

**PUMPING SYSTEMS-**  
**WATER LIFTING DEVICES**

# IMPORTANCE OF WATER LIFTING DEVICES

- Lift irrigation requires that water be raised from its source to the field surface.
- Whatever the source of water in a lift irrigation project, the efficiency of the system depends on the application of sound principles in the design and construction of utilization structure, usually the well, and the characteristics of the water lifting device in relation the source of water.

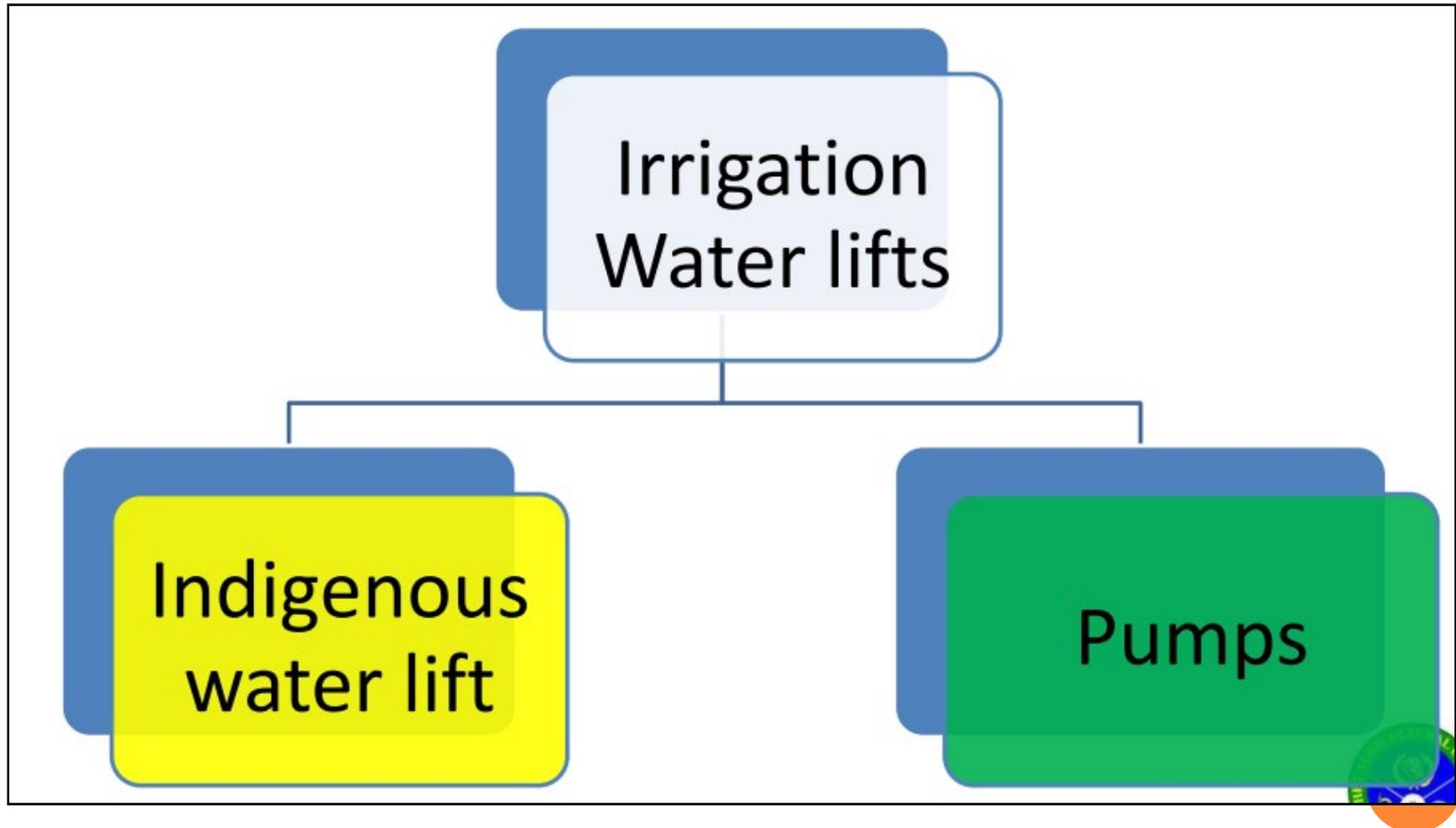


# TYPES OF WATER LIFTS

- I. Indigenous water lifts
- II. Advance water lift



# CLASSIFICATION OF IRRIGATION WATER LIFT



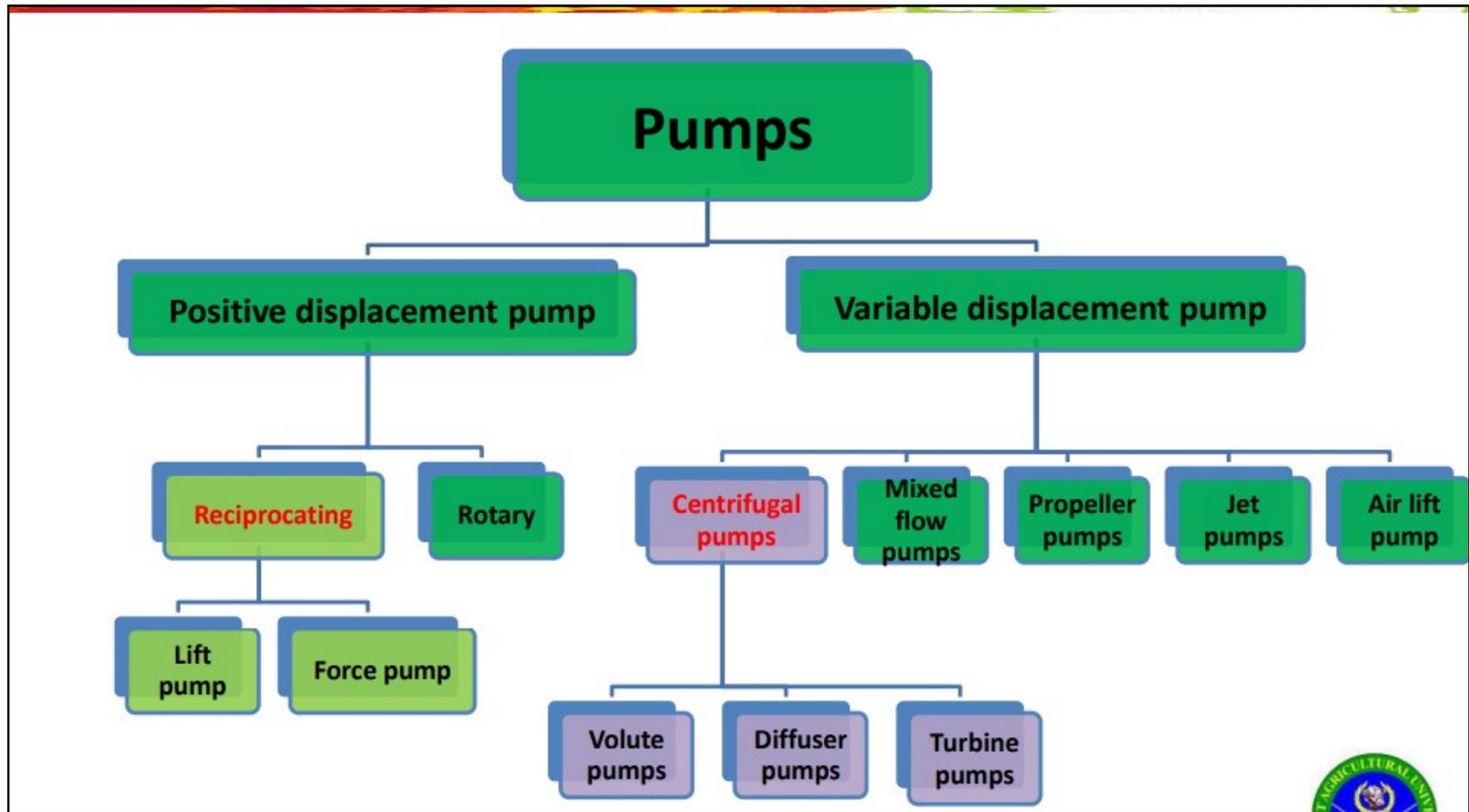
Indigenous  
water lift

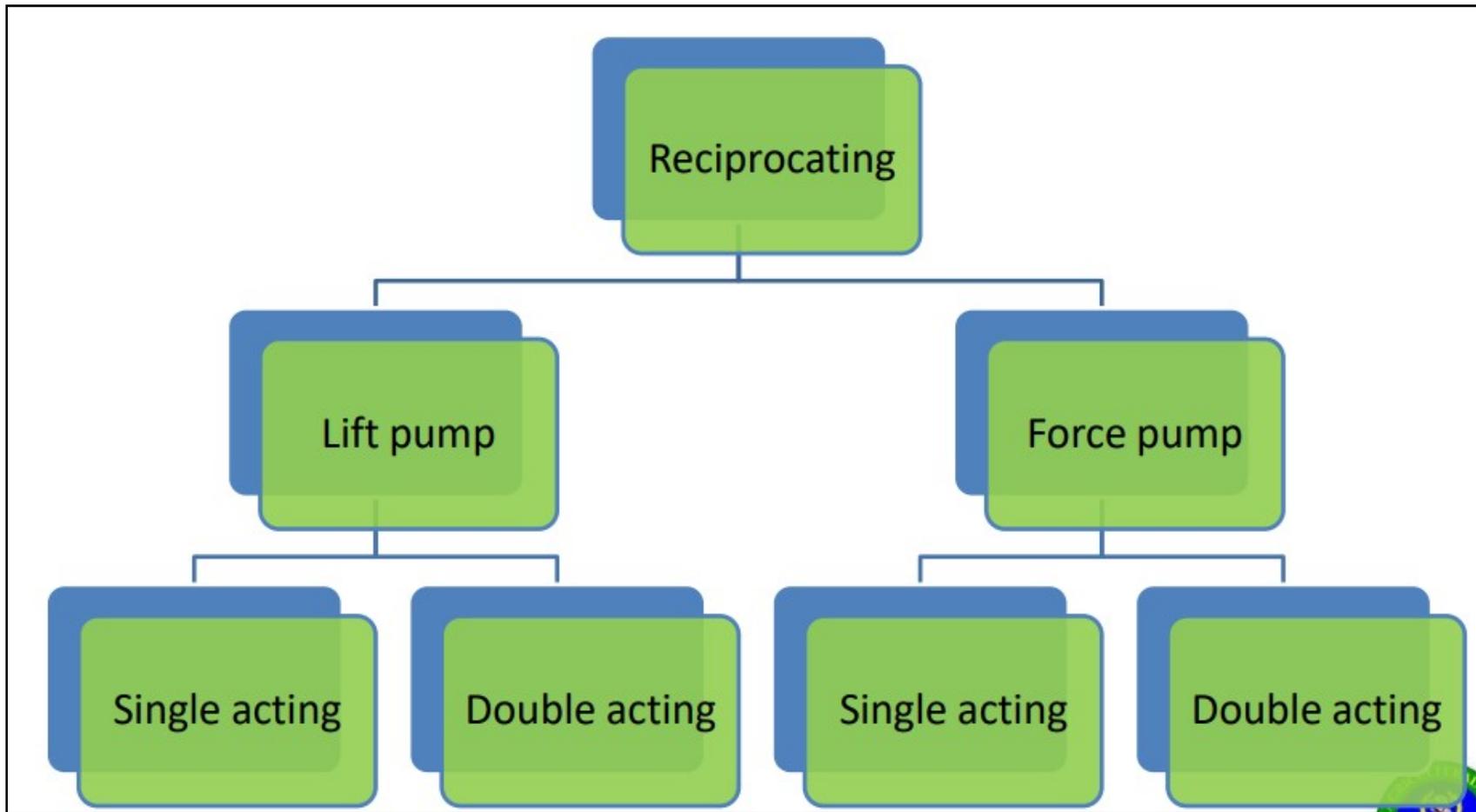
Low head

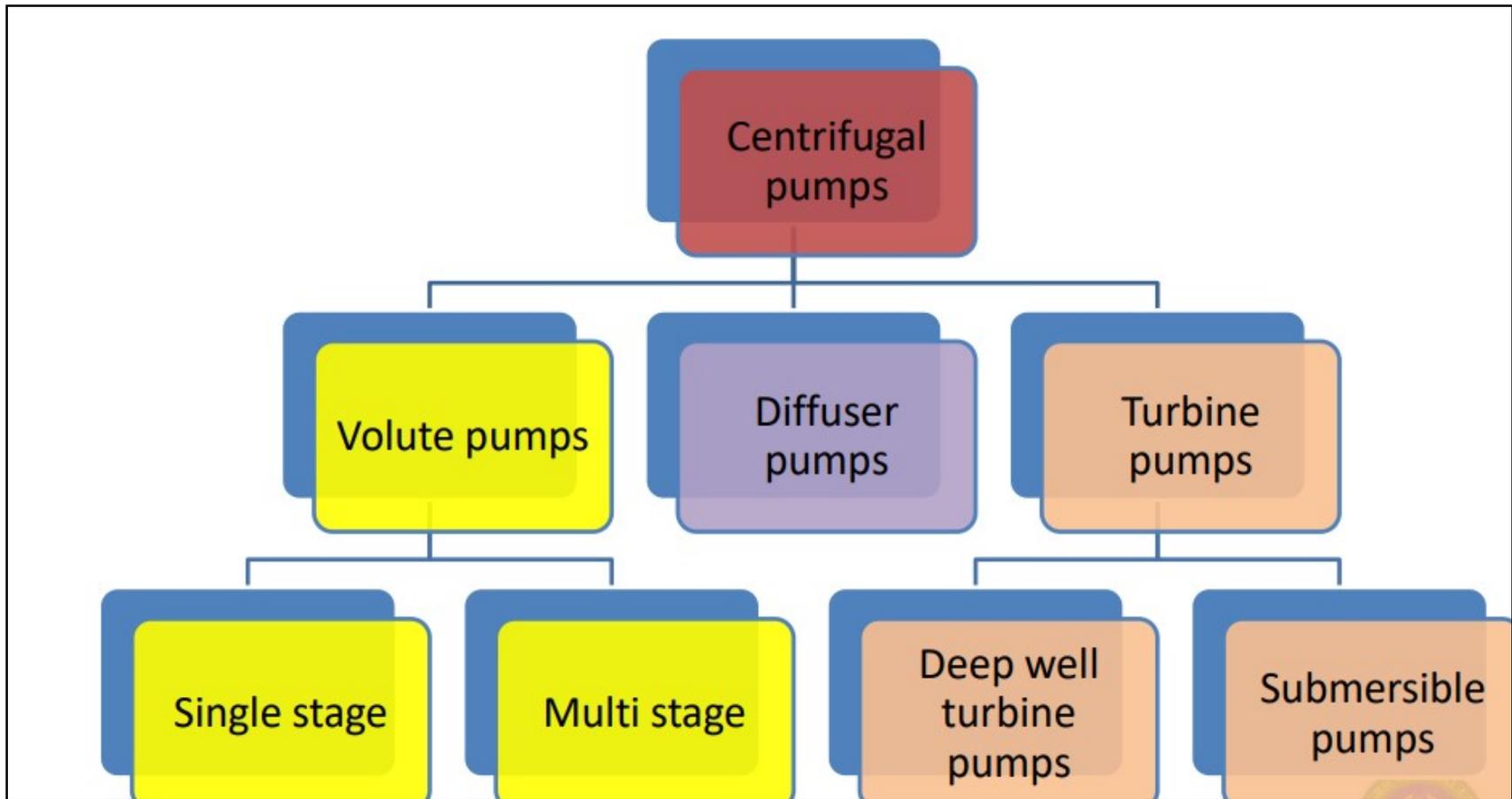
Medium  
head

High head









# INDIGENOUS WATER LIFTING DEVICE

- **Low head (Not exceed 1.2 m)**

- (i) Water bowl, water scoop/shovel

- (ii) Suspended shovel/scoop

- (iii) Swing basket

- (iv) Don

- (v) Water ladder

- (vi) Archimedean screw



## **MEDIUM HEAD (1.2 TO 10 M)**

(vii) Persian wheel

(viii) Chain pump

(ix) Rope and bucket lift with self emptying bucket

(x) counterpoise lift (shaduf)



## HIGH HEAD (MORE THAN 10 M)

(xi) Rope and bucket



LOW HEAD HEAD LIMIT: 0.2 M TO 1.2 M

### **Swing basket**

- Most ancient water lifting device
- Consist of a basket or shovel with attached rope in four corner
- Usually operate by two person
- Directly supply water to the field channel or field
- Optimum capacity to lift: 0.3 to 0.5 m
- Average discharge capacity:14000-19000 litre/hr

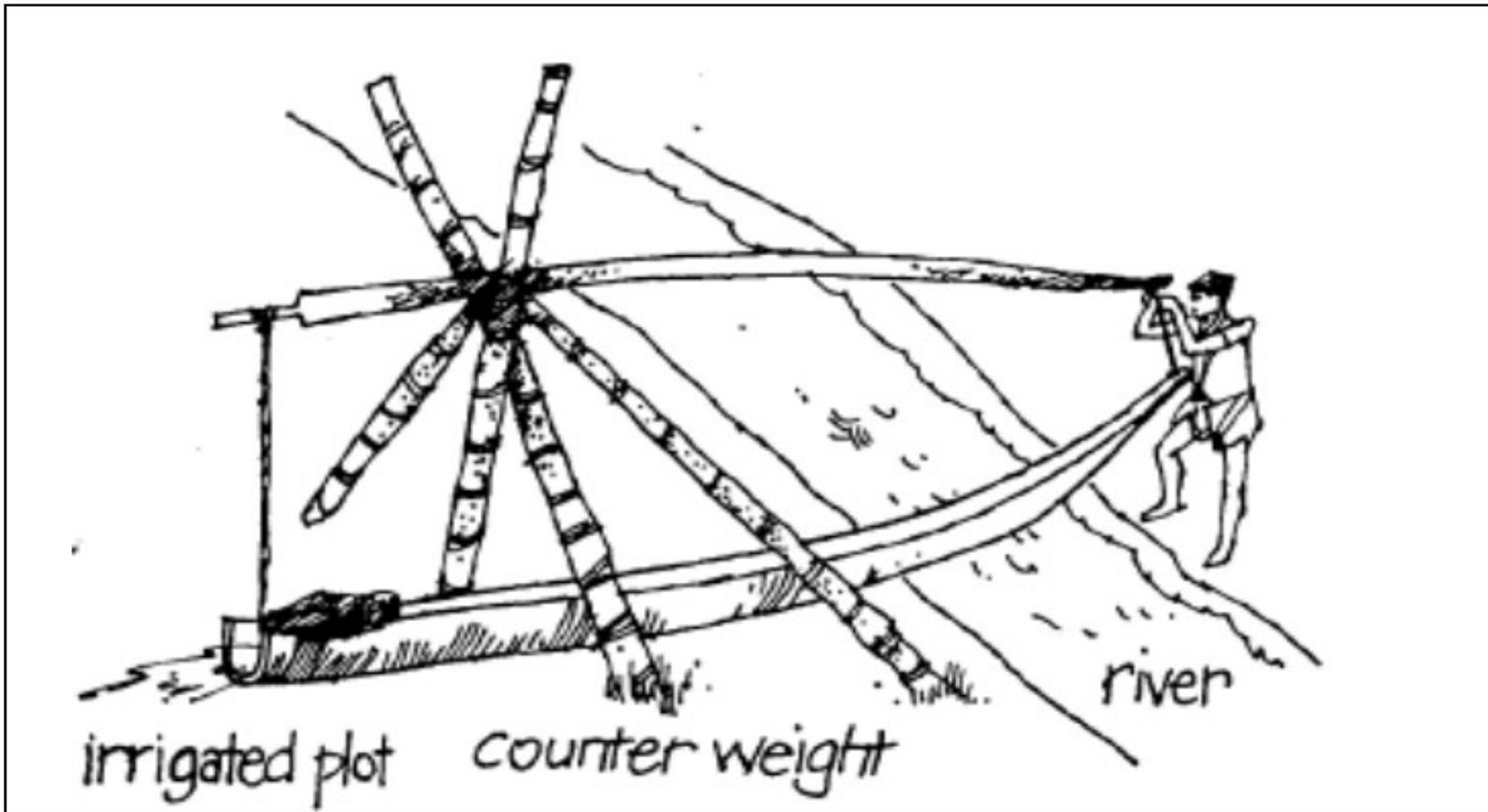




# DON

- Manually operating device, a single man can operate it
- Boat shaped, one side open but other end closed
- Close end is tied with a rope on a long wooden bar which is pivoted on a lever
- Optimum capacity to lift: 0.5 to 1 m
- Average discharge capacity: 9000-13000 litre/hr

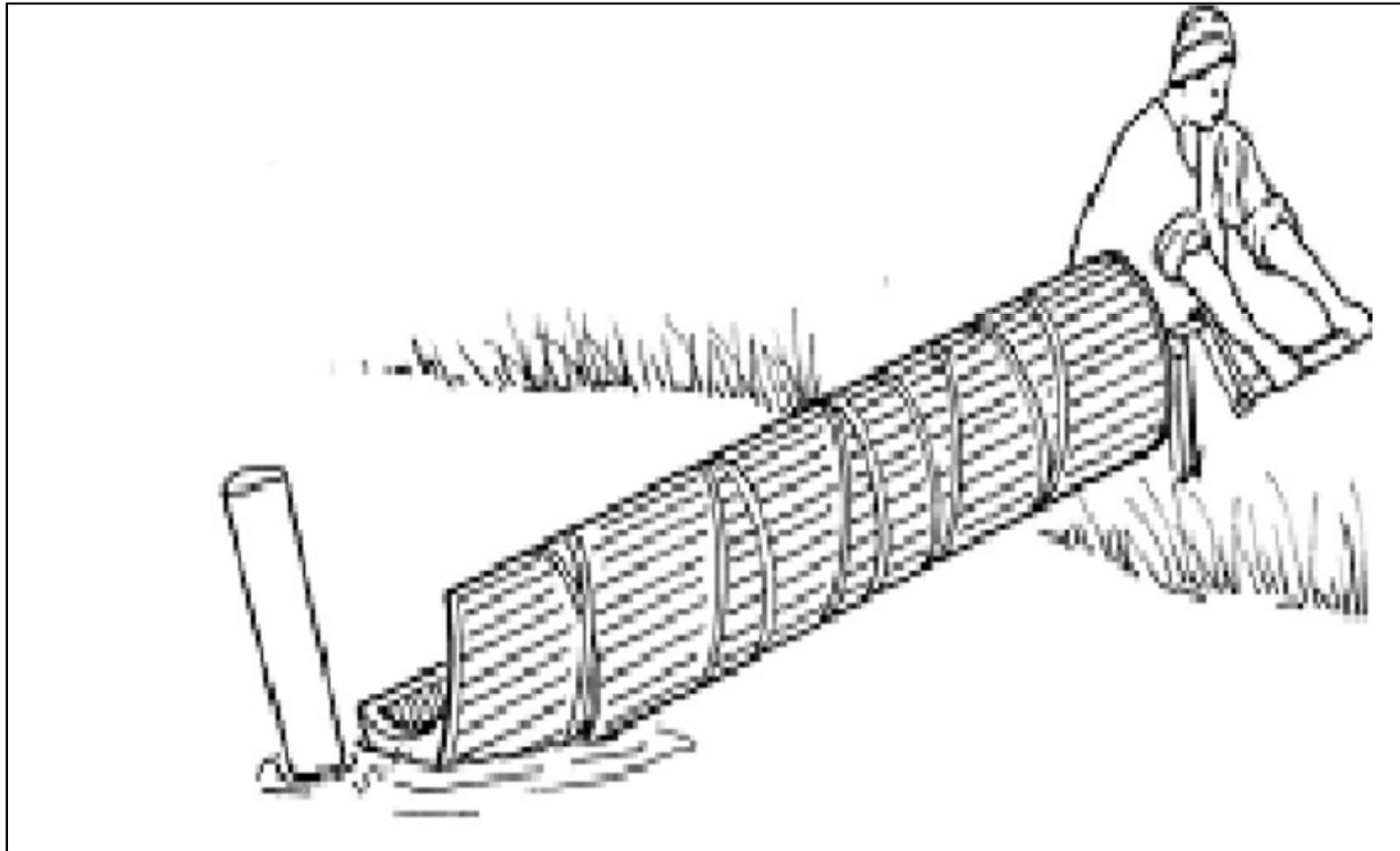




## ARCHIMEDEAN SCREW

- Manually operating, one or two man required to operate
- Wood or metal wheel drum, interior shape like a screw
- Rotated by handle which is fixed to a central spindle
- Drum is placed at an angle of less than 30 degree
- Optimum capacity to lift: 0.5 to 1.2 m
- Average discharge capacity: 14000 to 19000 litre/h
- Efficiency maximum when lower end of drum in half submerged
- More efficient device compare to swing basket or don.

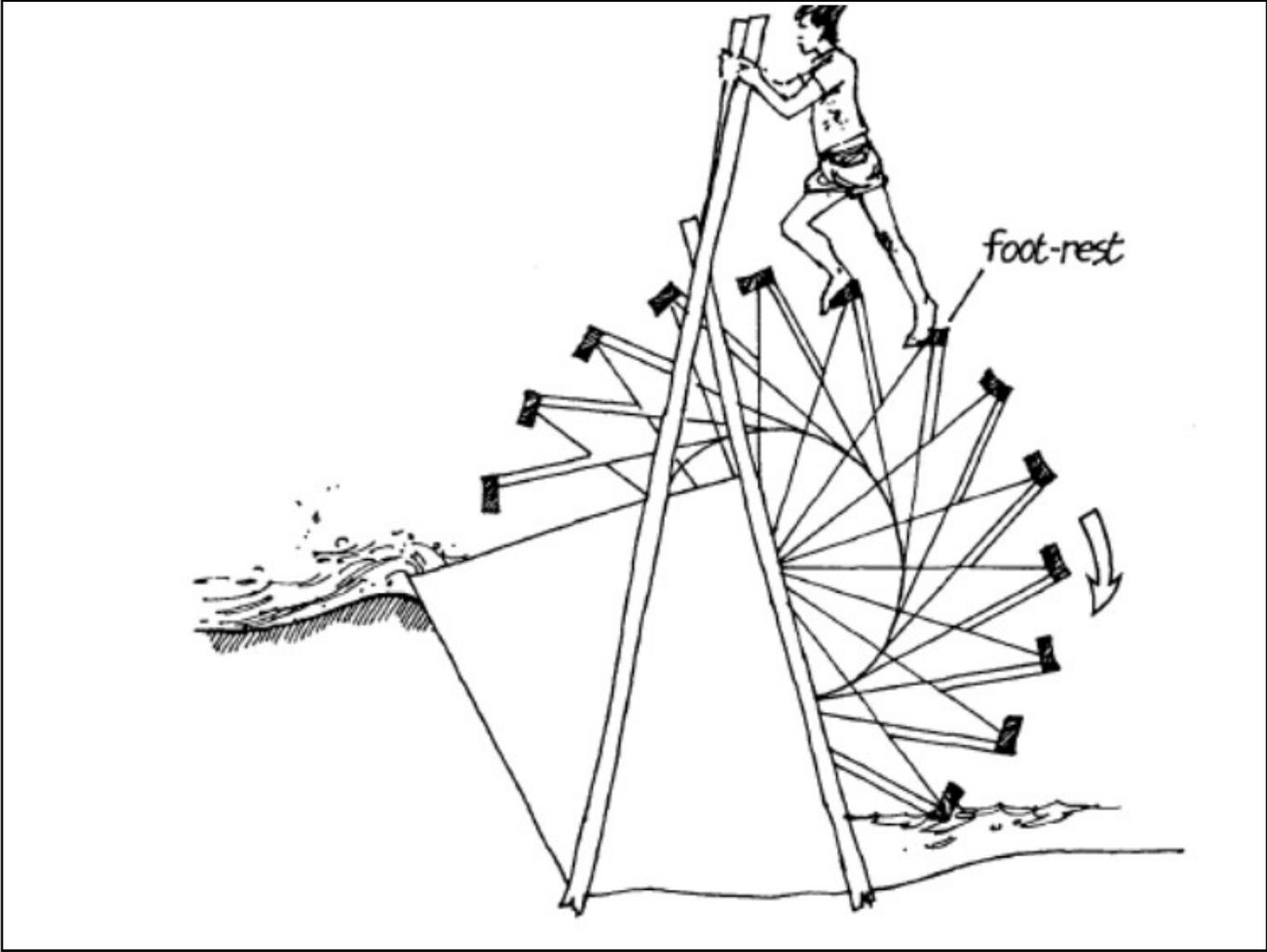




# WATER WHEEL

- Shaft is driven by animal
- Optimum capacity to lift: 1 to 1.2 m
- Average discharge capacity: 40000 to 50000 litre/h





## LIMITATION OF LOW HEAD DEVICE:

- Manually or animal Operated
- Used only when depth of water does not exceed 1.2 m
- Slow process and inefficient



## MEDIUM HEAD

- Persian Wheel
- Normally animal operated
- Consist of a chain and buckets mounted on a open spoked drum
- Capacity of a single bucket is 7-14 litre
- Optimum capacity to lift: up to 10 m
- Average discharge capacity: 14000 to 19000 litre/h
- Not use in Bangladesh, usually use in Northern part of India



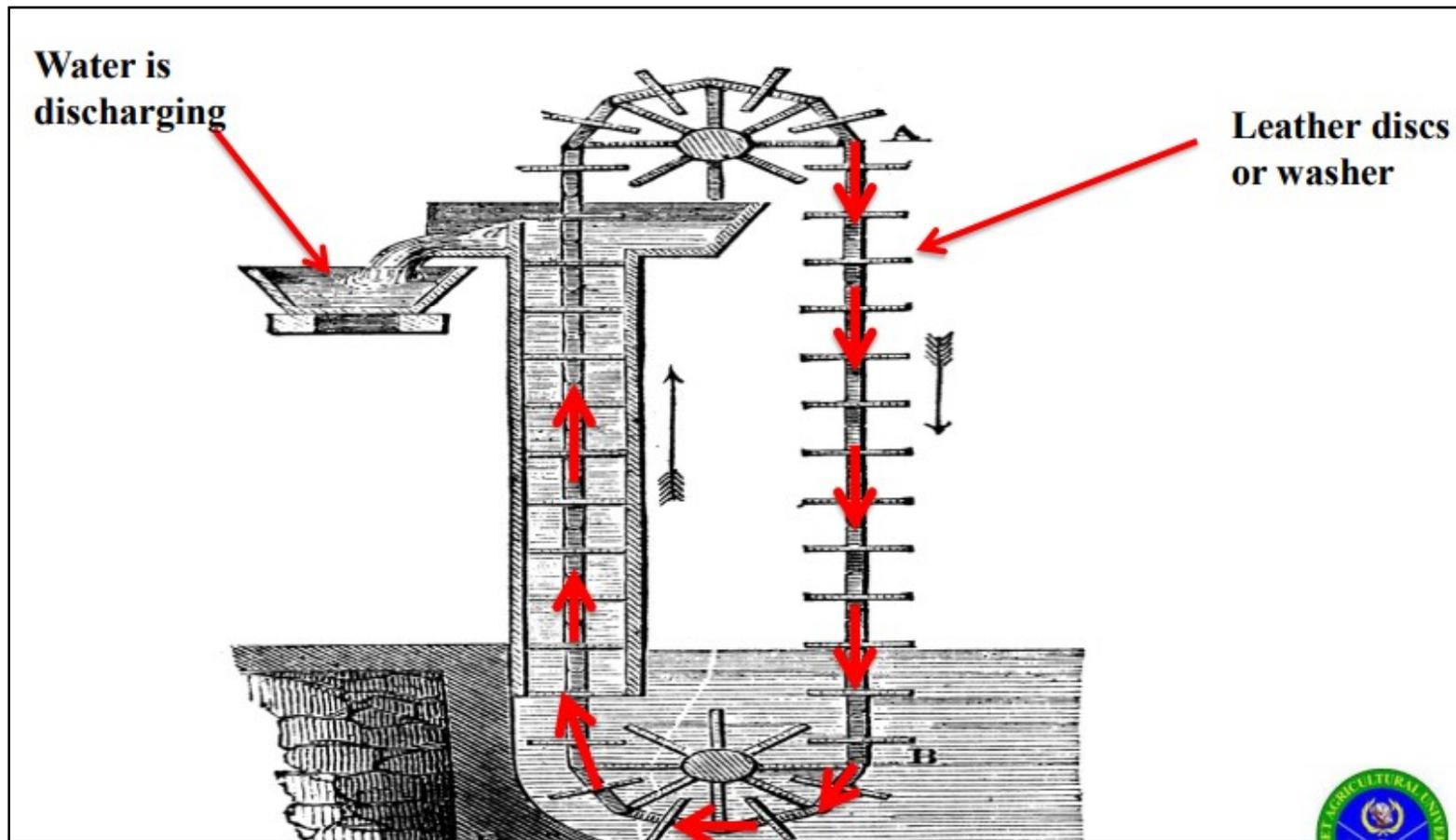




# CHAIN PUMP

- Consist of a endless chain which is provided with leather discs or washer
- Internal distance between two washer is about 25 cm
- One side of the chain has a pipe diameter of 10 cm
- Bottom of the pipe submerged about 60 to 90 cm in water
- Generally operated by one pair of bullock and a man
- Optimum capacity to lift: up to 6 m
- Discharge rate 15000 to 20000 litre/h

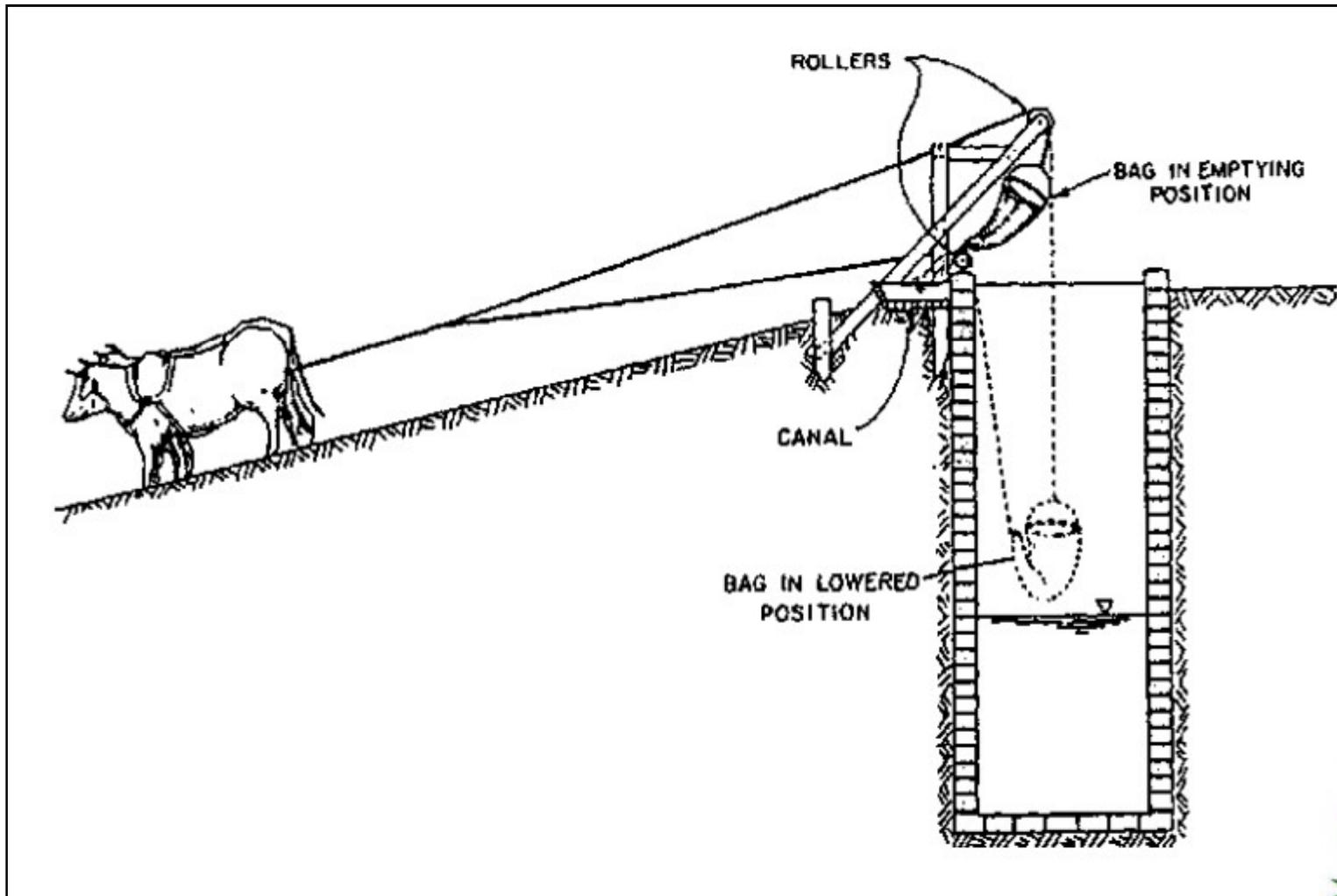




# ROPE AND BUCKET LIFT WITH SELF EMPTING BUCKET

- Generally operated by one pair of bullock and a man
- Capacity of the bucket 100 to 150 litre
- Optimum capacity to lift: up to 4 m to 6 m
- Average discharge capacity: 10000 to 15000 litre/h
- Generally used in South India



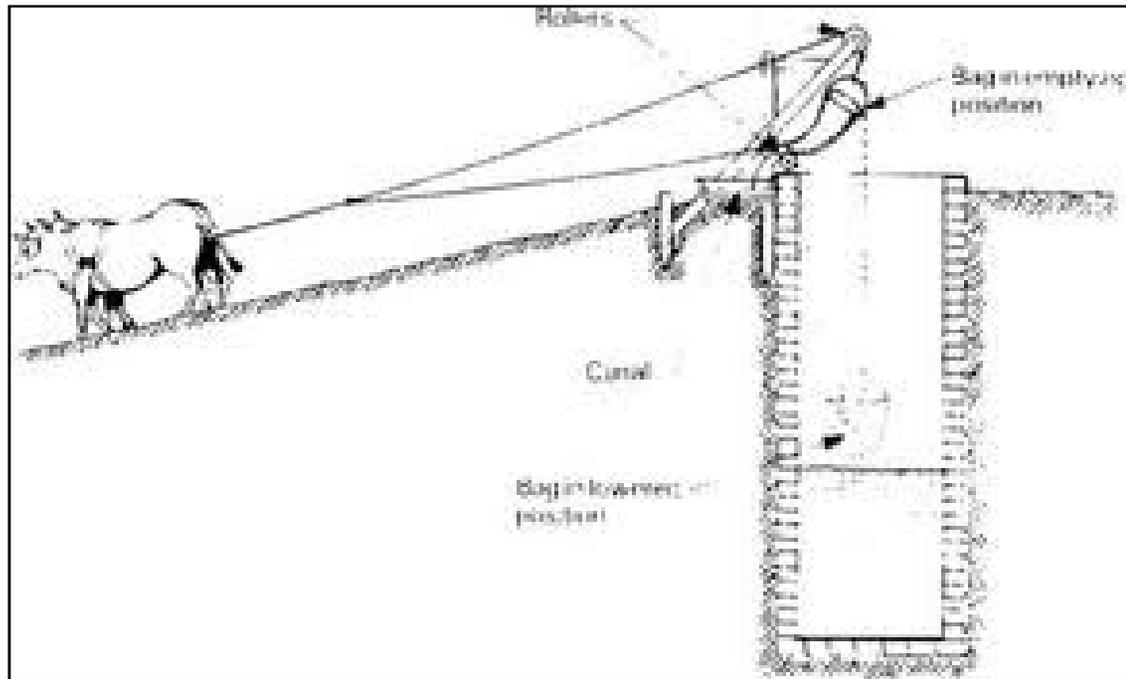


# HIGH HEAD

## ○ **Rope and Bucket lift**

- Suitable for deep wells, locally called Charasa
- Generally operated by one pair of bullock
- Bullock walk in earthen ram having sloped of 5-10 degree
- Capacity of the bucket 100 to 150 litre
- Optimum capacity to lift: 10 to 30 m
- Average discharge capacity: 6000 to 10000 litre/h
- Usually use in Rajasthan





## COUNTER POISE LIFT

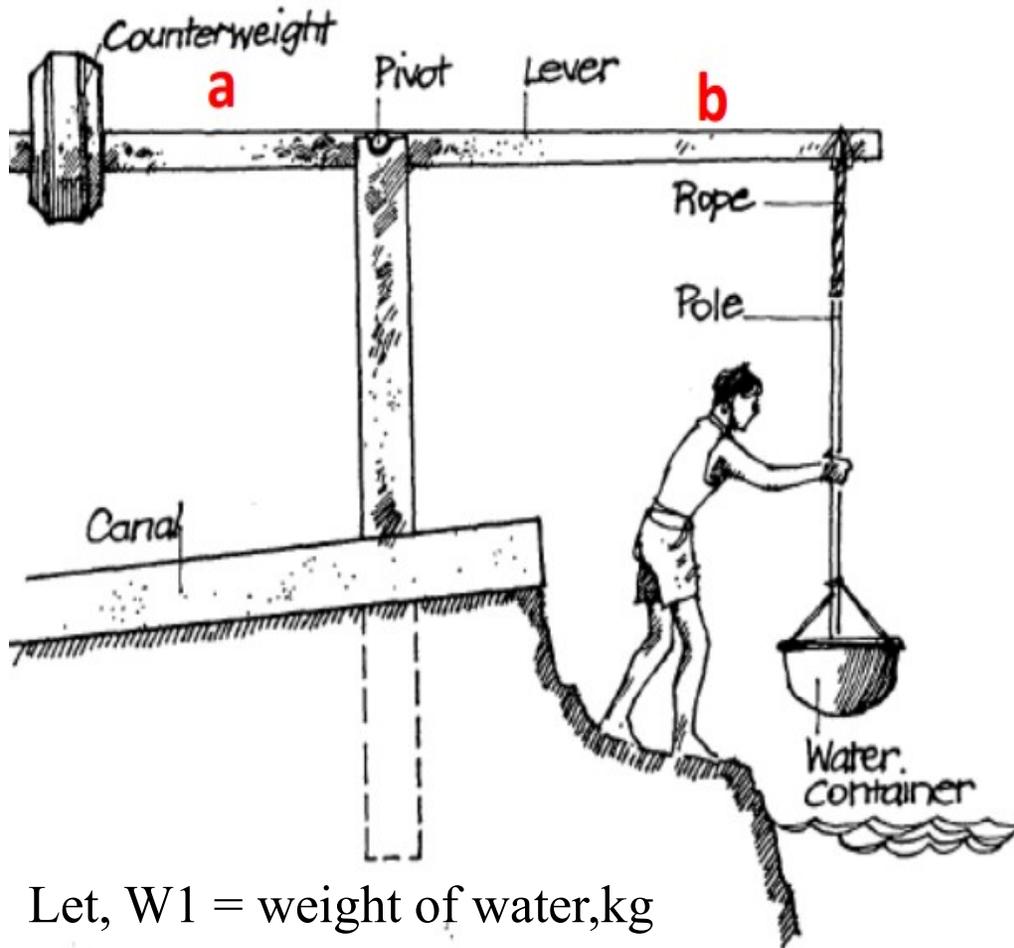
- This is another human power.
- It operates on the lever principles.
- Its output is more than the other water lifting devices .
- Tree truck are used for this purpose.
- A weight in the form of stones or bags filled with soil fixed to the shorter end of the lever.
- This weight act as a counter poise to a bucket suspended by a rope or a bamboo pole attached to the lower arm of the lever.



## COUNTER POISE LIFT

- Manually operated, single man can operate it
- Optimum capacity to lift: 1.2 to 4 m
- Average discharge capacity: 8000 to 11000 litre/h
- Used in South India and Northern part of Bangladesh





Let,  $W_1$  = weight of water,kg  
 $W_2$  = weight of bucket,kg  
 $W_3$  = Weight of counterpoise,kg

$$W_3 = b/a * (W_1 + W_2)$$

Where,  $a$  = distance between counter weight and pillar  
 $b$  = distance between pillar and bucket



# OTHER SOURCES

## ○ Windmill

- The windmill utilizes the natural power from wind to lift water.
- It consists of large diameter vanes.
- Wheel or rotor fixed on the top of a high steel or wooden tower and a reciprocating pump at its bottom.
- When strong wind blows , it rotates the vanes wheel, which in turn works the pump and water is lifted up.
- Usually the delivery pipe rises to a reservoir where the water
- is stored to be used, whenever required. Capacity depends on wind velocity and frequency.





## HYDRAULIC RAM

- A **hydraulic ram**, or **hydram**, is a cyclic water pump powered by hydropower.
- It functions as a hydraulic transformer that takes in water at one "hydraulic head" (pressure) and flow-rate, and outputs water at a higher hydraulic-head and lower flow-rate.
- The device uses the water hammer effect to develop pressure that allows a portion of the input water that powers the pump to be lifted to a point higher than where the water originally started.



- The hydraulic ram is sometimes used in remote areas, where there is both a source of low-head hydropower, and a need for pumping water to a destination higher in elevation than the source.
- In this situation, the ram is often useful, since it requires no outside source of power other than the kinetic energy of water.

