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Brownfield Development Scenario in India and Prospective Challenges

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ABSTRACT: Sustainable development approach of the contemporary times is vitalizing the potentiality of Brownfields. Future developmental strategies anticipate Brownfield development to confer the optimization of greenfield development strategies. **'**Brownfield Development' is considered to be one of the wisest approaches in the redevelopment applications from the past few decades across the globe. Practicalities demanded a technical approach in identifying and treating brownfields so as to get sustainable results. Successful case examples accorded that scientific treatment of brownfields yielded effective results in US and UK. This paper helps in knowing the characteristics of brownfield sites; understanding the implications of scientific treatment of brownfields with successful case examples across the world. This paper focuses on critically analyzing the scenario of 'brownfield development' in India; contemporary status and expected future challenges. Brownfield development strategy in India is limited to urban planning framework, with a negligible count of technically dealt projects. India, being a developing nation with rich diversity and resource potential, anticipates sustainable results in redevelopment implications. This study predicts certain challenges such as environmental related issues, managerial techniques, technical assistance for remediation, infrastructural development, shortcomings in contemporary methodologies in India etc. And, tried to recommend few strategies by taking due reference from successful examples on real time. Inferring from the predicted circumstantial lattice, this research concludes with identifying the necessity in formulation of an exclusive 'Brownfield Code for India'.

KEYWORDS: Technical Assistance, Herr's Island, Mumbai Spinning Mills, Brownfield Code.

1 INTRODUCTION

"Development is inevitable"

The term "Brownfield" was coined by the Environmental Protection Agency (EPA-US), in 2002. Brownfield sites are defined as "abandoned, idled or underutilized industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived contamination [1]. Brownfield development can be implemented effectively with a proper understanding as well consideration of factors such as economic concerns in real estate, consequential environmental behavior, issues and concerns on public health, land use regulations [2]. Lessons from consequences of conventional climate change also mandated the requirement of environmental protection. Recent studies states that rate of redeveloping brownfield sites are comparatively faster than Greenfield development [3]. Also, brownfield development accords environmental protection and justice with due consideration of concerned issues during redevelopment process [4]. The way the Brownfields are being dealt at global context, especially in US, UK etc., exemplifies the appropriate scientific approaches in the course of redevelopment. Scarcity of available land parcels for new establishments intensifies the importance of brownfields. In India, urban renewal and revitalization processes are being run successfully since many decades, while majority of recent redevelopment strategies are at verge of anticipated application of scientific way treating brownfields.

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2 UNDERSTANDING BROWNFIELDS

Brownfield sites are underutilized land parcels generally falls within the city core and often in the fringes as well in rural areas. There are cases where a whole settlement is isolated and abandoned due to various reasons. Urban morphology confers the then potential utilitarian aspect of the very site; but, with due course of time the same land parcel becomes barely competent for effective further usage. Such land parcels becomes potential brownfields in the course of urban redevelopment, thus minimizing the requirement of virgin land for the sake of future developments. Identifying and earmarking such potential brownfields requires a proper understanding on the attributes and characteristics of such land parcels.

2.1 COMMON CHARACTERISTICS

The following are the certain common characteristics of brownfield sites [5]

- Former manufacturing or industrial land;
- Currently abandoned, inactive or otherwise under-utilized;
- Urban setting;
- Environmental contamination, either real or perceived; and Contamination as the result of prior use.

Additionally, Brownfields can be found at different stages of remediation:

- Wholly unaddressed — no activity past or planned;
- Imminent or planned remediation;
- Partial remediation; or
- Wholly remediated

Land parcels thus identified and earmarked can be conferred for the development by adopting appropriate redevelopment strategies.

3 SUCCESS STORIES ON GLOBAL PLATFORM

3.1 HERR'S ISLAND , PITTSBURGH, NORTH AMERICA

Herr's Island popularly known as Washington's landing is a 42 acre small island parcel in River Allegheny flowing through dense industrial area onto northern part of Pittsburgh. Initially, owned by William Wilson got a patent on the island in 1972, later purchased by Benjamin Herr in 1797 and named after him used to be a huge vacant land parcel accommodating. The Pennsylvania Railroad bought Island into use as a 'midpoint transit halt' for cargo which had fleet from Chicago to New York. Livestock in the cargo were allowed to take rest as many cattle pens were existed; eventually meat packing and rendering facilities were established.

Fig. 1. Herr's Island (or) Washington's Landing, Pittsburgh, PA

The Pennsylvania Railroad bought a portion of the island in 1903 to be used as a stopover for its route from Chicago to New York. Herr's Island served as the midpoint, where the livestock were allowed rest in the many cattle pens located there. Even though isolated from the main city, this island marked its presence for miles around with its emanating stinking smell from the livestock industry, thus called as "Herr's Stink" [6].

3.1.1 ENVIRONMENTAL ISSUES

After 1980s Urban Redevelopment Authority (URA) of Pittsburgh conducted a study was made on the environmental impact in Herr's Island, thus produced a report of environmental Contamination Assessment stating that hazardous and nonhazardous wastes producing noxious odors. Samples of volatile Organics, Semi-Volatile Acids, Base/Neutral Extractable, Pesticides, and Polychlorinated Biphenyls (PCBs) were tested for on the land. Hazardous waste including Poly nuclear Aromatic Hydrocarbons (PAHs), found at levels of 0.4 to 430 ppm, (0.01 to 13 ppm accepted); PCBs, found at levels of 0.01 to 200 ppm (0.01 to 0.1 ppm accepted) were discovered [6].

PCBs are a known cause of adverse reproductive effects, developmental toxicity and tumor development in humans. These contaminants penetrate the body through skin, lungs and gastrointestinal tract and collect in fatty tissues.

Fig. 2. Brownfields of Herr's Island

3.1.2 SITE REMEDIATION

Urban Redevelopment Authority (URA) immediately initiated the site remediation for the benefit of environment; being brownfield development project URA implicated a scientific approach for the remediation for the future utilitarian prospects [7]. The process includes excavation and off-site disposal of the contaminated soils; further encapsulation of the soils underneath, using a High Density Polyethylene (HDPE) double lining which turned to tennis courts (Fig 3 e). Also, leach detection and collection systems began on March 12, 1990 by J.H. Water Systems, Inc., for effective monitoring and maintenance of the total redeveloped vicinity.

3.1.3 CURRENT STATUS OF THE HERR'S ISLAND

A Strategic and systematic approach in redevelopment of Herr's island resulted in a livable neighborhood, and a major source of recreation for inhabitants. Construction of new bridge, signal automation eased many traffic issues. Maritime related commercial activity centers such as Three Rivers Rowing Association, 400 Waterfront Drive, Washington's Landing Marina Inc., were formed after 1985. Initiative by Urban Redevelopment Authority (URA) for installation of four stainless steel groundwater monitoring wells used to test for leaks of PCBs, thus maintaining environmental cleanliness. URA established a neighborhood accommodating 100 townhouses assuring village atmosphere with sophisticated urban infrastructure in 1997 [8], [6]. Also, an architectural firm was commissioned to prepare a foot print with landscaping layout, thus conferring a healthy and serene environment for inhabitants (Fig 3 c & f [9]) [9].

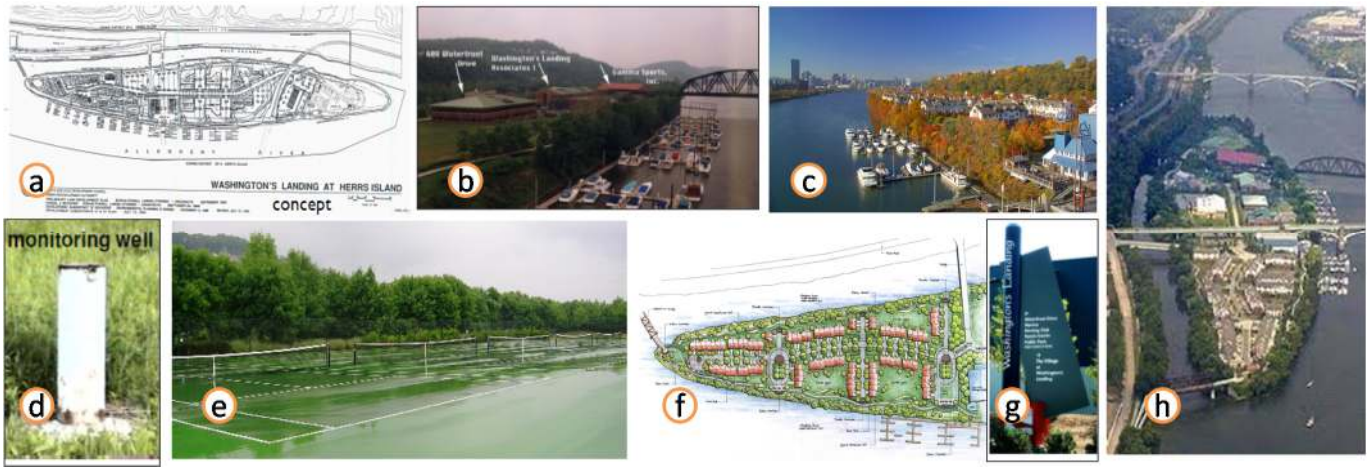

Fig. 3. Herr's Island Redeveloped

"Thirty-five years ago, Herrs' Island on the Allegheny River was notable for just one thing: the nauseating smells generated by the animal rendering plant housed there. What a difference a few decades--and a vision--can make [10].

3.2 CITY OF KINGSTON, REAP PROGRAM, CANADA

3.2.1 OBJECTIVE AND IMPLEMENTATION

Government of Ontario, Canada successfully implemented the Brownfield Development Initiatives in City of Kingston under REAP program; with an objective of 'redevelopment for environment and people' encompassing reducing environmental costs, remove liability, provision for infrastructure optimization, outcome specific focus and encouraging sustainable practices. Ontario Ministry of Environment and Energy explored and studied extensively multiple land use criteria and site specific risk assessment as tools for formulating guidelines such as a) Guidance On Sampling And Analytical Methods For Use At Contaminated Sites In Ontario-1996, b) Guidance on Site Specific Risk Assessment For Use At Contaminated Sites In Ontario-1996 c) Guideline for Use at Contaminated Sites in Ontario-1997.

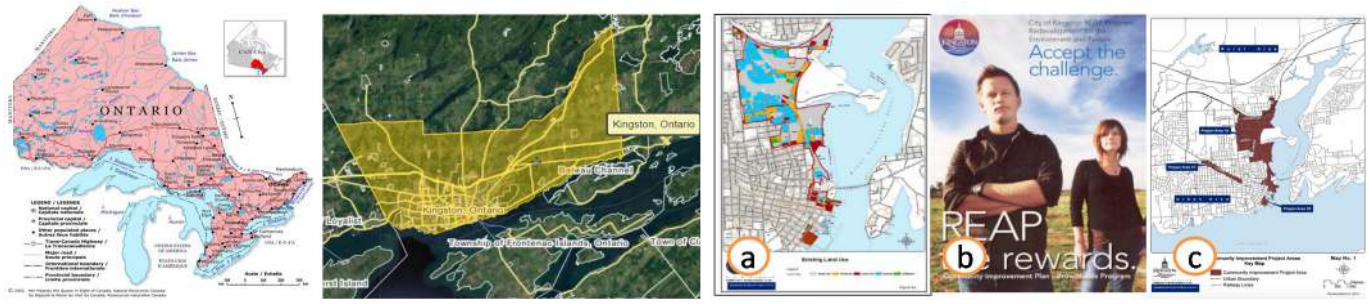

Fig. 4. City of Kingston, Ontario, Canada

City of Kingston, a designated Community Improvement Project by Government of Ontario, revitalized around 529 properties, an old industrial area, infill redevelopment, downtown water front revitalization, inner harbor precinct, and existing commercial core etc., (Fig 5 a-d) for contemporary and future use [11]. City of Kingston with The Province, initiated the brownfield redevelopment program successfully with due consideration of all the formulated guidelines and commissioning technical expertise for execution. Certain managerial strategies in planning and implementation of Kingston REAP program brought effective anticipated results for all the stakeholders, such as Provincial Incentive Program, Brownfields Financial Tax Incentive Program (BFTIP) (Fig 5 e), and Tax Increment-Based Rehabilitation Grant Program (TIRGP) (Fig 5 e) [12].

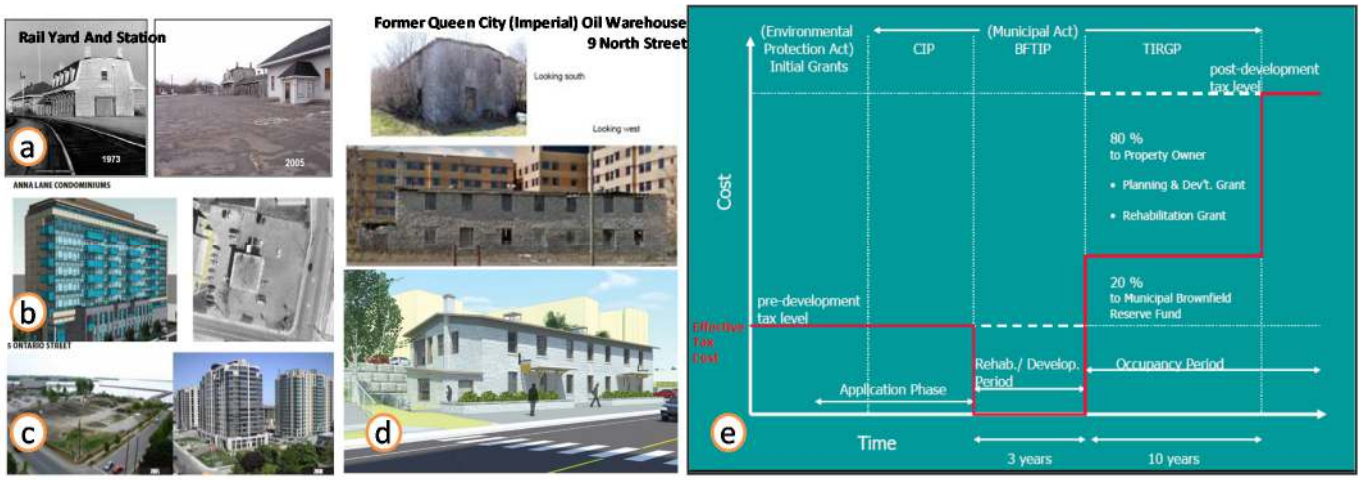

Fig. 5. Brownfield Development in Kingston - REAP Program

3.2.2 BROWNFIELDS FINANCIAL TAX INCENTIVE PROGRAM (BFTIP)

Kingston REAP Program strategy of 'Brownfields Financial Incentive Program (BFTP)' attracted and benefitted the stakeholders in all the possible ways. Local Authority provides Initial Study Grant (50 % of coat) for the preparation of assessment repots. Exemption given from paying Property Tax for all Municipal as well educational properties, during remediation or construction time; for a maximum period of 3 years.

3.2.3 TAX INCREMENT BASED REHABILITATION GRANT PROGRAM (TIRGP)

Post Occupancy, Kingston municipality levies 100% increment to pre-developmental tax. 80% of tax thus paid will remitted towards remediation costs as well Rehabilitation Grant to the property owner. 20% will be remitted towards Municipal Brownfield Reserve Fund. This provision will be continued for 10 years span. Thereafter property owner needs to pay 100%. Thus, Municipality assured the redevelopment with an appropriate community participation and liability.

4 SCENARIO IN INDIA

India with its rich resource potential, many industries were established during 1850-1900. With the introduction of railways by the British for conveying cargo catalyzed the rate of development of such industrial and colonial settlements. Many Railway Towns were established. With the increment rate of in-migrants into such towns for decades together resulted in high densities, congestions, unhygienic conditions, lack of services etc., thus resulting in urban blight. "Being a developing nation, can India afford to abandon huge parcels of potential brownfields?"- The debate during early decades after independence provocatively triggered the advocacy in redevelopment codes and regulations. Government of India started formulating and implementing urban renewal and urban revitalization strategies for the sophistication and up gradation of social and physical infrastructure by then, which could meet the demands in near future. Delhi, Bombay, Kolkata governments took early initiatives for redevelopment and could able to set standing examples in India. Many other municipalities started renewal programs [13]. In 2005 Remarkable step was taken for urban renewal in India by Jawaharlal Nehru National Urban Renewal Mission (JNNURM) with motto of integrated development; worked on objectives such as provision of basic services to the urban poor, also to assure security of tenure at affordable prices, sophistication of physical infrastructure, sanitation. The Mission also intended to provide proper education, health and social security for the urban poor [14]. However, all the redevelopment strategies implicated to both large scale as well small scale projects in India were formulated and implemented under the framework of prevailing urban planning norms and guidelines; with prime focus on addressing various issues such as land use, up gradation of social and physical infrastructure to meet the future requirement, but with little focus on scientific approach in dealing brownfield sites.

4.1 TEXTILE MILL LAND REDEVELOPMENT, MUMBAI

The First Indian cotton mill, "The Bombay Spinning Mill" was established in 1854 to curb the textile importing expenses. The rate of establishing Cotton mills exponentially grew within few decades i.e., by the end of 1895s there were 70 mills and

further 13 mills were launched by 1915. With the strong competition given by Japan mills started declining immediately after independence [15].

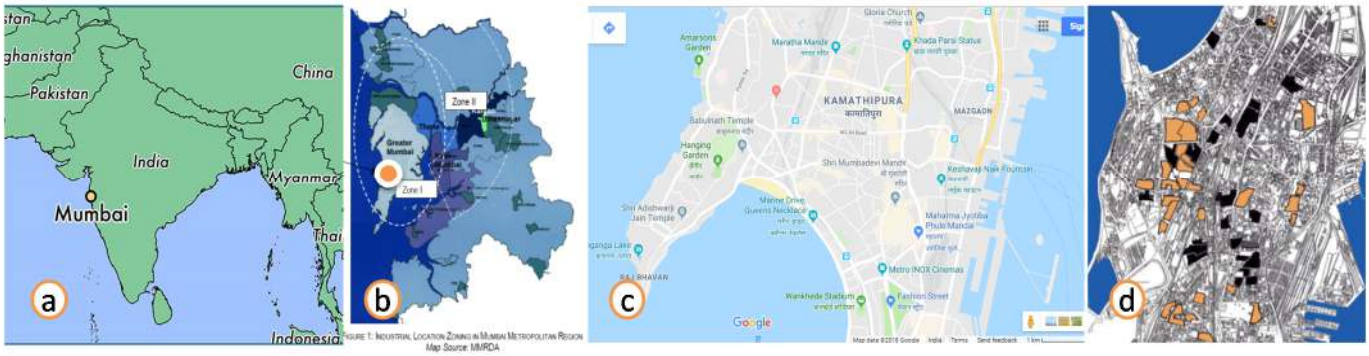

Fig. 6. Location of Textile Mill Land in Mumbai

Around 50 Textile mills were located in "Girangaon" meaning "Mill village in central Mumbai by 1950s, spread over dedicated land of 600 acres for the development of textile industry. The vernacular settlement typology of mill workers, community as well societal attributes of Mumbai mill workers predominantly characterized mill precincts for decades [16]. Cotton mills were given to mill owners by erstwhile colonial Bombay government at concessional rates to promote industrial production and were booming till 1970s. Taking over by Power loom sector in Mumbai by 1980s, certain managerial issues, series of strikes for longer durations by mill workers coffined the operation and maintenance of cotton mills. Thus, within no time out of 58 cotton mills, 26 were deemed to be 'sick', eventually taken over by Govt. of India; other 32 were under private ownership. Gradually deprived private patronage for running of mills has given rise to urban blight in the central Mumbai.

State Government of Maharashtra sought redevelopment of the cotton mills land with an objective of generating open spaces and public housing for the city to create coherent urban form (Fig 7 a-b). As per Development Control Rule 58 imposed in 1991, mill owners were given a provision to sell the mill land by satisfying the following mandatory clauses.

a. Bombay Municipal Corporation (BMC) should be handed 1/3rd land,

b. Maharashtra Housing and Area Development Authority (MHADA) to get 1/3rd land. Out of which half land should be given to housing projects for mill workers.

c. 1/3rd land is to be developed by Mill owner [17].

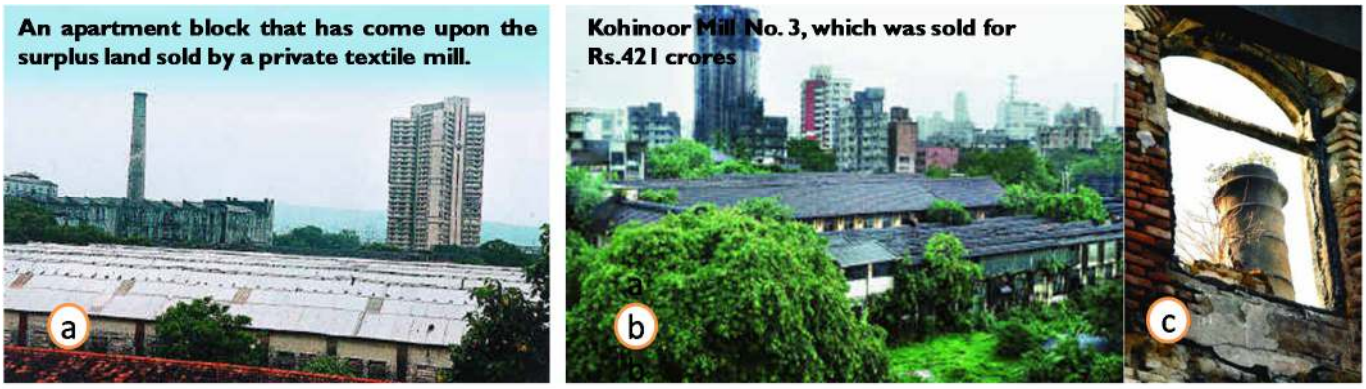

Fig. 7. Mumbai Textile Mills Redevelopment

Mumbai Mills Redevelopment set a remarkable example for effective redevelopment strategy that promoted gentrification in Central Mumbai. Many of the abandoned mill lands were revitalized / retrofitted for contemporary utilitarian aspects. However, the total process has been executed with a proper developmental regulation code of conduct. Redevelopment

sought by equitable disbursement of land with respective liabilities among all the stakeholders, confered the success in the league.

4.2 "IN-BETWEEN" ZONE OF NEW DELHI

"One of the most challenging developments in cities around the world is renewing and reusing sites that are abandoned, out of use, or have to be renovated to meet current needs at present day standards. This reuse of sites contributes to the compact city concept, because of their location within the existing city boundaries."

Delhi's Master Planning framework is based on a hierarchical system of developmental zones addressing different levels of population needs starting from the neighborhood; the community, the district and further to the zonal and city-level. Delhi, known for its adaptability throughout its transformation from Shahjahanabad to New Delhi, witnessed various redevelopment programs even few centuries ego. Many initiatives have been taken for redevelopment within Delhi; extensive studies executed, recordings, documentation, surveys, feasibility analysis reports were made to accord the sustainable outcome. Recently, revitalization of Shahjahanabad (walled city of Delhi), Chandini Chowk Redevelopment Plan were proposed and executed [18]. The Delhi State Industrial And Infrastructure Development Corporation Ltd. (DSIIDC, 1971) has played a key role in shaping the industrial growth and relocating them into zones specified.

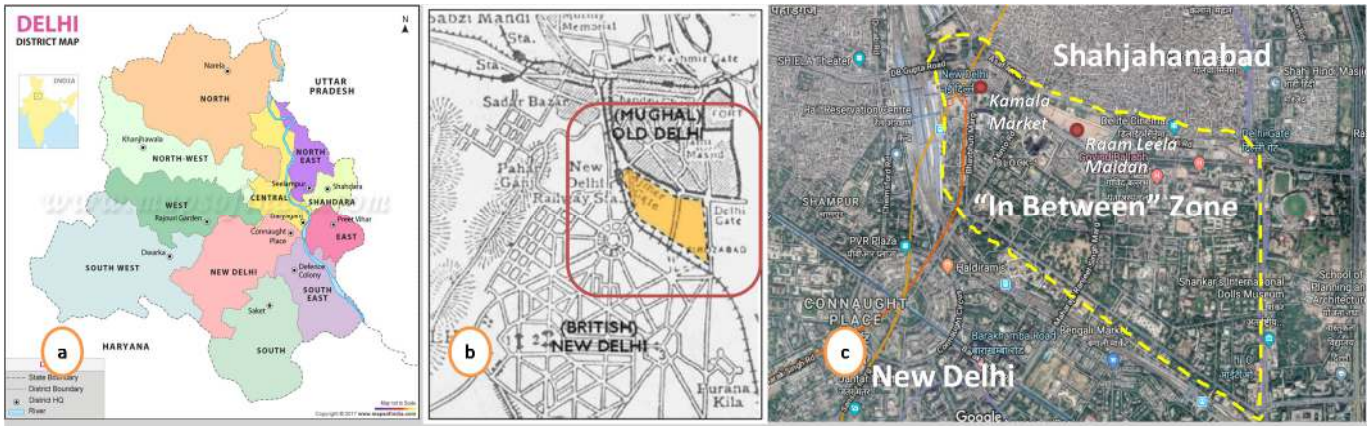

Fig. 8. "In Between" Resource: Area between Shahjahanabad and New Delhi

Transformation in urban fabric of Delhi was influenced by vivid administrative liabilities, cross cultural traditions, planning interventions throughout the centuries. In 1912, Sir Edwin Lutyens proposed a planned development towards southern quadrant of Shahjahanabad, intended to be the 'well-designed capital city of India''. Exclusive capital city with prime focus on designing an administrative quarter was formed by delineating the existing walled city. Shahjahanabad (walled city) has become 'Old Delhi', with its blighted settlements. An area along the outer periphery of old city has been conceived as a buffer zone " in-between" the above two predominant areas of Delhi; incorporating Kamala Market, Ram Leela Maidan, few buildings, open packets, parking lots, few city level amenities and squatter settlements

The "in-between" zone falls amidst a historic core of the walled city of Shahjahanabad exemplifying ''Medieval Urbanism' and Edwin Lutyens Delhi, a well manifested futuristic vision with western character; thus, having a challenge to balance both the characteristics with its redevelopment implications and imageability. The very precinct had large vacant parcels unoccupied, available for the development at the centre of the city to cater contemporary needs. Development authorities conceived the same area as potential brownfield for mediating old and new, also by bridging the gap at all levels of existence; aiming to promote and enhance functional, physical and sociological coherence [19].

4.3 RAIL LAND DEVELOPMENT AUTHORITY, INDIA

Indian Railways played a prominent role in shaping India's social and economic development right from the inception. Considered to be the fourth largest railway network in the world with its huge infrastructure is efficiently catering the needs of passengers and cargo conveyance. Indian Railways with a rich history of over and above 100 years constitutes designated land parcels and buildings across the country, serving as amenities. Successful operation and maintenance for many decades resulted in blight of such land parcels, building precincts. To address this issue Rail Land Development Authority (RLDA) was

established, set up by an amendment to Railways Act, 1989; with a prime objective of development of vacant railway parcels for commercial use so as to generate revenue [20].

Age old railway buildings such as staff quarters, office complexes, railway stations and precincts which are on the verge of deterioration and dilapidation are being taken over by RLDA for subjecting them to redevelopment strategies such as retrofitting, revitalizing to meet contemporary and future needs [21].

4.4 Recent Trends In Brownfield Development In India: Case Example - Sabarmati Riverfront Development

In early 21st century, with the advancement in awareness on 'scientific approach in brownfield development strategies adopted by developed nations', motivated Indian Government to implicate the similar site specific strategies for attaining an appropriate sustainable solutions. A remarkable example, Sabarmati River Front Development is a successful working project. The Riverfront Project was envisioned in 1960s; but, in 1997 Ahmadabad Municipal Corporation (AMC) launched Sabarmati Riverfront Development Corporation Limited (SRFDCL) to manage the construction and development. Project commenced after the preparation and submission of "Feasibility Report" by Environmental Planning Collaborative.

The Riverfront Project created an opportunity to develop a public riverfront onto the either banks of River Sabarmati for a stretch of 11.25 Km; with total land reclamation of 202.79 hectares by channeling the river to a constant width of 263m, also with reclamation of riverbed land. Sabarmati Riverfront Project prioritized objectives with various concerns such as a) Environmental Improvement: to control soil erosion and thus flood, proper sewage diversion management to assure the cleanliness of the water, retention of water and recharge; b) taking care of resettlement and rehabilitation of riverbed dwellers; c) to promote social interactions by providing socio-cultural amenities, parks; d) Anticipated sustainable development with revitalization of surrounding neighborhoods and assuring a continuous generation of resources [22].

5 Prospective Challenges In Brownfield Development in India

Scenario of brownfield development in India infers, the practice of redevelopment strategies in identified underutilized parcels are being perceived to be dealt under regulatory framework of urban planning', predominantly. Exploration of proposed redevelopment approaches are being carried out by due consideration of parameters such as inclusive development, land use characteristics, demand driven proposals, future demand etc. Thus, any renewal and revitalization programs executed in any underutilized parcels can be considered as brownfield development activates. Certain strategies such as pre-identification of probable brownfield sites, site specific technical analysis, scientific remediation procedures, proposing an appropriate and compatible utilitarian aspect after the treatment etc., will be able to give anticipated results with optimization of effects on environment and surroundings thereafter. A systematic and scientific approach in dealing brownfields would definitely accord the sustainable redevelopment. Certain code of conduct in brownfield development, with due consideration of the above discussed issues will be able give an appropriate solution for building better India. Following are certain recommendations proposed in accordance with challenges foreseen, in anticipation of streamlining contemporary strategies, with due consideration of inferences from past history of redevelopment and, for the betterment of sustainable brownfield development practices in India.

5.1 Environmental Concerns

5.1.1 Contaminated Sites

Rapid urbanization and industrialization in India is an Indicator for fast growth of the country. Industrial development started in India in mid 1850s resulting in the establishment of many industrial cities, colonial settlements across the country. There was a rapid growth in industrial development in India after World War II; the then industrial land parcels established in the urban fringes, with the expansion of the city, now moved to the center of the city being underutilized parcels due to wear and tear and retarded functionality. Such potential brownfield sites within contemporary CBDs; eventually, demanding the gentrification of the property. Many industries continuously pollute the surroundings (air, water and soil) with effluents, thus becoming catalysts for contaminating the environment within respective influential boundaries. There are so many types of industries, respective effluents which results vivid contamination typologies. So, it is always preferable to know the attributes as well behavior of constituent contaminant for proposing suitable remediation mechanism; further helps in suggesting an appropriate new development which is sustainable. Soil Salinization, top soil contamination, sub strata contamination, ground water contamination are some of the important concerns to look at in site investigation and further remediation.

5.1.2 CONVENTIONAL CLIMATE CHANGE

Conventional climate change warned the increment in frequency of occurrence of disasters across the globe, and forecasted the equal chances for eventual occurrence of devastated land parcels. In this regard, preparedness for resilient applications with proper scientific approach can minimize the probable intensity of damage thereafter.

5.1.3 ENVIRONMENTAL JUSTICE

Environmental Protection agency (EPA) defines Environmental Justice (EJ) as a fair treatment and meaningful involvement of each and every section of the society irrespective of caste, creed and economic stature. EPA encourages voluntary involvement of people in development, implementation and enforcement of various rules, regulations, policies and laws related to environment, thus making responsible stakeholders in protection of environment.

Being stakeholders, people have an opportunity to participate and express concerns while taking decisions which may affect their environment / health. Such concerns will be considered during decision making process. However, each individual as well every group within the community ought to bear equitable share of any negative environmental consequence, caused by industrial, commercial or governmental policies [23].

5.2 SCIENTIFIC TREATMENT OF BROWNFIELDS

Treating a brownfield site scientifically yields an appropriate sustainable solution. Scientific treatment considers all the attributes within past layers of the very site; critically analyses the condition of the site; recommends appropriate site specific remediation mechanisms; execution under technical expertise mitigates anomalies; logically derives the appropriate utilitarian factor that to be imposed on developed site; preparing and promoting the site suitable for anticipated utilitarian values. The process accords a logical approach in identification, assessment, analysis, execution and treatment of brownfield sites in a sustainable manner.

"Is India equipped with appropriate technical expertise for scientific development of Brownfield?"

Unfortunately, the rate of this application in India is negligible. The advantages of technical advisory as well scientific assistance in treating brownfields is not widely known in India yet. Lack of availability of trained professionals / technical expertise / consultants with acquired knowledge; and high commissioning charges for such applications are becoming the retarders to opt such services. Commissioning a technical team might increase in remediation costs, but with a strategic planning one can expect break even in lesser time than intended. The implication of technical approach will be advantageous for environment and stakeholders.

Technical Assistance to Brownfields (TAB) Community Program, an Environmental Protection Agency (EPA) initiative extends technical assistance in redevelopment of brownfield sites. Prime objective of this program to make people understand the risks associated with already contaminated properties as well potentially contaminated sites; also, bringing out awareness in people how to identify, assess and treat the contaminated properties in a sustainable manner for effective reuse. EPA also extending its support by funding certain agencies such as Kansas State University (KSU), Center for Creative Land Recycling (CCLR) and New Jersey Institute of Technology (NJIT) to be the resource centers and extending technical assistance. TAB does have an extensive network of skilled professionals across the country. The best part of TAB is service will be provided at no cost basis, thus promoting a prompt brownfield development for all the communities including underprivileged across the nation [24].

India is developing nation with an incremental rate of urbanization, consisting of vast population, rich geographical diversity and various climate zones; requires a strategic approach in developmental strategies. Research and application of scientific treatment of brownfields optimizes the requirement of virgin land area requirement for development, also rich diversity demands the site specific treatment mechanisms. Research based agencies such as Tata Energy Research Institute (TERI) contributed in preparation of manuals for application of appropriate technologies with region specific conditions for achieving sustainable goals across India [25]. Global Consultants such as SGS group India is offering technical and managerial solutions for redevelopment of abandoned and contaminated sites [26]. However, competency in technically treating brownfields and a proper service chain mechanism needs to be reinforced in India. Thus, increment in quantum of research and technical expertise in scientific treatment of brownfields is anticipated in India within near future.

5.3 FORMULATING BROWNFIELD DEVELOPMENT CODE FOR INDIA

Literature confers the reinforced laws that accord Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) by United States Environmental Protection Agency (USEPA) taking the initiative in cleaning up abandoned or accidentally formed contaminated sites; by providing Federal "Superfund". EPA cleans up the sites with unidentifiable titles [27]. And the subsequent accompanying Superfund Amendments and Reauthorization Act (SARA) passed in 1986, landowners are held strictly responsible for releasing hazardous substances on their property, and liable in assisting Environmental Protection Agency (EPA) for cleaning up activities, before selling of such properties. The law authorizes both short time cleanup activities as well long term remediation processes [28].

Regulatory body shall adopt certain managerial strategies as listed below, which would help in effective execution of the brownfield development activities; also, will be able to promote community participation and partnership in redevelopment activates; likewise, reinforce the social responsibility.

- Formulation of Brownfield Development Code
- Strict implementation of streamlined code
- Making mandate the scientific treatment of brownfields
- Commissioning relevant / site specific technical expertise
- Provision of financial assistance for cleaning up activities
- Incentives such as tax holiday, subsidy / grant for execution of remediation
- Disincentives / penalties for violations and misconduct
- Making landowner held liable for contamination etc.,

5.4 INFRASTRUCTURE AND SPATIAL QUALITY IN BROWNFIELDS

Spatial planning and Infrastructure developments are the key parameters as well driving tools for any kind of development. The task becomes more challenging when it comes to redevelopment. Any kind of redevelopment especially brownfield development demands an appropriate and sustainable solution. Conceiving something on a virgin piece of land during spatial planning requires comprehensive visualization caliber; but, for a brownfield its essential to have a command on overall attributes of the site, sometimes spatial planning may encounter certain constrains from past records. Developing infrastructure for a new development is an interesting task as it encompasses contemporary and future requirements while planning. But, developing infrastructure for a brownfield is more challenging and needs to e dealt with utmost care as it withholds series of layers beneath the proposed redevelopment. Development of brownfields creates an opportunity to opt sustainable planning approach and appropriate infrastructure management; as there is possibility for corrections, appropriations inferred from the past history while going for redevelopment. So, the following all some of the observations made which needs attention while planning a redevelopment or brownfield site.

5.4.1 PHYSICAL INFRASTRUCTURE

A fair opportunity will be created to design/upgrade/sophisticate all the integral components of physical infrastructure such as electricity, transportation facilities, roads, water supply and sanitation, solid waste management, information and communication technology etc in brownfield site. Among all, water supply and sanitation, especially ground water resource becomes more vulnerable while dealing with contaminated or potentially contaminated sites. Redevelopment demands an appropriate remediation mechanisms with due testing for constituent contaminations in ground water table and soil.

5.4.2 SOCIAL INFRASTRUCTURE

Presently, the practice of provision of social infrastructure as per demographic requirement is in vogue. Proposing social infrastructure for brownfields requires careful decision making to suit the compatibility with the anticipated development with that of the then existing physical attributes of the vicinity. Suitability and adaptability of particular proposal is a challenging issue.

5.4.3 LANDSCAPING

Landscaping controls the micro climate, intensifies aesthetics of the surrounding environment. The opportunity thus created for landscaping brownfield vicinity demands a careful and wise approach in selection of species which are compatible

with the existing topographical conditions, tolerant to technically remediated site conditions, anticipated resilience. Preferably indigenous, drought tolerant species gives a sustainable solution.

5.4.4 URBAN DESIGN

Urban Design is a bridging tool between spatial planning and physical planning. Urban design helps in maintaining harmony, balance, coherence of a given urban setting. Urban design approach intensifies the quality of imageability. So, implication of urban design in developing brownfields gives an appreciatable result.

6 CONCLUSION

The quantum of research as well application of technical expertise in brownfield development is not being executed in high spirits in India, even though various public and private organizations are pooling efforts for redevelopment of various underutilized parcels. There is a necessity for streamlining the technical methodology for identification, earmarking, application of appropriate mechanisms shall comprehend the sustainability of urban areas in India. Understanding the past layers of selected brownfield, adopting appropriate scientific approach in remediation for the anticipated development certainly accords a meaningful sustainable development. Thus, for the benefit of context, it is advisable to recommend the preparation of 'National Brownfield Code' for India, which helps in identifying, earmarking and treating brownfields scientifically.

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