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The Integration of the Stakeholders in the Process of Applying Natural-Based Solutions in Wastewater Treatment Projects in Egypt's Small-Scale Communities

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ABSTRACT

Until now, many small communities in Egypt in peripheral governorates and villages suffer from sanitation problems affecting health, safety, and quality of life. In addition to the emerging communities in new cities such as the Administrative Capital, New Alamein, New Mansoura, and others. All represent a high economic load on the country. This is coincident with the calls for sustainability and a green economy that attract large segments of the country's interests nowadays. Wastewater treatment methods and ideas varied between large stations to small home units. This study focuses on sustainable sanitation methods called Natural Based Solutions. Such projects may be excluded due to the absence of the role of stakeholders and the cooperative relations between them. For this reason, the topic is discussed in terms of stakeholder analysis. The main aim was to determine the roles of stakeholders in these projects, define their roles, their power, and their extent of interest. That came after defining (26) factors for providing an enabling environment for implementation, arranging their priorities using Statistical Product and Service Solutions (SPSS) software, and analyzing stakeholder participation in each. That helps to facilitate Natural Based Solutions sanitation projects in small-scale communities and encourage governments to look forward.

Keywords: Natural Based Solutions, Wastewater Treatment, Small-Scale Communities' Sanitation, Stakeholder Analysis, Stakeholders' Participation.

LIST OF ABBREVIATIONS

Acronyms	Description
CBOs	Community-Based Organizations
CTP	Centralized treatment Plants
HCWW	Holding Company for Water and Wastewater subsidiary company
LUV	Local Village Unite
MWRI	Ministry of Water Resource & Irrigation
NBS	Natural Based Solutions
NGOs	Non- Governmental Organizations
O&M	Operation & Maintenance
PCC	Pearson Correlation Coefficient
PMBOK	Project Management Body of Knowledge
Q	Quarter
SBR	Sequencing Batch Reactors
SH	Stakeholders
SPSS	Statical Produce and Services Solutions
Std. Dev	Standard deviation
UN	United Nations
WASH	Water Sanitation and Hygiene
WHO	World Health Organization
WWT	Wastewater Treatment

1. INTRODUCTION

Most studies on sustainability in the field of water are based on the exploitation of rainwater and floodwater. And with the increase of the water crisis, finding a new water source is no longer a luxury option. The speech on sustainability included various aspects of life, economic, environmental, architectural, and others.

The water conservation sector is one of the most important areas where the role of sustainability thought is clear, especially with the appearance of water shortage problems signs. Therefore, water resource conservation is considered one of the fundamental goals included in the UN. Sustainable Development Plan which matching also with Egypt's vision for 2030[1].

Recently, Egypt has encountered many challenges that directly affect the water sector. The most important of these challenges is the construction of a Renaissance dam, which will affect Egypt's share of water. In addition to, the increase of population, climatic changes, and others [1]. Thus, the management of the water sector should be effective and able to deal with this rapid current and expected changes. Egypt has made many achievements in the field of finding new sources of water including sewage treatment for agricultural purposes, energy production, and getting benefits from sludge by drying and reusing it for agricultural purposes [2]. In addition to smart water management studies [3]. Treated wastewater percentage reached 68.7% of the total wastewater in 2019, stands parallel to groundwater extraction stations and water desalination in coastal regions which were considered a top priority in recent years to combat water poverty. About 85% of all water supplies included treated water consumed in the agriculture sector [4], [5]. In response to Egypt's Vision 2030 of reducing water losses and saving water, 52 wastewater treatment plants are under construction in Upper Egypt, with a yearly capacity of 418 million m3, In Addition to 58 desalination plants, with a capacity of 440,000 m3 / day [6]. Recently, the project of the Bahr Al-Baqar water plant with a capacity of 5 million cubic meters per day became the largest triple treatment plant in the world where treated water was used to reclaim 376 thousand feddans in Sinai [7]. Despite the huge volume of recycled treated water provided by these mega projects per day, other decentralized wastewater treatment systems are suitable for small communities. Small-scale community refers to settlements or groups of settlements ranging from hundreds to a few thousand (about 5000 inhabitants), where individuals interact with each other in virtually many social situations or scope of work or even sharing in work style [8],[9]. It includes rural or urban settlements such as new cities compounds and villages. These decentralized systems are known as Community-based sanitation or Natural Based Solutions NBS can be considered the way to improve sustainable goals and green infrastructure features [10]. Septic Tanks (at EL-Shaikh Masoud - Minya governorate), Stabilization Ponds (at El-Moufty El-Kobra-Kafr El Sheikh Village), Package Treatment Plants (used in El-Gouna, Red Sea Governorate), Constructed Wetlands and the Living Machines are some prominent NBS used types. These methods depend on natural methods in treating water without resorting to chemicals, disinfectants, and other resources including land use areas [11]. Since it is difficult to select or prefer a specific NBS for a particular site, due to several limitations for each system represented in the site conditions, the degree of contamination of the discharge water, rate flow, and systems' capabilities indicated the need for specialists. However, the common issue among these systems is the stakeholders. So, as part of sustainable sanitation development, and to encourage new investments in the Wastewater Treatment WWT sector, the research highlights the stakeholders in wastewater treatment projects implemented by NBS. The stakeholder analysis methodology is applied to determine the roles of stakeholders in these projects, and their participation proportions in the various projects, to facilitate application in small-scale communities.

2. THEORETICAL BACKGROUND

2.1. Importance of Wastewater Treatment and Current Situation in Egypt

Wastewater can be categorized into domestic and industrial water. In cities and large residential communities, wastewater from residential areas is drained under each building in inspection chambers and transported through an extensive drainage network into lifting stations toward Centralized Treatment Plants CTP [12], [13]. In treatment plants, water passes through many treatment stages such as primary, secondary, biological, and sterilization. Then, water will convey back to drainage fields as some lakes or direct to the sea or back to the Nile unless it doesn't discharge into agricultural lands or is used in softscape irrigation. At the same time, many villages and governorates still suffer from a lack of sewage networks and pollution resulting from the spread of wastewater [2]. CTP consumes a large amount of energy, needs a huge footprint which is considered a national value itself, and requires a high financial cost. In addition to other technical problems such as energy consumption, fragmentation of operation, annual maintenance, cleaning, and the need for experienced working staff to follow monitoring and obtain successful operation [14].

2.2. Natural Based Solution Applying Motivations

While CTPs are considered the most appropriate in high-density urban communities, decentralized units are the most appropriate solution for WWT in rural areas and small communities. And in response to sustainability requirements, energy, and resource conservation, Natural Based Solutions are the prominent way. NBS is defined by The European Union as the WWT systems inspired by nature. It relies on natural elements like plants, soil, bacteria, and porous media to remove pollutants in wastewater through simple spontaneous processes [11]. Without chemicals, complex techniques, high-cost operation, and maintenance. Ancient Egyptian, Greeks, and Chinese were the first well-known cultures to use wetlands [11]. While the French were the first to use septic tanks in 1870 [15]. Then, innovative approaches are growing to apply these ecosystem technologies. NBS has many positive impacts on the surrounding environment, as they are:

- Contributing to setting healthy environments and supporting natural resources, provide many environmental, social, and economic benefits [16].
- Providing human welfare and biodiversity benefits.
- Achieving green infrastructure principles and sustainability [17],[14] where, it aims to improve public spaces, employing landscape elements and creating more livable habitats for birds and plants while improving air quality and reducing sewage treatment costs and energy consumption.

2.3. NBS Application Models in Egypt

NBS has many innovative ideas developed gradually; each NBS method has its own site limitations, specific contexts, scale, efficiency, and cost. A combination of technologies is usually essential. One of the experiments in Egypt was in Deir Gabal El-Tair in 2014, under the supervision of (HCWW), Egypt. The separation tank is followed by the trickling filter and the wetland [18], which give extra cleaning potential before use for agricultural purposes. If aquaculture is practiced in the village, as is often the case in Kafr El Sheikh Governorate, the treated wastewater can be further polished in fishponds [19]. So, there is no replicable model for NBS. The most prominent models are shown in **(Appendix 1, Table A1)**. The treatment process is carried out in two ways, aerobic and anaerobic treatments [20].

2.4. Natural-Based Solution Applying Factor

Many factors are considered to specify the ideal solution. These factors are classified into: Technical factors and Enabling environment factors [9]. The first group (referred to as T1 to T5) includes quantities and characteristics of wastewater, soil studies, current and expected population percentage, flow rates, and many other analyses in which specialized technicians can determine each appropriate treatment method. While the other includes organization and management factors from Y1 to Y2 as shown in **(Table 1)**. When specialists study all technical factors and select a specific compatible treatment system, the selected system is examined according to the enabling environment factors. If the system covers these factors, it will be activated and used as a replicable model. If not, the cycle is repeated to search for vulnerabilities or select another treatment system as shown in **(Fig. 1)**.

Table 1: Natural based solutions (NBS) applying factors. Adopted from: [9], [18]

Technical design factors	**T1.** System design parameters		
	T2. Factors Affecting the infrastructure price		
	T3. Quality of the work		
	T4. Water quality and quantity calculations		
	T5. Innovation obstacles		
	Factors		**Subfactors**
Enabling environment factors	**Y1.** Governmental support	**X1**	Sanitation strategy
		X2	Cost policy
		X3	Accept projects without supporting
	Y2. Legal and regulatory framework	**X4**	Standards and codes of practice
		X5	Plan for full cost recovery in case of sys failure
		X6	Encourage delegation of responsibilities to the communities
		X7	Using performance-based contracts for consultants and contractors
		X8	Enforcement of laws and regulations
	Y3. Institutional Arrangements	**X9**	Defining roles
		X10	Linkages between private service providers / NGOs and line agencies
		X11	Management capacity of communities
		X12	Management interface between communities and institutions
		X13	Linkages between the research sector and line agencies
		X14	Managing consultants and contractors
		X15	Role of donors
		X16	Form institutional memory
	Y4. Skills and Capacity	**X17**	Understand the processes
		X18	Enhancing O&M culture
		X19	Forming training program
	Y5. Financial Arrangements	**X20**	Capital costs
		X21	O&M costs
		X22	Finance return

	Y6. Socio-cultural Factors	**X23**	Dealing with the environment
		X24	Encourage decentralization culture
		X25	Benefit from previous experiences
		X26	Forming O&M organization

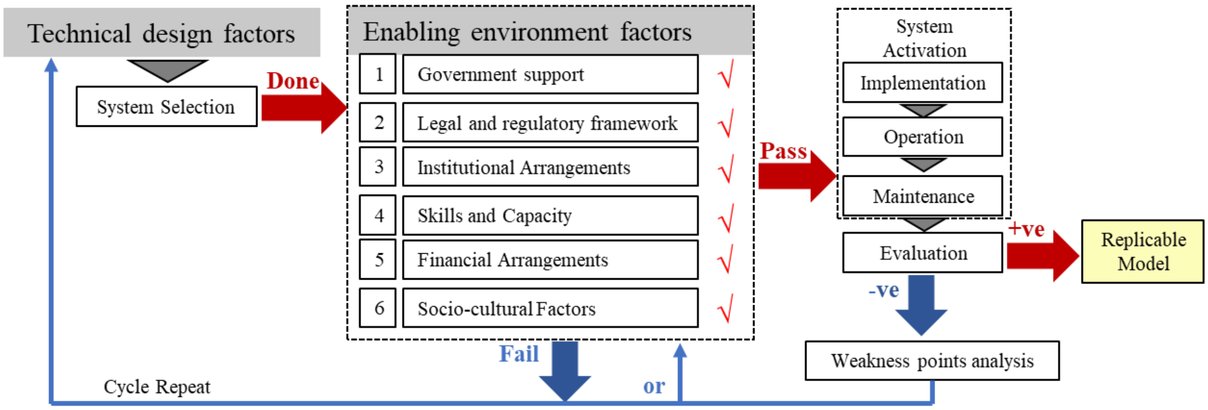

Figure 1:NBS selection cycle

2.5. Stakeholders' Analysis

Project Stakeholders SH are all those who are related to that project in concern and who are affected by implementation and operation, as well as everyone who affects this concern positively or negatively [21]. Stakeholder Management is one of the knowledge areas of project management as per the PMBOK guide. It is one of the important activities performed during the management process to organize responsibilities and decisions [22]. It includes the process of identifying the people, groups, or organizations which impact the project and developing management strategies for effective stakeholder engagement. The project stakeholder management process is divided into four phases, identify stakeholders, plan stakeholder management, manage stakeholder engagement, and control stakeholder engagement. For the first phase, stakeholder analysis is required. It is defined as a technique of systematically gathering and analyzing quantitative and qualitative information to determine participants' power and interest level. planning stakeholder management refers to the design of SH engagement criteria through the project life cycle. Where the SH engagement level is classified according to their interaction into unaware, resistant, neutral, supportive, and leading. Managing stakeholder engagement is the process of communicating and working with stakeholders. Finally, the control stakeholder engagement phase is defined as the process of monitoring overall the project stakeholders' relationships for maintaining and increasing the efficiency of stakeholder engagement [23].

In stakeholder analysis, a methodical process of identifying, classifying, and mapping is applied, with applying communication throughout, and then monitoring. It helps in winning resources and confirming understanding of tasks [24]. Stakeholders are divided into internal and external. The internal stakeholders are those who are members of the project coalition providing or getting benefits, while the external stakeholders are those others affected by the project in a significant way. They all have the power to be a threat or a benefit.

3. RESEARCH METHODOLOGY

The study was divided into three sections. The first, as described by the literature review, highlights the necessity of using Natural Based Solutions in wastewater treatment systems and identifies enabling environmental factors. The second can be summarized by applying SH analysis phases. While the third is the Linking between stakeholders and the enabling environment factors to achieve the research aim which is to facilitate the design of a Stakeholders' Engagement Plan as shown in **(Fig.2).**

The First section: Based on the literature review including the current situation in Egypt for WWT and motivations for applying NBS. The most used models of NBS and its applying factors have been presented. Finally, the stakeholders' analysis was introduced.

The Second section includes applying stakeholder analysis for NBS projects as the following steps:
<u>A. identifying the stakeholders</u>.
Identifying the stakeholders involved those who are:

- Responsible for the project and its different components (including funders, WASH officials, managers, employees, etc.)
- Intended users or beneficiaries.
- Negatively affected entities by the project
- Threaten the success of the project through their opposition or lack of cooperation.

- Represent the interests of people unable to participate.
- With unique knowledge related to an aspect of the project.

Among a wide range of possible stakeholders in WASH projects, collected from the literature review and existing projects in Egypt, [25], [26], [27], [28], [29], [19], [30] they can be classified into main 7 groups. Table 2 shows these groups, sub-groups of stakeholders, and their respective roles**.** The project's type and scale are prominent considerations while defining stakeholders. The local context, local institutional regulations, and cultural conditions are also important factors in identifying and classifying stakeholders [31].

B: Stakeholder categorization and mapping.

The analytical analysis method was conducted by designing a questionnaire distributed to different samples of stakeholders in NBS projects (20 participants). Two main steps were applied as shown in Part (1), and Part (2) in (**Appendix 2**). Part 1 was for categorization & mapping, while Part 2 was for analyzing relationships.

Categorization: Stakeholders in this stage are classified into four categories according to their interest and power to create a visual representation of stakeholders' location according to the project [32]. That was applied by selecting the mode (most frequent answer) of answers of the responded participants, (**Table A2, A3)** in Appendix.

Mapping: In this process, stakeholders are presented according to their classification within the interest/power grid matrix. Each quarter (Q) indicates the type of stakeholders and the action plan related to it whether they are one of the categories shown in **(Table 3)** [33], [34], [32]. The engagement level was also indicated according to the extent of their interaction with the project.

The resulting mapping for the NBS project stakeholders is shown in **(Fig. 3)**. It was found through the resulting mapping that the stakeholders' responses samples (20 participants) covered the four quarters of mapping. which included the following groups shown in **(Table 4)**.

Questionnaire participant groups include those who are interested in green infrastructure, sanitation work contractors, and households. In addition, several engineers work at the water treatment company in Al-Rehab and Al-Shorouk cities. These chosen cities are considered models for small communities divided into building groups and separate areas, characterized by green areas that allow the application of NBS and the exploitation of treated wastewater for irrigation purposes.

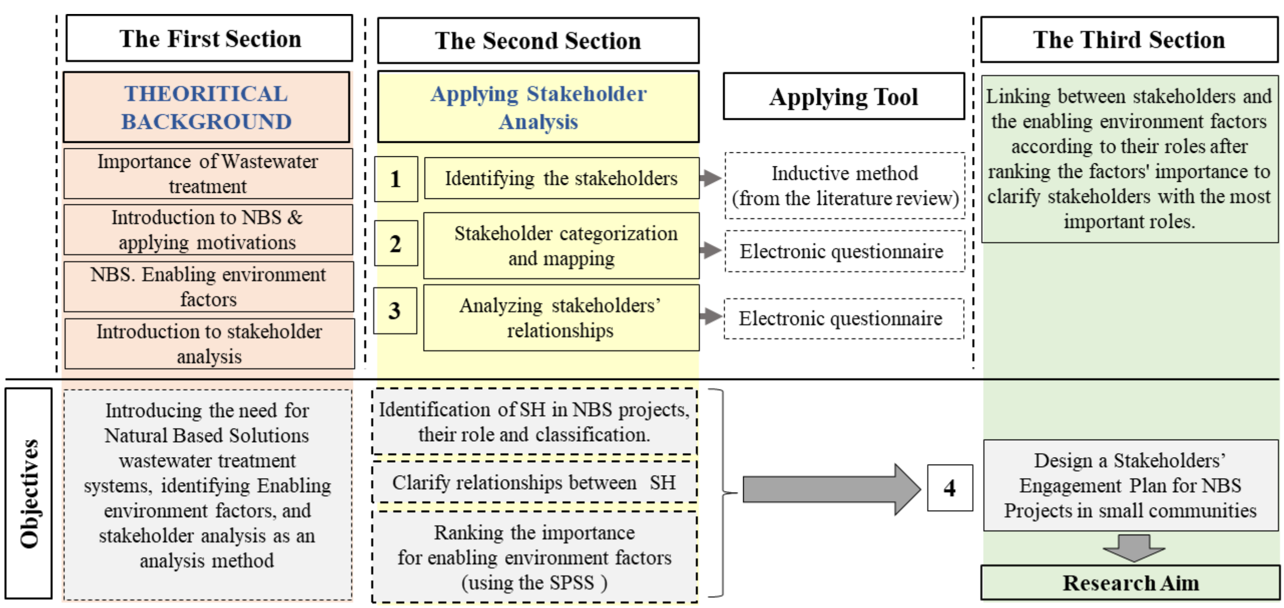

Figure 2: Research methodology

Table 2: Stakeholders of NBS sanitation projects. Adopted from: [25], [26], [27], [28], [29], [19], [30]

Stakeholders		Stakeholders' Role
1. Producer and Users Level / PUL.		
PUL.1	Householders	• Rising Community sense of participation in achieving green infrastructure. • Preserving public health by providing organized methods of collection and treatment, especially in poor villages that miss a sewage system.
PUL.2	Irrigation committee	• Augmentation of irrigation water resources • Improvement of irrigation water quality • Exploitation of natural fertilizers resulting from drying sludge in raising the efficiency of agricultural lands at a lower cost • Enhance economic feasibility and marketability.
PUL.3	Living near or around a beneficial area	• Observing the extent of benefit gained to the constructed project area to stimulate civil society.
PUL.4	Projects' owners (compounds)	• Saving the cost of water for irrigating the green areas of the landscape. • Participate in promoting green infrastructure ideas.
2. Local Level (village, compounds) / LL.		
LL.1	Local Village Unite (LVU), City Authority/Hall	• Represent the governorate office for small communities, it's responsible for offering all services. • Carrying out financial audits of the community associations' accounting.
LL.2	Community-Based Organizations (CBOs)	• Communicating community needs especially the poor voice to the higher authorities. • Coordinating project activities. • Consultation/participation in construction and maintenance
3. Governorate Level / GL.		
GL.1	Governorate Water and sewage company	• Link between the local community and the central WASH authorities. • Receiving and resolving the problems of local communities regarding water and sanitation issues. •Provide the requirements for public health safety • Increase green areas/landscaping • Issuance permits for projects' implementations • Represents public and popular image for the governorate.
GL.2	Governorate administration (water, urban, and other related)	
4. State Level / SL.		
SL.1	Ministries in direct relation to wastewater	• Support policies for Infrastructure development • Leading the support process for planning, budgeting, implementation, monitoring, and coordination. • Regulate tariffs amount and cost recovery from users. • Present the public image
SL.2	Ministries related to urban development	• Optimum planning for land uses • Coordinating agreements with other ministries
SL.3	Ministries related to health and the environment	• Prevent environmental deterioration and support green growth. • Solid waste management, sludge containment, and disposal. • Reduce/eliminate incidents of diseases.
SL.4	Ministries related to social development	• Improve living and environmental conditions for residents.
SL.5	Ministries of finance	• Mobilization of public finance for the water sector. • General economic planning.
SL.6	Water supply and sewerage authorities (HCWW)	• Provide sewerage and treatment facilities. • Provide supplying reclaimed water for reuse purposes. • Responsible for collecting network, maintenance, and renewal work.
SL.7	Regulatory bodies (Standards and Metrology Organization)	• Setting standards for effluent and water supply. • Monitoring effluent, water supply, and other standards. • Development of systems and standards for best management practices within the agricultural and water sectors. • Ensuring edible crops' safety and quality.
5. International Level / IL.		
IL. 1	International development	• Provide social, technical, and institutional support for obtaining

	agencies (such as UN agencies)	sustainable and integrated water resources management. • Support the quality of life for poor and vulnerable areas with many projects.
IL. 2	International standardization (such as WHO)	• Leading global efforts to prevent disease transmission and protect health. • Advising governments on health-based regulations and service provision. • Promote effective practices in assessing and managing sanitation risks in communities. • Strengthening sanitation safety plans and inspections of sanitation facilities.
IL. 3	Development banks (such as World Bank)	• Providing large concessional and commercial loans. • Giving small grants for preparation or technical support. • Sharing in managing large projects and institutional development. • Increasingly seeking investments in new ways to address city-wide sanitation.
IL. 4	Bilateral development agencies	• Grants and technical assistance for country projects through implementing partners (NGOs, UN agencies, contractors/ consultants, governments) • Grants funding to various stakeholders enabling freedom to try new approaches
6. Private sector Level / PS.		
PS. 1	Small to medium-scale sanitation enterprises	• Meeting market demand for water services especially in low-income areas (construction utilities; truck, driller, pipes)
PS. 2	International / national/local consulting firms	• Crossing policy cycle from research, sys. selection, design, implementation, monitoring, and evaluation
PS. 3	Local finance institutions (local banks)	• Finance private sector providers to expand their operations • Finance users to access basic WASH services and connect to the network
PS. 4	Private contractors	• Meeting market demand for water services • Sharing the construction process
7. Hybrid levels / HL.		
HL. 1	Non-profit organizations (NGOs, CSO)	• Implementation of sanitation and water supply services for the poor • Innovation in service delivery • Ensuring a positive impact on local communities. • Inventory of individuals' needs regarding health and the environment.
HL. 2	Technical specialists	• Develop tools to interface WASH challenges & identify solutions.
HL. 3	Research institutions/ Technical colleges	• Applied research about new sanitation technologies • Dissemination of knowledge • Developing best practices for agricultural use of reclaimed water. • Working as a third party for inspection in the water sector. • Support standardization of NBS systems in various regions to facilitate implementation and encourage investment. • Researching water quality • Research on the effectiveness of various water purification systems
HL. 4	Media	• Public awareness

Table 3. Stakeholder categories. Adopted from: [33], [34], [32]

	Name	Category of participants	Action	Engagement level
Q1	Subjects	high interest, low power	Keep satisfied, and consider empowering	Supportive
Q2	Key players	high interest, high influence	Closely manage (the biggest supporters or obstructors)	Supportive, leading
Q3	Context setters	low interest, high influence	Keep informed and activate potential supporters.	Resistant/ neutral
Q4	Crowd	with no interest, no influence	Monitoring. Can be left unconsidered but under surveillance.	Unaware/ neutral

Table 4. Questionnaire participants groups

Questionnaire participants groups	responses	Questionnaire participants groups	responses
Engineers at the water treatment company in Al-Rehab and Al-Shorouk cities in New Cairo – (Q2)	5	Researchers who are interested in green infrastructure and sustainability – (Q1)	8
Basic households – (Q4)	4	Sanitation work contractors in the two previous cities – (Q3)	3

Note: Several participants indicated the necessity of separating the households into two categories according to their interests, culture, and economic level. Where households in rural areas (Household a) need quick solutions to their poor sanitary problems, while urban households (Household b) prefer relying on CTP due to the lack of confidence in other systems.

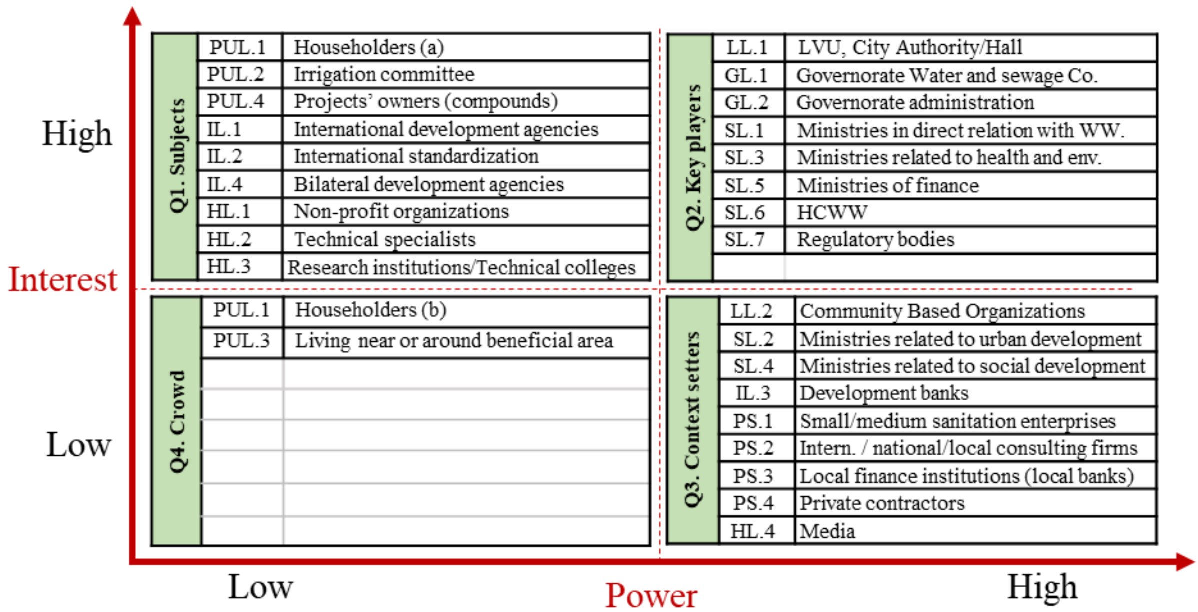

Figure 3: Interest/ Power matrix for NBS projects

C: Analyzing stakeholders' relationships. Through this process, the relationships between stakeholders are analyzed, whether they are in conflict, complementary, or cooperation relations [26]. The actor linkage matrix shown in **(Table 5)** is used to illustrate these relationships. Based on part (2) results of the questionnaire (Appendix 2) where: participants were asked to fill the relation matrix by percentages according to the relationship level between SH. from 0 to 100% as shown in (**Table A4**). These percentages are translated after calculating the mean of results into colored relations.

D: the stakeholders' engagement plan. A successful engagement plan helps stakeholders to have the opportunity to affect the decision-making through the project life cycle in the right manner. Another benefit is coming through involving stakeholders in the planning and implementation project phases, where it helps in:

- Make the implementation process preannounced transparently and fairly.
- Allow participation in the budget and anticipate upcoming financial responsibilities.
- Increase the effectiveness of the project due to meeting users' needs.
- Overcome the usual mistrust between stakeholders by building support.
- Identify priorities of different parties
- Develop the practice of agreement on issues that include various actors.
- Ensure the continuity of project sustainability.

The Third section of the methodology works on planning a strategic stakeholders' engagement plan for NBS which is considered the main research aim. Where, from the literature review, (six) factors and (twenty-six) subfactors have been deduced to provide an enabling environment for the implementation of NBS. A questionnaire to assess the importance of these factors was distributed to the same stakeholders previously asked. Inputs were entered into IBM SPSS software to test the reliability and stability of the sample. But significant variability was found. The reason is attributed to different local contexts and cultural conditions. Therefore, the questionnaire was re-distributed to another sample including the following as shown in **(Table 6).**

Reliability for the 26 subfactors was checked to ensure the precision of participant-entered data. It was measured by Cronbach's alpha value and varied between 0 to 1 with priority to upper values. Then, Pearson Correlation Coefficients coded with (PCC.) were measured too. SPSS helps in creating a correlation matrix between each factor and its subfactors. A correlation coefficient is a number between -1 and +1, indicates how much two quantitative variables are related, where the relationship is a direct relationship for (n) numbers between 0<n<1, and the relationship is an inverse relationship for (n) numbers between -1<n<0 [35]. (**Table A5)** Appendix2 part3 presented questionnaire results, while **(Table 7,8)** illustrates all statistical analyses.

(Table 7) is for the Consistency coefficients; it is used to examine the reliability of the questionnaire results. While PCC in (**Table 8)** are used to evaluate the relationship between each main factor and its subfactors in a data set.

Table 5. The actor linkage matrix.

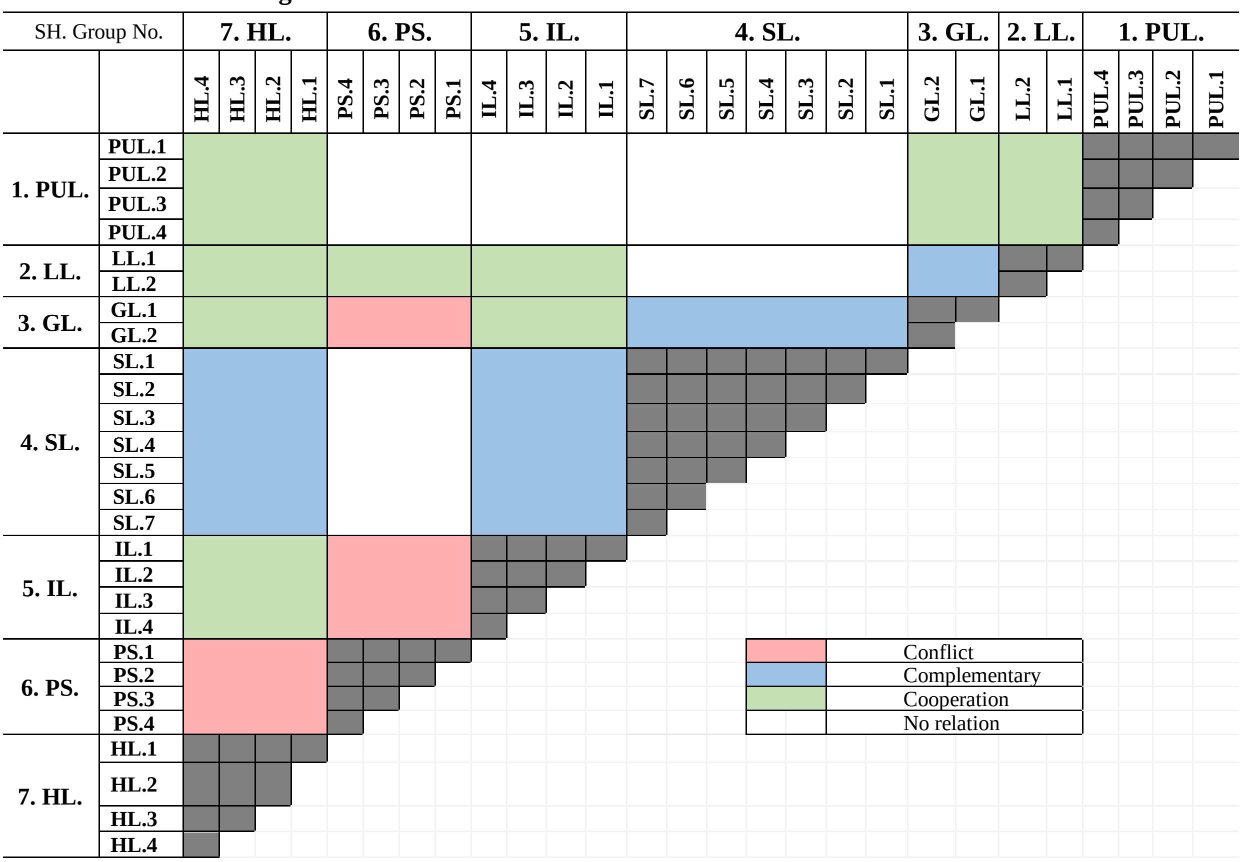

Table 6. The distribution criteria of the electronic questionnaire

participants	Architectural design	5	Urban planning	5
	Urban design	5	Civil engineering	5

Table 7. Consistency coefficients (Reliability Statistics)

	Enabling environment factors	**Cronbach's Alpha (0-1)**	N of Items
Y1	Government support and its factors	0.433	4
Y2	Legal and regulatory framework and its factors	0.328	6
Y3	Institutional arrangements and their factors	0.608	9
Y4	Skills and capacity and their factors	0.412	4
Y5	Financial arrangements and their factors	0.524	4
Y6	Socio-cultural factors	0.543	5
	Global values (factors with all subfactors)	0.739	32

Table 8. Pearson correlation coefficient matrices PCC. (a), (b), (c), (d), (e), and (f).

(a) Correlation matrix between government support factor and its subfactors

	Government support	Sanitation strategy	Cost policy	Accept projects without supporting
Government support	1	0.589	0.073	0.584

(b) Correlation matrix between legal and regulatory framework factors and their subfactors

	Legal and regulatory framework	Standards and codes of practice	Plan for full- cost recovery	Encourage delegation of responsibilities	Using performance-based contracts	Enforcement of laws and regulations
Legal and regulatory framework	1	0.057	0.556	0.697	0.283	0.461

Table 8. (Continue) Pearson correlation coefficient matrices PCC. (a), (b), (c), (d), (e), and (f).

(c) Correlation matrix between Institutional Arrangements factors and its subfactors

	Institutional Arrangements	Define roles	Link private service with others.	Management capacity of communities	Manage the interface between communities &institutions	Link research sector with agencies	Managing consultants & contractors	Role of donors	Form institutional memory
Institutional Arrangements	1	0.188	0.596	0.607	0.514	0.253	0.615	0.420	0.419

(d) Correlation matrix between Skills and Capacity factor and its subfactors

	Skills and Capacity	Understand the processes	Enhancing O&M	Forming training program
Skills and Capacity	1	0.428	0.710	0.500

(e) Correlation matrix between Financial Arrangements factor and its subfactors

	Financial Arrangements	Capital costs	O&M costs	Finance return
Financial Arrangements	1	0.485	0.721	0.576

(f) Correlation matrix between Socio-cultural Factors factor and their subfactors

	Socio-cultural Factor	Dealing with the environment	Encourage decentralization culture	Benefit from previous experiences	Forming O&M organization
ocio-cultural Factors	1	0.547	0.513	0.563	0.587

Then, all Enabling environment subfactors (from X1 to X26) have been ranked according to the mean of frequency taken from questionnaire results through SPSS as shown in **(Table 9)**. Small values of Standard deviation (Std. Dev) refer to the extent of the closeness of experts' opinions to the mean. Stakeholders' analysis stages can be ended by prioritizing identified SH. While it is essential to finalize stakeholder analysis by "monitoring and analyzing performance stage" to evaluate actual results upon expectations. The need for some adjustments may appear to direct stakeholder engagement in the right direction. This stage has been organized by the responsible competent authorities and was implemented in various Egyptian village models with the participation of the Holding Company for Drinking Water and Wastewater (HCWW) and research institutions [18], [36].

Table 9. SPSS ranking for enabling environment subfactors according to mean values

		Valid/Missing N		**Mean**	Std. Dev.	**Ranking**
X1	Sanitation strategy	20	0	4.7	0.57	2
X2	Cost policy	20	0	4.3	0.57	8
X3	Accept projects without supporting	20	0	2.95	0.89	20
X4	Standards and codes of practice	20	0	4.7	0.47	2
X5	Plan for full cost recovery in case of sys failure	20	0	3.5	0.61	16
X6	Encourage delegation of responsibilities to the communities	20	0	3.3	0.98	18
X7	Using performance-based contracts for consultants and contractors	20	0	4.65	0.49	3
X8	Enforcement of laws and regulations	20	0	4.15	0.81	9

X9	Defining roles	20	0	4.65	0.49	3
X10	The link between private service providers / NGOs and line agencies	20	0	3.95	1.05	12
X11	Management capacity of communities	20	0	3.95	0.89	12
X12	Management interface between communities and institutions	20	0	4.05	0.83	10
X13	Linkages between the research sector and line agencies	20	0	4.3	0.66	8
X14	Managing consultants and contractors	20	0	3.35	0.88	17
X15	Role of donors	20	0	4.5	0.69	6
X16	Form institutional memory	20	0	4	0.79	11
X17	Understand the processes	20	0	4.75	0.44	1

Table 9. (Continue) SPSS ranking for enabling environment subfactors according to mean values

X18	Enhancing O&M culture	20	0	4.55	0.60	5
X19	Forming training program	20	0	3.8	0.70	13
X20	Capital costs	20	0	4.55	0.51	5
X21	O&M costs	20	0	4.6	0.50	4
X22	Finance return	20	0	3.7	0.66	14
X23	Dealing with the environment	20	0	2.55	0.89	21
X24	Encourage decentralization culture	20	0	4.4	0.75	7
X25	Benefit from previous experiences	20	0	4.05	0.76	10
X26	Forming O&M organization	20	0	3.2	0.89	19

4. Results

Since weak collaboration between sectors is one of the main barriers to preserving hygiene and effective sanitation in natural systems [29], the stakeholders' engagement plan for NBS systems can be a feasible tool to achieve this collaboration. **(Table 10)** represents the enabling environment sub-factors as ranked, its Related Function RF (fromY1 to Y6) and the participating stakeholders with their related. Data was analyzed to measure the contribution of each stakeholder in providing the enabling environment factors as presented in **(Fig.4).** The average participation of each stakeholder in the overall NBS projects was also calculated and presented in **(Fig.5).** Analysis Excel is included in Table A6 an Appendix 2.

Table 10: Stakeholders' engagement plan in NBS sanitation projects

Sub-Factors as ranked		RF	Stakeholder participation	Related relation		
X17	Understand the processes	Y4	1. Producer and Users Level (PUL.1)	-	-	LL, GL, HL
			2. Local Level (LL.1, LL.2)	-	GL	IL, PS, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL
			4. State Level (SL.1, SL.2, SL.3, SL.5, SL.6)	-	IL, HL	-
			6. Private Sector Level (6.1,6.2, 6.4)	HL	-	-
			7. Hybrid Level (HL.1)	-	-	-
X1	Sanitation strategy	Y1	1. Producer and users Level (PUL.1, PUL.2, PUL.4)	-	-	LL, GL, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL
			4. State Level (SL.1, SL.5, SL.6)	-	IL, HL	-
X4	Standards and codes of practice	Y2	1. Producer and Users Level (PUL.1, PUL.2, PUL.3, PUL.4)	-	-	LL, GL, HL
			2. Local Level (LL.1, LL.2)	-	GL	IL,6, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL
			4. State Level (SL.1, SL.2, SL.3, SL.4, SL.5, SL.6, SL.7)	-	IL, HL	-
			5. International Level (IL.1, IL.2, IL.3, IL.4)	PS	-	HL
			6. Private Sector Level (PS.2, PS.3, PS.4)	HL	-	-
X7	Using performance-based contracts.	Y2	See X4			
X9	Defining roles	Y3	2. Local Level (LL.1, LL.2)	-	GL	IL, PS, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL

			4. State Level (SL.1, SL.2, SL.3, SL.4, SL.5, SL.6)	-	IL, HL	-
			5. International Level (IL.1, IL.2, IL.3)	PS	-	HL
			6. Private Sector Level (PS.1, PS.2, PS.3, PS.4)	HL	-	-
			7. Hybrid Level (HL.1, HL.2, HL.3)	-	-	-
X21	O&M costs	Y5	1. Producer and Users Level (PUL.1)	-	-	LL, GL, HL
			2. Local Level (LL.1, LL.2)	-	GL	IL, PS, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL
			4. State Level (SL.1, SL.2, SL.5, SL.6)	-	IL, HL	-
			5. International Level (IL.3, IL.4)	PS	-	HL
			6. Private Sector Level (PS.1, PS.2, PS.4)	HL	-	-
			7. Hybrid Level (HL.1)	-	-	-
X18	Enhancing O&M culture	Y4	See X17			
X20	Capital costs	Y5	See X21			
X15	Role of donors	Y3	See X9			
X24	Encourage decentralization culture	Y6	1. Producer and Users Level (PUL.1, PUL.3, PUL.4)	-	-	LL, GL, HL
			2. Local Level (LL.1, LL.2)	-	GL	IL, PS, HL
			3. Governorate Level (GL.1, GL.2)	PS	SL	IL, HL
			4. State Level (SL.1, SL.2, SL.3, SL.4, SL.5, SL.6, SL.7)	-	IL, HL	-
			7. Hybrid Level (HL.4)	-	-	-
X2	Cost policy	Y1	See X1			
X13	Linkages between the research sector and line agencies	Y3	See X9			
X8	Enforcement of laws and regulations	Y2	See X4			
X12	Management interface between communities and institutions	Y3	See X9			
X25	Benefit from previous experiences	Y6	See X24			
X16	Form institutional memory	Y3	See X9			
X10	The link between private service providers/NGOs	Y3	See X9			
X11	Management capacity of communities	Y3	See X9			
X19	Forming training program	Y4	See X17			
X22	Finance return	Y5	See X21			
X5	Plan for full cost recovery in case of sys. failure	Y2	See X4			
X14	Managing consultants and contractors	Y3	See X9			
X6	Encourage delegation of responsibilities	Y2	See X4			
X26	Forming O&M organization	Y6	See X24			
X3	Accept projects without supporting	Y1	See X1			
X23	Dealing with the environment	Y6	See X24			

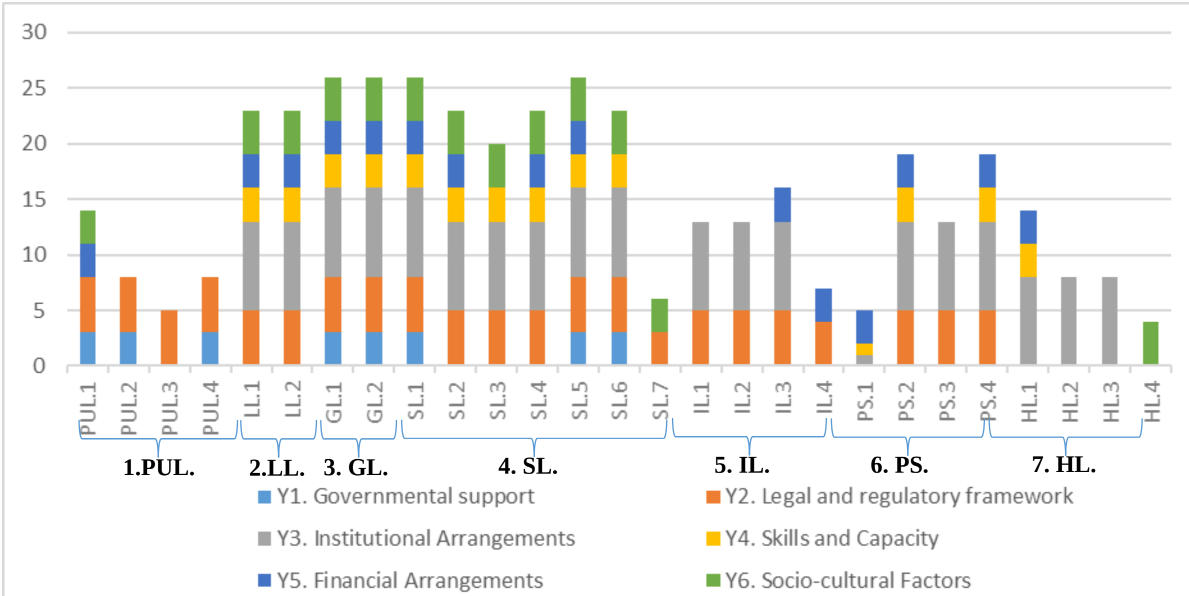

Figure 4: Stakeholder contribution percentage in the enabling environment factors

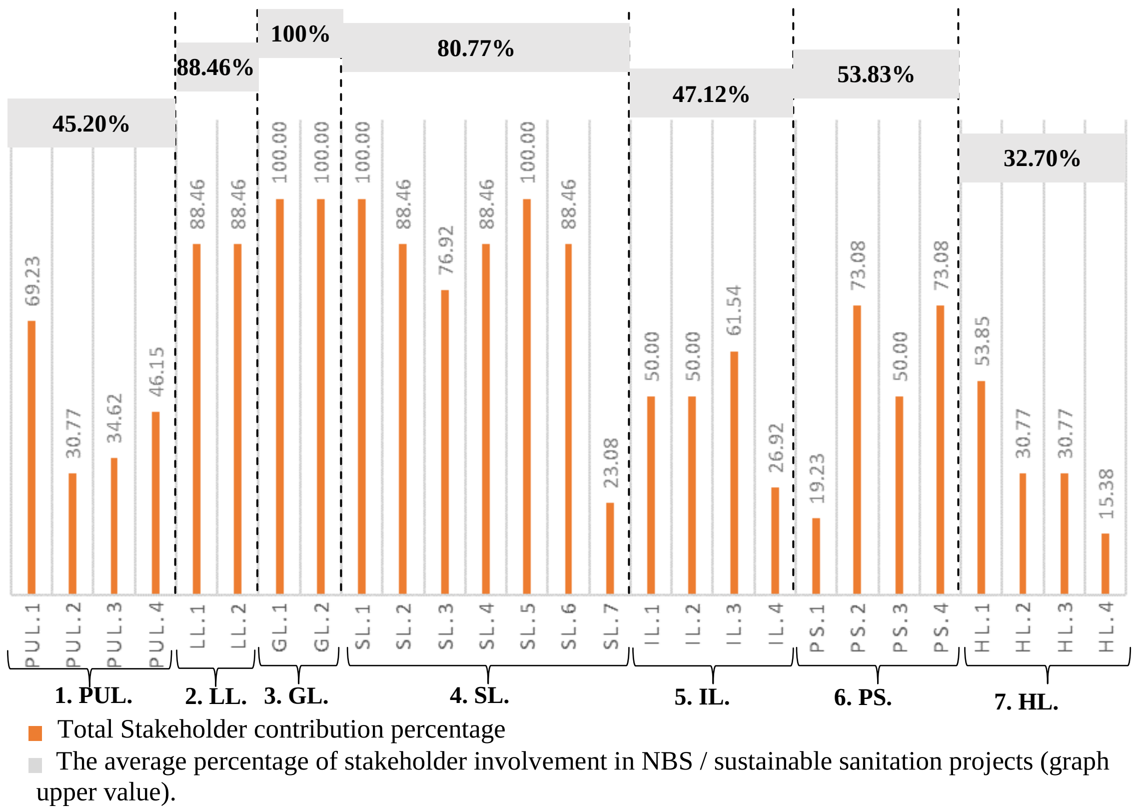

Figure 5: Average participation of each stakeholder in the overall NBS/sustainable sanitation projects

5. DISCUSSION

From the mean values in **Table A5** at Appendix Part (3), skills and capacity (Y4) were ranked as the most important factor. Two top 5 sub-factors were belonging to Y4, (understanding the processes X17, and enhancing O&M culture X18). That reflects experts' opinions about the extent of interest in understanding and proficient application of the NBS systems themselves. Financial arrangements (Y5) came in the second rank with another two of the top 5 sub-factors. It is often an impediment to the development processes, focusing on capital (X20), and the cost of operation and maintenance (X21) before considering financial return. Institutional arrangements, legal and regulatory framework, government support, and socio-cultural factors came consequently after. While it is clear from Table 11 the importance of sanitation strategy (X1), standards and codes of practice (X4) as the experts' evaluation had indicated. A clear implementation strategy for NBS and standardization are among the key aspects recommended by the various officials working on these projects. In the same context, defining roles (X9) rank reflects the necessity of applying SH analysis criteria which greatly intersected with this sub-factor. Unexpectedly, dealing with the environment came as the last importance, however with a small variation in value compared with the first values.

6. CONCLUSION

There are many challenges facing the world in the field of water scarcity and resource conservation. Releasing the burden on governments in establishing central water treatment plants that consume large amounts of energy is a crucial and necessary matter. Relying on nature in NBS systems for wastewater treatment is an emergence to achieve sustainability and maintain green infrastructure. The factors related to applying NBS systems have been classified into technical factors and providing enabling environment factors. The first one deals with the selection of the NBS model, while the second type includes a set of technical, financial, environmental, and social aspects.

Enabling environment factors were classified into six factors and 26 sub-factors, ranked according to their importance using SPSS software. A stakeholder analysis was applied. All phases of analysis are designed for NBS projects from defining stakeholders, categorization, mapping, and getting relationships. The percentage of stakeholders' contribution to the enabling environment factors has been analyzed. From the analysis of the results, the highest percentage of government participation indicates the nerveless separation between governments and infrastructure projects. They should only be directed toward achieving sustainability. Followed by close proportions of State Level and Local Level, which confirms the importance of the role of Community-Based Organizations along with ministries and official bodies. Then the role of each of the Private sector Levels with a rate of contribution exceeds 50% comes, followed by the Producer and Users Level and the International Level with close percentages as well, which should not be overlooked, as the responsibility of the household and the Irrigation Committee is a great burden in positive participation and preserving public health and saving the cost of water for irrigating.

Technical specialists and Research institutions/ Technical colleges, which are included in the list of

Hybrid levels contributed the least to achieving the enabling environment factors, due to the concentration of their contribution in the technical consideration factors in which the appropriate water treatment method is chosen.

Authors Contributions

Dr. Azza G. Haggag: conceptualization, original draft, writing - review & editing, questionnaire design.

Dr. Shaimaa H. Zaki: choose the analysis method, review and editing, questionnaire analysis.

Declaration Of Competing Interest

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APPENDIX 1

Table A1: Natural based solutions (nbs) wastewater treatment system models

Treatment System	System Description
Septic Tanks [37]	• Septic tank system is a model of sustainability, where water is treated on-site. • Treated with low technology and no additives, only solids need to be removed periodically. • Operate at a household level on-site. It is an underground built tank divided into two or more modules. Pollutants and sludge are deposited in the bottom, while purified water- by natural bacteria- is transferred to be reused mostly in irrigation, a cross-section of two module models is shown in Figure A1. • Pipes convey wastewater from each home to a tank where solids settle, and water is treated naturally after going to pipes and is released into a drain field, where soils and associated organisms filter and clean the wastewater. • Treated water moves through the soil profile to recharge the groundwater aquifer.

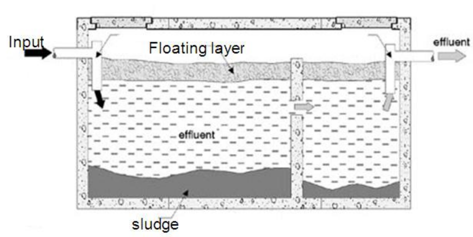


Figure A1: Septic tank with two modules - EL-Shaikh Masoud - Minya governorate [18]

Constructed Wetlands [38]	• Wetlands are one of the most productive natural ecosystems and perform many functions for both humans and wildlife. • It is a landscape feature that improves water quality and supports wildlife habitat. The artificial lake is covered with fully planted vegetation with a WW inlet and clean water outlet, cross-section shown in Figure A2. It can also be a cost-effective way to wastewater treatment.

	• Usually used for on-site treatment of stormwater, and as a component of CTP. • It depends on biological processes to treat water in an open environment. When water flows through a wetland, suspended solids trapped by vegetation settle out. Other pollutants are transformed into other forms when microorganisms remove them from the water.

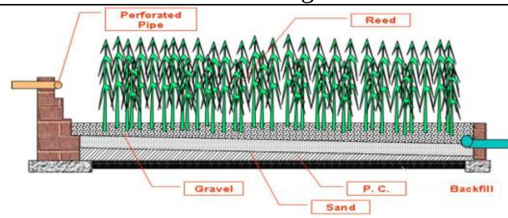
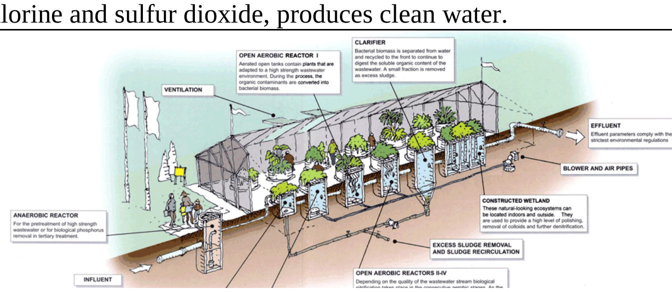


Figure A2: A constructed wetland. Last phase in the Deir Gabal El-Tair project [18]

Stabilization Ponds [39]	• Waste stabilization ponds are designed and built to reduce the organic content and remove pathogens from wastewater. • They are man-made ponds where wastewater enters on one side and exits on the other side as "effluent", after spending several days in the pond, during which natural treatment processes take place. • The system may consist of single or multiple ponds in a series as shown in Figure A3, each pond has its role in the removal of pollutants.

FigureA3: A Stabilization multiple Pond. (b) Single pond at El-Moufty El-Kobra-Kafr El Sheikh Village [19]

Table A1. (Continue)	**Natural based solutions (nbs) wastewater treatment system models.**
Living Machines [40], [41]	• It's a concept of treating wastewater utilizing biological processes and following principles of ecological systems design. • A series of cells form the basic design, as shown in Figure A4. The contents of each cell vary based on the stage in the process and the corresponding biological function needed for the filtering and cleaning of water. • Treatment is done through a series of processes (sedimentation, filtration, clarification, adsorption, nitrification and de-nitrification, volatilization, and anaerobic and aerobic decomposition). • Living Machine's processes leverage the activity of living organisms - plants, animals, and other organisms, to clean the water. • The living system takes human wastewater, and without the addition of harmful chemicals such as chlorine and sulfur dioxide, produces clean water.



FigureA4: Living machine model

Package Treatment Plants [42]	• It depends on the biological extended aeration principle in its operation, which includes the activated sludge treatment process by creating an environment with sufficient oxygen levels to allow for the bio-oxidation of wastes. • wastewater treatment system makes use of bacteria and other microorganisms to remove up to 90% of the organic matter in the wastewater. • Have many types; extended aeration plants, sequencing batch reactors (SBR), oxidation ditches, and contact stabilization plants.

	• They are prefabricated units available in varied capacities, elevated over ground level as shown in Figure A5, designed to deal with wastewater which can be duplicated easily in different areas including housing compounds, military bases, and mobile homes in remote areas.

Figure. A5. Package Treatment Plants

.

APPENDIX 2

Part (1):

Choose the extent of *Interest* and *Power* of each stakeholder from the table below by writing "L" refers to Low, or "H" refers to High.

High interested parties include stakeholders that have been affected actually or potentially by the Project and/or who could influence the project and the process of its implementation directly or indirectly. While stakeholders with high power include those who have the implementation power and influence decisions, and vice versa.

Table A2:Table model presented to questionnaire participants

		Stakeholders		Interest	Power	Quarter
1		**1. Producer and users Level**				
	1	1.1	Householders (a)	H	L	Q1
	2	1.2	Irrigation committee	H	L	Q1
	3	1.3	Living near	L	H	Q4
	4	1.4	Projects' owners	H	L	Q1
2		**2. Local Level (village, compounds)**				
	5	2.1	Local Village Unite City	H	H	Q2
	6	2.2	Community-Based Organizations	L	L	Q3
3		**3. Governorate Level**				
	7	3.1	Governorate Water and sewage	H	H	Q2
	8	3.2	Governorate administration	H	H	Q2
4		**4. State Level**				
	9	4.1	Ministries in direct relation with	H	H	Q2
	10	4.2	Ministries related to urban	L	L	Q3
	11	4.3	Ministries related to health and env.	H	H	Q2
	12	4.4	Ministries related to social	L	L	Q3
	13	4.5	Ministries of finance	H	H	Q2
	14	4.6	Water supply and sewerage	H	H	Q2
	15	4.7	Regulatory bodies	H	H	Q2
5		**5. International Level**				
	16	5.1	International development agencies	H	L	Q1
	17	5.2	International standardization	H	L	Q1
	18	5.3	Development banks	L	L	Q3
	19	5.4	Bilateral development agencies	H	L	Q1
6		**6. Private sector Level**				
	20	6.1	Small/medium-scale sanitation	L	L	Q3
	21	6.2	Intern. / national/local consulting	L	L	Q3
	22	6.3	Local finance institutions	L	L	Q3

	23	6.4	Private contractors	L	L	Q3
7		**7. Hybrid levels**				
	24	7.1	Non-profit organizations	H	L	Q1
	25	7.2	Technical specialists	H	L	Q1
	26	7.3	Research institutions/ Technical	H	L	Q1
	27	7.4	Media	L	L	Q3

Where:

Interest	**Power**	**Quarter (Q)**
High	Low	**Q1**
High	High	**Q2**
Low	Low	**Q3**
Low	High	**Q4**

Table A3: Combined results of stakeholders' categorization

	Stakeholders		**Participants classification**																			
			G.1					G.2				G.3							G.4			
	1. Producer and users Level																					
1	1.1	Householders (a)	q1	q1	q1	q2	q1	q1	q1	q1	q2	q1	q1	q3	q1	q1	q1	q1	q1	q1	q3	q1
2	1.2	Irrigation committee	q3	q1	q1	q4	q1	q1	q3	q1	q2	q1	q1	q4	q1	q4	q3	q1	q2	q1	q1	q1
3	1.3	Living near	q2	q4	q4	q4	q4	q4	q4	q4	q2	q4	q4	q4	q3	q4	q4	q4	q3	q4	q1	q4
4	1.4	Projects' owners	q1	q4	q1	q3	q1	q2	q1	q3	q4	q1	q3	q1	q1	q2	q1	q4	q3	q1	q1	q1
	2. Local Level (village,																					
5	2.1	Local Village Unite City Authority/Hall	q2	q2	q3	q1	q2	q4	q2	q2	q3	q2	q2	q3	q2	q2	q2	q4	q2	q3	q2	q2
6	2.2	Community Based Organizations	q3	q3	q3	q3	q2	q3	q2	q3	q2	q3	q3	q1	q4	q3	q3	q3	q4	q3	q1	q3
	3. Governorate Level																					
7	3.1	Governorate Water and	q2	q3	q2	q1	q2	q3	q2	q3	q2	q4	q3	q2	q4	q2	q1	q2	q3	q2	q2	q2
8	3.2	Governorate	q2	q2	q1	q4	q2	q1	q2	q2	q4	q2	q1	q4	q2	q1	q2	q2	q2	q4	q2	q2
	4. State Level																					
9	4.1	Ministries in direct relation with WW.	q2	q2	q1	q2	q1	q2	q3	q2	q4	q2	q1	q2	q4	q2	q4	q2	q3	q2	q2	q2
10	4.2	Ministries related to urban development	q1	q3	q3	q3	q4	q3	q3	q3	q3	q3	q3	q3	q3	q1	q3	q2	q3	q3	q1	q3
11	4.3	Ministries related to health and env.	q1	q2	q4	q2	q1	q2	q3	q2	q4	q2	q2	q2	q2	q4	q2	q2	q2	q2	q1	q2
12	4.4	Ministries related to social development	q3	q4	q3	q2	q3	q3	q1	q3	q2	q1	q3	q1	q3	q3	q3	q2	q3	q3	q3	q3
1	4.5	Ministries of finance	q2	q2	q1	q2	q2	q4	q2	q2	q2	q4	q2	q2	q2	q2	q2	q3	q2	q4	q2	q2
14	4.6	Water supply and sewerage authorities	q2	q2	q2	q2	q2	q4	q1	q2	q2	q4	q2	q2	q1	q2	q2	q3	q2	q4	q2	q2
1	4.7	Regulatory bodies	q2	q2	q1	q2	q2	q4	q2	q2	q2	q4	q2	q2	q2	q2	q2	q3	q2	q4	q2	q2
	5. International Level																					
16	5.1	International development agencies	q2	q1	q1	q1	q4	q1	q3	q1	q3	q1	q1	q1	q2	q1	q4	q1	q1	q2	q1	q1
17	5.2	International standardization	q1	q1	q1	q4	q1	q1	q4	q1	q1	q1	q1	q2	q1	q3	q2	q1	q3	q1	q1	q1
1	5.3	Development banks	q3	q4	q3	q2	q3	q3	q1	q3	q2	q1	q3	q1	q3	q3	q3	q2	q3	q3	q3	q3
1	5.4	Bilateral development	q4	q1	q1	q4	q1	q1	q4	q1	q4	q1	q1	q4	q1	q1	q1	q1	q1	q4	q1	q1

	6. Private sector Level																				
20	6.1	Small/medium scale sanitation enterprises	q3	q4	q3	q1	q3	q3	q2	q3	q4	q1	q3	q2	q3	q3	q3	q1	q3	q3	q3	q3
21	6.2	Intern. / national/local consulting firms	q3	q3	q3	q3	q2	q3	q4	q3	q4	q3	q3	q1	q2	q3	q3	q3	q1	q3	q2	q3
2	6.3	Local finance institutions	q4	q3	q3	q3	q1	q3	q3	q3	q3	q3	q3	q3	q3	q2	q3	q4	q3	q3	q4	q3
2	6.4	Private contractors	q3	q2	q3	q1	q3	q3	q4	q3	q4	q2	q3	q2	q3	q3	q3	q1	q3	q3	q3	q3
	7. Hybrid levels																				
2	7.1	Non-profit organizations	q1	q1	q1	q2	q1	q1	q1	q1	q2	q1	q1	q3	q1	q1	q1	q1	q1	q1	q3	q1
2	7.2	Technical specialists	q2	q1	q1	q3	q1	q1	q4	q1	q3	q1	q1	q2	q1	q4	q3	q1	q2	q1	q1	q1
26	7.3	Research institutions/ Technical colleges	q1	q2	q1	q1	q2	q1	q1	q3	q4	q1	q4	q1	q1	q4	q1	q3	q1	q1	q4	q1
2	7.4	Media	q3	q3	q3	q3	q4	q3	q1	q3	q2	q3	q3	q4	q2	q3	q3	q3	q1	q3	q3	q3

Part (2):

Please write the percentage in each cell that refers to the extent the of relation between stakeholders ranging from 0 (no relation) to 100 % (cooperation relation).

Table A4: **The mean percentages were collected from part participants responses**

	Hybrid levels	Private sector Level	International Level	State Level	Gov. Level	Local Level	Producer and users' Level
Producer and users' Level	≈ 70%	No relation	No relation	No relation	≈78%	≈98%	
Local Level	≈72%	≈69%	≈77%	No relation	≈65%		
Gov. Level	≈ 75%	≈ 32%	≈ 95%	≈65%			
State Level	≈ 60%	No relation	≈ 67%				
International Level	≈ 88%	≈ 25%					
Private sector Level	≈ 32						
Hybrid levels							

Where:

0%	No relation	34-67%	Complementary relation
1-33%	Conflict relation	68-100%	Cooperation relation

Part (3):

Table A5: Questionnaire results

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**mean**
Y1	4	4	3.6	3.3	4.3	3.3	4.3	3.6	4.3	4	3.3	4.3	4.6	3.6	3.6	4	4.3	4.3	4	4.3	3.98
X1	5	5	4	4	5	5	5	5	4	5	3	5	5	5	5	5	5	5	4	5	
X2	5	4	5	4	4	3	4	4	5	5	5	5	5	3	4	4	4	4	4	5	
X3	2	3	2	2	4	2	4	2	4	2	2	3	4	3	2	3	4	4	4	3	
Y2	4	4	4.2	4	4	4	3.4	3.8	3.6	4.4	3.8	4.4	4.2	4.6	4.2	4.2	3.6	4.4	4	4.4	4.06
X4	4	5	4	5	5	5	5	5	4	4	5	5	5	5	5	5	4	4	5	5	
X5	4	3	4	3	3	4	3	4	3	4	3	4	3	4	3	3	3	4	3	5	
X6	4	3	4	3	3	3	2	2	3	4	2	5	4	5	3	4	2	4	4	2	
X7	5	4	5	5	4	5	4	4	5	5	4	5	5	4	5	5	5	5	4	5	
X8	3	5	4	4	5	3	3	4	3	5	5	3	4	5	5	4	4	5	4	5	
Y3	4.3	3.9	4.5	3.7	4.4	3.6	4	4	4	3.9	4.3	4.5	4.5	3.8	4.9	3.6	4.3	4.5	3.5	4	4.09
X9	5	5	4	5	5	4	5	5	5	4	5	4	5	4	5	5	4	5	4	5	
X10	3	4	5	2	4	4	3	5	5	4	4	5	4	4	5	2	5	4	2	5	
X11	3	3	5	3	5	4	3	4	3	3	5	4	5	3	5	3	5	4	4	5	
X12	5	3	4	3	5	3	4	5	3	3	4	5	4	4	5	5	4	4	3	5	
X13	5	5	4	5	4	3	5	5	4	5	4	5	4	4	5	3	4	4	4	4	
X14	4	3	4	3	4	3	3	2	4	4	4	3	4	2	4	2	4	5	3	2	
X15	5	5	5	4	5	4	4	3	5	4	4	5	5	5	5	5	5	5	4	3	
X16	4	3	5	4	3	4	5	3	3	4	4	5	5	4	5	4	3	5	4	3	
Y4	4	4.3	4.3	4.33	4.7	4	4.3	3.7	4.3	4.3	4.3	5	4.3	4.3	5	4	4.7	4.7	4.3	4.3	4.37
X17	4	5	5	5	5	4	5	5	5	4	5	5	5	5	5	4	5	5	4	5	
X18	4	5	5	4	5	4	4	3	5	4	4	5	5	5	5	4	5	5	5	5	
X19	4	3	3	4	4	4	4	3	3	5	4	5	3	3	5	4	4	4	4	3	
Y5	4.3	4	4.3	4	4.3	4	4	4	4	4.3	4.3	5	4.3	5	4.7	4	4.7	4.3	4	4	4.28
X20	4	5	5	4	5	4	4	5	5	4	4	5	5	5	5	4	5	5	4	4	
X21	5	4	5	4	5	4	4	4	4	5	5	5	5	5	5	4	5	5	4	5	
X22	4	3	3	4	3	4	4	3	3	4	4	5	3	5	4	4	4	3	4	3	
Y6	3.8	3	3.3	3.8	3.5	3.8	3.8	3	3	3.5	2.8	4	3.5	4.3	3.3	4.3	3.75	4.3	3.8	3	3.55
X23	2	1	1	3	2	3	2	3	3	2	1	3	3	3	3	4	2	4	3	3	
X24	4	5	5	4	5	4	5	3	3	4	4	5	5	5	5	5	5	5	4	3	
X25	5	3	5	4	5	4	4	3	3	4	4	5	4	4	3	4	5	5	4	3	
X26	4	3	2	4	2	4	4	3	3	4	2	3	2	5	2	4	3	3	4	3	

Note: Y1, Y2, Y3, Y4, Y5, and Y6 are the values of enabling environment factors, they are the means of the entered values in the same sub-factor for each expert.

Table A6: Excel calculations for figure 4,5. (Based on Table 10)

			PUL. 1	PUL. 2	PUL. 3	PUL. 4	LL. 1	LL. 2	GL. 1	GL. 2	SL. 1	SL. 2	SL. 3	SL. 4	SL. 5	SL. 6	SL. 7	IL. 1	IL. 2	IL. 3	IL. 4	PS. 1	PS. 2	PS. 3	S.4	HL. 1	HL. 2	HL. 3	HL. 4
3	Y1	X1	1	1		1			1	1	1				1	1													
		X2	1	1		1			1	1	1				1	1													
		X3	1	1		1			1	1	1				1	1													
5	Y2	X4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1				
		X5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1				
		X6	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1		1	1	1				
		X7	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1		1	1	1				
		X8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1	1	1				
8	Y3	X9					1	1	1	1	1	1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	
		X10					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X11					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X12					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X13					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X14					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X15					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
		X16					1	1	1	1	1	1	1	1	1	1		1	1	1			1	1	1	1	1	1	
3	Y4	X17	1				1	1	1	1	1	1	1	1	1	1						1	1		1	1			
		X18	1				1	1	1	1	1	1	1	1	1	1							1		1	1			
		X19	1				1	1	1	1	1	1	1	1	1	1							1		1	1			
3	Y5	X20	1				1	1	1	1	1	1		1	1					1	1	1	1		1	1			
		X21	1				1	1	1	1	1	1		1	1					1	1	1	1		1	1			
		X22	1				1	1	1	1	1	1		1	1					1	1	1	1		1	1			
4	Y6	X23	1		1	1	1	1	1	1	1	1	1	1	1	1													1
		X24	1		1	1	1	1	1	1	1	1	1	1	1	1	1												1
		X25	1		1	1	1	1	1	1	1	1	1	1	1	1	1												1
		X26	1		1	1	1	1	1	1	1	1	1	1	1	1	1												1
26		Sum	16	8	7	10	21	21	24	24	24	21	18	21	24	21	4	18.1	13	16	7	5	19	13	25.4	14	8	8	2
		%	69.2	30.77	34.61	46.15	88.46	88.46	100	100	100	88.46	76.92	88.46	100	88.46	23.07	50	50	61.53	26.92	19.23	73.07	50	73.07	53.84	30.76	30.76	15.38