ISSN: 2456–5474 RNI No.UPBIL/2016/68367 Vol.-6* Issue-10*November- 2021
Innovation The Research Concept

Environment and Development Crisis of Sustainability : A Case Study of Village Mukhmelpur, Delhi

Paper Submission: 10/11/2021, Date of Acceptance: 23/11/2021, Date of Publication: 24/11//2021

Tejbir Singh Rana
Associate Professor
Deptt of Geography
Shivaji College,
University of Delhi,
Delhi, India

Galina Rana
Research Scholar,
Dept. of Economics,
IIT, Roorkee,
Uttarakhand, India

Aarushi Joon
Student,
Delhi Public School,
Sushant Lok,
Gurugram, Haryana,
India

Abstract

The human developmental activities always resulted into crisis with pristine sanctity of environment. The rural urban fringe of Delhi experienced the acute pressure on land, water and air resources. The study area is a village Mukhmelpur located in river Yamuna flood plains in north Delhi. The village has experienced significant changes in its land use pattern during post green revolution era. The construction of embankment to mitigate flood on river Yamuna, diffusion of technology and automation in agricultural sector, cropping intensification and expanding settlement for habitation altogether resulted into degradation of croplands, depletion of ground water table and encroachment over surface water bodies. The forested area is dwindling, common land resources are under acute pressure. Water channels become drain to flow the industrial and domestic pollutants. Ground water table has depleted at alarming speed due intensive cropping of water guzzling rice crop. Ground water contamination by industrial pollutants flowing through canal altered ground water as non potable. Though, farmers innovative efforts for sustainability are changing human response to natural resources and environmental conservation. Installation of biogas (methane) plant and solar power plant in accordance to the natural conditions leads to sustainable development.

Keywords: Cropland, Sand, mining, BrickKiln, Prosopis Juliflora, Persian Rahat, Waterbodies ,Canal, Embankment, Groundwater Table, CropIntensification.

Introduction

The diffusion of technology and automation in farm sector during Green Revolution brought significant pressure on natural resources at local level in India. The net sown area under food grain crops increased at large scale by altering the village common land, pastureland, and rangeland even the localized water bodies into croplands. Shifting from the animate power to mechanized farming during 1970s in north Indian plains resulted into mass production of food grain crops and led to monoculture farming. Subsequently, the farmers perception towards localized natural resources become more exploitative ignoring its consequences and limitations. The resources of commonalities in the villages (common land, forested area, water bodies and pastureland etc.) are the most threatened and vulnerable to get depleted. There is least administrative control over the management and conservation of village resources of commonality.

The introduction of tractor and electrification in agricultural practices increased the economic divide between farmland owners and landless communities in villages. The landless communities in the villages become most vulnerable of mechanization in farm sector. They lost their seasonal employment at farmland and share of farm products as the source of economic livelihood. Simultaneously, the encroachment and depletion of village common land by land-owning communities for croplands exhausted the alternate source of economic livelihood for landless communities in villages. The increased gap between rich and poor forced the working youth of landless communities to out-migrate from the villages to nearby urban centers in search of employment. Altogether, it dismantled the social fabric of interdependency between land owning and land less communities and reduced the carrying capacity of villages at micro level. In post green revolution phase, in north Indian villages the youth of landless communities completely deviated from agricultural labour and related economic activities and all farming and related activities are substituted and performed by immigrated laborers from other states particularly from flood disaster prone regions of eastern India.The nature and quantum of availability of natural resources of a village is determined by the geographical parameters as relief, topography, weather conditions, drainage, pedology, biomass, site, and situation. Whereas the intensity and level of exploitation of natural resources are determined by the proximity to urban areas, mode of accessibility, diminishing return from farm sector and demographic

composition. The mobility of youth and nature of their economic dependency on primary, secondary, or tertiary sector greatly determined the perspectives of exploitation of natural resources of the region

The availability, feasibility, and acceptance of technology by the varied social groups significantly deviate the human modus-oprandi from the conservation and management of localized natural resources. The introduction of LPG cylinders for domestic cooking purposes to rural communities helped in enhancing the biomass in the region. The availability of local vegetation served as the important source of fuel wood for cooking in the villages and the acceptance of LPG by all the economic strata of society reduced the chopping of tree cover. The introduction of paper pulp, ply and card-board industry in Yamuna Nagar region enhanced the biomass cover significantly as majority of farmers started growing poplar tree as agro-forestry in north Haryana. Poplar is the fast-growing soft wood tree which thrive in cold and moist conditions which provides cellulosic wooden material for the wood-based industry and the north Haryana region is ideally suited for the growth of plants

Significance of Study

The intensification, mechanization, and extension of agriculture after green revolution in India registered significant change in farm practices. The shift in cropping pattern from crop diversity to monoculture of food grain crops and rapid increase in gross sown area are the major dimension of land use change. The continuous application of chemical fertilizers over the decades along with insecticides, pesticides and weedicides increased deteriorated the quality of soil with increased sodacity. Intensive cultivation of water guzzling rice as commercial food grain crop during summer kharif cropping season depleted the surface water bodies and ground water table significantly. The increased population size and improved quality of life in rural habitations started discharging large amount of domestic and sometimes industrial wastewater which polluted the pristine sanctity of localized water bodies in villages. In order to maximize the profit from farmlands and extension of cropland by the farmers further encroached upon village forests and common land which reduced the biomass cover from minimum to negligible.

Encroachment on village common land for cropland extension by the farming community leads to the extinction of flora and fauna of forests, wildlife species, birds, reptiles, rodents, and overall biodiversity of the region. Common land of the village is also the source of natural catchment of rainwater for the localized water bodies in accordance to local area topography and slope. Therefore, the number, size and quality of surface water bodies in villages have decreased drastically in last decades. These localized water bodies determine the size of domesticated livestock population for milk and controls the ground water table by recharging it in accordance to weather conditions of the region. The availability of water bodies in rural habitat determines the biodiversity of flora, fauna and carrying capacity of the region.

The increasing pressure on natural resources is creating conflict of survival and sustainability of humanity at local level. The economic dependency on agriculture is reducing due to its diminishing return of investment. Rural youths are searching opportunities to migrate out to urban areas for their livelihood. Farming specialization leads to minimize the intra-regional dependency and shifting on inter regional dependency. The food mile distance has increased manifold and diverse availability of localized food items in accordance with cropping seasons get minimized. Ground water is contaminated with arsenics and heavy metals and become non potable. Farmlands are altered for varied non farming economic activities as construction of warehouses, recreational activities, and commercialized playgrounds etc.

The study will make an inventory of environmental issues due to agricultural intensification and disappearance of resources related to common land at micro level and suggest the road map for sustainability. Changing perspectives of human perception of different economic strata towards natural resources will be interpreted. The automation in agricultural sector forced the large number of rural unemployed youth particularly from landless communities to big urban centres. The combination of industrial and specialized tertiary sector in big urban centres offered perennial employment to all strata of workers. Delhi being the capital city with large base of small-scale industries and trade activities with huge potential the employment become the destination of inter state immigrants. Subsequently, the population of Delhi city exploded from 40.65 lakh in 1971 to more than 205 lakh in 2021. The five times increase in population size in five decades registered horizontal increase in

geographical extent of urban Delhi. Therefore, farmlands in the urban periphery are altered in non-farming activities to meet the urban demand. Simultaneously, the human pressure on natural resources especially croplands, village common land, forests and waterbodies in rural urban fringe get multiplied with distance decay factor. The natural resources of villages near the urban margins get depleted at faster rate than the villages located at distance and poor accessibility.

For the micro level study to analyse the depleting intensity and frequency of natural resources due to mechanization in farm sector and urban expansion village Mukhmelpur is identified which is located in rural urban fringe of north Delhi.

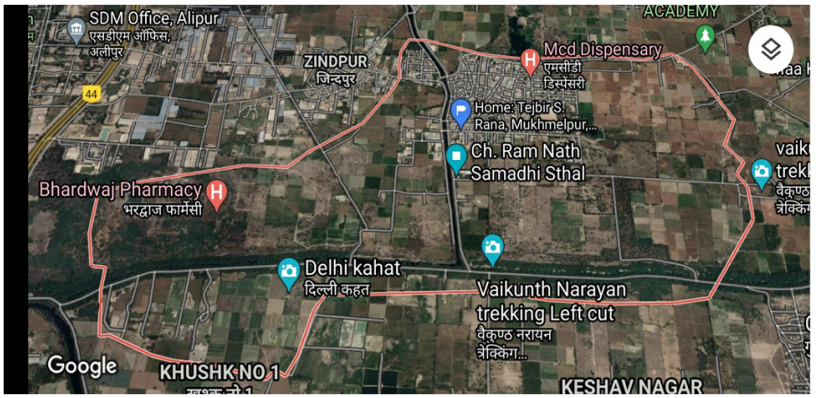
Objectives of Study

1. To identify the nature of increasing pressure on natural resources in the village.
2. To enquire about the intensity and frequency of depleting natural resources of the village.
3. To suggest the sustainable road map for human and natural resources coexistence.

Study Area and Methodology

The study area is the erstwhile flood prone village Mukhmelpur located in northern part of Delhi between river Yamuna and G. T. Road. Village Mukhmepur experienced its last flood of river Yamuna in 1978 and the construction of dam on the right margin of river Yamuna in 1980 leads to the water stressed conditions. Before 1978 flood, village habitat used to receive surplus water through the canal (Bawana Escape Canal and Drain No. 6) from river Yamuna but after the flood, the source of water from river Yamuna was disconnected. The village revenue area is dissected in three different pockets by these canals. Before the construction of regulator barrage Hathni Kund at Tajewala, Haryana in the upper course of river Yamuna, these canals were constructed to absorb and divert the flood water of river to low lying areas to save Delhi city from the disaster. The diversion of river water for irrigation particularly after the green revolution, inconsistent rain in catchment and construction of dams on river Yamuna altogether led to drastically reduced the discharge of river and village become water stressed. The farmers shift towards the cultivation of rice as commercial crop leads to the ground water table depletion at rapid pace from 20 feet in 1980 to 200 feet in 2021.

Map 1 Satellite Image of revenue area of Village Mukhmelpur, Delhi-110036



Source: Google map on 20-05-2021. Outer boundary line of village revenue area has minor exaggerations.

The relief features of the village carry remnants of oxbow lakes with low lying features and poor drainage. The habitational area of the village is encircled by canals from two sides whereas to protect the settlement and crops from Yamuna flood, villagers constructed the 3.40-kilometer-long earthen dam in remaining two sides through self help group in 1960s. The soil of the village ranges from alluvial to clay loam at different locations which is ideal for cereals, pulses, oilseed and green fodder. The construction of right margin embankment on river Yamuna in 1980 leads to complete withdrawal of flood water from the village and resulted into the loss its soil fertility. The soil is poor in nitrogenous nutrients therefore farmers use bio manure and chemical fertilizers to grow the wheat and rice as food grain crops. The village common land is widely covered with prosopis juliflora, an invading specie of thorny bush tree which has

completely replaced the native acacia nilotica (babool). Riparian forest of invasive bushes and trees of prosopis juliflora evolved along the canals, earthen dams and fallow land in the village.

The population of the village was 4911 persons in 2011 and it increased to approx. 6000 persons in 2020 with its heterogenous social fabric. The population of the village belongs to three major social strata as a). farmland owning communities, b). scheduled caste landless farm labourer communities and c). artisan communities of allied skills and services as blacksmith and barber. Formal and informal service sector is the main source of livelihood of the villagers. Farming is performed by a few farmers and none of the farmer is exclusively dependent on agriculture. The close proximity of the village with the urban area offered series of allied occupation that leads to deviation of farmers from farming activities. Majority of the farmland owners transferred their croplands to the private developers and left the agricultural activities as source of livelihood. The automation in agriculture completely deviated the local and native landless labour from the farm activities. Subsequently, farmers become dependent on seasonal immigrant labourers from flood disaster prone eastern Indian states for farm activities.

Land Use Change and its Impact on Natural Resources

The proximity of urban centre and diminishing return from agriculture in post green revolution phase leads to rapid change in land use pattern of the village. All types of land whether private or public, cropland or forested, habitational, or common land areas registered significant diversifications. The automation of agriculture resulted in the form of intensification of farming. The intensive farming of food grain crops of wheat and rice in alternate cropping seasons for commercial purposes depleted the ground water table from 30 feet in 1980s to about 300 feet in 2015 due to its excess withdrawal by tube wells. Subsequently, the input cost for raising the crops increased to the limit that profit margin get decreased and farmers deviated from its dependency. The small and fragmented land holdings, availability of alternate sources of livelihood to meet the urban needs and depleting quality of soil also forced the farmers to deviate from farming to tertiary sector for livelihood.

In last three decades, 70% of the total cropland of the village is utilized for manufacturing bricks by removing top 7 feet soil for its Kilns baking and 30% of the cropland further quarried up to the depth of 40 feet for sand mining. The sequent removal of fertile topsoil by quarrying and sand mining activities disturbed the irrigation channels, passages to access the farmlands and evolved the plain topography into undulated and wasteland. All such non replenishing exploitation of farmland depleted its ground water, soil fertility and crop productivity which leads the farmers to search alternate sources of livelihood. Such farmlands remained non cultivable wasteland for decades due to waterlogging and undulated topography. After the quarrying and mining of topsoil and sand for building construction purposes, the farmland cannot formulate the fertile soil for cultivation for decades and meanwhile farmers deviated to alternate economic activities and sold out the farm machinery. The gradual change in sequent-occupance forced the farmers to sell out its farmlands mainly for non-farming activities to meet the needs of expanding urbanization as settlement, warehouses and recreational grounds.

The village Mukhmelpur (28 78’ North and 77 15’ East) in Delhi has gone through drastic changes in its 562 Acre (One Acre farmland size is equal to 4840 yard square) of total land in past three decades. It put acute pressure on its environment and natural resources for sustainable livelihood. Net sown area and surface water bodies decreased whereas cultivable waste land of the village has increased drastically from 1990 to 2020.

Table1

Changing Land Use Pattern of Village Mukhmelpur,Delhi from 1090 to 2020.

S. No.	Land Use	1990 (Area in Acre and percentage)	2020 (Area in Acre and percentage).
1.	Cropland/ Cultivated Area	407 (**72.42%)**	75 (13.34%)

2.	Forested/ Pasturelands/ Village Common Land.	**106** (18.87%)	**170** (30.25%)
3.	Traditional Water bodies, Ponds, Talab etc.	6 (1.06%)	1 (0.17%)
4.	Public Utility, School and Cottage Industries.	6 (1.06%)	5 (0.88%)
5.	Settlement: Village Habitation.	31 (5.52%)	54 (9.62%)
6.	Recreational grounds/ Farmhouses.	6 (1.06%)	24 (4.28%)
7	Culturable Waste and fallow barren land.	--- (00%)	233 (**41.46%)**
8	TOTAL	562 (100%)	562 (100%)

Source: Based on extensive field study with village headman.

There is significant decline observed in cultivated area of the village. During 1990smore than 72% of the total area of village was the cropland which reduced to 13.34% in 2020. The crop diversity also reduced to only food grain and green fodder crops. Oilseeds, pulses, millets, vegetables and floriculture get disappeared and intensive cropping turned into extensive farming. The number of farmers and farm labourers reduced to minimum as most of the youth population shifted to tertiary based service sector economic activities. The number of tractors in the village also reduced from 41 to 9 in last three decades.

The size of culturable fallow wasteland in the revenue village has increased drastically from zero to 41.46% as large number of farmers sold their farmlands to urban developers. These real estate investors purchased large farmland from the native farmers as their safe investment for future in the periphery of urban areas so the land may be used for urban settlement. Such pockets of fallow land is lying vacant, barren and not available for cultivation. The removal of topsoil by brick kilns and sand mining in the croplands up to the depth of 30 to 40 feet deep converted the farmland to non-cultivable. It destroyed the irrigation network and the tube-well infrastructure subsequently farmers are unable to cultivate their farmlands and large number of farmlands are lying barren and uncultivated even they are not sold out by the farmers to urban developers.

The forested area of the village registered exceptional increase from 18.87% in 1990 to 30.25% in 2020. There are two reason behind the horizontal increase in forested or rangeland area of the village. One is that the pre-existing forested area of the village belongs to the notified protected forest land by the forest department which restricted encroachment on it and enclosed by concertina wires. Second is that during 1993, state administration acquired the 65 acres of farmland from the farmers of the village revenue area to develop the STP (Sewage Treatment Plant) of chemically polluted water from the drain no. 6 before draining it to river Yamuna. As the STP is not developed but the acquired farmland for the said purpose gradually evolved with dense growth of invading specie of prosopis juliflora (kabuli Keekar) bushes and trees. The prosopis juliflora has completely succeeded and replaced the native acacia indicus and acacia nilotica (desi keekar) trees in the entire region. It is visible everywhere on common land and in the form of riparian forests along the canals and roads. One-acre land of obsolete cottage industries in the name of Gandhi-Nidhi is encroached upon for settlement purpose in the village.

As the population size of village has increased significantly from 2272 persons in 1971 to 3710 persons in 1991 and 5858 persons in 2020. Therefore, the area under settlement expanded horizontally from 31 acre in 1990 to 54 acre in 2020. Since 1948 village residential area was not increased by local administration, so the increased population pressure forced to alter the adjacent farmlands, waterbodies and forested area for habitation. Three conventional waterbodies spread in more than 5 acres of

land located in the periphery of village settlement are encroached upon for habitation. Forested area (more than 6 acres) in the margin of settlement is cleared and encroached whereas croplands are also diversified by farmers to accommodate the increased population for settlement.

The urban land developers also purchased the croplands from native farmers and developed for recreational and commercial purposes as marriage or party celebration destinations. During 1991 only 6 acres of such croplands were diversified for commercial purposes and in 2020 it increased by 24 acres of croplands in the village along the main roads. Such type of commercial alteration of croplands into farmhouses further restricts the mobility of farmers to access their individual croplands as all such commercial establishments are enclosed by 10 feet high concrete walls. These commercial farm estates owned by urban dwellers stumbled the accessibility to the croplands of adjacent farmers located far from main roads. Subsequently, such farmers are forced to sell out their croplands due to enclosed walls and inaccessibility on cheaper prices. The cost of farmlands also increased rapidly in last one decade.

Table 2
The temporal increase in cost of per acre farmland in the village mukhmelpur, Delhi

S. No.	Year	Range of cost of per acre farmland/cropland in Rs.
1	1980 – 1990	Up to Rs.30000=
2	1990 – 2000	Rs.30000 to 100000=
3	2000 – 2010	Rs.100000 to 1500000=
4	2010 – 2020	Rs.1500000 to 40000000=
5	2020 onwards	Rs.40000000 to 60000000=

Source: Based on exclusive field survey through participatory approach.

The distance decay factor and accessibility of metaled road are the significant factors in determining the cost of the farmlands. Sand mining and quarrying by brick kilns are the insignificant factors as the purchaser of the land used to diversify the farmlands into non farming activities. The public utility land for common use in the village is encroached for settlement and only the 5 acres of land which used for state run primary and secondary level schools is available for public utility. The acute scarcity of land for habitation and diversification of farmlands in the village resulted in to decreasing number of livestock population. Non farming communities in the village left the rearing of domesticated livestock immediately after the introduction of automation in farm sector and green revolution. Whereas the farming communities also stopped rearing the domesticated livestock with the declining cultivated area of in the village.

Depleting Water Resource

The geographical location of sample revenue village for study is located in flood plains of Himalayan borne perennial river Yamuna. The habitation of village is concentrated on retreated sand mound encircled by the formation of oxbow lakes of river Yamuna. Historically the outflow of water from the levee of river uninterruptedly entered in the croplands of village. During colonial period two canals (Drain no. 6 and Bawana Escape canal) were constructed to absorb the flood water from river Yamuna to mitigate the flood in Delhi city. Therefore, both the factors of direct flow of flood water and the perennial availability of water in canals which encircled the farmlands and settlement of village recharged the surface and ground water. This phenomenon leads

to waterlogged conditions in the village for at least three monsoonal rainy months from July to September every year. The low-lying croplands cannot put under cultivation during rainy kharif cropping season in the village.

After the devastating flood of 1978 in river Yamuna, the 20-kilometer-long right margin embankment was constructed along river Yamuna to mitigate the flood in Delhi. Simultaneously, the source of canal no. 6 from river Yamuna was also blocked in 1979-80. Subsequently, the supply of water from river Yamuna was completely disappeared and the diffusion of automation in agriculture multiplied the demand of water for irrigation in farmlands. The intensification of crops and introduction of rice as water guzzling crop in the village in early 1980s shifted the farmers dependency from surface water to groundwater. Within the short time period after the green revolution, the number of electrified and diesel engine driven tube wells multiplied manifolds.

The sample village was electrified in 1964 and it started the installation of electrified tube wells to withdraw the ground water for irrigation. A tube well withdraws almost 20 times more ground water per day than the traditional Persian rahat which was driven by animate power. The Persian rahat is the obsolete technology to extract the ground water from the well with the help of moving or revolving buckets along the big sized wheel up to the depth of 100 feet. The wheel was driven by a pair of bullocks or sometimes a camel. The withdrawal of ground water from wells by Persian rahat for irrigation and the recharge of ground water through its aquifers remained almost equal. The introduction of electrified tube wells completely replaced the massive infrastructure of Persian rahats within a decade from 1964 to 1974. One Persian rahat was able to irrigate the 1-2 bigha of cropland per day depending on the texture of soil whereas an electrified tube well became able to irrigate the 10-15 bigha of cropland per day and without much labour input.

The combination of withdrawal of river Yamuna floods, introduction of electrified tube wells, tractors and machines in agriculture, intensification of crops and selection of rice as water guzzling crop in the village during 1970s and 1980s depleted the ground water level of entire revenue area of village from 10 feet to alarmingly 250+ feet depth. The depleting ground water table increased the investment cost of farming and decreased the profit margin of farmers and become one of the reasons for deviation from farming as occupation in village. The increasing population of village habitation expanded the settlement and encroached 5 water bodies (ponds) by filling the low-lying waterbodies with earthen material and village solid wastes. Remaining one pond in the village carry unusable/non-potable water as it is full of plastic and chemical pollutants.

Table 3
Trends of various parameters of Water Resource and related infrastructure from 1970 to 2020 in the entire revenue village Mukhmelpur, Delhi

S. No.	Parameters	1970	1990	2020
	No. of Functional Tube wells	5	28	9
	Net Sown Area under Rice Crop during Summer Kharif Crop.	2	110	12
	Fallow land (non-cultivated cropland) during summer season	30%	5%	80%
	Ground water level (Depth in feet)	15	250	200
	No. of tractors in village	3	19	7

	No. of water bodies as ponds etc.	6	2	1
	Share/No. of families rearing domesticated livestock in village.	75%	40%	2%

Source: Extensive field survey of revenue village through participatory approach.

The canal (drain no. 6) which passes almost three kilometer through the revenue area of village was closed from its source from river Yamuna in 1979-80. With the diffusion and expansion of industrial regions in Delhi after 1990, huge amount of chemically polluted water is released from Narela and Bawana Industrial areas. The perennial flow of untreated and chemically polluted water is discharged to river Yamuna through these canals. Subsequently, the flow of chemicals with poisonous and stinking water in canal through the settlement and croplands of village deteriorated the ground water and air quality. It also provided the suitable conditions for plant succession of ecological terrorist prosopis juliflora plant in the form of its riparian growth and contamination of ground water quality. The ground water quality in the marginal periphery of canal become completely non potable and increased the sodacity in soil while using it for irrigation. It stumbles the energy flow in ecosystem at micro level and deteriorated the carrying capacity of agriculture.

The number of birds, reptiles, rodents, mammals and micro-organisms along the canal reduced to minimum possible. Biodiversity of plants succeeded by the colonization of only one invading plant of prosopis juliflora. Native plant species disappeared completely especially along the canals. The number of respiratory diseases in all age groups of residents of village increased rapidly due to the stinking water flow in the canal. The diseases of domesticated livestock also become more prevalent and acute than humans due to the consumption of green fodder irrigated by the contaminated ground water near the polluted canal in the village. The canal as the source to drain out the untreated and chemically polluted water attracted many small-scale industries which release liquid chemical pollutants in the village which further deteriorated the air and water quality in the surrounding habitat.

Move towards Sustainability

The deviation from primary source of livelihood to tertiary and service sector, the number of families rearing domesticated livestock (cow, buffalo, goat and sheep) reduced rapidly. The increasing demand of milk and availability of vacant plots attracted the dairy farming in village. The commercial dairy farming to sell out the milk before its pasteurization is performed by the immigrant workers. These dairy farms produce sufficient amount of cow dung (gobar) on daily basis and used to drain out the same in the canal for its disposal. Ultimately, the cow, buffalo dung along with the pre-existed highly polluted and contaminated water in canal which drain into the river Yamuna further intensify the aquatic pollution of ecosystem.

Considering the perennial availability of cow dung in the village and its environmental hazards due to the release of methane gas in environment, one biogas (methane) plant was established in 2017. The biogas plant consumed 75 to 150 kg. of cow dung on daily basis and generate 45 normal cubic meter methane gas per day equivalent to 18 kg. LPG production capacity. It was constructed with the consultation of IIT Delhi to minimize the release of methane in the environment which is the most harmful gas for the depletion of ozone layer. The initial and one- time investment of plant was Rs. 9.50 Lakh whereas the cost of methane gas generated daily is approximately Rs.500 to Rs.600 with no cost of cow dung as input/raw material. The methane gas generated at biogas plant is utilized for cooking of food for mid-day meal scheme to supply food for children in schools. The methane gas is available for cooking the food in all the marriage celebrations in the village and free from charges.

The biogas plant helped in mitigating the pollution of river Yamuna, controls the free release of methane in environment, produce methane for using in cooking or generating up to 5 KW electricity throughout the day and maintaining the hygiene and sanitation of the village settlement. The biogas plant also produces solid and liquid bio-manures which is most suitable for organic farming. It became able to overcome the pressure on conventional natural resources for fuel supply in the village. The biogas plant also overcome the burden of dairy farm owner to dispose the cow dung.

The operational investment of the plant is negligible as it requires daily input of raw material for its proper functioning.

In order to deviate from the dependency on conventional sources for electricity, the sustainable on-grid solar power plant of 50 KW electricity generation installed in 2015. The roof top 200 solar photovoltaic plates of 250 watt each required no extra space. Apart from domestic consumption it also feeds the surplus non-conventional and renewable electricity to local distribution company. The solar power plant earns the carbon credit and minimizing the carbon dioxide emission in the environment at micro level. The solar power plant was installed with one-time investment and earns the recurring income without any maintenance cost. With increased electricity consumption, the solar power plant reduced the dependency on fossil fuel based thermal power plants.

Conclusion

The rural urban fringe habitat of Delhi is experiencing acute pressure on its natural resources. The change in land use pattern of cropland to non-farming activities further enhanced the pressure on resources of commonality as forest cover, ground and surface waterbodies. Process and forces of farmland diversification degraded the fertile cropland by quarrying the topsoil by brick kilns and mining for extracting the lacustrine sand deposited by retreating river Yamuna in its flood plain as building material in sequential order. Resulting that cropland become non-suitable for cultivation and increased the size of cultivable fallow land. The proximity of urban Delhi with exploding population size increased the pressure on land for varied non farming activities in the village.

The water resources faced acute pressure with changing agricultural automation and intensity. Surface and ground water depleted at very faster rate than its replenishment. The changing drainage system of canals further deteriorated the quality of water. The canals initially constructed to drain the surplus pristine water of river Yamuna become channel for draining out the industrial and domestic liquid waste. It leads to the contamination of ground water in the village. The proliferation of tube wells depleted the ground water at alarming rate. The withdrawal of ground water remained much higher than its recharge. Subsequently, it increased the input cost in farming and with decreasing profit margin farmers deviated from primary activities to tertiary sector for economic activities.

To overcome the increasing pressure on natural resources, the human economic activities are altered accordingly. The construction of biogas (methane) plant using the cattle and agricultural waste leads to sustainable dependency. The construction of roof-top on-grid solar power plant and the availability of near perpendicular sunshine supported the farmers to deviate from fossil fuel based thermal power plants. The forest cover located adjacent to settlement are depleting due to human encroachment for habitation whereas far from the settlement are expanding and flourishing with luxuriant growth. Though, prosopis juliflora replaced the native acacia indicus and other plants at large scale. The combination of expanding urbanization, increasing pressure on natural resources and depleting quality and quantity of ground and surface water, there is dynamic human response in order to maintain the sustainable modus-operandi of livelihood in the village at micro level.

Bibliography

1. *Singh, T., (2001) Environmental Implications of Farmland Diversification, Rajat Publication, New Delhi.*
2. *Rana, T. S. (2018) Process and Forces of Farmland Alteration in Delhi: A Micro Level Study of Budhpur Villlage, Remarking An Analisation, Vol.: 3, Issue: 5, pp. 21-30.*
3. *Delhi Statistical Handbook, 2015, Directorate of Economics and Statistics, Govt. of NCT of Delhi.*
4. *Makate, C., Wang, R., Makate, C. et. al. (2016), Crop Diversification and Livelihood of Smallholders Farmers in Zimbabwe: Adaptive Management for Environmental Change, SpringerPlus 5, 1135. https://doi.org/10.1186/s40064-016-2802-4*
5. *Tilman, D., 1999, Global Environmental Impact of Agricultural Expansion: The Need for Sustainable and Efficient Practices, Proceedings of the National Academy of Sciences of the United States of America (PNAS), May 25, 1999, 96 (11) 5995-6000.*
6. *Naikoo M W, Rihan, M, Ishtiaque M and Shahfahad, (2020), Analysis of Land use and Land cover (LULC) change and built-up expansion in the suburb of a metropolitan city: Spatio-Temporal analysis of Delhi NCR using landsat datasets, Journal of Urban Management, Vol. 9, Issue 3, pp.347-359.*