,532Nrs\* this year. Similarly according to DADO overall yield (productivity) of broom grass for this year, the yield is 6 MT/ha. One can extrapolate and estimate overall production of broom grass at 5022 Mt. After reducing wastage materials and proper processing, the actual production will fall by 40%. Two brooms are prepared with each kg of broom grass. If we compare **Table 1** and **Table 4** we will find that each HH will earn Nrs 88,580 this year in average, only from the sale of broom grass.

Forest is also an important source of cash income. Income thus generated is utilized to produce food from the market. Promotion of commercial forest product seems to be promising alternative to improve food security situation of Chepangs (*Piya et al.*, 2011).

Households, who used to depend on producing maize and millet for subsistence, carrying loads of manure to the uphill communities for a meager daily wage or poaching in the national park, have seen their lifestyles change after the project intervention. They now carry their own product of banana to the local markets and earn an average Nrs. 3,000 per month. Similarly, once they started benefiting from the project activities, local people stopped entering the Chitwan National Park and the Parsa Wildlife Reserve to illegally gather

wild fruits, roots and non-timber forest products (Federico and Bhujju, 2009). Much change has taken place in the traditional economic structure of the Chepangs as a result of a long period of interaction with non-tribal, they are now selling their products in the markets (Gurung, 1990).

We have found that there is a direct relationship between agroforestry product sale and decline in the poverty. Food security situation of Chepangs within the north-western corridor of the Makwanpur has improved in situation due to support by various development organizations between 2010 to 2011 (DFSN, 2011)

Hetauda Sandesh (a local media), CCDN, DFO and MDI stated that plantation and sale was observed from field visit and poverty has been minimized due to good income opportunity among Chepangs but on the other hand they stated that still many Chepangs households are still under the poverty and they are not connected with agroforestry plantation.

## CONCLUSION AND SUGGESTIONS

This study concludes that agroforestry plantation increases income opportunity; and more than half of Chepangs community has been involved by implementing organization, MDI. The trend of adopting agroforestry plantation is growing. Banana and amriso plantation is popular and higher in the ground. Agroforestry mainly elevates poverty due to high demands of its product in markets and good income opportunity from its sale. Since school going children are not used in agroforestry practices, the education sector can be strengthened in the area.

There are few recommendation and suggestions outlined as below:-

1) Agroforestry must be promoted among remaining households of study area. For this, MDI must increase plantation support and supply higher number of banana and broom grass to non-adopting households, whereas DFO must expand his area from two to more VDCs and provide tejpat and broom grasses for plantation in large amount. CCDN should expand activities and also promote plants spices such as asparagus, chhuri, banana etc.

2) MDI, CCDN and DFO must cover at least 80 per cent of the households jointly. This requires synergy and joint planning.

3) Organization who are active in promoting agroforestry product, should establish direct linkage between sellers and buyers. It is highly desired to prepare a market collection center within the study area.

4) DEO and DFO can promote the agroforestry campaign at least in the VDC and school level in order to spread awareness about the plantation and its impact. Posters and card display could be the best mode to promote this.

5) District authority such as District Development Committee (DDC), NGOs (International/ Non-Government Organization) and donor organization should make a plan in order to provide support to non-adopting households. DDC can do some plantation support in this area through VDC (Village Development Committee) to increase the plantation.

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## SOFT POWER FOUNDATION OF INDIA-BHUTAN PERENNIAL FRIENDSHIP

Lungten Wangdi\*

### ABSTRACT

*Bhutan has always wished India to have a stable government. Bhutan reaps the benefit of the stable Indian government. Diplomatic relations between India and Bhutan were established in 1968 with the appointment of a resident representative of India in Thimphu. The foundation of India- Bhutan bilateral relations is the Treaty of Friendship and Cooperation signed in 1949 between the two countries, which was updated and signed during the visit to India of His Majesty Jigme Khesar Namgyel Wangchuck in February 2007. Bhutan remains India's closest neighbor, friend and ally. The relationship has been cemented further with recent visit of Indian Prime Minister and the President.*

**Keywords:** Bodh Gaya, democracy, education, hydro-power, militant camps, Operation Flush Out, Project DAN-TAK, soft power.

### INTRODUCTION

Newly appointed Prime Minister of India, Narendra Modi made his first foreign trip to Bhutan on 15-16<sup>th</sup> June, 2014. While addressing a joint session of the Bhutan Parliament, he mentioned, "relationship with Bhutan will be a key foreign policy priority of my government." The visit was made in haste and obviously to preempt any negative consequences of the China- Bhutan Boundary talk scheduled in Beijing in July. The visit also indicated the importance of the Himalayan nation in the strategic calculus of India. It was also meant as a signal to China that India no longer would tolerate strategic maneuver of China in the name of economic diplomacy in its own backyard. In 2012, relationship between India and Bhutan appeared to deteriorate when meeting between then Chinese Premier Wen Jiabao and Bhutanese PM Jigmi Y. Thinley was held on the sidelines of the UN Conference on Sustainable Development at Rio De Janeiro, Brazil.

But the current visit has restored the old ties once again. During the two-day visit, Indian Prime Minister laid a foundation stone of the 600 MW Kholongchu Hydroelectric project, a joint venture between India and Bhutan. The two countries have expressed affirmation to expand the existing hydropower cooperation. The Framework Agreement on four Hydro Electric Projects totaling 2120 MW has already been signed in 2014.

The good neighbourly relationship was cemented way back when India's first Prime Minister, Pandit Nehru visited Bhutan in 1958. The long relationship of these two countries is based more on the "soft power" (Tharoor, 2007, pp. 23-30). Nowhere in the world, have two countries existed in perfect harmony as Bhutan and India have done that many critics envy. In one of the interviews, the first Prime Minister of democratic Bhutan, J.Y. Thinley, who in 2000 was the Bhutan's foreign minister stated:

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*THINLEY*: We have survived for centuries. In fact, ever since recorded history, Bhutan has always been a sovereign independent country. With China, we have no difficulties of any kind. With India, we have excellent relations.

*SAFER*: All one of them has to do is cough, and Bhutan can catch pneumonia, correct?

*THINLEY*: Yes, that is true. But we are hopeful and we are confident that if they do cough, they will not be facing Bhutan.

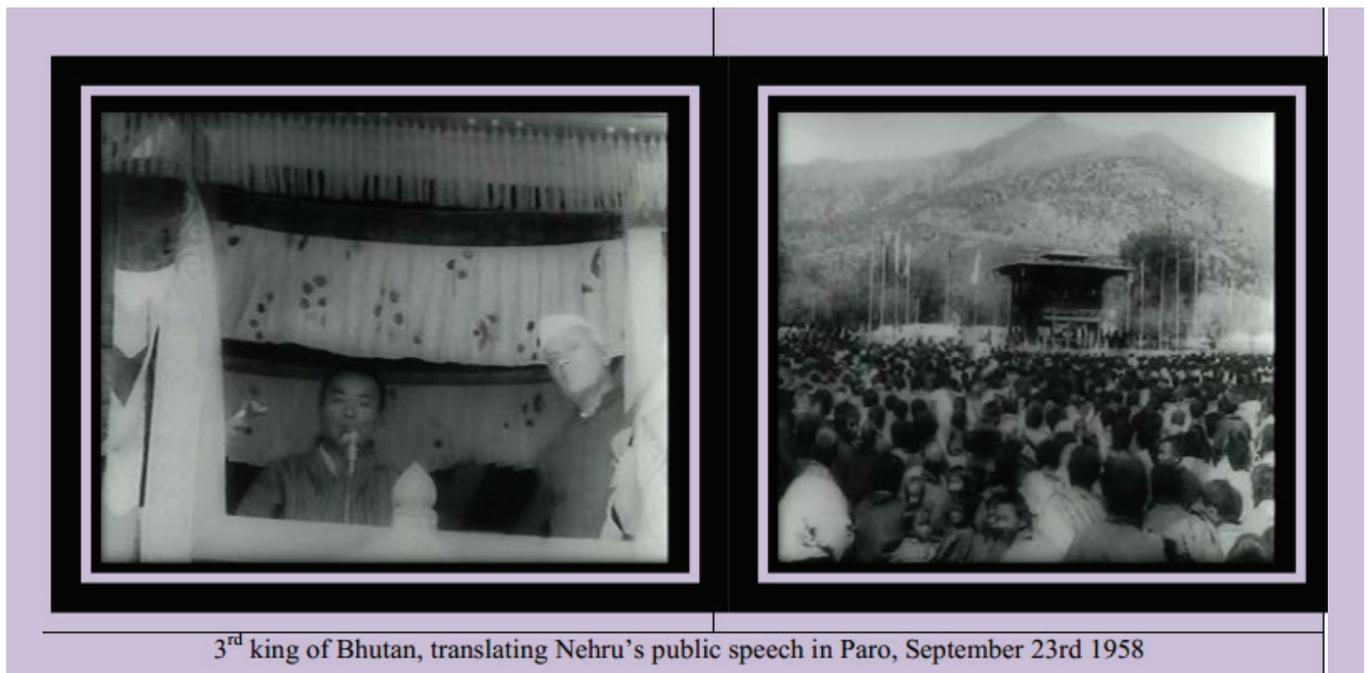
(*SAFER*, 2000)

For 100 years, this peaceable Buddhist kingdom of 650,000 people has steadfastly held the outside world at bay, and even repelled perhaps the most commanding intruder like Britishers of all, fearful that it might destroy their unique identity (*Aris*, 194, p. 64 ).

Bhutan is a tiny kingdom with limited economic scope and military might. In spite of its limitations, Bhutan is a peaceful country free from the threats from militancy, terrorism, and economic disparity within itself and tension has virtually been absent. In this sense, Bhutan has always been assured its independence and security by the Indian counterpart. The Indian Prime Minister Nehru addressed a public speech at Paro on September 23rd 1958:

*“Some may think that since India is great and powerful country and Bhutan a small one, the former might wish to exercise a pressure on Bhutan. It is, therefore, essential that I make it clear to you that our only wish is that you should remain an independent country, choosing your own way of life and taking the path of progress according to your will. At the same time, we two should live as friendly neighbors helping each other. Freedom of both Bhutan and India should be safeguarded so that none from outside can do harm to it.”* (cited in *Pradhan*, 2012, pp. 76)

#### Illustration 1 : Nehru’s 1958 Paro visit



Bhutan does not have military might or economic strength, but does have rich cultural heritage and a unique national identity to enhance our status as sovereign, independent country (*Pek*, 2007). And this is what is described as the power of “*soft power*” (*Tharoor*, 2007). Soft power is the bedrock of foundation of Bhutan-India relationship.

### **‘SOFT POWER’ FOUNDATION**

*Tharoor* (2007) describes *soft power* as an ability to change the behavior of other to get what you want. India gained independence in 1947 fighting against colonization with Mahatma Gandhi’s use of soft power of love, compassion and non-violence. India has tried to wield influence in its vicinity by following the same principle of soft power enunciated by Mahatma Gandhi. Bhutan and India’s eternal relationship survives on the foundation of the soft power and not the often employed diplomatic tool of ‘carrot and stick’. The great leaders of both India and Bhutan have realized that soft power is divine and eternal. India’s soft power is manifest in Gandhian philosophy and Bhutan’s soft power stems from its self-isolationist policy, preservation and promotion of a strong sense of identity and social cohesion and unity. Indian leader like Nehru was a leader groomed by Gandhiji and they were against the attributes of hard power at that time, especially with Bhutan. Though, the soft power is not a panacea for every emergent situation, but hard power worsens it, as seen from the American experience during the Vietnamese war, Soviet Union experience in Afghanistan and France’s defeat to Prussia. Soft power has the moral authority and it is through India’s soft power of carrying the responsibility of neighbouring peaceful Bhutan, that Bhutan joined United Nation Organization in 1971 (*Pradhan*, 2012).

### **BHUTAN-INDIA WIN-WIN THROUGH LIGHTING HOMES**

While India may look to some neighbors with political economic skepticisms but with Bhutan it has different economy, totally anti-Malthusian economy (*Kiyosaki*, 2011). Indian leaders are in favor of economy of abundance and the mega hydro- power projects are the result of this economy and both India and Bhutan are in the win –win situation (*Dorji, T & Pelgan, U*, 2014).

“Lighting homes”, is project of harnessing hydro power and turning the turbines of growth. The first mega-project was initiated with the financial assistance of Nu: 430M on March 23rd 1974. Today the five states of India viz. Sikkim, Bihar, Orissa, Assam and West Bengal are getting electricity to lit their homes from the project. Since then, various mega projects assisted by India are in operation.

**Table 1** : Mega Hydro-Projects in Bhutan being assisted by India

<b>Mega Project</b>	<b>Megawatt</b>	<b>Year</b>
Chukha Hydro-project	333	1988
Kurri chhu Hydro-project	60	1994
Tala Hydro-project	1020	1998
Puna Tsahnchu	1095	2008
Mangdi chu	720	2010
Kholong chu	600	2014

### **BHUTAN-INDIA POLITICS-WEAVING PATH TO HARMONY**

Bhutanese have historically been sensitive to issues of security with frequent disturbance occurring from internal warring factions prior to unification and establishment of the monarchy in 1907 (*Sinha*, 2004). John Claude White (1888-1909) and the first king of Bhutan, Sir Ugyen Wangchuk established the order and led to establishment of the Wangchuk dynasty in Bhutan (*Sinha*, 2004). Later, two signed the Sinchula treaty in 1865 which led to the recognition of present Indo-Bhutanese boundaries. External threat was present from AD1594-1651 during the time of Shabdrung Ngawang Namgyal with several failed attempts at invasion from the Tibetans (*Hasrat*, 1980). In the 19th century, Bhutan saw the loss of the Assam and Bengal Duars to British India. And after 1947, there was no drift toward hostilities, the Duar (door) was the end of it and the democratic independent India played a different political role which led to the strengthening and preserving

of Bhutan's sovereignty. Bhutan's polity of independence and territorial integrity has always been a matter of great importance for Bhutanese leaders (*Ura*, 1999).

### **BUDDHISM-UMBILICAL CORD**

Historic relations between Bhutan and India date back to 747 A.D. (*Sinha*, 2004). The great Indian saint Padmasambhava introduced Buddhism in Bhutan. Since then, Buddhism permeated all aspects of Bhutanese life and created a shared cultural and religious heritage. Buddhism which has been fast disappearing from the birth place, India, has been well established in Bhutan. In recent years, there is a resurgence to revive Buddhism and to bring all Buddhist nations together.

In India, Dr. Ambedkar started a neo-Buddhist movement among the untouchables during the 1950s. In India it is mostly the "untouchables" who are embracing Buddhism. It is only in Bhutan that Buddhism has the royal patronage and is the state religion of the country (*RGoB, Constitution of Bhutan*, 2005, p.7). However Bhutan's constitution also mention about secular credo : "A Bhutanese citizen shall foster tolerance, mutual respect and spirit of brotherhood amongst all the people of Bhutan transcending religious , linguistics, religion or sectional diversities" (*RGoB, Constitution of Bhutan* , Fundamental duties, Article 8, 2005,p.12). India has chosen to treat Bhutan as repository of Buddhist virtues. In BodhGaya, the historic place of Buddhist pilgrimage in India, there stands a Bhutanese monastery, constructed in 1983, symbolizing an embodiment of religious commonalities between Bhutan and India (*Dorji,T & Pelgan,U*, 2014).

### **EDUCATION**

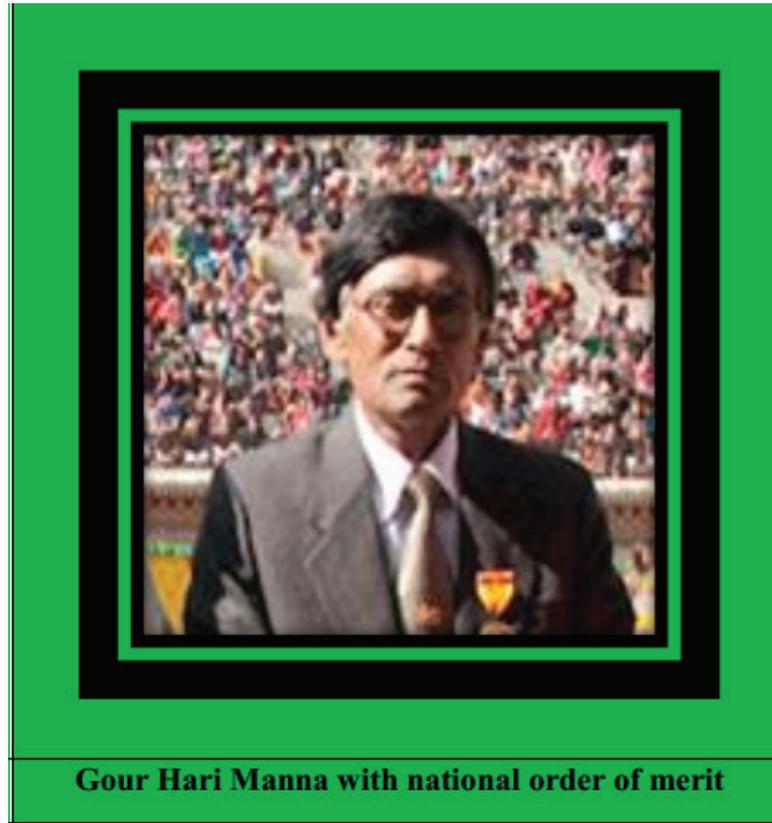
Earlier to 1950s, education in Bhutan was mainly monastic and Tibet was the centre for Bhutanese students. Under the second king, Bhutan opened its first secular schools with Hindi as medium of instruction in 1950. But it was in the 1960s, under the third king, His Majesty Jigme Dorji Wangchuck, that Bhutan began to build its education system in earnest. Realizing the need to communicate with the rest of the world, the third king made English the language of instruction. This laid the foundations for western education in Bhutan (*Rustomji*, 2004).

In the beginning, Bhutan recruited teachers, mainly from neighboring India. In the early days, Bhutanese and non-Bhutanese teachers alike had to endure daily hardships and make arduous journeys over treacherous mountain passes and through leech-infested jungles to bring education to the most inaccessible parts of the country. A teacher writes in his memoirs about the first day in Trongsa in 1962:

"With acute pain of swollen knees (arthritis), I have been lying in the bed, thinking about my past: why did I come to Bhutan leaving a fairly a good job at home (India, Kerala). To reach Trongsa, it took 10 days from Gelephu". (*Kurup*, 2002, pp. 22-23)

It was the Bhutanese first official education director, who went to India and got 20 teachers from Kerala and dropped them in the remote villages of Bhutan to be picked them after 10 months. There was no motor road accessible and they were posted as far as Lhuntse in eastern Bhutan (*Mackey*, 2002). With the school system still in its early stages, a number of Bhutanese students were sent to study at the highly acclaimed missionary schools in Darjeeling, India. Impressed by the quality of education in these schools, the Bhutan Government asked a Canadian Jesuit, Fr. William Mackey SJ, to set up a high school system in Bhutan. The Jesuits and nuns who came to Bhutan in the 1960s and 70s worked to establish a fully Bhutanese school system that would strengthen the country's indigenous cultural and religious traditions while helping its people to modernize (*Solverson*, 1995).

There were many Indian teachers who were dedicated and devoted who sacrificed their life for the Bhutanese education. There are teachers who have been teaching in Bhutan for life time and have shouldered the responsibility and even had borne the tragic ends. An Indian teacher, Gour Hari Manna received the National Order of Merit from the 5th King, Jigme Khesar Namgyel Wangchuk, on the 17th of December, 2007 (*Namgyel*, 2011, pp. 26-27). And there are unsung heroes who are forgotten but have done outstanding work for education in Bhutan.

**Illustration 2:** Legendary Indian teacher in Bhutan, Gour Hari Manna**BUILDING LIFE LINES**

Since 1962, it is Project DANTAK that kept the life line of Bhutan (*Dorji, T & Pelgan, U, 2014*). The DANTAK which is being implemented by the Border Roads Organization is aimed at the construction and maintenance of roads, bridges and airports. While all these serve India's strategic defense needs, it is also a life line for survival and economic benefit for the people of Bhutan. By the mid-1970s, roads had been built, largely by manual labor. Earlier, Bhutan lacked paved roads, and travel in Bhutan was by foot or on mule back or horseback. The 205-kilometre trek from the Indian border to Thimphu took six days to travel. Modern road construction began in earnest during the First Development Plan (1961–66). The jeep track road, now double lane, links Thimphu and Phuntsholing, the gateway from India to Bhutan. In the beginning, some 30,000 Indian labourers were imported to build the road with Indian aid at a time when India was bolstering its strategic defense against a possible Chinese invasion. An army Lieutenant General in 1962 describes Bhutan through his lens recalling a poem:

“I never see a map but I’ am away  
 On all the journeys that I long to do,  
 Over the mountains which are marked in grey,  
 Up all the rivers which are shown in blue,  
 And into those white spaces where they say”-

~ Anonymous

(*Vas, Journey through Bhutan, 1986, pp. 5*)

The Dantak group remains the unsung and the unheroic leaders for the people of Bhutan. To many Bhutanese, they were the saviour for building the life lines.

## A PROLOGUE TO UNITED NATION

In 1970, the then Indian President V.V. Giri led Bhutan to be an Observer of UNO General Assembly. Thence, India worked for the full membership of Bhutan in the UNO. Previously, the presence of Bhutan was non-existent in international diplomatic arena. Diplomatic circuit viewed it as one of the recently independent nation. There are so many instances when the Bhutanese delegations led by Prince Namgyal Wangchuk were surprised by the western diplomats. The ignorant diplomats thought Bhutan was an African nation and the comment like: "I did not know African looked like you" (*Pradhan*, 2012). Bhutanese were white African in UNO for some time. There were diplomat who thought Bhutan, a country from where the butane gas come from. Bhutan's application for membership in the UNO was finally accepted and Bhutan became a proud member of the organization. It was finally admitted to the United Nations in 1971. Subsequently, the UN opened a United Nations Development Program office in Thimphu in 1979. Bhutan is now a member of more than 150 international organizations.

## STANDING TOGETHER ALWAYS

In 1971, Bhutan stood strongly for India when there were hostilities in Indian sub-continent and it stood by its side in recognizing Bangladesh as an Independent sovereign state (*Agarwal*, 2004). Bhutan supported India's declaration of "zone of peace" in the Indian Ocean in the UNO. When there was severe world-wide condemnation after the demolition of a structure in Ayodhya and the violent demonstration that ensued afterwards, Bhutan stood with the government of India. Many a times, the soft power approach has limitation. The hard power is required to douse the crisis. The militants of violent outfits like the ULFA, NDFB and KLO had established easy hide-out in Bhutan. Indian government exerted a diplomatic pressure on Bhutan to remove the Indian militant presence in Bhutan through joint military operations. Bhutan, preferring a peaceful solution, declined the offer and instead initiated dialogue with the militant groups. In 2003, when negotiations failed, a combined Royal Bhutan Army and Royal Body Guards, a force of 6000, captured all the militant camps. This was the first military offensive undertaken by Bhutan in its modern history, and the operation was termed "*Operation Flush Out*". Bhutanese government thereby helped accomplish the objectives of Indian military by flushing the Indian North East militant from its forests.

## MEETING OF A YOUNG AND THE LARGEST DEMOCRACY

Bhutan signed a new Treaty of Friendship in 2007 (*Pradhan*, 2012, p. 260). There has been series of treaties that Bhutan has signed with its southern neighbours in last two centuries. Some of the landmark treaties include, interalia, the Treaty of 1774, the Anglo- Bhutanese Peace Treaty; Treaty of Sinchula, 1865 (*Moktan*, 2004, p. 22); Treaty with British, 1910 (*Moktan*, 2004, p. 38); Treaty of Perpetual Peace and Friendship Between Government of India and Government of Bhutan, 1949 (*Moktan*, 2004, p. 40).

The 2007 Treaty has a provision for Bhutan to enjoy broader sovereignty and no longer requires India's permission over arms imports. In 2008, the then Indian Prime Minister Manmohan Singh visited Bhutan and expressed strong support for Bhutan's move towards democracy.

Not surprisingly, the relations have grown exponentially over the years since the two countries signed the Treaty of Friendship and Cooperation in 1949. India seized the initiative to modernize and transform the relations by revising the original Treaty of Friendship in 2007 and this has paved the path for the future development of India-Bhutan ties in the 21st century. Adjusting to the new realities has kept the relationship dynamic and without friction. When Bhutan decided to embrace democracy, India was quick to share its expertise and experience in bolstering democratic practices and institution-building in that country. Indian electoral voting machine which was the invention of India (*Baru*, 2014) was used in Bhutan and India's Chief Election Officer visited Bhutan to observe elections in that country in the month of July, 2013. Officials of the Bhutanese Parliament have been attending training programmes conducted by the Bureau of Parliamentary Studies and Training (BPST) associated with the Indian Parliament.

## FRIENDSHIP WITHOUT BORDERS

In the contemporary world of changing political systems, it is not often that one comes across a personality like His Majesty Jigme Singye Wangchuck, the King of Bhutan whose sensitive mind and modern outlook sustains the unity of the State and obtains the loyalty of his people. Bhutan is India's closest neighbor, friend and ally. Its foreign policy is anchored on non-alignment. It has been playing an important role in SAARC since the creation of the regional body. Bhutan has long borders with Asia's two largest countries, India and China. Both borders have remained peaceful and tranquil. Indo-Bhutanese friendship has been a model that many neighboring countries seek to emulate. Bhutan is the only neighboring nation with which India never had any problems and this has been mainly because the successive government in New Delhi has given top priorities to the harmonious relationship with Bhutan.

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# FINANCIAL COMPARISON OF EXPORT CREDIT AGENCIES (ECAS) / EXPORT IMPORT BANKS OF INDIA, CHINA, USA, RUSSIA, SOUTH AFRICA AND AUSTRALIA

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## ABSTRACT

*In this paper, various financial parameters and financial ratios of the Export Credit Agency (ECAs) of India, China, USA, Russia, Australia and South Africa have been compared. ECAs of China and India have the highest capital (Issued and Paid up) as compared to ECAs of other countries. As regards to profitability and push for exports is concerned, Export Import Bank of China is at top followed by that of India. ECA of USA and Russia are making losses. Employees at Export Import Bank of India are the most productive followed by employees of ECA of China, Australia and South Africa.*

**Keywords:** Comparison of ECAs, Disbursements by ECAs, Export Credit Agency (ECA), Export Finance, Export-Import Bank, Export-Import Bank of India, Profitability of ECAs.

## INTRODUCTION

Importers have plethora of choices to buy from, as far as exporters as well as countries are concerned. It becomes imperative for the exporter to offer an innovative, different package to the importer so that s/he feels compelled to buy from that exporter. This is where financing makes a difference between a sale made or lost. Sometimes, it is not the exporter who offers but the importer who insists on having a deferred payment term. It is also possible that importer is very much interested to buy the goods from that particular exporter but does not have the necessary funds and the amount being huge, the exporter might not be in a position to provide the seller's credit. There is another possibility that seller can provide the credit but the duration of credit is quite long and it would adversely affect the business of the exporter due to constrained working capital. If export financing is not available, the exporter has to make a decision to accept the export order or not. He would not like to let go the export order but if s/he accepts the order, s/he has to provide seller's credit which is going to adversely affect her / his business.

In another scenario, the exporter finds huge, untapped market in a country and can also procure the order but is hesitant to go ahead due to commercial or the political risks involved. If her / his payment can be guaranteed by an organisation, s/he would like to go-ahead and expand her / his business

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This is where the Export Credit Agencies (ECAs) come into picture. They are very vital for the exports. They provide Trade Finance which includes Export Financing, Export Credit Insurance and various kinds of Guarantees so as to give a push to the exports. Asiedu-Appiah (2005) is of the opinion that trade finance covers the financial products and services which are creative and have been designed keeping in mind the needs of exporters and importers of a country.

## LITERATURE REVIEW

*Rhee* (1989) argues that exporters especially the smaller ones must have access to trade finance so as to accept the export orders. Without availability of trade finance, the small exporters are at a disadvantage as compared to big and established exporters. *Rhee* (1994) is of the opinion that trade finance should be given priority in the countries who are undertaking market-oriented reforms. There is quite less risk involved in trade finance as compared to other financing as this is normally for short term and based on transactions.

*Rajan and Zingales* (1998) say that industries which need more external finance develop disproportionately faster. World Bank says that this applies to the firms also. *Finger and Schulknecht* (1999) argue that financial institutions provide important services for international trade, and if these services are not there, the transaction costs of trade would go up substantially. They consider finance as a “lubricant” for international trade.

Using industry-level data on firms’ dependence on external finance for 36 industries and 56 countries, *Beck* (2003) has concluded that in countries where financial sector is highly developed, their export share and trade balances are high in industries which use more external finance.

*Samba and Yan* (2009) have concluded the opposite. They found how international trade in merchandise increases financial development of that country. *Shaheen, Awan, Waqas and Aslam* (2011) have proved that good financial development leads to international trade. *Susanto, Rosson and Costa* (2011) have shown that financial development impacts positively on bilateral trade flows for the manufacturing sector especially in developing countries. *Ronci* (2004) has demonstrated that in the short- term trade finance has a positive impact on export as well import.

*Assiedu-Appiah* (2005) is of the view that exporter has more chance of winning an order if s/he can offer different payment terms as per the needs of the buyer. He further adds that financing cost impacts the price strongly. *Klapper* (2006) talks about the problem faced by exporting firms as foreign buyers have disinclination to open letter of credit. Some buyers would like to pay after they have thoroughly checked the quality. It means that the buyers are looking to have credit and then there could be risk of non-payment.

*Auboin* (2007) says that more than 90% of trade transactions involve some form of credit, insurance or guarantee. He further says that trade finance is the lifeline of trade. *Shamsuddoha, Ali and Ndubisi* (2009) argue that finance and guarantee-related export assistance has an impact on export indirectly i.e. when exporters get the financial assistance they commit more financial and human resources for exports. *Aworemi* (2011) found that export profit would be negative if export finance is not used for exports.

*Damijan and Costevc* (2011) have concluded through their empirical research that external finance also helps the financially strong firms with strong internal accruals as they export more variants of their products and enabling them to venture into new markets at a quite fast pace. World Bank also says that external finance is very important for improving export competitiveness.

*Greenway et al.* (2005) found that the firms which are not strong financially have less inclination to export because export involves the entry costs which are not recoverable. Only financially strong companies can bear the entry costs. *Tybout* (2003) introduced the concept of sunk cost in entering the foreign markets. These are the costs which are incurred by the new exporting organisations in gathering information on foreign markets, developing marketing channels, adapting products and packaging to foreign tastes etc. He emphasized that the exporting firms need public funds to cover these costs at least in the initial phases. *Amiti and Weinstein* (2011) say that the exporting firms require external finance not only for the sunk costs but also for financing their working capital as compared to the firms supplying in domestic market only because export goods take longer time to reach the buyers. *Feenstra, Li and Yu* (2011) are also of the opinion that export firms require higher working capital.

As per *Auboin and Engemann* (2013), trade finance matters for international trade and export credit agencies have a very important role to play. *Stephens* (1998) is of the opinion that the traditional role of export credit agencies is to support trade and to facilitate trade.

According to OECD, export credits are government financial support, direct financing, guarantees, insurance or interest rate support provided to foreign buyers to assist in the financing of the purchase of goods from national exporters.

There are four kinds of risks involved in an international trade transaction – i) Economic or Commercial Risk, ii) Foreign Exchange Risk, iii) Transportation Risk; and iv) Political Risk. Exchange, Commercial Risks and Political Risks are the most difficult to manage.

The organization providing export credit is in a much better position to check the credit-worthiness of the borrower than the individual exporter and also at much lower cost (*Finger & Schulknecht*, 1999).

Export financing becomes all the more important when – i) the exports are of large value, high technology manufactured products (*Exim Bank of India*, 1995), ii) project exports where payment would be staggered over a large period of time, iii) the exports are being made to very poor countries, iv) the exports are being made to credit risk countries; and iv) there is lot of competition among the various countries to export leading to very competitive prices and hence financing of the exports has to be at very low interest rate. Here the ECAs come to the rescue of the exporters by giving them export credit.

*Peek* (2013) is of the opinion that international trade is riskier as compared to the domestic business. The guarantees given by financial institutions go a long way in ensuring that importer gets the delivery of the goods and the exporter gets the payment. Export Credit Agencies, most of those supported by their respective governments provide coverage of Political Risks.

Though *Gianturco* (2001) calls the Export Credit Agencies as the “Unsung giants” of international finance but the researchers in this paper do not agree with his view. ECAs might not receive the attention of average citizen but the companies who avail the services of ECAs are very much aware about the crucial role played by these organizations in lubricating the international trade. Even the media is very much aware of the role being played by these and keeps on highlighting the importance and developments related to ECAs from time to time.

## WHAT ARE ECAS?

IMF defines Export Credit Agency as an agency in a creditor country that provides insurance, guarantees, or loans for the export of goods and services. Export credit and investment insurance agencies, commonly known as ECAs, provide government-backed loans, guarantees and insurance to corporations seeking business opportunities in developing countries and emerging markets that are often considered too risky for conventional corporate financing (*Thenard*, 2002).

ECAs are the financial institutions that governments create to promote exports and facilitate investments in riskier overseas markets (*Crescencia Maurer & Ruchi Bhandari*, 2000). A recent research paper by the World Bank noted that Export Credit Agencies (ECAs) are institutions that can – under appropriate circumstances, rules, and discipline – help alleviate market failures in trade finance, but conditions for their effectiveness are demanding in terms of economic environment, institutional design, and governance (*Jean-Pierre Chauffour, Christian Saborowski and Ahmet I. Soylemezoglu*, 2010). Export Credit Agencies (ECAs) are seen as institutions that aim to support export industry in their home countries. They provide official credit or credit guarantees to public or private buyers, often in developing countries (*Oygunn Sundsbo Brynildsen, Diana Hulova and Nuria Molina*, 2011).

## Objectives of the Study

1. To find out age of each ECA;
2. To find the ownership of each ECA;

3. To find out the size of the Export Credit Agency in terms of Capital Employed, Assets, Loans, Liabilities, Borrowings and their comparison;
4. To find the net profitability and net profitability per employee for each ECA and their comparison;
5. To find out the contribution of ECA to its country's exports and their comparison; and
6. To find out various ratios – ratio of capital to assets, profit to assets, profit to capital, borrowing to total assets, capital and reserves to assets, loans to assets and their comparison.

## RESEARCH METHODOLOGY

This paper is based on the secondary data collected from the annual reports and the websites of Export-Import Banks or its equivalent of six countries (India – Export-Import Bank of India, Russia – Exim Bank of Russia, China – Export-Import Bank of China, South Africa – Export Credit Insurance Corporation of South Africa SOC Ltd, USA – Export-Import Bank of the United States and Australia – Export Finance and Insurance Corporation). Statistical tools used are ratio and the percentage.

## RESULTS AND DISCUSSION

### 1. Age of the ECAs

**Table 1: Age of Export Credit Agencies**

Country	Export Credit Agency (ECA)	Established (Year)	Age (Years)
<i>USA</i>	Export-Import Bank of the United States	1934	80
<i>India</i>	Export-Import Bank of India	1982	32
<i>Australia</i>	Export Finance & Insurance Corporation (EFIC)	1991	23
<i>Russia</i>	Export-Import Bank of Russia	1993	21
<i>South Africa</i>	Export Credit Insurance Corporation (ECIC)	1993	21
<i>China</i>	Export-Import Bank of China	1994	20

### 2. Ownership

All the six ECAs are fully owned by their Governments.

### 3. Financial Comparison of Export Import Banks:

#### Financial Assistance by ECAs

There are distinctly two categories – one category led by China India and the USA and another comprising South Africa, Australia and Russia. ECAs in the first category really push the exports of their respective countries. ECAs in the second category do not make a formidable difference to the exports of their countries.

**Table 2** shows that China has the highest share of disbursements in national exports at 5.06% followed by India at 2.33% and USA at 2.32%. Based on this data, we can conclude that Export-Import Bank of China gives the best push for the exports despite having substantially large amount of exports. India and USA Export Import

Banks give less than 50% push as compared to China Export Import Bank. Rest other three ECAs have less than 1% share. Though Russia's exports are more than 80% as compared to India's exports but the push provided by Russian Export-Import Bank is negligible. In fact Export-Import Bank of India provides 77 times more push for its exports than Russian Bank.

**Table 2: ECAs, Their Share of Disbursements in National Exports**

Country	Disbursements (in USD Billion)	National Exports (in USD Billion)	Disbursements / Exports (%)
China	103.720	2049.000	5.06
India	6.760	290.000	2.33
USA	35.800	1546.000	2.32
South Africa	0.645	87.000	0.74
Australia	0.510	256.000	0.20
Russia	0.157	525.000	0.03

Export-Import Bank of China has assets worth USD 250 Billions which is approximately 18 times more than ECA of USA and approximately 19 times more than ECA of India (**Table 3**).

**Table 3: ECAs: Total Assets**

Country	Total Assets (USD Billion)
China	250.221
USA	13.669
India	12.665
Australia	3.115
South Africa	0.537
Russia	0.309

**Table 4: ECAs: Total Loans**

Country	Loans (USD Billion)
China	189.886
USA	10.865
India	10.707
Australia	2.075
Russia	0.214
South Africa	0.060

It can be seen in **Table 5** that loans as % of total assets are highest (84%) for Export-Import Bank of India followed by that of USA (79%) and China (76%). This means that these ECAs do not have much cash or other deposits or investments but believe in giving loans to the exporters so as to the have more and more exports from that country.

**Table 5: ECA-: Ratio of Loans to Total Assets**

Country	Loans/ Total Assets (%)
India	84.54
USA	79.49
China	75.89
Russia	69.26
Australia	66.61
South Africa	11.17

#### 4. Resources and Profitability:

##### Assets and Capital Size:

The assets of the ECAs are also broadly on the same lines as per their push for exports as measured by ratio of disbursements to national exports. China has the highest amount of assets (**Table 3**) and also the highest disbursement % (**Table 2**). Similarly India and USA are close to each other in terms of assets as well as disbursements.

ECAs of China and India have the highest capital (Issued and Paid up) as compared to other countries (**Table 6**). Rest of the four countries come nowhere close to the capital infused by China and India in their ECAs. This means that these two ECAs are provided greater support by their Governments as compared to the other ECAs. Export-Import Bank of the United States is an exception. Its capital is negative but it provides lot of support through lending by the Government.

**Table 6: ECAs- Issued and Paid-up Capital**

Country	Issued & Paid up Capital (USD Billion)
China	0.807
India	0.509
Russia	0.061
South Africa	0.034
Australia	0.005
USA	-0.763

**Table7: ECAs- Share of Borrowings in Total Liabilities (%)**

Country	Borrowings/ Total Liabilities (%)
USA	83.02
Russia	78.96
Australia	64.24
India	21.41
China	18.67
South Africa	0.00

As discussed above, ECAs of China and India have highest capitalization; hence their borrowings as percentage of total liabilities are only 21% and 19% , respectively. ECA of USA has negative capital and hence is required to borrow heavily which stands at 83% of its total liabilities (**Table 7**).

##### Resources:

The major sources of the funds for ECAs are paid-up capital, reserves and the borrowings. As shown in **Table 8**, Export-Import Bank of China has the highest total of Paid-up Capital and Reserves followed by that of India, South Africa, Australia and Russia. Export-Import Bank of USA has negative Paid-up Capital and no Reserves.

**Table 8: ECAs- Paid-up Capital, Reserves and Total of Paid-up Capital and Reserves**

Country	Issued & Paid-up Capital (USD Billion)	Reserves (USD Billion)	Issued & Paid-up Capital+ Reserves (USD Billion)
China	0.807	2.413	3.220
India	0.509	0.695	1.204
South Africa	0.034	0.313	0.347
Australia	0.005	0.190	0.195
Russia	0.061	0.000	0.061
USA	-0.763	0.000	-0.763

As can be seen from **Table 9**, China has the highest borrowing despite having the highest paid-up capital and reserves. This becomes essential for ECA of China as it provides a huge push to its national exports. The loans given by Export-Import Bank of China to its customers are approximately 18 times more than those provided by Banks of USA and India.

**Table 9: ECAs- Borrowings**

Country	Borrowings (in USD Billion)
China	46.725
USA	11.348
India	2.712
Australia	2.001
Russia	0.244
South Africa	0

### Profitability:

The issue of profitability of ECAs is a complex one as these operate under various constraints and sometimes have to provide loans on considerations other than the commercial ones. As these are Government owned, the other considerations like diplomacy come into play. Interest rates and repayment terms for some loans might not be in control of ECAs. Notwithstanding this, the ECAs must work on financial prudent norms and must not be loss making.

In terms of the gross amount, ECA of China has the highest profit, followed by that of India, Australia and South Africa. ECAs of Russia and USA are making losses (**Table 10**).

**Table 10 : ECAs- Profit after Tax**

Country	Profit After Tax (USD '000)
China	608000
India	123000
Australia	20000
South Africa	6700
Russia	-2500
USA	-1975000

**Table 11: ECAs: Profit to Assets Ratio (%)**

Country	Net Profit/ Total Assets (%)
South Africa	1.25
India	0.97
Australia	0.64
China	0.24
Russia	-0.81
USA	-14.45

As per **Table 11**, the profit / assets ratio is highest (1.25%) for ECA of South Africa followed by that of India (0.97%), Australia (0.64%) and China (0.24%). This indicates that most productive use of its assets is being made by the ECA of South Africa followed by that of India, Australia and China

**Table 12** shows that there is a huge difference between the ECAs when comparison is made on the basis of ratio of profits to paid-up capital. Maximum is for the ECA of Australia (370%) followed by that of China (75%), India (24%) and South Africa (20%). It seems that the Australian ECA is making the best and most efficient use of the Paid-up Capital. This might be true. But when we consider other related parameters like gross amount of reserves and ratio of profits to Paid-up Capital along with Reserves, the situation changes drastically. The amount of reserves with ECA of China is more than 12 times and that with ECA of India are more than 3 times than that of Australia. China makes the best use of Paid-up Capital along with Reserves.

While comparing the ratio of profits to the reserves capital, we find that this is highest for the ECA of China (25%) followed by that of India (18%), Australia (11%) and so on as given in **Table 13**.

Taking into account ratio of profits to paid-up capital along with reserves, we find that the figure is highest for the ECA of China (19%) followed by that of Australia (10.26%), India (10.22%) as shown in **Table 14**.

**Table 12**

Country	Net Profits / Reserves (%)
China	25.20
India	17.70
Australia	10.53
South Africa	2.14
Russia	0.00
USA	0.00

**Table 13**

Country	Net Profits/ Paid up Capital (%)
Australia	370.37
China	75.34
India	24.17
South Africa	19.71
Russia	-4.10
USA	-258.85

**ECAs: Ratio of Profits to Paid-up Capital (%)**      **ECAs: Ratio of Profits to Reserves (%)**

**Table 14 : ECAs: Ratio of Profits to Paid-up Capital + Reserves**

Country	Net Profits/ Paid-up Capital + Reserves (%)
China	18.88
Australia	10.26
India	10.22
South Africa	1.93
Russia	-4.10
USA	258.85

As far as profitability as well as push for exports is concerned, Export Import Bank of China is at the top followed by that of India. Though ECA of Australia is third in terms of profitability indicators, but it does not come anywhere close to China or India as its push for exports (disbursements to exports ratio) is meager at 0.2%. The same figure for ECA of China and India is 5% and 2.33%, respectively (**Table 2**). ECA of USA does push exports vigorously at 2.32% but the same is loss making.

### Staff Strength:

The staff strength for ECA of China is highest at 2136 followed by that of USA at 400, India at 275, Australia at 88 and South Africa at 42 (**Table 15**). Figure for Russia is not available. **Table 16** shows that net profit per employee is highest for the ECA of India at USD 447,000 followed by that of China at USD 285,000, Australia at USD 227,000 and South Africa at USD 160,000. Employees at Export Import Bank of India are most productive.

**Table 15****ECAs: Number of Employees**

Country	No. of Employees
China	2136
USA	400
India	275
Australia	88
South Africa	42
Russia	Not Available

**Table 16****ECAs: Net Profit per Employee**

Country	Net Profit/ Employee (USD '000)
India	447.273
China	284.644
Australia	227.273
South Africa	159.524
Russia	Not Available
USA	-4937.500

**CONCLUSION**

Export Credit Agencies are institutions fully owned or backed by Governments to give an extra push to the exports from respective country. They provide credit, loans, guarantees and insurance to the exporters. Their main aim is to push exports by giving credits / loan / guarantees / insurance for the export transactions in the markets where the private sector is not capable of providing these services or is unwilling to take risks due to commercial or political risks involved. As these institutions have clear mandate for their respective Governments, these agencies sometimes provide credit on non-commercial terms.

The oldest ECA is Export-Import Bank of USA and the youngest is Export-Import Bank of China but it is the most aggressive one. Export-Import Bank of China gives the maximum push to its national exports as measured by disbursements to national exports. Loans as % of total assets are highest for the Export-Import Bank of India followed by that of USA and China. This means that these do not have much cash or other deposits or investments but believe in giving loans to the exporters so as to boost more and more exports from respective country. China and India have the highest capital (Issued and Paid up) as compared to other countries. ECAs of China and India have highest capitalization; hence their borrowings as percentage of total liabilities are less as compared to other ECAs. In terms of gross amount, ECA of China has the highest profit, followed by that of India, Australia and South Africa. ECAs of Russia and USA are making losses. Taking into account ratio of profits to paid-up capital along with reserves, we find that the ECA of China has the highest followed by that of Australia, and India. As far as the profitability and push for exports is concerned, Export Import Bank of China is at the top followed by that of India. Employees at Export Import Bank of India are the most productive followed by employees of ECA of China, Australia and South Africa.

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