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Final
Assignment

Title: Road water harvesting, Food Security and Climate Resilience
Arid and Semi-arid Areas, Case of Machakos County, Kenya

Name of Participant; Bonventure Musambi Makhaya

Abstract

DESCRIPTION AND BACKGROUND

Water is one of the key natural resources for man's survival, and an essential for all development endeavours. Currently water scarcity remains one of the main causes of poor livelihoods and health. Globally, more than 125 million children under five years of age live in households without access to an improved water source and more than 280 million children under five years live in households without access to improved sanitation facilities. Unsafe drinking water and inadequate availability of water for hygiene contribute to 88% of deaths from diarrhea diseases resulting to deaths of more than 1.5 million children below five years of age (WHO/UNICEF, 2002). More local initiatives have demonstrated the existence of many opportunities for sustainable water resources development where low cost and simple technologies can change around lives of the rural people to increase human well-being (Khaka et al., 2006).

One form of mitigating the negative effects of drought is the implementation of simple, small-scale, low cost schemes called rainwater harvesting. This involves the capture, storing and redirection of rainfall, runoff, and groundwater.

In Kenya, such schemes are being implemented in rural areas through different actors. Commonly, water is collected by digging shallow holes into dry riverbeds where groundwater tables are high.

The collected water is used for domestic purposes thus making agricultural production low due to lack of enough water for farming. By implementing rainwater harvesting schemes water availability for farming is expected to be improved.

Water scarcity remains a major development challenge in Kenya and particularly in the Arid and Semi-Arid lands (ASALs) like the Machakos County. The commonly used small-scale water harvesting structures included the shallow wells, water weirs, water tanks and water pans due to their affordability and low requirement of specialized skills. Although unreliable rainfall remains a key concern, lack of adequate water harvesting structures denies farmers access to water during the few rainy days. With an investment of 7–10 billion USD in sub-Saharan Africa, the development of roads is a major factor in the change of landscapes and the drainage patterns. Thus, roads often act as conveyance systems, but the impact is often negative, leading to erosion, waterlogging and flooding. These impacts come down hardest on the more vulnerable and least resilient, such as poor female-headed households, people leaving with disability and youth. Yet these negative effects can be turned around and roads can be made into instruments for rainwater harvesting, food security and climate resilience. In this regard, there is a variety of techniques that can be used—ranging from simple interventions in the area surrounding the roads to modified designs of road bodies. What drives the transformation of roads is a change in governance too—better coordination between road builders and water resource and agricultural departments and closer interaction with roadside communities. Promotion of road water harvesting techniques used has a great potential to increase resilience and the hydrological and socio-economic effects. This will increase access to water as well as capacity development in cost-effective water harvesting technologies.

Yatta, is among the ASAL sub-counties in Machakos County where water scarcity is prevalent, and where more than 80% of the people practice rain fed subsistence farming as their livelihood. The area experiences erratic rainfall coupled with long dry spells after which the existing water sources become inadequate.



Roads have a major impact on the landscapes immediately surrounding them. Roads also have an important impact on runoff because they often act as either an embankment or a conveyance system, bringing major changes to the natural hydrology (van Steenberg, et al, 2017). These changes often have negative impacts: roads cause local floods and waterlogging along the way, whereas the more concentrated discharge from drains and culverts causes erosion and sedimentation (Garcia-Landarte et al. 2014; Demenge et al.2015). This undermines the resilience of roadside communities, who lose

crops or property or suffer health effects from road dust .However, this negative aspect can be reversed if roads are systematically used as instruments for rainwater harvesting. Thus, road harvesting can generate substantial positive impacts: more secure water supply, better soil moisture, reduced erosion and respite from harmful damage (Demenge et al.2015). In addition, rainwater harvesting leads to better returns to land and labour and a higher ability of people, households and communities to deal with and prosper regardless of shocks and stresses .With the investment in roads in many countries exceeding that of any other programme, this is a large opportunity to improve the productive environment and increase the resilience of the population in the vicinity of the road.



Some households in Yatta have received training from various experts. They have realized that despite water scarcity, their land is very fertile and that a quick fix of the problem would ensure food security is achieved. Having an interactive approach with the farmers would help solve social and economic barriers and to in turn empower the community. This can be achieved through a mindset change for the Yatta community.

TECHNOLOGICAL SOLUTIONS

The persistent poor access to water for agricultural and domestic use in low-income regions necessitates the development of low-cost alternatives technologies to water harvesting to improve farm production. The water harvested can be stored using different technologies such as :



Use of ponds/pits to harvest water from roads. Ponds have been constructed to collect water from any source including roadside drainages. It is common to have water from a culvert channeled into a properly design pond. The storage of rainwater can provide an extra source of water for irrigation, helping to improve the food security in the area(Steenbergen, et al. 2017).



Deep trenches are often used to control runoff and enhance groundwater recharge processes. This also increases the in-situ soil moisture of the soils around the trenches thus increasing production within this area.



Channeling water from culverts and roadsides into farmlands: Diverting runoff (from roadsides and culverts) into farmlands. The purpose of this structure is to enhance the availability of water for crop production



Conversion of borrow pits to water storage and recharge structures: In some areas, catchment runoff is concentrated in a large cross-drainage structure with three culverts. This new structure creates a constant threat and fear of flooding and in one event. For example, more cost-effective 250-m-long canal can be excavated to the borrow pit which can be able convert to 5000 m³ storage and recharge pond.

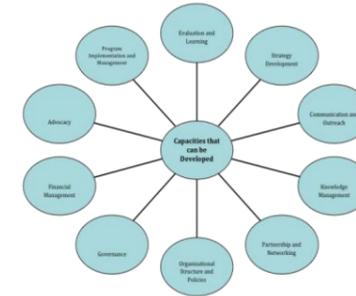
GOVERNANCE STRUCTURES

Water is an essential resource and the strength of the sector has significant impacts on economic growth, health and quality of life. Key industries, including agriculture and energy, rely on water as an input, with 78% of jobs globally being dependent on water (Journey & Changing, 2005). To move from 'roads that cause harm' to 'roads for resilience' requires changes in the technology used, appreciation of the different contexts in which roads are developed, the introduction of consultative processes and importantly changes in governance. Governance needs to be multi-stakeholder and recognize the reduction of risk and the distribution of access to benefits. It requires sensitivity of the impact of different road water harvesting options for male and female livelihoods, better linkages to male/female roles in different socio-economic contexts, ensuring female representation in local consultation processes and consideration of special measures to engage and support female-headed households in better road water harvesting and other opportunities created by roads for resilience.



Increasing demands of water for diverse use of domestic, agricultural and industrial consumption, both in quantity and quality pose tremendous pressure on the need of well-articulated management approaches. Such approaches are expected to address several challenges such as limited supplies, deteriorated quality of available and produced water, conflicting interests of public stakeholders and groups, adverse environmental and ecological impacts, climate changes, etc. Large number of these approaches exist and still evolve and develop for different purpose including data management, operation and governance, conjunctive management of water and energy, asset management, and technical support.

CAPACITY DEVELOPMENT



Capacity development is a holistic process through which people, organizations and societies mobilize, maintain, adapt and expand their ability to manage their own sustainable development (Batz, 2007).

Any or all of these capacities may be necessary within a given program or country context to the achievement of a healthy community with clean water supply and increased forest cover. The sustainability of water security requires involvement of target communities in resource mobilization for effective structural and capacity development investment.

To improve water harvesting and storage at household level, key aspects are;

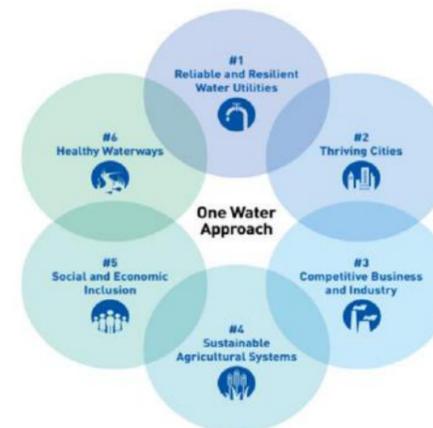
- A comprehensive knowledge and capacities in dealing efficiently with water. Clearly, the water problem (what), how to solve the problem and who are the beneficiaries and the concerned parties (the people who use water and the organizations who manage the water sector need such capacities.
- Capacity development interventions vary from expert-driven consultancy services and trainings to participant-driven peer-to-peer exchanges. The best capacity development programs employ a wide range of intervention types. The interventions are chosen based on a deep understanding of an issue's underlying causes and tailored to the local context. Traditionally, capacity development interventions have over-relied on big ticket events such as trainings and workshops.
- Identifying the range of capacities that seeks to develop include:
 - Technical capacities related to the impact area of any given intervention.
 - Operational capacities needed to accomplish individual tasks.
 - Systematic capacities to ensure that key functions are performed continuously over time.
 - Adaptive capacities to respond to changes in their operating environment.
 - Influencing capacities enabling an entity to bring about change within its environment.

SOCIAL INNOVATION

BUSINESS ROAD MAP

Incorporating social innovation in road water harvesting using cost effective technologies and materials enhance the improved livelihoods of the various communities. There is a huge Business opportunity and plan for road water harvesting in ASALs of Kenya. Road water harvesting will reduce the cost of road maintenance/infrastructure as most of the runoff is put to good use. You need to have the right resources and plans in place to implement and take it forward.

To embrace this idea into practice and create various opportunities within, the following should be considered:



- Stakeholders; this comprises of the various organizations or individuals with the idea and the target beneficiaries who will make use of the water harvested.
- Key business opportunities generated from the idea such as sale of farm produce
- Innovative water utilities are also transforming themselves as responsible managers of valuable resources, partners in local economic development and proactive members of the watershed community who are working to deliver maximum environmental benefits at an affordable cost (Shafer & Fox, 2016).

Farmers within Machakos County and the neighboring counties (Makueni and Kitui) have embraced rainwater harvesting technology to produce and sell food throughout the year. The use of water retention technologies such as the polythene sheeting enables farmers to conserve the available water and this ensures that their road harvested water lasts longer and that farmers get more value out of their investment. To ensure that the pond loses as little water as possible, it is designed deep and covered with an extensive net to minimize water loss through evaporation.

Road development is not only one of the major investments worldwide but also one of the practices that cause changes in runoff patterns in landscapes. For road water to be managed and to minimize all the negative effects there is a need to move towards the development of proper standards and approaches in the design and construction of roads. The sole purpose of building roads is that of creating transport corridors. In many counties, there is no cooperation between the Ministry of roads and infrastructure, agriculture, livestock and fisheries and Water and Irrigation.

There is need for the community to be encouraged and equipped with knowledge and skills on road water harvesting techniques. This will improve food production and increased groundwater level (SDG 1,2,11 and 13). Some of the techniques that can be adopted to harvest road run off achieve this include on farm ponds, retention ditches, terraces and check dams. Road water harvesting is an innovation that can be adopted for climate change adaptation in the Arid and Semi-Arid areas thus improving community livelihoods.

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