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THE FOURTH NATAN SAND DAM

Implementation Report of the sand dam between 22/10/2020 to 06/11/2020.

This report outlines the construction process/phases which was employed during the 14 days construction works of NATAN sand dam and some of recommendation to be observed in future sand dam implementation.

1. Acknowledgment

The Natan Sand dam survey has been carried out with the active Natan water committee and rotary community corps participation and engagement in the project implementation process. Our special thanks go to the Rotary club of Port Orchard, Rotary club of Gigiri, Nairobi and Rotary International for funding the survey. The local administrators are also acknowledged for their role in mobilizing the community and acting as guides to the community during project implementation process. Lastly, the survey teams, specifically the Utooni development engineers and artisans are appreciated for the good work by ensuring the 4th Sand dam is completed successfully within the stipulated timeline.

2. Executive summary

East Pokot is one of the six Sub-Counties in Baringo County; others are Baringo South, Baringo North, Baringo Central, Koibatek and Mogotio. It borders Turkana East to the North, Marakwet to the West, Laikipia and Samburu Districts to the East, and Marigat to the South. East Pokot covers on average an area of 4,238 square kilometers and has an estimated population of 666,763 people (2019 population census). It has two livelihood zones namely Agro-Pastoral (Churo division) and Pastoral (Kolowa, Tangulbei, Silale, Nginyang divisions). Over time the sub-county has been experiencing, Water shortage for domestic use and poor health and nutrition outcomes. These could be attributed to household food insecurity as a result of recurrent drought in the region.

Natan sand dam presents a medium sized sand storage dam. The site has the following characteristics;

- The riverbed formation is constituted by natural bed rock at the maximum depth of 1.2m below the sand bed level across the entire portion of the dam axis.
- The reservoir consists of coarse sand which presents a good water holding capability. Site situated at 140 meters from the river meandering hence less prone to changing of river course and adequate throwback guaranteed.
- Presents of local construction materials 2kms from the sand dam project site. The flashfloods being accommodated within the river channel as depicted by the flood marks.
- Accessible to the community residing in the project area, during sand dam construction the women who have sole responsibility of fetching domestic water were getting water about 80m from the sand dam embankment axis.
- Presents of scoop holes along the stream indicating a high potential of water harnessing as surface and subsurface flow is obstructed by the sand dam hydraulic structure.

During the implementation process, the following parameters and details were observed and taken care for the success of the Natan sand dam site 4.

3. Depth of excavation.

The site was excavated up to a depth of 1m at the center of stream and 2.6m on the wing walls. Its base was 2.4m wide although the dam wall was 1.8m wide, the other 0.6m were provision for slab (Apron).

Figure 1: Pegging and marking process of the foundation trench for guidance before excavation started,

Figure 2: Sand collection done by group of women who lined up on the both side of the sand dam wings i.e. right wing and left wing concurrently.

Figure 3: Excavated depth of the trench

4. Setting of base foundation.

A blinding of 1:2 ratios (cement:Sand) was provided on the base of the dam wall embedded on a twisted reinforced bars of Y-12 and Y-8 diameter. This was made to receive the dam weight and also used as base of sand dam wall embankment construction. Community members were guided on proper mixing of cement sand ratios 1:3 (cement:sand) which was to be used for walling and plastering.

Figure 4: Community members being guided on cement mixing by UDO artisan.

5. Steel reinforcement bars.

Reinforcement bars of twisted Y-20 and Y-10 were joined together with binding wire at intervals of 0.3 m horizontal Y10 and 1.2M for vertical bars Y20 to form both tension and compression forces, from one vertical bar to the other and of heights equivalent to the dam height crest. The Y-20 reinforcement bars were vertically set 1.2meters C-C (Centre to Centre), in the formed foundation base and at 0.5m from the sides of the timber formwork. After achieving the reinforcement, the formwork of timber and nails was provided perpendicular to the columns and firmly fixed.

Figure 5: Portion of dam reinforced by Y-20 and Y-10 bars, barbed wire used for linkage of bars.

6. Timber forms (form work):

Two timber forms were constructed, one for the upstream and the other for the down-stream side of the dam. These formworks were used to hold the concrete mixture for a period of one day until it is hardened before removing it. The two forms were made from horizontal boards and upright timbers. The horizontal timber boards were (6 by 1)' and of several meters long. The uprights timber boards were (4 by2)' 4m and a half meter high from the bottom to the top since our sand dam of 2.1M height from the foundation at the center of river. The horizontal timber and upright timbers were nailed together to create the form work.

Figure 6: Placing of form work attaining the shape of the dam, just immediately after finishing the slab

7. Concrete walls:

The form work was filled with mortar and stones under close supervision for the interlocking of the boulders. The mortar was made by mixing cement, sand and water as close to the sand dam wall as possible and with a mixed ratio of 1:3 (cement:sand) by the group members on the ground using shovels.

The stones were cleaned before they were embedded on the mortar to allow a strong bonding process. The interconnectivity was carefully made as close as 25mm from the one large flat stones, medium stones, and small stones to the other. This ratio of 1:3 was then maintained for the rest of the dam wall. Strands of reinforcement bars and barbed wire Gauge 12.5 mm diameter were placed in this mixture of mortar and stones at 0.5M intervals and repeated up to the superstructure crest. At the top of the spillway crest, a layer of 3 inch river ballast was placed to prevent the structure from eroding due to velocity of flow of storm water and rock debris. It was finally compacted to attain maximum concrete strength by removing air voids in the concrete keenly not to cause bleeding and segregation effects of concrete.

Figure 7: Interlocking of hardcore at 25mm from one to other

8. The spillway:

Natan sand dam spillway was built once in to a height of 2.1M and a gross free board of 1.5M was constructed. This is referred to as primary spillway and its work is to center and discharge the normal flow into the normal river channel during the rainy season. The length of the spillway is 13.8M and will be needed to guide the water through this channel and keep it in the normal river channel during the normal course of its running during the rainy season and it was determined by use of a tape measure after interpreting the design.

9. Wings

The wing walls were built enough taking into consideration the riverbanks levels of both sides and extended on sideways left bank and right bank 6.3M and 4.7M respectively. They are made to keep the flood waters from going around the sand dam and causing erosion and eventual undercutting of the dam walls. One of the greatest geographical advantages of the sand dam site has been very firm bed rock where the foundation started; this increases the strength of the wing walls, thus resistance against overturning and sliding effects.

Figure 8: construction and finishing of left and right wings wall

10. Finishing

The dam wall was finished by plastering the upstream, crest and downstream portion of overflow channel in a ratio of 1:3 (cement:sand) and a steel float used to achieve the desired plane.

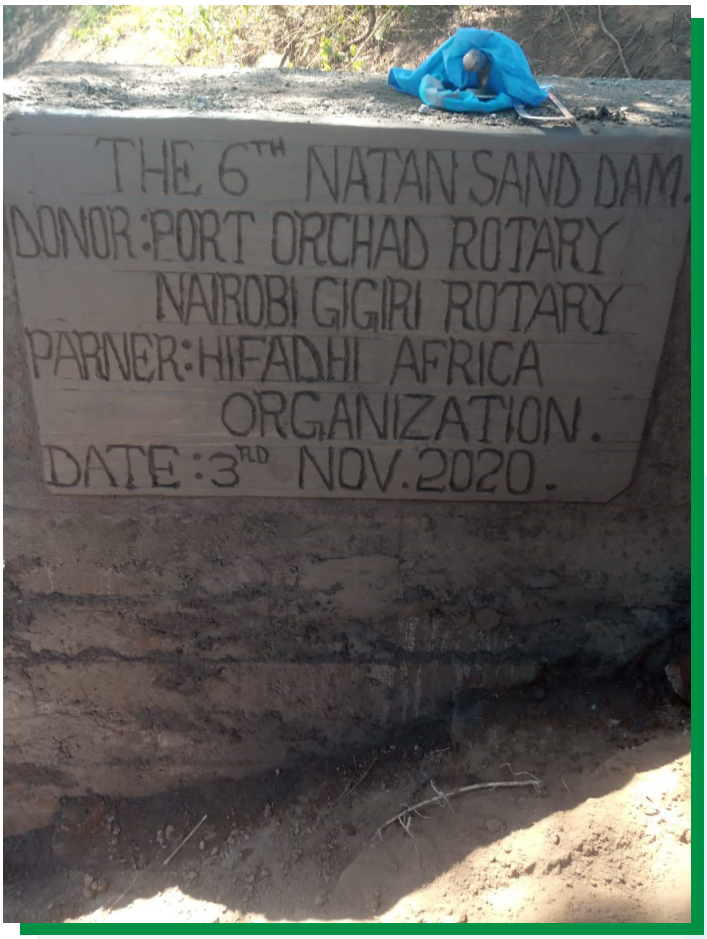

Figure 9: Inscription of partners and donors names on the dam walls

CEMENT

Figure 9: The sand dam was designed to utilize a total of 350 bags of which all the planned cement was properly kept on the site and fully used. Cement was properly kept out of rains and destruction on site covered with polythene sheet.

What needs to be done for immediate maintenance?

Dam wall curing:

After completion, for the 14 days the community should keep a close watch on the dam wall. The concrete must be kept damp to cure it properly so as to prevent the dam wall from cracking and leak. If the weather is very hot, the dam wall will need to be monitored carefully as the curing takes place, and more water may be needed to dampen the walls more frequently. In case of heavy rainfall during this time of curing, this process is ignored. For the case of just completed sand dam river sand should be poured on top of the spillway crest to act as the natural Dump Proof Membrane (DPM), this reduces the direct sun rays acting upon the dump concrete wall.

Recommendations for future Implementation of Sand storage dams

- Sand dams like any other open water structure is prone to contamination and pollution if measures to prevent water from the sources of contaminants are not administered by the beneficiaries., e.g. fecal coliforms, animal waste, soil erosion from the nearby graze lands.
- The community members both women and men should be trained on importance of water sanitation and hygiene.
- Community involvement in all phases of sand dam implementation is a key success of the project hence sustainability is guaranteed.
- For communities who are beneficiaries of the project, there is need to expose them to a similar works on or before implementation of the Sand dams so as to appreciate the benefits associated with this structure, by learning about sand dam utilization, ownership and maintenance.
- To keep the cost low and save time for sand dam implementation, the target community should be first trained on community participation and project ownership.
  Small gullies near the site which might act as potential erosion spots should be blocked to prevent soil erosion to the sand dam.
- 2 more sand dams can be constructed on the downstream side of the already implemented sand dam, presence of potential site.
- Capacity building training after sand dam construction ensures impartment of basic masonry skills to maintain sand dam wings in case of erosion.

Figure 10: Cost analysis for the 4 completed Natan sand dams under GG#1869224

Project Implementers			Hifadhi Africa Organization (HAO)				
Oversight organization			Utooni Development organization (UDO)				
			Cost of each sand dam in Ksh.				
Projects	**Length**	**Height**	**1**	**2**	**3**	**4**	**Totals**
First Sand dam	21M	2.3M	828,905				828,905.00
Second Sand dam	27M	2.0M		921,560			921,560.00
Third Sand dam	28M	1.9M			942,460		942,460.00
Fourth Sand dam	27M	2.1M				962,860	962,860.00
PROJECT EXPENDITURE COST							**3,655,785.00**

Analysis Notes

- Estimated construction price of a sand dam depends on the factors influencing that particular sand dam such i.e. size, location, nature of river bank and the engineering aspect associated with design.
- Each sand dam is unique in total construction costs because of the above factors. It is almost imperative therefore that it each requires separate price analysis.
- Engineering survey mapping of sand dam sites are done individually to generate BOQ estimates. This is normally done before construction commence i.e. to determine the number of cements, reinforcement bars and general materials. For example, the 4th sand dam was the largest from the rest of the other 3 dams.
- Pricing of construction materials is influenced by economic demands in the market. For examples the price of cement previously was @650, currently it's sold at @670 etc.
- For instance sand dam 1 no water was purchased during construction which make the project expenditure lower than the 4th sand dam.
- The sand dam height is directly factored by the foundation base i.e. the height of a sand dam equals the excavated depth and the height above the sand level.

Conclusion

We highly appreciate the Rotary club of Port Orchard (PORC) and the Rotary Club of Gigiri, Nairobi for being trusted partners in transforming people's lives through sustainable land and water management practices in East Pokot sub county, Baringo County.