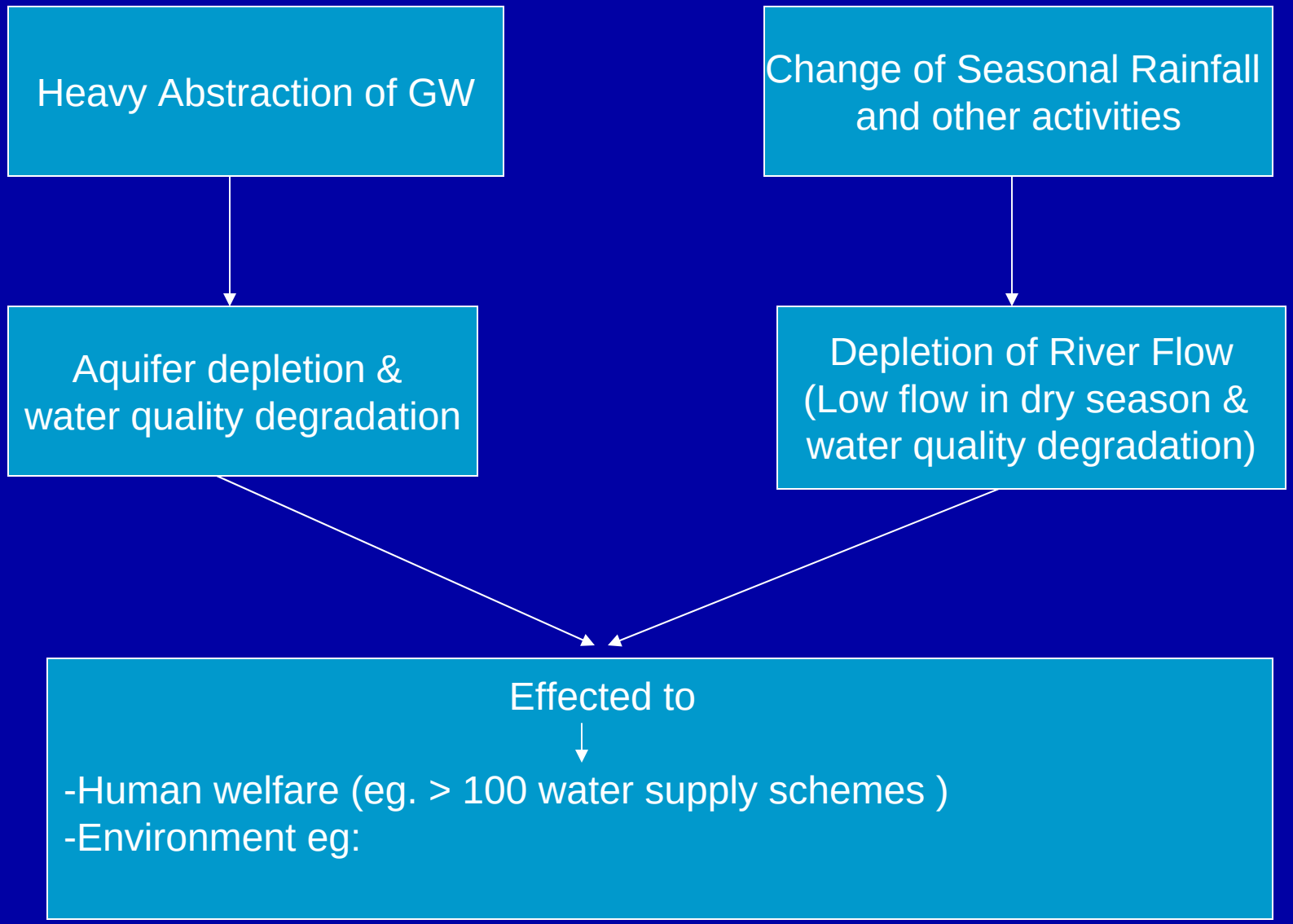
Enhancement of GW Recharge to improve River Flow

K.A.W. Kodituwakku

Water Resources Board
2A, Gregory's Avenue
Colombo-07

Introduction



Objective

- Enhancement of Groundwater recharge to Improve River Baseflow enabling to incorporate an integrated planning and management of surface water and groundwater in Watershed context.

SIGNIFICANCE OF THE STUDY

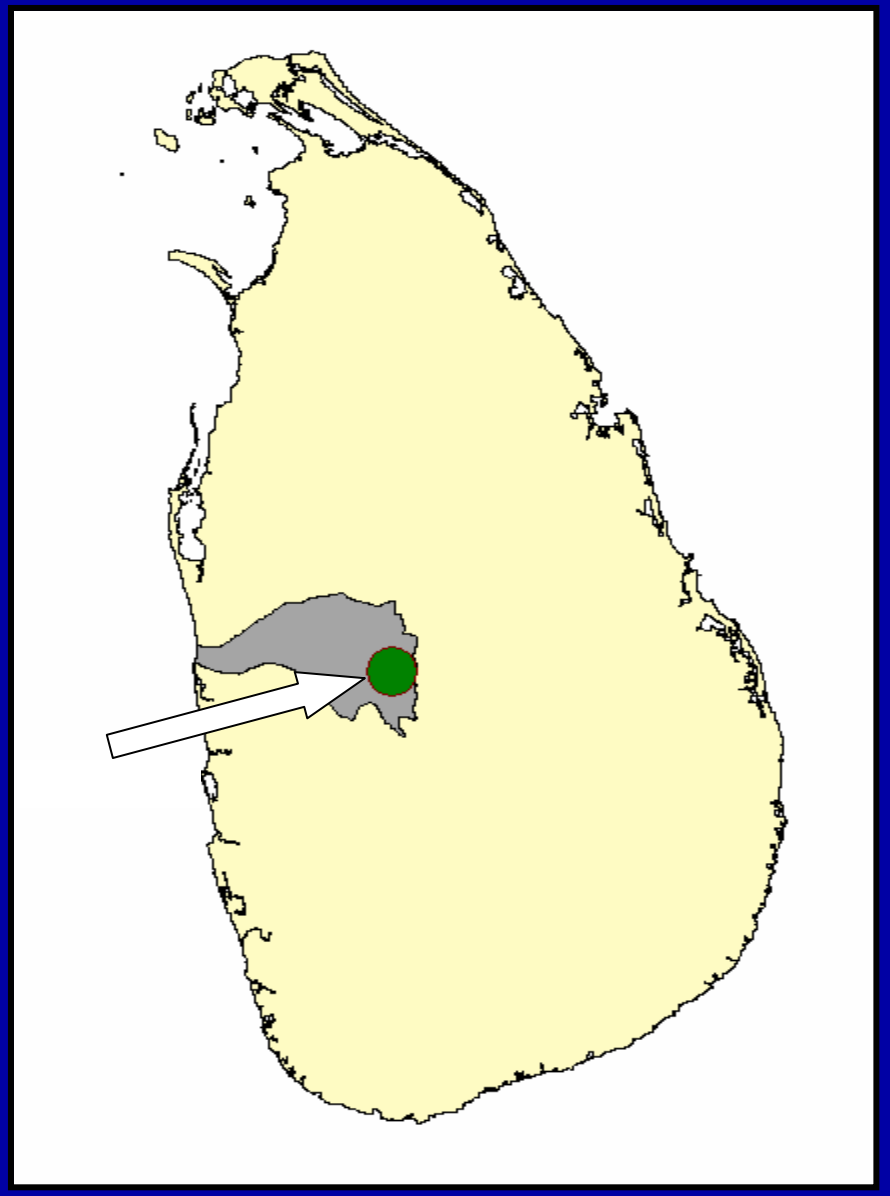
- Engagement of several institute NWRM (Institutional coordination – not sufficient eg: isolation in groundwater management)
- Preparation of National Water Policy and Water Resources Master Plan under preparation
- For the above coordinated mechanisms among SW and GW institution is necessary
- This study will be useful to incorporate in the above mechanisms.

Approach

- Understanding of hydrological aspects for integrated management of SW/GW system in River Basin context

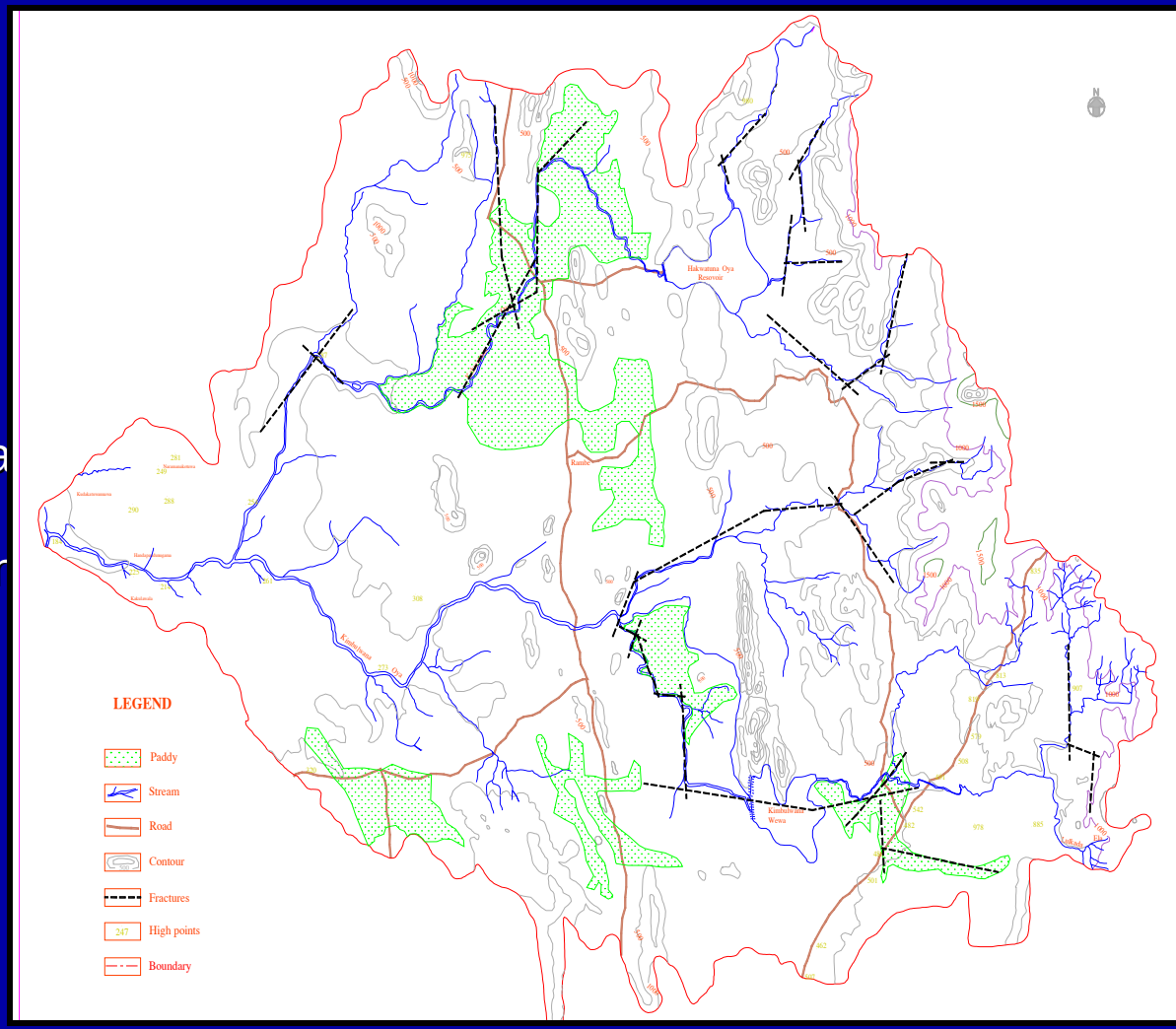
STUDY AREA

- Deduru-oya River
- North western dry zone in Sri Lanka
- Annual rainfall 900-1500 mm
- Avg.Discharge $1608*10^6$ Cu.M

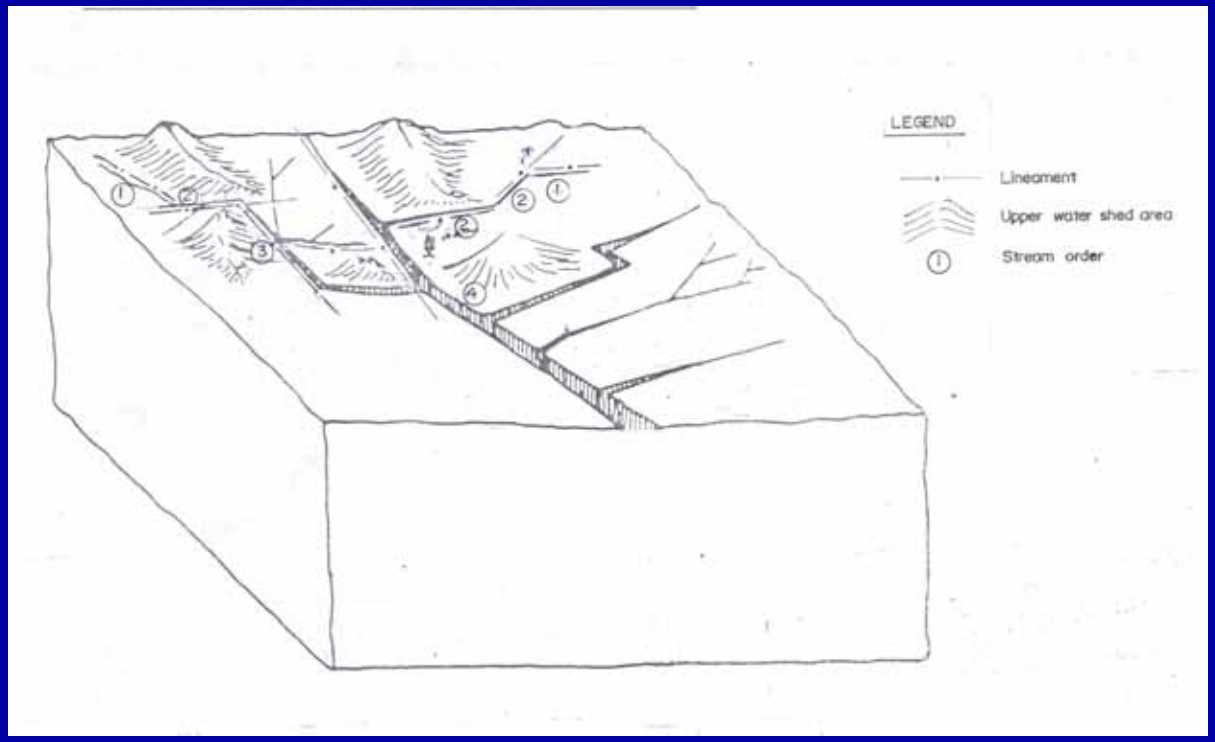


GEOMORPHOLOGY, DRAINAGE AND LAND USE

- Flat terrain with progressively rising elevation towards east (approx 300 m above mean sea level.)
- Some isolated hillocks are in the middle part as erosional remnants(figure2).
- The tributaries of Kimbulwana Oya and Hakwatuna Oya , mentioned above, originates ir the hill ranges flows through peneplain areas until it reach to the major river of Deduru Oya.
- The drainage pattern of the area is mainly controlled by geological structure.



GEOLOGY AND GEOSTRUCTURAL SETTING



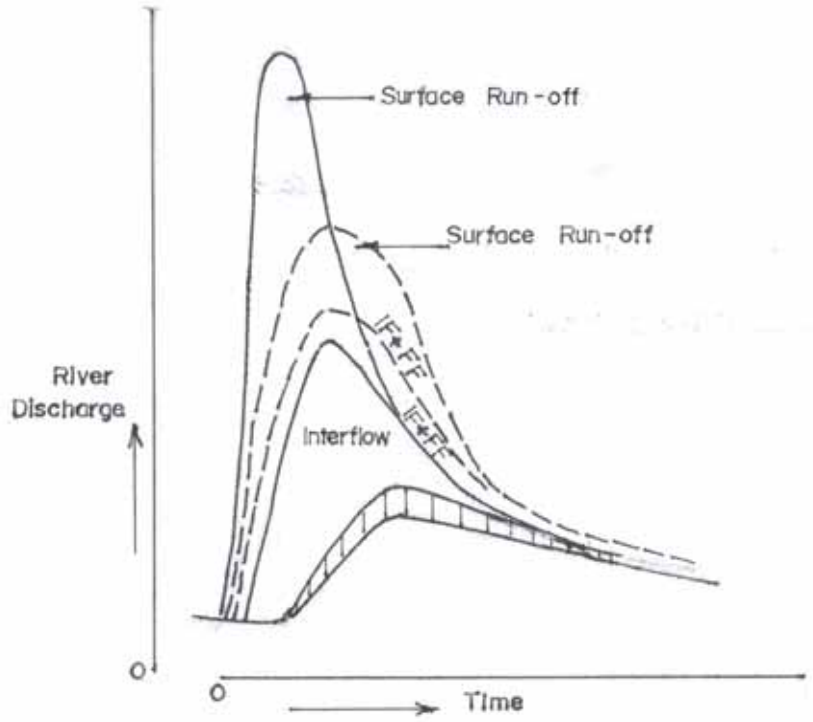
- Major rocks - Hornblende biotite and granitic gneiss, Charnockites and Quartzites.
- Minor and moderate folding structures upper water shed area
- lineation pattern in NE, NW and EW directions indicates fractures encounterd generally 30 – 50 m below ground level
- lineament of EW direction is dominant towards further downstream of the

GENERAL HYDROGEOLOGY

- With the available data on water level fluctuation, overburden , and fracture depths and intensity, well depths etc. collected from tube wells drilled in past years (KIRD report 1984) it is able to understand generalized hydrogeological characteristics with emphasis on groundwater and surface water interaction connected to the river flow. In general, occurrence of groundwater mainly restricted to the Regolith aquifer (soil and highly weathered overburden above bed rock) depths ranging from 2- 10 m and fractured hard rock aquifer where depths varying from 30- 50m .

METHODOLOGY

- Since the main objective of the study is to improve river base flow of downstream areas in dry period, it is necessary to increase groundwater component of river discharge . Therefore improvement of interflow and fracture flow components play main rolls an enhancement of groundwater recharge in upper water shed areas to increase the base flow of the downstream area during drought period. This is explained in figure 4.



GROUNDWATER COMPONENT OF RIVER DISCHARGE,
DASH LINE INDICATE IMPROVED GROUNDWATER FLOW

——— Flow Component before Improved recharge.

– – – Flow Component after Improved recharge

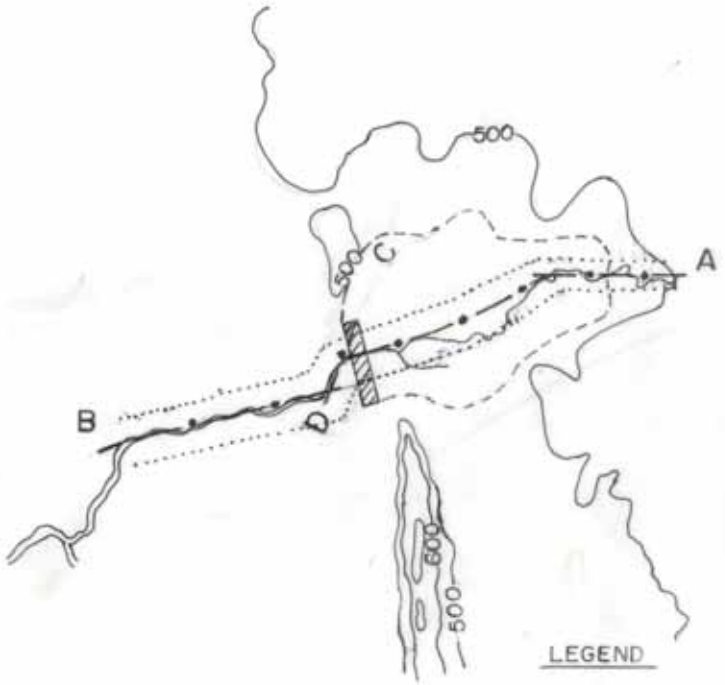
IF – Interflow

FF – Fracture flow

Delineation of fracture lineaments and mini watersheds

- Interpretation of aerialphotographs(1:25000) to
- delineating mini watershed boundaries . This required to assess groundwater potential and associated interflow mainly in watersheds occupied by 1st and 2nd order streams.
- productive lineaments due to fracturing of hard rocks, will be identified by the interpretation , mentioned above, as fracture flow is the main factor to be considered as major contribution for river base flow.

LINEMANT INDICATING PRODUCTIVE FRACTURE ZONE



LEGEND

- Storage dam
- Stream
- 500 – Contours
- Lineamant
- Productive fracture boundary
- Mini Water Shed

Scale_ 1 : 63,360

Land cover classification with soil conditions

- In those mini watersheds, identified above , further studies will be carried out to determine soil conditions and vegitation /forest coverage . This will be useful in assessing likely fevourable areas for infiltration and low run off which in turn good sites for reharge enhancement.
- in Interpretation of Land sat imageries and aerial photos will be incorporated this stage

FIELD ACTIVITIES

- **Infiltration Tests and confirmation of land cover types**
- **Hydrogeological Mapping**
- **Geological and Geostructural Mapping**
- linear geostruturel features due to faults, joints and geological contact zones will be identified to confirm the lineament map prepared by aerial photo study and interpretaion of landsat imageries.
- **Geophysical Surveys**
- to confirm productivity of the fractured aquifer based on fracture intensity . Earth Resistivity and Electromagnetic surveys will be applied to detect fracture depths and intensity. Geophysical profiles will be designed according to the geology and structure.
- **Pumping Tests**
- Pumping tests will be carried out in selected wells to determine aquifer parameters in various aquifer basins..
- **Measurement of River flow**
- A suitable river gauge will be installed to measure river flow in a selected out let.
- **Measurements of Groundwater levels**
- A monitoring net work will be selected to measure water levels in the basin as it is nessosory for groundwater modeling

OFFICE WORK

- **Map Preparation**
- Preparation of watershed map including geology, geostructures, lineaments, soil , vegetation cover etc,
- Infiltration maps on mini watershed basis
- Earth resistivity map along with linear fractured basins

DATA ANALYSIS Final Demarcation of aquifer basins

- Storativity (S) and Transmisivity(T) will be will be evaluated from the the pumping tests in regolith and fractured aquifers.
- Based on the above interconnected productive aquifer basins from upper watershed areas to river will be identified.
- This will also be usefull in identifying fevourable sites for recharge structures in upper watershed areas and will be discussed later in this proposal .

Groundwater/Surface water Modeling

- **Preparation of Conceptual Model**
- Prior to carrying out modeling activities it is essential to prepare a conceptual model of the watershed. This may be based on 3 aquifer layers such as over burden aquifer, weathered rock and fractured aquifer.

- **Groundwater Modelling**
- This will be done using existing model or with some modification to the existing model suitable for hard rock environment. Arbitrary recharge structured will be placed in fevourable sites selected by data interpretaion mentioned above. From this model output, it can be evaluated increased of groundwater baseflow due to enhancement of groundwater recharge in upper watershed areas. The model will also be carried out according to rainfall seasons with different vegitation types in recharge areas.

- **Model Calibration**
- Based on river hydrographs drawn according to river gauge results, modeling results (river base flow), will be compared in order to calibrate the model.

- **Conclusions to be drawn from the study.**

- This study reveals feasibility of enhancement of groundwater recharge in upper watershed areas and how to select fevourable sites for recharge structures based on geology, geostructure, geomorphology, soil and vegitation cover (different land use practices). Therefore this methodology can be applied for several other river basins in Sri Lanka with or without any modifications depending on watershed characteristics.

- **Benefit for the Country**

- Improvement of river flow will be benefited for the country in various development activities. For example, augmentation of existing urban and rural water supplies , irrigation and industrial water supplies . In addition, it will no doubtedly be helpful to maintain environmental sustainability
- study can be recommended to include in proposed Integrated Water Resources Management (**IWRM**) program to be implemented in Sri Lanka in near future

Thank You