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THE POTENTIAL OF SAND DAM ROAD CROSSINGS(DRIFTS) FOR WEALTH CREATION FOR COMMUNITIES IN ARID AND SEMI ARID AREAS OF KENYA.

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ROAD WATER MANAGEMENT FOR RESILIENCE- FRAME WORK



Order of Presentation

1. Introduction
2. Identify arid and semi arid counties of Kenya
3. Road Network and Investments
4. Water harvesting methods from roads
5. The economic importance of Sand Dam Road Crossings (Drifts) as water harvesting structures
6. Conclusion & Recommendations

1. Introduction

- The Republic of Kenya is characterised by **dry land regions**, ASALs.
- These regions receive **low** and **erratic** rainfall of up to 700mm per annum.
- **Periodic drought** and **low vegetation** cover are experienced in these areas
- Due to **lack of water**, only **light pastoral** use is possible and **rained agriculture** is usually not possible.
- This Results to **hunger** and **poverty**
(Goodin & Northington, 1985).

2. Arid Counties of Kenya

- Kenya has 47 counties administratively.
- **Twenty three (23) counties are arid and semi arid regions with total population – 14,044,847 (33.5%).**

- Arid counties:

Turkana, Wajir, Mandera, Marsabit, Isiolo, Garissa, Samburu, Baringo & Tana River

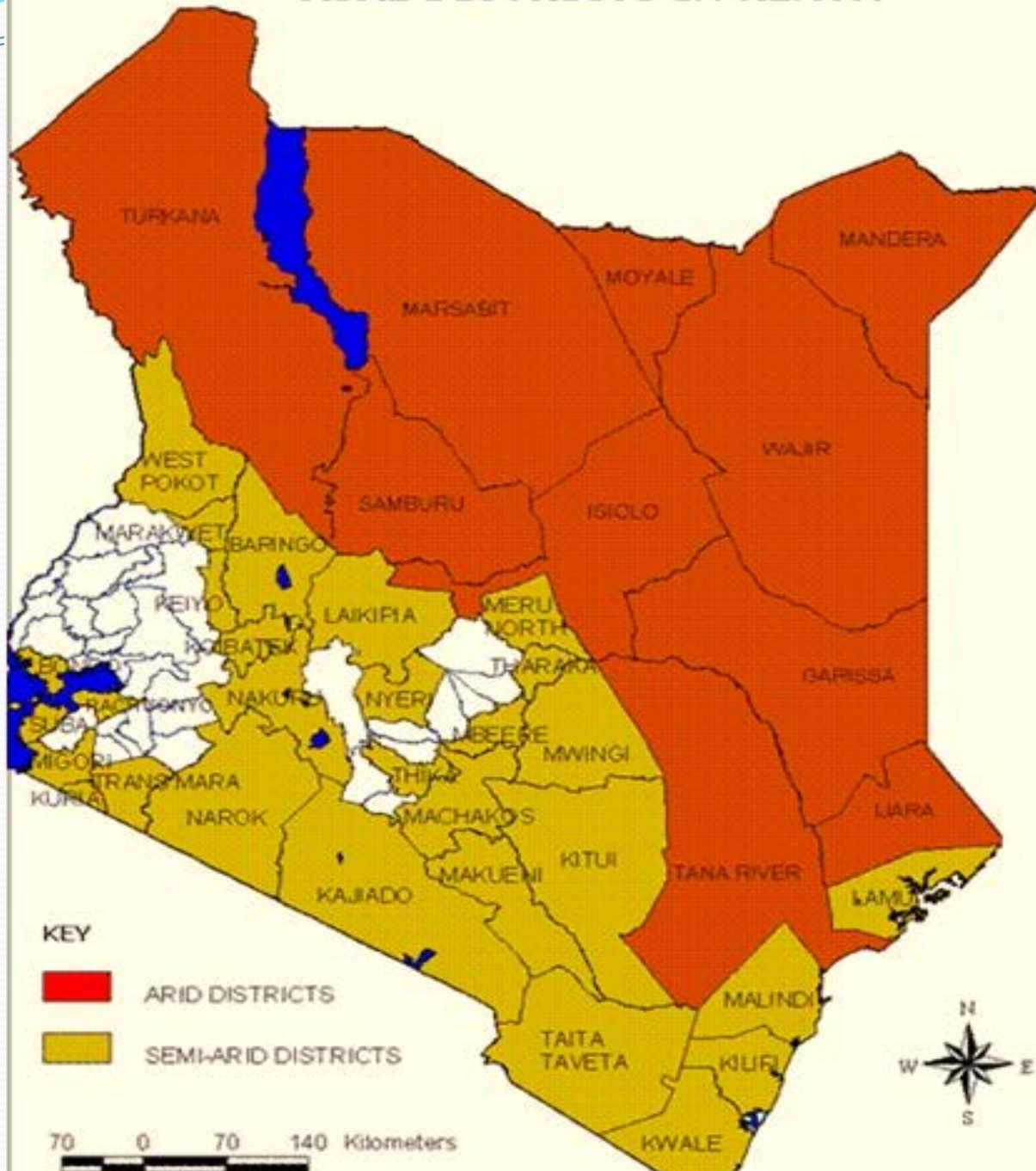
- **Semi arid Counties:**

Machakos, Kitui, Makueni, Meru, Embu, Tharaka-Nithi, West Pokot, Narok, Kajiado, Laikipia, Kilifi, Kwale, Lamu, Taita Taveta, Laikipia.

→ **The arid and semi arid counties are ranked the poorest in the country.**

(Source: Adapted from Vision 2030 Development Strategy for Northern Kenya and other Arid Lands (2011))

ASAL DISTRICTS IN KENYA



RAINFAL PATTERNS (Example of MAKUENI COUNTY)

- Average annual rainfall: **600 – 700** mm(**unpredictable** and **unreliable**)
- Short rains (**October – December**) and long rains (**March- May**)
- **Drought seasons** (years receiving less than 250mm of rainfall) tend to occur in 2-5 seasons with over 50% classified as drought seasons
- Annual mean temperatures: 21-30 degrees
- **High evaporation** experienced due to high temperatures and **low vegetation** cover.

3. Road Network in Makueni County

- Total road network in Makueni county – 3,800km
- National road network – 600 km
- County road network – 3,200 km

- **Over 98% of road network are in Rural Areas while less than 1% of road network is in Urban town centres.**

Road funding in Kenya

- **Main sources of funding**
 - Road maintenance Levy Fund (RMLF)
 - Development fund (Treasury)
 - Cess Funds
 - Transit tolls

Annual Road maintenance budget in Makueni County

- Total annual budget **Kshs 900 Million(us \$ 9.0m)**
 - Kenya Rural Roads Authority
 - ▣ Estimated **Kshs 300 Million (US \$3.0 M)**
 - Makueni County Government
 - ▣ Estimated **Kshs 600 Million (US \$6.0 M)**
- The Funds are used for
 - **Construction & Maintenance of roads**
 - **construction of low cost road crossings(Drifts).**

Source: KRB Annual public roads programme financial year 2016/2017

4. Water harvesting for people and Agriculture

- WHY?

- Become **resilient** to **harsh** climatic conditions.
- Water is goes to waste in Indian ocean.
- The **rivers dry up** quickly and leave the people without water for **animals** and **domestic** use
- The **crops dry up** leaving the people with **hunger** and **poverty**.

→ [Need to harvest water, store it and use it for agriculture and production .](#)

Water harvesting methods from roads

There are 2 key methods of collecting water from roads

1. Using road and road catchment to drain water through
 - Side ditches, mitre drains, diversions
 - Culverts
 - Ponds ,borrow pits etc.
2. **Road crossing structures (non vented drifts & key walls) on seasonal rivers.**



Water harvesting in seasonal rivers:
Kyuasini Non vented drift (80m x5m) constructed on
bedrock
(Road crossing as well as water retaining structure) -2012



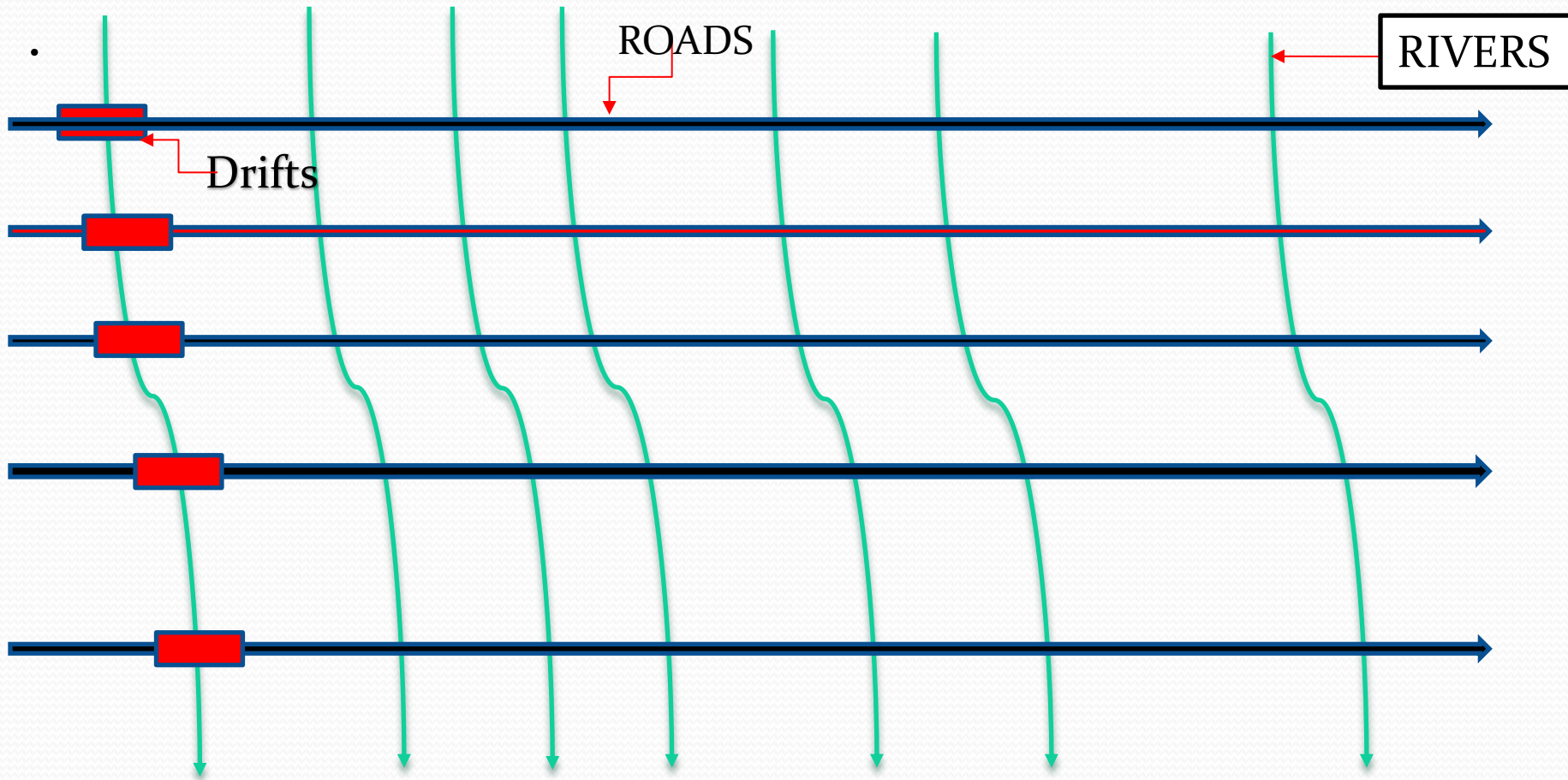
Harvesting water through roads crossings (drifts) in Makueni County

- Characteristics of rivers in Makueni County(1)
 - Many expansive(large) **sandy or rocky** seasonal rivers and **lack of water by the local communities.**
 - The rivers range in span from **5 -300 metres**
 - Rivers flow for just a **few days** a year. Then Drying up before water is used.
 - **Rivers cut across rural roads → challenge for road crossing.**

Harvesting water through roads crossings (drifts) in MAKUENI COUNTY

- Characteristics of rivers in MAKUENI County (2)
 - Sandy river beds are challenging to road traffic.
 - In dry conditions Sandy soils are too loose
 - In rain seasons they are floody - not passable.
 - Rocky river beds are too rough to drive through.
 - Bridges on large rivers are expensive to construct due to inadequate funding.
 - Culvert river crossings are too vulnerable.
 - Risk of being washed away by floods due to sedimentation
 - Culverts allow water to pass through, instead of storing the water.
 - Non-vented drifts
 - Provide affordable road river crossing for transport
 - Provide water for people

River – Road interactions in Makueni county



- Dry sand river bed in Yekanga river –100m span
(Too loose during dry seasons - Making it difficult for loaded vehicle to pass)



Wet sandy river bed in Muangini river (200m span), in rain seasons loaded vehicles sink— drift construction ensures access.



Expansive river crossing in Rocky River bed in Thwake river -170m span (The rocky surface is very rough and uncomfortable to drive- Drift construction ensures smooth riding surface)



A Vented culvert river crossing -
(Requires regular maintenance to remove sediments and
flotsam-the capacity of the culverts is greatly reduced
resulting in wash away and cut off road in addition it
does not retain water)



NON VENTED DRIFT (SAND DAM)

- In order to solve the problem of **Water** and **Hunger** which is pertinent in Makueni County,
 - Has resulted in a serious thought to develop and design **Non vented drifts(without culverts)-sand dam** to act as both **road crossing** and **water retaining structure**
 - To provide the surrounding communities who live within a radius of 3-5 km from the structure **with water all year round** and enhance **road connectivity**.

*Below: Muangini drift 60m span construction in 2012
(a source of water for domestic and small scale irrigation) and
improved ecosystem*



Mukuyuni drift - 120m span
(Constructed on sandy river bed acting as both a road crossing and a water retaining structure)-2012



THE BENEFITS OF NON VENTED DRIFTS(SAND DAMS)

1. Provide connectivity in rural roads enhancing trade

- Drifts create all weather road crossing enhancing trade and reducing travel time.
- *Below: isuuni river crossing - acting as an all weather road crossing- constructed in 2013(60m span)- Mbooni sub county*



2. Provide adequate source and sustainable supply of safe and clean water to homesteads and domestic animals.

- During the rainy season, the sand behind the retention walls will fill with water and sand and recharge ground water within the river belt
- *Below: Kako drift- a source of piped water for [Kako](#) and [Kyaluma](#) villages(Mbooni sub county)*



3. Increase food production through initiating small plots under small scale irrigation.

- Drift construction results in a sustainable source of water, the community can organize themselves through a [project management committee](#) to set up small irrigation plots ranging from 0.25-0.5 acres.
- *Below: A Small irrigation scheme in Muangini drift (a source of sustained food in rural areas)- Kilome sub county*



*Maize growing plot in Muangini drift
(A source of sustained food)*



A small scale irrigation farming in Kiboko river(Kibwezi west sub county)



Nthwake drift

a source of sustained food



4. A sustained source of clean river sand for development projects

- The non vented drift retains a lot of sand in the upstream side. **With organised sand harvesting, additional income** can be generated by the surrounding community and **shared** between the **individual households**.
- *Below: Retained sand in the river bed due to drift construction in Muangini drift.(1 – 2 KM upstream) from the crossing-(Controlled sale of sand to building sites generate income for the rural community)*



5. Increased individual house hold income through brick making.

- With explosion for need for housing and commercial buildings due to **devolved system of government in Kenya** and the **sustained availability of water in the sand dams**, the individual households can **make bricks for sale to earn income**. This will result in **creation of employment in rural areas**.
- *Below: Brick making activity in isuuni river drift -(A source of income for the rural community)*



6. Increased forest cover and improved ecosystem

- Non vented drifts ensure sustained water which is used for **setting up tree nurseries**. The community will plant trees in the **river belt, road sides** and also in their **individual households**. This **increases forest cover, sale of tree seedlings to other areas, controlled sale of timber & fire wood for income**
- Below: A forestation as a result of presence of water in the river due to drift construction along Muangini drift river banks-(Improved ecosystem and source of income – **timber/seedlings/wood sale**)



7. Increased school enrolment.

- When rivers flood during rainy season school going children are able to **access schools as a result of the constructed river crossing.**
- **With the drift in place water will be obtained within a short distance** and children will not be forced to leave school to go to search for water.
- **The increased income from the economic activities** will also ensure that parents get money to pay for school fees for their children in **primary/secondary schools and even at the universities.**

8. Increased Health

Dramatic fall in water related diseases

- **With the drift in place and clean water stored in the sand, communities observe a dramatic fall in water related diseases such as **malaria** and **diarrhoea** this results in an **increase in school attendance for school going children****
- **significant increase in household income and food production** since children and parents will have better health to work in their farms and in other related income generating activities .

9. Community owned and managed Projects

- **Community ownership and management** is key to the successful operation to any sand dam project. **It is important to involve members of the community during planning, implementation and commissioning of the project.**
- **Education on the monetary value associated with the drift is Key in order to realise full benefits of the project.**

10. Low cost and maintenance:

- Non vented drifts are constructed of **masonry** and **reinforced concrete walls** using **locally available materials** and **cheap labour** from the local communities. They are long lasting with life span of over 100 years
- *.Below: Mukuyuni drift - 120m span(constructed to good standard hence long lasting requiring very low maintenance) -2013*



ESTIMATED COSTS FOR NON VENTED DRIFTS BASED ON THE SIZE AND SITE LOCATION

Table 1: Drift construction costs per metre length in Makueni county 2016	KSH per metre	US dollar per metre
Drift type 1: Large drift, foundations excavated maximum depth 1.5 m and elevated 0.5 metre above the existing sandy river bed.	130,000	1300
Drift type 2: Large drift, constructed on bedrock, elevated 0.5-1.2 m above the existing river beds	80,000	800
Drift type 3: Small drift, constructed on normal ordinary river channels. Elevation 0.3m above the existing river bed level. Depth 0.5 -1.0 m	50,000	500
Type 4 : Small drift(Road slabs), constructed on swampy plains . Little or no elevation above the existing river bed level maximum depth 0.5m	35,000	350

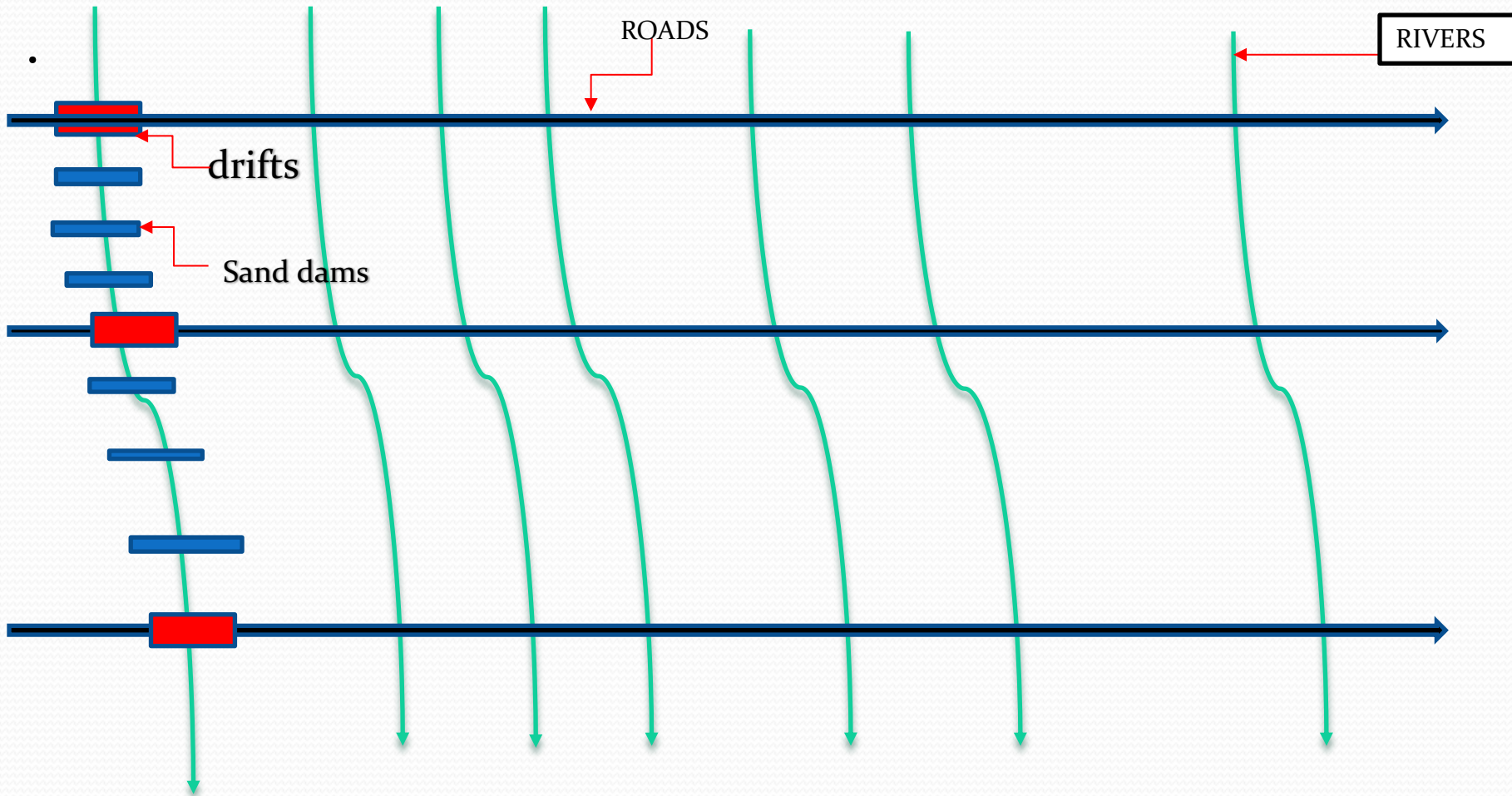
Recommendations

- **Adopt non vented drifts** as river crossing in low volume roads
 - Will result in **wealth creation** for communities living along river belts in ASALs areas of Kenya.
- **Integrate road water harvesting in National & County plans**, to provide clean water for **people** and **Agriculture**
- **Roads departments** who are the lead managers of Rural roads need to **partner with other departments of Water, Agriculture, Environment and Administration.**
 - Identify all low volume road – river crossings
 - Maximally utilize benefits by working together.
- **Sensitize and involve local communities** living in proximity of river banks during **planning, implementation and maintenance.**
 - For full potential utilization of the structure
- **Policies** needed on **water harvesting and management** from roads
 - Design manuals and guidelines
 - Expand road contract documents bill No. 25 to include water harvesting from roads component
 - Bring water harvesting from roads to full scale by incorporating the cost of water harvesting in the **project during planning and implementation.**

Conclusions and Way forward on our Rivers - lets emphasize



Combine non vented drifts with sand dams in rivers -(Results in green and rich river belts).



Let's avoid



If We do, We shall get...





END

Thank You