

Assessment of Indigenous Water Management System: A Case Study of Borana Community, Southern Ethiopia

Jatani Bonaya Godana* and Sisay Demeku Derib

College of Architecture and Civil Engineering, Department of Water Supply and Sanitary Engineering, Addis Ababa Science and Technology University, Ethiopia

Abstract

Water is the most domineering diet for living things/Bisaan sagalee mootuu/ means of a vital to alive next to air. Then, the management of this most essential resource for living things is very important. Different traditional water technologies and management practices have used in various parts of the world since time immemorial. The practices are actually dependent on the local situations. Some linked with surface water and others with groundwater extraction and management. A typical example, which has used for long and widely known, called Qanat. Qanat is a traditional water extracting and transporting technique that commonly used in Middle East. However, in Borana community this term knows by the expression called "Finna Marraa Bisaanii 'the rule of water and grass'. The Indigenous water resources management system of the Borana Community based on Gada system indigenous law of sources of water particularly for Tula-wells and ponds. Tula-Sallan is the permanent source of water in Borana. In Borana, Tula-wells owned by a distinct clan (tribe) and managed by the daily operation of the Tula-wells 'Abba Herrega'. The Borana indigenous water management systems vary based on categorizations of water sources and Borana traditional livestock watering calendar. In Borana community except river and surface water sources, the remaining water sources have some sort of indigenous rules and regulations followed for anyone to get access to them.

Keywords: Abba Herrega • Abba Guyya • Meri • Tula Sallan • Deep wells • Surface water • Groundwater

Introduction

Water is vital to life. Without water may, the life was difficult. Water has a strong tie to the physical and spiritual well-being of humankind. Notwithstanding of the differences in religion, culture, and social norms, every person depends on water [1]. The Indigenous water resources management system of the Borana Community based on indigenous administration system of Gada rule of 'Madda Bisaanii' means 'sources of water. Principal to the achievement of Borana pastoral system is the advanced Institutes of water management and land use, which subjective to landscape types and water patterns. Borana have defined local property rights to water sources [2]. The Borana traditional water resources have used to regulate watering systems [3]. The Borana land water sources divided into Surface water and Groundwater (Tula-wells). Surface water is temporary rain harvesting structures in the valley, rock, naturally depressed areas 'Dambalaa', Puddles of rainwater "Doloolloo" which are seasonal and naturally running water "Lolaa/floods" when it rains.

Some spring water sources developed into wells and further divided into 'Adaadii and Tulaa'. Tula is/are found in hot lowland of Borana (gammoojii) areas where there is scarce of water sources. Adaadii wells often founded in a forested upland (baddaa) or in its systems where there is relatively wetness. Ponds are rain surface water harvesting structures often found in hot lowland areas, which are located at far-away from Tula sources.

The Borana Gada territory, of southern Ethiopia circled by three national rivers locally called 'Galaanii sadeen dheeda Boorana Xoophiyaa marsa' means three river tamped Borana of Southern Ethiopia. These three rivers are

Ganale, Dawa and Segen. These three national rivers cross through the remote and bordering areas of the Borana land. Ganale River delineates Liban Region of the Borana Gada territory from Bale Zone; Dawa River splits Liban and Dire Regions of the Borana Gada territory, and Segen River bonds boundary between Borana Gada territory and Konso Land of southern, Ethiopia. These three rivers are across the southern Ethiopian desert, uncomfortable for herds as it marks in the gorges and there is continuous boarder conflict with the neighbor's pastoralist community.

Therefore, Borana focused into the Tula Cluster area 'of Borana Desert; which is copious for their herds. The Borana Gada territory crosses Ethiopia, Somalia and Kenya. Currently dominantly, they live in southern Ethiopia (called Borana Liban and Dirre /Liban-Dirre Gada territory) and Northern Kenya (Borana Saku and Borana Waso/ Saku-Waso Gada territory). However, they live in different and far area; their indigenous water management system is the same. Reverse of this, the area of Tula Sallan Cluster is limited to the Borana Dirre Gada Territory currently called Borana zone, of Oromia regional state. However, there are some deep wells in Liban, Saku and Waso of Borana Gada territory, but not Tula. The study has focused on the general assessment of indigenous water resources management system and specifically hit the traditional water management of Tula Sallan Borana as 'Deep wells (groundwater) management system.

The further studies on water management that titled "Indigenous Practices of Water Management for Sustainable Services Case of Borana and Konso, Ethiopia" is basically explain the three major features the associated with Borana traditional water management [4]. They tried to clarify the three features as the sources of solidarity in Borana originated from water. However, this very interested study; may lack the watering principles, period and animals' prestige of Borana which depending on water sources uses calendar of Borana and very general. . Therefore, this study has emphasized on this gap, as the indigenous Borana water management system has a huge hierarchy and based on Borana water sources uses calendar. Borana water sources uses calendar based on types of water sources, principal users, seasons of a year and period of utilization. In Borana indigenous water management system the words Konfi, Abba Herrega, Abba Guyya, Kora Hara ela, Obatu and Totu have much known.

'Konfi' is father of the water point/sources, whether it is ponds, adadii or tula. The power of Konfi inherited to children, grandchildren, and so on. The

*Address for Correspondence: Gratien Twagirayezu, School of Environmental and Municipal Engineering, Lanzhou Jiaotong University, Lanzhou, 730070, China, Tel: +8618709489146; Email: tgratien0@gmail.com

Copyright: © 2020 Twagirayezu G, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Received 07 December, 2020; Accepted December 14, 2020; Published 21 December, 2020

group that able to manage the system organized by elders of the clans with the lead of the Konfi to form a water point council traditionally called 'Kora Hara-Eela'.

'Abba Herrega' is an officer who follows up on the daily watering order and maintenance system at water point. Abba Herrega nominated on the virtue of managing ability, regard, and righteousness.

'Abba Guyya' is the one who has the power to control the daily activities around the water sources on his/her day of watering livestock.

'Obatu' are the collective name of all participants come to the water sources to manage and watering their herds.

'Totu' are the persons who line up to lift water from the Tula wells (groundwater) to Faccana (reservoir) and a cattle trough in case of Adadi and Tula.

'Obatu hara' is the persons those draw up 'Meerii' and fence the ponds in instance of ponds (surface water).

'Gogessa' is the line of 'Totu' and may short or long depends on the depth of the water in the Tula.

'Finna Hara-Ela' (Borana Water Sources Council /Finna Madda Bisaanii) are an assembly of the water source users that headed by the Konfi.

The core role of Borana Indigenous water sources council in the water management system is negotiation, mediation, enforcement and water allocation among the number of Ponds and Tula Sallan built on the 'Seeraa Finna Haraa Eelaa' (water sources rule).. In Borana, nobody excluded from using water. The management practice of Indigenous Borana Water Management System has no formal committee that constitutes a chairperson, financial officer, and so on, which commonly had known in Water Supply, Sanitation and Hygiene (WASH) and water users associations in irrigation systems. The management in Borana is unique in its nature. The governing rule is the Gada system (Gada Institutional Arrangement). Generally, grounded

on 'Gada Institutional Arrangement' Traditionally; Borana manages water resources properly. Therefore, the Borana Indigenous Water management system is very important in and need further advanced to develop into modern water management system.

Materials and Methods

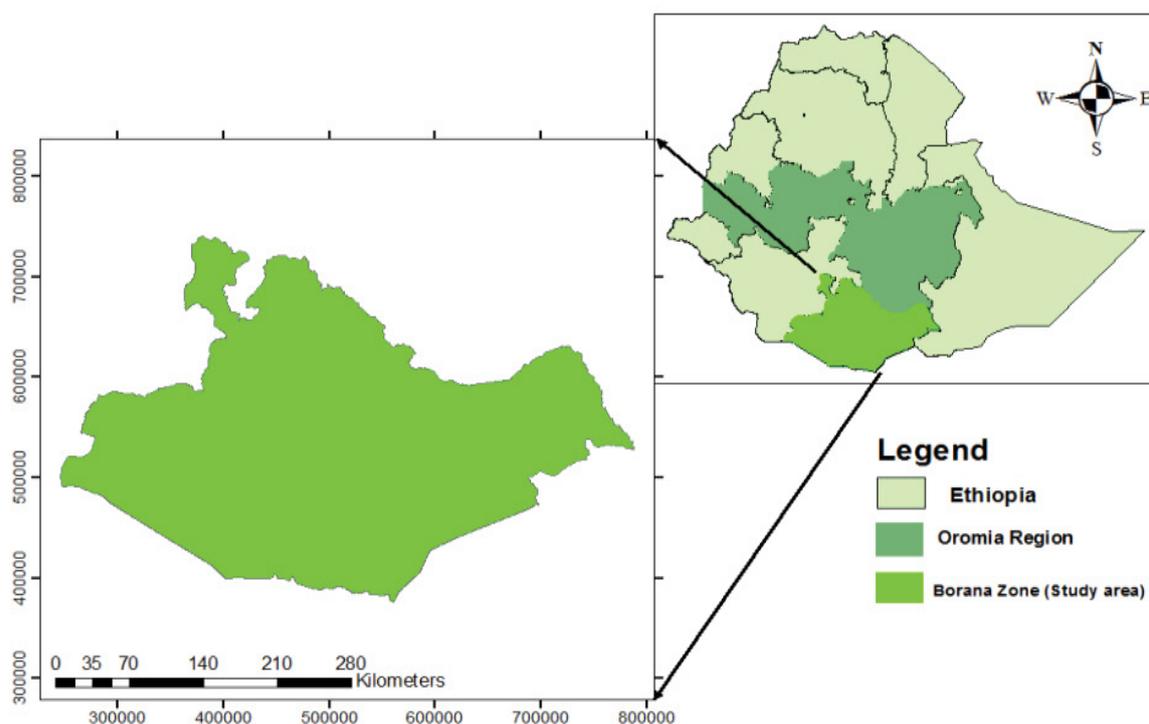
Description of the study area

The study was took place at Borana Dirre zone (currently called Borana zone) and traditionally called 'Dheeda Boorana Dirree'. Borana zone is one of the zones of the Oromia Regional state of Ethiopia. Borana Land (Gada Territory) bordered on the south by Kenya, on the west by the Southern Nations Nationalities and Peoples Region, on the north by West Guji, North east by Arsi and on the east by Somali Land. The study had taken place in Borana Dirre as all Tula Sallan cluster found in Borana Dirre (currently called Borana Zone). Borana Dirre of southern Ethiopia land covers 95,740.23 km² of the total land mass of the country and located to the south of the country. Geographically, the Borana Dirre zone were study took place lie between (3°36'- 6°38') E latitude and (3°43'-39°30') N longitude (Figure 1).

Borana zone has mainly characterized by a semi-arid climate. The area characterized by a general scarcity of surface water. The main source of water is a Tula. The other main alternative water sources in Borana Dirre are artificial lakes like Bake, Orbatte, Hara Bule, Daballe and etc. and two rivers at the edge of the zonal border Dawa (between Libani and Dirre), Sagan (between Borana and Konso). Annual mean temperatures vary from 19 to 24°C with little seasonal variations. Average annual rainfall varies from 440 to 1100mm. The zone comprises of two-town administration (Yaballo and Moyale town) and thirteen districts namely Yaballo, Dirre, Dillo, Moyale, Dhas, Teltele, Gomole, Guchi, Arero, Miyo, Dubluk, Wachile and Elwaye and devours human population over 2.1 million consisting of equal proportion of male and female [5].

The Borana zone pastoralists are survival livestock producers. The

Location Map of the Study area



Note: Study area location map. It indicates Borana Zone administration, low land of southern Ethiopia which located in Oromia regional state. The zone capital town Yabello is 550 Km far from Addis Ababa, Capital city of Ethiopia and Oromia regional state.

Figure 1. Location map of the study area, the Borana zone administration low land of Southern Ethiopia.

plenteously of livestock is the paramount resource of the areas that makes Ethiopia the first in Africa and the ninth in the world by cattle population. They mainly live on milk but increasingly supplemented by cereal grain. The annual livestock off-take is very low and directed to finance pastoral household basic requirements. Dry land cultivation has substantially increased in the area over the last two decades. Gross income of a pastoral household is the sum of subsistence plus marketed production and currently their income is decreasing extremely due to continuous dry climate condition (long dry season).

Data collection

Data collection procedure was followed both primary and secondary data collection. The researcher was followed interview, focus group discussion, Questionnaire's, and study area observation specially water sources point (Tula and Ponds). The data had collected at some water points located in Yabello, Dubluk, Miyo, Dhas and Wachille Districts. This was involved interviewed with key informants, group discussions, and field surveys at two ponds (Daballe and Bake) and in seven of the nine Tula-wells complexes locally known as Tula Sallan (i.e., Melbana, Dubluk/Elwak, Igo/Gofa Aba Rubo, Gorile/Gofa Tuto, Webi/Bosaro, Wachile, Irdar, Gofa and Laye) and the related documents had reviewed.

According to the researcher, field surveys data and interviews of informants from selected districts the Borana traditional water sources that have identified and developed by the local people using their indigenous knowledge and experience had known as 'Bisaan Haraa Eelaa' (Ponds and Wells) means locally stated as surface and groundwater. Also the Borana elders (Dr. Borbor Bule, Bonaya Godana, Jarso Jillo, Halake Jillo, Huka Garse, Jatani Dida, Dida Liban, Galam Gololle..) repeatedly told the same that Borana relies on Bisaan Haraa Eelaa.. These Borana Traditional water sources are Traditional Deep Wells or Singing Wells (Tulaa Sallan), Spring Fed Ponds (Yaatau), Open Surface Ponds (Haroo), Unprotected Perennial and Seasonal Springs (Gootuu), Scoop Wells on Sandy Rivers (Haadha'aa) and Shallow Wells (Adaadii). The Borana traditional water sources have grouped into two major types. They are permanent sources and seasonal sources. The stable traditional Borana water sources include Tula Sallan and hand-dug ponds that sturdily controlled by traditional laws and principles than the seasonal sources [6].

Data analysis

The researcher had analysis the collected data in appropriate way by comparing the field survey took place at water sources, report survey from the zonal administration, zonal water and mineral office, and his own engineering aspects during his field visit at different ponds, Adadi and Tula. The Borana Indigenous water resources management at different sources has its own traditional rule and regulations that has based on the Borana customary law of Gada system. Therefore, the study discussion on Borana traditional water sources particular indigenous water resources management at Hand dug Ponds, Adadi and Tula (Tula Sallan) separately and collectively for conclusion and recommendations.

The traditional and engineering aspects of the water sources location and settlements of the population around the water sources had discussed according to the data collected by field observation, focus group discussion and interview of informants at selected water points.

The Indigenous Borana water resources management actors and indicators key of seasonal and indigenous water uses calendar had emphasized for every selected sources of water. This investigated through Borana indigenous watering principles, period and animals' prestige of Borana community depending on water sources uses calendar, which may vary according to the types of water sources, principal users, seasons of a year and period of utilization.

Generally, the more emphasis specified on the concepts of water sources ownership experience, equity, enforcement, integrity, and unities, which are highly pronounced in modern water systems compared with that is of the Indigenous water managements system of Borana Community.

Results and Discussion

Borana concepts of indigenous water resources management

The Indigenous water resources management system of the Borana Community based on the Gada system indigenous law of "Madda Bisaanii" means 'sources of water' (particularly wells and ponds). The Borana land water sources can be divided into river water; pond water, spring water, surface water and Groundwater (Tula). Surface water is impermanent rain harvesting structures in the valley, rock, naturally depressed areas 'Dambalaa', Puddles of rainwater "Doloolloo" which are seasonal and naturally running water or floods" when it rains. The Borana water management systems vary based on categorizations of water sources. Except river and surface water sources, the remaining water sources have some sort of rules and regulations followed for anyone to get access to them. Therefore, for methodological reasons, the Borana indigenous Water Sources Management systems assessed in this paper were Community Dug pond, Adadi and Tula.

The Borana indigenous management system of the community-dug ponds

Community-Dug ponds are often made in the hot lowland areas where there is scarce of other alternative water sources. A man either to block the ongoing flood while raining or to make dam along a dry river during the dry period to harvest the upcoming rainwater originally initiates a community-dug pond. Immediately after establishing the new pond, the initiator must make fire with fire-stick (uchuma buusuu) at the newly establishing pond. This has done to legitimize ownership title, 'konfi'. Afterward, the konfi title had recognized to him and then passed down to his extended family along seniority line. That pond has named after the name of initiator forever. Thus, on top of its water provision and economic value, digging a pond by somebody else is to make a history and retain his good name in the society. The economic value of the pond has to do with water delivery services by the pond to domestic consumption, wild animals and livestock whose livelihoods of the people depend on. Once a pond is established, Borana have the most advanced indigenous systems to expand its capacity and to maintain it as Tula-wells. For instance, after the pond harvests the rainwater, community selects a water caretaker (Abba Herrega or Herrega). The herrega is often a different person from a konfi owner. He maybe or may not be from the konfi owner's clan. Then, through the management of herrega every water user need to participate into extended excavation of the pond according to the established norms of the users. That is owners of a herding unit of cattle is needed to remove on average 1 m³ of soil in every watering day, and to fetch a jerry-can of water (20 lit), a woman is required to remove 10-20 shovels of soil. Failure to participate in this work at a given water source will lead the guilty to not get access to other water sources in Borana.

For instance the fig below show that how Borana Community live in Borana Gada territory of dheeda Liban around Nagelle Borana town suffered from scarcity of water during the dry season. This picture captured in 2017 when Nagelle Borana people face huge water problem and suffered from the cholera (Figure 2).

The Borana custom allows his fellow Borana get access to any Borana pond, there are some regulatory systems considered. Normally, ponds are closed during wet seasons when surface water is available everywhere and then opened after surface water is used up. Closing and re-opening of the pond has done by kora haraa- eelaa (water coordination meeting). In the meeting of opening the pond, number of the ponds in that pastoral coordination, number of herd unit, watering modalities (either watering days be after 2 or 3 days; whether watering encourages extended excavation along with removal of silt or only depends on removal of sediment) are identified. When the identified ponds are not enough for permanent and satellite camps, dry herds (e.g. dry cows, bulls, oxen, young cows and bulls) will go to another place where they can get access to water. Then, while the amount of water in the ponds getting less; the community meeting again initiated whereby all herds of cattle decide to go to other water sources except herd units of herrega, konfi, traditional healers, ritual leaders and Gada councilors. Next, herrega has



Figure 2. Nagelle Borana town people fetching the water from Laga-Bora pond around Nagelle Borana town without being consideration in sanitation due water scarcity in the area (Source: Report by Raadonii Daandii Haqaa on case of Nagelle Borana Water Scarcity).

allowed watering his livestock for one last watering day of the final stage to windup water management for that specific season. Eventually, the little left over water in the ponds is reserved for domestic consumption only. Regarding maintenance of a pond, every pond user is responsible to re-build fence of the pond compound in each watering season. S/he is also subjected to desist the silt while using it when the pond's water is going down. Des-silting goes along with preparing meerii. 'Meerii' (a kind of trough for pond) is/are made up of thorny bush on one side and mud on the other side. It used to protect livestock not to go into the water. On three intervals of watering days, every user (obaatus member) must push 'meerii' forward as volume of water going down in the pond and prepare the new meerii (Figure 3). At end of every watering day, any user has to clean areas sited to his/her meerii, remove livestock dung and thorny bushes used for meerii. The procedural management of pond has headed by appointed caretakers - one leader and two assistants. Locally, this appointment had addressed as 'harchumree tikaa itti kennuu' (titled provision of official management). Here, Harchumree is an Oromo term that refers to a long thin stick usually water caretakers carry around with another normal stick while providing services to the users at water sources. Caretakers could have advised or replaced depending on its magnitude if they fail to carry out their responsibilities. Sometime if herrega is konfii and violates management systems of his own pond, he would have lost the herrega title; but not the konfi one. Besides, there are konfii owners, indigenous leaders and elders who watch and examine whether the management systems of herrega are going on according to the Borana Gada institution.

Generally, as that of the modern civil engineering consideration, the Borana indigenous ponds managements and construction make ensure about the ponds structures. They check uses for storing water and put side fill-up is high, amount of spring water, make sure about the properties of soil weather it is Soft and weak soil base or Unstable soil bases in a region of possible landslides, filling-up on steep slope and regularly management of the ponds [7].

Borana indigenous water management system of Adadi-Wells

Adaadii wells often found along the watershed of the forested mountainous or in the sandy dry river of the hill land areas. Those in forest systems have high yield of water in year round that can accommodate a huge number of users. In local terms this kind of adaadii wells categorized as Adaadii Karaabaa (Adadi that with enough water for livestock and domestic services for dry months) and Adaadii Buttee Yabbii (Adadi that with a little amount of water only for domestic and caves). Those in hill land areas have little amounts of water and so that they can benefit few harvesters for few dry times. During the dry months, they regularly serve for domestic consumption. These types categorized as adaadii buttee-yabbii (Figure 4).

Ownership of adaadii wells is/are traced through konfii or coqorsa systems.

The konfii system of adaadii wells was established long time ago when a person belongs to certain Borana clan first discovered a source of water, which never been investigated by anyone else. Ownership has approved only when the discoverer lit fire at the source with the presence of witnesses. Then, the konfii ownership has given to the founder and passed down to his descendants, and the wells owners are his clan members, of course. Coqorsa ownership systems is when certain geographical locations given to some Borana clans and then water sources over those areas are belong to them regardless of whoever invented or discovered the sources. Herrega persons of the adaadii wells can often be from well owning clans. Nevertheless, some time he can be from any Borana clan; only if assigned by the well owners' clans.

Borana Indigenous water management system of Tula-wells

Tula-wells is/are a perennial deep traditional water wells locally called "Tulaa Sallan Booranaa". Borana have 9 (nine) Tula wells/"Tulaa-sallan". They are Melbana, Erdar, Gofa, Lahe, Gofa Abba Rubo (Anole-Igo-Dubluk), Webi (Bosaro and Webi Gala), Wachile, Gofa Tuto (Gayo-Gorile-Dhas) and Madhacho. Borana pastoralist dug Tula-wells by themselves in particular a person have the knowledge of water wells had called "Suuftuu" means 'simulated odor of water', those had the knowledgeable of the Tula-wells and water resources. This kept the secret of knowledge has kept with individual families, who passed them on to their descendants, always through the firstborn sons.

According to Borana indigenous water resources management Tula-wells have three watering days headed by three different folks. First day is termed as Guyyaa Konfii (watering day of konfi owner), Second is said to be Guyyaa Olaa (watering day of well alliance clan) and Last day called Guyyaa Qaragoraa (Watering day of other members of clan owning a Tula (Figure 5).



Figure 3. Borana Community Hand-Dung Ponds Indigenous Managements and the watering day activities. The letters 'A' indicates a Members of Obatu, B. shows the thorn bushes used for meerii (Pond through) C. The meerii (Pond through) and D indicated when livestock are drinking water through the meerii (Source: Field Visit Report at Haro Daballe, Dhas District).

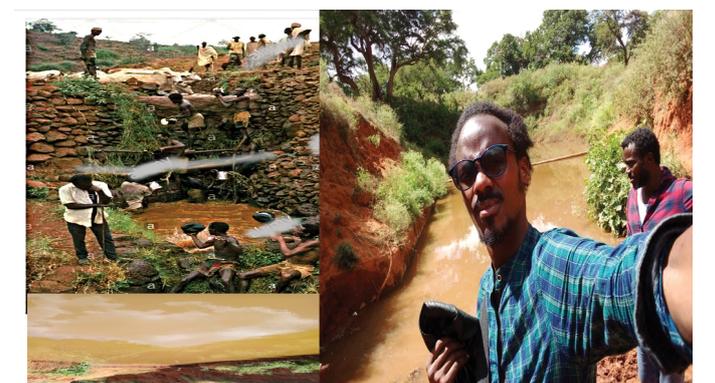


Figure 4. Ela borbor (Adaadii) that has enough water for livestock and domestic services for dry months and it had known as the Borana traditional shallow wells (Source: Field Visit at Borbori Oda Yuba, Dhas District Jan 2020).

In each watering day, the head person of watering day is responsible to manage the all-watering rules on his respective day under supervision of water caretaker. Alike the 'herregas' of the ponds, 'herregas' of the Tula-wells (Tula) are free servants, honest and formally appointed persons. However, they must be from Tula owning clan members and different persons from konfi. They must be willingness persons who come early to water sources and lately back home on each watering day for supervision, and must have indigenous knowledge of water sharing systems among the Borana in general and their own clans in particular. Apart from this, there are elderly people of the respective clan who usually oversee whether the management of 'herrega' is progressing in a logical manner or not. In case of mismanagement, the herregas of Tulaa are faced penalty.

Borana indigenous water resources management system in terms of Borana Water uses (Livestock watering calendar) calendar

In Borana community Watering principles, period and animals' prestige is depending on indigenous water budget or water uses calendar. The Borana Indigenous Livestock watering Calendar established based on the types of water sources, principal users, seasons of a year and period of utilization. Borana has known four traditional seasons. These are Ganna, Hagayya, Adoolessa and Bona, that is respect to scientifically seasons of winter, autumn, summer and spring. Ganna is a long rainy season from March to May. Adoolessa is a cool windy & dry period lie between June and August. Hagayya is short-rainy season (Middle of September to Mid of November) and 'Bona' is a dry season from December-February. The researcher tried to give tip-off about Borana water Budget Calendar in normal seasons of years by below table 1.

Generally, the Borana indigenous water sources management systems had established for pond, adaadii and Tula-wells. The 'adaadii' sources are mainly found at the foot of forested mountain; whereas, pond and Tula sources are excavated in the dry land. Management of these sources is/are still performed through facilitation of assigned managers by the community.

The ownership of water sources is continuing to trace through konfi title

based on clan association. Even though the ownership title traced through clan association, a Borana custom allows a member of Borana to use water from any source of 'adaadii, Tulaa' and pond that belongs to a fellow Borana clan. Excavation of pond for expanding in capacity and regular maintenance work is public affairs after konfi starts digging on the first day. However, excavation and maintenance of Tula primarily need contribution of corporate clan members.

Since the ownership of the water, resource is semi-private and it has attached to community ritual affairs, fewer interventions made from outsiders in the indigenous water management systems. Thus, management of this resource is/are relatively used according to the indigenous Borana rules of water management. However, there are some irregularities observed on pond management systems; for instance, in the past, the 'herrega' need to talk to elders in order to bring the agenda to community if he faces for any management issues beyond his capacity. Then, the whole community alerted for issues on water sources in all aspects. Nowadays, the 'herrega' sometime started keeping silence when observed mismanagement of water source under his supervision; likewise, there are community absents from meetings of water management. Those weaknesses can be resulted due to different factors: Because of thus factors the Borana traditional water resources management is cycles for Ponds, Adadi and Tula weakened today's (Figure 6).

Recently, there are developed various water sources like motorized water schemes, under and above ground cisterns, rock and roof catchments that resulted in other options for community to get access to water sources for livestock and human consumption. On the other hand, private sources of income such as water source and range land rehabilitations through cash for work; crop production, and so on, are creating individual thinking among the community rather than the communal one. Besides, establishment of small villages/towns around Tula-wells is polluting water there and obstructing pastoralists in getting access to those sources. Therefore, the rural town and villages must be far from Tula clusters water point.

The Figure 6 above shows that indigenous water management for ponds pass through Konfi, herrega, obatu and kora haraa eela. The Adadi pass through konfi, herrega, kora ela, obatu and totu and whereas the Borana indigenous water management of Tula authorization through Konfi, Herrega,



Note: The indicated letters represents Tula structures. A=Gulanta Ela, B=Baqassa Ela, C=Dargula Ela, D=Nanniga (Tula-wells through) E=Faccana (temporary reservoir) F=Qaawa eela (the end source from the tula discharge). (Source: Field visit at Gorile, Dhas and Wachille Tula).

Figure 5. Borana Tula-wells and its traditional structures that's show application of ancient Borana engineering practice.

Table 1. Summary of Borana livestock watering calendar in normal seasons of a year.

| Typical water sources | Description | Principal users | Seasons of a year and period of utilization | | | |
|-----------------------|--|--|---|---------------------------------------|------------------------------------|--|
| | | | Ganna/Winter | Adoolessa/Autumn | Hagayya/Summer | Bona/ spring |
| Water wells | Deep perennial water wells/Tula | Human & livestock (home based & satellite camp herds-Warra & Fora herds respectively) | - | July-mid of September (not intensive) | After mid of November | December–Mid of March |
| | Shallow water wells/ Adaadi | Human & livestock (In most cases Warra herds) | - | July-Mid of September | Mid of November-Mid of December | December-Mid of March |
| Ponds | Hand dug ponds | Human & livestock (In most cases Warra herds) | After mid of April-May | June-Mid of July | Mid of October-November | - |
| | Middle sized machine dug ponds | Human & livestock (Warra & Fora herds) | mid of April-May | June-August | Mid of October-November | December-End of January |
| | Big sized machine dug ponds | Human & livestock (In most cases Fora herds but currently both) | mid of April-May | June-August | Mid of October-November | December-Mid of March |
| Crater/Boke | Natural crater with water wells of salty water | Human & livestock (Warra & Fora herds), salty water hard for human consumption but, no alternative | - | July-August | Mid of October-November | December-Mid of March |
| Rivers/ Galana | Whole year flowing / Gannalle, Dawwa & Segen Rivers/ | Human & livestock (In most cases Fora herds) | - | - | - | January-February (not intensive) |
| Dams | Manmade dams | Human- mostly settlers for fruit production & Livestock mostly Warra herds | March-May (not intensive) | June –August (intensive) | September-November (not intensive) | December-Mid of March (very intensive) |
| Depressions/ Dambala | Natural dams | Human & livestock (mostly Fora herds) | April-May (not intensive) | Up to end of June | Up to mid of November | - |
| Puddles/ Dololo | Long narrow puddle of water | Human & livestock (In most cases Warra herds) | Mid of March-Mid of May | - | Mid of September-End of October | - |
| Running water/ Lola | Running water during rainy time | Human & livestock (Fora & Warra herds) | During raining time | - | During raining time | - |

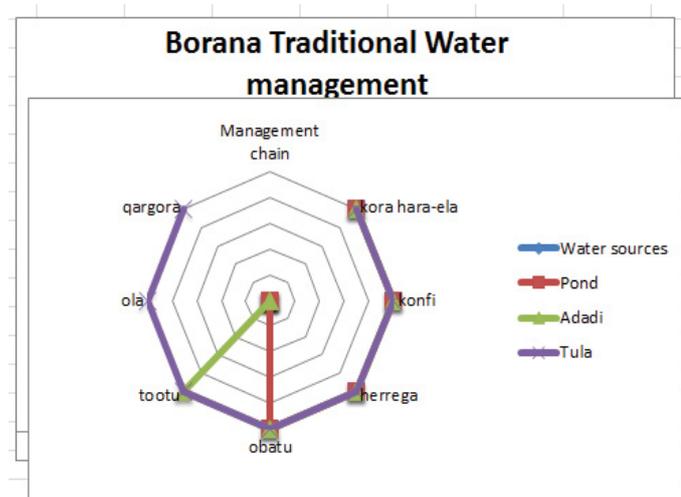


Figure 6. Borana indigenous water management cycle for ponds, Adadi and Tula.

obat, Totu, kora hara-eela and has particularly three watering days each known by three different name (Konfi, Ola and Qaragora) [8].

Conclusion

Borana Indigenous water management is the central to the success of Borana pastoral system is the advanced Institutions of resources management and land use. In Borana water management system and land use influenced by landscape types, land suitability, water and grazing patterns. Borana have defined local property rights to Tula-wells, Adadi and ponds. In general, the Borana traditional water management system/Institution has responsibility to organize and facilitate Tula “Eelaa (water wells)” and “Haroo (ponds)” maintenance and repair while all users have responsibilities to maintain wells and ponds on daily basis through contribution of labor, cash, animals and golden

time. Especially the clan members that own the Tula-wells or ponds should take lion share. The indigenous safeguarding upkeep for the water sources in Borana community includes the following techniques. These are Construction of fences, Cleaning the water sources on daily basis, Regular maintaining the of troughs (Naanniga) and temporary storage (Faccana) principally for Tula-wells and Adadi, Repairing and making of new meerii at all watering day based of the amount of water distance and depth to the through of ponds, Periodically excavating of Tula-wells, Adadi and ponds and etc. Restricted watering is a long held practice of the Borana society that has positive attributes in terms of conserving human labor, extending grazing radius from water points and increasing water-use efficiency.

Recommendations

Grounded on the assessment of Borana indigenous water resources management study took place in the Borana zone, the researcher outcomes and remarks accelerated a tough way to develop and encourage this indigenous precious engineering approach into the modern water management and keep it also as it are stated as:

1. The earliest indigenous water resources management systems of Tula-wells as structures of the Tula-wells of the Borana is one of the cultural heritages in the world that need to get recognition for protection. Therefore, the local and highest government body of water actors, as well as ministry of water resources should give the attention to the indigenous knowledge of water in the different parts of the country in varies community of Ethiopia.
2. Borana indigenous water management systems are still active and tolerable to sustain water sources that may use as the best performs in the other parts of the country, any development practitioners' requisite to respect and support them.
3. To improve sense of ownership with community side, water development projects should pass through indigenous water management systems

4. To conserve and pass the innovative indigenous water sources managements systems to the new generation, any water related actors on institutions in Borana requisite to articulate monitoring systems (what; when, who, why and how) of new water sources discovering and rehabilitation activities of the existing water sources.
 5. Re-arranging or appropriate the settlements need to be in place around water sources to defend environmental sanitation, upgrade of WASH projects at near water sources, particularly at nine clusters of Tula.
 6. Control the settlements and farmlands in the upper stream of water sources.
 7. Harmonize indigenous water management systems with policies of regional and federal government among the ministry of water resources and river basins ministry of Ethiopia.
2. Boku Tache and B Irwin. "Traditional, Institution, multiple stake holders and modern perspectives in common property: Accompanying change within Borana pastoral system." *Food and Agriculture Organization of the United Nations* (2003).
 3. Gemechu and Guduru. "The Sources of Life: Borana Concept of Wells and Water. (in) Palsson (Ed) From Water to World making; African Models and Arid lands." *Uppsala Scandinavian Institute of African Studies* (1990).
 4. Beshah et al. "Indigenous Practices of Water Management for Sustainable Services: Case of Borana and Konso Ethiopia." *Traditional Wisdom: Before It's Too Late* (2016).
 5. Canavas, C. "Public awareness and safeguarding, traditional knowledge, challenges and conflicts in preserving and representing 'kārīz/kānerjīng in xinjiang, P.R. China." *Water Sci Tech-W Sup* (2014): 758-765.
 6. Chuvieco, E. "Religious approaches to water." (2012).
 7. Helland, J. "Social organization and water control among the Borana of Southern Ethiopia. Nairobi, Kenya: International Livestock center for Africa." *International Livestock Research Institute (ILRI)* (1980).
 8. Legesse, A. "GADA: Three approaches to the study of African Society." *The Free Press* (1973).

References

1. <http://www.africanwater.org/religion.html>

How to cite this article: Godana, Jatani Bonaya and Sisay Demeku Derib. "Assessment of Indigenous Water Management System: A Case Study of Borana Community, Southern Ethiopia." *Civil Environ Eng* 11 (2021): 371