INCEPTION WORKSHOP
Groundwater Recharge for improving livelihoods and enhancing resilience in the dry zone

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Abstract

This inception workshop is planned to discuss and agree the workprogramme for an *Incubation* Pilot Project on groundwater recharge to enhance water resources in the dry zone as a multi-disciplinary, multi-stakeholder project. The main focus of the project is enhancing livelihoods of farmers and resilience of agriculture production systems against climate change. The outcomes are expected to be upscaled to a number of development projects that can also be combined with other potential water management systems.

Keywords: Transdisciplinary, Traditional and Modern Masaics, Groundwater, Weather Forecast

1. Introduction

Several modern irrigation schemes with centralized management that are designed for efficiency, have replaced a considerable part of ancient irrigation systems but much had been lost in social harmony, human-nature co-existence and system resilience that made the traditional systems sustainable. Now there is a need to integrate the lessons and experiences of the traditional agriculture systems with the efficiency of modern systems in new types of mosaic agriculture systems supported by science and innovative water management practices.

The thirty-year-old war that has engulfed the Northern and Eastern provinces of Sri Lanka and destroyed many of the surface water infrastructures, leaving only some of the tanks intact. About 300,000 people, most of them of farming communities, were displaced due to the war and are now being resettled in their ancestral lands. One of the major issues faced by these villagers is non-availability of sufficient water to engage in farming activities. In some of the areas people are faced with the necessity of travelling long distances for their domestic requirements. Another major issue that needs attention of planners is the salt water intrusion into some of the coastal areas in the region due to lowering of groundwater beneath the land, making the farming area smaller than what it used to be.

The United Nations University (UNU), over several years, has been conducting research on climate change effects, groundwater recharging procedures, and developing mosaic systems of traditional and modern irrigation systems in Sri Lanka. Based on these studies a new approach to address both of the above problems is proposed as a systematic approach to ground water recharge

to develop a reliable and equitable water supply system, that can at the same time, address a number of other emerging issues, especially climate change.

The effect of groundwater aquifers on vegetation and farming is clearly seen in Kilinochchi area of Sri Lanka, near Vishwamadukulam tank in the Northern Province (figure 1). The drastic difference in the area compared to parched neighbouring areas can be attributed to availability of sufficient ground water at the site where surface irrigation is not practised and the major crop is chilli. Introduction of a properly designed groundwater recharge system will address the issue of water needs of returning inhabitants to war affected areas by the use of familiar well irrigation and also addresses the second issue of salt water intrusion by increasing the fresh water lens in aquifers that will limit salt intrusions to a small coastal belt.

The study is proposed in North-Central and North-Western provinces, where the farming communities are living below poverty line. One of the best ways this can be addressed is by introducing other cash crops in their farm lands. This involves integration of traditional and modern cropping systems. Groundwater recharging will support well irrigation for diversification of their farming practices as well as the traditional home garden practices. The present proposal aims at using the expertise available at educational institutions, government agencies and international organizations to ensure social justice is served on the farming community of Sri Lanka where individual farmer is benefitted. To achieve this objective, it is necessary to design appropriate a water allocation scheme and implement them through the participation of local governments and other stakeholders.

2. Objectives

The objective of the project is poverty alleviation of Sri Lankan farmers in the North West region, ensuring a sustained supply of water by recharging ground water aquifers so that:

- Provide new water resources to farmers in the Northern dry zone areas, facilitate crop diversification and encourage home gardens.
- Intrusion of salinity is controlled in the respective areas, and
- Address flood problems due to expected increase of rain intensities through the rehabilitated traditional tank systems linked to modern agriculture systems.

3. Methodology

The study on enhancing resilience and productivity of irrigation systems is composed of three components.

Groundwater in Northern Province Irrigation Investigation of ground water potential for irrigation needs for a diversified crop calendar and the options for ground water recharge

Use of short term rainfall forecasts Incorporating short-term rainfall forecasts for irrigation supply decision making in bulk water allocation system (as used in Mahaweli H)

Figure 1: Vishwamadukulam and downstream

Mosaic of Traditional and Modern Irrigation Systems Water allocation and water distribution mechanism studied in the Deduru Oya system to be upscaled so that allocation among traditional and modern systems can be achieved though the cooperation of local farmer organizations and the irrigation department for managing in waster distribution.

In this paper, the first two items are only briefly mentioned where as more detailed description of the Mosaic System is made.

3.1. Groundwater as a potential remedy to immediate water needs

Groundwater potential of the study areas will be evaluated so that replenishment procedures can be developed. This will be conducted through a groundwater modelling study on two selected sites in Northern and North-Western provinces of Sri Lanka. The widely used industrial standard USGS modular 3D finite difference ground water flow model (MODFLOW) will be employed to represent the simplified dynamics of the groundwater flow system as a function of hydrogeomorphologic, climatic and environmental variables. To corroborate the modelling results, a remote sensing/GIS based approach will be utilized to demarcate and prioritize the potential recharge zone sites throughout the modelling domain.

The results from the integrated analysis will be applied to elucidate implementation strategies and to support water management decisions. The effort will promote sustainable development of the ground water potentials of the area to address the water needs of the community both for agricultural and other domestic uses. Moreover, the sustainable utilization of the ground water resource by balancing the rate of recharge with the rate of drawdown, especially in coastal aquifers, will help reduce salt water intrusions into fresh water aquifers.

3.2. Use of weather and climate change projections to assess rainfall changes and impacts

Global climate change projections predict longer dry spells and frequent/intense extreme rainfall events that will have complex implications on water resources such as scarcity of surface/ground water in dry periods for irrigation/domestic uses and increase in severity of flood events. However,

it is important to customise this projections to local conditions by carefully analysing the applicability and suitability of different global climate projections to Sri Lanka by assessing their skill in modelling current climate.

Impact of climate change on precipitation pattern will be analyzed through Global Climate Models (GCM) of Meteorological Research Institute (MRI) of Japan, the Weather Research and Forecast (WRF) model of the National Centre for Atmospheric Research (NCAR) of USA and the RegCM model of the International Centre for Theoretical Physics (ICTP) of Italy. Preliminary studies of applicability has already been conducted through downscaling data sets of different global projections for Sri Lanka. The studies showed that (a) only a few global models can adequately capture the monsoon rains in Sri and (b) Bias correction techniques need to be employed to correct the downscaled future climate projections. Further, it is found that emerging climate products of short term rainfall forecasts can be used to anticipate seasonal rainfall variability that can help in better water resources management.

In addition, UNU is currently carrying out real time high resolution rainfall forecasts in Sri Lanka, using the WRF model developed by NCAR, USA and being calibrated with ground observations made at three locations using high temporal resolution recorders.

The potential to improve water management using weather forecasts firstly, and secondly the introduction of incentives based on savings will be studies in this component.

3.3. Mosaic of Traditional and Modern Irrigation Systems

Water management in the Deduru Oya the 6th largest river basin in Sri Lanka, was studied in a joint research project among United Nations University, the University of Peradeniya and the Irrigation Department. The study found that

- The modern irrigation system will be adequate for two seasons irrigation under normal conditions.
- The combined traditional reservoir and modern irrigation system is required to address extreme conditions
- Joint water management agreement among the centralised and decentralised systems is an important pre-requisite for smooth operation of the *Mosaic* system.

The components of the study that still need to be continued and will contribute to the proposed study are;

1. Develop optimal water allocation plans/algorithms based on micro-macro hydrological and irrigation model
2. Assess and propose participatory water management arrangements for the above three types of irrigation systems with a strong emphasis on equity as the basis for resource management.
3. Assess the potential use of conjunctive groundwater resources to enhance livelihoods of farmer communities through vegetable and cash crop cultivation in upland.

4. Project partners

The following organisations are expected to take part in the preliminary study.

United Nations University Overall coordination, Ground water modelling, Weather forecasting and Climate Modelling, Mosaic Systems

Ministry of Mahaweli Development and Environment, Sri Lanka Overall coordination (local), Interface to national water resources management planning.

Irrigation Department, Central Province Directorate and the Office for Research and Project support field monitoring, water management

Nippon Koei Co. Ltd., Japan GIS, Water allocation

University of Peradeniya Hydrological modelling

Rajarata University Farmers engagement, groundwater and surface water distribution

Jaffna University Alternate crop calendars, modelling tank irrigation

The University of Tokyo, Japan Real time weather forecast, Climate projections

Association for Rainfall Storage and Infiltration Technology (ARSIT), Japan Groundwater recharge mechanisms

Meteorological Department Short and medium term forecasts, climate change

Mahaweli Authority, System H Extension of bulk water allocation procedure for conjunctive water use

5. Mechanism

The project will be implemented under the framework of **International Network for Advancing Transdisciplinary Education (INATE)** which is supported by the leading universities in the Asia Pacific region to promote transdisciplinary approach to participatory project design and implementation. After the pilot project phase, some of the project partners are expected to develop and upscale the findings to large-scale development projects.

6. Funding

UNU will fund the international collaboration. Local travel and field work support is expected from the Sri Lankan government and counterpart institutions. All participating institutions shall assign a focal point and contribute with in-kind resources.

7. Inate Structure

The components fo the project and what is expected from each partner is shown in the figure (2). We would like to organize the firs symposium to disseminate outcomes in January. The project members are expected to provide research/study proposal, resources available, resources required and expected outcomes at the inception meeting. The major work components are;

1. Short term and medium term weather forecasts, preparation of a appropriate climate projection data set
2. Hydrological model for the target area to estimate inflows to reservoirs
3. Water allocation model incorporating reservoirs and agriculture demands
4. Crop water requirements under different crop calendars
5. Flood control effectiveness with centralised and distributed (onsite facilities)
6. Estimation of excess surface flow volume and design of mechanisms for recharging groundwater.
7. Methodologies for implementing sustainable mechanisms for water management (guidelines for water distribution, role of farmer associations)

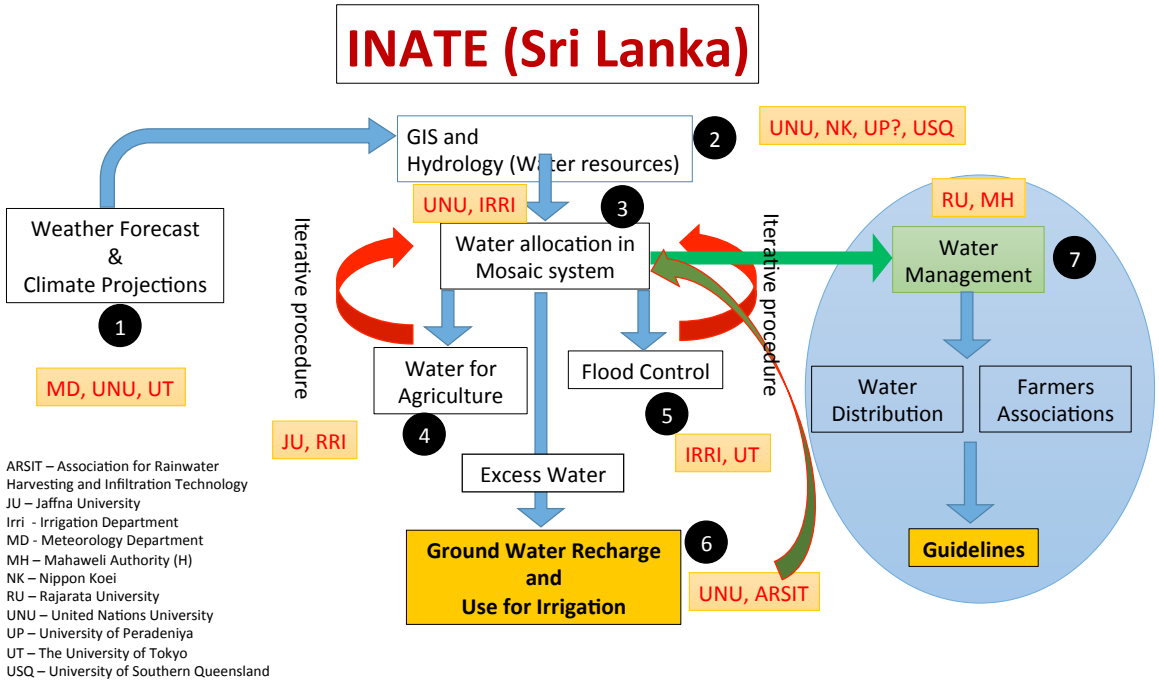

Figure 2: Structure of INATE project in Sri Lanka: Coordinated by the Ministry of Environment, Sri Lanka and the United Nations University, Tokyo, Japan.

The organizations attached to each task is tentative. The objective of the meeting is to refine the project objectives and clarify roles and research/study component of each participating organizaiton. In order to facilitate that, the partners are requested to fill up the attached form and submit to the secreatriat by the 2nd of August.