ENHANCING CLIMATE RESILIENCE THROUGH COST-EFFECTIVENESS AND VALUE-FOR-MONEY (VFM) APPROACHES IN THE IMPLEMENTATION OF EARTHEN GABION WALL/PROTECTION BUND IN GILGIT-BALTISTAN

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ABSTRACT

This research evaluates the cost-effectiveness and Value for Money (VFM) through earthen gabion wall/protection bund in the Kharko Valley, Gilgit-Baltistan to enhance climate resilience. Conducted under WWF's "Water Resource Accountability in Pakistan" (WRAP) project, with support from the UK Government's FCDO, the study promotes Nature-based Solutions (NbS) for improved water security and Integrated Water Resource Management. Analysis confirms that the gabion bund intervention not only met its objectives but provide effective and economical, supporting climate resilience and sustainable water management through low-cost, community-driven efforts. Notwithstanding this, the research found several critical limitations, including the requirement for trained personnel, necessity for regular maintenance, difficulty in acquisition of materials in remote locations, short-term environmental disruption during construction, and low incentives and poor awareness resulting in low degrees of participation among the community. In view of these limitations, the intervention is a cost-effective, effective, and inclusive solution. The research suggests that in order to maximize its effectiveness, it is imperative to involve the community throughout the course of the project, develop local labor, reinforce bunding with other basin management techniques, prioritize vulnerable sections of the community, and use simple tools to monitor the effectiveness of erosion control, water retention, and livelihood enhancement.

Key words: *VFM Analysis, Cost effectiveness 4Es, Gabion bund WRAP intervention, NbS*

INTRODUCTION

Pakistan stands at the top of the Global Climate Risk Index (Adil, L. et al., 2025), highlighting its high exposure to the extreme effects of climate change. The geographical location of the country and varied climatic conditions make it vulnerable to numerous natural hazards, placing it amongst the world's most disaster-prone nations. Located in an active seismological region, Pakistan is extremely vulnerable to earthquakes, especially along the northern and western edges—a risk brutally emphasized by the devastating 2005 earthquake. Aside from seismic risks, Pakistan confronts periodic terror from its monsoon season, which normally runs from June to September. They tend to bring on riverine floods, flash floods, and urban flooding in different parts of the country, inflicting extensive damage on infrastructure like roads, bridges, and buildings. The monsoon season of 2022, for example, caused extensive damage, displacing people and resulting in mass loss of lives. Apart from floods and earthquakes, droughts continue to pose a chronic danger, especially to Pakistan's agriculture and the country's water resources, weakening food and water security even further (GoP, 2022).

The last decade has seen heatwaves in Pakistan become more and more frequent and severe, posing severe threats to human health and agriculture. The synergy of prolonged heat exposure, high temperatures, and high humidity poses particular risks to susceptible populations like children, the elderly, and people with underlying medical conditions. Furthermore, Extreme heat waves have the potential to significantly interfere with agricultural systems and lead to crop loss, reduced yields, and interference with cattle production. All these disruptions erode not only food security but also cause economic loss, particularly for agricultural-dependent communities. There are large-scale effects of both natural disasters caused by climate change and others. They erode livelihood, destroy critical infrastructure, add pressure to healthcare services, and exacerbate already-exposed socioeconomic challenges. Most hit are most often disadvantaged groups like women, children, the elderly, and marginalized communities. These are less able to deal with fewer resources and restricted access to support systems, thereby exacerbating social and economic inequalities. Secondarily, excessive heat over the long term can destroy crops, lower farm yields, and destabilize animal husbandry, thereby leading to food shortages and economic losses. These weather and climate phenomena have socioeconomic repercussions that reach far. In addition to destroying basic infrastructure, overburdening health facilities, and destabilizing livelihoods, these disasters also raise poverty and inequality levels. These disasters disproportionately impact vulnerable groups such as women, children, elderly people, and poor comm, hence raising the already high socioeconomic inequalities.

Climate and natural disaster-wise, there are also challenges and vulnerabilities on the part of Gilgit Baltistan. It is particularly vulnerable to destruction when hit by monsoons. The tough terrain and desert climate aggravate the effect of heavy rainfall, resulting in riverine flooding in the lowlands and flash floods in the mountains. In addition to the immediate destruction, these floods have long-term effects such as damage to crops, interference with livelihood, and the breakout of water-related diseases. Another common problem that negatively affects water resources and farm production is drought. Long-term dry spells have led to food insecurity since most of the province's population relies heavily on agriculture.

An effective intervention to counter the exposure of Gilgit Baltistan to climate change needs to be an integrated one. It is essential to empower local communities with capacity and expertise to recognize and act upon risks, improve early warning systems, increase infrastructure resilience, and strengthen effective interagency coordination among the concerned parties. Moreover, funding for disaster risk reduction, climate change adaptation, and sustainable water and land management is crucial to reduce the impact of disasters and improve resilience. These measures also recommended by the Post Disaster Needs Assessment 2022 (PDNA) assist to achieve inclusive, people-centered, climate-resilient recovery from the impacts of the floods of 2022. The PDNA emphasizes the requirement of robust risk education programs aimed at community awareness and knowledge about potential risks and risk reduction methods and the requirement of resilience of infrastructure through the use of disaster-resistant construction practices, retrofitting of existing infrastructure, and integration of climate change adaptation into infrastructure planning.

On the basis of evidence from field observations, community feedback, government line departments, and other stakeholders, and lessons learned from the roll-out of past FCDO programmes, the application of gabion bunds in building climate resilience has been identified as a viable option. Gabion bunds have specific benefits in climate situations for a number of reasons. For starters, the shipping process is kept low because gabion parts are packed smartly and in a compact manner. Second, putting the mesh nets together does not necessitate professional labor, and hence, the cost of labor is kept low. Transportation of the filling material can usually be done from local quarries, and this saves on transportation costs. Gabion structures have low maintenance needs, so they are an economic choice in the long run. Environmentally, gabion bunds are very compatible with the surrounding environment. The interstices between the gabion stones provide an appropriate environment for vegetation to thrive in the long term, thus promoting ecological integration. Furthermore, gabions are strong and resilient against natural conditions, thus further promoting compatibility for climate adaptation measures.

This research study was conducted as part of the Water Resource Accountability in Pakistan (WRAP) Project, which is all about the development of Earthen and Gabion Check Wire and Protection Bunds in Kharkoo Village, within the Gilgit-Baltistan region. The WRAP Project, jointly funded by £10 million, is implemented by WWF Pakistan with assistance from the UK Government's Foreign, Commonwealth & Development Office (FCDO). The project is aimed at supporting enhanced initiatives towards improving Integrated Water Resources Management and water security in Pakistan. The project supports the demonstration and adoption of Nature-based Solutions (NbS), such as Ecosystem-based Adaptation (EbA) practices, to enhance water governance and enhance resilience of communities against climate change. These interventions are piloted in pilot locations in Gilgit-Baltistan (GB) and Khyber Pakhtunkhwa (KP), with the vision of empowering the government and concerned stakeholders to upscale these solutions in the country as a whole (FCDO, 2023). The area of research was Kharkoo village, situated in the Daghoni sub-division on the right bank of the Shyok River, between the villages of Daghoni and Saling in District Ghanche, approximately 90 kilometres from Skardu. The village consists of 12 hamlets, with a population of 7,661 people spread across 905 households, averaging 8.4 persons per household (PBS, 2023). Approximately 90% of the village structures are Kacha—built with mud and stone. Due to the region's cold climate, houses are typically two-storied, with the ground floor used for livestock and grain storage, and families residing on the upper floor. The area is highly prone to floods, followed by river erosion and flash floods. Notably, floods from the Garbong Nullah in 2010 and August 2020 caused significant damage: 71 houses and 5 acres of agricultural land were completely destroyed, 160 houses were partially damaged, and 6 cows along with 5,000 to 7,000 trees were lost. The Shyok River has eroded substantial tracts of farmland, and at times, flash floods and landslides have damaged both residential areas and croplands.

Riverbank erosion caused by the Shyok River presents a serious threat to both productive farmland and water quality. The loss of topsoil from erosion has significantly reduced soil fertility and damaged agricultural land. According to local residents, a substantial portion of their farmland has been lost to river erosion.

The primary objective of this research is to assess the cost effectiveness and Value for Money (VfM) of the Gabion-bund intervention using the Four Es framework: Economy, Efficiency, Effectiveness, and Equity. The study aims to generate evidence-based recommendations to guide the prioritization of climate adaptation measures that deliver the greatest return on investment and impact. By doing so, it supports the effective allocation of resources toward enhancing climate resilience and promoting sustainable development. Value for Money (VFM) is a methodical process that guarantees equitable and fair distribution of benefits during the project implementation by considering economy, efficiency and effectiveness. One may characterise VFM as follows:

- Economy — cutting the input costs.
- Efficiency — reaching the best input conversion into output rate.
- Effectiveness— getting the best outcome given the degree of expenditure.
- Equity — How closely aid programs follow "leaving no one behind" to target the poorest and most underprivileged? Higher impact does not indicate that an intervention reaches the lowest cost and biggest number of individuals. The crucial questions are whether we get to people most in need of help and if that help is given in the most inexpensive, efficient, and effective manner.
- Cost effectiveness — reaching the desired impact or the ultimate result of a program overall aim.

2 Approach and Methods: Data Gathering and VFM Modeling

As previously mentioned, Value for Money (VFM) is a systematic approach that incorporates the principles of economy, efficiency, and effectiveness, while also ensuring that project benefits are distributed fairly and equitably during implementation. The VFM analysis of the WRAP project employed a structured and comprehensive framework to assess these dimensions. This multi-dimensional evaluation included data collection, calculation of total costs and benefits, cost-benefit analysis, and a detailed assessment of the four key VFM components: Economy, Efficiency, Effectiveness, and Equity (DFID, 2015; Jakupec & Kelly, 2016).

As part of the sensitivity analysis, the quantitative model applied a base case discount rate of 8.66 percent, with high and low scenarios using rates of 15 percent and 5 percent, respectively. The analysis assumed initial sustainability, with undiscounted costs projected over a 25-year period and benefits modeled to flow linearly throughout this timeframe.

Data collection on the implementation of the Gabion Bund for the VFM Analysis was meticulously carried out from WRAP, Site Office Skardu. The supporting data was documented as the Means of Verification (MOVs) which was followed by secondary data.

i. Each crop's vulnerability to flooding along with the depth, duration, timing of flooding, farm costs and farm-gate values all have to be factored in estimating damages to standing crops during inundation against design flood. The estimate of potential yield loss is based upon predicted on the economic farm-gate gross income minus on-farm expenses that would have been incurred had there been a flood occurring later. The cumulative estimation of monthly crop losses per hectare of the Culturable Command Area (CCA) is computed depending on the impacts of flooding to each crop relative to the cropping pattern, month of flooding, and probability of flood occurrence per month. Estimating non-crop direct damages from erosion or flooding becomes simpler due to the concentration of residential, road, and railroad infrastructure within the project's covered area on a unit area basis. Flood damage factors for housing and other infrastructure are estimated taking into account the population density and structure as well as the unit cost of replacement for each region.

ii. The World Bank database was painstakingly accessed to derive economic data, such as discount rates, GDP deflator, and inflation rates, which are fundamental for financial assessments, thereby guaranteeing the use of current and reliable information.

iii. The discount rate applied in the calculation of financial indicators is of paramount importance, as it directly influences the present value of future cash flows. As a key evaluative metric, a social discount rate is calculated for the projects which must be managed for their socio-economic returns – much like WRAP. Such discount figures include space for opportunity cost of investing the money elsewhere, market-based factors of showing real – world benefits of managing cost of capital and estimating the return on savings, and simplicity of application. These calculations are also mirrored in our sensitivity testing, where both the sensitivity tests are based on the measure of average of lending and deposit rates. In this analysis, a discount rate of 8.66 % was utilized. This rate was derived from authoritative sources, specifically the World Bank and the State Bank of Pakistan's macroeconomic data repository.

iv. The State Bank of Pakistan's online database was accessed in order to retrieve currency exchange rates, which are a financially important aspect of calculations. This helped ensure all the conversions were correct between Pakistani Rupees, Great Britain Pounds, and US Dollars. This extensive data procuring process ensured the WRAP project analyses and appraisals were grounded on credible, accurate, and current information, thereby providing a solid foundation for the subsequent analyses and decision-making processes.

VFM analysis was also performed with the VFM software. This model is a structured and sequential method of undertaking a VFM appraisal. This tool adopts the full set of VFM criteria, Theory of Change (ToC), and evaluation methods to encourage a comprehensive approach.

2.1 Gabion Wall lifespan decision for quantitative analysis

A gabion bund is a wire mesh cage containing materials like stones, boulders, rocks, or sand/soil. Gabions are primarily installed to stabilize and shield riverbeds, riverbanks, and slopes from erosion. Gabion stepped weirs are frequently utilized for river training and flood control schemes because their tiered configuration promotes the dissipation of energy in flowing water. The stones' interlocking arrangement within the mesh ensures internal structural stability, and their weight—along with natural vegetation cover growth—resists hydraulic forces. The gabion wall is projected to have a lifespan of approximately 25 years, provided it receives regular maintenance and necessary technological upgrades.

3. Cost effectiveness Analysis

The Gabion bund at Kharko was constructed in two phases: the first phase was completed in 2023, followed by the second in 2024. The total expenditure was PKR 11,031,264 (11.031 million) i.e 32445 £ having exchange rate of 340, with the breakdown as follows: -

Table 1: Total Cost of Gabion bund

S#	Description	Unit	Number	Rate	Amount (PKR)
	Phase-I				
A	**LABOUR**				
1	Skilled	Person	40	2500	100,000
2	Semi-Skilled	Person	15	2000	30,000
3	Sledge Hammar Expert	Person	12	1800	21,600
4	Unskilled	Person	30	1200	36,000
	Total (A)				**187,600**
B	**MATERIAL**				
	a-Non-Local Material				
1	G I wire hot dip (#8) double galvanized)	Sft	5000	69	345,000
2	Geo Textile Membrane	Sft	190	70	13,300
3	Binding Wire	Kg	50	390	19,500
4	LLDPE lateral Pipe for drip (16mm)	Rft	500	55	27,500
	b-Local Material				
1	Stone	Cft	5100	50	255,000
2	Boulder	Cft	3000	40	120,000
3	Gravel filling	Load	22	1200	26,400
4	Tools & implement cost	Set	1	12000	12,000
5	Willow Tree Mesh	Sft	180	55	9,900
6	Plantation on top	Set	1	30000	30,000
	Total (B)				**858,600**
	Grand Total (A+B) for one unit-50 ft at Tapari				**1,046,200**
	Total cost for 3 Bunds (6-unit 50 ft)				**6,277,200**
	Phase-II				
C	**LABOUR**				
1	**Skilled**	Person	55	1800	**98,182**
2	**Unskilled**	Person	22	1000	**21,951**
	Total (A)				**120,133**
D	**MATERIAL**				
	a-Non-Local Material				
1	**G I wire hot dip (#8) double galvanized)**	Kg	4700	55	**258,500**
2	**Geo Textile Membrane**	Sft	175	15	**2,625**
	b-Local Material				
1	**Stone**	Cft	3600	35	**126,000**
2	**Boulder**	Cft	2000	30	**60,000**
3	**Tools & implement cost**	Set	1	12000	**12,000**
4	**Plantation on top**	Set	1	15000	**15,000**
	Total (B)				**474,125**
	Grand Total (C+D) for 1 Unit-50 feet				**594,258**
	Total Cost for 2 Bunds (8 Unit of 50 feet)				**4,754,064**
	Total Cost (A+B+C+D)				**11,031,264**
	Cost in £				**32,445**

Source: Derived from WRAP-BOQ

3.2 Implementation Costs

Implementation costs, on the other hand, encompassed a broader spectrum of expenditures incurred during the activity execution. This category encompassed expenses such as project operational costs, and other material cost, see Table 2. To ensure a comprehensive evaluation, the methodology considered the anticipated project duration of 25 years lifespan of most of the Green Infrastructure interventions. Accordingly, Operation and Management (O&M) costs were estimated at 4% of the intervention's total cost per year, distributed over the project's expected lifespan.

Table 2: Implementation Cost

S#	Implementation Cost	Cost £
1	Operational Cost	1200
2	Other cost	98
	Total Cost	1298

Source: Author's own calculations.

3.3 Total Benefit calculations

The assessment of total benefits within the VFM analysis involved a multi-faceted approach that aimed to provide a comprehensive understanding of the expected gains from the intervention. The primary data source for benefit calculation was derived from that total benefit and nature of such benefit. It is crucial to estimate the economic benefits of the protection provided by the proposed works in the economic evaluation of any intervention for flood control. The principal benefits of a flood protection wall/gabion bund are quantified by the quantity of flood losses that are anticipated to be averted or reduced as a result of the intervention. Flood benefits/damages are classified as either direct or indirect in terms of their physical aspects. Contact with floodwater can result in direct damages, which may be caused by sediment deposition, wash-out by erosion, and drenching. The development of flood damaging factors and flood-prone regions that are to be inundated, eroded, and reclaimed for proposed projects has allowed for the calculation of direct and indirect main benefits under pre-project and post-project conditions.

Factors Contributing to Flood Damage

It is a parameter that is expressed in rupees per hectare inundated and represents the direct losses per unit area from river spill/river erosion and reclamation of eroded land. The primary types of direct damages are those that are caused by the contact of flood water with crops, private housing, infrastructure, and other facilities. Flooding induces indirect damages, as opposed to those resulting from floodwater contact, such as the termination of irrigation supplies in downstream regions, which results in the loss of irrigation facilities.

The depth, duration, and time of flooding, the flood susceptibility of each crop, the farm cost, and farm-gate prices have all been taken into account when estimating the flood damage to standing crops during inundation against design flood. The anticipated monthly economic value of potential yield loss is calculated by subtracting the on-farm cost that would have been incurred post-flood event from the expected economic farm-gate gross revenue. The estimated total value of monthly crop losses per hectare of Culturable Command Area (CCA) is determined by combining the effects on each crop in relation to the month of flooding and cropping pattern with the monthly probability of flood occurrence to determine the crop losses per hectare of flooded area.

The analytical procedure that considers the cropping pattern, yield level, farm cost, farm-gate prices, and cropping intensity is the foundation of the crop factor due to river erosion. In order to determine the net potential of flood losses for Kharif and Rabi crops, the gross margin per hectare is estimated. The crop losses per hectare resulting from river erosion are calculated by combining these losses with the cultivation pattern of the specific problem area. The crop factor for reclaimed land is determined by taking into account the cropping and production level that is similar to that of the surrounding region and that may be attained during the following ten index years after the project works have been completed.

- The major portion of housing, road, and railway infrastructure within the project's protected area is used to calculate estimates of non-crop direct damages due to inundation/erosion on a unit area basis. The composition, density, and unit cost of replacement in each area are used to estimate the flood damage factors for houses and infrastructure.
- Other direct inundation/erosion elements, including damages to irrigation facilities, water supply, electrical networks, and telecommunication, are estimated using a 1:1.2 crop/housing/road and rail to total direct damages ratio. Indirect inundation/erosion damages, caused by the interruption of economic and physical linkage on or near the flood plain, are estimated to be 10% of total direct damages. Table-3 presents the estimated flood damage factors for Pakistan (Four Provinces and Gilgit-Baltistan) in terms of inundation and erosion of the land.

Table 3: Flood Damage Factor

Province	Crops	Private Housing	Infrastructure	Other Direct Damages	Indirect Damage	Composite-Factor
Inundation Factors	Rupees per Hectare					
Khyber Pakhtunkhwa	9,522	23,717	3,002	7,248	4,349	**47,838**
GB	24,905	30,140	13,991	12,794	7,677	**89,508**
Punjab	31,149	57,343	6,355	18,969	1,382	**125,198**
Baluchistan	65,684	21,639	4,759	18,416	1,050	**121,548**
Sindh	38,278	26,480	8,545	14,661	8,796	**96,760**
Weighted average for Pakistan	**37,361**	**33,368**	**5,853**	**15,317**	**9,190**	**101,089**

Source: Pakistan Federal Flood Commission (2017) Economic Evaluation of Schemes Proposed Under FPSP-III of NFPP-IV

3.4 Financial Metrics and Sensitivity Analysis

The primary objective of the Cost Benefit Analysis (CBA) was to evaluate the economic viability and financial attractiveness of the project. For this purpose, a set of financial indicators was computed, such as the Net Present Value (NPV), Economic Internal Rate of Return (EIRR), and Benefit Cost Ratio (BCR). These indicators are significant in determining whether the project is profitable, suitable to generate returns, and cost-effective. One crucial part of the analysis was sensitivity testing. Because economic and financial environments are in some way uncertain, sensitivity analyses are required to be undertaken. It diminishes the associated risks pertaining to expected variations based on shifting socio-economic environments. Two sensitivity analyses were performed—one using increased discount rates and one using decreased discount rates. The purpose of these analyses was to determine the impact of the fluctuation in discount rates on the financial outcomes of the project.

3.5 Cost Benefit Analysis (CBA)

Gabion bund intervention, being the first cost of the program, has the greatest Net Present Value (NPV) of £70,207 and Economic Internal Rate of Return (EIRR) of 12.37%. The two values represent the favorable economic return on investment against costs, thereby attesting to the economic feasibility of the project. The NPV approximates the net monetary payoff from the intervention, and the EIRR approximates the worth of cash return flows—both values representing a value-added project.

Sensitivity analysis was performed to ascertain the strength of the intervention. The low sensitivity situation (5% discount rate) left the NPV having dramatically increased to £132,500 with a positive EIRR of 7.78%. The high sensitivity situation (15% discount rate) yielded a strong NPV of £62,942 and a high EIRR of 15.62%. The findings indicate the strength of Gabion bund intervention in addressing various economic and political conditions. All interventions in the project have yielded consistently positive outcomes, hence confirming the overall viability of the program. The Gabion bund is particularly notable for its ability to deliver the maximum benefits despite functioning under conditions of stress, and it warrants an appeal for further research into its distinct mitigating properties. Total performance parameters such as NPV, IRR, and BCR, as well as sensitivity analysis outcomes, are shown in Table 4.

Table 4: Performance Summary

Performance Summary					
			Base case	**Low**	**High**
	Net Present Value	PKR (M)	70,207	13,250	62,942
	BCR		3.12	1.32	2.90
	Internal Rate of Return	%	12.37%	7.78%	15.62%

Note: NPV, BCR, IRR and sensitivity analysis of Low and high discounting rate testing through intervention of Gabion Bund.

TABLE 5: COST & BENEFIT CALCULATION- AT BASE YEAR DISCOUNT RATE (8.66%)

1.1	Gabion Bund	£	33,743	32,445	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Costs	Total Undiscounted	£	33,743	32,445	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	Total Discounted (Present Value)	£	33,039	32,445	48	45	42	39	37	34	32	30	28	26	24	23	21	20	18	17	16	15	14	13	12	11	10	10	9
Benefits	Avoided crop damages	£	5,261		26	51	77	103	128	154	180	205	231	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
	Avoided damages to housing	£	161,396		787	1,575	2,362	3,149	3,936	4,724	5,511	6,298	7,086	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873	7,873
	Avoided damages to infrastructure	£	74,920		365	731	1,096	1,462	1,827	2,193	2,558	2,924	3,289	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655	3,655
	Avoided other direct damages	£	45,674		223	446	668	891	1,114	1,337	1,560	1,782	2,005	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228	2,228
	Avoided indirect damages	£	27,406		134	267	401	535	668	802	936	1,070	1,203	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337	1,337
		£	-																										
	Total Undiscounted	£	314,658		1,535	3,070	4,605	6,140	7,675	9,209	10,744	12,279	13,814	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349	15,349
	Total Discounted (Present Value)	£	103,246		1,413	2,600	3,589	4,404	5,066	5,595	6,008	6,319	6,542	6,689	6,156	5,666	5,214	4,799	4,416	4,064	3,740	3,442	3,168	2,915	2,683	2,469	2,272	2,091	1,925

TABLE 6: COST & BENEFIT CALCULATION- AT HIGH DISCOUNT RATE (15%).

Sub-activity	Intervention	Unit	Total	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
1.1	Gabion Bund	£	33,743	32,445	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Costs	Total Undiscounted	£	33,743	32,445	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
	Total Discounted (Present Value)	£	32,780	32,445	45	39	34	30	26	22	20	17	15	13	11	10	8	7	6	6	5	4	4	3	3	2	2	2	2
Benefits	Avoided crop damages	£	4,185		20	41	61	82	102	122	143	163	184	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204
	Avoided damages to housing	£	20,384		99	199	298	398	497	597	696	795	895	994	994	994	994	994	994	994	994	994	994	994	994	994	994	994	994
	Avoided damages to infrastructure	£	2,580		13	25	38	50	63	76	88	101	113	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
	Avoided other direct damages	£	76,277		372	744	1,116	1,488	1,860	2,233	2,605	2,977	3,349	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721
	Avoided indirect damages	£	45,768		223	447	670	893	1,116	1,340	1,563	1,786	2,009	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233
		£	-																										
	Total Undiscounted	£	149,194		728	1,456	2,183	2,911	3,639	4,367	5,094	5,822	6,550	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278	7,278
	Total Discounted (Present Value)	£	26,529		633	1,101	1,436	1,664	1,809	1,888	1,915	1,903	1,862	1,799	1,564	1,360	1,183	1,029	894	778	676	588	511	445	387	336	292	254	221

TABLE 7: COST & BENEFIT CALCULATION- AT LOW DISCOUNT RATE (5%)

Sub-activity	Intervention	Unit	Total	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
1.1	Gabion Bund	£	33,743	32,445	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52	52
Costs	**Total Undiscounted**	£	**33,743**	**32,445**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**	**52**
	Total Discounted (Present Value)	£	**33,177**	**32,445**	**49**	**47**	**45**	**43**	**41**	**39**	**37**	**35**	**33**	**32**	**30**	**29**	**28**	**26**	**25**	**24**	**23**	**22**	**21**	**20**	**19**	**18**	**17**	**16**	**15**
	Avoided crop damages	£	4,374		20	46	72	97	123	149	174	200	226	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204
	Avoided damages to housing	£	45,147		99	887	1,674	2,461	3,249	4,036	4,823	5,611	6,398	994	994	994	994	994	994	994	994	994	994	994	994	994	994	994	994
	Avoided damages to infrastructure	£	15,284		13	378	744	1,109	1,474	1,840	2,205	2,571	2,936	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126	126
Benefits	Avoided other direct damages	£	70,903		372	595	818	1,040	1,263	1,486	1,709	1,932	2,154	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721	3,721
	Avoided indirect damages	£	42,544		223	357	491	624	758	892	1,025	1,159	1,293	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233	2,233
		£	-																										
	Total Undiscounted	£	178,251		**728**	**2,263**	**3,798**	**5,333**	**6,867**	**8,402**	**9,937**	**11,472**	**13,007**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**	**7,278**
	Total Discounted (Present Value)	£	96,119		**693**	**2,052**	**3,281**	**4,387**	**5,381**	**6,270**	**7,062**	**7,765**	**8,384**	**4,468**	**4,255**	**4,053**	**3,860**	**3,676**	**3,501**	**3,334**	**3,175**	**3,024**	**2,880**	**2,743**	**2,612**	**2,488**	**2,369**	**2,257**	**2,149**

3.6 The 4Es of the VFM framework

A Value for Money (VFM) framework is a methodical process that is set to maximize the productivity across all aspects of a program through judicious assessment of its performance in four principal dimensions (King, and OPM, 2018): Economy, Efficiency, Effectiveness, and Equity (or the 4E's). An exhaustive appraisal confirms that resources are being utilized economically, activities are being performed economically, desired results are being attained economically, and inclusivity is being enabled equitably. We also include an impact measure that will enable a complete description of the VFM analysis.

Table-8 Expected benefit from intervention: -

Assumed benefit	Unit	Amount
Avoided crop damages	£	5,261
Avoided damages to housing	£	161,396
Avoided damages to infrastructure	£	74,920
Avoided other direct damages	£	45,674
Avoided indirect damages	£	27,406

3.7 Economy Analysis in Value for Money: -

The Economy segment of the VFM analysis is an essential element in evaluating the WRAP project's VFM study. This part focusses on the compilation, structural categorization, and comprehensive evaluation of the project's overall expenses, with a critical analysis of its economic worth relative to similar benchmark programs, specifically: "Water Conservation through PM-Agriculture Emergency Program." This study also includes the number of recipients, enabling a per capita assessment of the overall WRAP initiative. The per capita cost corresponds to a small amount when factoring in the number of recipients. The per capita cost amounts to only £15, as seen in table 9, when accounting for the number of recipients.

Table-9 Economy Analysis in Value for Money -Value in £

Metric	Projected value	Number of beneficiaries	Adjusted cost per beneficiary (£)
Gabion Wall	32,445	2027	15
Benchmark Value	Water Conservation through PM-Agriculture Emergency Program		40
Difference			(25)

3.8 Efficiency Analysis in Value for Money

The Efficiency component of the VFM analysis is a vital aspect for assessing the performance of the WRAP project. This part primarily evaluates the benefit-cost ratio (BCR) of the overall project. The project's interventions are characterised by their cost-efficiency and value generation, which are emphasised by the conversion of inputs into outputs, which is the fundamental unit of analysis. Incorporating the concept of comprehending the advantages derived from inputs, efficiency in value for money (VFM) operations functions separately for each intervention and offers a systematic examination of the entire project. We aggregate the discounted costs and benefits for each intervention type to compute the efficiency ratio. This computation yields a quantifiable assessment of benefits obtained per unit of expenditure expended, providing distinct insights into the effectiveness of resource allocation. This study also includes a list of beneficiaries, a crucial element of the final report in the VFM analysis methodology. This thorough assessment measures project efficiency while also integrating per capita perspectives, thereby improving the evaluation of the project.

Table 10: Individual Efficiency of the WRAP Project Interventions

S.No	Output	Discounted Cost (£)	Discounted Benefit (£)	B/C (Discounted Benefit/Discounted Cost)
1	Gabion Wall	33,039	103,246	3.12

In above tables, the establishment of Gabion-Bund an impressive BCR of 3.12, signifying that every 1£ invested as a cost generated £ 3.12 in benefits.

3.9 Effectiveness Analysis in VFM

The Effectiveness part of the VFM study is a vital aspect for assessing the Gabion intervention. This domain evaluates the project's capacity to deliver specified results in proportion to the expenses invested to obtain these outcomes. Utilizing the conceptual framework of WWF, the study involves a thorough cost-benefit evaluation of these outcomes. The finalization of outcomes depends on the project's ability to quantify the advantages obtained and correlate them with the targeted results. Similar to that constraint, and the predetermined result indicators derived from the Logical Framework by WWF, interventions were regarded as distinct outcomes. The initial analytical breakdown indicates the achievement rate for the result designated as NbS, implemented for integrated water resource management, river basin management, and watershed management protection', which stands at an impressive 3.05, see Table 11.

Table 11: Effectiveness Calculation.

S.No	Outcome	Total discounted costs (£)	Total discounted benefits (£)	Effectiveness ratio
1	Outcome Nature-based Solutions (NbS) introduced for integrated water resource management, river basin management, and watershed management protection	33,743	103,246	3.05

3.10 Equity Analysis in VFM

The Equity segment of the VFM analysis is crucial for promoting inclusion and equality in the Water Resource Accountability in Pakistan Project (WRAP). This component is committed to maintaining the values of non-discrimination and equality, guaranteeing that the initiative helps all disadvantaged groups impartially. The Equity analysis aims to provide equal access to project interventions through a thorough evaluation, see Table 12 below:

Table 12: Equity index

CRITERION WEIGHTING	INDICATOR PROJECTED VALUE	INDICATOR GOAL	INDICATOR PERCENTAGE ACHIEVED	WEIGHTED EQUITY METRIC
Working Women and Homemakers	2027	608.1	333%	100%
Disable	8	32	25%	1%
	100%			

(Source: - National Disability Survey Module PSLM (Pakistan Social and Living Standard Measurement 2024)

According to the disaggregated intervention data, the project achieved to reach to women, orphans and the disabled population.

4. LIMITATIONS, CONCLUSION AND RECOMMENDATIONS

The VFM Analysis has been carried out for gabion bund at Kharko revealed some limitation.

1. **Skilled Labor Requirement**: Proper construction requires trained personnel to ensure structural stability, which may not always be locally available.

2. **Limited Lifespan Without Maintenance**: Gabion structures can degrade over time, especially if not properly maintained or if the wire mesh corrodes.

3. **Accessibility of Materials**: In remote or mountainous regions, transporting stones and wire mesh can be logistically challenging and expensive.

4. **Environmental Disruption During Construction**: Installation may disturb local habitats temporarily, especially in riparian or ecologically sensitive areas.
5. **Community Participation Challenges**: Engaging local communities in construction and maintenance may be difficult without proper awareness or incentive structures.

Finally, the Value for Money analysis of the WRAP intervention identifies strong financial effectiveness and efficiency in addressing its intended goals. Through effective spending, cost-saving strategies, and participatory approaches, the construction of Gabion Walls has largely enhanced sustainable water resource management and climate resilience.

Some of the key recommendations are to actively engage local people in the planning, construction, and maintenance stages to ensure ownership and sustainable long-term development. Equipping local workers with practical skills for gabion construction is also a requirement to minimize reliance on foreign contractors.

In addition, combining gabion bunds with other watershed management practices that are mutually supportive—i.e., check dams and vegetation planting—can reinforce the overall effect. At the design stage, particular sensitivity should be accorded to meet the specialized requirements of marginalized groups, including but not limited to those with disabilities women, and children. Lastly, the implementation of straightforward monitoring tools is essential in order to determine the success of the bunds in preventing erosion, holding water, and maintaining livelihood.

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