Pictorial description of step-wise tree transplantation

Geo Blanketing at Parsa East & Kanta Basan Opencast Coal Mine Project

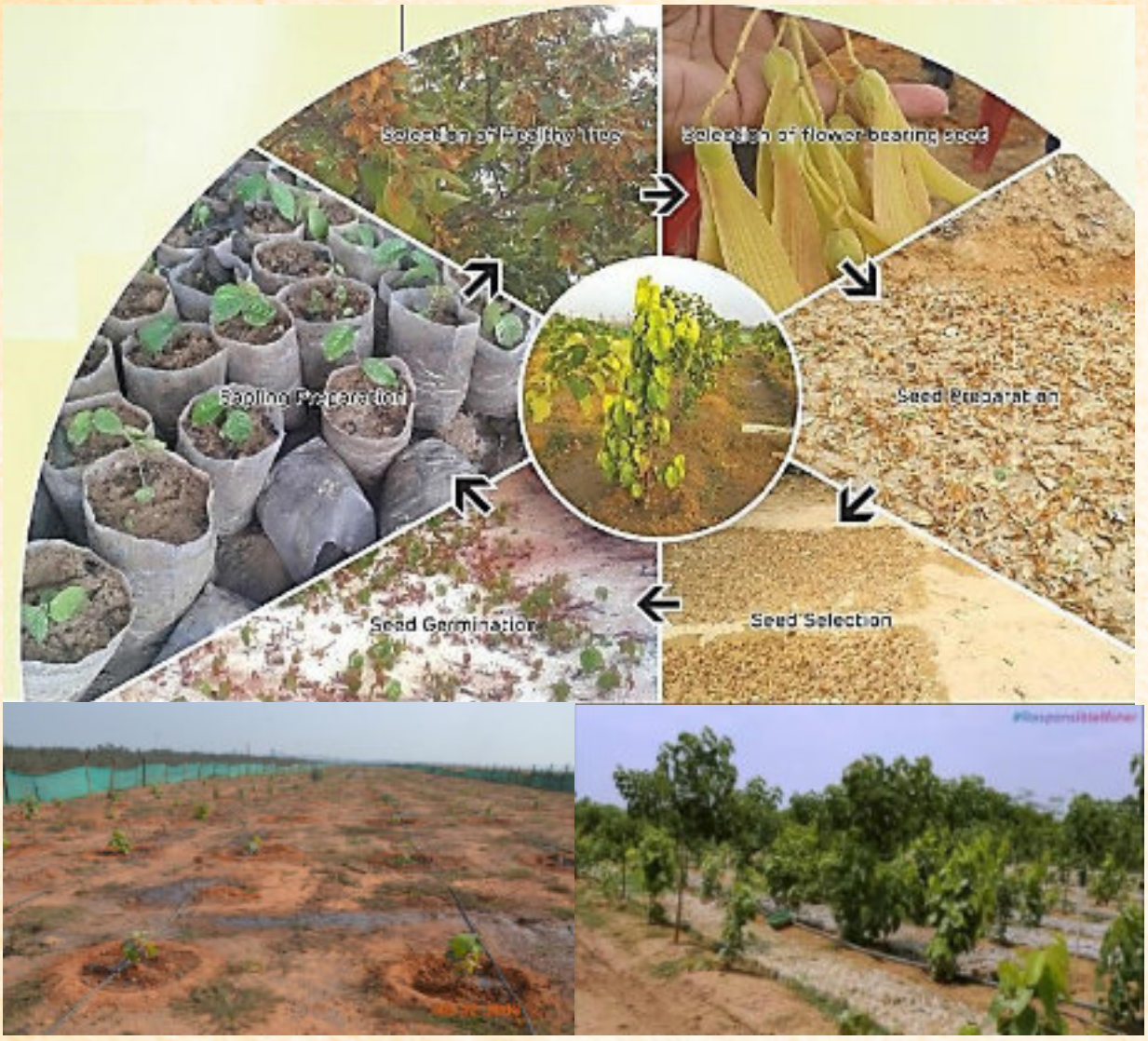
An eco-friendly Geo-green Blanketing has been done for slope stabilization and erosion control. It has several positive impacts on environment such as protective shield preventing action of rain beat and reducing surface run off, arrests immediate migration of soil, favours development of dense vegetation.

Sal Regeneration in Parsa East & Kanta Basan (PEKB) Opencast Coal Mine Project Sarguja, Chhattisgarh

Sal regeneration is unique process for propagation of indigenous Sal Trees in the restoration area. Artificial plantation/regeneration of Sal is being done successfully at PEKB, Sarguja, Chhattisgarh.

As Sal seedling and sapling are moisture sensitive, regular watering is key to survival of plants. In the areas which have good rainfall (average 1400 mm per annum) it is better to plant one year old saplings, so in the first year of planting root can grow around 1 meter length at the site. Some photographs of Sal Nursery and regenerated Sal plants with adoption of drip irrigation technology at the afforestation site are given below.

Sal regeneration process adopted



Methodology

In 2011, BCCL prepared a Roadmap for ecological restoration through Forest Research Institute (FRI), Dehradun and also associated FRI to take up and showcase a model eco-restoration site at Tetulmari spoil dump (8 Ha), which has been completed in 2014.

Removal of invasive weeds like *Lantana camara, Eupatorium odoratum, Chromolaena odorata, Parthenium hysterophorus, Ocimum gratissimum* was the first step in ecological restoration, so that the weeds do not interfere in the growth of the plants.

Efforts were specially made in selection of species which could have utility to the local people of the area but without human interference. Therefore, species of trees, shrubs, herbs, grasses with multiple use value like fuel, fodder, fruit, medicine were extensively used during the process of ecological restoration.

Seeds of different grasses, shrubs and native tree species were broadcasted on the mine spoils. The seeds were mixed with cow dung and soil to prepare seed balls. The seed balls

were broadcasted over the spoil dumps just before the onset of monsoon rains. Grass and seedlings of different species germinated successfully from the seed balls. Other methods of propagation like planting of saplings, stem cuttings, grass culms and planting of bulbils were adopted.

Grass species like *Heteropogon contortus, Chrysopogon, Cymbopogon, Dichanthium, Arundo, Eragrostis, Cenchrus ciliaris, Cenchrus setigerus, Cynodon dactylon, Pennisetum pedicellatum, Saccharum bengalense, Stylosanthes hamata, Panicum nitidum* etc for ground cover; Shrub species like *Crotalaria juncea, Dodonaea viscosa, Indigofera trita, Mimosa pudica, Mucuna pruriens, Withania somnifera, Bambusa bambos* as the second tier and native tree species like *Aegle marmelos, Albizia lebbeck, Albizia procera, Bauhinia purpurea, Bombax ceiba, Butea, Dalbergia sissoo, Madhuca indica, Ziziphus, Phyllanthus emblica, Cassia fistula, Terminalia arjuna, Vitex, Adhatoda* etc. as the third tier have been introduced in the mined out areas.

Based on the physical condition of the OB dumps specific physical measures like mulching was widely carried out to serve the purpose of moisture conservation and stabilizing the slopes from erosion.

Northern Coalfields Limited

Since inception, NCL has been a leader in providing excellent environment management of its opencast mines. New reclamation techniques and initiatives have been taken to operate all the Mining projects in environment friendly manner. The number of trees planted till now is more than 2.37 crores.

Environment Management Plan includes the following:

- Technical Reclamation – Backfilling and technical reclamation of voids and dumps form an integral part of method of working at NCL.
- Biological Reclamation
- Plantations
- Air Pollution control & Dust Suppression
- Effluent Treatment
- Noise control
- Hazardous waste management

Technical and Biological Reclamation

NCL has biologically reclaimed an area (Mined out area + External dump area) of 2708.13 hectares since inception to 31.03.2019. Beside this, social afforestation (Colonies, Roadsides, Blank plain areas etc.) has been done in 2932.56ha till 31.03.2019. Thus, total biological reclaimed area by NCL is 5640.69 hectares.

Ecological restoration of mines

The work for eco-restoration has been completed through FRI, Dehradun for 2 sites for 5 ha each at Nigahi and Krishnashila Projects. This is one of the endeavours for improving the quality of afforestation through the latest scientific methodology which will create a rich bio-diversity with 3 tier plantation, grassing, etc. For this work, NCL was awarded

with SKOCH BSE-Order of Merit Award in 2016. At Nigahi, about 90% area was flat and remaining 10% was slope. However, at Krishnshilla Project, the ratio of flat and slope area was about 1:1. Both of these areas contained about 90% boulders and 10% loose material. The complete restoration work was done in following steps:

i) Spreading of top soil depending on amount and availability at the sites

ii) Mulching on slopes for conserving and retaining soil moisture

iii) Identification of suitable grasses, herbs, shrubs and tree species depending on site condition and objective of the study

iv) Establishment of plants through application of various means i.e., direct seed sowing, seed mix soil ball, seedling planting, stem cutting, root stock, culm planting etc.

v) Digging of pits of size 2x2ft, and plant to plant distance 3m.

vi) About 5500 pits at Nigahi and 3000 pits at Krishnshilla were dug out

Ecological restoration work at Nigahi and Krishnashila mines of NCL.

Health Motivation: Salt and Water Smartness for Staying Healthier and Happier

Milan K. Sinha

(Stress Management Consultant, Motivational Speaker/Writer...)

Health and happiness are two most important requirements of life and are equally interdependent. The following three quotes by **George William Curtis, Dalai Lama and Leigh Hunt** respectively vindicate this point: Happiness lies, first of all, in health; Happiness is the highest form of health; Ground work for all happiness is health. There is also no denying the fact that everybody wishes to remain healthy and happy on a regular basis.

We all know the defining role of salt and water in our life. We consume these items almost daily. These items are necessary for staying healthy. Health experts are of the opinion that if we become salt and water smart, many of our health problems are well taken care of. We shall be discussing these issues elaborately in next few paragraphs.

Salt Smartness: The importance of salt in our day-to-day life can't be over emphasised. Salt has been the important item to make a large number of our eatables tastier besides being a requirement for our body as it contains sodium.

We know well that the chemical name of salt is Sodium Chloride. Sodium which is present in common salt to the extent of 40% is necessary for proper muscle function and for regulating the amount of water in human body.

Actually, processed, frozen and packaged food items contain far more salt because salt is not only used to add to taste but also as a preservative. **And to say the least, consumption of excess amount of sodium through intake of salt in different ways is one of the major causes of many health problems including high blood pressure, stomach cancer, kidney stone and osteoporosis.**

In fact, the average adult needs 3-4 grams of salt on daily basis. The children need even lesser amount of salt. Unfortunately, however, the average Indian consumes more than 8 grams of salt through normal daily diet.

Now the question is how to be Salt Smart? It's not difficult provided you are a conscious eater. To say, daily consumption of salt in all forms- raw, cooked and processed must not be beyond 4 grams. Adequate water consumption and normal exercise should be part of your daily routine. If possible, prefer the use of rock salt, at least for home-made food and for sprinkling on food items while eating. Truly speaking, the rock salt contains a number of minerals including calcium, potassium and magnesium which are very good for human health. It is also found to have amazing health benefits like improving respiratory function, pH balance of body, bone and vascular health, to name a few

Water Smartness: Everybody knows well that "water is life"; if there is no water, there is no future for all living beings; our dependence on water cycle is immense. Dr. Batmanghelidi, an internationally renowned researcher, author and advocate of the natural healing power of water says that "Water is the basis of all life and that includes our body.

Notwithstanding these facts, we are yet to learn well when to drink water and how and how much to drink water? Undeniably, we can keep our body adequately hydrated and reasonably toxin free thereby reaping significant health benefits if we learn and practise the proper way of drinking water.

To put it precisely, it is desirable for us to drink three to four litres of water daily in a normal condition. We should drink water slowly while seated comfortably. Experts do opine: 1) Do not drink water in between any meal and just before or after any meal. Truly speaking, we should drink water at least half an hour before and after any meal 2) Drinking two glass of water, preferably lukewarm mixing two spoonful lemon juices during morning hours in empty stomach is highly advantageous for our health. For added benefits, you can add some honey **(one spoonful, if you are not diabetic)** or some salt, preferably pink salt **(quarter spoonful, if you don't have high BP problem)** and 3) It is better to drink lukewarm water than cold or normal water as it helps in nasal and throat congestion, digestion, reduction of body weight, prevention of pimples and acne, prevention of premature aging and skin infections, to name a few, Drinking lukewarm water has another big advantage - we are at a relatively lower risk of falling prey to a number of water borne diseases.

To say, **if we practice water smartness, many of our health problems and diseases which include Arthritis, Heart burn, Migraine, Constipation, Colitis, Kidney problems, Asthma, High BP and Back pain,** will be mitigated to a large extent without incurring any extra cost.

Finally, one point of caution: In case you are under treatment of any disease or under any medical supervision, do follow the prescription of your doctor and/or seek his/her medical advice on the subject. (hellomilansinha@gmail.com)

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Changing scenario of health

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The Television and the social media have made a mockery of **Health.** The recommended regime is that you wake up early and drink some concoction followed by some dry fruits and then a ready-made and packet modulated breakfast. Go to work and eat some salad for lunch and green tea and some ready-made snacks around 5 pm and then dinner with little carbohydrates. If you can squeeze in some exercise its fine.

This is not true.

Let me share some good recommendations which is suited to our Indian scenario.

Under 40 years; two to three glasses of water in the morning (warm or normal) followed by a cup of tea (either milk or green tea or coffee). A healthy breakfast of some carbohydrates (bread, roti, paratha, dalia, cornflakes) and some proteins like eggs is mandatory. The breakfast should be within 2 hours of waking up (8 to 8.45 am).

A light snack like a biscuit with some tea or coffee around 11.30 am if at work or a fruit like apple, pear, watermelon, cucumber etc.

Lunch (1.15 to 1.45 pm) can be chapatti, rice, dal, one subji, some curd preparation or a small portion of non veg dish and lots of salad. It should not be a full meal.

4.30 to 5.30 pm. A light snack like bhuja, makhana, roasted chana, with some hot beverage. Avoid fried snacks on 6 days a week so that one day when you have good company you can cheat on fried ones.

Dinner (around 8.30 pm). Should be subji, dal with one or two chapattis (less of carbohydrates at night) and this should be at least two hours before you hit the bed. Before going to bed it is a good practice to have some hot skimmed milk (100 to 150 ml).

Total water intake should be around 8 to 10 glasses in winter and about 12 to 15 glasses in summer. Please remember that water is the only agent which purifies and filters your toxic metabolites. If you are topped up with water you can delay your fatigue and your efficiency level is high.

Above 40 years. Please listen to your doctor;

Diabetes: you have to avoid (not completely stop) or take in very small anmounts of high-end carbohydrates, oils and sugars etc. please match your sugar and carbohydrate intake to your exercises.

Cardiac patients; Do not listen to the fancy advertisements which shout that this oil is good and this contains bla bla bla. ***ALL OILS are harmful***. We now recommend Ghee, butter and sarson oil as the best cooking medium and it should be in minimum quantity. Do not forget to exercise and visit your doctor regularly (blood tests and ECGs should be done every six months)

Some key points to remember;

Green tea with honey and warm water are good anti oxidants but do not help you reduce weight. You have to eat less and exercise more to lose weight. If you are very obese and cannot control your diet then we recommend Bariatric surgery for you, followed by abdominoplasty.

Pour water on Burns till pain subsides (running water for 15 to 20 mins).

Alcohol is never recommended. However, if taken in small amounts (less than 60 ml) once in a while does not cause much harm. It should never be consumed on an empty stomach.

Smoking Kills you.

Fried snacks can be had once in a week but is better avoided if you are a cardiac patient or diabetic

Water is your best friend. It flushes your metabolites and delays your fatigue.

Late nights are never recommended.

Regularly visit your doctor. Stay safe and stay Healthy.

Kusumi of Maromar

Raza Kazmi

(Conservationist, Wildlife Historian, Storyteller)

"Among all the forests you have been to, which one is your favourite?" This is a question I've been asked all too often, and one that I have fumbled over equally often. I have been lucky to have been able to spend time in some of the most picturesque and stunning forests of India; yet no matter how beautiful a forest I go to, no forest, no place, can evoke the same emotions in my heart as does a place called Maromar, deep in the heart of the Palamau tiger reserve in western Jharkhand. Sure enough I have been to forests and rest houses that might edge Maromar in terms of sheer visual beauty, yet nothing ever quite lives upto Maromar. So perhaps then that is my favourite forest – Maromar. But why do I often stop short of proclaiming it to be so when asked, and what makes Maromar so special? Therein, lies a story.

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Long before the Ministry of Home Affairs designated Latehar as a severely LWE-affected district; long before its parent district Palamau became infamous for the atrocities of upper-castxce zamindars and 'bandhua mazdoori'(forced labour)in the 1970s and their subsequent ouster by Naxal rebels who have since, along with their mutated successors, lorded over the region; long before Palamau became synonymous with injustice, oppression and violence, Palamau was famed for its beautiful Sal forests, its myriad wildlife and dozens of different Adivasi communities who lived simple, independent and content lives. As the sun finally set on the colonial rule in Palamau, and across India, in the year 1947, a young Indian forest officer S.P. Shahi was mesmerised by a nondescript forest village in the heart of the monsoon forests of western Palamau, not very far from the border of the then Central Provinces. Maromar, was a small forest hamlet, primarily inhabited by the Kharwar adivasis, lying at the edge of the narrow, rarely-used, unmetalled road that snaked through the densely forested rolling hills and valleys of the Koel river's basin, connecting the mofussil town of Daltonganj with the then summer capital of united Bihar, Ranchi, via Netarhat, the highest spot in the district and a charming hill-station. Watched over by the mighty Huluk hill, watered by a forest stream, cooled by the breeze filtering down from Netarhat through miles of unbroken tiger and elephant forests, shaded by day by thousands of primeval trees, lit up by the night under a million stars, Maromar was magical. The young forest officer, who would later go on to become the youngest Conservator of Forests in the history of India, bewitched by the beauty of the place, decided to build a quaint forest rest house, a little away from the village, close to the forest stream. And so, as a new nation was born, so was the Maromar forest bungalow, accompanied by the pink bougainvilleas, silver oaks and red bottle brush trees in later years, complimenting the wild native flowers of the forest.

While much transpired outside the little happy world of adivasis of Maromar, both in the history of the nation and the history of Palamau district itself, precious little changed in Maromar, where time seemed to stop still. The incorporation of Maromar and its forests into the Palamau tiger reserve, one of the original nine tiger reserves of India, conceived in 1972, and the metalling of the old kuccha road with it being designated as a State Highway, were perhaps the only notable events in Maromar's history in those years.

*****

Almost half a century after the birth of the Maromar bungalow, years after S.P. Shahi had passed on to happier hunting grounds, another young forest officer, S.E.H. Kazmi fell in love with Maromar. He would camp for days at the bungalow during tours, and even otherwise, using any excuse he could to get away from his office at Daltonganj with its mounds of official files, each fattened to the brim with the peculiar blue-inked official papers of the pre-computer era.

Summers in Palamau are scorching, and even Maromar's favourable geography could only do little much to allay the heat. For a few weeks, sleeping outside dwellings, under the moon and stars, was the way to go, both for the villagers and those at the bungalow. On one such hot summer night in 1994, as Kazmi slept on a cot in the gravel driveway in front of bungalow's verandah, he dreamt of the largest and most venerated of Maromar's inhabitants, elephants, roaming about in the bungalow. He woke up in the morning, only to realise that his visions were no dream. A small herd of elephants had indeed visited him in the night, leaving their tell tale signs in the form of dung piles all round the bungalow's perimeter, and a few droppings next to his cot. They had ripped apart the floor mats on the verandah, others had expertly used their trunk to pull down the window curtains and gorge on the bananas that were kept on the old wooden table inside the room, and yet, throughout all this, they had been careful to not wake Kazmi from his slumber! Kazmi didn't want to test the patience of those gentle elephants again, and had a novel idea to get around this problem – the towering Kusum tree a few dozen feet in front of the bungalow! He instructed Uday Singh, the old wizened Bungalow chowkidaar, who had a chuckle or two about the entire situation, and his local range officer to set up a basic machaan (wooden platform) on the forked bole of the tree which, from here on, would be his cot during the hot nights of Maromar. He could sleep peacefully without dreaming of elephants around his bed again, and the elephants could exercise their right of precedence in occupancy of the bungalow unhindered. He then went on a short leave to his village. When, he returned a few days later, in his words, he was greeted with the beautiful toothless smile of old Uday Singh standing in front of the most ugly and clumsily unwieldy machaan he ever saw in his career. He sighed, shook his head and decided to take matters in his own hands, ably assisted by his trusted forest guard Shyam Vyas Rai. And so, a few months later, was born the younger sibling to the Maromar bungalow, a beautiful tree house wrapped around the Kusum tree.

But every bungalow must have a name. Maromar was already taken by the older sibling, and so Kazmi and his team pondered over a suitable name for this structure until a few weeks later he bumped into the famous Bengali writer Buddhadeb Guha, who would often visit Maromar, while he was staying at the old Maromar Bungalow. "Call it Kusumi, after the Kusum tree around which it is constructed", suggested Guha. And so the tree house was formally christened – the Kusumi tree house of Maromar. Little did anyone realise then, that, Kusumi would become another notable event in the history of Maromar, and would soon put this sleepy forest village on the tourism map of the state and in the itineraries of many wildlife enthusiasts across India.

Kusumi and Maromar's fame spread organically. Anyone who spent a night at Kusumi would go spread the word among all his kith and kin about the existence of a magical rest house around a Kusum tree in an obscure tiger reserve, a place where you could sleep next to a living tree in your room, a place where you could rest your body against its massive trunk while looking out at the cheetal and elephant herds who often descended into the

small open grass plot in front of the tree house. The Huluk hill, an ancient crocodile-shaped forested massif, stood as a towering sentinel, looking over Kusumi just as it had looked over the old bungalow and the village all these years, and all those, both human and non-human, who moved about in that space. On rare occasions, bears would come down and claw on the wooden stilts of the tree house, something which the casual Bengali tourist wasn't too pleased about, always complaining to Uday Singh to do something about these damn bhaalus lest they climb up the stairs. By day, an array of birds fluttered around, while the soothing soft murmur of the gurgling forest stream skirting the tree house to its front and to its left were a constant. By night, millions of twinkling stars up above and millions of 'living stars' - fireflies – illuminated the forest floor and the tree line, while the occasional hooting of an owl, or the rutting call of a cheetal, or the barks of a Kotri (barking deer) alarmed by a predator on the move, pierced the silence of the night. Every evening, as dusk would begin giving way to night, charming kerosene lamps would be lit up and hung on the balcony of the tree house by Uday Singh, as he had been doing for decades for the old bungalow. Almost simultaneously, one could notice, from the balcony of the tree house, a sudden appearance of dozens of small yellow flickers on the horizon to the right coupled with the onset of a melodious tinkling chorus, and the emergence of small plumes of smoke just as the last spokes of daylight faded to give way to the night – it was Maromar village getting ready for the night, as the cattle returned home, just like it always had. No wonder then that when the Governor of Bihar visited Maromar after hearing about the place many a times, he was narrated a particularly amusing tale of how both the bungalows at Maromar came to be –it was a romantic British officer who trod these forests about a hundred years ago, and bewitched by the beauty of this place constructed this tree house and the bungalow. The imaginative story gained quite a bit of currency and even made it to some pamphlets by the tourism department! I always wondered what good old Uday Singh would have had thought of this story, perhaps he would have chuckled and added his two bits to it as well. However, they say all good things come to an end, and it was only so long before the turmoil that engulfed the rest of the district and many more across multiple states of India, finally caught up with the cocooned idyllic world of Maromar. A bloody new chapter in the history of Maromar was on the anvil.

*****

On 22nd August 2007, Kazmi received a phone call – Kusumi tree house was gone. On the preceding night, a large Maoist platoon had set fire to it. The giant Kusum tree perished along with in the inferno. The old bungalow had also been severely damaged, albeit saved from being razed to the ground because the explosives fitted near the base of the window-bearing wall – the same window which many moons ago had been used by the elephants to gorge on bananas meant for the sahib – had failed to detonate properly. The few staff members stationed there had been thrashed, while the platoon consigned all the papers, the vintage rest house register and other records in the campus, to fire. My father said nothing; perhaps he expected this call someday. The insurgency in Palamau had been spiralling out of control for some years by then, and the forests of Palamau tiger reserve had become a rebel citadel.

The Maromar of old had almost become a dream by then – the landmine blasts, the teenaged local adivasi boys ‘encountered’ by the security forces and the merciless slaughter of young jawans by the naxals, young boys and men on both sides, fighting a war not of their making, and the local villagers caught in the crossfire – some detained and thrashed by the forces accusing them of being “naxal sympathisers”, others disappearing in the aftermath of

raids never to be seen again, and yet others ending up dead, often with their throats slit, on that very picturesque road beside which Maromar lay, branded “police mukhbir” (police informers) by those who proclaimed to be protecting these very people against the State. And as humans laid waste to humanity here, the cheetals that once grazed around Kusumi disappeared too, as did the massive, yet gentle, gaurs that once lumbered nonchalantly in the surrounding forests. The nights were truly silent now, no sambars bellowed from the foothills of Huluk, no cheetal called for his mate, and no kotri barked anymore for their were hardly any predators to look out for anymore – the monarch of Palamau’s forests since eons, its tigers, had been quietly deposed forever. No lamps were lit anymore either, and the fireflies too seemed to have dwindeled, those still remaining trying their best to bring some light in the darkness that engulfed Maromar. Sometime during this period, an officer, who didn’t quite ever feel the need to visit Maromar, however, on a personal whim, ordered the construction of a high wall all around the rest house premises. The elephants were no longer welcome here, he had decreed. The Kusmi tree house was gone, and with it were gone those who had necessitated its birth. Even the most adventurous of Bengali tourists now gave Maromar a miss, and so did those damn Bhalus that often irked the more temperamental Bengali occupants.

Soon almost all senior and mid-level forest officers stationed at Daltonganj, the park’s headquarters, stopped visiting Maromar completely, including the gentleman who had banished the elephants. By 2007, it had been a few years since Maromar had been abandoned by all, except for the security forces which every now and then broke open the locks of the quaint bison-motif gates of the campus and forcibly occupied the bungalows for days at end during their combing operations.

“I’m happy Uday Singh is no more to see this day”, my father sighed as he told me about what had transpired at Maromar the night before. Uday Singh, had passed away a few years ago, having served his entire life – from his early teens, as one of the labourers who built the bungalow brick by brick, till his last day as an octogenarian – at the bungalow, His elder son, Jagmohan, whom he had been grooming to take over after he was gone, died a few months after his father, bitten by a snake. Uday Singh’s younger son turned out to be an alcoholic.

*****

It would take my father a full two years to gather courage to go see Maromar, or what was left of it, again. I went with him. The staff present at Maromar on that fateful night would keep repeating it over and over again that the commander of that platoon that went on rampage was drunk, along with most of his men, and that most of them spoke in a language they did not understand. "Kuch Tamil-Telgu type bol raha tha uu log" (they were speaking in a language that sounded like TamilTelgu), they kept saying, thus emphasising their belief that this wanton destruction was not done by "our local boys" – the staff and the naxal foot soldiers stood on opposite sides of the divide, yet for the old daily-wage staffers, most of whom came from various villages in the forest, they were still “their boys”, boys who had gone astray but were still part of their closely-knit village communities. On that night, this platoon had then marched onwards to Kujrum, one of the remotest forest villages in Palamau, where the first naxals had arrived exactly 20 years ago in 1987, and razed Kujrum’s quaint mud and thatch forest rest house to ashes, apart from thrashing the staff. Similar attacks on forest department infrastructure had happened in the territorial divisions adjoining the tiger reserve.

After all these years, I still don't have the right words to describe our emotions when we finally stood at Maromar, in the monsoon of 2009. The forests were sparkling green, washed by the rains. There were two retired forest guards accompanying us, Shyam Vyas Rai and Vijay Singh, both of whom had overseen Kusumi's construction alongwith my father. The bison-motif gates were left wide open. The staff quarters abandoned. Uday Singh's kitchen out-house had partially collapsed. The old bungalow stood forlorn and abandoned. One of the wooden pillars in the verandah was charred, its lower half blown apart, gaping holes in the roof and the walls, where the unsuccessful detonation took place, cracked, the cracks running right down to the floor before terminating at an old etching on the floor-side which read – 1947.

Overrun by bushes, an old red-roof tile pathway starting from the old Bungalow front took us to Kusumi. Amidst overgrown bushes, four concrete pillars, four wooden steps, a few inches of handrails columns, and a burnt ghost of a Kusum tree – that was all that was left of the Kusumi tree house. The four of us stood there, gazing at it, not uttering a word. I distinctly remember looking towards my father, and watching his eyes welling up as he silently gazed at his beloved Kusumi – it was the only 'house' he would ever build in his life. He had designed and planned the entire structure, and along with Shyam Vyas Rai, Vijay Singh and Uday Singh, spent countless hours overseeing every step of its construction, just as one would oversee the construction of his own house. I remembered how he would personally go to shops all the way to Ranchi, some nearly 200 kms away, to chose and purchase each bolt, each accessory; spend hours deciding which shade of paint would go best with the surrounding forest, which mattresses to put, which bedsheets to buy, anything & everything that was to be used would be handpicked by him. Once the bungalow was complete, he would bring anyone and everyone to come experience the place, be it the villagers of Maromar or any tourist who wished to come stay there – for my father it wasn't an official bungalow meant exclusively for the sahibs, for him it was a common property of Maromar, embracing anyone and everyone who so wanted, without discrimination, just like the Kusum tree, that formed its core, would. And now, 15 years later, he stood there, almost in a trance like state, gazing at the gutted remains of his beloved house. On that day, I first realised what losing one's home feels like.

As I stood there beside Abba, I reminisced those numerous days and nights we spent here together as a family, sitting by the stream, trotting the animal tracks, gazing at the Huluk hills with the clear star studded night sky in its backdrop. I remembered Kiki, the orphaned macaque baby that was brought to us here, and how we hit it off within a few minutes of our first meeting on Kusumi's balcony. And I couldn't help but imagine Uday Singh walking down from his kitchen-outhouse any moment, white haired with a toothless broad smile, the most delicious wild mangoes and wild jamuns I have ever eaten, in his hands, handpicked from the respective trees that grew behind his kitchen – somehow this was the most vivid memory of his etched in my mind as a kid. But Uday Singh never turned up, neither did the mangoes and the jamuns, and Kiki had been gone for decades while the view of the Huluk blocked by some carelessly planted Eucalyptus. The animal tracks existed no more, for those who designed those tracks had been long gone too.

Abba finally turned back, and spoke for the first time. He didn't wish to go ahead with the planned next couple of days of visits around the forest; he wanted to go back to Ranchi. But before we left, we went to meet Uday Singh's wife. Dressed in a bright red sari, which

somehow accentuated the thousand wrinkles on her sunlit bronze face, she seemed very happy to hear familiar voices and see faint outlines of familiar faces, outlines since she explained she was going blind and would soon lose vision completely. She asked my father to try talking some sense into Manmohan, the younger drunkard son, and see if he could be employed at the bungalow. Perhaps that would turn him sober again, and turn his life around, or so she believed. She sometimes wandered from her house in the village to the abandoned bungalow premises, she told me, remembering her late husband and elder son, and better times, both for her family and Maromar.

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Two years later, in 2011, after a gap of 13 years, Kazmi was posted back to Palamau, this time as the Field Director of the tiger reserve. Slowly, and assiduously, by the end of the year, some semblance of order was brought back to the beleaguered reserve. One of the focal points of this larger effort was centred around the revival of Maromar. Kazmi would camp alone for days at the hitherto abandoned Maromar bungalow, hoping that a senior officer's presence would re-instill confidence among a dispirited field staff and boost their morale shattered over the years. It worked. The staff slowly returned, and by 2012, old Maromar Bungalow along with a lot of other derelict and abandoned infrastructure across the tiger reserve, was repaired and revived. When the damaged walls and flooring of the bungalow were repaired, a new grey tile was placed at the site of the failed detonation on the floor, and etched on this title was the year – 1947. Keeping the promise made to Uday Singh's wife, Manmohan was employed as the new bungalow chowkidaar. But sadly by then a job was not enough to turn his life around. A few months later, he left the job, preferring to spend his days drinking his Mahua and Hadia liquors. Soon, a few tourists started trickling back to Maromar, yet again the Bengali tourists taking the lead. By the end of 2012, with the naxals passing on a message promising non-interference, as long as forest department didn't allow their properties to be taken over by the security forces, tourists were finally given the permission for night stays at the bungalow. Since then, barring a few hiccups here and there, Maromar once again began witnessing a steady flow of visitors. After an interregnum that lasted more than a decade, the quaint kerosene lamps once again began lighting-up the benighted Maromar bungalow, just like they used to all those years ago. My father, however, decided to leave the ruins of Kusumi untouched, for he wanted it to be a reminder of an important, even if dark, phase in Maromar's history. Kazmi bid goodbye to Maromar, and the forests of Palamau, in 2014, retiring from the service less than two years later.

New FRH Maromar

Sustainable Municipal Solid Waste Management in India - Threats, Barriers and Opportunities

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ABSTRACT

India faces major environmental challenge associated with municipal waste generation, waste collection, transport, treatment and disposal. Existing systems in India are not commensurate with the volumes of waste generated by ever burgeoning urban population. The threats and barriers in the systems are noticeable and so are the opportunities. The waste hierarchy, sustainable waste management and circular economy practices help us to move from dependence on waste dumps that offer no environmental protection to waste management that retain useful resources within the economy. Waste segregation at source (up to 90%) culminating into waste processing has a key role to play in maintaining sanitation and cleanliness in cities. Adoption of long-term waste management technologies by ULBs, Private sector and NGO such as decentralized composting (Aerobic and vermi composting) and waste to energy (Incineration, Palletisation, Bio meth nation) has potential to answer many a ills inflicting our health and environment for poor management of our wastes. Disposal of residual waste after extraction of material resources needs investment in waste-to-energy facilities and engineered landfill sites. The potential of energy generation from landfill via methane extraction or thermal treatment is a major opportunity to capitalize on. The key barrier is the lack of sufficient funds, eager stakeholders as also the shortage of qualified and experienced ready to deliver professionals.

Keywords: Waste management, Sustainable development, Population growth, Resource recovery, Waste to energy

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INTRODUCTION

Municipal Solid waste Management (SWM) is a major problem in India and Jharkhand in particular. Population explosion and rapid industrialization has led to the migration of people from villages to cities generating thousands of tons of complex Municipal solid waste (MSW) daily. Municipal solid waste is generally a combination of household and commercial wastes generated by the living community. The informal sector has a key role in extracting values from waste with 90% of residual waste currently dumped. The management of municipal solid waste is going through a critical phase due to non-availability of suitable facilities to treat and dispose large amounts of MSW generated daily in cities. There is an urgent need to move to more sustainable new management systems as SWM facilities in India have remained largely unchanged over the years. An effective waste management system utilizes data on quantity and quality of waste generated from different socio-economic groups for determining an effective solid waste management system. These parameters depend on factors like seasonal variations, food habits, sources

of generation and socio-economic conditions of the people. As such, the characterization studies help in determining the existing deficiencies in the MSW management system and can help in identifying appropriate steps to minimize it in the MSW management process (Kumar R, 2019). In India, it has been reported that the organic fraction of MSW varies generally between 35 to 60% and even more in different parts of country. Poor solid waste management practices and low quality of compost production causes huge constraints in exploring such large amount of plant nutrients present in organic fractions which in turn can be helpful in increasing crop productivity. Lack of sufficient data regarding quantity and nature of MSW creates hurdle in developing an integrated MSW management plan. Majority of the studies reported are based on Metropolitan and Tier-I cities. Very limited studies have been reported for characterization of municipal solid wastes in Tier-II cities of India. These are often the state capitals or designated industrial hubs with a population of about 1 million and above (Sharholy, M et al 2008). The waste Management and Handling Rules in India were introduced by the Ministry of Environment and Forests in year 2000 and amended in 2016 though compliance limited. This paper reviews the threats, barriers and opportunities associated with municipal waste management in India.

Threats

1. India is experiencing population explosion and rapid demographic shift from rural to urban areas in search of job and better living. The population of India has reached to a level of 1350 million in 2018 from 1252 million in 2013 and 1028 million in 2001. Megacities are a relatively recent phenomena associated with globalization of the economy, culture and technology. Megacities in India are Ahmedabad (6.3 million population), Hyderabad (7.7 million), Bangalore (8.4 million), Chennai (8.6 million), Kolkata (14.1 million), Delhi (16.3 million) and Greater Mumbai (18.4 million population). The problems associated with waste become acute as size of the communities increase.
2. Estimating MSW quantity and characterisation and forecasting future waste generation is fundamental to successful waste management planning. The high urban waste generation is reported from Maharashtra (115 364–19 204 tonnes per day), West Bengal (11 523–15 363 tonnes per day), UP, Tamilnadu, Andhra Pradesh, Kerala (7683–11 522 tonnes per day each), Mizoram (3842–7662 tonnes per day) and still lower from Madhya Pradesh, Rajasthan, Gujarat, Karnataka states. Relatively lower quantity of waste generation occurs in **Jharkhand (1710 tonnes per day, CPCB study report 2010-11)**, Bihar, Chhattisgarh, Orissa, Goa, Assam, Arunachal Pradesh, Meghalaya, Tripura, Nagaland, Manipur and Jammu and Kashmir (< 3841 tonnes per day). MSW generation per capita/day in India ranges from 0.17 kg per person per day in small towns to 0.62 kg per person per day in cities. Waste generation in urban areas of India will increase to 0.7 kg per person per day by 2025. This is 4 to 6 times higher than in 1999. 40-60% of waste is generated from households. Inert waste is generated for construction, demolition and road sweeping. Waste contains 19 % potentially recyclable materials. The waste produced in urban areas of India is about 170 000 tonnes per day (=62 million tonnes per year) and this is expected to increase @ 5% per year owing to increases in population and changing life styles.

6. World waste production as on date is about 3,532, 255 tonnes per day. This is expected to reach 6, 069, 705 tonnes per day by 2050. One third of this will come from Asia with major contributions from China and India.
7. Waste collection and disposal is the responsibility of the municipal corporations in India. Provisions for the purpose include primary and secondary collection centres with effective systems for monitoring, collection, transport and disposal. Colour coded bins are normally provided for collecting segregated samples like wet, dry and rejects. Mixed waste and inert waste is often dumped with open burning being a common practice.
8. Local bodies spend around Rs.500–1000 per tonne on SWM with 70% of this amount spent on collection and 20% spent on transport. SWM disposal is at a critical stage of development in India. There is a need to develop facilities to treat and dispose of increasing amounts of MSW. >90% of waste in India is believed to be dumped in an unsatisfactory manner.
9. It is estimated that approximately 140 km^2 was occupied by waste dumps in 1997 and this is expected to increase exponentially to 1350 km^2 by the year 2050 (Fig 1).

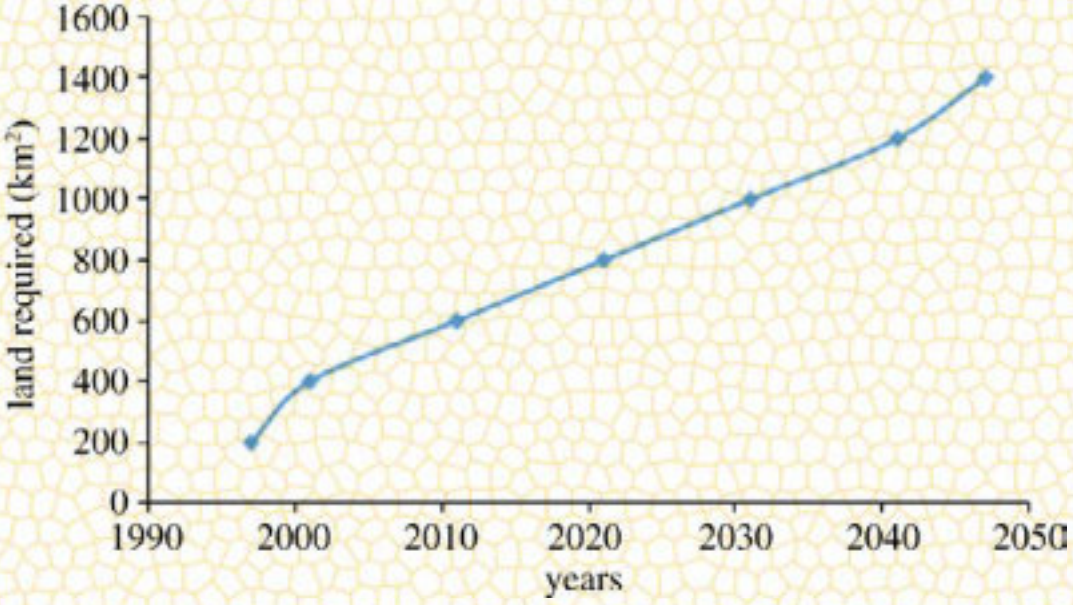

Figure - Cumulative land required (km^2) for disposal of MSW (Source: Singhal & Pandey)

10. Waste dumps have adverse impacts on the environment and public health. Open dumps release methane from decomposition of biodegradable waste under anaerobic conditions. Methane causes fires and explosions and is a major contributor to green-house gases and global warming. There are also problems associated with odour and migration of leachates to receiving waters. Odour is a serious problem, particularly during the summer when average temperatures in India exceeds 45°C. Discarded tyres at dumps collect water, allowing mosquitoes to breed, increasing the risk of diseases such as malaria, dengue etc. Uncontrolled burning of waste at dump sites releases fine particles which are a major cause of respiratory disease and cause smog. Open burning of MSW and tyres emits 22 000 tonnes of pollutants into the atmosphere around Mumbai every year.

12. The impacts of poor waste management on public health have led to increased incidences of nose and throat infections, breathing difficulties, inflammation, bacterial infections, anaemia, reduced immunity, allergies, asthma and other infections.

Barriers

1. Low on environmental awareness, motivation and training has inhibited innovation and adoption of new technologies in MSW management.
2. Non availability of qualified waste management professionals besides negative public attitude towards waste is a major barrier to improving SWM in India.
3. The lack of strategic MSW plans, waste collection/segregation and a strong will on part of those who matter are major barriers to achieving effective SWM in India.
4. Municipal authorities responsible for managing MSW in India have insufficient budgets to cover the costs associated with developing proper waste collection, storage, treatment and disposal facilities.

Opportunities

1. Wastes are potential high value resource. Effective waste management with resource extraction is fundamental to effective SWM. Value extraction from waste can be materials, energy or nutrients. A recent study of six Indian cities found that waste pickers recovered approximately 20% of waste, with 80 000 people involved in recycling approximately three million tonnes. It is estimated that every tonne of recyclable material collected saved the ULB approximately INR 24 500 per annum and avoided the emission of 721 kg CO_2 per annum.
2. Waste management needs to be respected as an essential service requiring sustainable financing. A strong and independent authority is needed to regulate waste management as per provisions made in SWM Rule 2016. ULBs need to own and exercise responsibility for waste management, with the Commissioner and Chairman directly responsible for performance of waste management systems.
3. The waste management sector needs to include attractive and profitable businesses with clear performance requirements imposed by the ULB with financial penalties for violations. Finance for waste management companies and funding for infrastructure must be raised from waste producers through a waste tax. An average charge of 1 rupee per person per day would generate close to Rs.1350 million annually. With this level of funding it would probably be sufficient to provide effective waste management throughout country.
4. State-level procurement of equipment and vehicles is necessary for primary and secondary collection with effective systems for monitoring collection, transport and disposal using GPS to make system full proof. Jamshedpur, Nagpur and the likes have introduced a system for sweeping roads in which every employee sweeps a fixed road length. The Swatchata Doot Aplya Dari (sanitary worker at your doorstep) scheme of the Centre for Development Communication was selected as an example of good practice by UN HABITAT in 2007.

5. Waste management must involve waste segregation at source to allow efficient value extraction and recycling. Separating dry (inorganic) and wet (biodegradable) waste should be the responsibility of the waste producer.
6. Adoption of Long-term waste management technologies by ULBs, the private sector and NGO such as decentralized composting (Aerobic and Vermi composting) and waste to energy (WTE) (Incineration, Palletisation Bio meth nation) has potential to make our cities sustainably clean.
7. There are a number of research institutes, organizations, NGOs and private sector companies working on a holistic approach to SWM. Future waste management in India must involve extensive involvement of the informal sector throughout the system.
8. There is a need to capacity building at every level.

Game changer and future strategies

There is a need to cultivate community awareness. Undertaking 100% door-to-door collection, source segregation (up to 90%) and maximum resource extraction can make Jharkhand cities rank high among SWACH states of the country. Adoption of decentralized household and community side composting coupled with biogas production (>60% organics) has potential to solve more than half of waste, sanitation and health related problems. The sale of recyclables and reusable combined with safe disposal of residual waste through the development of engineered landfill and waste-to-energy facilities will generate funds required for making the enterprise sustainable. Adoption of zero waste policy has potential to earn state the most envied contemporary environmental tags as "NO DUMP CITY" and "CLEAN, GREEN and HEALTHY CITY" as we raise OWNERSHIP of waste with a PURPOSE

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Portrait of a Dragon- fly

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The name 'dragon- fly' sounds fearful but rest assured the word is misleading, for it is neither a dragon nor a fly to disturb us. It is an insect, totally harmless to man and what a wonderful insect it is, if we care to spare a few minutes watching it in flight or perched on a wire or a twig as it basks in the sun! The sun recharges it for its daily run. In popularity, dragon-fly rivals bird and butterfly the world over, but in Japan it ranks higher. Then, why do we not find collection of dragon-flies in museum or elsewhere popular? It is because its body losses elegance, charm and colours after death.

Scientists have found the earliest remains of dragon-flies in fossil forms and calculated that they evolved some 300 million years ago, far before the advent of the dreaded Dinosaurs on earth. While the Dinosaurs are extinct, the dragon-flies are thriving, amazingly retaining their original design and overall forms of body structure except undergoing reduction in size and scale from 78 cm wing span to present day maximum 15 cm. Time has failed to make dent on its evolutionary process. Can it be because the dragon-flies have achieved a level of perfection, morphologically, to perform the functions related to survival? It appears so.

Globally about 6000 species have already been identified and recorded of which the Indian contribution presently stands at 470. It is expected to increase with intensive field work and research going on in uncharted places.

Dragon-flies are distributed world wide with exception in polar region and other permanent frozen areas. Tropical belts with warm and moist conditions having fresh water bodies support its growth very favorably. Even in cold climate extending up to boreal forest, dragon –flies distribution is fairly numerous. It is an aquatic insect and belongs to the order 'Odonata'.

Odonata is a Greek word meaning 'the toothed one'. And the dragon-fly contains row of serrated teeth in its mouth parts called the mandible to facilitate biting and crushing its morsel of food it likes. It is a strict carnivore, hunting its prey in air while in flight by scooping through its legs catching mosquitoes, bees, flying termites, ants and small butterflies etc. Such feat requires exceptional aerobatic ability. It is a predatory insect with voracious appetite. Dragon-fly prefers to hunt in groups. In turn, it has to face formidable enemies who are ready to pounce upon the dragon-fly and they are- bats, birds specially bee eaters, drango, garden lizards, spiders and the larger species of dragon- flies itself. Nature knows best how to exercise control and keep things in check and balance.

Nature has been enermously generous in bestowing some extraordinary gifts in terms of visual excellence and flight capacity to dragon-flies which have charmed the scientists and now they are looking forward to incorporate it in the most advanced flying machines of today. For example, the dragon-fly possesses compound eyes giving it a very large field of vision of 360 degrees which has no scope of further improvement. Our field of vision is restricted to 120 degrees only. The Compound eyes of the dragon-fly contain about 30000 separate light sensitive optical units that act like lens of cameras. These eyes, bulging and protruding over the dragon-fly head, in hemispherical formations cover 80% of the head, giving a wonderful

eye sight to help it catch its prey in the air through its powerful legs. No radar or electronic helmets of fighter pilot can match this feat of 360 degrees of unobstructed vision. This exacts some costs- 80% of the capacity of brain is utilized in analyzing the vast amount of visual data. As if the 30000 optically sensitive units of the compound eyes are insufficient, the dragon-fly boasts three more simple eyes called OCELLI on its forehead, the function of which is not very clear. Two tiny antennae are also present. The large spherical head is delicately joined with the main elongated body with a flexible thread like member, called the neck.

Apart from the exceptional vision, nature's second boon bestowed to it is related to the incomparable flight dexterity it posses. It can dash forward, fly backward, turn instantly by 180 degree, glide, fly upward or downward and can hover like a helicopter. The two pairs of wafer thin wings attached to the main body, called thorax, perform the impossible in-flight tricks. The wings are always transparent, may be colourless in some species but mostly a tapestry of kaleidoscopic patterns are visible in others. The two pairs of wings are almost equal in length. These wings can not be folded and thus remain perpetually in horizontal position. Since the wings are coated with natural wax, they are not soiled by dust or affected by moist and other weathering elements. Dragon-flies were amongst the first winged insects to evolve. The wings in the long evolutionary process have achieved such an aerodynamic refinement that thrust generation, lift, drag minimization for speed and enhanced stability are far more efficient compared to the modern aircraft The four wings can be operated independently. Wind –tunnel experiments have indicated that the vortex generated during flight are gainfully utilized by dragon-fly. Jet fighter air crafts of fifth generation have mimicked this technique by providing a pair of small extra wings fitted in the nose section called the canard, to convert the energy generated by vortex or unsteady flow of air into speed. Robotic gadgets working on the principle of dragon-fly system have been developed so that they can be sent undetected to narrow and difficult section for spying and other activities.

Being air-borne is a favourite pass- time of the dragon-fly. Some of the species patrol their territory flying linearly, making many rounds to guard its domain zealously: intruders of its own kind or men are watched closely.

Feel elated when such incident happens before you, realizing that 30000 lenses are focused, just 4-5 feet away on a head turned towards you. Fly- past like this usually occurs on sweet water- front or near by area. The mating behavior is unique: male and female unite in air, contorting their bodies in double-S wheel formation, flying in unison, seldom alighting on trees/land. Duration varies with species. To photograph dragon-flies in mating posture is extremely difficult, a nightmarish experience. Eggs are laid in water, on damp rocks or on water plants on its stems or leaves, fastening it securely. The Young, nascent offspring coming out of the eggs are called nymphs. It has six legs. The nymphs as larvae, spend considerable time in water-from month to years- before emerging as a fully developed adult dragon-fly, skipping the pupal stage. Nymph is a predator of first order from birth, catching tadpoles and tiny fishes. It propels itself inside water by the action of jet propulsion-forcing water in high speed through the tail end of its body, demonstrating Newton's third law application. To catch a prey, the larvae throws the lower part of its lips fast forward in a manner similar to the grab fixed to earth moving machine and then retracts back. This curious device called mask, is unique to dragon-fly nymph. When not in use, it is folded back to rest inside the mouth, hence this nomenclature. The action is similar

to the shooting out the long tongue by garden lizard or by a frog to catch prey. As a matter of fact, a dragon-fly looks like a mechanical contraption, the most efficient flying machine nature has produced.

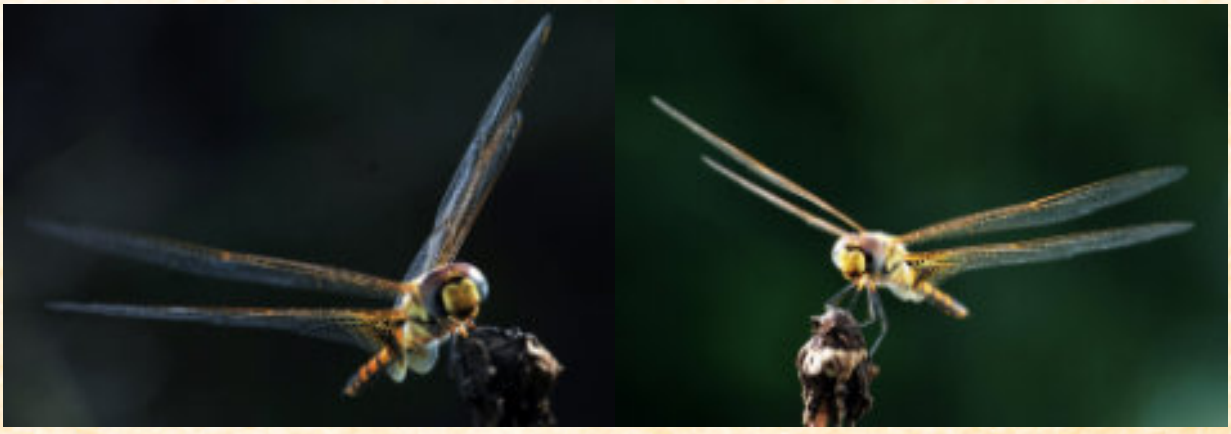
The insect order, Odonata consists of one more species namely the damsel-fly. The name aptly signifies its feeble and fragile appearance. I n comparison to the robust and stout dragon-fly, the damsel- fly appears a weakling, indulging in low level hopping flight in slow speed as if it is perennially tired. Damsel-flies are capable to fold their wings while resting; dragon flies can not replicate this. Dragon- flies always rest with their wings spread horizontally.

So much attributes bestowed to one entity at a time! But it is not without some cost for the dragon-fly has been deprived of the basic faculty of walking though, like all other insects, it has six legs. Is it an example of natural justice? In this balancing act, the dragon-fly has gained speed by sacrificing walking ability. An Australian dragon-fly has said to reach about 60 mph (97kmph). This is the fastest speed achieved by any insect. Undisputedly, the dragon-fly deserves to be crowned a king of the insect world. A beautiful and elegant creature it is.

Watching or photographing dragon-flies is an interesting and satisfying hobby. The dragon–fly exhibits curiosity and may allow the viewer to go close enough for a good shot after familiarization achieved through many attempts.

Presence of dragon-flies is an indicator of a healthy environment. Such extraordinary insect deserves our respect.

Photographs of Dragon-fly



(Text and photographs by **Prabhat Kumar**)
