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An investigation of the key Challenges and Resolutions for Sustainable Groundwater Management in Paktika, Afghanistan

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ABSTRACT

If Afghanistan's current environmental problems are not addressed, the consequences could include severe water scarcity in some areas, which could threaten livelihoods, create environmental refugees, exacerbate adverse humanitarian conditions, and increase regional tensions. Therefore, the study was conducted in Sharana, the center of Paktika province, and was attended by 45 farmers. The goal of the research was to determine the major threats to Sharana's groundwater resources. For this study, questionnaires and field observations were chosen as techniques. according to the study's findings that drought, increased use of solar-powered submersibles, a lack of water management plan, a lack of regulations related to groundwater exploitations, and extensive use of underground water for irrigation due to farmers' lack of awareness and traditional irrigation systems are among the key challenges threatening groundwater in Paktika. Because the groundwater level has dropped, it is not unlikely that this situation may turn into a disaster if it continues. The primary components that can contribute to the sustainability of groundwater resources management in Paktika city are raising public knowledge about water resources management, switching to smart irrigation techniques, and adopting an integrated water resources management framework.

KEYWORDS

groundwater resources; solar-powered submersibles; sustainability

INTRODUCTION

Afghanistan was surrounded by land and covered 652,000 square kilometers. In Afghanistan, agriculture consumes more than 93 percent of the total water and barely 20 bcm of the country's entire potential water (Habib, 2014). Afghanistan has a generally dry continental climate. The volume, timing, and distribution of precipitation all play a role in the availability of irrigation water. During the winter, about 80% of precipitation falls as snow in areas where the height is greater than 2,500 meters above sea level. The cultivable land of Afghanistan is estimated to be 7.7 million ha or around 12% of the country's total area. In Afghanistan, informal irrigation systems account for 90% of irrigated areas and virtually all (99%) of the country's irrigation systems. Snowmelt in the spring and early summer is a major source of surface water. Karez, spring-fed, and well-fed irrigation systems are all classified as groundwater systems. Groundwater development has significantly increased to fulfill both irrigation and expanding domestic water demand. Afghanistan has implemented modern well-drilling and pumping technology(Rout, 2008). Large irrigation schemes established with central state assistance, financing, management, operation, maintenance, and outside technical and economic support are termed formal systems. These systems, which were first installed in the late 1940s and early 1970s, were made to fulfill water needs and solve distribution constraints that informal practices couldn't handle. However, because of a lack of funding and capacity, the effectiveness of these systems has declined during the last 30 years. So, since the larger part of formal frameworks are right now unused, the worldwide community has propelled a arrangement of activities to assist them restore over the final decade. In spite of the fact that the 10 formal frameworks are spread all through the nation, they advantage as it were 10% of watered arrive in Afghanistan, covering around 332,000 ha. Surface water, which includes diversion structures, tiny dams, and water harvesting, has been used in informal irrigation systems, along with groundwater extracted via wells, springs, and karez. Water for livestock and domestic purposes is also supplied through informal irrigation systems (Gonzalez, 2012). The sad reality is that the environment in Afghanistan in its current state has adversely affected the livelihoods of generations. It adversely affects the health of Afghan people. It perpetuates the cycle of poverty in which many Afghans are trapped and hinders Afghanistan's post-conflict reconstruction and development. Failure to address Afghanistan's current environmental challenges could lead to severe water shortages in some regions, threatening livelihoods, creating environmental refugees, exacerbating the adverse humanitarian situation and increasing regional tensions (NEPA, 2007). Agriculture, on the other hand, may be a critical sector that helps to meet the expanding global population's food needs while also boosting the economies of different countries across the globe. Agricultural techniques must take both ecological and environmental limits into account. They must, in particular, limit rapid land degradation while ensuring that water resources are conserved optimally and cleanly (Saad et al., 2020). As a result, understanding the major threats to groundwater is critical for some regulations and water management plans. The goal of the study is to identify the key threats to groundwater sources in Paktika, Afghanistan. The goal of this study is to find out what the major threats to groundwater in Paktika are. What kinds of actions are needed for long-term groundwater management?

RESEARCH METHODS

Paktika province's latitude and longitude are respectively 31.59- and 33.42-degrees latitude and 67.81- and 69.54-degrees longitude. The province covers 36360 km2 and has a 360 km2 boundary with Pakistan, which is 210 kilometers from Kabul (Fig. 1). According to the Afghan organizational division's political and socioeconomic divides, Paktika is a third-class province. It contains eight districts in addition to the capital. It has a total population of 434742 people, with Pashtuns accounting for the large majority of the population, which is separated into many tribes speaking Pashto (Mazloom Yar 2016).

Figure 1. Paktika Province Map

Data Collection and Research Instrument

The information was gathered from both primary and secondary sources. Field observation is a primary data source, and a survey instrument consisting of one set of questions was constructed and delivered to target respondents to collect information that would subsequently be used for further investigation to discover the significant concerns threatening groundwater. The data acquired through the questionnaires were descriptively analyzed, and the results of the analysis were used to support the study's desired outcomes. The surveys were written in Pashto, Afghanistan's national language so that respondents could better understand and answer the questions. Books, journals, papers, and conference proceedings were used to gather secondary data. Closed-ended questions were included in the questionnaire, which was handed to 45 farmers in Paktika, Sharana's central city. The reason that the questionnaire was reliable and consistent, every survey respondent answered the same questions. A detailed field survey was done to gather information regarding present irrigation conditions among local inhabitants. SPSS 24 is used to examine the results descriptively. Frequency and Percentage were chosen as the research analysis approach since it is the best and most appropriate way for examining question papers.

RESULTS AND DISCUSSION

The questionnaire utilized in this study includes questions regarding participants' general information, crop types, agricultural water resources, deep bore wells, power sources, irrigation system types, groundwater management issues, and more. The results of the questionnaire are presented in Table 1 below.

Table 1. The results of the questionnaire

Questions	**Parameters**	**Survey responses participants**	
		Frequency	***Percentage***
Respondents Gender	Male	45	100.0
	Female	0.00	0.00
	Total	45	100.0
Crop types	Wheat	30	66.7
	Vegetables	4	8.9
	Maize	4	8.9
	All of them	5	11.1
	No answer	2	4.4
	Total	45	100.00
Graden type	Apples	27	27
	Apricots	0.00	0.00
	Grapes	0.00	0.00
	Peach	0.00	0.00
	All of them	6	13.3
	Do not have	12	26.3
	Total	45	100.0
Water resources for agriculture	Borewells	45	100.0
	Karez	0.00	0.00
	Spring	0.00	0.00
	Wastewater	0.00	0.00
	Total	45	100.0
Deep of bore Wells	15-30	7	15.6
	31-50	28	62.2
	51-80	9	20.0
	No answer	1	2.2
	Total	45	100.0

Power source	Generator Solar panel Both Total	15 29 1 45	33.3 64.4 2.2 100.0
Power system cost	50000-100000 Afg (1$=88Afg) 100000-200000 Afg 200000-300000 Afg Total	20 14 11 45	44.4 31.1 24.4 100.0
Types of Irrigation systems	Flooding Pond Dropping Sprinklers No answer Total	41 3 0.00 0.00 1 45	91.1 6.7 0.00 0.00 2.2 100.0
The groundwater management plan	Yes No Total	0.00 45 45	0.00 100.0 100.0
Groundwater management challenges	Lack of plan Lack of regulations Traditional irrigation systems Lack of farmer awareness related to water importance All of them Total	18 2 9 11 5 45	40.0 4.4 20.0 24.4 11.1 100.0
Decrease in the level of groundwater	Yes No Total	39 6 45	86.7 13.3 100.0
Factors of groundwater decrease	Increase of private Drilling wells Drought much use of underground water Traditional irrigation systems All of them No answer Total	9 19 4 6 6 1 45	20.0 42.2 8.9 13.3 13.3 2.2 100.0

The Current Conditions of Groundwater Management in Paktika

People in all parts of Sharana, Paktika's capital, use groundwater for drinking and farming, according to the findings of the study. Paktika residents extract groundwater for drinking and irrigation using hand pumps and submersible pumps. Paktika residents typically use two types of submersibles, one powered by a generator and the other by solar energy. Solar submersibles are becoming more common by the day, posing a major threat to groundwater. This is because there is no rule prohibiting the exploitation of groundwater, and farmers consume excessive amounts of water due to a need of open mindfulness and advanced irrigation methods. In most locations, over-exploitation of groundwater has resulted in a drop in the water table. Due to the prevalence of solar-powered submersibles, several water wells in Paktika province have dried up

Figure 2. The Current Conditions of Groundwater Management in Paktika

Figure (2): a- Generator powered submersible, b- Solar-powered submersible, c- Traditional irrigation Drought, the increased use of solar-powered submersibles, the lack of a water management plan, the lack of a law related to groundwater exploitations, and the extensive use of underground water for irrigation due to farmers' lack of awareness and traditional irrigation systems are among the key challenges that threaten groundwater sources in Paktika, as shown in table (1). Rainfall variability, groundwater removal during the rainy season for irrigating crops, increased withdrawals owing to construction, and extraction from deeper confined aquifers through bore wells are all factors for dropping groundwater levels in unconfined aquifers (Maggirwar & Umrikar, 2011). Groundwater is vital for preserving the global ecosystem and supporting society's needs for drinking water and food production in the absence of adequate surface water supply from streams and stores. Groundwater request is quick rising in pair with populace development, whereas climate alter is putting additional strain on water assets and expanding the probability of serious dry season (Wu et al., 2020). Building dams to retain rainwater, sewage water treatment, and monitoring water mains for damage or leaks are all strategies that assist preserve and protecting water sources. Switching to smart irrigation techniques instead of traditional irrigation techniques can assist farmers to avoid water waste during irrigation (Saad et al., 2020). The development and implementation of automation in the agricultural sector is an essential additional aspect of the efficient use of irrigation water, allowing for savings of up to 15-20% in irrigation rates. In addition, micro-and macro-sprinkling irrigation systems have been established in recent decades. Sprinklers for under-crown irrigation of plantations and orchards, which replaced inefficient overirrigation, are among them. Micro-sprinklers are also widely used to cultivate vegetables in tiny farming areas, achieving a high irrigation uniformity coefficient. It is no longer debatable that drip irrigation saves more water than alternative irrigation methods. Drip irrigation is thought to be more efficient than 90% of the time (MINISTRY OF AGRICULTURE AND MELIORATION OF THE KYRGYZ REPUBLIC, 2015). All parties must pay attention to commit to, and dedicate themselves to the long-term management of the water resources. The function of education in the long-term management of the aquatic environment is critical (Jayawardena, 2012).

In the management of environmental resources, public awareness is extremely crucial. This is because ready to energize the common open to connect in common asset preservation and natural security efforts by raising public awareness and providing access to information. For fostering communication and public awareness, a range of instruments are available, including mass media, traditional media, wall-writing, school programs, and outdoor education initiatives (Rahmani, Wafa, & Mazloum Yar, 2021). There is a great deal of ongoing debate about whether integrated water resources management can address these challenges. Integrated water resources management can be defined as a sustainable development process that systematically allocates and monitors the use of water resources according to social, economic, and environmental objectives. Different user groups (farmers, communities, environmentalists, and others) can influence water resource development and management strategies. This provides additional benefits, as informed users can more effectively enforce local selfregulatory regulations regarding issues such as water conservation and watershed protection. much more than central regulation and supervision can. The lack of regulations regarding groundwater management is another major challenge in Afghanistan. Jaspers (2003) characterizes water administration as "the social capacity to reliably mobilize water assets to attain maintainable improvement". Jaspers focuses out that the degree of water administration in any society is decided by components such as the presence of agreement, the degree of agreement and compliance, and the accessibility of a administration framework inside a economical system for the execution and monitoring of these policies (Dijk., et al 2015).

CONCLUSION

People use groundwater for drinking and cultivation in all parts of Sharana, Paktika's capital. Paktika residents extract groundwater for drinking and irrigation using hand pumps and submersible pumps. Residents typically use two types of submersibles, one powered by a generator and the other by solar energy. Drought, the rise of solar-powered submersibles, the lack of a water management plan, the lack of a law governing groundwater exploitations, and the widespread use of groundwater for irrigation due to a lack of farmer awareness and traditional irrigation systems are the main threats to groundwater sources in Paktika. Building dams to retain rainwater, sewage water treatment, and monitoring water mains for damage or leaks are all strategies that assist preserve and protecting water sources. Sustainable management of water resources needs the attention, commitment, and dedication of all stakeholders. Public awareness plays an important role in the sustainable management of water resources.

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