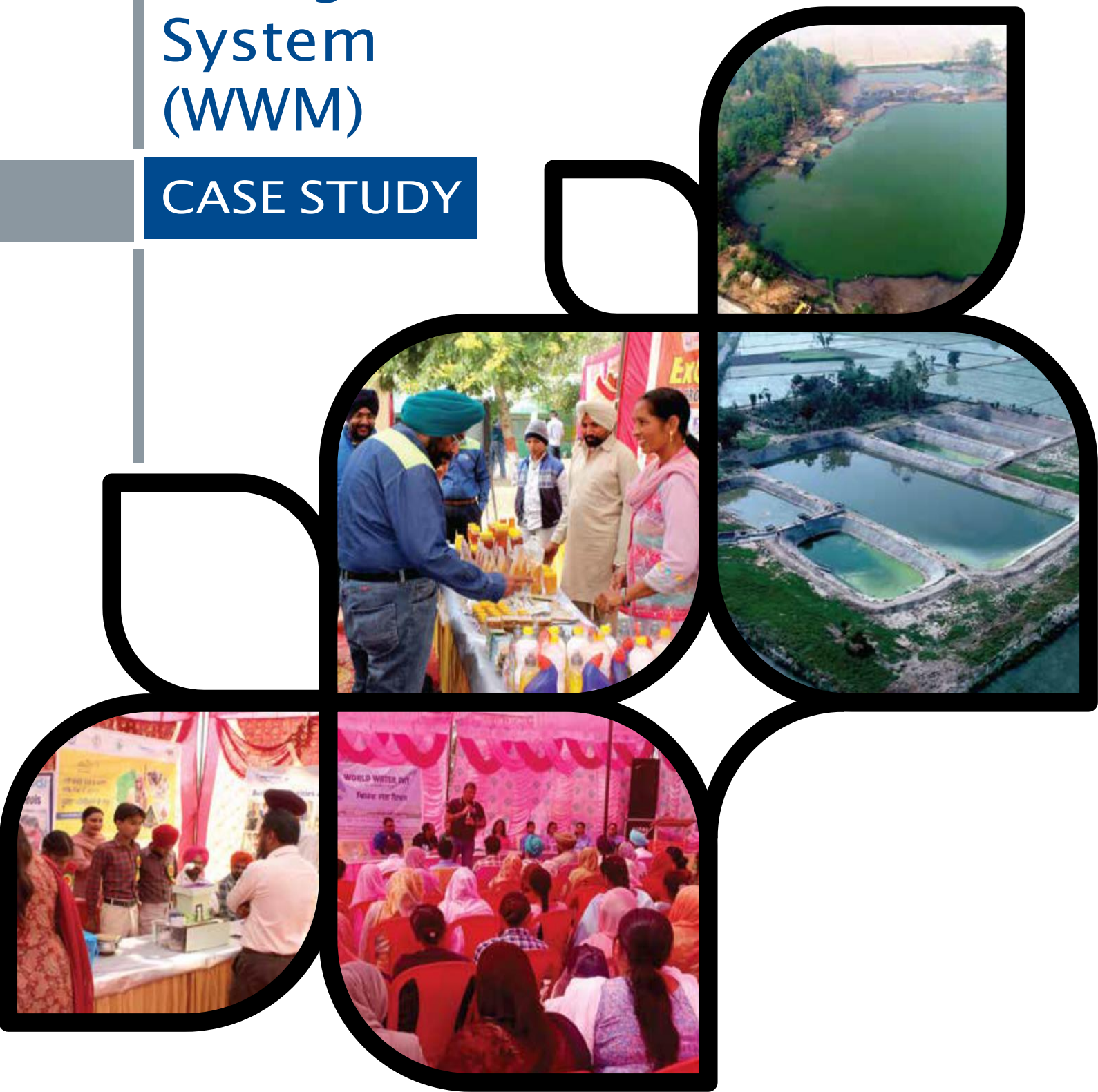
Partners in Development

# Bijalpur Wastewater Management System (WWM)

## CASE STUDY



| | |
|---|---|
| **Village** | Bijalpur |
| **Block** | Bhawanigarh |
| **District** | Sangrur |
| **State** | Punjab |
| **Document status** | Final report |

## Executive Summary

The Bijalpur Wastewater Management System (WWM) is a decentralized village-scale wastewater treatment and reuse intervention in Bijalpur village, Bhawanigarh Block, Sangrur District, Punjab, developed under the Sustainable Water Resource Development and Management (SWRDM) Program. The wider program planning in the area was initiated in 2017, and the Bijalpur system was implemented between October 2019 and March 2020 in response to unmanaged wastewater flows into the village pond, deteriorating environmental conditions around the site, groundwater stress in a tubewell-dependent agricultural setting, and the need to improve sanitation while creating productive value from wastewater.

The intervention combines screening and grit removal, anaerobic treatment, facultative treatment, and maturation-based polishing within a decentralized natural-treatment system suited to village conditions. The system is further supported by site improvement measures such as plantation, green-area development, fencing, water-quality monitoring, and a solar-energized pumping arrangement that enables treated water to be lifted for irrigation in surrounding fields. With an annual treated-water recovery potential of 48.18 TCM, the intervention has practical significance in a village where agriculture depends heavily on groundwater and where even a supplementary water source can contribute meaningfully to local irrigation needs.

The significance of the Bijalpur intervention lies not only in treatment performance, but also in the way it has been connected with wider village development processes. The work in the village has included community mobilisation, awareness generation, capacity building, institutional strengthening, and continued engagement with Panchayat members, Water User Groups, women's groups, farmers, and other community members. These processes have helped build local understanding around wastewater management, pond maintenance, water reuse, sanitation, and responsible stewardship of shared village assets. In this way, the WWM system has been supported through a broader village process that links environmental improvement with local participation and institutional responsibility.

The intervention has also been accompanied by efforts that strengthen agriculture, livelihoods, and village self-reliance. Alongside irrigation reuse, the broader village engagement has encouraged more water-conscious agricultural practices, promotion of micro-irrigation, and discussion around diversification through horticulture, floriculture, and related farming improvements where relevant. At the same time, women's Self-Help Groups in the village have been supported through capacity building and livelihood-oriented training in activities such as detergent powder making, herbal soap preparation, beauty-parlor work, soft-toy making, stitching, and other small enterprise skills. These efforts have contributed to strengthening women's participation, local livelihood opportunities, and the wider village ecosystem within which the WWM system functions.

Stage-wise water-quality results indicate that the treatment train is performing its intended stabilization and polishing role. The treated-water profile supports irrigation use in the intended local context under continued monitoring and responsible management. The intervention has also contributed to visible improvements in village environmental conditions, including cleaner surroundings, reduction in odor and mosquito nuisance, improved movement around the pond area, and a stronger sense of local ownership over a once-degraded village asset. Community feedback further reflects the practical value of the system for farmers who are able to access treated water for irrigation.

Bijalpur WWM system demonstrates how village wastewater management can contribute to multiple outcomes when technical infrastructure is supported by community participation, institutional development, agriculture-related engagement, and livelihood strengthening. In Bijalpur, the intervention has helped transform the pond area from a site of wastewater accumulation into a better-managed village asset that supports environmental improvement, irrigation use, local institutions, and a more sustained process of village-level stewardship.

## 1. Background and Rationale

Bijalpur is an agriculture-based village in Bhawanigarh Block of Sangrur District, Punjab. Paddy and wheat dominate the local cropping pattern, with maize, vegetables, and fodder also forming part of the farming system. In such a setting, water availability directly shapes livelihoods, environmental quality, and the day-to-day functioning of village life.

Before the WWM intervention, village wastewater accumulated in and around the pond area without a structured treatment system. The pond increasingly came to be associated with stagnant wastewater, foul odor, mosquito breeding, and unsanitary local conditions. Community narratives also indicate that the absence of a proper sewage system allowed wastewater to spread through drains and surrounding areas, making the site difficult to use and affecting everyday comfort and health.

The rationale for intervention was therefore both environmental and developmental. In a groundwater-dependent village, untreated wastewater is not only a sanitation concern; it also represents a lost opportunity to create a supplementary irrigation-supporting water source. A decentralized pond-based treatment and reuse system was therefore relevant not only as an environmental correction measure but also as a practical village water-management response.

## 2. Objectives and Scope

The Bijalpur intervention was conceived as a village-level water management initiative that combines wastewater treatment, productive water use, environmental improvement, and local capacity strengthening. Its purpose is not limited to improving the condition of the village pond, but also to support more effective use of water resources, strengthen village institutions, encourage community participation, and contribute to agriculture- and livelihood-related improvements that enhance long-term local sustainability.

*Table 1. Objectives and intended value*

| Core objective | Intended purpose |
|---|---|
| Wastewater treatment and pond improvement | To intercept and treat domestic wastewater through a decentralized natural-treatment system, improve the condition of the village pond area, and reduce stagnation, odor, and related environmental nuisance. |
| Productive reuse of treated water | To enable the use of treated water for irrigation in surrounding fields through appropriate reuse arrangements, thereby improving the practical value of the system in a groundwater-dependent village context. |
| Village environmental health and sanitation | To improve cleanliness, reduce mosquito breeding and wastewater-related discomfort around the pond area, and support a healthier and better-managed village environment. |
| Agriculture and water-use strengthening | To encourage more efficient and sustainable use of water through irrigation-related awareness, promotion of micro-irrigation and improved water-use practices, and support for agriculture diversification, including horticulture and floriculture where relevant. |
| Community institutions and local stewardship | To strengthen the involvement of Panchayat members, Water User Groups, women's groups, farmers, and other community members in the upkeep, responsible use, and long-term stewardship of village water assets. |
| Capacity building and livelihoods | To support awareness generation, community mobilisation, and skill-building activities that strengthen local capacities, including women-led livelihood initiatives and other village-level development processes linked with self-reliance. |

# 3. Village and Water Context

Bijalpur comprises 354 households and a population of 1,764. The village lies in an alluvial plain, and almost the entire agricultural area depends on tubewells for irrigation. This heavy dependence on groundwater gives every local water-management intervention strategic importance. Any measure that improves water efficiency, reduces avoidable pollution, or creates a supplementary irrigation source has direct relevance for the sustainability of local livelihoods.

*Table 2. Village and site profile*

| Parameter | Details |
|---|---|
| Administrative location | Bijalpur, Bhawanigarh Block, Sangrur District, Punjab, India |
| Coordinates | 30°18'10.30" N, 76°03'44.39" E |
| Households | 354 |
| Population | 1,764 |
| Economic base | Agriculture-dominated rural settlement |
| Principal crops | Paddy and wheat, with maize, vegetables, and fodder grown in part |
| Irrigation dependence | Almost the entire agricultural area is irrigated through tubewells |
| Hydrogeologic setting | Alluvial plain with groundwater occurrence at substantial depth |

## 4. Baseline Situation and Need for Intervention

Before the intervention, the Bijalpur pond had effectively ceased to function as a healthy village water asset. Domestic wastewater entered the pond environment without structured treatment, while surrounding uses such as solid-waste dumping near the pond edge and animal pressure added to contamination risk. As a result, the pond became associated with polluted stagnant water rather than with shared community value.

This baseline condition created multiple consequences at once: foul odor, mosquito breeding, poor site aesthetics, risk of contamination, and loss of productive water utility. In a village that depends heavily on groundwater for irrigation, the situation also reflected a missed opportunity. Wastewater was being allowed to accumulate as a nuisance instead of being treated and converted into a usable irrigation-supporting resource.

*Table 3. Baseline concerns identified during site assessment*

| Issue | Implication for the village system |
|---|---|
| Untreated wastewater inflow | Domestic wastewater entered the pond environment without structured treatment. |
| Stagnation and nuisance | Odor, mosquito breeding, and standing polluted water affected environmental quality around the site. |
| Solid-waste contamination pressure | Waste disposal near the pond edge increased pollution risk and reduced the quality of the site environment. |
| Animal-use pressure | Animal movement and pond use added to contamination pressure in and around the water body. |
| Loss of community water-asset function | The pond shifted from being a useful village asset to becoming a wastewater sink. |



*Figure 1. Pond area before intervention, showing degraded site conditions and stagnant wastewater accumulation.*

## 5. Project Genesis, Implementation History, and Partnership Approach

The Bijalpur Wastewater Management System was developed within the broader Sustainable Water Resource Development and Management (SWRDM) work in the Channo Cluster, Bhawanigarh Block, Sangrur District, Punjab, where village water security, wastewater management, agriculture, and community processes have been addressed together over a period of time. The wider planning and technical assessment in the area were initiated in 2017, and the Bijalpur WWM system was subsequently implemented between October 2019 and March 2020 as a village-level response to unmanaged wastewater accumulation, deteriorating pond conditions, and growing pressure on groundwater-dependent agriculture.

From the beginning, the effort in Bijalpur was shaped through a combination of technical planning and village participation. The intervention was taken forward with involvement of the Gram Panchayat, farmers, community members, and other local institutions so that the system would respond to practical village needs rather than remain confined to engineering design alone. This was important in Bijalpur because the issue was not only wastewater treatment, but also the condition of the pond area, the need for cleaner surroundings, the productive use of treated water, and the longer-term care of a shared village asset.

Over time, the village process around the intervention has extended beyond construction and commissioning of the treatment system. It has included continued engagement with Panchayat members, Water User Groups, women's groups, and other community members through awareness

generation, community mobilisation, capacity building, and local coordination. These efforts have helped strengthen village understanding around wastewater management, pond upkeep, irrigation reuse, sanitation, and responsible stewardship of common resources. They have also helped situate the WWM system within the wider social and livelihood context of the village.

The broader engagement in Bijalpur has also been linked with agriculture- and livelihood-related processes that contribute to long-term local sustainability. Alongside the wastewater-management system, village-level work has included promotion of more water-conscious agriculture practices, encouragement of micro-irrigation and improved water use, support for diversification through horticulture and floriculture where relevant, and capacity building for women's livelihood activities through Self-Help Groups. In this way, the intervention has contributed to a broader strengthening of village institutions, local participation, and resource-use practices that reinforce the relevance and sustainability of the system over time.

The continuity of maintenance and follow-up after implementation is therefore an important part of the Bijalpur story. The value of the system lies not only in its establishment during 2019-2020, but also in the way it has continued to be supported through monitoring, maintenance, village participation, and institutional engagement in the years thereafter. This continuity has helped the Bijalpur WWM system emerge as a functional and better-managed village asset with environmental, agricultural, and community significance.

*Table 4. Key implementation and stewardship milestones*

| Milestone | Details |
|---|---|
| Program planning and assessment | Wider SWRDM planning and technical assessment in the area initiated in 2017. |
| WWM implementation | System implemented between October 2019 and March 2020. |
| Local partnership base | Engagement with Gram Panchayat, farmers, community members, and local village institutions during implementation and follow-up. |
| Community and institutional processes | Awareness generation, community mobilisation, capacity building, and local coordination around wastewater management, pond upkeep, and water reuse. |
| Agriculture and livelihood linkages | Promotion of improved water-use practices, micro-irrigation, agriculture diversification where relevant, and livelihood-oriented engagement through women's groups. |
| Post-implementation continuity | Continued maintenance, monitoring, and village-level engagement to support long-term functioning and stewardship of the system. |

## 6. System Design and Infrastructure Features

The Bijalpur WWM system is a decentralized village-scale treatment and reuse arrangement. Wastewater first passes through screening and grit removal to separate coarse matter, after which it moves through an anaerobic pond, a facultative pond, and a maturation pond. This sequence is appropriate for rural conditions because it combines natural-treatment processes with relatively low operational complexity.

The system is strengthened by supporting infrastructure that improves both functionality and village acceptance. These components include green-area development, plantation, fencing, site improvement, regular water-quality monitoring, and a solar-energized pumping arrangement for lifting treated water to surrounding fields. Together, these features make the intervention an operational treatment-and-use system rather than a set of isolated structures.

The annual treated-water recovery potential is 48.18 TCM, equivalent to about 48.18 million liters per year, or roughly 0.132 MLD on an annual-average basis. At village scale, this is a meaningful quantity because it creates an irrigation-supporting water source in an area where agriculture depends heavily on groundwater extraction.

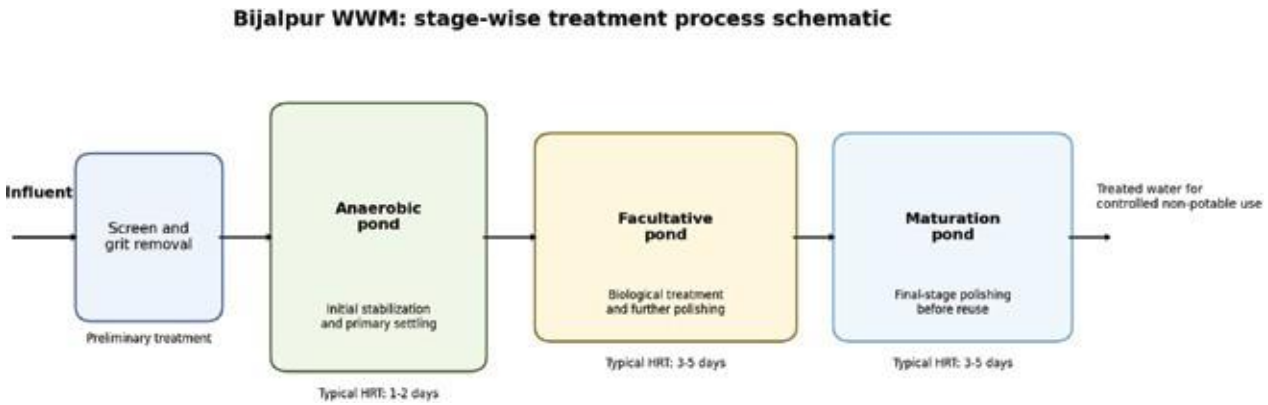



*Figure 2. Stage-wise treatment process schematic of the Bijalpur WWM system.*

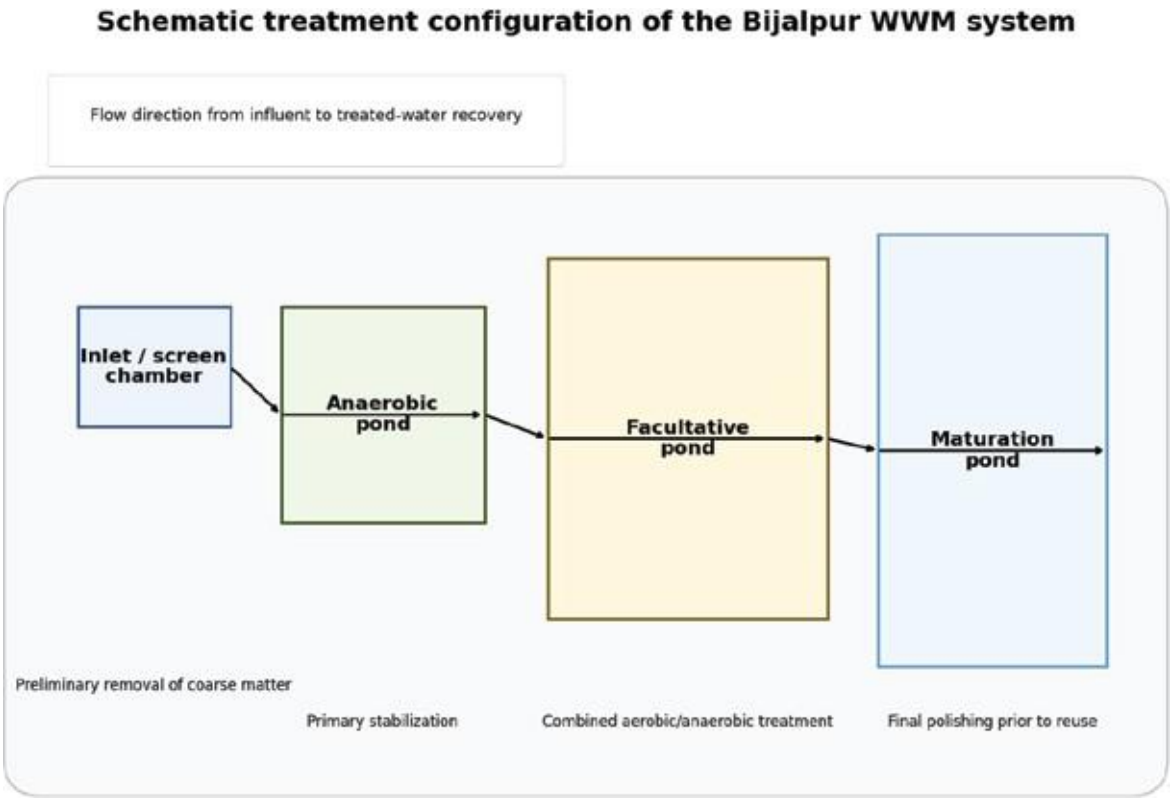



*Figure 3. Schematic treatment configuration showing the sequential pond system.*

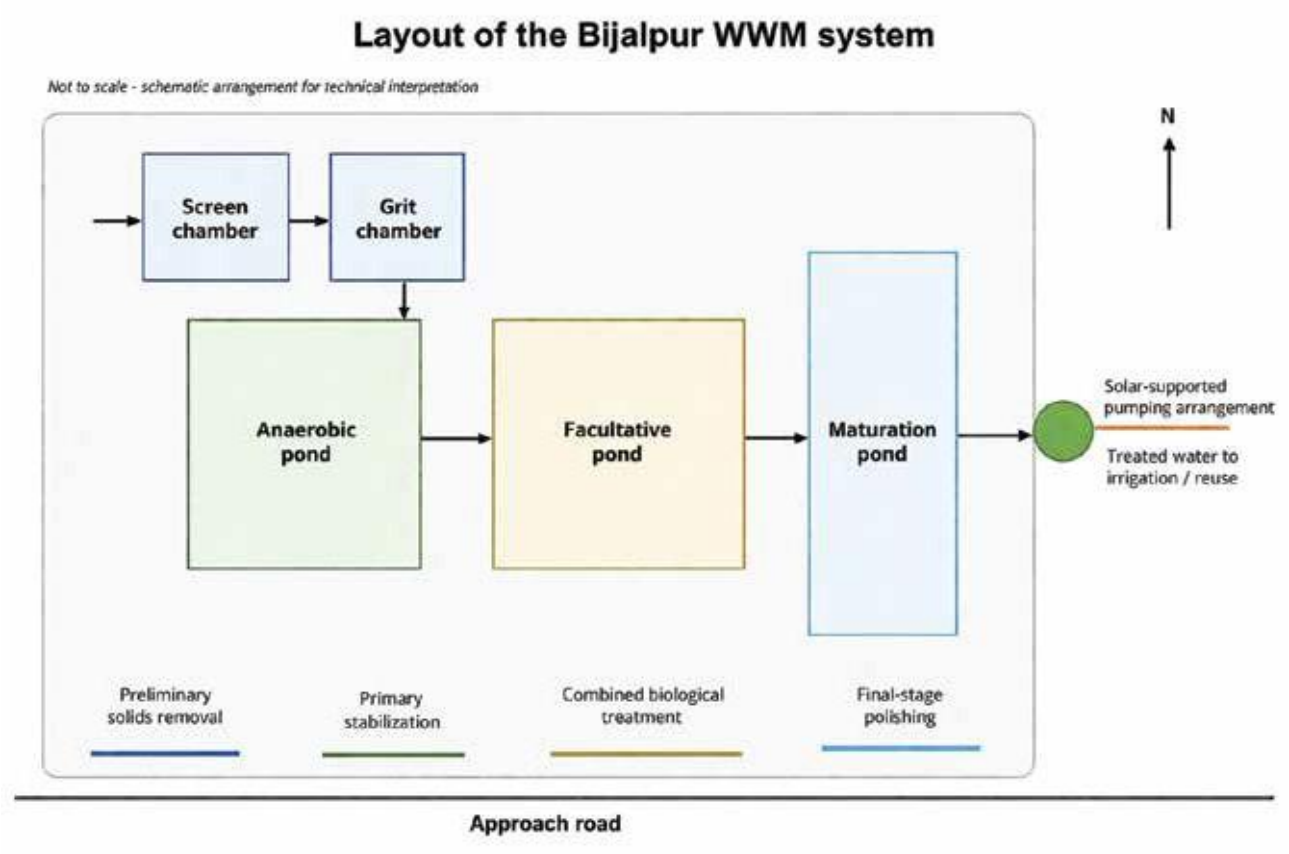



*Figure 4. Bijalpur WWM system showing key treatment units and treated-water movement.*

*Table 5. System components and functional role*

| Component | Functional purpose |
|---|---|
| Preliminary treatment | Screen and grit chamber to arrest coarse matter and protect downstream pond performance. |
| Anaerobic pond | Initial stabilization under low-oxygen conditions. |
| Facultative pond | Intermediate treatment through combined aerobic and anaerobic processes. |
| Maturation pond | Final-stage polishing before irrigation reuse and related controlled application. |
| Supporting infrastructure | Plantation, site improvement, green-area development, and fencing. |
| Reuse infrastructure | Solar-energized pumping arrangement for lifting treated water to surrounding fields. |
| Monitoring and management | Water-quality monitoring together with capacity building of community and user groups. |
| Estimated recovery potential | 48.18 TCM/year (~48.18 million liters/year; ~0.132 MLD on an annual-average basis). |



*Figure 5. Completed treatment-pond system and improved site condition after intervention.*

## 7. Local Institutions, Community Participation, Capacity Building, and Livelihood Processes

The Bijalpur intervention has gained strength through the way technical work has been accompanied by village-level participation, institutional engagement, and continued community processes. The WWM system has not functioned only as a treatment arrangement around the pond area; it has gradually become part of a wider village effort to improve environmental conditions, strengthen local responsibility, and encourage more informed use and management of shared resources. In this process, the Gram Panchayat, Water User Groups, women's groups, farmers, and other community members have all had an important role in shaping local ownership and support around the intervention.

Community engagement in Bijalpur has included awareness generation, community mobilisation, and capacity building related to sanitation, wastewater management, pond upkeep, water conservation, and responsible use of treated water. These efforts are important because the long-term value of such a system depends not only on the quality of physical infrastructure, but also on whether the village understands its purpose, supports its maintenance, and uses it in a disciplined and constructive manner. By linking the system with local institutions and everyday village practice, the intervention has helped build a stronger foundation for sustained stewardship.

The role of village institutions is particularly significant in this regard. Engagement with Panchayat members and local user groups has helped ensure that the WWM system remains connected to broader village priorities rather than being viewed only in functional or technical terms. This institutional involvement supports coordination around site upkeep, community participation, responsible management of common assets, and continued attention to the environmental condition of the pond and its surroundings. Over time, such processes contribute to stronger local confidence and a more rooted sense of collective responsibility.

The village process around the intervention has also been linked with agriculture-related awareness and improved water-use practices. In a village where farming depends heavily on groundwater, this connection is especially relevant. Efforts in the village have therefore included promotion of more water-conscious agriculture, encouragement of micro-irrigation practices, and support for diversification through activities such as horticulture and floriculture where relevant. These elements strengthen the practical relevance of the intervention by connecting wastewater management with broader concerns of water efficiency, farming resilience, and more sustainable use of local resources.

Women's participation has been another important dimension of this process. In Bijalpur, two women's Self-Help Groups have been supported through capacity building and training for livelihood-oriented activities. These include detergent powder making, herbal soap preparation, beauty-parlor training, soft-toy making, stitching, and other small enterprise skills. Such efforts are important not only from the perspective of income generation, but also because they strengthen confidence, participation, and the role of women within village-level development processes. The value of the intervention is therefore reflected not only in cleaner water management and irrigation use, but also in the way it contributes to a broader and more inclusive village ecosystem.

Taken together, these institutional, social, and livelihood-related processes have helped strengthen the foundation on which the Bijalpur WWM system continues to function. They have linked the

intervention with local governance, community participation, women's engagement, agriculture-related improvement, and practical village-level capacity building. In doing so, they have contributed to a more sustained process of village stewardship in which environmental improvement, resource management, and local development reinforce one another.







## 8. Treatment Performance and Water Quality Assessment

Stage-wise water-quality results indicate that the Bijalpur system is performing its intended stabilization and polishing function. The most consistent performance signals are a near-neutral pH profile across the treatment stages, low suspended-solids values, a lower electrical conductivity value at the maturation pond, and improved total-coliform results in the later stages of treatment.

At the same time, some dissolved-phase indicators such as TDS and hardness remain within a narrow band across the treatment train rather than showing large reductions. This is technically consistent with pond-based rural wastewater systems, which are generally designed to stabilize wastewater, reduce nuisance conditions, and improve the quality of water for practical reuse rather than to remove dissolved minerals aggressively.

For reuse interpretation, the most important point is that the treated-water profile supports irrigation use under responsible management. Total coliform reduces to zero in the later stages. This means that treated water can be used for irrigation in the intended village context, provided monitoring continues and local safe-use discipline is maintained.

*Table 6A. Core stage-wise water-quality indicators (Part 1)*

| Parameter | Unit | WW-01 Grit | WW-02 Anaerobic | WW-03 Facultative | WW-04 Maturation |
|---|---|---|---|---|---|
| pH | - | 7.50 | 7.56 | 7.88 | 7.79 |
| Electrical Conductivity (EC) | mmhos/cm | 0.80 | 0.78 | 0.80 | 0.70 |
| TDS | mg/L | 420 | 514 | 510 | 509 |
| Hardness | mg/L | 210 | 316 | 320 | 311 |

*Table 6A. Core stage-wise water-quality indicators (continued)*

| Parameter | Unit | WW-01 Grit | WW-02 Anaerobic | WW-03 Facultative | WW-04 Maturation |
|---|---|---|---|---|---|
| Total Suspended Solids | mg/L | 2.12 | 2.16 | 2.14 | 2.12 |
| Bacterial Count (x1000) | count/mL | 0.00 | 0.00 | 0.00 | 0.00 |
| Hydrogen Sulfide | mg/L | BDL | BDL | BDL | BDL |
| Total Iron | mg/L | BDL | BDL | BDL | BDL |
| Manganese | mg/L | BDL | BDL | BDL | BDL |
| Total Coliform | MPN/100 mL | 2 | 2 | 0 | 0 |

*Table 6B. Supplementary chemical indicators across treatment stages*

| Parameter | Unit | WW-01 Grit | WW-02 Anaerobic | WW-03 Facultative | WW-04 Maturation |
|---|---|---|---|---|---|
| Calcium (Ca) | mg/L | 1.0 | 1.5 | 1.5 | 1.4 |
| Magnesium (Mg) | mg/L | 1.0 | 1.1 | 1.6 | 1.2 |
| Sodium (Na) | mg/L | 2.0 | 2.3 | 2.8 | 2.4 |
| SAR | - | 0.40 | 0.30 | 0.43 | 0.40 |
| SAR adjusted | - | 0.40 | 0.30 | 0.40 | 0.40 |
| Chloride (Cl) | mg/L | 1.0 | 1.0 | 1.1 | 1.0 |
| Boron (B) | mg/L | 1.0 | 1.0 | 1.0 | 1.0 |
| Bicarbonate (HCO3) | meq/L | 2.20 | 2.20 | 2.18 | 2.10 |
| Carbonate (CO3) corrected | meq/L | 0.00 | 0.00 | 0.00 | 0.00 |
| RSC corrected final | meq/L | 2.07 | 2.03 | 1.97 | 1.93 |

| | | | | | |
|---|---|---|---|---|---|
| Sulfate (S04) | mg/L | 1.7 | 1.6 | 1.2 | 1.3 |
| Nitrate (N03) | mg/L | 1.5 | 1.3 | 1.3 | 1.3 |
| Potassium (K) | mg/L | 2.1 | 2.4 | 2.2 | 2.4 |

## 9. Irrigation Reuse, Livelihood Value, and Village Utility

A key strength of the Bijalpur intervention lies in the way treated wastewater has been linked with practical village use. The system has helped create a treated-water stream that can support irrigation in surrounding fields through the solar-energized pumping arrangement provided as part of the intervention. In a village where agriculture depends heavily on groundwater, this has important local value, as even a supplementary source of water can help reduce pressure on tubewell-based irrigation and improve the productive value of water that would otherwise have remained a source of environmental stress.

The importance of this treated-water use is not limited to immediate irrigation alone. It also reflects a broader effort to encourage more thoughtful and efficient use of water within the village economy. The village process around the intervention has included promotion of improved irrigation practices, greater attention to water-use efficiency, and encouragement of micro-irrigation and more sustainable agriculture practices where relevant. This helps position the WWM system within a wider local effort to strengthen water management in ways that are practical, resource-conscious, and aligned with village needs.

The intervention also has relevance for agriculture-related improvement at a broader level. By supporting better use of available water resources, it creates space for discussion and demonstration around diversification in farming practices, including horticulture, floriculture, and other water-sensitive agricultural activities where feasible. In this way, the value of the system extends beyond wastewater treatment and contributes to a more resilient and efficient local production environment.

Its livelihood significance should also be understood in this wider sense. Water, agriculture, and household livelihoods in Bijalpur are closely connected, and improvements in one area often support progress in another. When wastewater is treated and put to productive use, the pond area becomes cleaner, surrounding conditions improve, and treated water gains practical utility for farmers. At the same time, the broader village engagement linked with women's groups, local institutions, and capacity-building efforts helps ensure that the benefits of the intervention are experienced across different parts of the village ecosystem rather than remaining confined to the treatment site itself.

The village utility of the Bijalpur system therefore lies in the combination of environmental improvement and productive reuse. It has helped shift the pond from being associated with stagnant wastewater and poor site conditions to becoming a more functional village asset that supports irrigation, encourages more efficient resource use, and contributes to the wider process of agriculture strengthening and local livelihood resilience. This practical relevance is central to the long-term importance of the intervention in the village.

## 10. Rainfall and Groundwater Context

The significance of the Bijalpur WWM system becomes even clearer when viewed against the village hydrological setting. Agriculture is groundwater dependent, while rainfall is variable from year to year. Under such conditions, a supplementary irrigation-supporting water source has value not only in dry years but also as part of a broader strategy to reduce pressure on groundwater resources.

Validated rainfall records for 2021-2025 show marked inter-annual variability. Annual rainfall ranged from 193.0 mm in 2024 to 600.71 mm in 2025, while monsoon rainfall ranged from 164.1 mm in 2021 to 573.41 mm in 2025. Groundwater observations from two village monitoring locations also indicate a variable rather than fixed water-table condition. Together, these datasets confirm that Bijalpur operates within a changing local water environment rather than a stable one.

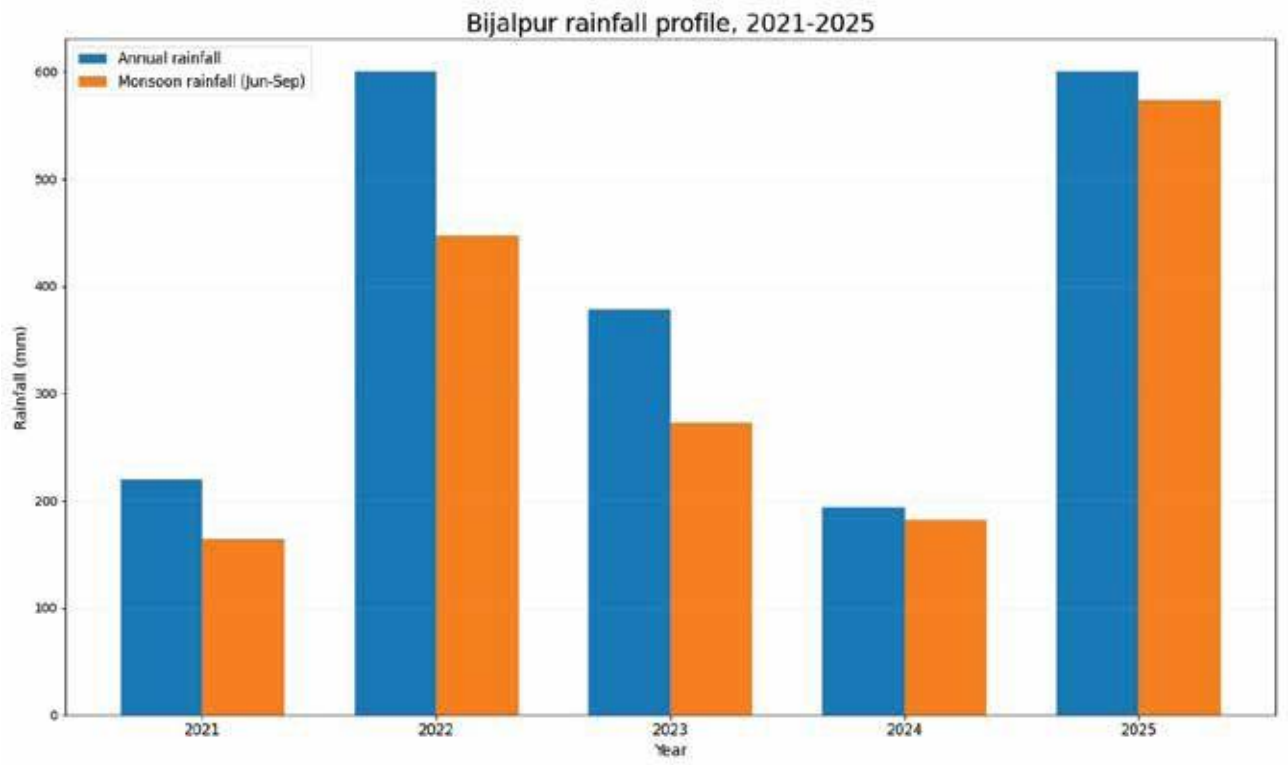



*Figure 6. Bijalpur annual and monsoon rainfall profile, 2021-2025.*

*Table 7. Validated rainfall summary*

| Year | Annual rainfall (mm) | Monsoon rainfall Jun-Sep (mm) |
|---|---|---|
| 2021 | 219.9 | 164.1 |
| 2022 | 600.3 | 447.2 |
| 2023 | 378.3 | 272.2 |
| 2024 | 193.0 | 182.1 |
| 2025 | 600.71 | 573.41 |

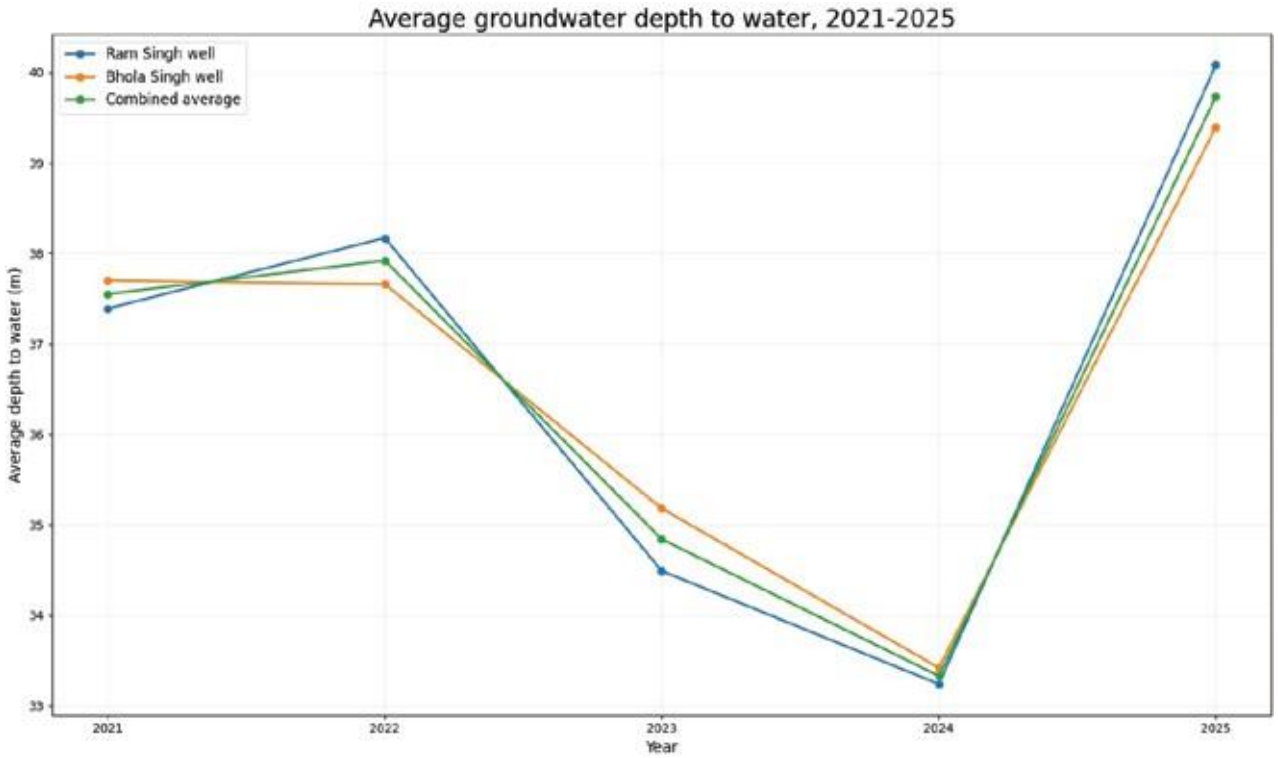



*Figure 7. Average recorded groundwater depth to water, 2021-2025.*

*Table 8. Annual average groundwater depth to water*

| Year | Ram Singh avg (m) | Bhola Singh avg (m) | Combined avg (m) |
|---|---|---|---|
| 2021 | 37.39 | 37.70 | 37.55 |
| 2022 | 38.17 | 37.66 | 37.92 |
| 2023 | 34.49 | 35.18 | 34.84 |
| 2024 | 33.24 | 33.42 | 33.33 |
| 2025 | 40.08 | 39.39 | 39.73 |

Taken together, the rainfall and groundwater data strengthen the case for decentralized wastewater treatment and irrigation reuse in Bijalpur. They show that the village operates in a water environment marked by variability and groundwater dependence, which is precisely the context in which treated wastewater can provide meaningful local value.

# 11. Community, Health, and Environmental Outcomes

The significance of the Bijalpur WWM system is reflected not only in the treatment of wastewater, but also in the visible improvement it has brought to the village environment and the everyday experience of people living around the pond area. Before the intervention, the site was associated with stagnant wastewater, foul smell, mosquito breeding, and an overall sense of neglect. Over time, the treatment and management of wastewater, together with site improvement and continued village engagement, have helped transform this condition into a cleaner, better-managed, and more functional part of the village environment.

One of the clearest outcomes of the intervention has been the improvement in environmental conditions around the pond. Cleaner surroundings, reduced stagnation, lower odor, and better movement in and around the site have contributed to a more dignified and usable village space. This change is important because village ponds are not merely physical structures; they are shared community spaces whose condition affects public perception, local comfort, and the quality of everyday village life. In Bijalpur, the intervention has helped restore the pond area as a more positive and better-maintained village asset.

The intervention also has an important health-related dimension. Reduction in stagnant wastewater and mosquito nuisance contributes to a healthier local environment and helps address some of the everyday concerns associated with wastewater accumulation near habitation. While such outcomes are experienced at community level in practical rather than clinical terms, they remain significant because they shape how people view the usefulness of the system and the value of maintaining it over time. A cleaner and more orderly pond environment improves not only physical conditions, but also the sense of safety, comfort, and wellbeing associated with the site.

The community value of the intervention is further strengthened by the wider village processes that have accompanied it. Awareness generation, community participation, institutional engagement, and capacity building have helped ensure that the system is understood as part of village improvement rather than as an isolated technical facility. Engagement with Panchayat members, user groups, women's groups, farmers, and other community members has contributed to a stronger sense of local connection with the intervention and has helped deepen its social relevance within the village.

This wider process also gives the intervention importance beyond sanitation and environmental management alone. By linking wastewater management with women's participation, livelihood-oriented training, agriculture-related awareness, and local institutional strengthening, the village has been able to derive broader value from the effort. As a result, the Bijalpur WWM system has contributed not only to cleaner surroundings and more productive water use, but also to a wider sense of village improvement in which environmental conditions, community participation, and local development are mutually reinforcing.

These outcomes show that the Bijalpur intervention has helped change the role and perception of the pond area within the village. What was once seen largely as a site of wastewater accumulation and nuisance has increasingly come to be viewed as a better-managed, more useful, and more valued community asset. This shift in perception is itself an important outcome, because it strengthens the social foundation required for continued care, responsible use, and long-term local stewardship of the system.



**Community voice 1**

*"Earlier, the area around the pond used to remain dirty and difficult to move through. There were foul smell, stagnant wastewater, and constant concern about mosquitoes and illness. After the wastewater management system was developed, waterlogging reduced, the surroundings became cleaner, and movement near the pond became much easier." Harwinder Singh, Bijalpur*



**Community voice 2**

*"For farmers who can access it, treated water has practical value. It has supported irrigation for crops such as wheat, paddy, andfodder. In my case, it has also reduced irrigation cost and lowered the need for urea."*

- Chamkor Singh, farmer, Bijalpur



**Community voice 3**

*"The condition of the village has improved after the WWM system. The surroundings are cleaner, complaints related to dirty water have reduced, and the pond area looks better managed. There is also a noticeable reduction in mosquitoes and foul smell."*

*- Rashandeep Singh, Bijalpur*

## 12. Sustainability, Operation, Maintenance, and Local Stewardship

The long-term value of the Bijalpur WWM system depends on sustained operation, regular upkeep, and continued village engagement. The significance of the intervention lies not only in the creation of treatment infrastructure, but in its ability to remain functional, relevant, and supported over time. This requires attention to both physical maintenance and the local processes that help ensure the system continues to serve the village effectively.

At the physical level, sustainability depends on the continued functioning of the treatment sequence and associated site infrastructure. This includes periodic cleaning of the screening and grit-removal units, upkeep of the pond system and embankments, protection of plantation and green areas, maintenance of fencing and site conditions, and continued operation of the solar-supported pumping arrangement used for irrigation purposes. Such routine attention is essential to preserve treatment performance, maintain the condition of the site, and ensure that treated water remains useful within the village context.

At the same time, long-term sustainability is equally dependent on the strength of local stewardship. Continued engagement of Panchayat members, Water User Groups, women's groups, farmers, and

other community members helps ensure that the system remains linked with village priorities and receives the attention needed for its upkeep. When the community sees the pond and treatment system as a shared village asset, the basis for regular care, responsible use, and continued protection becomes much stronger. In this sense, sustainability is closely tied to institutional participation and local responsibility.

Awareness generation, community mobilisation, and capacity building also remain important to this process. The usefulness of the system can be sustained only when village-level understanding continues around wastewater management, sanitation, safe and responsible use of treated water, and the importance of keeping the pond area clean and functional. These social processes help reinforce the discipline and collective responsibility that are necessary for long-term maintenance of common water-related assets.

The broader village processes linked with the intervention further strengthen this foundation. Engagement around agriculture-related improvement, efficient water use, women's participation, and livelihood activities helps keep the intervention connected with everyday village life rather than limiting it to the treatment site alone. As a result, the WWM system is supported not only through maintenance routines, but also through the wider village relationships, institutions, and capacities that give it continued relevance over time.

Monitoring is another important part of sustainability. Continued observation of water quality, site condition, and system functionality helps ensure that the treatment process remains stable and that the reuse of treated water continues in an appropriate and beneficial manner. Such monitoring also supports timely corrective attention wherever needed and strengthens confidence in the performance and practical value of the intervention.

Sustainability in Bijalpur rests on a combination of functional infrastructure, regular maintenance, community participation, institutional support, and continued local stewardship. These elements together have helped the WWM system remain a useful and better-managed village asset. The continuation of this approach will be central to preserving the environmental, irrigation-related, and community benefits created through the intervention.

## 13. Key Findings and Overall Assessment

The Bijalpur WWM system may be assessed as a technically sound, socially relevant, and practically useful village-level intervention. Its importance lies not only in wastewater treatment, but in the way the intervention has helped improve environmental conditions, support irrigation use, strengthen local participation, and connect water management with wider village processes over time.

A major outcome of the intervention has been the improvement in the condition of the pond area and the reduction of the nuisance associated with unmanaged wastewater accumulation. The shift from stagnant wastewater, foul smell, and poor site conditions toward a cleaner and more functional pond environment represents an important environmental and community outcome. This change has improved not only the physical condition of the site, but also its value as a shared village asset.

The treatment system has also created a treated-water stream that supports practical reuse for irrigation in surrounding fields. In a groundwater-dependent agricultural setting such as Bijalpur, this has important local value. Even as a supplementary source, treated water contributes to more productive use of village water resources and strengthens the relevance of the intervention for agriculture and local livelihoods. The solar-supported pumping arrangement further improves the utility of the system by helping connect treated water with field-level use.

The intervention has gained additional strength through the involvement of local institutions and village participation. Engagement with Panchayat members, Water User Groups, women's groups, farmers, and other community members has helped create a stronger social foundation around the system. This is important because the long-term success of such an intervention depends not only on infrastructure, but also on local responsibility, awareness, and continued attention to upkeep and responsible use.

Its wider significance is also reflected in the community processes that have developed around it. Awareness generation, community mobilisation, capacity building, women's participation, livelihood-oriented activities, and agriculture-related engagement have helped connect the WWM system with the broader development context of the village. As a result, the intervention has contributed to more than wastewater management alone and has supported a wider process of environmental improvement, local participation, and village-level strengthening.

The long-term sustainability of the system depends on continued maintenance, monitoring, and institutional engagement. The treatment infrastructure, pond environment, irrigation-use arrangements, and associated village processes all require regular attention if the benefits of the intervention are to be preserved over time. The continued involvement of local institutions and community members is therefore central to maintaining the practical, environmental, and social value of the system.

Overall, the Bijalpur WWM system represents a meaningful village example in which wastewater treatment, irrigation reuse, environmental improvement, institutional participation, and local stewardship have come together in a mutually reinforcing manner. Its value lies in this combination, which has helped transform the pond area into a better-managed and more useful village asset with continuing relevance for water management, agriculture, livelihoods, and community wellbeing.

# 14. Conclusion

The Bijalpur Wastewater Management System demonstrates the value of village-level wastewater management when treatment, reuse, environmental improvement, and community processes are brought together in a practical and sustained manner. In Bijalpur, the intervention has helped improve the condition of the pond area, reduce the nuisance associated with stagnant wastewater, and create a treated-water stream that supports irrigation use in surrounding fields. These outcomes are important in a village where agriculture depends heavily on groundwater and where improved management of local water resources has direct relevance for livelihoods and environmental quality.

The significance of the intervention also lies in the wider village processes that have supported it over time. Engagement with Panchayat members, Water User Groups, women's groups, farmers, and other community members has helped strengthen local participation, institutional responsibility, and stewardship of the system. Awareness generation, capacity building, agriculture-related engagement, and livelihood-oriented activities have further contributed to making the intervention meaningful

within the everyday life of the village and not only within the treatment site itself.

The Bijalpur experience shows that the long-term relevance of such a system depends on the continued relationship between infrastructure and community. Treatment performance, irrigation reuse, environmental improvement, village institutions, women's participation, and local livelihood processes together have shaped the value of the intervention. This combination has helped the pond area move from a condition of neglect and wastewater accumulation toward a more functional, useful, and better-managed village asset.

Overall, the Bijalpur WWM system reflects a practical village model in which wastewater management contributes to cleaner surroundings, improved use of water, stronger local participation, and a more sustained process of village stewardship. Continued maintenance, monitoring, and institutional engagement will remain important for preserving these gains and strengthening the contribution of the system to the village in the years ahead.




# Alternative Development Initiatives

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