**RIVERS AND RIVER SYSTEMS**

**TERMS USED**

1. A RIVER refers to a mass of water flowing over the land surface from its source to the mouth.
2. River’s source is a place where river gets water from. Is where the river starts.
3. River’s mouth is to where the river ends, pour its water into the sea or lake.
4. Catchment area refers to the region which drains all the rainwater that falls on it into a river. It may be a lake, forests spring etc.
5. Water shed or divide is a highland region or elevated boundary separating the headstreams of rivers to different river systems. These are uplifts separating two rivers flowing to different directions.

Water shed

1. Riverregime refers to the seasonal variation in the volume of water in a river. It depends on the changes in rainfall.
2. River profile refers to the length of the river channel from its source to the mouth. These are of two; the longitudinal and cross river profiles as seen below with their illustration
3. ***Longitudinal profile of a river:*** *This is a section / stage of a river from its source to its mouth. Its gradient is steeper in the upper (Youthful stage, moderate in the middle(mature stage) and low lying in the senile stage( old stage).It shows the distance covered by a river.*

***youthfull stage Mature stage***

-Gentle gradient, increased wate volume, balanced erosion and deposition, meanders, river transportation, Lateral erosion etc

-steep gradient, faster water, hard rocks, small water volume’ v-shaped valley, common vertical and head ward erosion etc

***Senile stasge***

-Low lying gradient, Lateral erosion, river deposition, river discharge and floods, open U-shaped valley etc

1. ***Cross profile of a river:*** *This is a section of a river showing the vertical or shape)nature of the valley of a river from side to side.*

*In the upper stage show a* V-*shaped valley due to intensive vertical erosion on the bed, the valley is deep. In the mature stage, it has a* U*-shaped valley due to lateral erosion valley sides which widens it. And the lower stage, the valley is open* U-*shaped (broadly or widely opened) and flat bottomed valley due to lateral erosion, the valley is shallow due to deposition of the load.*

**Old stage** *with lateral erosion effects of broad and flat bottomed valley*

**Mature stage** *with lateral erosion effects*

**Youthful stage** *with vertical erosion effects*

***Qn: Distinguish between a cross river profile and a longitudinal river profile.***

**STAGES OF ARIVER PROFILE**

From the above distinction of river profiles, there are three stages along river profile as

I-Youthful stage ii-Middle stage iii-Old stage

**The Youthful stage and its characteristics**

* It is also called upper stage or torrent stage.
* The river flow over a steep gradient caused by the hard parent rocks.
* The river is fast flowing or high velocity due to a steep gradient.
* The valley cross profile is V-shaped, deep and narrow due to vertical erosion at the valley bed.
* The dominant erosion is vertical erosion which deepens the valley and headward erosion which lengthens the valley profile. The river under cuts back to its source.
* The river winds between the interlocking spurs which are uplands of hard rocks.
* It has a small water volume flowing due to few tributaries joins the main stream.
* It has the catchment area, a section where river water starts to flow from.
* The valley bottom is rough due to existing potholes
* Other features in this stage include waterfalls, and rapids, V-shaped valleys, spurs, plunge pools, etc formed due to rivers erosion.

**The middle stage and its characteristics**

* It is also called mature stage lying between the upper and lower sections.
* It has an increased water volume due to more tributaries joining the main stream.
* The gradient is gentler than in the youthful stage with reduced rivers speed.
* The lateral erosion occurs on sides to develop a U-shaped valley.
* The valley cross profile is wide with U-shaped valley.
* River meanders and bends begin to develop as spurs are under cut laterally.
* River cliffs are common as spurs are laterally eroded.
* There is reduced erosion with few erosion features of cliffs.
* Deposition of sediments begins with big rock debris and some depositional features.
* Commonly river transportation exists in which river loads are moved to the old stage.

**The senile stage and its characteristics**

* It is also a lower section or old stage of a river.
* It owns the river mouth where river water is poured into a sea or a lake.
* River flow over a low lying area or flat land area.
* The rivers speed is very slow due to a low gradient.
* Deposition is dominant due to reduced rivers speed.
* The valley flow is covered by a layer of sediments called alluvium.
* The load consists of mainly silt and other fine materials.
* The deposition cause several distributaries (small Channels) to form deltas.
* Lateral erosion has developed a widely open U-shaped valley.
* A high river discharge due to several tributaries joining the main valley.
* Other existing features are braided channels, differed tributaries, slip off tributaries, meanders etc.

**DAVISIAN CYCLE OF EROSION IN A RIVER VALLEY**

* It is also called a geographic cycle or erosion cycle in which landscapes are formed along the long river profile.
* It was advanced by Davis Morris William, an American geomorphologist in 1850-1930 after travelling extensively and studying landscapes in North America.
* He proposed that landscapes develop through distinct stages of youthful, mature and old age.
* The ideal puts it that, any landform is a function of Structure, Process and Time.
* By structure refers to the nature of the rock and how they differ from one another in hardness, permeability, faults, dipping, colour age etc.
* By process relates to agents act on rocks by exogenetics of weathering, erosion by wind, water and ice etc.
* And as well as endogenetic processes of faulting, volcanicity warping and folding.
* And time is the length of period during which the process/ agents have acted on rocks to cause a landform.
* He illustrated that Young sedimentary rocks (structure) are acted upon by compression forces (process) for a long period of time to lead formation Mountains. This created gradient levels.
* The uplift of land creates a youthful stage with youthful landscapes dominated by a steep gradient/slopes and irregular surfaces.
* Rain falling on this landscape soon collects in depressions and develop youthful river systems with V-shaped valleys and other youthful features
* The youthful river system soon begins to plane (erode) down the landscape and reduce the steep gradients to more gentle slopes.
* This produces the mature stage and landscapes against which mature rivers flow.
* In this stage the streams widen their valley through meanderings and floodplains are formed.
* Prolonged river erosion finally reduces the mature landscapes to an almost undulating landscape, which he called **pene-plain** (**low** lying plain) and on which old stage flow.
* In the old age rivers are reaching their base level and meander more widely, depositing sediments across extensive low lying plain.
* The application of youthful maturity and old age to landscape created a fluvial process.
* Davis wrote ‘a young landform has young stream of torrential activity, while an old landform would have an old stream of deliberate or even feeble current’.

***Criticisms***

* *He dint know that some rivers have a stronger velocity in the old stage than in the upper stages* ***eg*** *River Mississippi and Brahmaputra.*
* *Many researchers like Walter Penck criticized Davis model for over- simplification and for not, being cyclic but instead a one directional process that changes a landscape from highland to peneplain.*
* *However, despite such incorrect assumption Davis model is still represents an important framework within which geographers can explain landform development.*

***QN: Explain the Davisian cycle of erosion to the formation of the river valley landscapes.***

**RIVERS ACTION / ACTIVITIES AND LANDFORM FORMATION**

These include rivers erosion, transportation and deposition.

**Rivers erosion ,processes and landscapes**

There are three types of river erosion of:

* ***Headward erosion***
* Refers to the erosion at the source of a stream or river and it results into the lengthening of a river valley/profile.
* It takes place when a river cuts back upstream of the valley above its origin source.
* It is caused by rain-washing, gulling, soil creep and spring sapping.
* ***Vertical erosion***
* *This refers to erosion ,which wears down the river bed*
* *It causes the deepening of th of the channel through abrasion process mainly.*
* *It produces a V-shaped valley aided by small water volumes.*
* ***Lateral erosion***
* *This refers to erosion, which wears down the bank sides of the river valley.*
* *It cause widening of the valley channel to U-shaped valley*
* *It is the most at the curved bends of the river.*
* *It is largely done through hydraulic process and solution actions.*

**Processes of river erosion** -These are mechanisms or ways in which rivers erode its valley and they include abrasion, hydraulic, attrition and solution.

***Abrasion/Corrasion action***

* refers to the wearing away of the sides and bed of the river channel a load.
* It is by gridding/ scratching the bed using the load commonly boulders and pebbles.
* It also causes potholes along the river’s channel bed.
* It is common in rivers like Nyamwambw, Mubuku, Sironko, Manafwa, Mpamga, Ikwe, etc.
* It causes an increase in the load boulders which are swept downstream during flooding.

***Hydraulic/cativation action***

* It is caused by the force of fast moving water, which is able to remove loose materials of gravel, sand and silt.
* These sweeps out weak materials by surging into cracks hence breaking up solid rocks.
* Water compresses air in cracks and cause bubbles which also bursts to cause shocks that loosens, lifts and break up solid rocks.
* It is common on the river sides to cause river cliffs

***Attrition***

* This consists of wearing down of the load by its self into small particles.
* This take place as rock fragments are in constant collision with each other and other materials and bed.
* It causes boulders to breakup into smoothened and rounded materials as move down stream.
* These are seen along R. Ewaso Ngiro, Naro, Moru, Ruvu,Mubuku,Ruimi,Nyamwamba etc ***Solution/ Corrosion***
* This involves the solvent action of a river
* Soluble rocks of calcium carbonate/limestone (CaCO3) are dissolved and carried away in water by solution.
* Solubility depends on the mineral/chemical composition of the rock over which river flows.

**Factors influencing rivers erosion in East Africa**

**-The volume of river water** as small water cause vertical erosion in the upper section while large volume cause lateral erosion in the mature and old sections.

**-The nature of the parent rock along the profile** as hard rocks of spurs in the upper section limit erosion to the bed to cause V-shaped valley. Some limestone rocks are weak to quickly dissolve in water for erosion.

**-The climate and mostly rainfall and temperatures**. Eg rainfall cause water discharges in a valley and increase lateral erosion in the mature and old stage. It also do rain washing in the catchment areas to cause headward erosion. While hot temperatures especially in dry areas cause water volumes to fall and facilitates vertical erosion.eg river Turkwel in north eastern Kenya.

**-The nature of the gradient over which river flows.** In the upper section the gradient is steep to facilitate fast flowing water which causes abrasion and hydraulic causing vertical erosion. The senile gradient is low lying causing slow bank washing by lateral erosion.

**-The volume and size of the load carried by the river.** Big and heavy boulders are rolled through abrasion to erode the river channel bed through vertical erosion. These however collide through attrition to provide more load which increase the rate of erosion in rivers.

**-The effects of the earth’s movements acting in the river areas**. Faulting, volcanicity for example occur across the profile causing steep gradient over which fast river water flows to effect erosion in the upper stage.

**-The human activities** also accelerate erosion in river through damming; farming on stream banks etc. these provide large loads which increase abrasion.

**Relief Landforms in the upper section due to river erosion**

***Qn: Describe the effects of rivers erosion on landform evolution along the river profile in East Africa***

1. ***A V-shaped valley***

-It is a cross sectional view of the profile in the upper section of a river

-It is a narrow deep river valley caused by vertical erosion

-It is formed due to abrasion on the rivers bed which scratches to erode the bed racks

-This is because the rocks are less resistant than those on the sides of the valley

-It is seen in the rivers of Isiolo, sagoma, Thuchi, flowing from mt.Kenya and Mubuku, Nyamugasanyi and semliki from mt.Rwenzori

River

1. ***Interlocking spurs***

-These are the uplands /highlands where youthful stages originates through which rivers flows down the slope.

-Vertical erosion rapidly wash down the bed to deepens the valley through abrasion

-The river twists and turns around obstacles of resistant rocks on concave sides but eroding soft rocks on concave banks

-These are seen on Semliki, Thuchi, Mubuku in Uganda;R. Timau,Thuchi,Sagana etc

**spur**

**spur**

**spur**

**spur**

**main stream**

**spur**

1. ***Potholes***

-These are semi circular depressions on the river bed. Are uneven bed of a fast flowing river

-Formed due to abrasion and hydraulic actions by loads and swirling water

Potholes

River direction flow

1. ***Gorge/canyon***

-This is a deep, narrow steep sided V-shaped valley.

-it is formed due to abrasion in which river under cut its bed by its load

-A powerful river cutting down its bed at a rate far greater than weathering and mass wasting which wear down the valley slope.

-gorges includes Great Ruaha gorge in Tanzania, Mitano gorge on river Birila in western Uganda, Murchison gorgeon the Albert nile as it enters L. Albert.



**Gorge**

1. ***A plunge pool***

-It is a broad shallow depression at the base of the waterfall or an enlarged pothole.

-it is formed due to progressive drilling and grinding of the valley floor.

-Plunge pool also form where resistant rocks overlie less/soft resistant rocks .

-May also be formed due to river rejuvenation where river renew its erosive activity.

-Erosion of the underlying soft rocks produces a waterfall; a pothole is formed at the base of the soft rocks by scouring action, swirling and undercutting which enlarges potholes to plunge pool.

-Examples seen at Murchison fall on Albert Nile, Sezibwa falls in Buikwe, sipi falls in Kapchorwa and Kisizi falls in Rukungiri

Waterfall

Plunge pool with calm water

Cliff

**Hard rocks**

River flow

**Soft rocks**

**Soft rocks**

1. ***Water rapids***

-This refers to the irregularity of the water flowing in the river channel. In some areas is deep and in other areas is shallow.

-It is like waterfalls however it is formed when soft rocks are eroded to expose hard rocks to the surface by swirling actions.

-It occur on a steep gradient but not vertically dipping rocks

1. ***Waterfalls and cataracts***

-This is the sharp break in the channel bed over which the river flows from a higher level to a lower level suddenly.

-Waterfalls develops when resistant rocks overlying a less resistant rocks, is horizontal,or vertical or dips gently up-river.

-They form due to hydraulic forces of falling water to form a plunge pool at its bed

-Examples include Sezibwa falls in Buikwe, Murchison falls on river Nile, on river Bujuku valley ion mount Rwenzori, Turkwell falls and Torok Falls in knya;etc

**Waterfalls**

**Hard rocks**

Plunge pool

Cliff

**Hard rocks**

River flow

**Soft rocks**

**Soft rocks**

**Causes and processes to the formation of Waterfalls**

* ***Waterfalls are formed due to difference in the parent rocks of hard and soft rocks*** across a river course. The soft rocks are quickly erodes downstream to cause a sudden fall in gradient over which river water flows to cause water fall. See the diagram above.eg the Gura, Tana, Grand and Adamson falls on R. Tana , Fourteen falls on R. Athi
* ***Through earths movements waterfalls by faulting and volcanicity. Faulting*** is the fracturing of the surface and vertical displacement of rocks across a valley river***.*** This cause sharp knick points over which waterfalls occur.

**Water falls**

River direction

**Fault line**

**Tensional forces**

***Vulcanism*** cause ***intruded sills and dykes to be exposed*** through river erosion to cause rock dipping for sudden water falling to lower levels. It also cause ***fluid lava*** to flow distance s into river valleys where it solidifies to block river flows forming lava dams which over flows to form waterfall.

* ***A waterfall is formed by glacial actions*** as hanging valley melt water fall into glacial valley troughs over steep slopes. See glaciations hanging valleys seen in Bujuku valley on mout Rwenzori.
* ***Landslides across a river*** may create a waterfall where the river drops over the edge of the barrier e.g lily falls in Madagascar.
* ***River rejuvenation*** cause sharp knick points resulting into waterfalls e.g the Charlotte falls in Sierra Leone
* ***River capture*** in which one river captures head waters of a nearby river and waterfalls occur at the elbow of capture course.
* ***Waterfalls form where a river falls over a plateau edge***, especially when flowing from a high level to a lower one e.g Augrabies falls in South Africa

**River transportation**

It refers to the movement of the loads down the stream. The large materials are moved for a short distance while small and light materials are moved for the long distance. The loads are boulders, pebble, gravel, and sand and silt materials.

A river transports its load in four ways;

* By **traction** involves dragging of large pieces of boulders, pebbles along its bed.
* By **saltation** involving the bouncing of small pieces over its bed
* By **suspension** as the light materials like silt and mud in the water are moved
* By **solution** involving certain materials dissolving in water.

Factors influencing the transportation in rivers

-The speed of water able to move all load nature down stream.

-The river water volume as small volume is able to tract the load for short distance

-The roughness of the valley bed as potholes trap the dragged loads of the pebbles etc.

**Rivers Deposition**

Refer to the dropping of the load by the river. This can take place at any point in a river course. It takes place when a river has insufficient energy to carry all its loads. The boulders and pebbles are dropped first and sediment of silt last and these accumulate to form alluvium. This take place due to the reduction in speed of a river caused by reduced gradient , channel shape, size of load, river flooding. This also commonly occurs in the lower section of the river.