IN ASSOCIATION WITH

GuruJal
COLLABORATIVE . COMMITTED . CONSCIOUS

SUPPORT A POND INITIATIVE

सत्यमेव जयते
NITI Aayog

Standard Operating Procedure for

Restoration and Rejuvenation of Ponds

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RESTORATION AND REJUVENATION OF PONDS

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SUPPORT A POND
INITIATIVE

NOVEMBER 2022

प्रो. रमेश चन्द
सदस्य
Prof. Ramesh Chand
MEMBER

सत्यमेव जयते

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August 24, 2022

Message

Water management in India is quite distinct from other parts of the world owing to the uniqueness of challenges. Our reliance on ground water is so large that its over extraction makes the rivers dry during lean season, leads to land subsidence, salt water intrusion, geogenic contamination of ground water and many other concerns. Nearly 2000 habitations are Arsenic or Fluoride affected across the country, which is one of the direct impacts of groundwater depletion. It is extremely important to revive surface water bodies in such areas. Water conservation with people's participation is one of the most successful strategies to address water scarcity. Country has witnessed many success stories of NGOs and civil societies taking up the challenging task of rejuvenating water bodies which were extinct for decades and ensuring its sustained maintenance. However it has not achieved the required momentum to scale up across the country. So, every single effort in this direction has to be valued and encouraged.

This Standard Operating Procedure (SOP), prepared based on the practical experience of NGO's work in water body rejuvenation, will be much useful for those who wish to take up such works. It is commendable that the steps are covered in detail right from planning of works, implementation, record keeping and sustainable maintenance practice. I wish this document is used by a vast majority of water stakeholders and updated based on new experience. I would like to remind that *'water is everyone's business'*, and all of us should do our part either by conserving or by saving this precious resource.

(Ramesh Chand)

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26th Aug 2022

FOREWORD

Had the total fresh water available in the world been distributed proportionate to the population, India must have had at least four times more water than it has today. Unfortunately, distribution of water resources doesn't follow the demographic patterns either globally or within the country. As the world had progressed in tune with the pace of industrialization, green revolution and urbanization, the stress on water resource soared. Climate change and frequent extreme weather events of flood and drought further worsen the situation. All these factors demand a total paradigm shift from the conventional approach of centralized storage and lengthy distribution networks to a more customized way of devising solutions that suit the local needs.

Successful outcome of water management efforts is best assured when it is done with active participation of beneficiaries. Creating and utilizing local storages through tanks and ponds has been quite successful model in India even in the ancient times. Many such water bodies are now extinct due to pollution, encroachment, lack of regular maintenance, disruption of feeding water channels and many other anthropogenic factors. Revival of such water sources through people's movement has proven to be a sustainable and impactful approach. Though this concept is well received, its implementation is often stumbled for various reasons, among which lack of clarity on procedural formalities and technical fundamentals are the major ones. This Standard Operating Procedure (SOP), prepared based on the hands-on experience of Gurujal Society in Gurgaon District in rejuvenating water bodies, will help to tide over this hurdle.

The document depicts a vivid picture of the end-to-end process followed from the selection of water body, its profiling, planning, execution, official procedures, records to be maintained, monitoring and ways of sustained maintenance. I am sure that this SOP will come handy for many who are striving to accomplish the Hon'ble Prime Minister's vision of 'Amrit Sarovar' – the mission aimed at developing and rejuvenating 75 water bodies in each district of the country as a part of celebration of Azadi ka Amrit Mahotsav. I am optimistic and confident that with *'Jan Bhagidari'* (people's participation) the nation will soon become water secure.

AVINASH MISHRA

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Water Management initiative by
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ACKNOWLEDGEMENTS

Water is called the elixir of life for a reason. With changing lifestyle and rural habits, ponds are losing their relevance and hence the change of usage, converting these centres of life and civilization to a public menace with grey water to most of them, especially in peri-urban regions. Thus, Wastewater Ponds are an important resource of perineal water, besides having the ecological, aesthetic and socio-economic values. From more than three years GuruJal, a quasi-government, public private partnership organization is working in the Water Governance. While presenting the Standard Operating Procedure for Pond Restoration and Rejuvenation, we wish to share the learnings and guidance that we have gained from our first-hand experiences. This report manifests the actions and results of the team GuruJal. While this document aims to outline the general approach to carry out pond rejuvenation and restoration, there are chapters in the document, that would discuss the matter in a context specific setting to illustrate the learnings effectively. Being the first of its kind initiative in 773 Districts of the Nation, GuruJal is an evolving and growing organisation that perseveres on the path of excellence; therefore, it is requested to the reader to approach the document to understand the possible challenges and learning, and to take this document 'Standard Operating Procedure for Wastewater Pond Restoration and Rejuvenation' as reference, and the learnings may be applied according to varying topography and physiography. This document is intended to be used as a resource for knowledge exchange.

The Program Management Unit of GuruJal extends its warmest gratitude to the esteemed guidance of the Mr. Amit Khatri, Mr. Yash Garg, Mr. Nishant Kumar Yadav, Mr. Narinder Sarwan, Society Members, and Government Officers of Gurugram. We owe our ever-evolving approach to our Advisory Board, the collective of active citizens, corporates and other social organisations that have helped GuruJal in all of its endeavours since its inception. We are proud to be presenting all of the findings and learnings from implementation of projects thus far in the District of Gurugram, Haryana. National Institution for Transforming India (NITI) Aayog's vision and expertise were instrumental in this exercise. I place on record our gratitude to Mr. Avinash Mishra, Adviser (Water Resources), NITI Aayog for his valuable guidance, review and insights at various stages of preparation of this document. I sincerely extend my wholehearted thanks to our partner Hero MotoCorp, with special mention to Mr. Ravi Pahuja from RKMF, a CSR entity of Hero MotoCorp Pvt. Ltd., and all the funders of GuruJal to make our program successful. Last but not the least, I welcome feedbacks/suggestions for further improvement in our earnest endeavour to serve, and be able to serve, better.

We would be looking forward to hearing back from domain experts, water practitioners, policy makers and other relevant stakeholders, for whom this document is intended to be.

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Abbreviation

ABR	Anaerobic Baffle Reactor
AIBP	Accelerated Irrigation Benefit Programme
BMC	Biodiversity Management Committee
BCM	Billion Cubic Meters
BOD	Biochemical Oxygen Demand
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CNB	Cement Nalla Bandh
CPCB	Central Pollution Control Board
CPHEEO	Central Public Health and Environmental Engineering Organization
CSR	Corporate Social Responsibility
DEWATs	Decentralized Wastewater Treatment System
DGPS	Digital Global Positioning System
DAC	Department of Agriculture and Corporation
DO	Dissolved Oxygen
DOLR	Department of Land Resources
EODB	Ease of Doing Business
GMDA	Gurugram Metropolitan Development Authority
GDP	Gross Domestic Product
GIS	Global Information System
GoI	Government of India
HPWWMA	Haryana Pond and Waste Water Management Authority
HSPCB	Haryana State Pollution Control Board
ILR	Inter-Linking of Rivers
IMD	Indian Meteorological Department
IWMP	Integrated Watershed Management Program
IEC	Information, Education and Awareness
JSA	Jal Shakti Abhiyaan

KLD	Kiloliter per Day
LPCD	Liter per capita per day
MCG	Municipal Corporation of Gurugram
MoHUA	Ministry of Housing and Urban Affairs
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
MOWR	Ministry of Water Resources
MW	Mega-Watt
NGT	National Green Tribunal
NWP	National Water Policy
OFWM	On Farm Water Management
O&M	Operation and Maintenance
PMKSY	Prandhan Mantri Krishi Sinchayee Yojna
SPCB	State Pollution Control Board
SS	Suspended Solids
STP	Sewage Treatment Plant
TDS	Total Dissolved Solids
TCM	Thousand Million Cubic Feet
TS	Total Solids

India and its Water Ways

India is one of the water richest countries in the world, receiving approximately 4000 Billion Cubic Meters (BCM) in the form of rainfall of which 1123 BCM of it is available as surface water and ground water. However, the rainfall has a wide temporal and spatial variation across the country. The driest parts of the Nation receive as little as 50 mm of rain in Leh in comparison to 11,872 mm of rain in the wettest part of India, in Meghalaya. Climate change has recently been one of the factors to exasperate this variation causing more extreme rainfall events; with the number of days, and duration in which the rainfall events occur reducing, but the intensity of rainfall has increased. The figures also imply that the water utilisation plans based on rainfall received and water management must be put in place to accommodate for the growing demands for all lifestyle activities including farming practices must be take into account the variations in rainfall patterns. A recent example of this was observed in Mumbai monsoon season of 2020; according to the local weather stations, representative of south Mumbai, the rain received surpassed the monthly average with 293 mm of rain over a 12-hour period and 332 mm over 24 hours.

Currently, water scarcity that is faced by almost 1/3rd of India's population in today's date, with almost 12% of the population living in 'Day Zero' conditions. With an ever-expanding population growth, unchecked and unabated pollution of the waterways, encroachments of unprotected stretches of waterbodies, and serious rise in demand, if the water scarcity issue is not resolved, it is estimated to cost the nation a loss of approximately 6% of the GDP and thousands of lives along with it by the year 2030. According to the Central Ground Water Board (CGWB) in 2017, 256 Districts of the country are water stressed (where the demand is more than the supply), where 1186 blocks of these Districts are over-exploited (where the recharge of water is significantly lower than the recharge of water). Despite of these harrowing statistics, it is suggested that the water available (1123 BCM) is enough to sustain 22.8 billion people – 17 times of the current population (Down to Earth, 2020); thus, the solution surely lies in management of resources and infrastructures to allow for the optimised usage of the available water.

PONDS – THE CULTURAL PHENOMENA THAT RECHARGE AND REVIVE

Fortunately, the Indian traditional architectural designs has had a robust systems that has been evolved over several millennia to be water conscious and allow for optimised water usage. A part of this traditional robust system is the wide-variation and widespread of rain-water harvesting structures or tanks that are dotted around the country. These traditional water bodies are known by many names across the nation including but not limited to Jhalara, Talab, Bandhi, Bawari, Taanka, *Johad*s etc.

Figure 1: *The above figure shows several of the traditional rainwater harvesting structures dotted around the country that have served as essential secondary source of water.*

Recent statistics suggests, that if proper maintenance, rejuvenation and renovation of ponds, are carried out with the help of MGNREGA scheme, one of the oldest methods of rain-water harvesting of the nation, it would be enough to meet the water demand(Down to Earth, 2020). In areas where the water demand can be met by secondary water resources, at 55 litres per capita per day (lpcd), the stored water in ponds would be able to serve 6000 people in the village. Rao et. al also shows that that storage of water within a single pond structure contributed to a range of 26,000 to 62,000 m^3 to groundwater recharge over a year, that was equivalent to 1.3 to 3.6% of the total water recharge volumes in the study carried out in Ramganga Basin, India, which would serve to irrigate lands of 8 to 18 hectares of land cropped in the rabi season.(Rao et. al, 2017) As such ponds demonstratively serve as an essential structure for water security. Although it serves to only hold a relatively small volume of water, the stored water becomes vital for food security and economic stability within a small community.

Ponds are also essential structures that provide water security in areas where groundwater has grown extremely saline and cannot be used for irrigation purposes. Irrigation channels have been built in such areas during the Green Revolution in these areas in order to meet irrigation demands in this region. However, in order to supply to the increasing demands of high yield production, a lot of pressure has been put on the agriculture industry, as a result of which freshwater demand has increased. The original channels are therefore not sufficient to meet the current water demands. Without accesses to enough water, structures such as ponds

become of essential service to allow for agriculture to be sustained in areas of water scarcity.

These traditional water bodies are what saved drought hit villages from the brink of extinction and starvation in the great spell of droughts that the nation faced in the 1970's. Examples of pioneers, who revolutionised and reinstated the importance of having water storage and wise utilisation for increasing crop yield have served as models for reviving these traditional lifelines within the rural eco-system, while setting important benchmarks for its urban counterparts. Culturally, due to its life-sustaining properties, ponds have also been the centres or natural hubs for monthly or annual fairs to be held, and have been biodiversity hotspots that encourages the link between human and wildlife.

Therefore, ponds form a fundamental part of the hydrological cycle in the environment and has allowed a rich cultural, agricultural and societal practices to flourish in India Since ponds can be formed in a much broader range of environments and landscapes, they demonstrate a wide range of physiochemical activities that allows a wide range of flora and fauna to flourish.

THE DEATH OF WATER CONSCIOUSNESS

Out of the 1123 BCM of water that is available, only 18.19 BCM of water is confined in water body structures such as ponds/lakes etc (Down to Earth, 2020). Over the decades, due to the population expansion which led to inevitable rapid development of infrastructure, encroachment of these essential water bodies invariably increased; most of the times by overtaking and filling up dried pond sites and erecting multi-storey buildings on them. It has been studied that in District of Gurugram the total number of water bodies decreased from 641 in 1956 to 123 in the year 2018 according to the official revenue records. In fact, locals claim of receding ponds due to the erection of high rise commercial buildings and residential colonies around Ghata Jheel, in Gurgram City, once which was swamp area. Evidently the complete lack of awareness of the importance of these ponds and water body structures within local communities has led to their severe encroachment.

Industrialisation and infrastructure development have contributed heavily to water pollution of surface waters, with unregulated release of polluted effluents with high concentrations of toxic constituents. The eventual percolation of these toxic surface waters to ground water, have shown a very high potential of contributing to the pollution of already depleting ground water table. While several laws and acts have been passed post-independence regarding the abatement of unregulated pollution activities, much remains to be done in order for better enforcement of these regulations on ground in order to gain control of India's water ways.

Post-Independence, several revolutions intended to strengthen the economic conditions and increase the self-sufficiency of the nation, were implemented; specifically the Green Revolution that was implemented in the 1950-1960's, led to the overexploitation of water resources which has now currently manifested as water scarcity in the Nation. The Government of India (GOI) took strong steps in order to combat this issue which will be explored in the subsequent chapter.

Water Governance in India

With the increasing water demand, the Central and State Governments are struggling to enforce strong policies around water management. A need for policy-level framework and the step by step ground implementation are needed to address the issue. However, the challenge of serving a diverse demographic for a country of 1.35 billion people and its water demand is no small task. There were multiple water-related ministries that are now governed by the Ministry of Jal Shakti. The Water Resources Department, Department of Drinking Water and Sanitation and Central Groundwater Board have merged under the Jal Shakti Ministry which has taken-up various initiatives.

Various Government Departments in India have taken initiatives to construct water harvesting structures in the potential zones, which are not only storing water on surface but also contributes to recharge of groundwater.

Initiatives such as artificial recharge and rainwater harvesting structures while also bringing about behavioural change initiatives for water conservation have also been taken. A large number of demonstrative projects have been successfully executed across India with the construction of check dams, underground Bandharas, cement plugs, etc.

In the need for water harvesting and rainwater conservation, the Indian government has made National water Policies and timely updates the mandates in the policy. The National Water Policy acts as a base document for State governments for good water governance projects to approach water as a state subject in India.

Water Act, 1974

The Water (Prevention and Control of Pollution) Act, 1974 passed by the Government of India pertaining to regulate the environmental aspects in the country. Rising water pollution due to domestic and industrial activities became a cause of distress, leading to the inaction of this legislation.

The main feature of the Water Act is to control pollution through a permit or "consent administration" procedure. Discharge of effluents into water bodies was only allowed by obtaining the consent of the State Board, within restrictions.

This Act was passed after a majority of states of India (Assam, Bihar, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Rajasthan, Tripura and West Bengal and the Union territories) accepted this legislation. Constitution of the Central Pollution Control Board and State Pollution Control Boards, respectively, are provided the authority to exercise the powers conferred to them under this Act.

Following are the major objective of the water cess acts are:

- To prevent and control water pollution.
- To maintain "wholesomeness" of water, i.e. to maintain the qualities of water so that its consumption and use by living organisms is not hampered.
- To establish State Boards for prevention and control of pollution, which gets subsumed by the Air Act, passed in 1981.
- To empower the Boards for prevention and control of pollution.
- To provide penalties for breaking the rules of the provisions under this Act.
- To establish state water testing laboratories and develop its protocols.

Water Cess Act, 1977

The Water (Prevention and Control of Pollution) Cess Act, 1977 aims to provide for the levy and collection of a cess/tax on water consumed by persons carrying on certain industries and by local authorities, with a view to augment the resources of the Central Board and the State Boards for the prevention and control of water pollution constituted under the Water (Prevention and Control of Pollution) Act, 1974.

This cess is collected with a view to augment the resources of the Central Pollution Control Board (CPCB) and the State Pollution Control Boards (SPCBs) for the prevention and control of water pollution, as mandated under the Water (Prevention and Control of Pollution) Act, 1974.

WATER SHED DEVELOPMENT, 1992

Department of Wastelands Development in the Ministry of Rural Development and Poverty Alleviation was created in 1992, which converted in to the department of waste land development in 1999. This now named as Department of Land Resources.

The main objectives are to restore the ecological balance by harnessing, conserving and developing degraded natural resources such as soil, vegetative cover and water. The outcomes are prevention of soil erosion, regeneration of natural vegetation, rain water harvesting and recharging of the ground water table.

Government of India is committed to accord high priority to water conservation and its management. To this effect Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) has been formulated with the vision of extending the coverage of irrigation 'Har Khet ko pani' and improving water use efficiency 'Per Drop More crop' in a focused manner with end to end solution on source creation, distribution, management, field application and extension activities. The Cabinet Committee on Economic Affairs chaired by Hon'ble Prime Minister has accorded approval of Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) in its meeting held on 1st July, 2015.

PMKSY has been formulated amalgamating ongoing schemes viz. Accelerated Irrigation Benefit Programme (AIBP) of the Ministry of Jal Shakti. Integrated Watershed Management Programme (IWMP) of Department of Land Resources (DoLR) and the On Farm Water Management (OFWM) of Department of Agriculture and Cooperation (DAC). PMKSY has been approved for implementation across the country with an outlay of Rs. 50,000 Crore in five years.

GROUND WATER REGULATION AND CONTROL OF DEVELOPMENT AND MANAGEMENT ACT, 2005

Through the Ground Water Regulation and Control of Development and Management Act, 2005 by Water Resource Department, Government of India (GOI); the State Governments were advised to form board on groundwater. The Act states anyone who would want to extract groundwater through mechanical means in the notified area would require permission from the State Groundwater Board. The board regulates and governs the water extraction in the areas to address the depleting water table in the region.

Along with the National and State-specific policy and plans; National government and state governments launch programs for the development of water security. Some of the programs that have been launched are the following -

BALRAM TALAB, 2007

The agriculture sector has the most consumption of freshwater in India. The farmers are mostly dependent on the Groundwater and rainwater for irrigation. To support agriculture activities on a sustainable basis by conservation of rainwater, Madhya Pradesh Government launched a State-specific incentive-based scheme for the farmers to develop farm ponds. The scheme was named Balram Tal, and was functional between the years 2007- 2010. There were around 7518 farmers who constructed farm ponds in their agricultural lands. The initiative was first started by the Dhar District Collector, initially the scheme was taken up by the large farmers with their own money. Subsequently, the Chief Minister of Madhya Pradesh took up this scheme and named it as Balram Tal and announced incentive for the beneficiaries. The project aimed to develop water security in the region and make farmers self-sustainable in terms of farming.

NATIONAL WATER POLICY, 2012

National Water Policy(2012) was developed by the Ministry of Water Resource which now is governed by Ministry of Jal Shakti. As water is a State subject in India, the National Water Policy is a brief outline that can be acted upon as a base document for the state governments to make their water management plans and policies (National Water Mission). The objective of the National Water Policy (NWP) is to address the present and upcoming water usage; management issues and water resource distribution. The NWP also referred to the possible policy level recommendations to be adopted to make Country water-rich to tackle different agro-climatic zones; Drought situation and Impact of climate change on the hydrology cycle. The suggestions in the NWP, have been drafted as such that demand side management and to increase water use efficiency through water pricing have also been addressed; conservation of water bodies and river corridors; flood and drought management.

NAMAMI GANAGE, 2014

Namai Gange Program was launched by the Honourable Prime Minister Mr. Narendra Modi, to clean the River Ganga. The project will extensively cover the Ganga River bank states Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal in is an Integrated Conservation Mission, which includes the waste water treatment; River Front Development; River Surface

cleaning; Bio-Diversity Management; Afforestation; Public Participation & Awareness; Industrial Effluent Monitoring and Developing Ganga Gram. On the bank of river Ganga models' villages to be developed in regards with the waste water treatment, solid liquid waste management. River Surface cleaning for collection of floating solid waste from the surface of the Ghats and River and its disposal at local level.

INTERLINKING OF RIVERS (ILR), 2014

The Ministry of Jal Shakti is working on an ambitious project of interlinking the Rivers across India. The aim of this program is to make sure greater equity in the distribution of water by enhancing the availability of water in drought-prone and rain-fed areas. Under the project, the Ministry has already identified 14 links under Himalayan Rivers Component and 16 links under Peninsular Rivers Component for inter-basin transfer of water. Under the project it will comprise of 30 links to connect 37 rivers across the country through a network of almost 3000 storage dams to form a massive South Asian Water Grid. The project will impact the lives of 160 million people across the country. The project aims to generate 34000 MW (34 GPW) hydro power . The project will help flood mitigation and drought management. The project claims to provide irrigation to 35 million hectares (m ha) of land in the water-scarce western and peninsular regions. While the project is ambitious in increasing the employability in the region, it will undoubtedly help resilience amongst the farmers of the country who depend on rain and ground water for irrigation. The project will provide water security to the farmers to cultivate their crops. The well connected and water channels; canals; perennial rivers increase the water potential availability throughout the year will provide water to the farmers. In the water scarce area which are only dependent on the rain water and groundwater can irrigate their crops through surface water.

JALYUKT SHIVAR, 2015

Maharashtra has been facing consecutive droughts in the region like Marathwada; Vidarbha. To develop water capacity in the region, the Maharashtra State Government has propelled a project "Jalyukt Shivar Abhiyaan" in an effort to make Maharashtra a drought-free state in the coming future. Jalyukt Shivar Abhiyan comes under the water conservation department of Maharashtra Government. The project included deepening and widening of streams, construction of cement and solidify stop dams, work on nullahs, and digging of farm ponds. For monitoring and governance of the project the State government launched a mobile app and developed a dashboard to collect all the details of the project. The project is aimed to make 5000 villages drought-free in a year. This initiative was launched to boost the rural economy, increase in groundwater table and develop water security in the region. The project also aimed to arrest maximum runoff in the village area; create Decentralized Water Bodies; increase the Groundwater Level in Drought areas; Rejuvenation of the water storage capacity of various existing structures like Village Tank, Percolation Tank; Cement Nalla Band (CNB) through repairs and renovations; to increase storage capacity of water bodies by removing silt with the help of the local community. The ultimate outcome of the project was to make more than 11000 villages to be drought free; to increase the water storage capacity by approximately 16.82 Lakh TCM(Thousand million cubic feet); which will recharge the Ground Water Level by 1.5 to 2 m;

Increase in the Agriculture productivity by 30 to 50%. The scheme is still in operation and the impact would of the project would be evident in the forthcoming years (CGWB, 2019).

JAL SHAKTI ABHIYAN(JSA), 2019

The Ministry of Jal Shakti launched Jal Shakti Abhiyan (JSA) as an intensive water conservation campaign that was built on a citizen participation approach to accelerate water conservation across the country. The campaign will focus on integrated demand and supply-side management of water at the grassroots level, including creation of local infrastructure for source sustainability using rainwater harvesting, groundwater recharge, and management of household wastewater for reuse. The main objective of the program is to shift the burden of ground water extraction to other means of water. The aim of the project is bring about changes in the behavioural approach and improve sensibility of the community in water consumption and administration. Eventually this will lead to development and restoration of old water bodies with a community based approach. The JSA is run in two Phases: Phase 1 from 1st July to 15th September 2019 for all States and Union Territories; and Phase 2 from 1st October to 30th November for States and UTs receiving the retreating monsoon (Andhra Pradesh, Karnataka, Puducherry, and Tamil Nadu). Special interventions are designed in the JSA.

- Water conservation and rainwater harvesting
- Renovation of traditional and other water bodies/tanks
- Recharge and Reuse Structures
- Watershed development
- Intensive afforestation

The project will inculcate a consciousness among the residents of these Districts to conserve water, importance of planting trees, importance of ponds and old water bodies in the area.

ATAL BHUJAL YOJNA, 2019

The Atal Bhujal Yojana (ATAL JAL) was launched on 25/12/2019 which envisages in promoting panchayat led groundwater management and behavioural change with a primary focus on demand-side management. The scheme is to be implemented over a period of five years with the World Bank assistance. The objective of the scheme is to improve groundwater management in the water exploited area's (Haryana, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujrat, Maharashtra & Karnataka) in the country through community participation. The scheme is specifically for states like Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh. These States represent about 25% of the total number of overexploited, critical and semi-critical blocks in terms of groundwater in India (MoWR). After the implementation of the scheme, it is expectedly going to benefit nearly 8350 Gram Panchayats in 78 Districts in these states. In the project ground implementation of water conservation measure, behavioural change in water consumptions and rainwater harvesting are the key focused activities are included. Funds under the scheme will be made available to the participating states as Grants. The scheme envisages active participation of the communities in various activities such as the formation of Water User Associations, monitoring and disseminating groundwater data, water

budgeting, preparation, and implementation of Gram-Panchayat wise water security plans and IEC activities related to sustainable groundwater management.

MERA PANI MERI VIRASAT, 2020

In the State of Haryana, most of the people are dependent on Agriculture, a major chunk of the farmers is dependent on ground water for irrigation. Haryana agriculture sector contribute 2.3% in the country's overall GDP, where wheat, rice, mustard, maze are the common crops. A large part of the state is cultivating rice crop, which demands a lot of water, which creates over exploitation of ground water. In the early days of the Green Revolution, the groundwater potential in Haryana was good. However, due to excessive demand for water to harvest rice crops, groundwater extraction increases. This leads Haryana to one of the most water groundwater exploited state in the country. To overcome this challenge, the Government of Haryana launched an incentive-based scheme for the rice farmers in the state. The government is trying to shift the cropping pattern of the farmers to divert them towards the less water consumable crop. They named the scheme as Mera pani meri virasat. The shifting of cropping pattern from rice to any other crop will save water. Rice is one of the most water consumption crop which is grown in India, crop shifting will reduce the water demand in the area which leads to less extraction of groundwater.

CHALLENGES AND WAY FORWARD

Although the Government is taking many initiatives state and region-specific there are some challenges in the implementation and formation of the policies. The features of water resources both the quantity and the quality may also markedly affected by the changes in the land use in the form of urbanization, industrialization, and changes in the forest cover.

Neither the water policy nor the climate policy discussions seem to notice the worth of rainwater harvesting and wastewater treatment as an adaptation, especially the areas where water resources are fast depleting due to the rapid increase in population and unrestricted use of water. Climate change and anthropogenic activities are likely to increase the variability of water resources affecting human health and livelihoods. Therefore, special impetus should be given towards mitigation at the micro-level by enhancing the capabilities of the community to adopt climate-resilient technological options. There is a dire need for wastewater policy both for urban and rural areas that promotes water use efficiency, recycling, and reuse, while also ensuring the financial viability and sustainability of water utilities.

Thus, the District Administration through GuruJal is working towards addressing the issue of water conservation and wastewater treatment in the rural settings of the district. To resolve the untouched subject of groundwater recharge from the treated wastewater, GuruJal starts working in this direction. The technical and qualitative details of the pond restoration and rejuvenation have been elaborated in the further chapters.

Support a Pond

Support a Pond is the dedicated discipline for undertaking the restoration and rejuvenation of enclosed water bodies in a local community with an understanding between government departments, corporates, communities and individuals, in a systematic and holistic fashion.

OBJECTIVE OF THE DISCIPLINE

a. Restore and rejuvenate water bodies in the District of Gurugram.

b. Facilitating pond profiling and making it open for the public for sharing and collaborating.

c. Compiling the Standard Operating Procedure (SOP) as a guiding tool for more effective implementation.

d. Being instrumental for the government departments and the local community in reviving the water bodies.

e. Helping the corporate partners to undertake projects for pond restoration and rejuvenation.

PROJECT NEED AND METHODOLOGY

Most of the existing traditional water bodies have either been encroached or levelled due to urbanization. According to GMDA, the number of water bodies in the District has been reduced from 644 to 124 in the last six decades (1956–2019). The 124 sites that are identified still have water present in the water body. The brighter side is that there are almost 250 *Johad*s (Ponds) under the jurisdiction of Panchayati Raj and more than 20 ponds in urban areas which can still be revived. The 250 ponds that have been identified are currently either encroached with solid waste or temporary settlements, and receive polluted wastewater from the domestic therefore upon rejuvenation, they could be reinstated as a *Johad*. The overall target is to restore and rejuvenate 320 water bodies across the District.

Additionally, developing these pond areas by landscaping them will provide a space for recreation and leisure around the water body, and allow for the biodiversity of the area to develop by planting of native species of flora. Therefore, sustainability of projects undertaken for restoration and rejuvenation of ponds will have to be holistic and systematic in nature. Hence a robust feedback model has been suggested and followed for sustainable interventions

to take place in regard to the pond restoration and rejuvenation. As per the nature of the model, it allows for the integration of site-specific information into the model and allows for the planning and execution of customised interventions for the particular study area according to the specific constraints and liberties that can be taken into the consideration.

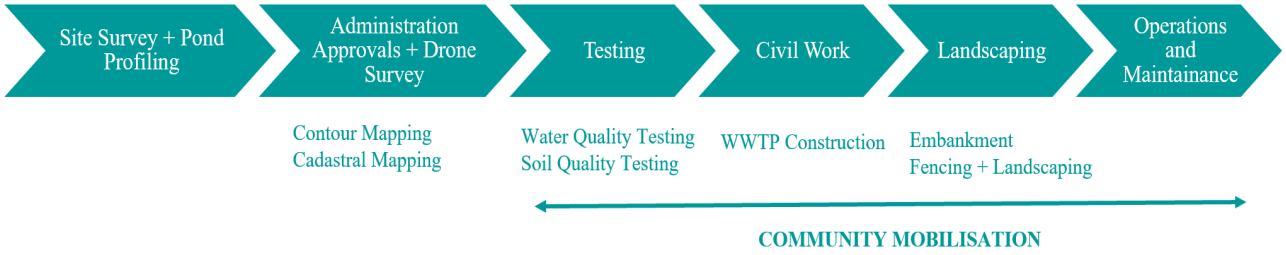

Figure 5: *Data Fed Feedback model used for pond restoration and rejuvenation model*

This model propels innovative design solutions on ground, as this model allows for the customised solutions to be designed. Moreover, the sustainability of the interventions therefore remains ensured; all factors and constraints of the particular challenges faced for the pond restoration and rejuvenation of a particular site will already be accounted for from the initial steps of design and planning stages. It should be noted that while there are several mandates that encourage the restoration and rejuvenation of ponds, it was GuruJal's implementation on-ground, and learnings that the model was curated, developed and compiled.

The above model has been enumerated and further broken down into steps as follows

1. Pond Identification and Pond profiling
2. Project Feasibility Assessment
3. Administrative Approvals (Demarcation, GIS mapping, and Panchayat Resolution)
4. Detailed Project Report
5. Financial Approval
6. Community Mobilization
7. Cleaning and Levelling
8. Civil Work, Micro-STP Installation and Waste Management
9. Landscaping and Beautification
10. Sustainability Plan (O & M)
11. Monitoring and Evaluation

While the above steps can be further broken down for execution but still critical purposes, it is important to give the sequence of steps its due importance. The above-mentioned steps ensure that any intervention that is suggested on-ground is done on administrative records and involving the community participation so that the technical intervention is "for them, by them" for the maximum impact to be seen. A systematic approach that has a holistic overview of the pond rejuvenation project is ensured with the above steps. Each of these steps play an integral part in the successful completion and sustainability of the project. These have been discussed in detail in the subsequent chapters.

Pond Identification and Pond Profiling

POND IDENTIFICATION

Determination of the actual pond site is the first and acts as a precursor to the actual primary task of pond profiling, as historical records and landmarks change over the years with development that takes place. There have been several instances through site reconnaissance the concerned pond has either been dried up, but existent according to the official revenue records, or most often can be encroached with infrastructural development, or otherwise simply being used a dumping site for solid waste. Most of the ponds receive wastewater from the local communities and have become no more than a mere dumping site for both solid and liquid waste. Therefore, determination of the actual state and location of the pond is an important part of the process.

POND PROFILING

Pond Profiling is the first step that allows for identification of the ponds and the particular problems that need to be addressed in order for the restoration and rejuvenation of the ponds.

The Need of Pond Profiling

By carrying out the process of Pond profiling, one will be able to gain details about the pond such as source of pollution, and other major problems associated with the pond. The pond profiling process is an essential step to understand the topography of the area and determine the possible challenges on site according to the area available for possible interventions. While physical landscapes around the pond are subject to change, it is important to also note the changes in physical landscapes and landmarks over the years that may influence the physical features around the pond. Physical features around the pond are the determinant factor of whether technological intervention for pond rejuvenation can take place on site. Therefore, the technical team that undertakes the task of pond restoration and rejuvenation would need to carry out the detailed study of the pond in a scientific manner as they would be able to assess the factors required for both designing and implementation of proposed restoration and rejuvenation projects. Pond Profiling is also an essential step to understand the function that the particular ponds serve, and attempt for the intervention implemented will be able to maximise the function that it serves in the local community, apart from its natural function of recharging ground water. Therefore, pond profiling is done in a manner to understand not only the current scenario of the pond, but the historical significance that the pond served and the future purposes that it may serve in the local community and environment at large.

PROCESS OF POND PROFILING

Physical Survey

Pond Profiling as the name suggests is the collection of data in a systematic manner that would aid in making informed decisions concerning the possible interventions regarding rejuvenation of ponds. This is done by collection of the following information that is either physical or technical in nature, but can be much more detailed depending on the area of study –

- Length of Total Area
- Breadth of Total Area
- Area of Pond
- Area of Pavement around the Pond (if any)
- Area left from pavement in remaining free area of Gram Panchayat
- Total Area of the site (Free area around the pond + Actual area of the pond)
- Depth of the Pond
- Capacity of the Pond
- Quantum of inflow of untreated sewage in to the pond
- Encroachment around the pond area
- Diminishing biodiversity of the area
- Outflow of polluted water to critical and larger water bodies

Apart from the above information, other physical information that is collected during the profiling process. Other details that are collected during the physical profiling process is –

- Latitude and Longitude of the location and comparison to the revenue records and historic images.
- Location details such as village name, tehsil name, block name.
- Physical appearance of the ponds – details such as colour, odour and notice if any eutrophication is present (which is indicative of nutrient overloading in the pond) the density of vegetation in and around the pond periphery is also recorded
- Other details such as evaporation rate, rainfall data, and ground water levels are also recorded from the nearest measurement sites.

All of the above information is systematically recorded in a Pond profiling checklist, that is to be used for primary site visits. Pond Profiling of Tajnagar Village Pond in Gurugram, Haryana for reference is attached in Annexure A.

Table 1 The following table shows a Blank Sample of Pond Profiling Checklist

Table 1: Pond Profiling Checklist

Physical Description	
Name of Pond	
Location	
Latitude and Longitude	
Area of Pond	_____in acre/hectare
Maximum depth in meters (full water level)	_____in meter
Mean depth in meter	_____in meter
Type of pond	Natural or Artificial/Man-made
Current status of pond	a. Dry b. Encroached c. Polluted
Source of water (inflow)	a. Rainfall b. Runoff c. River d. Covered drain e. Open drain f. Treated wastewater from STP g. Irrigation canal h. If other, Specify
Is there any outflow from the pond	Yes/No. If Yes, describe
Water level changes (annual)	_____in meter
Are there any river/canal/ major open drain passes within a radius of 2-5 km of the water?	Yes/No. If Yes, Specify with distance with direction
Groundwater level (pre-monsoon and post monsoon)	_____in meter
Does pond dry out completely? (frequency)	a. Every year b. During summer season c. Rarely
Catchment area of the pond in sq.km.	a. Hilly area (if possible, provide slope) b. Plain
Land use of the catchment area (in %)	a. Urban b. Agriculture c. Forest d. Mining

Total Population (as per Census, if possible, provide Current population	
Is the pond used by animals for drinking and bathing?	Yes/No
Type of flora and fauna around the pond	
Geo-tagged pictures of the pond from different angles (to cover entire pond)	
Ownership of the land	
Khasra number/Survey No. covered in the land	
Free space around the pond in sq.m.	Government/ Private
Landscaping around the pond	
Can pond be used as active urban and public space	
Are there any construction activities going on near the pond	Yes/No. If yes, please elaborate the impact due to construction on pond.

Functions of Pond	
Is the pond used for any of these?	e. Drinking f. Agriculture g. Horticulture h. Fisheries i. Other, specify
Function of the pond	a. Groundwater recharge b. Flood mitigation c. Tourism d. Support biodiversity e. Influence micro-climate f. Socio-cultural g. Aesthetic

Source of Pollution and Problem	
Does solid waste dumping take place near the pond?	Yes/No. If Yes, a. Biodegradable b. Non-Biodegradable c. Construction and Demolition Waste d. Electronic waste e. Hazardous Waste
Solid waste disposal in pond	Local activities

Source of pollution in the pond	a. Domestic sewage b. Industrial effluent c. Agriculture runoff d. In-pond human activity e. Cattle wading
Nutrient level in the pond	a. Negligible b. Low c. Moderate d. High e. Very high
Major Problems	a. Reduction in area b. Reduction in depth c. Encroachment d. Algal bloom e. Aquatic weeds f. Decline or loss of fisheries g. Eutrophication h. Organic pollution i. Toxic pollution

Remedial Measures	
Are local communities aware of the problems of the pond?	Yes/No
Are local communities interested in the restoration of the pond?	Yes/No
Are there active local conservation groups or NGOs that are interested in the pond?	Yes/No
Any measures taken in the past to restore the pond?	Yes/No
Is it possible to source good quantum of rainwater/ treated water throughout the year?	Yes/No
Restoration activities required	a. Improvement of water quality by in-situ treatment b. Diversion and treatment of sewage c. De-siltation for removal of organic/ toxic sediments d. Weed removal e. Catchment area treatment to check treatment

Technical Survey

Other technical details involve the detailed study of the surrounding area around the water body which involve both water and soil testing –

Water Testing

Determination of the water quality of the water body is one the primary indicators of the type of treatment and intervention required in the area. In fact, parameters of the water flowing into the water body, and the water stagnating in the water body will have varying characteristics. Therefore, measuring these parameters become important to understand the biological and chemical processes that are happening in the water body, that will be evident from the water quality tests results, and therefore, is essential for pond profiling information. The following are the parameters that are often tested –

- pH
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Nitrogen as N
- Total Phosphorus
- Total Hardness as CaCO3
- Total Dissolved Solids
- Total Suspended Solids
- Arsenic as
- Mercury as Hg
- Cadmium as Cd
- Total Chromium as Cr
- Copper as Cu
- Zinc as Zn
- Cobalt as Co
- Nickel as Ni

The water samples are collected from the inlet of the pond and around the periphery of the pond as a composite sample, in order to gain an understanding of the differences in water quality of the incoming wastewater and the water stored in the water body. The analysis between several important parameters gives a detailed understanding of the processes that may lead to nutrient accumulation, one of the primary causes of eutrophication, and if there are any influents carrying excessive amounts of some elements that may lead to toxic effects in the water being stored in the water body. For example it is seen in the case of Haryana, home-set ups of textile industries are common, and therefore might play a role in the composition of the influent received by the ponds. Therefore, wastewater effluent characterisation is imperative to understand the kind of treatment technology to setup in order to restore and rejuvenate

the water body. Based on the analysis of water quality, processes best suited for treatment can be determined, keeping in mind the standards of treatment. The importance of standards followed in India for discharge of wastewater has been elaborated in the subsequent section.

Importance of Guidelines and Standards of Treatment

'Water Governance in India' elaborates on all the policies that have been effect in the recent years In year 2019, Hon'ble NGT revised the standard for disposal of treated wastewater in water body. The new standards that have been implemented also put an extra pressure in the existing WWTP infrastructure, to deliver discharges that meet the required standards. However, the strict discharge standards are set in a manner that the discharged water may be reused and recycled in the light of decreasing water bodies across the nation. Therefore standards of treatment are important as they are the key that will promote reuse and recycle of treated water. The latter holds particularly true in the context of rejuvenation of traditional water bodies, where the water collected in *Johad*s or ponds to be used for various secondary purposes, However over the past few decades, as discussed in the Introduction, the release of wastewater that has caused unabated pollution is causing a severe water quality problem in these *Johad*s; which feeds and perpetuates the further neglect of these waterbodies. Therefore, to protect these water bodies, the following standards of waste water discharge that were required for all State Pollution Control Boards (SPCBs) are to be enforced. The standards of water quality that is followed, according to the orders of the Hon'ble National Green Tribunal (NGT) and recommended by the Central Pollution Control Board (CPCB) are given in the following table –

Table 2: The following table shows the standards that the wastewater must meet according to NGT

Parameter	Value	Units
pH	5.5 -9.0	
BOD	<10	mg/l
TSS	20	mg/l
COD	<50	mg/l
Total Nitrogen	<10	mg/l
Total Phosphorus	1.0	mg/l
Faecal Coliform	1000	MPN/100 ml

Therefore, the type and duration of treatment of water is dependent upon how much the tested parameters vary in comparison to the set standards. A sample of water quality report is given in Annexure B.

Soil Testing

Soil Testing of the area around the pond is an essential source of information for the type of natural and native flora is able to be supported in the kind of soil quality. Therefore, the following parameters are tested in order to understand the soil characteristics.

- Physical Parameters – pH, Organic Matter, Type of Soil and Electrical Conductivity (EC) of the Soil
- Chemical Parameters – Ammonia, Calcium, Magnesium, Nitrogen, Phosphorus, Iron, Potassium, Manganese, Copper, Zinc, Boron and Sulphur.

The requirement of carrying out elemental tests, with both respect to water and soil, is to support the natural treatment as much as possible for the overall rejuvenation of the water body and to create a flourishing natural environment around it that is able to support the biodiversity of the region. A sample of soil quality report is given in Annexure C.

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Project Feasibility Assessment

Project feasibility is essentially a decision-making process based on a numerous factors such as funds available, land constraints, population to be served, amongst others. The precedence of these factors are dependent on the nature of the project. Detailed fund utilisation plans are therefore an important components of project feasibility, which presents and explains the need for allocation of a certain sum of money for the required interventions, in order to satisfy the needs of the end goals of the project undertaken. This cumulative decision-making process, while has the number of constraints for each of type of projects undertaken, the weightage of each factors changes according to the location of implementation for the technical intervention. The information of some of these factors have already been discussed in the previous chapter, both in terms of the physical and technical information of the water body.

The factors under consideration for the project feasibility for pond restoration and rejuvenation are the water quality, soil quality, land availability, community responsiveness, current status of the water body in terms of volume of water present in the pond, funds available both in terms of CAPEX and OPEX. All of the mentioned factors can be arranged in a decision matrix that carries different weightages, which can be adjusted according to the requirements of the community. Project Feasibility as a decision-making tool therefore allows the determination of the extent and type of technical intervention possible according to relative weightage of different factors discussed for pond restoration and rejuvenation in an identified site.

FACTORS AND REQUIREMENTS FOR SETTING UP A TREATMENT SYSTEM

While most of the wastewater that is generated in a village or remote setting is domestic wastewater, there are occasional cases where small industries are setup, that may contribute to heavy metals being discharged into the wastewater. Even while looking at wastewater discharged from an urban setting, most of the wastewater that is received is either domestic waste in nature, or waterbodies that receive runoff generated from rainfall events, which carry pollutants from the catchment area. Therefore, the first judgement of the type of treatment system to be designed is on the basis of the existing water quality (present or being discharged in the water body) in comparison to the discharge standards set by NGT. The SPCB or any NABL accredited lab carries out the testing of parameters regulated by NGT and CPCB, along with others that might be required for further analysis of the environment or locality.

Wastewater Characterisation – Inferences made from Pre-studies

While there are various parameters that are required for the characterisation of wastewater,

four parameters play a significant role for the treatment of wastewater – namely Biological Oxygen Demand (BOD), Chemical oxygen Demand (COD), Suspended Solids (SS) and Total Dissolved Solids (TDS). BOD and COD are the primary indicators "biodegradable" and "inorganic" constituents respectively that can be removed from the wastewater. A high COD in comparison to BOD will often suggest that there is a higher percentage of inorganics than organic material and therefore would require a more conventional physio-chemical wastewater treatment system such as membranes systems, whereas if BOD is higher, then the treatment system can be more naturalised with treatment systems such as over-land flow systems or constructed wetlands as possible treatment options. The ratio of BOD/COD ratio is a strong indicator for the type of treatment technology to be chosen. The following are the limits of BOD/COD ratio and the interpreted quality of water, according to which the class of treatment may be suggested –

Table 3: The inferences made from BOD/COD ratio to decide the type of treatment required

BOD/COD Ratio	Type of Water Quality	Type of Treatment suggested
2.0-3.0	The biodegradable fraction of pollution is high	Biological treatment would suffice.
3.0-4.5	Both Biodegradable and Inert materials are high	A combination of biological and mechanical treatment (aeration) would be required
>4.5	Inert and chemically polluted wastewater	Purely electromechanical or chemical means of treatment would be required

Suspended Solids as the name suggests are constituents that can be suspended from the water, given enough area and detention time whereas dissolved solids cannot be settled out without a physio-chemical treatment system. Therefore, another indicator of treatment system required can be made from studying the type of solids in wastewater.

Elemental pollution caused by Nitrogen and Phosphorus may also be a source of concern, and can be confirmed from visual checks if there is severe eutrophication in the water bodies. This can especially be a case where discharge from farming lands are led to the water body, where high levels of both nitrogen and phosphorus may be found to cause algae growth. However, wastewater in domestic setups do not generate large amounts unlike urbanised domestic sewage, (where a lot of these elemental pollution is caused by the use of detergents, and the use of other highly processed materials).

It should be noted however that the above wastewater characterization must be assessed in holistic terms and not as individual parameters for assessing the level and type of treatment required, and only a treatment system that addresses and satisfies the most conditions must be chosen.

Figure 6: *Sample collection from the inlet to the water body where the domestic wastewater is being discharged from.*

TREATMENT TECHNOLOGY SELECTION

While there are a plethora of wastewater treatment technologies that one could choose from while designing, one would need to consider the following factors along with influent wastewater characteristics and effluent treated wastewater standards, in order to adapt the treatment technology applied to the location (Sperling, IWA, 2007) –

i. Wastewater Flow and Peak Flows;

ii. Toxic Compounds that need to be removed prior to the treatment system, so that the treatment infrastructure is not destroyed;

iii. Environmental conditions such as temperature, prevailing wind conditions and other climatic conditions;

iv. Sludge processing and soil conditions for sludge disposal;

v. Natural flora and fauna of the location that might be dependent on the water source;

vi. Resource requirements such as chemicals, auxiliary equipment's (pumps, motors), power and energy requirements, human resources to operate and maintain the plant;

vii. Reliability of technology and

viii. Capital & Operation and Maintenance cost for the Treatment Plant.

The above-mentioned factors are not in order of importance, rather have an equal weightage to decide the type of treatment system required.

Designers often use a decision matrix that incorporates most of the above factors. Depending on the constraints and demands of the site, the weightage of these factors are decided

on decision matrix. Broadly speaking, wastewater treatment systems are divided into three stages namely the Primary Treatment systems which are able to remove the large majority of suspended solids from the wastewater, thereby reducing COD by approximately 30-45%, Secondary Treatment systems which are mainly biological systems to degrade the biological organic constituents in the wastewater, which reduces the BOD by at least 60-70%. Biological systems can be designed to also remove excess levels of nitrogen and phosphorus. The tertiary stage of treatment is used as a polishing step to further reduce the BOD, COD, SS and TDS along with removal of colour and odour. The following two tables provide a brief of the advantages and disadvantages of the various wastewater technologies and principles of treatment processes used.

Table 4: Advantage and disadvantage of various technologies both nature based and electro-mechanical means of treatment (IWA, 2007; CSE 2018)

System	Advantages	Disadvantages
Stabilisation Pond Systems		
Facultative Pond	• Satisfactory BOD removal efficiency • Reasonable pathogen removal efficiency • Simple construction, operation and maintenance • Reduced construction and operating costs • Absence of mechanical equipment • Practically no energy requirements • Satisfactory resistance to load variations • Sludge removal necessary after periods greater than 20 years.	• High Land requirements • Difficulty in satisfying discharge standards • Operational simplicity can bring a disregard to maintenance (e.g. Vegetation growth) • Possible need for removing algae from effluent to comply with stringent discharge standards • Variable performance with climatic conditions (temperature and sunlight) • Possible insect growth
Ponds – maturation pond system	• High pathogen removal in comparison to other pond systems • Reasonable nutrient removal efficiency.	• Similar to facultative ponds • Rapid filling of the sedimentation ponds with sludge (2 to 5 years) • Need for continuous or periodic (few years interval) removal of sludge from sedimentation pond.

System	Advantages	Disadvantages
Land Disposal Systems		
Overland Flow	• High Removal efficiency of BOD and coliforms • Satisfactory removals of N and P • Combined treatment and final disposal methods • Practically no energy requirements • Simple construction, operation and maintenance • Reduced construction and operation costs • Good Resistance to load variations • No sludge to be treated • Provides soil fertilisation and conditioning • Financial returns from irrigation in agricultural areas • Recharge of groundwater • Generation of a final effluent with a dependence on ground slope. • Lowest dependence on soil characteristics among land disposal systems	• Potential contamination of groundwater with nitrates • Very high land requirements • Possibility of bad odours • Possibility of vector attraction • Relatively dependent on climate and nutrient requirements of the plant • Dependent on soil characteristics • Contamination risk to the plants to be consumed if applied indiscriminately • Possibility of the contamination of the farm workers • Possibility of chemical effects in the soil, plants or groundwaters • Difficult inspection and control of the irrigated vegetables • The application must be suspended or reduced in rainy periods • Greater dependence on ground slope • Generation of a final effluent.
Bioremediation	• Is ideal for treating wastewater generated from a small community and primarily for treating domestic wastewater • No external power source required • Simple operations and maintenance	• Chemical components cannot be degraded through this system • Nutrient/ Substrates are not regenerative, therefore external chemical would be required • Temperature dependent process

System	Advantages	Disadvantages
Constructed wetland	• High removal efficiency of BOD and coliforms • Practically no energy requirements • Simple construction, operation and maintenance • Reduced construction and operational costs • Good resistance to load variations • No sludge to treated • Possibility of using the produced plant biomass	• High land requirements • Wastewater requires previous treatment (primary or simplified secondary) • Need for a substrate, such as gravel or sand • Susceptible to clogging • Need of macrophytes handling • Possibility of mosquitoes in surface flow systems
Anaerobic Reactors		
UASB	• Reasonable BOD Removal efficiency • Low land requirements • Low construction and operational costs • Tolerance to influents highly concentrated organic matter • Practically no energy consumption • Possibility of energy use of the biogas • Support medium not required • Simple construction, operation and maintenance • Very low sludge production • Sludge stabilisation in the reactor itself • Sludge with good dewaterability • Sludge requires only dewatering and final disposal • Rapid start up after periods of no use (biomass preservation for various months)	• Difficulty in complying with restrictive discharge standards • Low coliform removal efficiency • Practically no N and P removal • Possibility of the generation of an effluent with an unpleasant aspect • Possibility of generation of bad odours, although controllable • Initial start-up is generally slow (but can be accelerated with the use of seeding) • Relatively sensitive to load variations and toxic compounds • Usually needs post treatment.

System	Advantages	Disadvantages
Phytorid	• Negligible sludge production • No odour • No chemicals required • Negligible consumption of electric power • Landscaped cells of plantations	• Electric power is required • Periodic Operations and Maintenance of Plants required for optimum treatment efficiency • Land requirement is high • Uniform flow must be maintained
Septic Tank – Anaerobic Filter	• Same as UASB Reactors (although support medium required) • Good Adoption to different wastewater types and concentrations • Good resistance to load variations	• Difficulty in complying with restrictive discharge standards • Low coliform removal efficiency • Practically no N and P removal • Possibility of the generation of an effluent with an unpleasant aspect • Possibility of the generation of bad odours although controllable • Risks of clogging • Restricted to the treatment of influents without high solids concentrations.
Activated Sludge Processes		
Conventional activated sludge	• High BOD removal efficiency • Nitrification usually obtained • Biological removal of N and P is possible • Low land requirements • Reliable processes as long as it is supervised • Reduced possibility	• Low coliform removal efficiency • High construction and operational costs • High energy consumption • Sophisticated operation required • High mechanisation level • Relatively sensitive to toxic discharges • Requires complete treatment and final disposal of the sludge • Possible environmental problems with noise and aerosols.

System	Advantages	Disadvantages
Sequencing Batch Reactors	• High BOD removal efficiency • Satisfactory removal of N and possibly P • Low land requirement • Conceptually simpler than the other ASP systems • Operational flexibility (through cycle variation) • Secondary sedimentation tanks and sludge recycle pumps are not necessary (operation as extended aeration: primary clarifiers and sludge digesters also not necessary)	• Low coliform removal efficiency • High construction and operational costs • Greater installed power than the other activated sludge systems • Treatment and disposal of the sludge required (variable with the conventional or extended aeration mode, although the latter is more frequent) • Usually economically more competitive for small to medium size populations
Low rate trickling filters	• High BOD removal efficiency • Frequent nitrification • Relatively low land requirements • Conceptually simpler than activated sludge • Relatively low mechanisation level • Simple mechanical equipment • Sludge digestion in the filter itself	• Low coliform removal efficiency • Lower operational flexibility than activated sludge • High construction costs • Land requirements higher than high rate trickling filters • Relative dependence from the air temperature • Relatively sensitive to toxic discharges • Thickening/dewatering and final disposal of the sludge required • Possible problems with flies • High head loss required
Membrane Systems		
Membrane Bio Reactors	• High quality effluent for reuse without separate nutrient removal and fine filtration • Compact system, reduces plant footprint by 25-40% compared to a conventional STP • These membranes are stated to be durable to ensure reliability and long membrane life, and low membrane replacement frequency	• Each vendor advocates his own criteria for the membrane and their types which makes is it difficult to bring about a common and validated design criterion • It is not possible to cannibalise the system between different manufacturers • High reliance on energy input in the absence of bio-methanation

System	Advantages	Disadvantages
	• The modular system is expandable • Higher stability to organic shocks/upsets due to higher MLSS concentration • The process operates under low suction, the ideal filtration method for small to large scale membrane facilities, hence low power consumption • Automated system makes the process operations easier to operate	• Patented process technology and decanters defying local cannibalisation • Detailed evaluation of existing plants required either by IIT, CPCB or NEERI.
Moving Bed Bio Reactor	• There are no limitations on height as long as suitable compressors can be used • Circular structures can be used to economise on construction costs and time • The structures can be easily covered for indoor air quality when needed. • Requires lower footprints compared to activated sludge processes • Easy to operate and maintain	• The area per unit of the media offered by various vendors are different and also each vendor advocated his own criteria for the relative ratio of volume of media to volume of aeration tank, which makes it difficult to bring about a common and validated standard design criteria. The quality of plastic media varies • The verification of whether the media is moving about the entire volume of the tank or merely clumping at the top layers and if so method of mixing it up through the tank volume without shearing of the biomass on the are issues of uniformity and which may gentle movers of media through the volume of the tank • Furthermore, the media is a patented product • Higher energy input if used without bio-methanation.

Table 5: Advantages and disadvantages of the main conventional methods used for the treatment of polluted industrial wastewater (Grégorio Crini, Eric Lichtfouse, 2018)

Process	Main Characteristics(s)	Advantages	Disadvantages
Chemical Precipitation	Uptake of the pollutants separations of the products formed	• Technologically simple (Simple Equipment) • Integrated physicochemical process • Both economically advantageous and efficient Adapted to high pollutants loads • Very efficient for metals and fluoride elimination • Not metal selective • Significant reduction in the chemical oxygen demand	• Chemical consumption (Lime, Oxidants, H2S, etc. • Physicochemical monitoring effluent (PH) • Ineffective in removal of the metal ions at low concentration • Requires an oxidation step if the metals are complexed • High sludge production, handling and disposal problems (management, treatment, cost)
Coagulation/ flocculation	Uptake of the pollutants separations of the products formed	• Process simplicity • Integrated physicochemical process • A wide range of chemicals are available commercially Inexpensive capital cost • Very efficient for SS and colloidal particles Good sludge settling and dewatering characteristics Significant reduction in the chemical oxygen demand and biochemical oxygen demand • Interesting reduction in total organic carbon and adsorb able organic halogen (pulp and paper industry)	• Requires adjunction of non-reusable chemicals (coagulants, flocculants, aid chemicals) Physicochemical monitoring of the effluent (pH) • Increased sludge volume generation (management, treatment, cost) • Low removal of Arsenic

Process	Main Characteristics(s)	Advantages	Disadvantages
		• Bacterial inactivation capability • Rapid and efficient for insoluble contaminants (pigments, etc.) removal	
Flotation Froth flotation	Separation process	• Integrated physicochemical process Different types of collectors (non-ionic or ionic) Efficient for removal of small particles and can remove low-density particles which would require long settling periods • Useful for primary clarification • Metal selective • Low retention time • Used as an efficient tertiary treatment in the pulp and paper industry • Mechanisms: true flotation, entrainment and aggregation	• High initial capital cost Energy costs • Maintenance and operation costs no negligible • Chemicals required (to control the relative hydrophobicity's between the particles and to maintain proper froth characteristics) • Selectivity is pH dependent
Chemical oxidation Simple oxidation Ozone **Hypochlorite treatment** **Hydrogen peroxide**	Use of an oxidant (e.g., O_3, Cl_2, ClO_2, H_2O_2, $KMnO_4$)	• Integrated physicochemical process • Simple, rapid and efficient process • Generation of ozone on-site (no storage-associated dangers) • Quality of the outflow (effective destruction of the pollutants and efficient reduction in colour) • Good elimination of colour and odour (ozone)	• Chemicals required Production, transport and management of the oxidants (other than ozone) • Pre-treatment indispensable • Efficiency strongly influenced by the type of oxidant • Short half-life (ozone) • A few dyes are more resistant to treatment and necessitate high ozone doses

Process	Main Characteristics(s)	Advantages	Disadvantages
		• Efficient treatment for cyanide and sulphide removal Initiates and accelerates azo bond cleavage (hypochlorite treatment) • Increases biodegradability of product • High throughput • No sludge production Possibility of water recycle • Disinfection (bacteria and viruses)	• Formation of (unknown) intermediates • No diminution of chemical oxygen demand values or limited effect (ozone) • No effect on salinity (ozone) • Release of volatile compounds and aromatic amines (hypochlorite treatment) • Generates sludge
Biological methods Bioreactors **Biological activated sludge (BAS) Microbio-logical treatments** **Enzymatic decomposition** **Lagoon**	Use of biological (pure or mixed) cultures	• The application of microorganisms for the biodegradation of organic contaminants is simple, economically attractive and well accepted by the public Large number of species used in mixed cultures (consortiums) or pure cultures (white-rot fungus) White-rot fungi produce a wide variety of extracellular enzymes with high biodegradability capacity Efficiently eliminates biodegradable organic matter, NH3, NH4+, iron Attenuates colour well • High removal of biochemical oxygen demand and suspended solids (BAS) Decisive role of microbiological processes in the future technologies used for the removal of emergent contaminants from waters	• Necessary to create an optimally favourable environment • Requires management and maintenance of the microorganisms and/ or physicochemical pre-treatment (inefficient on non-degradable compounds or when toxic compounds are present) Slow process (problems of kinetics) • Low biodegradability of certain molecules (dyes) Poor decolorization (BAS) Possible sludge bulking and foaming (BAS) • Generation of biological sludge and uncontrolled degradation products

Process	Main Characteristics(s)	Advantages	Disadvantages
			• The composition of mixed cultures may change during the decomposition process Complexity of the microbiological mechanisms • Necessity to have a good knowledge of the enzymatic processes governing the decomposition of the substances
Adsorption/ filtration Commercial activated carbons (CAC) Commercial activated alumina (CAA) **Sand** **Mixed materials Silica gel**	Non-destructive process Use of a solid material	• Technologically simple (simple equipment) and adaptable to many treatment formats • Wide range of commercial products • Wide variety of target contaminants (adsorption) Highly effective process (adsorption) with fast kinetics • Excellent quality of the treated effluent • Global elimination (CAC) but possibly selective depending on adsorbent • Excellent ability to separate a wide range of pollutants, in particular refractory molecules (CAC is the most effective material) • CAC: efficient for chemical oxygen demand removal; highly efficient treatment when coupled to coagulation to reduce suspended solids, chemical oxygen demand and colour	• Relatively high investment (CAC) • Cost of materials (CAC, CAA) • Non-destructive processes Non-selective methods Performance depends on the type of material (CAC) Requirement for several types of adsorbents Chemical derivatization to improve their adsorption capacity • Rapid saturation and clogging of the reactors (regeneration costly) • Not efficient with certain types of dyestuffs and some metals (CAC) • Elimination of the adsorbent (requires incineration, regeneration or replacement of the material)

Process	Main Characteristics(s)	Advantages	Disadvantages
		• Sand: efficient for turbidity and suspended solids removal • Alumina: efficient for fluoride removal	• Regeneration is expensive and results in loss of material (CAC) Economically non-viable for certain industries (pulp and paper, textile, etc.)
Ion exchange Chelating resins Selective resins Macro porous resins Polymeric adsorbents Polymer-based hybrid adsorbents	Non-destructive process	• Wide range of commercial products available from several manufacturers Technologically simple (simple equipment) • Well-established and tested procedures; easy control and maintenance • Easy to use with other techniques (e.g., precipitation and filtration in an integrated wastewater process) • Can be applied to different flow regimes (continuous and batch) • High regeneration with possibility of external regeneration of resin • Rapid and efficient process Produce a high-quality treated effluent. • Concentrates all types of pollutants, particularly minerals • Relatively inexpensive and efficient for metal removal; clean up to ppb levels (to ppb levels for selective resins) Can be selective for certain metals (with suitable resins) Interesting and efficient technology for the recovery of valuable metals	• Economic constraints (initial cost of the selective resin, maintenance costs, regeneration time-consuming, etc.) • Large volume requires large columns • Rapid saturation and clogging of the reactors Saturation of the cationic exchanger before the anionic resin (precipitation of metals and blocking of reactor) • Beads easily fouled by particulates and organic matter (organics and oils); requires a physicochemical pre-treatment (e.g., sand filtration or carbon adsorption) to remove these contaminants • Matrix degrades with time and with certain waste materials (radioactive, strong oxidants, etc.) Performance sensitive to pH of effluent Conventional resins not selective

Process	Main Characteristics(s)	Advantages	Disadvantages
			• Selective resins have limited commercial use Not effective for certain target pollutants (disperse dyes, drugs, etc.) • Elimination of the resin
Incineration **Thermal oxidation Catalytic oxidation Photocatalytic destruction**	Destruction by combustion	• Simple process • Useful for concentrated effluents or sludge's • Highly efficient • Eliminates all types of organics • Production of energy	• Initial investment costs Transport and storage of the effluents • High running costs Formation of dioxins and others pollutants (metals, etc.) • Local communities always have opposed the presence of incinerating plant in the locality
Electrochemistry Electrode position Electro-coagulation (EC) **Electro-flocculation (EF)** **Electro-flotation Electro-oxidation Electrochemical oxidation Electrochemical reduction Cementation** **Indirect electro-oxidation with strong oxidants** **Photo-assisted electrochemical methods**	Electrolysis (E)	• Efficient technology for the recovery/recycling of valuable metals (E); interesting method for the recovery of gold and silver from rinse baths • Adaptation to different pollutant loads and different flow rates (E) • Increases biodegradability (E) • More effective and rapid organic matter separation than in traditional coagulation (EC); pH control is not necessary; generation of coagulants in situ; economically feasible and very effective in	• High initial cost of the equipment • Cost of the maintenance (sacrificial anodes, etc.) Requires addition of chemicals (coagulants, flocculants, salts) • Anode passivation and sludge deposition on the electrodes that can inhibit the electrolytic process in continuous operation • Requires post-treatment to remove high concentrations of iron and aluminium ions

Process	Main Characteristics(s)	Advantages	Disadvantages
		removing suspended solids, dissolved metals, tannins and dyes (effluents from textile, catering, petroleum, municipal sewage, oil–water emulsion, dyestuff, clay suspension, etc.) • Efficient elimination of SS, oils, greases, colour and metals (EC, EF) • EF: widely used in the miming industries • Effective in treatment of drinking water supplies for small- or medium-sized communities (EC) • Very effective treatment for the reduction, coagulation and separation of copper (EC) • Cementation: efficient for copper removal	• EF: separation efficiency depends strongly on bubble sizes • Filtration process for focus Formation of sludge (filtering problems) • Cost of sludge treatment (electro-coagulation)
Membrane filtration Microfiltration (MF) Ultrafiltration (UF) Nanofiltration (NF) Reverse osmosis Dialysis **Electrodialysis (ED)** **Electro-electrodialysis (EED)** **Emulsion liquid membranes (ELM) Supported liquid membranes**	non-destructive separation Semi permeable barrier	• Wide range of commercial membrane available from several manufacturers; large number of applications and module configurations • Small space requirement Simple, rapid and efficient, even at high concentrations Produces a high-quality-treated effluent • No chemicals required	• Investment costs are often too high for small and medium industries • High energy requirements • The design of membrane filtration systems can differ significantly • High maintenance and operation costs • Rapid membrane clogging (fouling with high concentrations)

Process	Main Characteristics(s)	Advantages	Disadvantages
		• Low solid waste generation Eliminates all types of dyes, salts and mineral derivatives Efficient elimination of particles, suspended solids and microorganisms (MF, UF, NF, reverse osmosis), volatile and non-volatile organics (NF, reverse osmosis), dissolved inorganic matter (ED, EED), and phenols, cyanide and zinc (ELM) • Possible to be metal selective • A wide range of real applications: clarification or sterile filtration (MF), separation of polymers (UF), multivalent ions (NF), salts from polymer solutions (dialysis) and non-ionic solutes (ED), desalination and production of pure water (reverse osmosis) Well-known separation mechanisms: size exclusion (NF, UF, MF), solubility/diffusivity (reverse osmosis, pervaporation), charge (electrodialysis)	• Low throughput • Limited flow rates • Not interesting at low solute feed concentrations The choice of the membrane is determined by the specific application (hardness reduction, particulate or total organic carbon removal, potable water production, etc.) • Specified processes • Elimination of the concentrate

Process	Main Characteristics(s)	Advantages	Disadvantages
Evaporation Membrane **pervaporation**	Concentration technique Thermal process Separation process	• Several types of evaporators exist on the market • Versatile technique (the number of cells can be adapted to the required evaporation capacity) • The energy costs are well known for the different configurations • Efficient processes Interesting for the production of water for rinsing operations (recycling of distillates), the concentration of rinsing effluents for re-introduction into the process and for the purification of treatment baths (to maintain their nominal concentration) • Also interesting for the separation of phenol by steam distillation • Membrane pervaporation: a quite recent technology applied to the removal of organics from water	• Expensive costs for high volumes of wastewater (energy consumption, volume of the concentrate and costs of disposal) Investment costs are often too high for small and medium industries • High pollution load in the concentrates • Crystallization due to the concentration of the wastewater and corrosion of the heating elements in the evaporator due to the chemical aggressiveness of the concentrated effluent Problem with the evaporation of effluents containing free cyanide Requires the installation of a cleaning circuit (to prevent atmospheric pollution) • Potential contamination of the distillate preventing reuse (due to the presence of some volatile organic compounds or hydrocarbons in the effluent)

Process	Main Characteristics(s)	Advantages	Disadvantages
Liquid–liquid (solvent) extraction **Membrane-based solvent extraction**	Separation technology Solvent extraction	• A well-known established separation technology for wastewater recycling Principally used for large-scale operations where the load of contaminants are high • Extraction/stripping operations easy to perform Simple control and monitoring of process Economically viable when both solute concentrations and wastewater flow rates are high • Relatively low operating costs • Recyclability of extractants • Selectivity of the exchangers for metals efficient for metal removal (cautions, anions, ion pairs) • Efficient for the separation of phenol • A good alternative to classical lime precipitation for phosphoric acid recuperation	• High investment (equipment) • Uneconomic when contaminant concentrations are low (<0.5 gL) • Use of large volumes of organic extractants • Use of potential toxic solvents • Not interesting at low solute feed concentrations Hydrodynamic constraints (flooding and entrainment) Entrainment of phases giving poor effluent quality Possible cross-contamination of the aqueous stream Emulsification of phase with poor separation • Fire risk from use of organic solvents and volatile organic compounds emissions

Process	Main Characteristics(s)	Advantages	Disadvantages
Advanced oxidation processes (AOP) Photolysis Heterogeneous and homogeneous photocatalytic reactions **Non-catalytic wet air oxidation (WAO) Catalytic wet air oxidation (CWAO) Supercritical water gasification**	Emerging processes Destructive techniques	• In situ production of reactive radicals • Little or no consumption of chemicals • Mineralization of the pollutants • No production of sludge Rapid degradation • Efficient for recalcitrant molecules (dyes, drugs, etc.) Very good abatement of chemical oxygen demand and total oxygen demand WAO: technology suitable for effluent too dilute for incineration and too toxic and/ or concentrated for biological treatment Destruction of phenol in water solution: WAO, CWAO Insoluble organic matter is converted to simpler soluble compounds without emissions of dangerous substances (WAO)	• Laboratory scale Economically non-viable for small and medium industries • Technical constraints Formation of by-products Low throughput • High-pressure and energy-intensive conditions (WAO) pH dependence (in particular for WAO) • WAO: completed mineralization not achieved

Administrative Approvals

WHY IS WATER A GOVERNMENT COMMODITY?

Water is a commodity of an essential service, and a critical resource, which has a major role to play in a country's economic growth and prosperity. As such, water becomes an important jurisdictional subject for National governments to control, distribute and use. Figure 3 shows various hierarchies of government and organisations with specific policies at an International, National and State level.. As such this chapter elaborates on the learnings concerning administrative approvals specifically required in the context of Haryana, however, a similar position may be taken for other States as well, while making necessary adjustments according to the various hierarchies involved.

NEED OF ADMINISTRATIVE APPROVALS

As GuruJal is an organisation that acts on the initiatives of the government, the unique precedence that it sets is for all the work undertaken is that a formal written agreement is taken from all the concerned stakeholders, may that be external or internal entities. This establishes the binding consent for all the stakeholders involved, and also provides evidence of the type of work that takes place, which hinders further data forgery. Administration approval is the overarching term that is used to govern all of the documents that are issued from all the authority bodies, which includes the Gram Panchayat, the vendors that are employed by GuruJal to provide carry out all construction work on-stie, and a written agreement from the District Administration. These documents help in planning and giving foresight of all the possible scope of work and the required support from any of the stakeholders involved, and spells out the terms and agreements for which the work is being allowed to take place. Therefore, if any party, is not able to uphold the standards and agreements to which previously had been agreed upon, work may be re-allotted to a more suitable candidate; this may especially be the case for third party independent vendors. For changing personnel's in a departmental role, work is ensured to carry on through the written agreements and letters that had

been agreed upon by the previous administrative personnel. The documentation and written agreements therefore under administration approval are checkpoints to ensure the sustainability of work undertaken.

PROCESS OF ADMINISTRATIVE APPROVAL

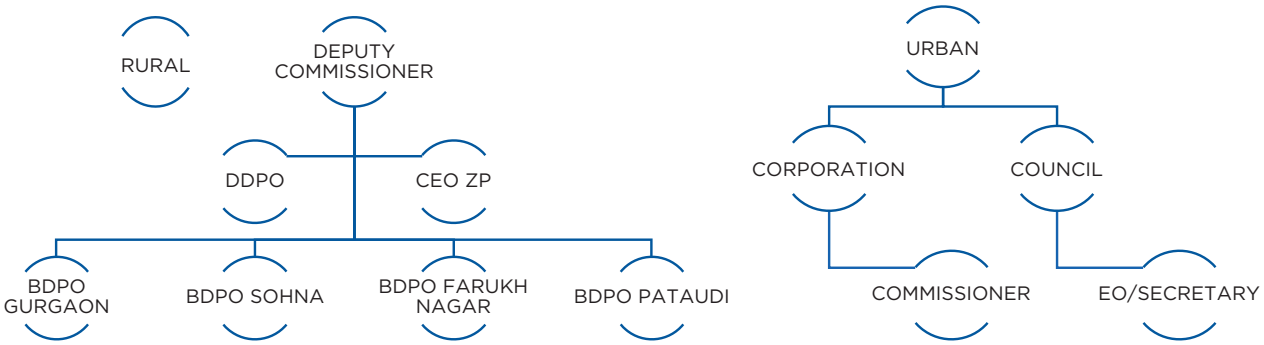


Figure 7: *Overall Structure of Government at a District Level at Rural and Urban Area in District of Gurugram, Haryana.*

Urban

In areas where the water body is within the urban area, or is within the jurisdiction of the Municipal Corporation or Committee, administrative approval will be given by Municipal Commissioner or any designated officer for the proposed work. Within the urban area, several different utility-based government bodies such as PHED, Hydrology Department, Agriculture Department etc. may already have mandates that they would be working upon, therefore prior alignment and coordination with them would be required prior to carrying out any work on-ground, in order to avoid duplicity of work. For Example, there are currently, there are 24+ government departments that are working in the District of Gurugram itself, and therefore aligning and working within the capacities of the individual department's mandates is essential. This exercise not only increases transparency within the various departments involved in works related to water, but also enables efficiency,

Rural

At rural level administrative approval will be given by Deputy Commissioner (DC)/District Magistrate (DM), District Development and Panchayat Officer (DDPO)/ Block Division Officer (BDO)/ District Rural Development Agency (DRDA) or Sarpanch of that particular Village.

It is important to note that the file movement from the different offices of all the government departments and stakeholders is meticulous in nature, and is designed, so that any further work even after the project is completed (work that may relate to the operations and maintenance of the projects) will be referenced and all the concerned authorities will be informed, and hence this forms a checkpoint for the sustainability of the project.

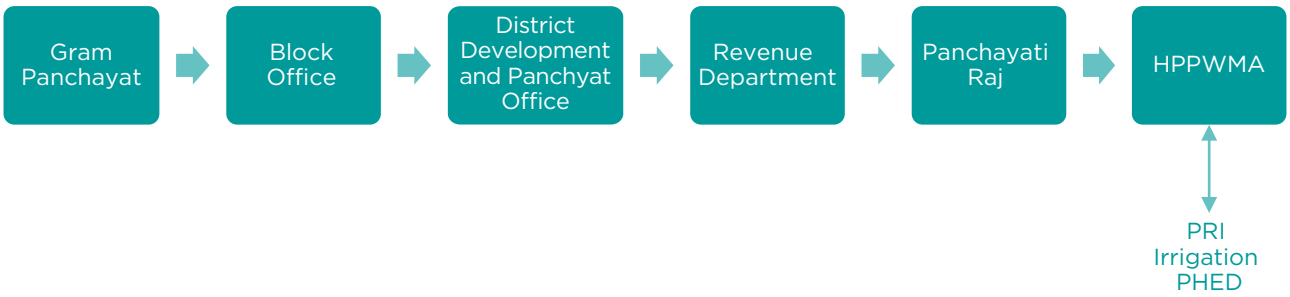


Figure 8: *File movement from the different government offices in ascending order of hierarchy for the rural setting.*

Administrative approval is attached in Annexure D. A simple flow diagram can show the concerned offices in an ascending fashion in Figure 8.

Resolution

Administrative approval in the form of Gram Panchayat resolutions are important and therefore the Gram Panchayat of each village with pond is sent detailed information about the pond (for example latitude, longitude, khasra number). In addition to this Gram Panchayat gives resolution of various work pertaining to the type of intervention to be implemented at pond site. Also, Gram Panchayat passes the resolution whether the proposed work is done under the Panchayat fund or not. A sample of resolution letters and few formats have been attached in Annexure D.

All of the above written documentation are compiled and managed properly within records, both in print and in digital to ensure proper maintenance. These records become an essential asset especially during an event of administration personnel change.

It should be noted that there are special tender documents that are passed for engaging third-party vendors for engaging them for their services for on-site work implementation, for which, along with standard terms and conditions, additional terms to ensure time-bound and sustainable development are also included in the work orders issued with specific timelines.

THE IMPORTANCE OF UPDATING REVENUE RECORDS

Revenue Processes are critical in any land matters. However, sometimes, due to lack of clarity about the detailed processes and their impact, they get missed out in projects taken up by communities or NGO's. The Tehsil office and the role of local *Patwaris* are crucial in the long-term sustainability of the projects.

Revenue Records are maintained in two categories, namely, identifying the land ownership, or identifying the land use, also known as the process known of *Jamabandi*. The methods of maintaining and updating these revenue records are through demarcation reports. Demarcation

is the action of fixing the boundary or limits (in most cases, an area). These, demarcation reports can either be done by on-site demarcation by local *Patwaris* of the Revenue office, or through GIS Mapping with Drone Survey. Therefore, an extensive exercise is carried out in order to ensure that identified ponds are registered, updated and clearly demarcated sites, in terms of both *Jamabandi*, where the pond is an identified as a water body site, and further as an area under Gram Panchayat ownership. This process ensures that further development or encroachment would not be able to take place without the permission of the Revenue office and the local Panchayat body.

Identification of the land use type and assessing the current situation can be carried out with GIS Mapping and Drone Survey. The information gathered, from the drone survey can further be processed with software such as QGIS. The advantage of using GIS mapping over on-site demarcation is that it gives one real time images of the pond and one can easily get the ownership data of the land adjacent to the pond site. After ownership data is available, the encroachment on site can easily be identified alongside any free Government land available. After obtaining the demarcation of pond an Architect/Engineer/Planner can get the exact area for landscaping & beautification and also provide some other facility (like open gym, kid play area, etc.) depend on the site specific constraints.

On-site demarcation of pond site will be done by the regulatory Authority (i.e. Tahsildar). After obtaining the ownership data one can easily start the planning work for the proposed work; as on-site demarcation is a time-consuming process. Step involved under drone survey for demarcation is shown below

Drone Survey/Demarcation

Realtime images of pond site captured by using Phantom 4 RTK Drone

↓

Processing of captured images using Pix4D Mapper Quadcopter Software

↓

Contour Mapper also generated using same software

↓

Overlay of Cadastral vector layer to mosaic image

↓

Addition of all required details of ownership data, khasra and murabba number to the final map

↓

On-site verification and demarcation using Differential Global Positioning System (DGPS)

The territories are marked thereafter consulting and getting approvals from the concerned Government department.

A sample of demarcation done by drone for pond located in Khentawas Village is attached in Annexure E as a reference. For example, in Haryana, ownership data can be easily assessable through Haryana Government Online Portal namely EODB and Zamabandi. Similar satellite images may be accessed through Bhuvan, ISRO's initiative to provide detailed satellite imagery.

Detailed Project Report

The Detailed Project Report (DPR) is a report that is prepared for planning the project and implementing the project. DPR is a tool used for making decisions related to investment, technology and timeline decision-making, approval and planning. DPR can be formulated in-house or through the consultant depending upon the skills and budget of the work.

DPR is an important document for the planning and decision-making for the proposed project as it includes the details of every single constituent of the project which has to be implemented. The proposed timelines for the project completion and success is also discussed in brevity. It also gives the SWOT (Strength, Weakness, Opportunity and Threat) analysis of the proposed project; identifying how the proposed project will impact (direct or indirect) on various constraints include environment, demography, socio-economic, transportation etc. Direct impacts of the proposed restoration and rejuvenation are explored through scientific assessment of the environmental impacts like increase in ground water table, and the proposed minimization or decrease in the extraction of ground water are also elaborated. Indirect impacts are also equally important and factors such as increase in biodiversity of the area (attract specific species of migratory birds), change in micro-climatic condition are also studied. All of the above factors enable the decision makers to envision the holistic approach to pond restoration and rejuvenation of the project. The socio-economic characteristics of the that particular area, assess direct impacts like employment generation, increase tourism are also products of the pond restoration and rejuvenation project, and therefore suggestions regarding the anticipation of these factors can also be predicted. The DPR will also include the detailed Bill of Quantities and Estimate of each item required for the restoration and rejuvenation purpose of the pond. While preparing the DPR following points should be considered (attached below) to assess the restoration and rejuvenation work.

DETAILED PROJECT REPORT CHECKLIST

1. **Objective of the Project**
   - For each of the project sites, the objective will be formulated
   - Layout of the work will be mentioned
   - Approximate timelines will be mentioned
2. **Need for the Project**
   - Need for the project will give a general idea as to why the project is required
   - The benefits of the project, upon completion, will also be shared

3. Methodology adopted for the Project

Methodology refers to the step by step procedure adopted from the starting to the completion of the project. It also includes the study of each of the parameters.

4. Introduction

- Status of the hydrology in the area will be shared
- Proper flow chart will be followed in this parameter, starting from the India to the concerned State, to the concerned area of intervention.

5. Historical Importance

This chapter will give an idea about the historical importance or significance of the water bodies (for example, traditional water bodies like *Johad*s) and give some context regarding the intervention area.

6. Regional linkages/ connectivity of the Project Site and Village

Regional linkages will be shown through the map

7. Demography and Socio-Economic Characteristics of the Village

- Information gathered from the primary and secondary sources (including site survey and census data) will be shared
- This chapter will give an idea on how the demography and socio-economic aspects influence the water management and biodiversity in the study area, over a long period of time

8. Issues and Potential

- The issues & the potential of the project will be analyzed on the basis of the lab test results of the following
  - Water
  - Air
  - Soil
- Details on how the parameters will influence the climatic conditions and impact humans, flora and fauna of the particular area and also the adjoining area will be mentioned

9. Project Proposals

- A proposal for the pond rejuvenation work will be included. It will include the steps of pond rejuvenation; such as dewatering, desilting, development of embankment, installation of micro STP, development and demarcation of catchment area, and landscape development.
  - Future utilization plan will be shared
  - Community mobilization plan will be shared
  - Project substantiality plan will be shared

10. Maps (the following will be shared in the detailed project report)

- Regional linkages
- Demographic pattern
- Site layout plan
- Contour map
- Cadastral map
- Land use/land cover map
- Watershed or catchment area map / drainage map
- Pond reviving–improvement plan (specific about the development of water body includes location of Micro STP)
- Landscape plan
- Composite map of the project

Fund Management

Fund Management is the process of assessing larger resource requirements which can be bifurcated into the following

- Manpower
- Material
- Machines

The process of monetary exchange and budgets to sanctioned for financial approval for the restoration and rejuvenation of pond is dependent on the head of budget from the proposed project has been allocated. This chapter discusses the fund management experiences and learning from implementation of on-ground work in Gurugram. Similar processes, alignments of departments and sponsors would need to be done for other areas of intervention. It should be kept in mind that fund management is a continuous exercise that is maintained through the entire life-cycle of the projects, and therefore is a very dynamic process. Often based on outcomes, fund management is an artform that emphasises on the usage of all resources wisely, and removes the focus from monetary exchange.

In urban and rural areas of Gurugram, the budgets for restoration and rejuvenation of pond is sanctioned and managed from different budgetary heads.

Manpower is the component of fund management that refers to the management of staff and labour. While the labour component can be sourced under the MGNREGA scheme, the work that is sanctioned is carried out at the DC Rate for all unskilled, and semi-skilled and skilled labourers. On the other hand, the technical staff can be sourced through CSR (Corporate Social Responsibility) funds, which are granted on a contractual basis according to stringent performance parameters.

Funds acquirement and management also largely depends on the engaged sponsor's interests. Alignment and fulfilment of their objectives of investment in a project must be catered to once a prospective sponsor are onboarded. This is the case especially when funding from CSR from a large company is received. However the final sanctioning power remains with the nodal government authority, which in the case of Gurugram, is MCG for urban areas, and DC Gurugram for rural areas.

Fund Management in the government setup is heavily is reliant upon coalitions and collaborations formed for satisfying the requirements of funds management. Fortunately, as the management of wastewater is a mandate for various government departments, alignment and collaborations are made such that certain resources can be managed and coordinated from them, such as,

aligning of the Irrigation Department for Dewatering a pond, and alignment with Panchayati Raj Institution (PRI) and IWMP Departments for Desilting a Pond. GuruJal has proven to be instrumental in constructing a framework that allows for clarity, transparency and coordination between various departments to have concerted efforts. Whereas, it has been previously been the case, where each Irrigation Department and PRI had received orders from the Headquarters for Dewatering and Desilting of 10 ponds respectively. However, it was found that the ponds that had been dewatered and the ones that had been desilted were completely different from each other, causing a massive waste of exercise and funds. Navigating funds for procurement of different services and materials such as testing at subsidised rates also require alignment of departments and mandates.

There are several others government departments and organisation from which financial help direct or in-direct can be taken, only if the work comes under their scope

- MPLADS
- MLA Development Fund
- GMDA
- MGNREGA
- Forest Department
- Horticulture Department
- HSPCB
- SBM
- NYK
- IWMP
- Irrigation

Fund Management in terms of monetary flow can also be procured from Gram Panchayats that may be convinced by similar action. For example, inspired by the GuruJal initiative of pond restoration and rejuvenation in Tajnagar, Gram Panchayats of Bhondsi and Wazirpur showed keen interest in the restoration and rejuvenation of wastewater ponds in their respective villages. Budgets can also be sanctioned from D-Plan or State Budget. In D-Plan, Deputy Commissioner will give the financial approval and in Gram Panchayat, Sarpanch has the power to allocate the budget. In State Government budget, Deputy Commissioner has the power in rural areas whereas area under Municipal jurisdiction gets approval by the Municipal Commissioner or any project in-charge as directed by Municipal Commissioner.

Funds sanctioned and management should be based on the project report or Detailed Project Report that presents a strong case for fund utilisation. It must be ensured that work under each head and sub-head of the Bill of Quantities (BOQ) has to be checked and cross-verified to ensure that the work has to be done according the Haryana Schedule of Rates or Rates which are provided by the competent authority in the place of intervention.

Community Mobilisation and Communication

Information Education & Communication (IEC) forms the fundamental backbone on which the success of grassroot projects depend on. Through IEC, information dissemination and awareness is created amongst the local community with open dialogue between the authorities and those that are impacted first hand when the intervention is established. Therefore, the method of IEC that has been effectively adopted by GuruJal is that of 'Community Mobilisation'.

Community mobilization is the process through which an open channel of communication through engagement in various activities between the local community and representatives of the local community is established and the sensibility of "For the people, by the people" is instilled. The activities are designed such that it may provide a stimulus to the community to increase the water consciousness in the community and is planned, carried out, and evaluated by a community's individuals, groups, and organizations on a participatory basis and is carried out on a regular basis, alongside the actual interventions taking place. It can be viewed as a process which begins a_dialogue among members of the community to determine who, what, and how issues are decided, and also to provide an avenue for everyone to participate in decisions that affect their lives. Therefore, as bricks are metaphorically laid down on ground for the restoration and rejuvenation of the water body, brickwork is also laid down to enable the ownership of the project being taken up the local community. This helps to raise awareness of and demand for the environment. The entire process of community engagement and mobilisation therefore is an act of creating sustainability of the project.

Another fundamental part of IEC is empowering the local community through involvement in the intervention for better operations and management, to encourage ownership of the project. This may be done at various stages of pond restoration and rejuvenation, for example, during plantation stage.. Involvement and employment of the local regional groups, self-help groups, religious groups to communicate the needs of project, with the intention of enforcing better communication between the authorities and the community.

METHODS USED FOR COMMUNITY MOBILIZATION

Community Mobilisation is a participatory communications approach that seeks to engage the whole community as individuals and as groups, including under-represented members of the community such as women, children, the unemployed to identify their problems, suggest solutions and initiate actions themselves. For this, these methods are used

1. Community Meetings: In villages, conduct meetings with villagers on the water-related issues. Identify their problems, discussion on the issues, try to understand it and suggest the solutions.

2. Community Mobilization Van- Advertise our goal and importance of water with the help of mobile van. Videos are the best way to attract the audience. Interact with the village people,especially children, through interactive learning videos. This tool is very powerful tool in the community
3. Individual Interaction: Try to build a connection and trust factor through individual interaction.
4. Workshops: Focused workshop aim to sensitize the influencing people through activities and another interactive session so that they can lead the society in a better way.
5. Community Participation through involving them in Landscaping and Beautification of the Pond Area. (This will be elaborated upon further in the chapter on Landscaping)

While it is impossible to expect behavioural change to occur overnight, with years of conditioning and ingrained belief systems, community mobilisation through essential gatekeepers of the society has brought about changes, and therefore a well-designed and thought out approach that factors in the human element is essential for the success of the interventions to be implemented for pond restoration and rejuvenation projects. While there is no single method to encapsulate the 'human factor' while designing the campaigns and plans for community engagement, it is essential that an open dialogue is present, and that all of the local community including the marginalised sections of the society are heard and represented in the decision-making process. It is therefore important to realise that community mobilisation while may be a time consuming process, change may be brought about by concerted efforts at different levels; public, mobilizers or behaviour change agents, development agencies and concerned authorities etc. the process from the lack of awareness stage to the final stage of improved behaviour amongst people has been depicted below:

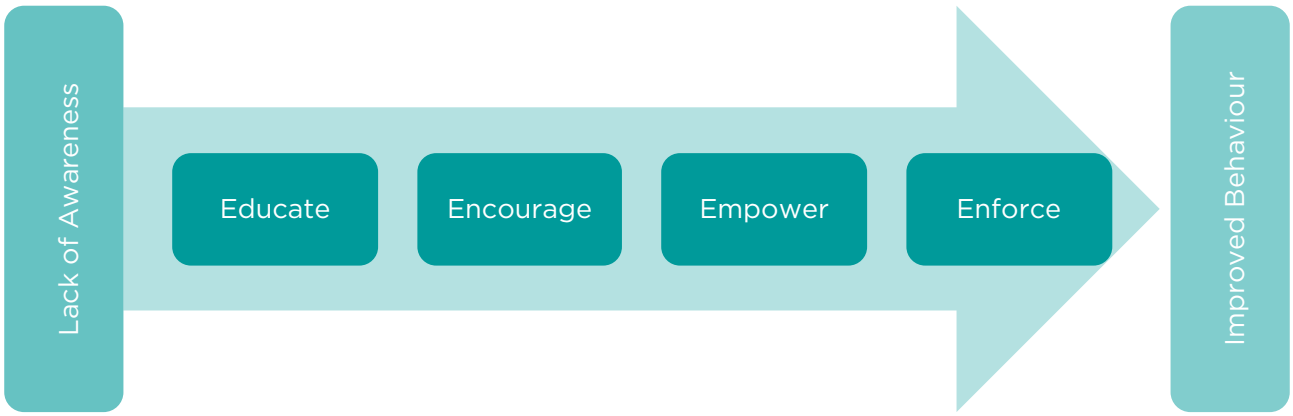


Figure 9: *4 E's of Behaviour Change*

In a brief description of the above model, the first step is to educate people about what, why, where, when and how's of water conservation, practices with regards to restoration and rejuvenation of ponds objectives. To encourage is the second step that aims to inspire, and raise the spirits of people to adopt the new behaviour in their lives on a day-to-day basis. Thirdly, emphasis will be laid to empower the masses with knowledge on issues, problems which they may face in water crisis, how even the smallest of the good habits imbibed and

internalized in people can prevent them from stress emerging due to recurring health issues amongst the society. The last one is to enforce, where all the concerned stakeholders will play their role in making a Water Conscious District.

For the same, workshops are to be planned regularly, so that there can be interaction at the ground level and hands-on training. Workshops and interactions are planned in such a manner that each stakeholder should participate in it. For better implementation, different groups are targeted in a community/ village (where pond is located) like children, schools and college students, local villagers of all age groups, and other stakeholders such as the government and private sector employee and farmers.


Figure 10: *Interaction with villagers*

After identifying the target groups schedule can be prepared in a such a manner that need and purpose of restoration and rejuvenation of pond can be reached in each households of the community/village.

A schedule prepared for the Community Mobilization in different Villages of Gurugram District is attached in Annexure F.

To create awareness among the people, the following points are covered:

- Water crisis
- Vision, mission and target of the group/society
- Previous pond conditions and their importance
- Pond restoration and rejuvenation
- Benefits of pond/*Johad*
- Future utility of the rejuvenated pond
- Social responsibility of the villagers
- Need and significance of biodiversity park
- Simple ways to regulate the use of water and save water
- Water efficient agricultural practices (using drip irrigation, crop rotation)
- Reuse of Treated Water
- Need of planting native species

- Role of Biodiversity Management Committee
- Discussion based on problems, ideas and suggestions

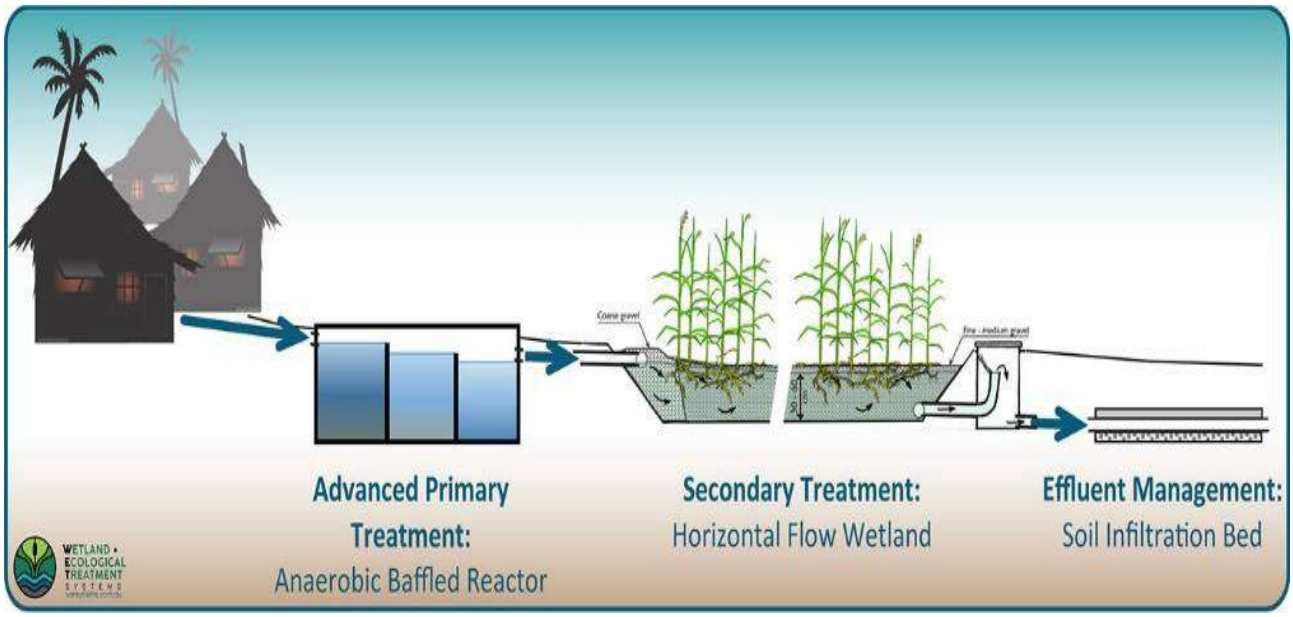


Figure 11: *Treatment of wastewater by Decentralised Treatment*

Designing of IEC and Communication Materials

It has been shown through various IEC activities through on-ground experience and through studies that if some tangible materials such as handouts, pamphlets/ handprints that allow them to visualise and understand through pictorials of different scenario of importance of water and its management. The impact of crop rotation and use of drip irrigation in agriculture fields over traditional method are also elaborated upon to convey the importance of water consciousness in all aspects of life. The images below depict some powerful message during the community mobilisation on above discussed points.

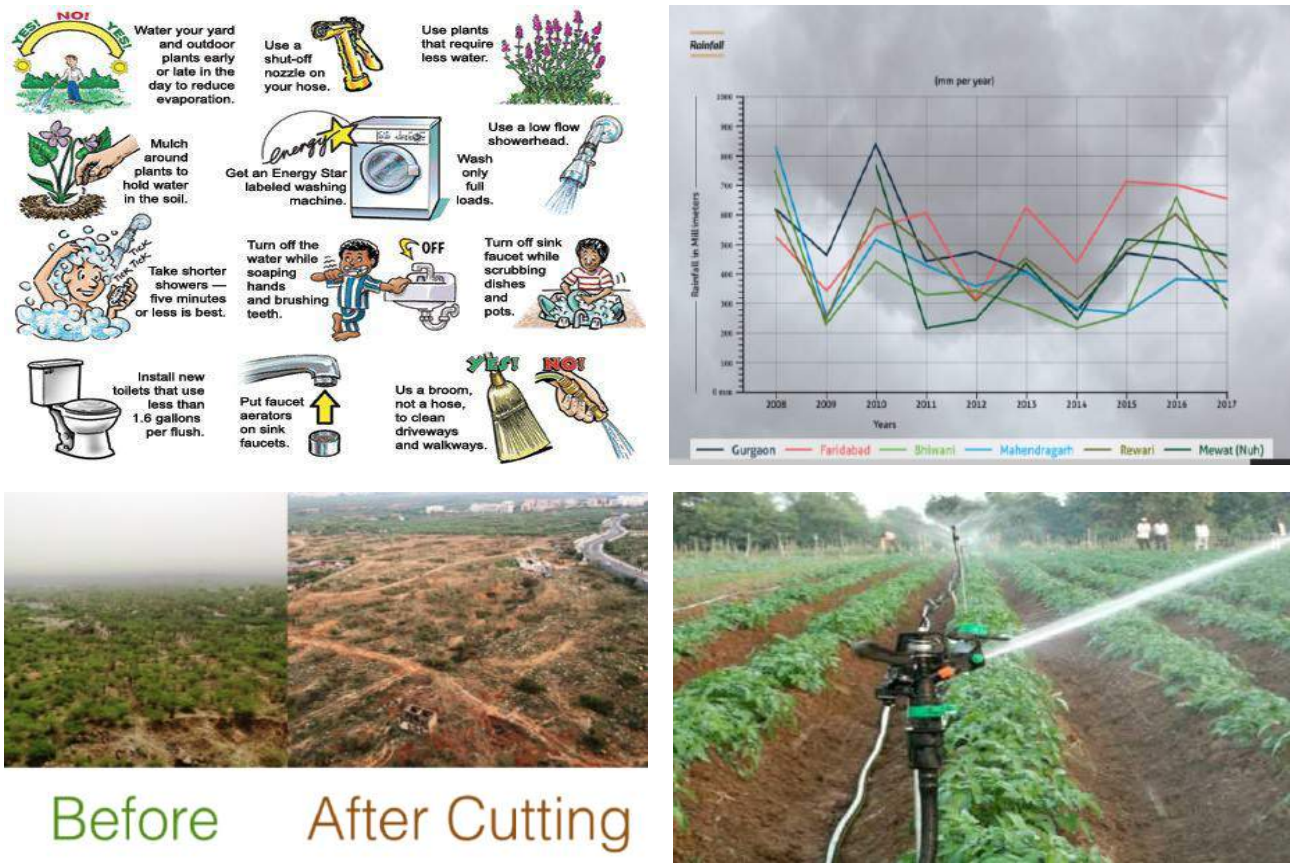


Figure 12: *The above pictures are some representatives of IEC materials.*

GuruJal's Van, Gurugram, Haryana

GuruJal's van is a means to deliver the message of water conservation across the urban, semi-urban and village crowd via videos and jingles. Video prove to be more impactful as everybody can understand what's happening when they visualise it. Not all people might be able to read, hence, video are more advantageous. Such awareness initiative will also build trust for the government.

Figure 13: *GuruJal Community Engagement Van that is used for Community mobilisation.*

Capacity Building and System Strengthening

Training and capacity building are needed at all levels to ensure that the right messages are getting to the right people in the most effective and cost-effective manner. There is strong need for training and capacity building as the perception of Officials, support agencies and implementing authorities needs to be aligned with an IEC focus for pond restoration and rejuvenation and critical aspects of water conservation and technical knowledge for the O&M of the wastewater treatment plant as a priority. This capacity building of the local community will serve as another checkpoint for sustainability of the project and for the ownership of the intervention to be transferred to the local community.

IEC

Informal communication dissipated through social media allows for a wider reach of information amongst the concerned citizens through awareness campaigns. The intended impact of creating awareness campaigns and engagement on social media, is to involve a larger mass for volunteering purposes. Moreover, awareness of ground stories and realities is more effectively communicated from the common public to key decision makers. Water woes and problems are highlighted that allows the feedback mechanism to operate seamlessly.

While IEC is the method through which information concerning the intervention and project is disseminated to the community, it is also the essential process to collect information regarding the needs and specific concerns of the community. In order to communicate these specific concerns and needs of the community, formal communication is an essential tool to convey the information back to key decision makers and stakeholders in the government setting. Therefore formal communication in the forms of letters, Gram Panchayat Resolutions that address specific points are key to close the feedback loop presented in Figure 5.

Formal Communication is an essential tool that is used across all Government Departments to expedite any process. As the governance model of GuruJal enables itself to be in working capacity with 22+ department bodies, formal communication becomes an important reference point to meet litigation needs in case required. Moreover, as Government projects are subject to audit and requires transparency, the following formal documents pertaining to the projects should be maintained meticulously:

- Letters between Government Departments regarding implementation of the project on ground.
- Context of the project and its needs
- Direct Orders
- Minutes of Meetings

Cleaning and Levelling

Cleaning and levelling is the first phase of work that is undertaken for the execution of construction work on ground for the restoration and rejuvenation of pond. Ponds (natural or man-made) are located in depression areas, thus the runoff generated during a rainfall event will allow the flow paths to be created as such that the runoff flows in to these depression areas, under the influence of gravity. Alternatively, we can say that as per the natural topography of the area water (either fresh, rainwater or wastewater) will flow under the influence of gravity as per the slope of the area. However as urbanisation or the settlement density of any particular location increases, these flow paths may be disturbed due to encroachment in flow path areas, or due to topography changes over the years, or due to other un-anticipated reasons. So, flow paths must be channelized and cleaning and levelling of the area should be done, before undertaking any civil construction of the area.

It should also be noted that flowing water will also carry some silt, dirt and solid waste into the pond. For example, in ponds which are located in villages in the District faces disposal of solid waste in the pond and near the pond and also construction waste apart from silt. Also, direct dumping of wastewater into the pond will create more organic content in the pond, which will lead to the increase in algal bloom and eutrophication in the pond. So, for restoration and rejuvenation work, cleaning and levelling of the pond and nearby areas are to be taken up first.

Figure 14: *Cleaning of Pond Site*

DEWATERING AND DESILTING

Dewatering of pond is another important aspect in cleaning of the pond as the water present in the pond is wastewater. It is important to dewater the pond entirely, before putting the

treated wastewater into the pond. The removal of water from the pond is an arduous process that requires external machinery such as pumps that would be used to extract the water from the pond. Therefore, extensive logistical planning must be done prior to employing these machineries on site, taking into account weather conditions, and stopping inflow to the pond. Dewatering is followed by desilting of the pond.

Figure 15: *Dewatering of The Pond*

Desilting is the process of cleaning of pond bed and area adjacent to the pond, and is done to remove the silt and solid waste deposited on the bottom of the pond and also around the embankment of the pond. Areas adjacent to the pond is also cleaned to remove unwanted material from the site. Removal of the deposited layers of silt is to increase the percolation rate of the water to the ground as the continuous deposition of silt and other unwanted material (like solid waste and organic matter) present in the pond form a thick layer at the bottom of pond which reduce the seepage of water into the ground or the rate of ground water recharge decreases with increase in time.

Figure 16: *Desilting of the pond*

Another aspect is removal of unwanted plantation like algae growth, and water hyacinth present in the water. The reason for removal for algae growth, and water hyacinth is that they are the prime cause of eutrophication in the pond and because of presence of this self-cleaning property of water will not happening as sun light does not penetrate deep into the pond.

LEVELLING UNDULATIONS

After cleaning of the pond site, the area adjacent to the pond has to be levelled to carry out landscaping and beautification of the pond site. Levelling of the site is required to make the terrain plain prior to construction activity and is essential for foundations of structures to be built.

A detailed estimate has to be prepared for the cleaning and levelling required for the restoration and rejuvenation of pond. A sample estimate prepared for the Fazalpur Badli village in District is attached in Annexure G.

Figure 17: *Levelling of Pond*

Civil Work, STP Installation and Waste Management

CIVIL WORK AND MICRO STP INSTALLATION

After the completion of cleaning and levelling, civil work for structures can be commenced. In civil work, channelization of open drains which carries the wastewater to the pond, inlet chamber to the wastewater treatment plant and setting up of wate water treatment plant are done. The wastewater treatment plant is setup to treat the wastewater at the point where it is generated, and by this, we can dispose the treated wastewater into the pond. In civil work, development of embankment can be done depending upon the requirement. These points have been elaborated earlier in the document in Project Feasibility section. The design and capacity of the treatment plant should be done to suit the needs of the area of the intervention.

Often, the domestic wastewater is not of such poor quality that it would not require any treatment, and could be directly released into the pond depending on natural attenuation processes of the water bodies.

Also, laying of footpath around the periphery of the pond to make pond an open space is done through landscaping. Before the execution of on ground work, detailed estimates for both water treatment plant and landscaping, would have be included in Bill of Quantities (BOQ).

WASTE MANAGEMENT

Waste management is the crucial aspect in India. One of the main reasons why waste gets dumped in water bodies such as ponds is that these water bodies are usually located at the outskirts of the village, and therefore often are neglected, until they actually start causing a nuisance. The waste eventually finds its way towards polluting the water body. To, avoid this, proper waste management of the village has to be formulated. This would be required in order to ensure that landscaping around the pond is maintained, and that the significance of the water body in the community remains reinstated. Waste dumping around the pond would also produce unfavourable odours. and A sample waste management plan for Bilaspur village in District Gurugram is attached in Annexure H.

Landscaping

Landscaping and beautification are the final phase of restoration and rejuvenation of the water body. Landscape and garden planning were the most essential features of the town planning of ancient Indians. Our ancestors were worshippers of nature. Water and trees, therefore, had unique importance in ancient Indian architecture. While the act of implementing technical interventions to quantitatively restore and rejuvenate the water body is important, the implementation of qualitative aesthetic value is done through the final act of landscaping and beautification. Through these activities, the importance of a water body within the local community is reinstated, and thereby most significantly increases the value of water consciousness amongst the community, when they have a dedicated space for community gatherings and general spirit upliftment.

This phase is where the community may be engaged in the restoration area, in order to increase the water consciousness at a local community level. Landscaping is done through infusing architectural elements that allow for the use of pond area as a community gathering space, and for increasing the natural biodiversity of the area. Tangible elements such as play areas for the children, sensory path for the kids to understand nature better, meeting points for the elderly and planned herbal medicinal gardens are such elements that allow for the usage of these spaces. One of the main goals is to connect the life of the village to the growing recreational use of the pond itself and to revive the importance of water and nature from ancient India to the present and future.

The main purpose of landscaping is not only to create a joyful environment around the pond and give the residents a healthy atmosphere, good appearance, and natural beauty. but also adopting the sustainable measure to use our resources efficiently, to maximize the rainwater retention and to reduce the heat island effect further reducing the overall energy consumption plays an important role. Another important goal of the landscape is to rejuvenate the spaces, or water bodies which were treated as a dump yard or an unsafe site to transform into socially active public spaces.

Figure 18: *Community Mobilisation through the active engagement of the local community in Mojabad village, Pataudi Block, Gurugram.*

Landscaping and beautification therefore play an important role during the operation phase after work as it will ensure the ownership of the project to be undertaken by the local community itself.

The flora of any area plays an important role to improve the environmental quality of the particular area and even the adjoining areas. The flora not only gives an aesthetic sensibility but is able to influence the microclimate of the region as suspended matters present in the atmosphere are removed and gives us the fresh air free from pollutants.

Figure 19: *Plantation Drive taking place with the help of the community and empowering the women of the local region by providing employment through MGNREGA scheme.*

Increasing the flora diversity also has the direct impact of increasing the biodiversity of the region including many species of the birds and reptiles both the native as well as the migratory species. Therefore, the benefits of landscaping can be enumerated as follows (GuruJal, 2020):

- It decreases the concretization of the land;
- Decrease soil erosion;
- Capture the suspended solid present in the atmosphere;
- It reduces the noise level
- A single mature tree can absorb carbon dioxide at a rate of 12 kg/year and release enough oxygen back into the atmosphere to support 2 human beings, for a year.
- 4046.86 m2 of trees annually consumes the amount of carbon dioxide equivalent to that produced by driving an average car for 26,000 miles. This same acre of trees also produces enough oxygen for 18 people to breathe for a year.
- On average, one tree produces nearly 118 kg of oxygen each year. Two mature trees can provide enough oxygen for a family of four for a year.

- A good landscaping improves the micro-climatic condition of that area; during the summer season the temperature of the area where large number of trees are planted have lower temperature than the ambient temperature of that area.

It is important to plant the native species of that area or region. List of native species in Gurugram District, landscaping plan for Bhondsi pond and BOQ for landscaping and beautification is attached in Annexure I and Annexure J respectively.

Sustainability Plan (O&M)

Operation and Maintenance of wastewater treatment plant is very crucial aspect in urban as well as rural areas. While infrastructures is readily built, planning for sustenance of these infrastructure still poses as a huge problem, and therefore this is the phase where the project fails. The reason for the failure in both urban and rural areas with respect to O&M constraints are unique to each of the areas. In urban areas the main reason of failures will be the flow rate which is coming to the plant and efficiency of the plant will be compromised. Whereas in rural areas the most probable reason of failure will be the lack of skilled labours and lack of budget.

In order to better manage the expectations and prevent the failure of projects; steps have been undertaken on a policy level especially in regards to pond restoration and rejuvenation; to employ a dedicated workforce for proper Operations and Maintenance. The formation of Haryana Pond and Wastewater Management Authority (HPPWMA) has been crucial for steering monitoring activities as it overlooks the formation of Biodiversity Management Committees to strengthen District Consultation and Management Committees through the District, Parishad, Blocks and Panchayat Levels, under Section 6 of Act No.33, as notified on 23.10.2018.

FUNCTIONS OF HPWWMA

Under the Section-6 of Act No. 33 of 2018 as notified on 23.10.2018, the main functions of the Authority are:

- To survey and study pond, its boundaries and protected areas;
- To analyse water of pond for ascertaining its suitability for irrigation and other uses;
- to take steps for regulation, control, protection, cleaning, beautification, conservation, reclamation, regeneration, restoration and construction of pond;
- to make environmental impact assessment of pond;
- to prepare integrated plan for development of pond and removal of encroachment;
- to promote community participation and awareness in cleaning, conservation, tourism and beautification of pond by organising awareness programmes, workshops and seminars;
- to develop infrastructure such as pumping machinery, channels and pipe systems for utilization of pond water and effluent of sewage effluent treatment plants for the purpose of irrigation;
- any other function, as may be directed by the Government.

FUNCTIONS OF BIODIVERSITY MANAGEMENT COMMITTEE

As per Section 41 and Rule- 22 of The Biodiversity Act, 2002 and Rules, 2004; the committee would have the following functions:

- Conservation and sustainable utilization of biological resources.
- Eco-restoration of the local biodiversity.
- Management of Heritage Sites including Heritage Trees, Animals/Microorganisms, etc., and Sacred Groves and Sacred Waterbodies.
- Regulation of access to the biological resources and/ or associated Traditional Knowledge, for commercial and research purposes.
- Conservation of traditional varieties/breeds of economically important plants/animals.
- Biodiversity Education and Awareness building.
- Documentation, enable procedure to develop bio-cultural protocols.
- Sustainable Use and Benefit Sharing.
- Protection of Traditional Knowledge recorded in People's Biodiversity Register (PBR.)

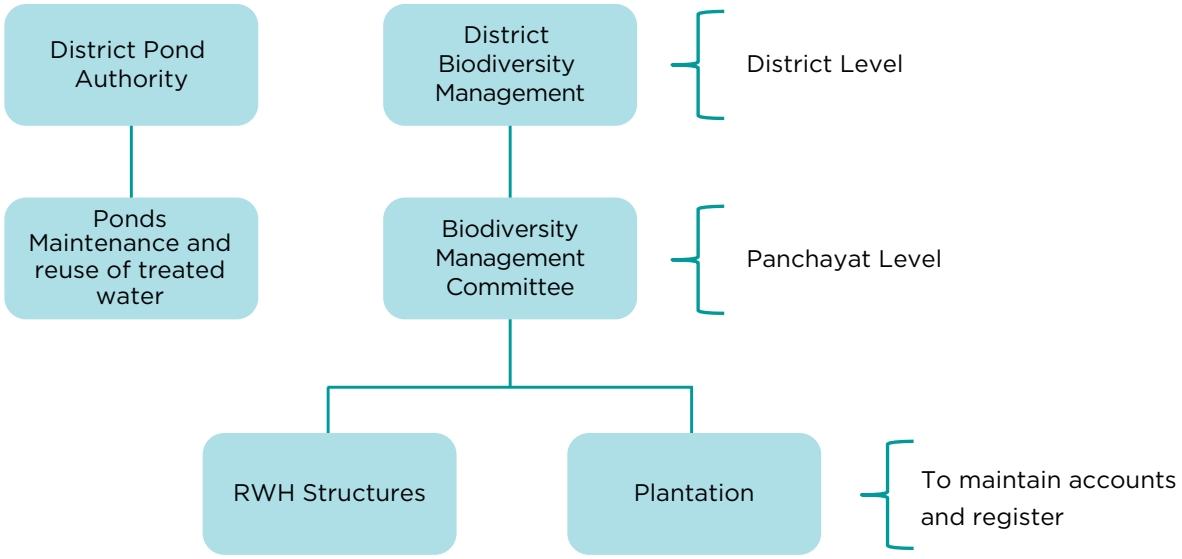


Figure 20: *Distribution of Hierarchy, roles and responsibilities of authorities responsible for Sustenance of Pond Rejuvenation and Restoration Projects.*

Gurujal's Example

Through the entire process, GuruJal plays the pivotal role of catalysing the coordination between various departments/stakeholders and ensure the long-term sustainability of the projects through enforcement and compliance. Capacity building of the institutions and empowering them by providing skills, knowledge, human resources and funds also become critical factors ensure the sustainability of the projects. However the main issue in Gurugram District was that DCMC, VPWWMC and BMC were non-functional at that time, and so the first task of the GuruJal is to activate these committees for smooth O&M.

PROJECT SUSTAINABILITY

In India treated sewage is being used for a variety of applications such as farm forestry, horticulture, toilet flushing, industrial use as in non-human contact cooling towers, fish culture and indirect and incidental uses (CPHEEO Manual).

Sustainability of the restoration and rejuvenation of pond project in rural areas is very big task. Because of budget constraints in rural areas, O&M of the project is quite difficult. To overcome this project should be self-sustainable so that O&M cost can be easily recovered by the project itself. The ways by which a project can be self-sustainable depends upon the type of technology used for the treatment of wastewater. The human capital that is required for the continuous and smooth monitoring and operation can be sourced from the local community itself, when the community is called upon to take the ownership of the projects. Dedicated personnel from the local community would enable a better understanding of the communities requirement and the transparency to be maintained, which would allow for better reporting.

Besides the technical intervention, all the restoration and rejuvenation of pond project must prepare a Water Utilisation Plan of the pond. Different sustainable ways are illustrated in below paragraph:

Water Utilisation Plan

Pond water utilisation plan is prepared to highlight the quantum of treated wastewater that can be utilised in various ways:

- Quantum of water percolated into the ground (helps in increasing the ground water table of the area)
- Evaporation loss
- Agriculture Purpose (treated wastewater can be used for agriculture purpose as well; it will help in reducing stress of over exploitation of ground water)
- Usage of pond water in other activities (like horticulture, construction, industrial purpose etc.)

For reference, water utilisation plan for the Village is attached in Annexure K. The importance of water utilisation plan is that it gives an idea of how much revenue can be generated by selling the treated wastewater in various streams of water usage. It should be noted, that water utilisation plans may vary from place due to evaporation loss, percolation rate and other hydrological losses.

Electrical Consumption

Most of the wastewater treatment plant runs on electricity and huge amount of electricity is consumed during the operation phase of the treatment plant and simultaneously bill is generated. This can be overcome by installing the Solar Power Plant for the running of the plant. Also, other method to cut the electricity consumption of the plant like using Methane Gas generated during the Sludge Digestion as a source of energy for running of plant could be explored.

Dry Sludge

During the operation phase of wastewater treatment plant sludge disposal is major issues in every treatment plant. Instead to disposal of sludge, sludge can be sold to farmers and various stakeholders after drying it; as, dry sludge is good manure of the agriculture and agriculture related activities.

Monitoring and Evaluation

Monitoring and Evaluation are the essential tools through which the system is continuously improved through a feedback loop model that was introduced in the first few chapters. It is through this essential step do we understand if the implemented intervention is successful, and is helpful in identifying which factors may change/eliminated/added to allow for the system in place to have a larger and better impact. Monitoring and Evaluation needs to have both a quantitative and a qualitative aspect, in order for system to be holistically improved. While there are certain aspects of the system that cannot be changed, however regular maintenance ensures the physical longevity of the infrastructure and most certainly yields better results from the intervention. Although mentioned as the last step in this report, it needs to understand that maintenance and evaluation should exist as an ancillary step, so that continuous stream of information can be feedback into the system making it stronger and more well-developed system.

Monitoring and Evaluation is often measured with Key Performance Indicators (KPI's) for a process; in order to efficiently track progress the tasks. The identification of these parameters is a critical process, as these are the parameters which determine the successes of the project, and in what terms the success will be measured. While there are several overlapping indicators to monitor progress for all the stages of pond rejuvenation work, having customised indicators to monitor progress in a pond rejuvenation process, it would be useful to divide the process into three stages, i.e. Before, During and After.

Before the Pond Rejuvenation Process takes place, would entail mapping out the conditions before any intervention takes place. Several factors including the physiological, biological and physical characteristics of the pond is mapped. Anthropogenic indicators and behaviours should also be critically mapped in order to understand the importance that the pond has in the society and the function it serves.

Should a technical intervention be implemented at a site for rejuvenation purposes, the above steps that are followed will need to have indicators for measuring their progress. Therefore the indicators would be similar to those that are found for any construction project. However, since pond rejuvenation is primarily an environmental intervention, impact on environmental factors would also be considered as indicators for progress during the implementation of the technical intervention.

After the construction phase of the technical intervention, the KPIs developed and used for measurement are essential for the monitoring and evaluation process; as these are the factors that ensure the sustainability of the process. Defining time periods of measurement after the intervention has been placed, also plays a key role as to how progress will be measured.

The following table shows the KPIs for the various stages of pond rejuvenation process that are defined above. Note that maintaining proper documentation during the entire process of rejuvenation work is pertinent for the success and sustainability of the process –

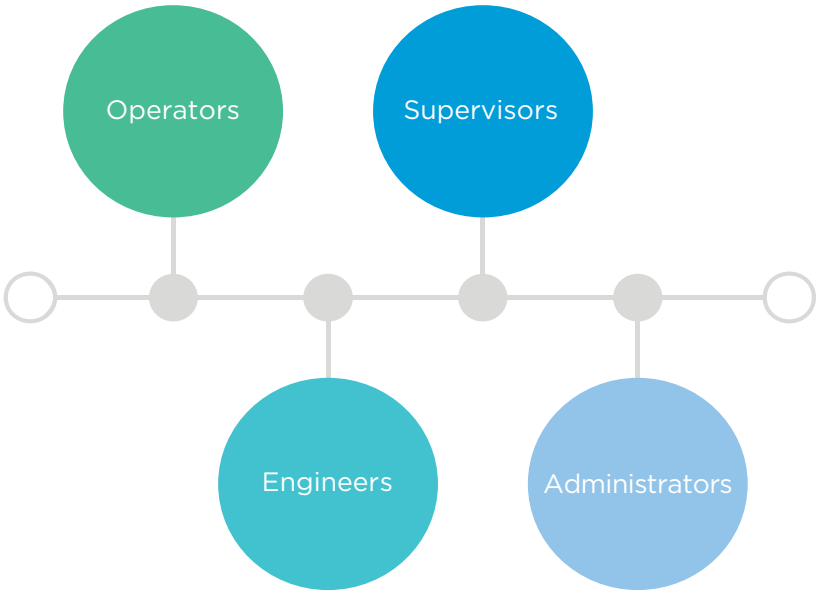
Table 6: Key Performance Indicators for the three stages identified before, during and after the process of Pond Restoration and Rejuvenation Work

Before	During	After
Amount/Flowrate of wastewater	Amount/Flowrate of Wastewater	Amount/Flowrate of Wastewater
Water Tests	Water Tests	Water Tests–Improvement of water Quality
Solid waste disposal rate	Transportation of raw materials	Soil Test
Rate of groundwater Extraction	Community Engagement–Workshops with BMC/Pond Authority	Waste Management
Water Utilisation	Training of local authority	Energy Consumption
Number of species of flora and fauna	Fund Utilization/Bill Payment	Standards/Protocol Adhered to
	Construction–Deadlines/Timelines/Standards adhered	Transportation of raw materials–that needs to be replaced
		Community Engagement–Workshops with BMC
		Operations and maintenance–Supervision
		Quantitative area of restored area

As already mentioned, the time periods for applying the KPI's also needs to be determined according to scope of the project being undertaken, and protocols for measuring these KPI's must also be standardised. An example of this may be the water quality tests that are conducted. If the location, time and frequency of collection point deviates, then very differing results are produced, which may lead to misinformed decisions.

ROLES AND RESPONSIBILITIES

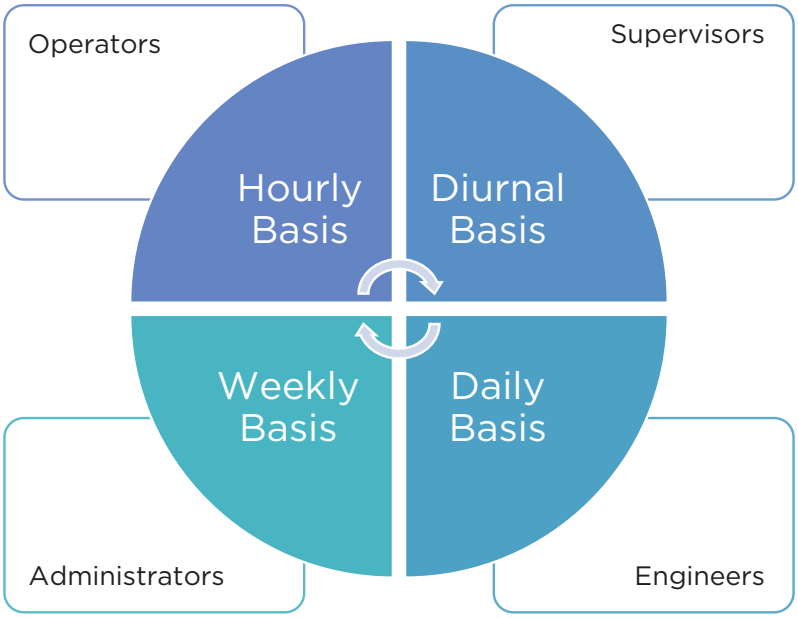
There are several stakeholders that directly influence the workings of a WWTP, primarily with respect to the people that are depended on it, and the environment that will be directly impacted by the quality of the functioning of WWTP. Nevertheless, the Operators, Supervisors, Engineers and Administrators are the primary points of contact for the smooth O&M of the WWTP. This section briefly describes the roles and responsibilities of each of these members associated in the functioning of the WWTP. Assignment of roles and responsibilities enables the clarity of all the required tasks that need to be completed, and the ability to demarcate a certain individual for that certain role would avoid duplicity of efforts, easier collaborative efforts and streamlining of tasks.



- **Operators and Supervisors** are the primary personnel appointed that'd be assigned to take care of the WWTP on a daily basis, in operating and maintaining screens, grit removal devices, pumps, aerators, valves, etc. in directing the treated water and settled sludge to various units for /after treatment. They should be able to sense troubles and act as ears and eyes of the Plant manager. They should also assist the electrical/mechanical maintenance technician(s) in carrying out the preventive and breakdown maintenance tasks. They should have some form of ITI Qualification and should be trained in extensive record keeping regarding the plant operation hours, be thorough with the exact nature of operations of the plant, know troubleshooting for the plant, be thorough with the procedure of sample collection, keep personnel contacts for emergency replacement of parts and be able to report problematic issues when required. The main difference between Operators and Supervisors would be that a supervisor would be responsible for several sites whereas operators are specifically assigned to one particular site.
- **Engineers** are the primary technical contact that ensure that the performance output of the WWTP's are meeting the required standards and legislations. Moreover, the engineers will be the primary source of contact for resolving all the issues regarding the functioning of the plant, which ensure the physical maintenance of the equipment and that the processes are being optimised. Morever, record checking is a major components of ensuring quality checks and monitoring. Hence, picking up any abnormality based on analysis of performance is a primary skill set required by on-site engineers. The minimum educational background that the engineer should have is Post -graduate degree in Environmental Sciences or a Graduate degree Environmental Engineering /Chemical Engineering with one year experience or a Diploma in Environmental / Chemical Engineering with 3 year experience or Graduate in Environmental Sciences /Microbiology with 5 year experience in Maintenance or Design of WWTP.

- **Administrators** are key stakeholders that enable and execute decision making processes that involve the movement of money and material. Their mobilisation enables the sanction of finances and resources required for the integral operations and maintenance of the WWTP. Moreover, tasks regarding administrative support, garnering public opinion and enabling better decision making to ensure sustainability of the project are dealt within the ambit of the administrators' responsibilities.

The above are the roles and responsibilities that are involved for each of the members and stakeholders who are involved in the operations and maintenance of the plant at various levels. However, while there are some specific duties, reporting and communication across members at all levels is of the utmost importance. Therefore the reporting of data between the intermediate members must take place on a frequent and regular basis.



Updates and record keeping between the different members concerned is suggested to take place on the following frequency –

- Between Operators and Supervisors – From an hourly basis to a diurnal basis
- Between Supervisors and Engineers – From a Diurnal Basis to a Daily Basis
- Between Engineers and Administrators – From a Daily Basis to a Weekly Basis

Quality Check Records Books must be maintained by Operators and Supervisors and must be shared with Engineers on a diurnal to daily basis in order to ensure the continuity of events.

Reports of Performance based on Quality and Quantity must be published by Engineers and Administrators demonstrating the utilisation of funds and the major decisions that are taken in order for the operations and maintenance of the plant. The time frames of reporting are shown below –

The following is a checklist that can be used for monitoring and evaluation in general and has incorporated the above KPI's. A similar checklist can be drafted for the various stages of the intervention with time scale and specific KPI's mentioned in the list. The regular performance evaluation of the entire lifecycle ensures the end to end implementation of the project.

6. Daily wastewater inflow and outflow at the STP
    a. This parameter will be assessed by the STP logbook which is maintained to check the quantity of wastewater coming to the STP and the amount of water treated.
    b. For this flow meter will be checked, is it working properly or not;
    c. It also gives the peak flow during any time and any season, help in understanding the reason for peak flow at any particular duration and season.
7. Number of inlets
    a. To understand the number of drains flowing into the villages which are directly coming to the pond;
    b. Are all the inlets entering the pond are trapped or not; If not trapped, then where the wastewater is going?
    c. Developments of new inlets/source of wastewater to the pond during monitoring and evaluation
8. Is there any storm water directly coming to the pond?

    If any storm water drains directly coming into the pond it will reduce the pollution load in the pond
9. Are the screens properly cleaned?
    a. Schedule for the screen cleaning
    b. Where the debris and floating material collected from the screens will be disposed?
10. Schedule of sludge removal and disposal
    a. Quantity of sludge generated and the timing of the cleaning the sludge;
    b. Where the sludge will be used? (sludge generated from the STP is rich in nutrients and can be used as a manure in farmland)

11. Plant health and vegetation cover
    a. For assessing these parameters, number of plants planted, and type of species planted within the pond site are to be recorded
    b. Are all the species planted survived and if not, the reasons there of?
12. Is there any floating material or weed growth in the pond or within the adjoining areas
13. Is there any weed growth near the pond site, which implies wastewater is not treated up to the mark as per the prescribed standard
14. Is there any odour and foul smells near the pond site and breeding of insects which will cause water borne disease.
15. Influent wastewater quality and discharge from treatment plant
    a. This is helpful for identification of type of wastewater coming to the STP and their characteristics;
    b. Also, to check if discharge from the treatment plant meet the standards
    c. Monitoring wastewater quality at inlet and outlet – should be conducted biweekly to check performance
    d. Parameters such as pH, and BOD at the inlet are to be monitored daily, irregularities, if any, to be reported.
16. There should be uniformity of flow along the bed of the sewage treatment plant
17. Duration of the cleaning of the bed of the sewage treatment plant and the subsequent cleaning of the bed.
18. Reporting of all monitoring checks to appropriate authorities concerned so that adequate support can be received for foreseeable problems.
19. Any other issues found near the pond site (includes damages in the civil structure, checking of pumps, electricity bill, flow meter etc.)

RECORD KEEPING

Running Records are required to be kept for various operating machines on a daily basis such as mechanical and manual Screens, Pumps, Motors, Aerators, Chemical consumption, Chlorine consumption etc. as maintained by the operators and kept at Control Room or duty room of the operators that is closer to the location of the machines.The records of treated water quality and other laboratory tests are kept in the laboratory as per daily sample collection and testing schedules.

The record with respect to flow need to be maintained by operators as per Table below. The daily log sheet is passed to the Plant Manager on the subsequent day duly signed by the operator in the first shift. All operators shall be responsible to fill up their part of observations and calculations. The Supervisor and Engineer shall verify the daily record as well as the calculations and shall be responsible to generate further data using these.

It is pertinent to mention that there shall be a requirement of drawing site specific procedures and formats/forms for keeping records. This shall be the responsibility of the Engineer

Flow Measurement

Hourly record of Flow as measured/recorded through the Inlet

Date /Time	Rate of flow	Average rate of flow in past hour	Flow quantity
__/__/__	m^3 /hour	m^3 /hour	m^3
0800		-	-
0900			
1000			
1100			
1200			
1300			
1400			
1500			
1600			
1700			
1800			
1900			
2000			
2100			
2200			
2300			
2400			
0100			
0200			
0300			
0400			
0500			
0600			
0700			
0800			
Average Flow			

Water Quality Record Keeping

Computations of daily figures for the System:

Date /Month / Year	Daily Flow	Raw Effluent		Treated Effluent		Organic load removed	SS passed into outfall
		BOD	SS	BOD	SS		
	m^3/day	mg/L	mg/L	mg/L	mg/L	Kg/day	Kg/day

Electricity Consumption

Record of consumption of Electricity from the Energy meter:

Date	Energy Meter Reading At 08:00 Hours Daily	Energy Consumed in Past 24 Hours	Rate /Unit of Energy	Energy Expenses Per Day
	KWH	KWH	Rs.	Rs.
Total for the month		Units. S =		Rs. S =

Record of Chemicals/Spares Consumption

This record has to be prepared using a page for each chemical especially with regards to the functioning of AER Plant,

Name of the Chemical /Spares:					
Date	**Quantity Procured**	**Rate Procured**	**Quantity Consumed**	**Balance in Stock**	**Cost of Consumption**
	Kg./Ltrs.	**Rs. /Kg. /Ltr.**	**Kg./Ltrs.**	**Kg./Ltrs.**	**Rs.**
Total for the month			Units. S =		Rs. S =

Anaerobic Tanks Check

TANK LOCATION AND FUNCTION:			
Component	**Frequency**	**Date of Performance of Operational Task**	**Operator Signature**
Free Wastewater Flow			
Grease Formation			
Water Seal Level for Settler			
Gas Leakages at water seal in Settler			
Checking of Air vents if they are working in proper conditions			
Check for water levels at the outlet, by maintaining the swivel level			
Weeding removal of dead leaf litter and other litter			

SUMMARY REPORT

Village Name: Block: Plant Technology:	Technician:	
	Date/Time:	
	Weather/Temp.:	
	Location:	
	Persons connected:	

Type of waste water treatment plant or functional unit (mark*)		**Defect**		**Findings** (short description, for detailed description use section further below or separate sheet)
		Structure	Function	
Septic Tank	☐	☐	☐	
Anaerobic Baffled Reactor	☐	☐	☐	
Anaerobic Filter	☐	☐	☐	
Constructed Wetland	☐	☐	☐	
Waste Water Pond	☐	☐	☐	

*if a combination of treatment systems than mark accordingly

Technical device	**Defect**		**Findings** (short description, for detailed description use section further below or separate sheet)
	Yes	No	
Pump (1,2,..) (control unit, switches, etc.)	☐	☐	
Aerator (1,2,..)	☐	☐	

Sludge level

Water depth	Chamber 1	Chamber 2	Chamber 3	Chamber 4	Chamber 5	Chamber 6
m	m	m	m	m		

Determined parameter/On site

Effluent:	pH	Colour	Odour	Settable solids	Temperature
(periodically also for the influent)				ml/l	°C

Determined parameters /Effluent sampling and laboratory analyze

COD: mg/l	BOD5: mg/l	NH4-N mg/l	NO3-N mg/l	NO2-N mg/l	TNb mg/l	PO4-P mg/l	pH
Sludge vol.	Settable s.	Odour	Colour	Temp.			
ml/l	ml/l						

Arrange sludge removal Yes ☐ No ☐ Order for defect correction Yes ☐ No ☐

Remarks	
	Technician

GuruJal Society

Haryana has been identified as one of the most water stressed States of the Nation. Currently in Haryana, 19 out of 22 Districts are declared to be in 'Dark Zone' of the country; over-exploitation of ground water resources takes place in these Districts. This is primarily due to the fact that Haryana historically has been agricultural state, currently with 78.8% of the land being used for farming, and thus generating most of its revenue from agricultural produce. The main agricultural products that have been cultivated been of rice, wheat and cotton, which are all water intensive crops. As mentioned earlier, to meet the growing demands of high agricultural produce, freshwater canals were built for irrigation purposes during the Green Revolution. These canals however were not able to meet the consequent freshwater demand. Therefore, groundwater has continuously been pumped out to meet the demands for irrigation.

In the District of Gurugram, the rate of extraction of groundwater exceeds the recharge rate by 308% (NITI Aayog, 2019). The average depth at which ground water level is found to be at 40 meters below ground level, and yet the unabated and unabashed extraction of ground water and accompanied with the continuous release of wastewater in open streams continues. While several institutionalized mandates and regulations have been launched, there have been several gaps that did not allow proper implementation of these mandates. Previous initiatives undertaken, however have had limited capacity to address the issues concerning lack of clarity for roles and responsibilities between the implementation agencies, proper planning for sustainability of projects on-ground. Moreover, these initiatives also suffer from the lack of technological innovations.

Thus, GuruJal Society was formulated by the District Administration Gurugram in May 2019; supported by the Raman Kant Munjal Foundation (CSR initiative of Hero Moto Corp) to ensure better water management in the District. The following image shows the structure of the GuruJal Team and its management unit dedicated to the cause of the water issues in District of Gurugram.

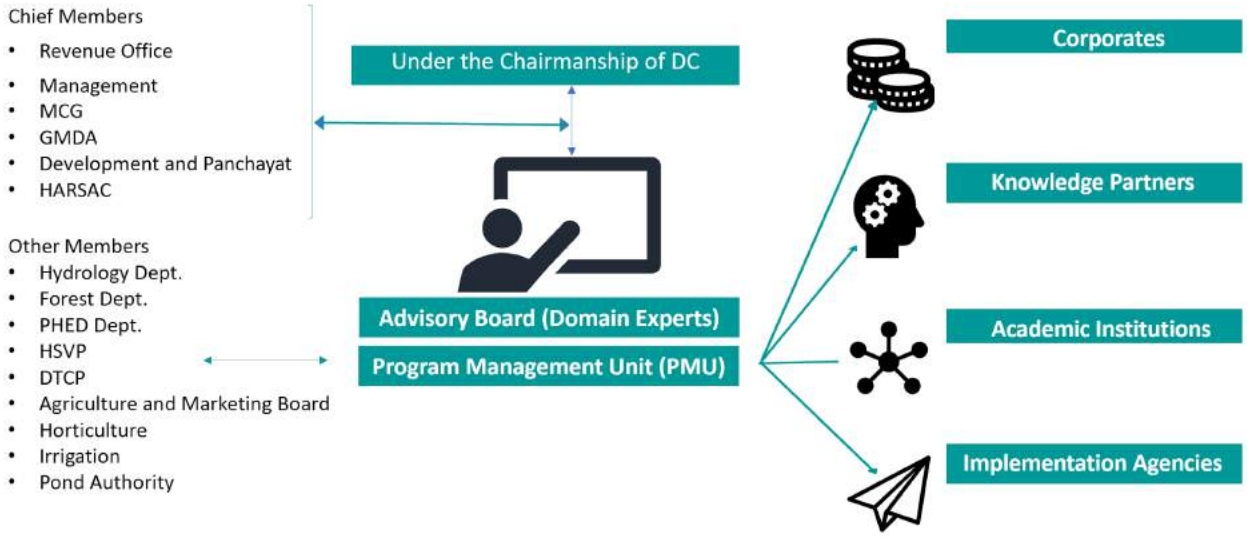


Figure 21: *Public Private Partnership Water Governance Model of GuruJal Society*

The structure of the Society is as such that the Deputy Commissioner of Gurugram is the Chairman; the Additional Deputy Commissioner, Gurugram and Additional Municipal Commissioner, Municipal Corporation Gurugram are both Co-Vice Chairperson of the Society. The District Development & Panchayat Officer Gurugram is the Member Secretary of the society.

The structure of the Society is also accompanied by the Program Management Unit (PMU) consisting of young professionals with an advisory board of expert domains.

The GuruJal Model is based on a Public-Private-Partnership (PPP) model within the Government unit to leverage the maximum accountability of all the concerned stakeholders dealing in the water sector within the District of Gurugram and allows for the enforcement and compliance of water mandates.

VISION

GuruJal's vision is to encourage social responsibility; sustainable development, lifestyle, and consumerism; protection of environment; inspiring and implementing solutions to the environmental crisis that Gurugram is facing. Our values distinguish us and guide our actions.

MISSION

To collaborate with 18 + government departments to ensure water conservation and efficient water management in Gurugram, work committedly and make citizens of Gurugram, water conscious and mobilize them towards sustainability.

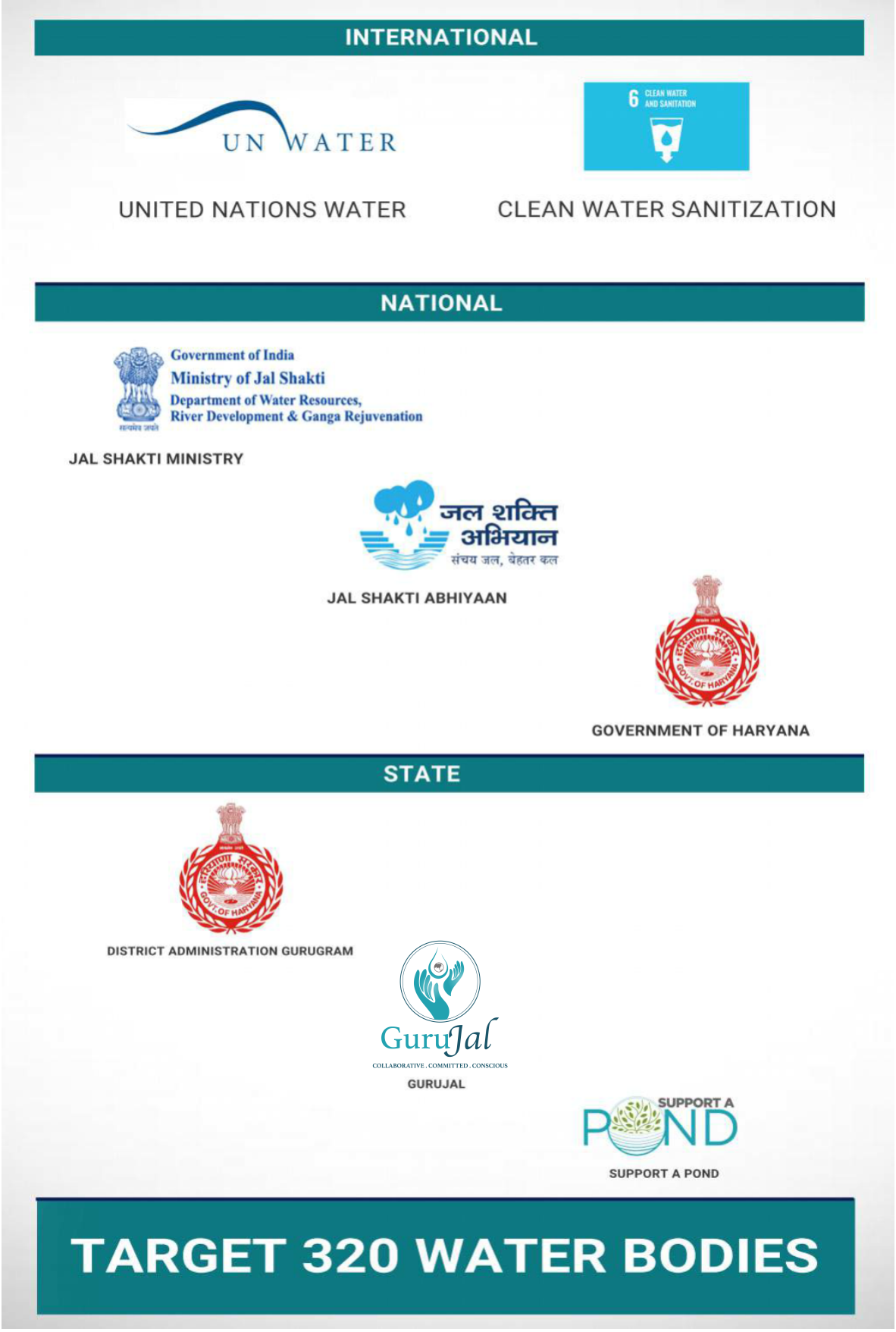


Figure 22: *The associations and the scheme of influence that GuruJal envisions to implement its projects under.*

AIM AND OBJECTIVE

Keeping the gaps and urgency of the issue in mind, GuruJal was envisioned with the objective of addressing the problems of ground water depletion, water scarcity, urban flooding and hence water mis-management in Gurugram District of Haryana. The following enumerate the aims and objectives of GuruJal –

1. Research and analysis of the existing water initiatives by various governments, corporate sponsors and non-government organizations, for their impact and success along with failure to avoid duplicity of efforts, centralize efforts and incorporate learnings from past projects.
2. In-depth analysis to find accurate data points and precise root cause of water mis-management and hence devise effective solutions.
3. Adopt a holistic, collaborative and focused approach; enabling inter and intra department support for implementation of proposed solutions to improve water management scenario in the District.
4. Implement strict and timebound monitoring of water conservation schemes of compliance.
5. Making Gurugram a "Water Conscious District", the first of its kind in 727 Districts of India.
6. Conduct campaigns, educate and create awareness sessions for the citizens of the District, around the subject of water conservation, scarcity and restoration.
7. Facilitating third party assessments for the Government and private body for proper implementation of water conservation plans in the larger public interest.
8. Deploying staff members and interns/volunteers to carry out the above objectives
9. Imparting training to the government officers to make them water conscious
10. Designing parameters and providing products and facilities to make the District water conscious.
11. Supporting various Government departments to ensure 100% and efficient compliance to all schemes directly affecting surface/ground water levels of quality
12. Onboarding individuals or expert organizations to fulfill targets.

The aim of the Society therefore became to create a water positive District and to deal with water-related issues with research and analysis. The effort would be made through this society to avoid duplicity of tasks and centralize efforts by including stakeholders who affect decisions related to water, and to improve implementation of water management by following a holistic-collaborative-focused approach. This would include enabling inter and intra department support, monitoring of water conservation scheme compliance, and onboarding individuals and expert organizations to fulfil the targets.

Figure 23: *Tools Used By To Enforce The Objectives Of GuruJal To Make Gurugram A Water Conscious District.*

The tools are used to implement the above stated objectives have been enumerated in Figure 4. These tools were formulated to help address the key gap areas in water management in a comprehensive and thorough manner. These tools, namely, ensuring better enforcement of existing mandates, creating awareness campaigns around concerned issues, supporting compliance of existing mandates, designing innovative solutions, and suggesting policy changes, may be understood as guiding principles based on which any project in GuruJal is initiated and implemented upon.

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3. Soil and Water Conservation Department. Government of Maharshtra. Jalyukt Shivar Abhiyaan. Program to make Maharashtra Water Secure by 2019. http://cgwb.gov.in/Bhujal-manthan/bm3-file3.pdf
4. Biodiversity Parks, GuruJal Society, 2020. https://gurujal.org/biodiversity-parks/

Annexures

ANNEXURE A: POND PROFILING CHECKLIST

Table A.1: The following table shows the Pond Profile for Tajnagar village in Gurugram.

Physical Description

Name of Pond	Tajnagar Village Pond
Location	Near Railway Station
Latitude and Longitude	28.388231, 76.826579
Area of Pond	1.5 Acres
Maximum depth in meters (full water level)	3.65 meters
Mean depth in meter	2.5 meters
Type of pond	Natural
Current status of pond	a. Encroached b. Polluted
Source of water (inflow)	a. Rainfall b. Runoff c. Open wastewater drains
Is there any outflow from the pond	No
Water level changes (annual)	1-2 meters
Are there any river/canal/major open drain passes within a radius of 2-5 km of the water?	No
Groundwater level (pre-monsoon and post monsoon)	Pre-Monsoon: 22.70 meters Post Monsoon: 22.30 meters
Does pond dry our completely? (frequency)	Rarely
Catchment area of the pond in sq.km.	Plain

Land use of the catchment area (in %)	a. Urban b. Agriculture
Total Population (as per Census, if possible, provide Current population	4000 + as of year 2019
Is the pond used by animals for drinking and bathing?	Yes
Type of flora and fauna around the pond	No boundary is present, agricultural lands surround the pond.
Geo-tagged pictures of the pond from different angles (to cover entire pond)/Google Map Image	
Ownership of the land	Gram Panchayat
Khasra number covered in the land	Khasra no. 60. Gram Panchayat. 22/15 – N/A, 22/06 – Private.
Free space around the pond in sq.m.	Government/Private
Landscaping around the pond	Not Done, however required.
Can pond be used as active urban and public space	Yes
Are there any construction activities going on near the pond	No

Functions of Pond

Is the pond used for any of these?	Agriculture
Function of the pond	a. Groundwater recharge b. Support biodiversity c. Influence micro-climate d. Socio-cultural e. Aesthetic

Source of Pollution and Problem

Does solid waste dumping take place near the pond?	Yes a. Biodegradable b. Non-Biodegradable c. Construction and Demolition Waste
Solid waste disposal in pond	Yes, Domestic Households
Source of pollution in the pond	a. Domestic sewage b. Agriculture runoff c. Cattle wading
Nutrient level in the pond	High
Major Problems	a. Reduction in depth b. Encroachment c. Algal bloom d. Aquatic weeds e. Decline or loss of fisheries f. Eutrophication g. Organic pollution

Remedial Measures

Are local communities aware of the problems of the pond?	Yes
Are local communities interested in the restoration of the pond?	Yes
Are there active local conservation groups or NGOs that are interested in the pond?	No
Any measures taken in the past to restore the pond?	No
Is it possible to source good quantum of rainwater/treated water throughout the year?	Yes
Restoration activities required	a. Improvement of water quality by in-situ treatment b. De-siltation for removal of organic/toxic sediments c. Weed removal d. Catchment area treatment to check treatment

ANNEXURE B: WATER TEST RESULTS

Figure A.1: The following is a sample water test result report for Tajnagar

Forms. 80/75

Laboratory Of The
Haryana State Pollution Control Board
Vikas Sadan Ist Floor Gurgaon

Tel-2332596

~~Paid~~ / **Monitoring**

Description :-
Sample of Pond at Tajnagar,
Gurugram
28.38838, 76.82593

Report No:- 1254-1255
Dated: 03.12.19

Description of the Sample: - Received on 27.11.19 a sample of Pond at village Bilaspur K-I & K-II from Sh. Ajay Singh, AEE and Ms. Sayani Halder, Gurujal, Gurugram collected on 26.11.19.

ANALYSIS REPORT

RESULTS

Sr. No.	Parameter	K-I	K-II
1.	Colour	Light Grey	Light Green
2.	Odour	Bad	Mild
3.	pH value	6.8	6.7
4.	Suspended Solids mg/l	121	98
5.	B.O.D. for 3 days at 27°C mg/l	23	19
6.	C.O.D. mg/l	128	112
7.	Oil & Grease mg/l	1.0	2.0
8.	Conductivity us/cm	1190	1230
9.	Total Dissolved Solid mg/l	630	630
10.	Total Hardness as $CaCO_3$ mg/l	235	235
11.	Phosphate as P mg/l	0.2	0.4

Sample Collected/Not Collected by us
Sample Consumed in testing

LAB INCHARGE

HSPCB/Lab/GR/2019/ 2804-2805

Dated 03.12.19

Copy to M.S./R.O./

O/C

ANNEXURE C: SOIL QUALITY TEST RESULTS

Table A.2: The following is a sample of the soil test reports for 60 sites, the highlighted lines shows the results for Tajnagar.

Sr. No.	Block	Village	P.H	E.C.	OC%	Nitrogen (KG/Hac)	Phousforus (KG/Hac)	Potash (KG/Hac)	Sulpher (ppm)	Zn (ppm)	Fe(ppm)	Mn(ppm)
01	Farrukhnagar	Jhanjrola	9.00	0.82	0.10	40.43	11.35	239.68	37.76	1.384	6.162	7.540
02	Farrukhnagar	Mibarikpur	9.10	0.13	0.22	73.39	10.48	221.76	62.72	0.692	7.142	3.902
03	Farrukhnagar	Kaliyawas	9.00	0.43	0.24	78.33	9.94	255.36	40.32	2.094	10.320	4.660
04	Farrukhnagar	Ghoshgarh	7.90	0.11	0.01	14.89	10.43	293.44	36.48	1.194	6.162	9.298
05	Farrukhnagar	Gugana	8.50	1.02	0.15	53.20	11.10	228.48	48.96	2.060	8.250	3.594
06	Farrukhnagar	Patli Hazipur	9.50	0.67	0.90	259.18	11.67	288.96	52.48	1.724	9.554	3.440
07	Farrukhnagar	Khetawas	8.40	0.16	0.25	79.98	9.67	306.88	52.16	0.938	4.589	9.345
08	Farrukhnagar	Fazilpur Badli	9.50	0.18	0.20	65.56	12.05	253.12	37.44	1.212	8.250	8.900
09	Farrukhnagar	Mehchana	9.00	1.83	0.29	92.34	11.08	338.24	47.04	1.430	10.320	11.230
10	Farrukhnagar	Birhera	8.30	0.49	0.59	173.08	11.81	248.64	41.92	1.648	12.360	8.226
11	Farrukhnagar	Iqbalpur	8.60	0.47	0.61	179.26	11.19	297.92	56.96	0.846	8.870	5.840
12	Farrukhnagar	Tajnagar	9.10	0.14	0.39	119.12	9.31	313.60	47.36	0.874	9.554	4.360
13	Farrukhnagar	Khandewla	9.20	0.20	0.33	102.64	11.57	282.24	35.52	2.098	8.250	7.262
14	Pataudi	Rampur	9.00	0.11	0.27	86.16	11.89	266.56	43.20	2.200	14.210	11.490
15	Pataudi	Bhora Kalan	8.80	0.32	0.44	131.47	10.13	257.60	58.88	1.892	12.360	10.080
16	Pataudi	Nanu Kalan	9.50	0.16	0.51	152.07	9.34	342.72	45.12	1.232	11.230	2.010
17	Pataudi	Maujabad	8.70	0.48	0.18	61.44	9.67	331.52	37.12	1.978	6.638	7.954
18	Pataudi	Bilaspur	9.00	0.18	0.63	185.03	9.86	275.52	56.32	0.816	10.320	2.812
19	Pataudi	Uncha Majra	9.00	0.58	1.02	292.14	10.21	333.76	38.40	1.016	11.230	9.034
20	Pataudi	Narhera	9.30	0.32	0.42	127.35	12.27	239.68	47.68	0.650	8.870	8.632
21	Pataudi	Mumtazpur	8.90	0.36	0.83	238.58	10.32	304.64	63.04	1.660	7.142	4.660
22	Pataudi	Lokri	9.00	0.10	0.65	189.15	11.46	221.76	51.52	1.794	8.870	5.550
23	Pataudi	Bas Padamka	9.10	0.10	0.21	69.68	12.38	230.72	40.32	2.064	7.676	10.600
24	Pataudi	Khor	9.00	0.18	0.50	147.95	11.97	286.72	42.88	1.164	5.708	6.416
25	Pataudi	Rajpura	9.20	0.11	1.20	341.57	10.67	235.20	57.92	1.302	7.142	2.334
26	Pataudi	Darapur	9.50	0.08	0.73	212.22	11.62	248.64	59.84	0.766	9.554	19.580
27	Pataudi	Goriyawas	9.50	0.34	0.40	122.41	10.72	306.88	40.00	2.024	10.320	3.902
28	Pataudi	Inchhapuri	9.00	1.25	0.26	82.04	12.65	224.00	38.72	0.816	10.320	2.494
29	Pataudi	Basatpur	9.50	0.55	0.23	73.80	12.16	297.92	57.60	0.692	8.250	4.208
30	Pataudi	Lohchabka	8.20	0.87	0.38	116.64	11.81	331.52	55.68	1.698	14.210	2.970
31	Pataudi	Gadaipur	7.90	0.31	0.97	277.31	9.72	255.36	58.88	1.438	12.360	7.678
32	Manesar	Noorpur	8.10	0.09	0.26	82.04	9.64	324.80	49.92	1.212	11.230	6.416
33	Manesar	Palasoli	8.30	0.11	0.51	152.07	10.67	228.48	36.16	0.712	12.360	3.594
34	Manesar	Naurangpur	9.50	0.17	0.60	176.79	11.54	320.32	55.04	1.806	14.210	5.402
35	Manesar	Naurangpur	8.90	0.11	0.13	3.77	10.43	293.44	592.00	0.748	12.360	5.256
36	Gurugram	Nawada	8.90	0.67	0.32	98.52	9.53	219.52	51.84	2.264	9.554	15.200
37	Gurugram	Dhankot	8.70	1.49	0.56	164.43	10.81	333.76	38.40	0.930	8.870	7.122

ANNEXURE D: RESOLUTION AND DEMARCATION

Figure A.3: The following are blank samples of Resolution Formats that is to be submitted for the procedure of Administration Approvals

From

Chairman, GuruJal Society cum
Deputy Commissioner, Gurugram

To

1. BDPO Sohna, Gurugram
2. BDPO Farrukhnagar, Gurugram
3. BDPO Pataudi, Gurugram
4. BDPO Gurugram, Gurugram

No. 243 /GuruJal Society Dated 21.01.2020

Subject: Panchayat Resolution required from Gram Panchayats for the works of Pond Rejuvenation under Jal Shakti Abhiyan & Information regarding Pond works meeting on 27.01.2020, ie, Monday at 2:00 PM.

On the subject cited above, as discussed in the GuruJal Society Meeting dated 15.01.2020, resolutions under 'Support a Pond' intervention are required from every panchayat *(List of Panchayats shared in Annexure A)* in the format shared *(Annexure B1, B2, B3 & B4)*.

This is to note that the same format as attached is to be used by every gram panchayat, and the format will be one of the four formats attached depending upon the setup.
Annexure B1- Format for Pond cleaning
Annexure B2- Format for Pond cleaning and installation of micro STP along with gram panchayat funding
Annexure B3- Format for Pond cleaning and installation of micro STP
Annexure B4- Format for Pond cleaning along with gram panchayat funding

You are required to share the resolutions **latest by Friday, ie, 24.01.2020**. A **pond works review meeting will take place on 27.01.2020, ie, Monday at 2:00 PM in DC Office, Mini Secretariat,** Gurugram.

For more details, you may call Ms. Nikita Jain at +91-7838094282.

Chairman, GuruJal Society cum
Deputy Commissioner, Gurugram

A copy needs to be sent to DDPO Gurugram for information and coordination.

Format for Cleaning of Pond

प्रस्ताव

जोहड़ के सौंदर्यीकरण

पत्रांक..... **दिनांक.....**

सरपंच महोदय ने पंचायत की बैठक मे यह प्रस्ताव रखा कि गाँव के खसरा नंबर.....पर जोहड़ के पास वाली भूमि , जो गाँव का कचरा डालने के लिए प्रयोग किया जाता है। इस कचरा से गाओ का वातावरण ख़राब हो रहा है , जिसके निवारण के लिए इस भूमि को वृक्षारोपण एवं सौंद्रियकरण के लिए प्रदान करने पर विचार विमर्श करे।

विचार विमर्श के बाद हाजिर पंचो ने निर्णय लिया कि ग्राम पंचायत की भूमि खसरा नंबर ..... को वृक्षारोपण एवं सौंद्रियकरण के हेतु उपलब्ध करवाई जा रही है । आने वाले समय मे गाओ की जैव-विविधता में वृद्धि होगी, सौंद्रिय मूल्य में वृद्धि होगी, सामाजिक कार्य का आयोजन भी किया जा सकता है।

वृक्षारोपण एवं सौंद्रियकरण कार्य के लिए गुरुजल प्रस्ताव के आधार पर पंचायत के पास उपयुक्त धनराशि नहीं है। पंचायती स्तर पर ग्राम पंचायत अपना पूरा सहयोग गुरुजल को प्रदान करेगी।

सरपंच

ग्राम पंचायत-.....

ब्लॉक .....

Format for Restoration and Rejuvenation of Pond

प्रस्ताव

जोहड़ का पुनरुद्धान

पत्रांक..... **दिनांक.....**

सरपंच महोदय ने पंचायत की बैठक मे यह प्रस्ताव रखा कि गाँव के खसरा नंबर.....पर जोहड़ है जो कि बरसाती पानी तथा गाँव के गंदे पानी को जमा करने के प्रयोग मे आता है । इसके अलावा गाँव के गंदे पानी की निकासी ठीक ढंग से न होने के कारण इधर उधर पानी भर जाता है । इस लिए गाँव के द्वारा गंदे पानी कि निकासी एवं समाधान के लिए जोहड़ के पास अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाने हेतु भूमि उपलब्ध करवाई जाये, जिस पर अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाया जा सके । इस बारे मे ग्राम पंचायत विचार करे ।

विचार विमर्श के बाद हाजिर पंचो ने निर्णय लिया कि ग्राम पंचायत की भूमि खसरा नंबर .....अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाने हेतु उपलब्ध करवाई जा रही है । आने वाले समय मे यह भूमि जोहड़ के कार्य के लिए ही उपयोग मे लाई जाएगी । जोहड़ के पानी का प्रयोग ग्राम पंचायत द्वारा सिंचाई, निर्माण कार्य तथा पशुओं के लिए किया जा सकता है ।

जल उपचार संयंत्र (Waste water treatment plant) की अनुमानित लागत के लिए गुरुजल प्रस्ताव के आधार पर पंचायत के पास उपयुक्त धनराशि नहीं है। पंचायती स्तर पर ग्राम पंचायत अपना पूरा सहयोग गुरुजल को प्रदान करेगी।

सरपंच

ग्राम पंचायत-.....

ब्लॉक .....

Format for Construction of WWTP for Pond Rejuvenation

प्रस्ताव

जोहड़ का पुनरुद्धान (पंचायती धनराशि के साथ)

पत्रांक..... **दिनांक.....**

सरपंच महोदय ने पंचायत की बैठक मे यह प्रस्ताव रखा कि गाँव के खसरा नंबर.....पर जोहड़ है जो कि बरसाती पानी तथा गाँव के गंदे पानी को जमा करने के प्रयोग मे आता है । इसके अलावा गाँव के गंदे पानी की निकासी ठीक ढंग से न होने के कारण इधर उधर पानी भर जाता है । इस लिए गाँव के द्वारा गंदे पानी कि निकासी एवं समाधान के लिए जोहड़ के पास अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाने हेतु भूमि उपलब्ध करवाई जाये, जिस पर अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाया जा सके । इस बारे मे ग्राम पंचायत विचार करे ।

विचार विमर्श के बाद हाजिर पंचो ने निर्णय लिया कि ग्राम पंचायत की भूमि खसरा नंबर .....अपशिष्ट जल उपचार संयंत्र (Waste water treatment plant) लगाने हेतु उपलब्ध करवाई जा रही है । आने वाले समय मे यह भूमि जोहड़ के कार्य के लिए ही उपयोग मे लाई जाएगी । जोहड़ के पानी का प्रयोग ग्राम पंचायत द्वारा सिंचाई, निर्माण कार्य तथा पशुओं के लिए किया जा सकता है ।

जल उपचार संयंत्र (Waste water treatment plant) की अनुमानित लागत के लिए गुरुजल प्रस्ताव के आधार पर पंचायत उपयुक्त कार्य हेतु.....धनराशि पंचायत समिति (कार्यपालक प्राधिकारी- Executing authority) को प्रदान की जाती है। गुरुजल इस प्रोजेक्ट के मैनेजमेंट, निगरानी और मूल्यांकन मे ग्राम पंचायत को मदद प्रदान करेगी बिना किसी लागत के।

सरपंच

ग्राम पंचायत-.....

ब्लॉक .....

Format for Cleaning of Pond Via Panchayat Fund

प्रस्ताव

जोहड़ के सौंदर्यीकरण (पंचायती धनराशि के साथ)

पत्रांक..... **दिनांक.....**

सरपंच महोदय ने पंचायत की बैठक मे यह प्रस्ताव रखा कि गाँव के खसरा नंबर.....पर जोहड़ के पास वाली भूमि , जो गाँव का कचरा डालने के लिए प्रयोग किया जाता है। इस कचरा से गाओ का वातावरण ख़राब हो रहा है , जिसके निवारण के लिए इस भूमि को वृक्षारोपण एवं सौंद्रियकरण के लिए प्रदान करने पर विचार विमर्श करे।

विचार विमर्श के बाद हाजिर पंचो ने निर्णय लिया कि ग्राम पंचायत की भूमि खसरा नंबर ..... को वृक्षारोपण एवं सौंद्रियकरण के हेतु उपलब्ध करवाई जा रही है । आने वाले समय मे गाओ की जैव-विविधता में वृद्धि होगी, सौंद्रिय मूल्य में वृद्धि होगी, सामाजिक कार्य का आयोजन भी किया जा सकता है।

वृक्षारोपण एवं सौंद्रियकरण कार्य के लिए गुरुजल प्रस्ताव के आधार पर पंचायत उपयुक्त कार्य हेतु .....धनराशि पंचायत समिति (कार्यपालक प्राधिकारी) को प्रदान की जाती है। गुरुजल इस प्रोजेक्ट के मैनेजमेंट, निगरानी और मूल्यांकन मे ग्राम पंचायत मदद प्रदान करेगी बिना किसी लागत के।

सरपंच

ग्राम पंचायत-.....

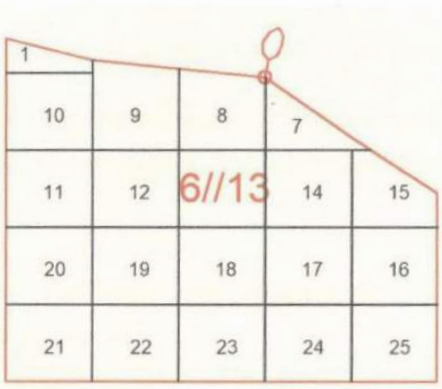
ब्लॉक .....

Demarcation Report of Pond

Demarcation Report of Panchyati Land covering Khasra Numbers 105/1 at Village Machana, Tehsil Farrukhnagar, Gurugram

The demarcation had been carried out on 29th November, 2019 using GIS and DGPS technology and "Earth Matters " had been appointed to carry out the demarcation work.

The present demarcation report is based on Differential Global Positioning System (DGPS), a satellite based navigation system, Geographical Information Systems (GIS) and Remote Sensing (RS) those are highly accurate combination of technologies and capable to provide accuracy even up to inches. In Machana Village the Mustatil stones are not existing on the ground and for demarcating the land we have been told to pick up the killa lines points in form of boundary walls and fencing by the Halka Girdawar, Patwari, Nambardar and some other eminent residents of the village Machana. For demarcating the land we have taken the first reference point existing on Khasra Number 13//9SW corner (Fig.1), second reference point we have taken as Khasra number 30//9 SW Corner (Fig.2) and third reference point existing on Khasra Number 6//8 Burji Stone (Fig.3). These three points have been considered as main reference points those are also forming a triangle within a relative accuracy of up to one feet. All the present members as Halka Girdawar, Patwari, Nambardar and other eminent residents of the village Machana gave their consent to demarcate the land from these reference points and we started our survey using DGPS instrument in (RTK) and demarcated the land.



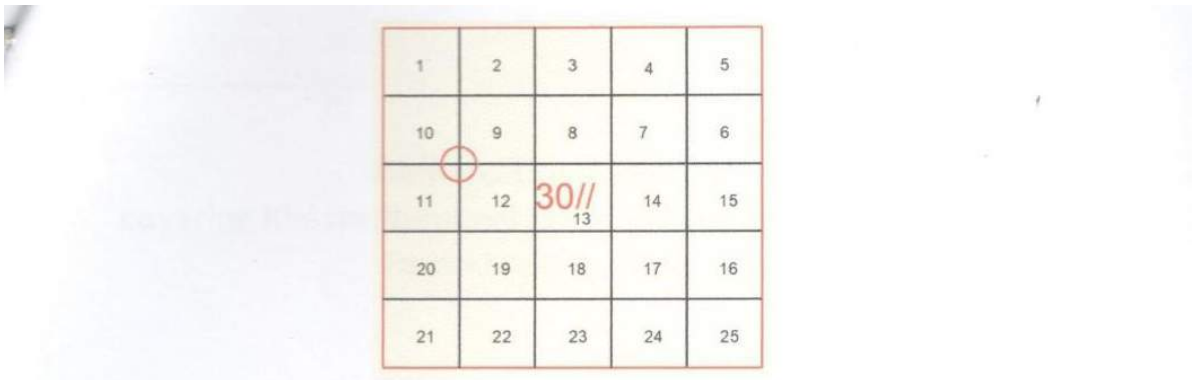


Figure-1: Showing the Three main reference points those have considered for demarcating the Land

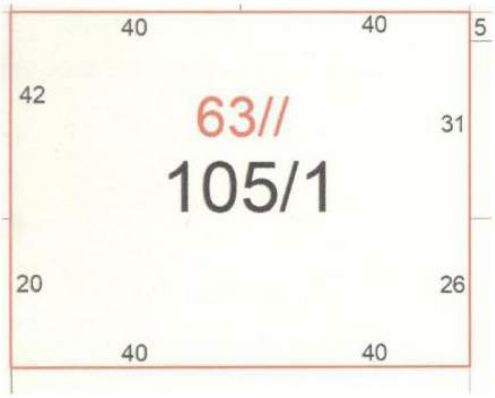


Figure-2: Showing the Revenue map of covering Khasra 105/1 at Village Machana those have been demarcated on ground

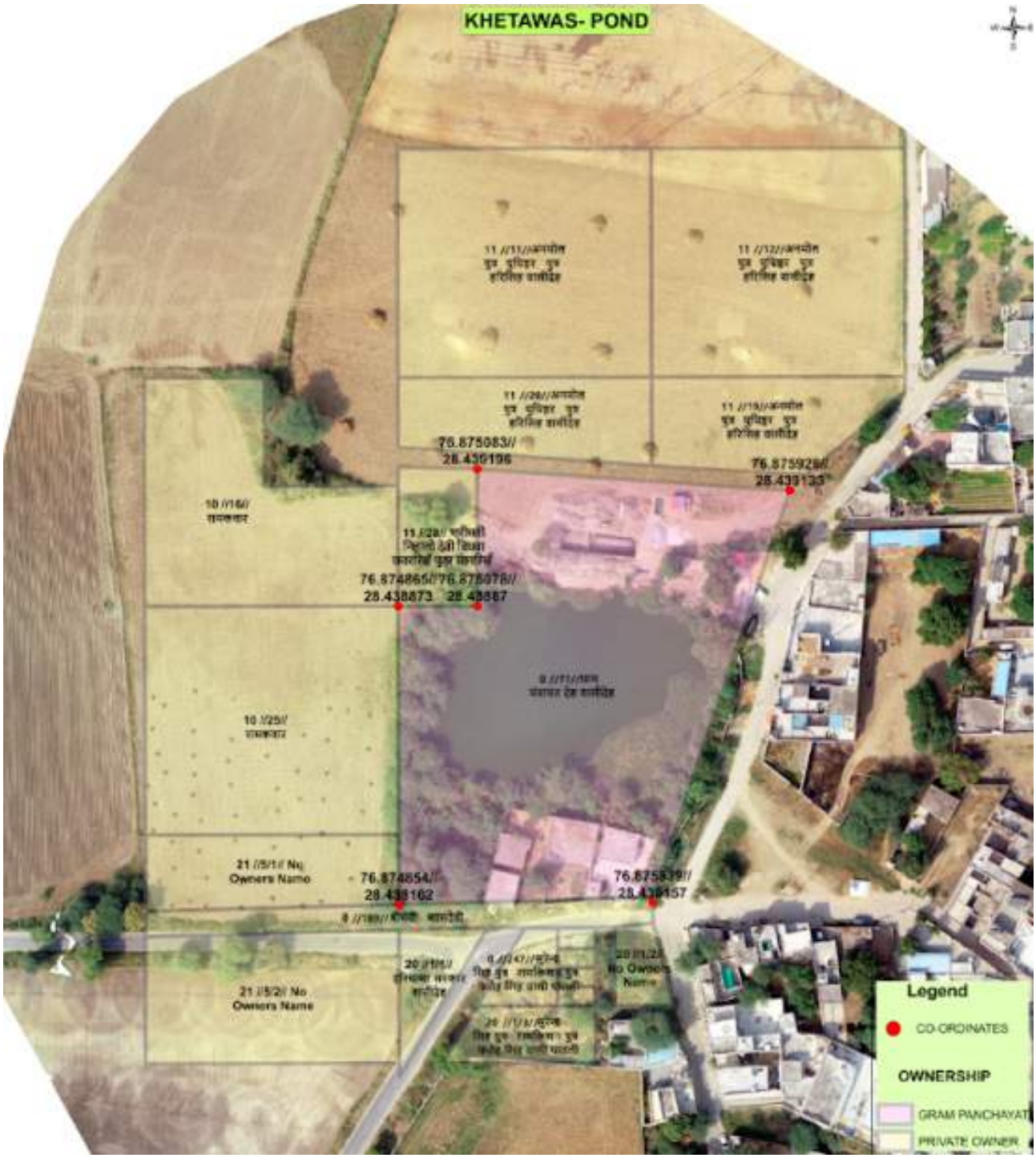
During the demarcation process the observation came that there is no encroachment on the demarcated land

Conclusion: The demarcation work had been carried out successfully and (Kanoongo) Patwari and other present plaintiffs, Nambardar Deh members are satisfied with the demarcation.

EARTH MATTER GURUGRAM

ANNEXURE E: GIS MAPPING (DEMARCATION THROUGH DRONE)

Figure A.4: The following is a Demarcation Map showing the ownership data for Khentawas



ANNEXURE F: COMMUNITY MOBILISATION SCHEDULE

Table A.3: GuruJal's Community Mobilisation Schedule planned for a quarter

Date	Village	Population Mobilized	Discussion Points	Purpose of Mobilization
26th September 2019	Khoh	20	Depleting groundwater level; Yuva group initiative; Use of wastewater for plants; Need for active participation of the villagers; Need and significance of Micro STP; Role of Biodiversity Management Committee	Biodiversity Park Development & Jal Sanrakshan
29th September 2019	Maidawas	40	Ways to dispose waste properly; Ways to ensure judicious use of water; Need for rainwater harvesting structure in schools; Technology used for pond rejuvenation; Role of Biodiversity Management Committee	Pond Rejuvenation
4th October 2019	Sehrawan	5	Need for the biodiversity park; Benefits of the park for locals; Water crisis; Depleting groundwater level; Role of Biodiversity Management Committee	Biodiversity Park Development
5th October 2019	Iqbalpur	80	Depleting groundwater level; Declining quality of water and ways to prevent it; Ways to dispose waste properly; Social responsibility toward traditional water bodies; Need for rainwater harvesting system; Role of Biodiversity Management Committee	Pond Rejuvenation
10th October 2019	Budhera	25	Village support for pond rejuvenation; Benefits of the project; Ways to prevent wastage of fresh water; Importance & need of fixing the leaks; GuruJal's vision, mission, & targets	Pond Rejuvenation

Date	Village	Population Mobilized	Discussion Points	Purpose of Mobilization
23rd October 2019	Bilaspur	30	Village support for pond rejuvenation; Benefits from the project; Wastage of fresh water; Leakage of supply water; GuruJal's vision, mission, & targets; Role of Biodiversity Management Committee	Pond Rejuvenation
15th December 2019	Khentawas	20	Village support for pond rejuvenation; Benefits from the project; Wastage of fresh water; GuruJal's vision, mission, & targets; Role of Biodiversity Management Committee	Pond Rejuvenation

ANNEXURE E: CLEANING AND LEVELLING

Table A.4: Bill of Quantities presented for Fazalpur Badli for Cleaning and Levelling

Measurements of the Site (For reference: Fazalpur Badli)				
S. No.	**Detail of Dimensions**	**Unit**	**Value**	**Remarks**
1	Length of total area	m	100	Average
2	Breadth of total area	m	110	Average
3	Total area of the site	sq. m	12141	
4	Area of the pond (containing water)	sq. m	8093.7	
5	Remaining free area of Gram Panchayat	sq. m	4046.9	
6	Depth of the pond	m	2.4	Average
7	Capacity of the pond	cu. m	19425	Full Capacity
8	Perimeter of total area	m	420	
9	Area of the pavement around the pond	sq. m	200	100m*2m
10	Free GP area minus the pavement area	sq. m	220	

Calculation of Sewage Water				
S. No.	**Details**	**Unit**	**Value**	**Remarks**
1	Total household	no.	472	
2	Total population	no.	3000	
3	Population discharging sewage waste into pond	no.	2400	80% of Total Population
4	Per day water availability per capita	Lpcd	135	
5	Per day wastewater production per capita	Lpcd	108	
6	Total wastewater produced in a day	litre	259200	
7	Additional waste coming	lit/day	25920	From local market (10 % of total waste produced)
8	Total sewage generated	lit/day	285120	

S. No.	**Description of the Item**	**Quantity**	**Unit**	**Rate + Ceiling Premium**	**Amount**	**HSR Item Code/ Local Rate**
Project 1: Survey, DPR, Cleaning and Levelling of Surrounding Area						
1	Contour survey	1	Number	12,000	12,000	
2	Detailed Project Report making (with designs &drawings)	1	Number	15,000	15,000	
3	Cleaning & levelling					

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
a	Area cleaning by mechanical means, which includes stripping of grass & removal of solid waste around the water body area	4046.85	sq. m	10	40,468.5	Local Rate
b	Levelling of area surrounding the pond for STP installation & landscaping purpose, taking 1 metre as the average height of the area filling by earthwork (by the help of mechanical means)	4046.85	cu.m	40	1,61,874	Local Rate
e	Earthwork of silt-clearance of channels & drains for depth of 7.5m	607.0275	cu.m	564.5	3,42,667	6.1(B)
Total					**5,72,010**	
Escalation Charges (15%)					**85,801**	
Grand total					**6,57,811**	
Project 2: Pond Cleaning						
1	Removal of weeds & other growth, with roots, i/c refused material such as polythene, cloths, algae etc. from facultative pond of STP & disposal up to 50 metre lead and 1.5 metre lift as directed by Engineer in Charge including all required T & P, boat with boatman, bamboo, plunger, cutter, bucket, rope etc. and all safety equipment such as safety belt, gas mask, oxygen cylinder etc. (required for pond cleaning)	8093.7	Sq. M	20+310%	663683.4	25.8
Total					**663683**	
Escalation Charges (15%)					**99553**	
Grand total					**763236**	
Project 3: Fencing & Connecting RCC Drain						
1	Fencing & Connecting RCC Drain					
a	1.20 meters high fencing with 1.65-meter posts placed at every 2.5 to 3 meters, embedded in cement concrete blocks, provided with 4 horizontal lines of G.I> barbed wire, weighing 9.34 kg. per 100 meters (minimum) and including drilling holes in complete posts (excluding the cost of posts, struts, earth work and concrete which is payable).	420	Metre	5.9+500%	4578	24.36

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
b	Cement Post with Struts	210	Number	700	147000	Local rate
c	Earth work in excavation in foundations, trenches, etc. in all kinds of soils, not exceeding 1 meter of depth including excavated soil, clear from the edge of excavation & subsequent filling around masonry, in 15 cm layer with compaction, including disposal of all surplus soil, as directed within a lead of 30m.	0.42525	Cubic Metre	1108.10+ 450%	2591.707	6.6
d	Cement concrete 1:4:8 with stone aggregate 20mm nominal size in foundation and plinth.	0.42525	Cubic Metre	420+450%	982.3275	10.38
e	Excavation for pipeline running in trenches and pits, in open areas, where disposal of surplus earth is done along with the alignment including trimming & dressing sides, levelling of beds of trenches to correct grade, cutting jointing holes, cutting trees and bushes etc. refilling consolidation and watering of refill, in 15cm layers and restoration of unmetalled and unpaved surface to its original condition, including the cost of dewatering of rainwater , diversion of traffic, night signal , fixing caution boards, watching , fencing outside the town in ordinary soil with timbering and shoring exceeding 1.5m depth, but up to 2.25m	2	100 Cubic Metre	1472+25%	3814	6.2 (B) (ii)
f	Collection system with NP3/NP4 RCC pipes of diameter 900 mm for the length of pprox.. 100m from the pond	30	Meter	1065	31950	Local rate
g	1 underground RCC water tank with MS Jali for screening of solid waste from incoming sewage water (capacity 50k litres)	0	Litres	10	0	Local rate
Total					**190916**	
Escalation Charges (15%)					**28637**	
Grand total					**219553**	

ANNEXURE G: BILL OF QUANTITIES FOR CONSTRUCTION OF 200 KLD WWTP

Table A.5: Bill of Quantities for the Construction of 200 KLD WWTP

Measurement for 200 KLD Root Zone System					
S. No.	Item	Dimension			Quantity
		L	B	D	Cubic Metre
1	Screen Chamber	2.5	2.5	2	12.5
2	Settler Tank	13	5.5	2.9	207.35
3	Root bed	24	6	2.8	403.2

Quantity Calculation for 200 KLD Root Zone System									
S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
1	Excavation for foundation / pipe trenches in earth, soils of all types, excluding backfilling, etc. complete								Job
	Lift 0 to 1.5 m								
	For Primary Settler	1	15	7.5	1		112.5		cu.m
	For Root Zone bed	1	26	8	1		208		cu.m
	For Screen Chamber	1	4.5	4.5	1		20.25		cu.m
Total							340.75	340.75	cu.m
2	Excavation for foundation/pipe trenches in soft rock, excluding backfilling etc. complete by all means								
	Lift 1.5 to 3.0 m								
	For Primary Settler	1	15	7.5	0.5		56.25		cu.m
	For Root Zone Bed	1	26	8	0.5		104		cu.m
	Lift 1.5 to 3.0 m								
	For Primary Settler	1	15	7.5	1.2		135		cu.m
	For Root Zone bed	1	26	8	1.2		249.6		cu.m
3	Providing & laying in-situ cement concrete M-15 of trap/ granite/quartzite/genesis metal for foundation & bedding including bailing out water, form work, compaction, curing etc. complete								
	PCC M 15								

S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
	For Primary Settler	1	13.6	6.1	0.1		8.296		cu.m
	For Root Zone Bed	1	24.6	6.6	0.1		16.236		cu.m
4	Providing & laying in-situ cement concrete M-15 of trap /granite /quartzite / genesis metal for RCC work in foundation like raft, RCC m-30 for foundation								
	For Raft Slab M 30								
	For Primary Settler	1	13.3	5.8	0.2		15.428		cu.m
	For Root Zone bed	1	24.3	6.3	0.2		30.618		cu.m
	For Screen Chamber	2	2.8	2.8	0.2		1.568		cu.m
Total							47.614		cu.m
5	Providing & laying in-situ cement concrete of trap / granite /quartzite /genesis metal of approved quality for RCC work as per detailed drawings & designs etc. complete. (excluding MS, or TOR reinforcement)								
	RCC m-30								
	Roof slab/vertical walls								
	a) Vertical Walls								
	For primary Settler	2	13	0.2	2.9		15.08		cu.m
		2	5.5	0.2	2.9		6.38		cu.m
	For Root Zone Bed	2	24	0.2	2.8		26.88		cu.m
		2	6	0.2	2.8		6.72		cu.m
	For Screen Chamber	2	2.5	0.15	2		1.5		cu.m
		2	2.5	0.15	2		1.5		cu.m
							58.06		cu.m
	b) Baffel								
	For Primary Settler	0	5.5	0.1	2.4		0		cu.m
		0	5.5	0.1	1.5		0		cu.m
	For Root Zone Bed	2	6	0.1	2.1		2.52		cu.m
		1	6	0.1	1.7		1.02		cu.m
Total							119.66		cu.m

S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
	c) Slab								
	For Primary Settler	1	13.4	5.9	0.15		11.859		cu.m
	Total Quantity of Slab & Vertical Wall							131.52	cu.m
	d) Beams								
	For Primary Settler	4	13.4	0.2	0.25		2.68		cu.m
6	Providing & fixing in position steel bar reinforcement etc complete								
	Total Qty of Concrete						181.81		cu.m
	Tor bar at 110Kg/cum						19999	19.999	m
7	Providing cement plaster 12 mm thick in two coats in cement mortar 1:3 without finish, to concrete brick surface, in all positions including scaffolding and curing complete								
	a) Internal Plaster								
	For Primary Settler	2	13	2.9			75.4		sq. m
		2	5.5	2.9			31.9		sq. m
	For Root Zone Bed	2	24	2.8			134.4		sq. m
		2	6	2.8			33.6		sq. m
	For Screen Chamber	2	2.5	2			10		sq. m
		2	2.5	2			10		sq. m
Total							295.3		sq.m
	b) External cement plaster								
	For Primary settler	2	13	2.7			70.2		sq. m
		2	5.5	2.7			29.7		sq. m
	For Root Zone bed	2	24	2.7			129.6		sq. m
		2	6	2.7			32.4		sq. m
	For Screen chamber	2	2.5	2			10		sq. m
		2	2.5	2			10		sq. m
Total							281.9		sq.m
Total (7a + 7b)							577.2		sq.m

S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
8	Providing & applying water proofing treatment to vertical surface of brick & RCC wall as directed by Engineer in Charge etc. complete								
	For Primary Settler	2	13	2.9			75.4		sq. m
		2	5.5	2.9			31.9		sq. m
	For Root Zone bed	2	24	2.8			134.4		sq. m
		2	6	2.8			33.6		sq. m
	For Screen Chamber	2	2.5	2			10		sq. m
		2	2.5	2			10		sq. m
Total							295.3		sq.m
9	Providing & applying two coats of water proof cement paint of approved manufacturer & of colour & shade to the plastered surfaces, including scaffolding if necessary, cleaning & preparing the surfaces, watering for two days complete								
	For External Plaster								
	For Primary Settler	2	13	1			26		sq. m
		2	5.5	1			11		sq. m
	For Root Zone Bed	2	24	1			48		sq. m
		2	6	1			12		sq. m
Total							97		sq.m
10	Supplying laying & spreading in layers stone aggregates of following sizes of trap /granite /quartzite /genesis stone metal at the road side including conveying and stacking								
	Total media as per Root Zone Bed	1	24	6	2.9		417.6		cu.m
	a) 25 mm Metal	25% of total media					104.4		cu.m

S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
	b) 50 mm Metal	50% of total media					208.8		cu.m
	c) 100 mm Metal	25% of total media					104.4		cu.m
11	Providing & fixing in position SFRC manhole frame & cover including loading unloading transportation taxes etc. complete as per instructions of Engineer in Charge (Size 0.9 * 0.45 m)							6	No
12	Providing and fixing in position M.S. ladder 0.50 M wide etc. complete as directed by Engineer-in-charge	4	3					12	RMT
13	Refilling the trenches with available excavated stuff with soft material first over pipeline and then hard material in 15 cm layers with all leads & lifts including consolidation, surcharging etc. complete								
	Total Excavation						885.6		cu.m
	Deductions						0		cu.m
	PCC						24.532		cu.m
	Raft						181.81		cu.m
	Volume of settler tank	1	13	5.5	2.4		171.6		cu.m
	Volume of Root Zone tank	1	24	6	2.4		345.6		cu.m
	Volume of screen Chamber	2	1.8	1.65	0.7		2.079		cu.m
	Total Deduction						0		cu.m
	Net Quantity						519.28	250	cu.m

S. No.	Item of Work	No.	L	B	D	H	Qty	Say	Unit
14	Dewatering the excavated trenches & pools of water in the building trenches /pipeline trenches, well works by using pumps & other devices including disposing of water to safe distance as directed by engineer-in-charge (including cost of machinery, labour, fuel etc complete) (Bd-A-9/261)	No. of pumps	HP of each pump	No. of hrs. per day	No. of days				
		2	5	10	40			2	Nos.
15	Providing & fixing mild steel grill work for windows/ ventilators of 20 Kg/sqm as per drawings including necessary welding & painting with one coat of anticorrosive paint & two coats of oil painting, etc. complete	2	1.4	1.4				3.92	sqm
16	Providing & fixing information board of size 1.20m * 0.90m etc. complete	1					1	1	No.
17	Providing & laying of Bio Media							18.75	lit
18	Providing, stabilizing & plantation of plant for treatment in Root Zone Bed & around landscape	1	24	6				144	sqm
19	Providing & installing disinfection system	1						1	No.

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
Project 5: Earth work, Construction of Screen Chamber, Settler Tank and Root Zone Bed in RCC						
1	Excavation for pipe line trenches including all safety provisions using site rails & stacking excavated stuff up to a lead of 90 metres, cleaning the site etc. complete for lifts & strata as specified, in all short of soil and soft murrum.					
	Lift 0 to 1.50m	340.75	Per 100 cu.m	1422+370%	22774	6.5 (b)
2	Excavation for pipe line trenches including all safety provisions using site rails & stacking excavated stuff up to a lead of 90 metres cleaning the site etc. complete for lifts & strata as specified in soft rock & /or masonry in CM or LM or lime concrete.					
	Lift 0 to 1.50m	160.25	Per 100 cu.m	96.95+425%	816	6.2 (e)
	Lift 1.50 to 3.00m	384.6	Per 100 cu.m	124.65+425%	2517	6.2 (h)
3	Providing & casting in-situ C.C. in grade M-15 (properties as per mix design or as per table 9 of IS456-2000 in sesses by weigh batching) using granite, quartzite trap metal of size 6 mm to 20 mm for RCC work, including scaffolding centring, form work, needle vibrated consolidation, curing up to 6 metre depth or height (excluding cost of reinforcement & neat finishing) with centring and shuttering etc. component for structure other than water retaining.	24.532	cu.m	420+450%	56669	10.38

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
4	Providing & casting in-situ C.C. in grade M-30 properties as per mix design by weigh batching using granite, quartzite trap metal of size 12 mm to 20 mm & or 6 mm to 12 mm including scaffolding centring, form work, needle vibrated consolidation, curing & hydraulic testing, etc. complete (excluding cost of reinforcement) up to 6m height/depth Av. G.L. for all water retaining structures.					
	For raft slab M 30	47.614	Cu.m	774+450%	202693	10.90+10.95
	Roof slab/vertical walls	73.459	Cu.m	1084+450%	437963	10.82+10.95
	Beams	2.68	Cu.m	1188.75+450%	17522	10.86+10.95
5	Supplying, cutting, bending & placing in position steel as per plan & designated as per ISS 2502 including cost of steel & binding wire for reservoirs / structures only including lift up to 6m height or depth below G.L. for all diameters Thermo Mechanically Treated (TMT) bars Fe-415 grade for all diameters	19.99943	100 Kg	917+500%	110037	18.22
Total					**8,50,990**	
Escalation Charges (15%)					**1,27,648**	
Grand total					**9,78,638**	
Project 6: Water Proofing of Tanks, Laying of Filter Media & Backfilling of Trenches of Pipeline for STP						
1	Cement plaster 20mm thick in C.M. 1:2 using water proofing compound of approved quality including finishing etc.	577.2	Sq. M	30.70+500%	106320	15.77
2	Providing water proofing treatment using polymerised water proofing compound to the virgin slab in three coats including material and labour, etc.	97	Sq. M	147	14259	PWD DSR 2014-15, page no 72 item no 121)

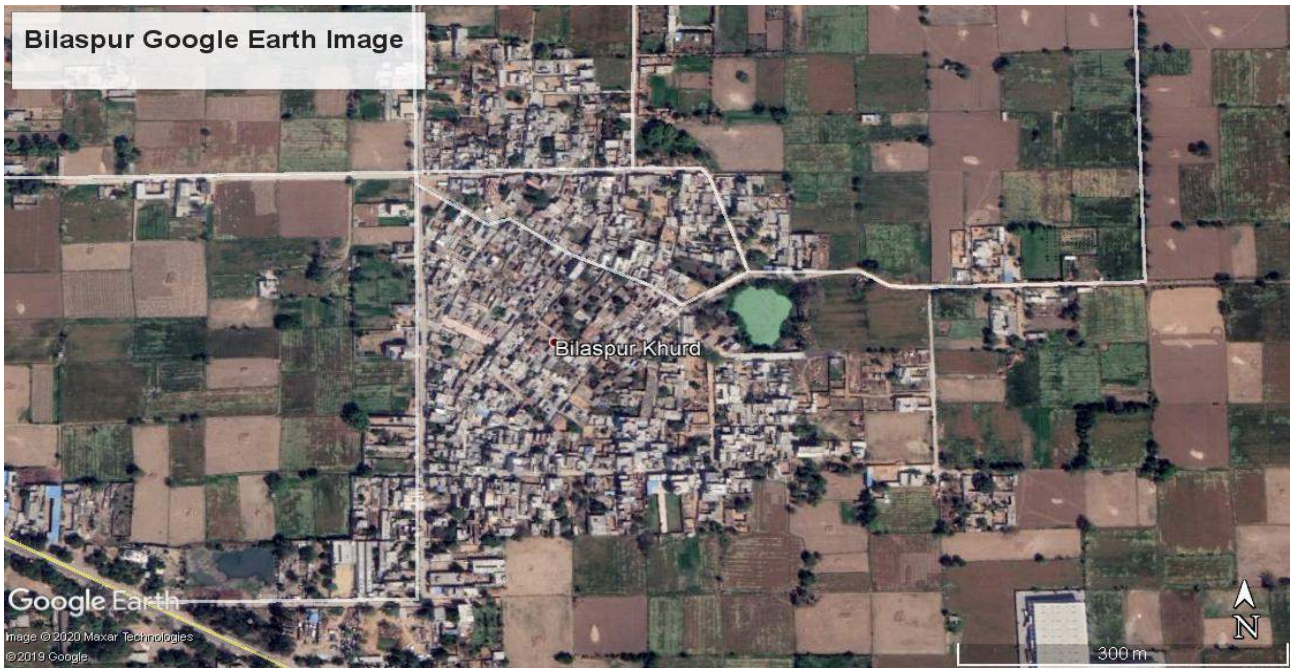
S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
3	Providing & applying two coats of water proofing cement paint of approved manufacturer & of colour and shade to the plastered surface, including scaffolding if necessary, cleaning & preparing the surfaces, watering for two days complete.	97	Sq. M	3.1+230%	992	16.62
4	Providing lowering, laying & joining ISI mark rigid non-plasticised PVC pipes for potable water with rubber ring joints including cost of rubber rings as per IS- 4985/1998, all local & central taxes, transportation, freight charges, transit insurance, inspection charges, loading, unloading, conveyance to store /site & stacking the same in closed shed duly protected from sun rays and rains, etc.					
	110 mm diameter 6kg/cm2 pipes	50	RMT	241	12050	DSR 2014-15, page no 73,78 item no 1, 3)
5	Supplying & spreading crusher broken of following sizes of trap /granite /quartzite /genesis stone metal at the road side including conveying and stacking.					
	25 mm nominal size	104.4	Cu.m	1143.57	119389	Local rates
	50 mm nominal size	208.8	Cu.m	975.57	203699	Local rates
	100 mm nominal size	104.4	Cu.m	975.57	101850	Local rates
11	Providing & fixing in position SFRC manhole, frame & cover of approved make including loading, unloading, transportation, all taxes, etc. complete as per instruction of Engineer in charge.					
	0.90 X 0.90 m	6	Cu.m	2633	15798	Local rates

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
12	Providing & fixing 50 cm wide M.S. ladder fabricated from M.S. Flats 10 mm X 75 mm with 20 mm diameter steel bar steps in double rows, @ 30cm C/C. this include stays of 10 mm X 50 mm M.S. flats with welded anchoring &. 3 coats of anticorrosive paint.	3.92	RMT	1200+500%	28224	24.94
13	Refilling the pipeline trenches including ramming, watering, consolidating deposal of surplus stuff as directed within a radius of 3km.	519.279	Cu.m	118	61275	Local Rate
Total					**663856**	
Escalation Charges (15%)					**99578**	
Grand total					**7,63,434**	
Project 7: STP Dewatering of trenches and tanks, Providing & fixing of Mild Steel Grills and other miscellaneous works						
1	Dewatering the excavated trenches & pools of water in the building trenches /pipeline trenches (up to & beyond 1.5m depth)	4000	Per 100 BHP-HR	365.65+450%	80443	10.33
2	Providing & fixing mild steel grill work for windows /ventilators of 20kg/Sq., as per drawings including necessary welding & painting with one coat of anticorrosive paint & two coats of oil painting, etc. complete for screen.	3.92	Sq. M	1040.35+ 500%	24469	18.12
3	Providing & fixing information board of size 1.20 X 0.90 m	1	Number	20342	20342	PWD CSR 2014-15, page no 202, item no 62ib/23
4	Providing & loading of bio media as per specifications & under supervision of scientist.	18.75	Litre	6700	125625	Local rates
5	Providing, stabilizing & plantation of plant for treatment in Root zone system & around landscape.	144	Number	75	10800	Local rates
6	Providing & installing with disinfection system	1	Lump	Job	50000	Local rates

S. No.	Description of the Item	Quantity	Unit	Rate + Ceiling Premium	Amount	HSR Item Code/ Local Rate
7	Providing & installing non clog submersible pump or polder pump with all ancillary equipment such as cable, starters, panel board, gauges meters, valves, pipes, etc. complete	-	Lump	Job	150000	local rates
8	Add for structural design 7 detailed drawing perpetration	-			6639	1% of RCC work cost
9	Charges for conceptual design, vetting & supervision during commissioning	-	Lump	Job	50000	Lump sum
Total					**518318**	
Escalation Charges (15%)					**77748**	
Grand total					**596065**	

ANNEXURE H: WASTE MANAGEMENT PLAN OF BILASPUR VILLAGE

Bilaspur is a village, in Pataudi block of Gurugram District, in the state of Haryana. Bilaspur Village is located at a distance of approximately 23 km form Mini Secretariat, Gurugram in South-West direction. National Highway-8 (Delhi- Jaipur Highway) is passing through in West direction. Due to rapid urbanization and the location being near a major road network, Bilaspur's population has increased manifold due to migration of people in search of job opportunities. Currently Bilaspur has a population of approximately 10,000 people.



Waste Generated

Quantity of waste generated within the town /village varies from place to place. It also depends on type of culture, occupation and most importantly socio-economic characteristics of particular area. For calculation of waste within a village following parameters/waste streams will be considered namely: bio-degradable waste, non-bio-degradable waste, hazardous waste, construction and demolition waste and bio-medical waste. Mainly, three categories of the waste will be considered in the Bilaspur study area as bio-medical waste is treated separately and it does not come under Municipal Solid Waste whereas Construction and Demolition waste does not play much role in the Bilaspur.

As per CPHEEO Manual, 2016 on Solid Waste Management waste generated per capita per day in a village will be taken as 350 gm per capita per day out of which 200 gm per capita per day will be bio-degradable waste and 150 gm per capita per day will be non-bio-degradable and domestic hazardous waste (percentage of domestic hazardous waste is very less in capita generation of waste).

Total amount of waste generated per day = 3.5 Tonnes per day

Wet Waste generated per day = 2.0 Tonnes per day

Non-biodegradable waste generated per day = 1.5 Tonnes per day (Approximately 1-2 % of 1.5 TPD, domestic hazardous waste will be generated)

For a waste management plan, it is important to consider the future forecasting of the population, as the amount of waste generated is directly depend on the population. For population forecasting assume, 2% increase in population per year, the population within a next decade will be 12,000.

Quantity of waste generated by the next decade i.e. by the year 2030 will be 4.8 TPD.

Current Status of Waste Management in Bilaspur

Waste collection, transportation and disposal is arguably one of the most mismanaged systems in the Bilaspur. There is no collection, transportation and disposal/treatment facility available in the village. All the waste generated within the village is thrown in the outskirt of the village and near the pond site and also thrown into the open drains even somehow waste find their way to open drain which crisscross the village.

As most of the village waste is thrown or disposed near the pond site or even floating in the pond, which the degrade the quality of the pond and also create nuisance in the nearby areas. The unscientific way of disposal leads to the ground water contamination due to percolation of leachate into the ground.

Financial Requirement

Approx. 25.00 Lakhs Rupees will be required for proper collection, transportation and treatment of the waste. Following activities has to be undertaken for better waste management:

- For collection and transportation of waste 3 tricycle will be deployed with 6 to 8 containers in one tricycle will cost approximately 80,000 INR excluding the cost of containers
- Development of 1 Material Recovery Facility (MRF) with compost pit; construction of the facility will cost 12-15 Lakhs INR.
- Information, Education and Communication (IEC) Activities in the village; costing 5 Lakhs INR.
- Capacity Building of the Sanitary Staff; costing 10,000 INR.
- Distribution of Personal Protective Equipment to the Sanitary Staff; costing around 15,000–20,000 INR.
- Putting of 3 dustbins in every 500 m of 100 liter capacity and in commercial and public areas 3 dustbins in every 100 m which cost around 1 lakhs INR.

ANNEXURE I: LANDSCAPING AND BEAUTIFICATION

Plants needed for different purposes

S. No.	Purpose	Type of plant
1.	Landscaping of Pond Site	Native/Ornamental Plants
2.	Pond Cleaning	Aquatic plants
3.	Herbal/Medicinal garden	Herbal/Medicinal Plants
4.	Navgarh vatika	Plants associated with zodiac sign
5.	Nakshatra Garden	Plants associated with zodiac sign

Types of garden in different pond sites

Sr. No.	Types of Gardens
1	Herbal Garden
2	Navgrah Vatika
3	Navshatra Garden

List of Plants for Herbal Garden

S. No.	Scientific Name	Plants Name
1	Bryophyllum Pinnatum	Patharchat
2	Barleria prionitis	Vajradanti
3	Murraya koenigii	Curry Plant
4	Aloe Barbadensis	Aloe vera
5	Ocimum tenuiflorum	Tulsi
6	Lemon	Nimboo
7	Mint	Pudhina

List of Plants for Navgrah Vatika

S. No.	Common Name	Scientific Name
1	Aak/Shwetark	*Calotropis gigantea*
2	Palash	*Butea monosperma*
3	Apamarg	*Achyranthus aspera*
4	Gular/Anjeer	*Ficus racemosa*
5	Khadhir (Nalla Sandra)	*Acacia catechu*
6	Peepal	*Ficus religiosa*
7	Shami/Khari	*Prosopis cenneraria*
8	Durva	*Cynadon dactylon*
9	Darbha	*Desmostachya bipinnata*

List of Plants for Nakshatra Garden

S. No.	Birth Star	Common Name	Botanical Name
1	Ashwini	Adulsa	*Adhatoda vasica /Justicia adhatoda*
2	Bharani	Amla	*Embilica officionalis*
3	Kritika	Umbar	*Ficus glomerata*
4	Rohini	Jamoon	*Syzygium cuminii*
5	Mruga	Khair	*Acacia catechu*
6	Aadra	Laxmi taru	*Simarouba glauca*
7	Punarvasu	Bamboo	*Bambusa vulgaris*
8	Pushya	Peepal	*Ficus religiosa*
9	Ashlesha	Undi	*Calophyllum inophyllum*
10	Magha	Wad	*Ficus benghalensis*
11	Purva	Palas–flame of forest	*Butea monosperma*
12	Uttara	Payar	*Ficus armottiana*
13	Hastha	Jai	*Jasminum grandiflorum*
14	Chitra	Bel	*Aegle marmelos*
15	Swati	Arjun	*Terminalia arjuna*
16	Vishakha	Nag keshar	*Mesua ferrea*
17	Anuradha	Sitaashok	*Saraca indica*
18	Jeshta	Savar	*Bombax ceiba*
19	Moola	Dev babhul	*Acacia farnesiana*
20	Purvashada	Vet	*Calamuspseudotenuis*
21	Uttarashada	Jack Fruit	*Artocarpus heterophyllus*
22	Shravan	Rui	*Calotropis gigantea*
23	Dhanishtha	Shami	*Prosopis juliflora*
24	Shataraka	Kadamba	*Anthocephalus cadamba*
25	Purvabhadrapada	Mango	*Mangifera indica*
26	Uttarabhadrapada	Neem	*Azardirachta indica*
27	Revati	Moha	*Madhuca indica*

List of Native, Fruiting & Ornamental Plants for Landscaping

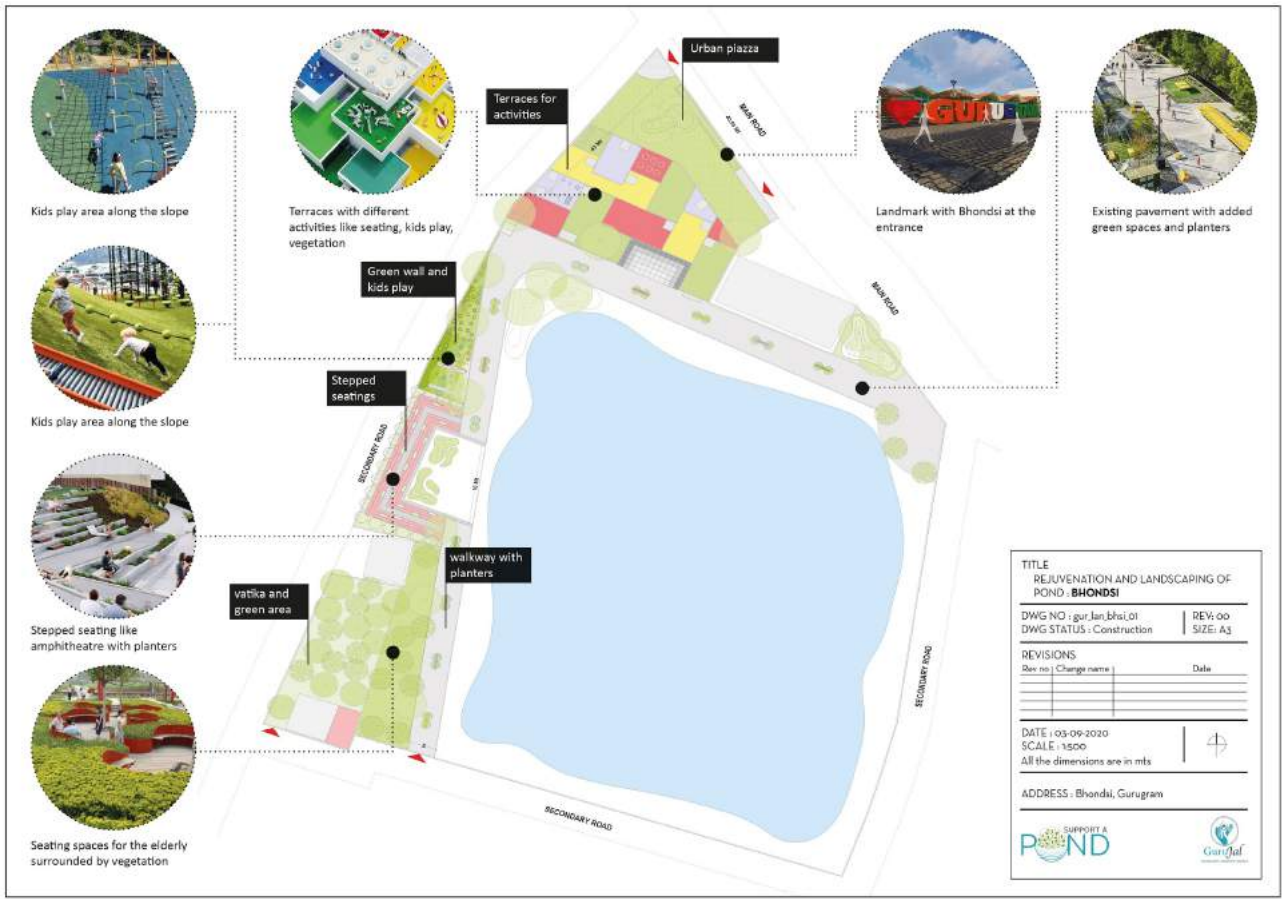
S. No.	Scientific Name	Plant's Name
1	Ocimum tenuiflorum	Scarlet bush
2	Hibiscus rosa-sinensis	Gudhaal
3	Bauhinia variegata	Kachnar

S. No.	Scientific Name	Plant's Name
4	Holoptelea integrifolia	Papri
5	Melia azedarach	Bakayan
6	Ficus	Anarmi
7	Tecoma stans	Gori chori
8	Cascabela thevetia	Kaner
9	Saraca asoca	Ashok
10	Michelia champaca	Champa
11	Bougainvillea	Bougainvillea glabra
12	Combretum indicum	Madhumalti
13	Rosa	Rose
14	Tagetes	Mari gold
15	Jasminum	Jasmine
16	Mangifera indica	Aam
17	Syzygium cumini	Jamun
18	Psidium guajava	Amrood
19	Aegle marmelos	Bel
20	Pomegranate	Anar
21	Carica papaya	Papita
22	Delonix regia	Gulmohar
23	Cassia fistula	Amaltas
24	Ailanthus altissima	Ailanthus
25	Acacia tortalis	Umbrella thorn acacia
26	Dalbergia sissoo	Shisham
27	Neolamarckia cadamba	Kadam
28	Azadirachta indica	Neem
29	Ficus benghalensis	Banyana
30	Ficus religiosa	Peepal

List of Plants for Water Treatment

Scientific Name	Plant's Name
Canna indica	Canna
Cyperus alternifolius	Umbrella palm

Landscaping Plan of Bhondsi Pond



ANNEXURE J: BILL OF QUANTITIES FOR LANDSCAPING AND BEAUTIFICATION

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
Landscaping											
1	**Cleaning & levelling of area around the landscape and surrounding**	Surface dressing of the ground including removing vegetation and in-equalities not exceeding 15 cm deep and disposal of rubbish, lead up to 50 m and lift up to 1.5 m. All kinds of soil (4.4.1)	**4.4.1**	Sqm					2250	12	27000
2		Filling available excavated earth (excluding rock) in trenches, cum plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift up to 1.5 m.	**4.32**	Cum					2850	52	148200
3	**Pavement work for pathway & landscape area**	Providing, laying, spreading and compacting stone aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with 3 wheeled steel/vibratory roller 8-10 tonnes in stages to proper grade and camber, applying and brooming requisite type of screening/binding Materials to fill up the interstices of coarse aggregate, watering and compacting to the required density.complete as per technical clause 404 of MORT&H specifications	**17.22.2**	Cum	300	2	0.075		45	1372	61740
4		Supplying and providing of Tangri River Sand under floors Including watering cum and compaction in 25cm layers, dressing etc. complete In all respects (As per item 10.2)	**10.3**	Cum	300	2	0.1		60	553	33180
6	**Pavement work for pathway & landscape area**	Providing and fixing covel stone/garden stone of size 150 mm x 150 mm laid in 20 mm thick cement mortar 1 :3 including grouting the joint with white cement and matching pigment complete in all respect (Covel/Garden stone to be as per manufacturer's specifications to be got approved from Engineer-incharge)	**10.99**	Sqm	200	1.2			240	2138	513120

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
7	**Stone work lotus pond**	Coursed rubble masonry (first sort) with hard stone in foundation and plinth with:	**7.87**	Cum	12	0.23	1.1		3.036	4163	12638.868
8		Brick work with common burnt clay modular bricks of class designation 7.5 in foundation and plinth in:	**7.20.1**	Cum	10	0.23	1.8		4.14	4341	17971.74
9	**For Drainage Ramp / passage**	Providing and laying of 52 mm thick cement concrete flooring with concrete hardener topping, under layer 40 mm thick cement concrete 1 :2:4 (1 cement : 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick cement hardener consisting of mix 1 :2 (1 cement hardener mix : 2 graded stone aggregate 6 mm nominal size) by volume, hardening compound mixed @ 2 litre per 50 kg of cement or as per manufacturer's specifications. This includes cost of cement slurry, but excluding the cost of nosing of steps etc. complete	**10.11**	Sqm	10	5			50	437	21850
10	**Mounds & Green Area treatment**	Preparation of mounds of various size and shapes including supply of cum good earth, in layers not exceeding 20 cm in depth, breaking of clods, watering each layer, dressing etc, lead up to 50 m and lift up to 1.5 m complete as per directions (excluding cost of good earth and manure which will be supplied separately.)	**26.52**	Cum	12	3	1.4		50.4	220	11088
11		Turfing lawns with fine grassing (selection no.1/ Bermuda and Mexican/Neelgiri grass)including ploughing, dressing including breaking of clods, removal of rubbish, dressing and supplying of selection no. 1 /Bermuda doob grass and Mexican/ Neelgiri grass roots, including supplying and spreading of farmyard manure at the rate of 0.60 cum per 100 sqm, maintenance till weed free turf is formed	**26.9.4**	Sqm					350	112	39200

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
12		Edging of paths/beds with bricks/tiles laid dry, including required excavation, refilling, consolidating with hand and spreading neatly surplus earth within a lead of 50 meters	**26.55.3**	meter					185	67	12395
13		Digging holes in all kinds of soil, and refilling the same, with the excavated earth, mixed with well decayed farmyard manure (cost of well decayed farm yard manure to be paid separately	**26.13.1**	Each					120	65	7800
14	**Plantation**	Supplying and planting all type of plants, in pit of appropriate depth with manure and watering plants atleat 3 months from plantation includes (Neem, champa, ashok, hibiscus, jamun, banyan, flower includes marigold, bogan villa, native species) with all complete work as per engineer in charge	**N.S Item**	Each					150	150	22500
										Total	**995547.608**
Fenching and M.S Work											
15	**Fencing around the boundary of whole site**	Fencing With Welded Steel Wire Fabric 75 Suggestive mm x50mm Unit per metre per metre Providing 1.20 metre high fencing with angle iron per metre 34.30 posts 50 mm x 50 mm x 6 mm at 3 metre centre to centre with 0.40 metre embedded in M15 grade cement concrete, comer, end and every 10th post to be strutted, provided with welded steel wire fabric of 75 mm x 50 mm mesh or 75 mm x 25 mm mesh and fixed to iron posts by flat iron 50 x 5 mm and bolts etc. complete in all respects.	**34.29.3**	meter					450	741	333450

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
16	**Fencing around the boundary of whole site**	Excavating holes more than 0.10 cum & up to 0.5 cum including getting out the excavated soil, then returning the soil as required in layers not exceeding 20cm in depth, including consolidating each deposited layer by ramming, watering etc, disposing of surplus excavated soil, as directed within a lead of 50 m and lift up to 1.5 m.	**4.34.1**	Each					150	19	2850
17		Brick work with common burnt clay modular bricks of class designation 7.5 in foundation and plinth in:	**7.7.1**	Cum					55	4451	244805
18	**Fencing for herbal garden & shrubs**	Providing and fixing of garden fencing of green hexagonal net. Fixing of fencing with MS angles 25 x 25 x 3 mm, 1.5 m sqm above ground fixed 30 cm under ground at 3m centre to centre with cement concrete 1 :2:4. Net to be fixed with nut bolts with washer at three places and one 4 mm GI wire running through the net at top and bottom for stability and strength.	**26.66.1**	Sqm	30	1.5			75	267	20025
19	**MS & steel works**	Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.	**13.4.1**	Kg					1250	112	140000
20	**Sheet**	Supply, fabrication and installation of self-supported arch shaped galvalume/SqM 195 1234 1429 Zincalume steel sheet roofing 1.00 MM thick (BMT) (only ± 0.2mm tolerance allowed) and 1.075 MM thick (total thickness)(only ± 0.2mm tolerance allowed) tensile strength 350 MPa coating mass 150 gm per sqm etc. of approved make . The manufacturer shall follow the IS codes 15961, type III with Super Durable Polyester paint, IS code 513, IS code 16163 and all other relevant Indian codes as per approved specification, design & drawings.	**9.30.1**	Sqm	15	2			30	1429	42870

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
21	**Walkway**	for steps and ghats–Providing and fixing of 40 mm thick fine dressed stone flooring over 20 mm (average) thick base of cement mortar 1 :5 (1 cement : 5 coarse sand) with joints finished flush–Red sand stone	**10.39.1**	SQM	200	1.8			360	602	216720
22	**Kota Stone**	Providing and fixing of Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand) : 25 mm thick	**10.37.1**	SQM	20	2			40	885	35400
										Total	**1036120**
Miscellaneous Items											
23	**Dustbin**	Providing and fixing pair of Plastic dustbins 100 litre volume each, of each set two different colours, for dry and wet waste, made of virgin plastic to be mounted on MS rectangular hollow section 50 x 25 x 3 mm frames pivoted on 3 MS square hollow section verticals, 1 m above ground, one 35 cm RHS welded to each vertical member at base and grouted in 180 x 40 x 30 cm 1 :2:4 cement concrete.	**26.76**	Each					2	11944	23888
24	**Garden Benches**	Chair type garden bench with L-shaped sides made of each 57 5334 5391 reinforced concrete (M30), thickness 100 mm, overall height 1000 mm, base width 620 mm. Back and seat shall consist of 5 Nos. reinforced concrete planks 1500 mm x 100 mm x 50 mm one plank 1500 mm x 200 mm x 50 mm. Seating height of the bench shall be 450 mm. The bench shall be fixed with nuts on concrete mount, all holes sealed after assembly and installation. All materials required to be as per BIS specifications.	**26.58.1**	Each					3	5391	16173

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	Activity Proposed	Description of Items	HSR No.	UNIT	L	B	H	Nos.	Quantity	Rate	Amount
25	**Garden Benches**	Rectangular garden bench with h-shaped sides made of each 84 3943 4027 reinforced concrete (M30), thickness 100 mm, back height 750 mm, base width 450 mm. Back and seat shall consist of rectangular reinforced concrete planks 1500 mm x 350 mm x 50 mm. Seating height of the bench shall be 450 mm. The bench shall be fixed with nuts on concrete mount, all holes sealed after assembly and installation. All materials required to be as per BIS specifications	**26.58.2**	Each					4	4027	16108
26	**Solar Street Light**	Providing Installation of LED Street lights 25 watt includes MS pole of minimium 15 ft height above G.L and foundation for fixing the light .	**N.S Item**	Each					2	21000	42000
27	**AWLR**	Installation and fixing of AWLR which includes civil work,machine,solar panel,G.I pole,wiring,cable and providing all required material for running of AWLR with all complete work as per Engineer in charge	**NS item**	Each					1	185000.00	185000
28	**Water Fountain Solar**	Providing and Installation of fountain of material IP302 having the dia of 8 feet with SS nozzles, pipeline, wire, control pane, wiring, laser waterproof lightening includes solar fittings and energy consuption for 1-2 H.P motor with all complete work as per Engineer in charge.	**NS item**	Each					1	265000	265000

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	Activity Proposed	Description of Items	HSR No.	UNIT	L	B	H	Nos.	Quantity	Rate	Amount
29		Leg Press: Providing designing and fixing of leg press of size 2000x550x1600 mm fabricated with main post of 114mm dia and 2.5mm thick and rest of the pipes 40mm dia and 2.5mm thick. All pipes made up of hot rolled tubular steel and hot dipped galvanized and powder coated using Akzo Nobel or equivalent of 80-120 micror thick. All joints of pipe are robotic welded with joints scalloped as necessary and dressed off removing sharp edges and burrs. Zinc primer paint to be applied at all welding points prior to finishing. Handle bars to be provided with high quality grip rubber on top end Pedals shall be made up of Nylon alloy with rounded edges to prevent any impact of injury Seat and base plate cover to be made up from virgin LLDPE manufactured by rotational moulding with minimum thickness of plastic as 3mm colorful and UV resistant and environmental friendly. Bearing used shall be maintenance free duly oil sealed and selt lubricated made by reputed company to be approved by Engineer in charge. Equipment to be fitteed with in inbuilt limiters to prevent unwanted movements. All open ends of pipe to be closed by GI/LLDPE caps for user safety. The equipments to be fixed on ground with concrete of minimum strength M-25 and J shape welded bolts and once the concrete is set fix	**NS item**						1	30100	30100

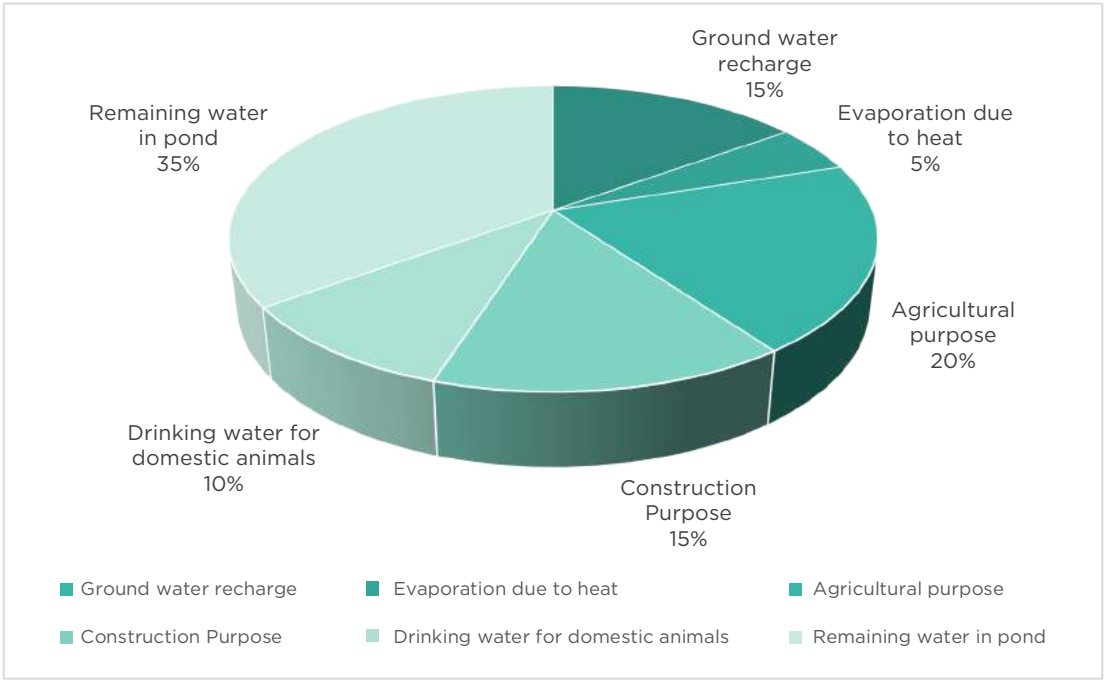
BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
30		Elliptica exerciser: Providing designing and fixing elliptical exercise of size 1200 x 540 x 1600 mm fabricated with main post of 114mm dia and 2.5mm thick and rest of the pipes 40mm dia and 2.5 mm thick. All pipes made up of hot rolled tubular steel and hot dipped galvanized and powder coated using Akzo Nobel or equivalent of 80-120 micron thick. All joints of pipe are robotic welded with joints scalloped as necessary and dressed off removing sharp edges and burrs. Zinc primer paint to be applied at all welding points prior to finishing. Handle bars are to be provided with high quality grip rubber. Pedals shall be made up of Nylon alloy with rounded edges to prevent any impact or injury. Seats and base plate cover to be made up from virgin LLDPE manufactured by rotational moulding with minimum thickness of plastic as 3mm colorful and UV resistant and environmental friendly. Bearing used shall be maintenance free, duly oil sealed and self lubricated made by reputed company to be approved by Engineer in charge. Equipment to be fitted with inbilt limiters to prevent unwanted movement. All open ends of pipe to be closed by GI/LLDPE caps for user safety. The equipment to be fixed on ground with concrete or minimum strength M-25 and J shape welded bolt and once	**NS item**						1	38000	38000

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
31		Double Cross Walker/Cross trainer double:- Providing, and fixing Double Cross Walker of size 1600 X600 X 1600 mm make of Green Gym or Equivalent fabricated with main post of 140 mm dia and 3.0 mm thick rest of the pipes are 40 mm dia and 2.5 mm thick all pipes made up of hot rolled tubular steel and hot dipped galvanized, and powder coated using Akzo Nobel or equivalent of 80-120 micron thick. All welding joints of pipe are robotic welded with joints scalloped as necessary and dressed off removing sharp edges and burrs. Zinc primer paint to be applied at all welding points prior to finishing. Padals shall be made up of Nylon alloy with rounded edge of prevent any impact of injury and seat to be made from virgin LLDPE manufactured by rotational moulding with minimum thickness of plastic 4.00mm, colourful and U V resistant environmental friendly. Bearing used shall be maintenance free, duly oiled sealed and self lubricated made by reputed company to be approved by Officer -in-Charge. Equipment to be fitted within built limiters to prevent unwanted movements. All open ends of pipe to be coloured by GI/LLDPE caps for user safety. The equipment to be fixed on ground with concrete of minimum strength N425 and J shaped welded bolts and once the concrete is set, fix the equipment on to it and cover nuts and bolts with the base plate cover, all complete as per direction and approval of Engineer-in-Charge regarding material, shape of equipment, colour on metal, seat and base cover plate and fixing of equipment etc.	**NS item**						1	32400	32400

BILLS OF QUANTITY											
Wazirpur WWTP Site (Landscape Estimate)											
S.No.	**Activity Proposed**	**Description of Items**	**HSR No.**	**UNIT**	**L**	**B**	**H**	**Nos.**	**Quantity**	**Rate**	**Amount**
32		Sea-Saw (4 seater): 8' L x 5'.5 W x 15" high. Frame is of m.s pipe 2" x 12gauge. Sitting planks is of m.s pipe 2" x 12 gauge and its cantilever & handles is of m.s pipe ¾" x 12 Guage .Sitting seats-4nos is of molded FRP material in 3mm thick with suitable PU Primer & PU Paints. Complete item with GST, Transportation, Installation with C.C & labor at site. (Including fixing at site and supervision & transportation & all type taxes)	**NS item**						1	12700	12700
33		Bridge Ladder: 10'L x 2'W x 6'H. Horizontal ladder is of m.s pipe 2", ¾" & vertical ladder is of same material of 12 gauge ISI mark with suitable PU Primer & PU Paints. Complete item with GST, Transportation, Installation with C.C & labor at site.	**NS item**						1	23800	23800
36		Providing, Fixing with MS Plate and Screwd Letters for Sculpture of 6' Ht and 6"Thickness (Any Letter) with MS Frames and 2-4mm thick ACP Covering/ Cladding, hollow from inside **WAZIRPUR**	**NS item**						80	400	32000
37		Supply and installation of Sinages on sun board , message board	**NS item**						8	3500	28000
										Total	**745169**
Total of all Components											**2776836.6**
Miscelleaneous @ 8%											**222146.93**
Contigency @ 2.5 %											**55536.732**
Grand Total											**3054520.3**

ANNEXURE K: WATER UTILISATION PLAN CHANGE THE CHART

Tajnagar pond will serve as the source of ground water recharge after the desilting of the pond, as treated wastewater will percolate in the ground water at a faster rate after the desilting of the pond and increases the ground water table of the area. Other important functions of the pond are that it will increase the flora and fauna of the area, improves the micro-climatic condition, use for agriculture as well as for the construction projects. Utilization plan of pond water is shown in below chart:



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