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KNOWLEDGE IS IMMORTAL

A REPORT OF THE WORKSHOP ON RAINWATER HARVESTING

Organised
By
The Physics And Chemistry Departments
Shillong College, Shillong

Sponsored by the U.G.C under specific location curricula

Message from the Principal

"Jack and Jill went up the hill to fetch a pail of water"

I am delighted to know that the Departments of Physics and Chemistry will bring out a report on the week long programme on "Rainwater Harvesting" organised by the two Departments w.e.f from 18th to 23rd June 2010.

It goes without saying that from time immemorial the search and need for water continued even till today and man learned to extract, use, and store water for man's activities.

Major parts of our country have been facing continuous failure of monsoon and consequent deficit of rainfall over the last few years. Also, due to ever increasing population of India, the need to use ground water has increased drastically leading to constant depletion of ground water level causing the wells and tube- wells to dry up. In some places, excessive heat waves during summer create a situation similar to drought.

Rain water harvesting is a system by which the rainwater that collects on the roofs and the area around the buildings is directed into open wells through a filter tank or into a percolation chamber, built specifically for this purpose. Rainwater harvesting essentially means collecting water on the roofs of buildings and storing it underground for later use. Catching the rain when and where it falls and guiding it to the underground storage can go a long way in mitigating the water crisis that arises. Rainwater that is collected directly or recharged into the ground improves ground water storage. Water that is not extracted from ground during rainy days is the water saved. It is imperative to take adequate measures to meet the drinking water needs of the people in the country besides irrigation and domestic needs.

Rain is the ultimate source of fresh water. With the ground area around houses and buildings being cemented, particularly in cities and towns, rainwater which runs off from terraces and roofs, was draining into low-lying areas and not percolating into the soil thereby, precious rainwater is squandered, as it is drained into the sea eventually.

In states like Tamilnadu, Gujrat, Rajasthan, Karnataka, Kerala, New Delhi, the respective state Governments have taken decisive measures to start and implement rainwater harvesting programs to ensure adequate water supply throughout the year. Many NGO's are also working in order to spread awareness about necessity of rainwater harvesting besides providing necessary information regarding various harvesting methods and their implementation.

I hope that the programme has created an awareness among the students who will spread the message to other fellow students and the society at large.

May God Bless you all

"Little drops of water, little grains of sand,
Make the mighty ocean and the pleasant land"

13/7/10

Dr (Mrs)M. P. R Lyngdoh
Principal

Message from the Vice Principal

Earth's total water is estimated to be 1.4 billion cubic kilometers. Out of the total water present on earth only about 2.8 percent, called fresh water, is suitable for human consumption. The remaining 97.2 percent is salt water in oceans and seas. Earth's freshwater resources consists mostly of icecaps, glaciers and ground water and are not readily available. The water in rivers, lakes, streams and other bodies on earth's surface forms the readily available source by human. These constitute a very small part of the total global water. The river runoff represents the renewable water resource and provides major volume of water for consumption. Ground water is second to rivers as a distributor of fresh water. However with the ever expanding human population there has been over exploitation of these reserves of water and today one of the most serious problem faced by humanity is the global water crisis.

None the less, in the process of technological advancement for more and more effective measures to exploit river and ground water sources, the most easily available source of water – the rain water is often forgotten. It is the water that seasonally recharges the rivers and the ground water reserves. The term water harvesting is used to define the activity of direct collection of rain water. Rain is the first form of water that we know in the hydrological cycle and hence it is one of the primary source.

The growing concern for water has been echoed in different national and international forums. It is high time that the concept of water management be given importance in every sphere human activity. Rainwater harvesting at the community level has not yet gained as much importance as it is essential. Therefore ,creation of awareness to tap this easy source by using modern technology is the need of the hour. Keeping these in view, under the U.G.C., sponsored **location specific curricula**, the departments of Physics and Chemistry jointly organized the Workshop on **'Rain water harvesting'** through programmes like popular talks, poster presentation , handbill distribution, etc. The whole programme was indeed a very successful Endeavour and I am extremely happy to learn that the entire proceedings is going to be published soon. I hope that with the cooperation from everyone the process creating awareness for water conservation will continue and Shillong College remains the pioneer in the effort.

Dr Malay Dey
Vice Principal

Aims and Objectives of the "Workshop on Rain Water Harvesting"

GNT

The Department of Physics and Chemistry, Shillong College, Shillong, have organized a one week workshop on Rain Water Harvesting from the 18th – 23rd June 2010. This program was organized to create awareness amongst the staff and students of the college, since the two departments feel that this is the need of the hour.

The Objective of this workshop is to address the growing need to manage water resources, water shortage problem and the initiatives taken to conserve and optimize the use of this precious resource. Safeguarding fresh water ecosystem, addressing water efficiency by harvesting rain water can enhance environmental stability and thus involve everyone in the process of Green initiatives. Shortage of water has resulted in ground water reserves being tapped in many areas, often to unsustainable levels. The cost structure in industries has also been adversely affected by stiff water tariffs. With this scenario it has become an attractive proposition to adopt simple and cost-effective alternative solutions like rainwater harvesting to conserve and manage water.

Simple water harvesting systems can ensure yearlong water supply. These systems are low in capital cost and once put in place operate on their own without much monitoring or further expenditure. Thus rainwater harvesting offers promise of cleaner water, more water and greater control over water.

Topics discussed during the workshop includes, "Rain water harvesting and its effective use" by Dr. Anup Das, Senior Scientist Agronomy from ICAR, Umiam and "Role of Remote Sensing and GIS in water resource management" by Dr. B.U. Choudhury, Scientist Soil Science, ICAR, Umiam. Another lecture was delivered by Bro. C. Naronha, Executive Director Bethany Society, Shillong on the topic, "Water is Life".

The workshop aims to create awareness in the college, since it is felt that academic Institutions is the best place to start the program about the potential of rainwater harvesting as a simple and cost effective measure to conserve, manage and meet ones water requirement and also to make them aware and understand that rainwater harvesting is the need of the hour, since the students are the future of tomorrow. Unless we get rainwater harvesting as a movement we will not be having a bright future and for that people have to be motivated to make this a habit. It is not something that we should do to ensure a better tomorrow for our future generation, but it is something we need to do to save the planet and the human race.

Simple water harvesting systems can ensure yearlong water supply. These systems are low in capital cost and once put in place operate on their own without much monitoring or further expenditure. Thus rainwater harvesting offers promise of cleaner water, more water and greater control over water. Despite the technological advances that mankind has made, a vast majority still do not have access to portable drinking water. We are all familiar with the fact that women in some villages have to walk hundreds of kilometers to bring home a few pots of drinking water. However, the fact that, there are areas in the major metros of this country, where families depend on water supplied by tankers once a week, might shock a few of us.

Though rainwater harvesting has been in practice from time immemorial in the form of kunds in the Thar desert, kul and bamboo irrigation methods and temple tanks, the importance of it had dwindled considerably. Traditional rainwater harvesting is still prevalent in rural areas, in surface storage bodies like lakes, ponds and irrigation tanks, temple tanks etc. In urban areas however, due to the shrinking of open spaces, rainwater has to be harvested in order to ensure that the ground water level goes up.

It is therfore high time for all of us now to know that harvesting rainwater is one of the simplest and affordable ways of ensuring that we leave behind the legacy of a world that is green and where this precious liquid- water is still available in abundance. Well, if you still haven't discovered the benefits of rainwater harvesting here is your chance.

Rainwater harvesting has several advantages:

* Helps you cut down on your water bills (especially in cities where people have to buy water).
* Reduces demand on the municipal water supply.
* Makes efficient use of a valuable resource.
* Reduces soil erosion.
* Prevents the contamination of ground water and also reduces the possibilities of the occurrence of natural calamities such as floods.

We believe that the workshop was a very informative and a benefiting one which have tremendously profit the audience presence and their involvement and participation.

"It is not something that we should do to ensure a better tomorrow for our future generation, but it is something we need to do to save the planet and the human race".

"WATER IS LIFE"
SO HARVEST RAINWATER FOR THE WORLD IS THIRSTY!
&
HARVEST THE RAIN TO FEED THE WORLD!

Mrs. E.N.Dkhar
H.O.D.Physics
Shillong College, Shillong

"Rain-Water Harvesting"

Organized by the Physics and Chemistry Departments, Shillong College, Shillong

It is a great pleasure for the Departments of Physics and Chemistry, Shillong College, Shillong to be able to organize a weeklong programme from 18th June 2010 to 23rd June 2010, on "Rain-Water Harvesting". I, on behalf of the Departments of Physics and Chemistry, am very grateful to the Principal of Shillong College, for giving us an opportunity to organize such a vital programme in the college. The objective of the programme was to create an awareness about the importance of harvesting of rain-water, not only to the staff and students of the college, but also to all the people from different localities and villages.

The importance of the concept of rain-water harvesting can be applied to a variety of fields such as, in agriculture and tapping and treatment of the rain-water for consumption. I am also grateful to the U.G.C (Under location specific curriculum) for sponsoring this programme, without which this programme wouldn't have happened. The entire programme was conducted in three sessions. Apart from these sessions, there was poster-display competition and distribution of pamphlets to all the students of the college, concluded by prize distribution programme, which was graced by the Principal and Vice Principal of the college.

Over the years, rainfall period has gradually become shorter. With the variation in the manner in which rain-water is being received, along with deforestation, charging of the soil has decreased immensely. Moreover, in urban areas, there has been a lot of exploitation of the water-table, as many have started the system of drilling water for commercial purpose. As a result, many natural springs have become smaller gradually and a lot more have dried up. All these account for water-crisis in the urban as well as rural areas, especially during dry season. However, there is a silver lining in this dark cloud which is rain-water harvesting and this can be the solution to this crisis.

Looking at the other aspects, this programme has brought in a sense of closeness, understanding and unity among the staff of the two departments through their active participation and co-operation. I strongly believe that this programme will have a positive impact in the minds of the people who have attended the programme and relieve the people from facing water-crisis in the dry season.

Shri T. J. Kharbhih
H.O.D, Chemistry
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Rain water harvesting and its diversified uses

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Introduction

Water is the most indispensable natural resource available to mankind. Of all the planet's renewable resources, water has a unique place. It is essential for sustaining all forms of life, food production, economic development, and for general well being. It is impossible to substitute for most of its uses, difficult to de-pollute, expensive to transport, and it is truly a unique gift to mankind from nature. Water is also one of the most manageable of the natural resources as it is capable of diversion, transport, storage and recycling.

The north eastern region comprising the states of Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim lies between 20 81' and 29 30'N latitudes and 89 40' and 97 50' E longitudes. The region is characterized by diverse agro-climatic and geographical situations. Annual average rainfall of the region is 2450 mm accounting for 10% (42.0 Mha m) of the country's total water of 420 Mha m. In spite of its rich water resources base, the region has not progressed to the expected level. It can till date utilize only less than 1% of water resource (0.88 Mha m of water). Remaining more than 41.0 Mha m water is lost annually due to its major portion being hilly. This also depletes the soil fertility and imbalance the ecology of the region.

The practice of rainwater harvesting in ponds and reusing the stored water for life saving irrigation of crops and also for domestic purpose is prevalent in India since ancient times. One can find efficient management of water in the NE region in traditional farming systems like 'Zabo system' of Nagaland and Bamboo drip irrigation of Meghalaya and rice + fish farming in Apatani valley of Arunachal Pradesh. Almost all the kingdoms had ponds, lakes etc around their palaces for security, irrigation, fishery as well as for recreation. It's almost a common scene in the states of Tripura, Manipur, Assam, and other states especially in plains that every household have at least one farm pond for their day to day activities like domestic uses, cleaning, small scale irrigation some cases even for drinking.

The nature has been generous in bestowing the region with bounty of water resources in form of rainwater but in the absence of scientific management of this vital resources from rain and consequent surface flow and underground storages, the water resources goes waste and creates havoc downstream. Much of the enormous water resources remain unutilized due to absence of proper water resource planning and scientific management. The efficient utilization and management of available rainwater is the core issue if the cropping intensity and production is to be enhanced. Rainwater harvesting and its recycling through the micro irrigation systems may revolutionize the regions agriculture by enhancing the production, productivity and quality of produce. This would also reduce presuure on ground water.

Water resources in NE region

More than 97% of the worlds water resources are in the oceans and seas and are too salty (3% salt) for most of the production uses and not fit for human consumption. Of the available fresh water (2.6%) also, only a small fraction (0.52%) is available as surface water. For all practical purpose mankind depends on this small fraction of water.

Water is one of the key resources of North Eastern region. North East is endowed with bounty of water resources accounting for about 40% of the total water resources in the country.

The tentative assessment of this dynamic resource in the North East India is about 60 million hectare-meter. Unfortunately, this vast potential has not been exploited as yet. The region experiences a paradoxical hydro climatic environment and represents a typical hydrological entity in the world atlas. Endowed with huge water resources potential, it has also the worst water resource problems rendering untold sufferings to millions every year. The water budget of the N-E states is given in table 1.

Table 1 Annual Water Budget of North Eastern States

Item		Arunachal	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	Total
GA (km^2)		83740	78440	22330	22430	21080	16580	10490	255090
Avg. Rainfall	mm	2930	2336	1972	2253	2535	1986	2516	2493
	MCM	245358	183236	44035	50535	53438	32928	26393	635923
E.T. Losses	mm	905(31%)	873(37%)	864(43%)	807(36%)	976(39%)	872(44%)	857(34%)	883(35.5%)
	MCM	75785	68478	18891	18101	20574	14458	8990	225267
Recharge of ground water	mm	205(7%)	234(10%)	118(6%)	113(5%)	128(5%)	99(5%)	151(6%)	183(7.3%)
	MCM	17168	18355	2635	2535	2698	1641	1584	6716
Surface water runoff	mm	1820(62%)	1229(53%)	1008(51%)	1313(59%)	1431(56%)	1015(51%)	1508(60%)	1426(57.2%)
	MCM	152405	96403	22509	29751	30166	16829	15819	363582

GA -Geographical area.

The region experiences excessive rainfall and high floods during monsoon months and also suffer from acute shortage of even drinking, water in many areas due to lack of management. The basic issue underlying the water resources problems, are recurring floods, drainage congestion, soil erosion, human influence on environment and so on and calls for its integrated use for drinking, irrigation, generation of hydropower, navigation, pisciculture, recreation etc. Since most of the areas in the North East region have been declared as restrict area, even the scholars have no access to elementary physiographic or geomorphological datas to make proper inventory. Per capita fresh water availability in the Himalayan Region is evaluated to range from 1757 m^3/yr. in Indus, 1473 m^3/yr. in Ganga, 18417m^3 in Brahmaputra with an all India average of 2214 m^3/yr. It may be mentioned here that the definition of water stress is that less than 1000 m^3 of water will be available per person per annum.

Rainfall Pattern in NE India

The North Eastern Region is the highest rainfall zone of the country and enjoys typical monsoon climate with variants ranging from tropical to temperate conditions. The rapid changes in topography result in climatic changes within short distances. The foothill plains, sheltered valleys and the mountain ranges are however marked with climatic contrasts and as such any generalization regarding the climate of the whole region will be hardly apt for its micro zone. The rains are of long duration and occur mostly between March and October. During March and

April the rainfall is sporadic but it is steady and heavy or very heavy during May and October. Annual rainfall in northeastern portion of Arunachal Pradesh, north west of Dihang and north east of Bomdila is about 4000 mm, but gets reduced in southern western district. The rainfall increases in Khasi Jaintia and Garo hills (over 10,000 mm) but drop down in the north of Brahmaputra valley (about 2000 mm). The central parts of Meghalaya are famous for phenomenonaly high rainfall experience there with, average annual rainfall exceeding 2700 mm (Anonymous, 2004). The northern and adjoining central area is in the rain shadow region having rainfall varying 4000 to 2000 mm. The Imphal, Lumding region which partly lies in the rain shadow of the Mikir hill range records lowest rainfall (1000 -2000 mm).

The rainfall is mostly associated with storms and is generally heavy with average number of days having 25 mm or more rainfall are over 100 except southern Meghalaya where there is an average of two days in three. The pre monsoon rainfall (March-May) accounts for 25% of annual rainfall while bulk of the rainfall (67%) occurs during June -Sept which constituted the monsoon season. The monsoon withdraws from the North East almost abruptly in the last week of Sept or first week of Oct. and post monsoon rainfall (Oct -Dec.) and winter monsoonal rainfall are scanty limiting the scope for agricultural activities during the rabi season. The annual variations in rainfall is very wide from one place to another and its duration is most uncertain. The monthly rainfall pattern in Meghalaya is depicted in Fig.1.

The fig 1 shows that the rainfall is skewed and ill distributed. Delay in pre monsoon showers and delay in onset of monsoon not only lead to serious dislocations but also cause great damage to the crops. On the other hand, the excessive precipitation causes very rapid runoff on steep slopes resulting heavy soil loss as well as siltation of riverbed and catastrophic flood hazards in plains and also dangerous land slides at excessive leaching of losses causing poor base status and soil acidity leading to detrimental environment for nutrient availability of common agricultural crops.

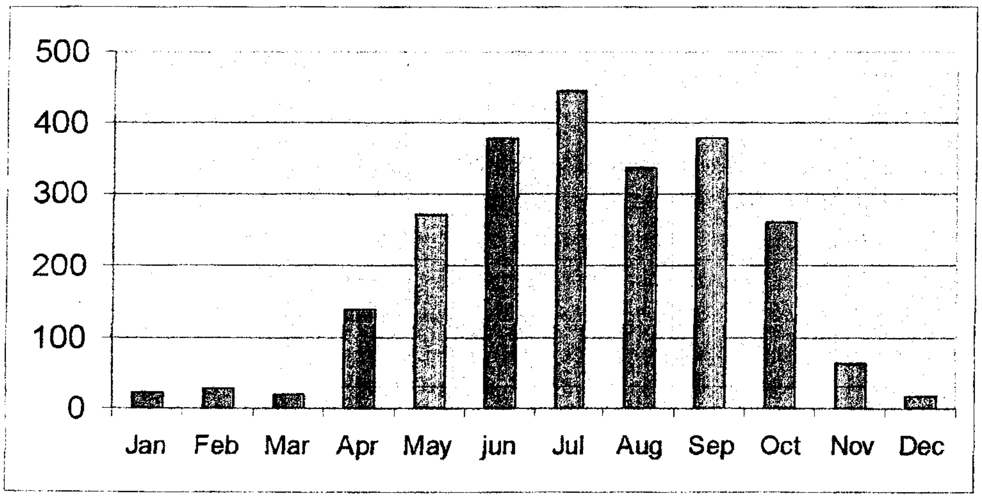


Fig 1 Rainfall pattern in Meghalaya

Water management constraints of the region

The major constraints are undulating topography, highly eroded and degraded soils and inaccessible terrain, land tenurial system, size of land holding and prevalence of shifting cultivation. Infact, there is no water when we really need it, but when we do not need water there is plenty of water.

Monthly rainfall analysis indicates that this region receives more than 84 per cent of annual rainfall during the months of May to October. July is the wettest month with an average of 437.18 mm rainfall.. Month of December is the driest month with a mean rainfall of 12.15 mm having maximum drought months. It is also having the highest value of co-efficient of variation (152 12), which shows the erratic pattern of rainfall. There is therefore too much too little syndrome of rainfall in the region.

There is also problem of growing crops during *rabi*, although the region falls in moisture index zone of 6-8, yet there is acute scarcity of moisture from November to March.

Development of natural water resources, rain and springs, conservation of rain water and its proper use for maximizing crop production are, therefore, the major thrust area of the water management in this region.

Rainwater Harvesting in the Present Context

The region loses the lion share of the rainwater through runoff. It is in this background that the rainwater harvesting assumes significance. It can be implemented as a viable alternative to conventional water supply considering the fact that any land anywhere can be used to harvest rainwater. Rainwater harvesting is in reality extending the fruits of the monsoon based on the principle **"Catch the water where it falls"**. Rainwater harvesting besides helping to meet the ever increasing demand for water, helps to reduce the runoff, which is choking storm drains, avoid flooding of roads, augment the ground water storage and to control decline of water level, reduce groundwater pollution, improve quality of groundwater and reduce soil erosion . This is considered an ideal solution of water problem where there is inadequate groundwater supply or where surface resources are either not available or insufficient. The other advantages are that it helps utilize rainfall runoff, which flows into sewer or storm drains and therefore helps reduce flood hazards. The rainwater is bacteriologically pure and free from organic matter and soft in nature. The structures required for harvesting rainwater are simple, economical and eco-friendly.

Rainwater harvesting is viewed as a water security measure with two broad types of programmes as given in Fig. 2.

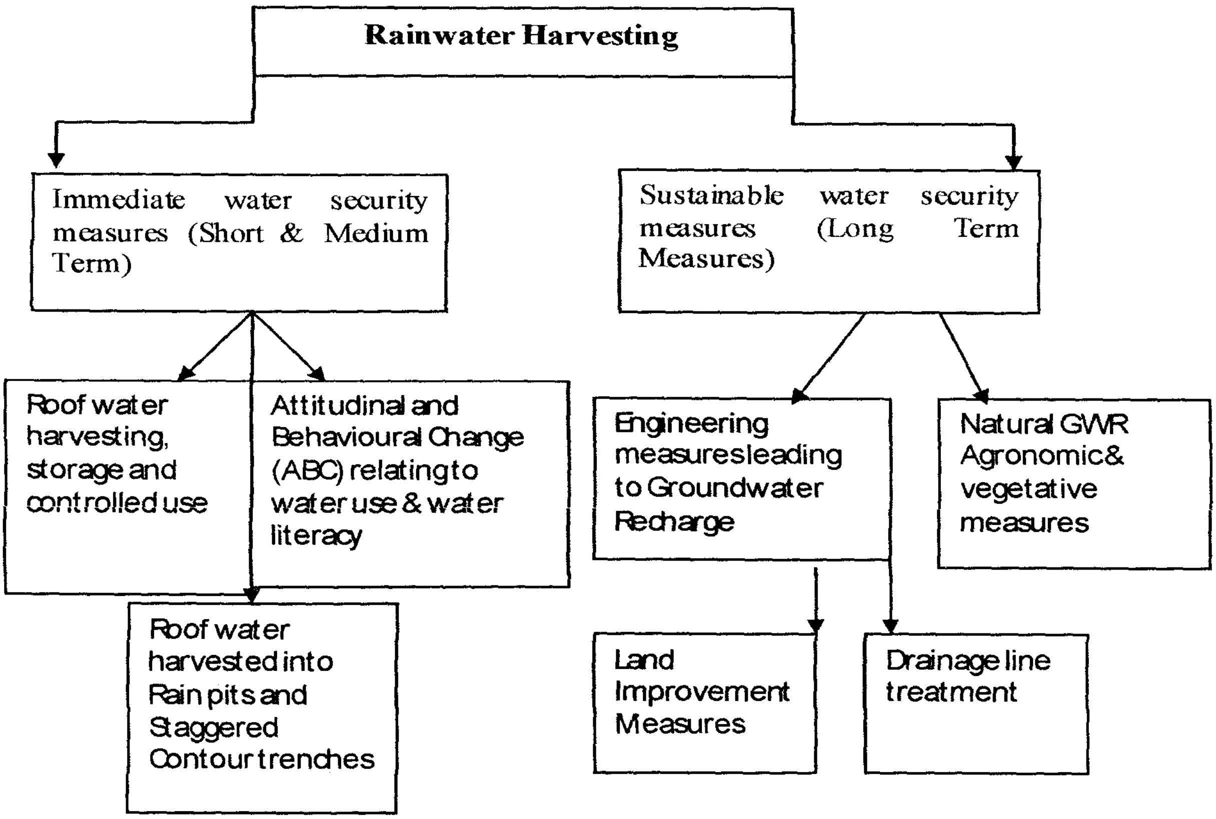


Fig 2. Two broad areas of Rainwater Harvesting

Rainwater harvesting, irrespective of the technology used, essentially means harvesting and storing water in days of abundance, for use in lean days. Storing of rainwater can be done in two ways; (i) storing in an artificial storage and (ii) in the soil media as groundwater. The former is more specifically called roof water harvesting and is rather a temporary measure, focusing on human needs providing immediate relief from water scarcity, while the latter has the potential to provide sustainable relief from water scarcity, addressing the needs of all living classes in nature. The rainwater or runoff in the form a spring or stream can be harvested in RCC/ Ferro-cement/ Plastic/fibre tanks or various types of low-cost lined ponds for utilizing in lean periods.

On going works of research and developments for different modules of water harvesting structures in the Institute are described below:

A)Water harvesting structures

Dug-out-cum embankment type of water harvesting structures are used for creating seasonal and perennial ponds mainly at the foot hills of micro-watersheds. Pond is created by embankment of earth dam with core wall made of either masonry or impervious soil to check seepage in the middle of the designed section and with proper height along with surplusing arrangement by way of constructing masonry spillway etc. Provision of emergency earth spillway to handle peak flow must also be provided against over topping of run off at one end or either end of the dam. Ponds so created have the manifold uses for home use, irrigation, drip and sprinkler irrigations, animal uses, recreation purposes etc. Also integrated fish farming like fishery + piggery, fishery+ duckery and fishery + poultry rearing etc. could be taken up profitably where the animal excreta fed to fishes for early growth and quick income generation.

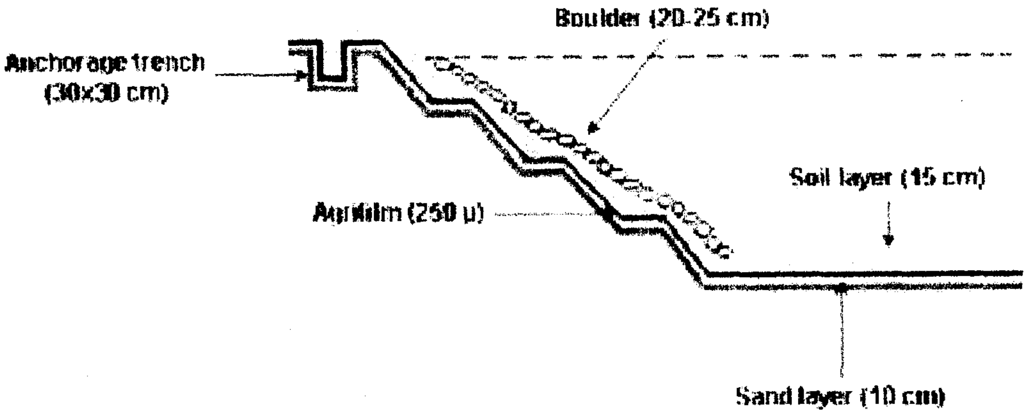
Many water harvesting ponds in foot hills and valley lands have been created under two projects on NATP and NWDPRA of the ICAR Research complex for NEH Region, Umiam, meghalaya to demonstrate at the farmer's field. Twelve (12 nos.) of ponds of different sizes are created under NATP out of which 10 nos. have been created at Mawpun and 2 nos of ponds at Umroi A total of 9 nos. of water harvesting ponds have been created of minimum sizes 20 mx 30mx 1.5 m of water depth under NWDPRA project out of which 3 ponds at Mawthei, 1 pod at Lumsohlang, 4 nos. at Umdohbyrthih and 1 in Umeit.

ICAR Research Complex for NEH Region, Umiam popularizing intensive farming system based on farm ponds for sustainable utilization and recycling of natural resources. The following four Intensive Integrated systems were studied along with one control pond for comparison;

1. Poultry-crop-fish-duck-horticulture along with hedgerow on contour bunds.
2. Crop-fish-poultry-multipurpose trees.
3. Crop-fish-goat- multipurpose trees.
4. Crop-fish-dairy-mushroom-vermicompost-horticulture-hedgerow.

B. Agri-film lined (LDPE) farm ponds

Agri-film lined (LDPE) and UV resistant plastic (silpaulin) ponds had been established in the institute as part of research studies and the results were quite encouraging. A study of storage behaviour of the pond revealed that seepage loss from agri-film lined pond was reduced from 55 to 2.9 l/m2/day i.e. by 94.7%. In a similar manner, it was found that the percolation rate through the silpaulin-lined pond is nearly zero and the storage hydrographs of the unlined pond and lined pond clearly showed the increase in water saving efficiency of the pond after lining in terms of both quantity and duration of storage. Furthermore, the input/output statement of Farming System Research Project taken up by the ICAR Complex, Barapani revealed that the Agri-horti-silvi-pastoral system and dairy farming becomes profitable due to the integration of silpaulin lined water harvesting structure. These technologies have been popularized among the farmers of the hilly regions through NWDPRA, NAIP, KVK and other extension programmes. Schematic diagram of Agri-film lining of water harvesting pond is given below:



According to a study at ICAR Research Complex for NEH Region, Barapani, seepage losses could be as high as about 55 l/m^2/day. Owing to the high rate of seepage loss, harvested water will be lost within 1-2 months of recession of rain. Therefore, lining of pond with low *density polythene* (LDPE) agrifilm is very much essential for retention of harvested water in the pond for the entire dry season i.e. from November to March.

Method adopted for lining of the pond with agrifilm

After the pond was dug as per the design, pond bed and sides was made weed and stone free. Steps at 50 cm vertical interval were made on sides of the pond to hold the agrifilm at its place. On top of the sides, continuous trench of 50x50 cm was dug for the purpose of anchoring the agrifilm to prevent it from sliding down. Pre-emergence herbicide was also sprayed on sides and bed to arrest the weed growth. After the sides and bed were dressed properly, 10cm thick layer of sieved sand was spread uniformly on bed and sides to provide cushion to the agrifilm. After that, agrifim was laid properly in the pond. LDPE agrifilm of 250 μ was used for lining. Utmost care was taken in joining the agrifilm to suit the shape and size of the pond. For joining, bitumen of 85/127 and 80/100 grade in the ratio of 2:1 was used. While laying too much stretching or tightness of the agrifilm was avoided, particularly on sides. Over agrifilm, soil cover of 30 cm was provided. Then stone pitching was done on sides only to safeguard the sides of the pond against erosion and any other external forces. Study of storage behaviour of the pond revealed that seepage loss from agrifilm lined pond was reduced from 55 to 2.9 l/m^2/day i.e. by 94.7%.

Advantages of lined ponds

It is observed that the construction of a dugout pond and lining it with strong and durable plastic sheets for harvesting rain and spring water has the following advantages:

(i) Effective storage of harvested water by hindering seepage losses,

(ii) Low capital investment per litre of collected water,
(iii) Multiple use of harvested water.

The performances of Agri-film lined (LDPE) pond at farmers level yet to be assessed as only one farmer at Umroi area of Ribhoi Distt tried this particular technology recently.

C. Micro rain water harvesting structure- *Jalkund*

The Northeastern region of India is characterized as the highest rainfall zone of the country. However, the water availability for domestic use, animal and crop production is negligible not only during the off-season but to some extent also during the rainy season particularly for families residing on hillocks.

The Institute has developed the low cost, simple, polythene based micro rain water harvesting structure for hill top and it was demonstrated in the fields of 111 farmers in four NE states. The capacity of a Jalkund is 30,000 litres at Rs. 6055. Each Jalkund can harvest approximately one and half times its original capacity considering replenishment of the pond by intermittent rains and consequent evaporation loss of about 10%. Hence, the total water harvested per annum through the applied research programme of ICAR Complex is almost 5 million litres (5,000 cubic metres) which otherwise goes as runoff and might create flood problems in the downstream areas. The water harvested in 111 Jalkunds can irrigate 35-40 ha under high value crop through drip irrigation. These activities are likely to increase the additional income to around Rs. 3.77 lakhs at the regional level. Subsistent farmer investing in micro water harvesting structure like Jalkund and its recycling can increase productivity and diversify their homestead farming to growing remunerable crops and rearing cattle, pigs, poultry, etc. From each Jalkund, the farmer can grow 250 tomato plants with 18,000 litres water and the remaining 12,000 litres can be used for rearing 3 piglets or 10 ducks and 100 fish or 50 poultry birds.

ICAR Research Complex for NEH Region, Umiam is implementing a pilot project on "Scaling up of Water Productivity in Agriculture for Livelihhood through Training and Demonstration" since 2007. Under this programme, about 2000 farmers and 200 trainers from across the region has be trained in various aspects of water harvesting and its efficient use.

***Jalkund* construction mechanism**

- Excavation of the *kund* on selected site was completed before the onset of monsoon.
- The bed and sides of the *kund* were leveled by removing rocks, stones or other projections, which otherwise might damage the lining material.
- The inner walls, including the bottom of the *kund*, were properly smoothened by plastering with a mixture of clay and cow dung in the ratio of 5 : 1
- After clay-plastering, about 3–5 cm thick cushioning was done with locally and easily available dry pine leaf (@ 2–3 kg/sq. m) on the walls and bottom, to avoid any kind of damage to the lining material from any sharp or conical gravel, etc.

This was followed by laying down of 250 mm LDPE black agri-film. Seepage loss was completely checked throughout the year. The agri-film sheet was laid down in the *kund* in such a way that it touches the bottom and walls loosely and uniformly, and stretches out to a width of about 50 cm all around the length and width of the *kund*. A 25 x 25 cm trench was dug out all around the *kund* and 25 cm outer edge of agri-film was buried in the soil, so that the film was tightly bound from all around. At the same time, side channels all along the periphery of the *kund*, helps to divert the surface run-off and drain out excess rainwater flow. This is to minimize siltation effect in the *kund* by allowing only direct precipitation. Silpaulin sheet 250 GSM can be also used for longer duration in place of LDPE black agri-film. *Jalkund* was covered with thatch (5-8cm thick) made of locally available bamboo and grass. Neem oil (10ml/sq.m.) is also advocated to reduce evaporation in off season.

Farmers have the option to go in for size and capacity of the *Jalkund* according to the water requirement for crops intended to be cultivated. Preparation cost is reflected accordingly. However, considering the seepage loss of water, the size was restricted from 6000 to 30,000 l with respective dimensions of 3 m x 2 m x 1 m, 3 m x 2 m x 1.5 m, 4 m x 3 m x 1 m, 4 m x 3 m x1.5 m and 5 m x 4m x1.5 m. The size of lining material of the corresponding dimension was 6 m X4 m, 7 m x6 m, 7 mx 6 m, 8 m x 7 m and 9 m x 8 m respectively.

D. Roof water harvesting

Model demonstration unit on roof water harvesting mechanism (Fig 3) is made at research farm for studying storage behavior in silpaulin based storage tank both during wet and dry seasons (winter rains) and its effectiveness to meet out water requirement of crops grown during dry season. There is a scope to popularize the technology in other locations. The technology involves fitting guttering systems to the roof, collecting and diverting pipes and storage tanks/ponds. Farmers in the hills use bamboo guttering with a small cemented tank/ metal drum for collection of water.

Fig 3. Roof water harvesting in Silpaulin lined pond at ICAR, Umiam, Meghalaya.

Issues of Rain Water Management

Some of the important aspects of rainwater management and the major scope for enhancing irrigation facilities in the terrain can be envisaged as follows:

- Management of runoff on slopping land use and in-*situ* retention of rainfall by adoption of appropriate soil conservation measures and land use practices.
- Ensuring safe disposal of surplus water from higher to lower level.
- Increased utilization of stream flow through diversion works at feasible locations.
- Storing surplus water at appropriate locations by constructing small reservoirs and recycling it in the same area.
- Stream flow lift irrigation.
- Conjunctive use of surface and ground water on rotational basis.
- Adoption of scientific on farm water use and management technology.
- Drainage of high water table areas.
- Tackling flood and irrigation an integrated manner.
- Proper harvesting and recycling of spring water
- Following integrated water resource management strategy including treatment of catchments, aforestation, erosion control, maintaining water quality and effective use of water.

Conclusion

The locally adoptable low-cost technologies for rainwater harvesting can be implemented as a viable alternative to conventional irrigation and drinking water supply schemes considering the fact that any land anywhere can be used to harvest rainwater. The Government and local communities has to identify it as an effective measure to combat the problem of finding a workable technology option for mitigation of droughts, preserving the ground water reserves, hinder soil erosion, and providing a dependable source of drinking as well as irrigation water. Rainwater harvesting, irrespective of the technology used, essentially means harvesting and storing water in days of abundance, for use in lean days. Storing of rainwater can be done in two ways; (i) storing in an artificial storage and (ii) in the soil media as groundwater. The former is rather a temporary measure, focusing on human or small scale irrigation needs, providing immediate relief from water scarcity. The rainwater or runoff in the form a spring or stream can be harvested in RCC/ Ferro-cement/Plastic tanks or various types of low-cost lined ponds for utilizing in lean periods. The studies suggested that these technologies are sustainable, locally adoptable, cost-effective and affordable to the farmers.

The rainwater harvesting and groundwater recharge initiatives will bring together the experiences and energies of a wide spectrum of stakeholders in mitigating the ill effects of drought and providing security against future droughts. It requires equitable involvement of local people to analyze localized problems and to arrive at the best possible solutions regarding natural resources management activities in the corresponding watershed area.

Rainwater harvesting and water resource management: A Remote Sensing Approach

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Status of water resources of NE region

Northeastern regions (NER) of India alone account nearly 40% of the country's renewable fresh water resources, mostly due to the occurrence of annual rainfall of 641 km^3 at an annual average of 2474 mm. This region is endowed with world's highest rainfall (>1000 cm annually) area i.e. Mousinram near Cherrapunji. However, due to erratic variability in rainfall (both in spatial and temporal dimensions), irony of the region is that even Mousinram, which receives the highest rainfall in the world, also suffers most often from severe water scarcity during pre and post monsoon months. Most of the surface water in the region is confined to two major river basins (Brahmaputra – Barak) which are in highly dynamic stage due to Himalayan glacial fed origin and steep gradient. As a result, only 3.8% of total surface water resources (24 km^3) of the region are utilizable. Although, the average per capita per year total surface water (Brahmaputra and Barak basins) in NER is as high as 16589 m^3, yet, the total utilizable water resources per capita per year is as low as 1404 m^3. It is projected that by 2021, an additional 20 million population will be added to the region. Consequently, the already low per-capita per year total utilizable water availability (1404 m^3) will further reduce to < 1000 m^3 and the region will be pushed from already water stressed to water scarce zone (as per the international norms, less than 1700m^3, the region is classified as water stressed and below 1000 m^3, water scarce). This will be further compounded by the increase in fresh water demands from present 27.4 km^3 to 43.0 km^3 by the year 2025 and agricultural sector will be the major consumer (>65%) of it.

Abrupt changes in climate will further modify hydrological cycle and water balance front of NE region, most likely in adverse way. A warm climate will alter rainfall distribution pattern (temporal and spatial dimensions). Intense rain may occur over fewer days and thus, total amount of rainwater received over longer time span will be further shortened. As a result, magnitude of runoff loss of water will increase by several folds from the existing very high rates. Dominance of hilly terrain features, faulty land use practices, deforestation, shifting cultivation, unscientific rampant mining of ground waters, minerals, reshaping of the landscape by constructing large dams etc. in NER will further encourage the severity of runoff, loss of fertile soils, erosion-sedimentation-siltation of reservoirs and thus aggravate the grim scenario of water resources of the region further.

Therefore, efforts are needed for more efficient management of water resources in an integrated way. Since ***rain water is the sole source of water in general and more particularly for northeastern regions,*** harvesting/conservation of rainwater and its subsequent judicious use to meet the demands all major stakeholders (viz. agricultural, industrial, and domestic including drinking purposes) is the utmost need.

Fortunately, in the recent times, several initiatives have been made in NER through various governments, NGO's, community, co-operatives, private run programmes to harvest/ conserve the rain water and its judicious use in different sphere of human needs. However, most of these efforts are confined at smaller scale (either individual house hold or at farm or field level) baring few at watershed level with only traditional approaches. Application of satellite remote sensing has a cutting edge over traditional (manual) methods of surveying and mapping of water resources. Greatest strength of hydrologic remote sensing is its ability to identify, measure, map, inventory, monitor, model, forecast, surveillance of hydrologic events and phenomena. While many of these are in research mode, remote sensing activities ahead of us hold better promise for space hydrology. While it may be appreciated that not all elements of 'water cycle' are amenable to remote sensing.

Basic concept of remote sensing

Remote Sensing is the science of obtaining information regarding an object without coming in direct contact. In the present context, the information flows from an object to a receiver (observer) in the form of radiation transmitted through the atmosphere. The interaction between the radiation and the object of interest conveys information required on the nature of the object (e.g. reflection coefficient, emittance, roughness). All objects in nature have their own reflectivity depending on surface conditions.

Examples

i) The reflection of sunlight from vegetation will give information on the reflection coefficient of the object and its spectral variation, and thus on the nature of the object (green trees, etc.). We identify objects from visible light reflected from their surface Visible light consists of blue, green and red components. We see vegetation as green because it strongly reflects green light within visible light. In addition to visible light, the surfaces of objects also reflect near infrared (IR) and ultra violet (UV) light which are invisible to human sight.

ii) Microwave radiation transmitted from a radar system and scattered from a rain cloud in the back direction to a receiver will give information on the raindrop size and intensity.

Passive and active sensing

The first example above is an example of passive remote sensing, where the reflected radiation observed originates from a natural source - the sun.

The second example is an example of active remote sensing, where the scattered radiation originates from a specially designed active radar system.

The nature of electromagnetic radiation

Radiation can be observed either as a wave motion, or as single discrete packets of energy, photons. The two descriptions are not really contradictory. The energy is emitted as photons, but its statistical distribution over time is described by a wave. Normally, one is dealing with a large number of photons arriving in a short time, and the radiation can be treated physically as a wave motion.

The varied advantages of satellite remote sensing in effectively harnessing the available natural resource potential have been successfully utilized in many parts of the world. The unique capability of spaced based sensors to provide a wide range of information available in the electromagnetic spectrum, in a synoptic and more frequent manner has made this technology an inevitable tool in sustainable development and rational utilization of natural including water resources. Data acquired by remote sensing techniques from aerial and satellite platforms provide very valuable information in developing and managing various water resources projects. The spectral signatures of water, agricultural land, forests, wasteland etc. differ from each other distinctly. Near infrared spectral bands of Landsat and IRS sensors have played an important role in remote sensing studies for water resources evaluation as water can be discriminated from all other surface features and objects due to its very low reflectance. This enables us to discriminate and map surface water bodies, rivers, drainage channels etc. By virtue of its ability to image vast areas at regular intervals of time, satellite remote sensing techniques are increasingly being employed to solve problems related to water management both at national level and at local level.

Remote sensing in rain water harvesting and water resources management

Rain water harvesting

In humid, undulating hilly tropical regions with high rainfalls like NER, it is necessary to store the maximum amount of rainwater during the monsoon season for use at pre and post monsoon months, especially for agricultural and domestic water supply. Since most of the places in NER receive more than 70% of the total annual rainfall only in monsoon months, spread over just 3 months. Prevailing undulating terrain feature along with lack of any efforts in harvesting/ conserving these waters at larger scale (watershed and above), most of them end up beyond human reach (crosses trans-boundary). As a result, during pre as well as post monsoon months, water becomes one of the most scare resources to support agricultural production and even other basic domestic needs. Under such circumstances, in and ex-situ water harvesting is the most appropriate measures to overcome these shortfalls. ***Rainwater Harvesting*** concentrates rainfall by allowing and encouraging it to run off catchment's surfaces in a controlled way and then storing the harvested water for subsequent use. Water may be stored in a number of ways: small dams, cisterns, shallow aquifers, or in the soil profile. It is then made available to fulfill various needs More precisely, Rainwater Harvesting can be defined as the process of concentrating rainfall as runoff from a larger catchment's area to be used in a smaller target area (micro-catchment). Rainwater Harvesting techniques may be at micro-catchment level that directly supply water to target crops, recharge soil profile in-situ and meet other domestic needs without any artificial storage structures or at macro-catchment's level that concentrate run-off flows and store them in prepared reservoirs for subsequent use. The choice of technique and target crop depends on local circumstances, including topography condition (slope gradient, length), soil characteristics (texture, depth, water retention and transmission properties), rainfall characteristics (amount, intensity, distribution and variability), run-off coefficients and available technologies.

Remote sensing coupled with Geographic Information Systems can help in the assessing and selecting suitable areas for large-scale rain water harvesting on watershed, regional, continental and even at global scales. It can be utilized for identifying suitable sites for soil and water conservation measures/structures (e.g. check dam, recharging well, pond, percolation tank, injection well, contour bunding/trenching etc.) to harvest the rainwater alike reduce the runoff loss in the macro as well as micro-watershed levels. Digitized sets of satellite images, topographic information, soil types, vegetation, hydrology, and meteorology are combined with specific water harvesting techniques to provide an expert system for decision making for large-scale development investments. The scope of hydrological applications has broadened dramatically, although the problems of flood protection and water resources management continue to be of importance and relevance for the security of communities and for human, social and economic development.

Watershed Characterization (Planning and Management)

Proper planning is essential for the conservation and management of rain water and land resources based on watershed approach since watershed is the basic unit of conservation scale for optimum productivity. Characterization and analysis of watersheds are pre-requisite for this. Watershed characterization involves measurement of parameters of hydrological, geological, hydrogeological, geo-morphological, soil, land use/cover etc. Aerial photo-interpretation has brought out substantial improvement in watershed surveys and mapping techniques during the last 2-3 decades. In general, the remote sensing techniques can be applied for:

- Delineation of watershed area
- Watershed characterization and assessing watershed priority, evaluation of
- Problems, potentials and management requirements of various watersheds.
- Erosion intensity mapping and identification of erosion prone areas.
- Soil, land use/land cover mapping
- Drainage pattern mapping
- Evolving water conservation strategies in a watershed.
- Site selection for check dams/reservoirs construction of on stream/streamlets
- Suggesting sites for rain water-harvesting structures.

Soil moisture determination

The soil moisture determinations are paramount in a variety of ways. While the remote sensing techniques can be used in identifying and delineating areas of different grades of soil moisture, the microwave remote sensing holds promise for sub soil moisture measurements. Such information is vital not only for irrigation engineers but also to the agriculturists. Models for soil moisture estimation using single frequency, polarization and look angle SAR data have also been developed.

Exploration and monitoring of surface water bodies

Mapping and monitoring aerial extent of surface water bodies/reservoirs using multi-spectral data has been well established. Multi-date satellite imageries are used to update area capacity curves of reservoirs to facilitate computing storage capacity. Multidate imagery can be used effectively in making inventory of surface water bodies like streams, lakes, ponds, wetlands etc., and monitoring the water spread of such bodies. Landsat TM and IRS-1A LISS-III data in near infrared band is best for mapping surface water bodies depending upon the contrast with the surrounding features. Now water bodies as small as 0.4 ha or even smaller can also be mapped using IRS LISS-III Landsat TM or SPOT imagery.

Ground Water Exploration

Remote sensing techniques have now become fully operational in targeting potential ground water zones. The technique has been found to be extremely useful in respect of ground water exploration in difficult areas like NER of India with undulating hilly terrain features, inaccessible to human reach. It has been possible to fully operationalize the technique for:

- Delineating suitable geological features and structures for ground water exploration
- Expeditious survey of large areas to progressively narrow down target areas through multistage remote sensing and save an effort of exploration by providing information of low potential areas.
- Locating potential recharge and ground water spring areas and monitoring the temporal changes.

For groundwater exploration, the various surface features amenable to observation on remote sensing data products can be grouped into two categories:

- first - order or direct indicators, i.e. those ground parameters that are directly related to ground water occurrence, (e.g. springs, canals, ponds, lakes, rivers and soil moisture etc.) and
- second - order or indirect indicators, i.e. those hydrogeological parameters which regionally affect and therefore reflect the groundwater regime e.g. drainage characteristics, fracture systems, soil/rock type, structure, landform etc.

Flood Inundation Mapping

The satellite remote sensing has proved to be powerful tool in assessing the water spread during floods, mapping of flood prone areas and also for assessing physical damage caused to crops; habitations and public utilities which are vital for effective flood management. In view of its synoptic, repetitive and near real time coverage, satellite image provides quick and accurate information of the water spread and its duration in a time sequence which otherwise is not only time consuming but also lacks the desired accuracy.

Water Quality

Remote sensing of water quality is of very recent origin and is still at incipient stage. Although, recognition of surface water by remote sensing technique is well established. Water quality, because of its varied nature and attributes is difficult to quantify in real sense. However, integration with GIS supported by laboratory based analytical information, surface water quality zone may be delineated to certain degrees.

Hydrometeorology

The satellite can be effectively utilized for estimation of aerial rainfall and the forecasts of rainfall. A relationship is known to exist between measurements of the aerial extent of storms obtained from satellite data and the stream run off measurements. This has opened up a new vista, however considerable research and development efforts are needed to make the techniques fully operational in hydrological modeling.

Weather and climate studies

Pursuing high quality research in meteorology using satellite inputs from the Kalpana, INSAT-3A and upcoming INSAT-3D and Megha-Tropiques missions to arrive at weather forecasting models is yet another area of importance.

The efforts focus on the retrieval of parameters from satellite data and their validation and use in the application areas of monsoon dynamics, numerical weather prediction, ocean state forecasting, tropical cyclone intensity and track prediction. Towards densifying the networking on ground to provide *in-situ* data for appropriate integration with the weather models, development of Automatic Weather Stations (AWS), AgroMet Towers and Doppler Weather radars (DWR) has also been taken up with the help of industry, besides launching efforts to develop appropriate meso-scale weather models to provide local level weather information.

Snow, Ice and Glacier Study

The knowledge of snow melt and glacier run off into multipurpose reservoirs gives information useful for reservoir operations. Some of the river valley projects get their supplies from snowmelt. Therefore a systematic inventory of Himalayan Glaciers is useful for overall development of the mountainous regions of the Himalayas. This information is useful for planning and operation of mini and micro hydroelectric stations and disaster warning. In addition, glaciers can provide historical records of past climate, which can serve as valuable clues for the study of future climatic changes

The satellite remote sensing has proven capabilities of providing information about aerial extent of snow cover and the changes of snow line which is used to forecast runoff during the depletion period. Remote sensing techniques are being used in making glacier inventories, mass balance and glacier-melt runoff. The IRS-1C & 1D LISS-III sensor with high spatial resolution (23 m) has the capability for mapping snow-cover in very small basins up to 100 m^2, with SWIR band having proven capability for discriminating snow from cloud. The IRS-PAN data of 6m resolution provide unique opportunity to study avalanche-run site, mapping avalanche hazard zones and development of high resolution digital terrain models (DTMs).

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THE NEED TO HARVEST RAINWATER

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The tragedy of the emerging freshwater crisis is occurring worldwide due to environmental degradation and pollution, overuse and mismanagement of available water resources. India does not lack in water resources but barely 15% of these are tapped and the rest flows down to the sea. Besides rivers and waterbodies in all parts of the country are decaying due to the wastes from cities, chemicals and effluents from industries and human activities. At the same time the demand for fresh water keeps rising with the increasing population and a number of human activities. The International Food Policy Research Institute projects that India's water demand will go up by 50 % over the next 20 years. By the year 2020 it is estimated that most regions in India will be **'water-stressed'** meaning that water shortage will become chronic and widespread. There are about 5-6 million villages in India in which over 50 % lack safe and adequate drinking water. The scarcity of surface water due to reasons known and more than these, that rain water being allowed to run off means that there is now increasing dependence in ground water, but ground water needs to be replenished by rainwater. With increasing demand more and more of ground water is pumped up without giving a thought and consequently the water table declines, and according to National Environmental and Engineering Research Institute, in several states of India ground water is being drawn faster than its rate of recharge. Due to this declining water table in several cities especially the metros, the Union Water Resources Ministry is now contemplating a move to make it mandatory for all big government and private buildings, commercial complexes to install and revive the age-old traditional system of rainwater harvesting. India has had a rich tradition of sustainable water harvesting systems for ages. Remnants of such tradition systems can still be found at several places.

In cities like Chennai and Hyderabad there are already by-laws making it mandatory for major building complexes to set up water harvesting systems to collect rain water. This system has an important aspect of recharging the ground water level. For instance in Rajasthan rainwater falling on the sloping roofs of houses was taken through a pipe to *tankas* or underground tanks built in most houses. The *tankas* were circular holes made in the ground lined with fine polished lime and beautifully decorated and covered with tiles to keep the water cool. The water collected from the rooftops was collected in these tanks and used only when other supplies fail. In the sandy tracts of the Thar desert, villagers evolved an ingenious system of rainwater harvesting known as Kunds. A kund is a circular depression of about 16 m diameter whose sides were plastered with lime and ash. It has two openings from which rainwater can enter. In the Kutch district of Gujarat, the nomadic Maldheris have developed a unique rainwater harvesting system called *virdas*, these are shallow wells dug in low depressions or *jheels*. Here enough rainwater is collected to ensure the availability of freshwater throughout the year. Roof top water harvesting is not a new idea, in fact it is an old tradition of using the roof top as a catchment area to collect rain water, sloping roofs of the houses are used to collect rainwater when passed through pipes to circulate the water to the houses. In Meghalaya too, an ingenious system of tapping stream and spring water using bamboo pipes is used to irrigate plantations where water is used to irrigate plantations where water is transported over hundreds of metres using interconnected bamboo channels. Cherrapunjee is a place in Meghalaya known to have heavy rainfall of about 15000mm but is officially recorded to have water shortage due to the fact that torrential downpours of rainwater are allowed to run off .Interestingly, Jaisalmer, a place in Rajasthan known for drought yet did not waste the scarce downpour of rain that was collected by an ingenious system of wells and canals to supply comes occasionally to maintain water for public distribution . Similarly Bangalore obtained its water from an intricate system of interconnected stone tanks that capture rainfall runoff. According to a report, Bangalore has built football stadiums and apartment buildings over some of the tanks. Ingenious systems for harvesting rainwater for irrigation purposes are also prevalent in several parts of the country. The deficiencies in the modern water distribution systems have been removed to a great extent by resuscitating the age-old Indian water harvesting system.

Though this old system was somewhat cast aside with the promise of underground pipe water urging to sink deeper tubewells to tap the underground water especially in cities where it often seems that the traditional systems are neglected but now seem to be revived due to the water crisis that threats our environment today. The deficiencies in the modern water distribution systems have been removed to a great extent by resuscitating the age-old Indian water harvesting. Thanks to the Science and Environment organizations that introduce several innovative, effective, low-cost and locally suited traditional water harvesting techniques that have been practiced in several parts of India since ages. Theoretically speaking there is now no village in India which cannot meet its drinking and cooking water needs through rainwater harvesting.

LEGISLATION ON RAINWATER HARVESTING

Implementation of the Bye-Laws in different Countries, States & Cities

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History of man's relation to water illustrates varied approaches to the management of water resources. The Etruscans had a deep knowledge of hydrology and hydraulics, a knowledge which they put to good use in their many land drainage schemes. The lower lying portions of Rome such as the area between the Capitol and Velia was formerly marshland. Settlement of the low-lying ground would never have been a possibility without the hydraulic engineering skills of the Etruscans. This took place around 625 BCE when, according to archaeological evidence a network of drainage channels was dug through the marshy ground, and at the same time, the stream that separated the two hills of the Capitoline and Palatine was regulated, its embankments were strengthened, and it was finally covered over.
Water involves controversy in some parts of the world where a growing population faces increasing competition over a limited natural supply. Disputes over rivers, lakes and underground aquifers across national borders. Although water law is still regulated mainly by individual countries, there are international sets of proposed rules such as the Helsinki Rules on the Uses of the Waters of International Rivers and the Hague Declaration on Water Security in the 21st Century.
Long-term issues in water law include the possible effects of global warming on rainfall patterns and evaporation; the availability and cost of desalination technology; the control of pollution, and the growth of aquaculture.

In order to tackle the water menace, many organisation started forming and one of them is the **International Water Association** (IWA). IWA is a self-governing non-profit organization which aims to cover all facets of the water cycle. IWA has its roots in the International Water Supply Association (IWSA), established in 1947, and the International Water Quality Association (IAWQ), which originally formed as the International Association for Water Pollution Research in 1965. The two groups merged in 1999 to form IWA. The body is headquartered in London, and operates through a board of directors, a strategic council, and various member groups. The group's mission is to serve as a worldwide network for water professionals and to advancing standards and best practices in sustainable water management. The association has four member types: individual, student, corporate, and governing members. There are about 10,000 individual and 400 corporate members, with national committees in approximately 80 countries. Annual events co-ordinated by the IWA include World Water Monitoring Day, which aims to build public awareness and involvement in protecting water resources around the world by empowering citizens to carry out basic monitoring of their local water bodies.

This article aims at highlighting the legislation put forward by the countries, both International and National and in particular the state of meghalaya

INTERNATIONAL WATER-HARVESTING AND RELATED FINANCIAL INCENTIVES

1. USA

The USA Government had announced a one-time tax credit of 25% of the cost of water conservation system (the maximum limit is $1,000) for its residents. The water conservation system is defined as any system, which can harvest residential grey water and/or rainwater. Even the builders are eligible to get the tax credit up to $200 per residence unit constructed with a water conservation system.

• Any citizen of Arizona in this state who has purchased a water harvesting system on or after January 1st, 2008, can apply for the Arizona tax credit. There is roughly $250,000 per year allocated for these tax credits.

• In Santa Fe County- Residences with 2,500 sq ft or more area must install an active rainwater catchment system comprised of cisterns. All commercial developments are required to collect all roof drainage into cisterns to be reused for landscape irrigation.

• The 77th Texas Legislature passed in 2001, amended Section 11.32 of the Texas Tax Code to allow taxing units of government the option to exempt from taxation all or a part of the assessed value of the property on which water conservation modifications have been made.

• Rainwater The residents of the city of Austin can buy rain barrels at subsidized rates and also they can avail rebate for the installation of approved cistern systems. Commercial/industrial properties can avail rebates up to $40,000 for the installation of rainwater harvesting and Grey water systems.

• Rainwater The citizens of San Antonio are eligible up to 50 per cent rebate for rainwater harvesting projects under San Antonio Water System's (SAWS). SAWS will give up to 50 per cent rebate on the cost of new water-saving equipment, including rainwater harvesting systems, to its commercial, industrial, and institutional customers. Rebates are calculated by multiplying acre-feet of water conserved by a set value of $200/acre-foot.

2. AUSTRALIA

State Governments in the following states in Australia have taken active steps to ensure that the newly constructed houses are designed and built with the latest energy and water efficient designs and products. This initiative is supported by legislation in different state of Australia.

• Rainwater Since July 2005, new houses and apartments in Victoria must be built to meet the energy The 5Star standard requires: 5 Star energy efficiency rating for the building fabric;
Water efficient taps and fittings; plus either a rainwater tank for toilet flushing, or a solar hot water system.

• In South Australia, new homes will be required to have a rainwater tank plumbed into the house.
In Syndey and New South Wales, the BASIX (Building And Sustainability Index) building regulations call for a 40% reduction in mains water usage. A typical single dwelling design will meet the BASIX target for water conservation if it includes: a. Showerheads, tap fittings and toilets with at least a 3A rating; b. A rainwater tank or alternative water supply for outdoor water use and toilet flushing and/or laundry

• Construction of 3,000-litre (800-gallon) rainwater tank has been made mandatory in the Pimpama Coomera Master Plan area of Gold Coast. This is for all homes and businesses centres connected to the Class A+ recycled Water system (those approved for development after 29 August 2005). The tank should be plumbed to their cold-water washing machine and outdoors faucets.

• A rebate of up to $1,500 for the purchase and installation of home rainwater storages has been offered by the State of Queensland in Australia.

3. GERMANY

Rain taxes are collected for the amount of impervious surface cover on a property that generates runoff directed to the local storm sewer. So, more the rainwater is caught and conserved, less is the runoff added to the storm drains. Less runoff allows smaller storm sewers, which, in turn, saves construction and maintenance costs at the site. Thus people get rain tax reductions by converting their impervious pavement/roof into a porous one.

B.NATIONAL WATER-HARVESTING AND RELATED FINANCIAL INCENTIVES

NEW DELHI

• Since June 2001, the Ministry of Urban Development has made rainwater harvesting mandatory in all new buildings with a roof area of more than 100 sq. m. and in all plots with an area of more than 1000 sq. m., that are being developed.

• The Central Ground Water Authority (CGWA) has made rainwater harvesting mandatory in all institutions and residential colonies in notified areas (South and South-west Delhi and adjoining areas like Faridabad, Gurgaon and Ghaziabad). This is also applicable to all the buildings in notified areas that have tube wells. The deadline for this was for March 31, 2002. CGWA has also banned drilling of tube wells in notified areas.

Implementation

Building plans are not sanctioned unless such provision is provided. DDA/MCD representatives undertake a site inspection before issue of Completion Certificate to the building and ensure that the RWH is made as per plan. Central Ground Water Board has undertaken a study of critical groundwater zones in the city All buildings/plots willing to drill boreholes in the premises need prior permission from CGWB Delhi Jal Board (under Ministry of Water Resources) has a dedicated Rain Water Harvesting Cell

Incentives

Delhi Jal Board under Ministry of Water Resources provides financial incentives for construction of RWH pits in the form of 50% of the cost of construction or upto Rs. 2 Lakh cash to registered Resident Welfare Associations which have implemented RWH.

KERALA

The Kerala Municipality Building Rules, 1999 were amended by a notification dated January 12, 2004 (Local Self Government Department Notification) issued by the Government of Kerala to include rainwater harvesting structures in new constructions. Exemption from this can be granted for cases where water logging is common or in areas with impermeable subsoil conditions to considerable depths.

Implementation

Implementation of RWH structures was distributed amongst different agencies: Kerala Water Authority (1231 of the 6,000 subsidized structures) and Jalanidhi (816 of the 6,000 subsidized structures) Kerala Government plans to take up 8,750 wells for RWH.

Incentives

Kerala Government planned to subsidize the construction of 6,000 water harvesting units in 2007 (distributed amongst Kerala Water Authority and Jalanidhi)

INDORE (MADHYA PRADESH)

• Rainwater harvesting has been made mandatory in all new buildings with an area of 250 sq m or more. RWH has been made mandatory for G+3 Structures.

• A rebate of 6 per cent on property tax has been offered as an incentive for implementing rainwater harvesting systems.

• Rainwater Department of Housing and Environment and Urban Administration and Development, Government of Madhya Pradesh have issued Directives to Urban Local Bodies under Government Order no. F 23 (107) 95 XXXII dated 7th July, 2004 for ensuring installation of Rainwater Harvesting Structures.

• Rainwater Building Departmentof IMC sanctions building permissions only after implementation of RWH schemes on site The department has implemented over 3,000 RWH projects in residential buildings and over 150 in public buildings and gardens.

• Rainwater A separate department named Rain water harvesting and Recharging Department was set up under Indore Municipal Corporation (IMC) in 2000 for awareness generation and to help citizens adopt RWH in new and existing buildings.

• Rainwater All Government buildings; Old and new gardens under IMC are being provided with RWH pits as pilot projects RWH cell undertakes activities related to awareness generation, conducts exhibitions, distributes pamphlets and coordinates with NGOs

Indore is amongst one of the foremost leaders in propagating and implementing RWH on a large scale. The number of RWH structures in Indore is 3,000 compared to 1,000 in Delhi

Incentives/ Penalties

Initial incentive of a one year complete property tax waiver for buildings undertaking RWH helped popularize RWH and ensured high compliance level. Building Department of IMC gives a rebate of 6% in property tax for those implementing the scheme (under Amendment to Article 138 of MP Municipal Corporation Act, 1956 and Article 126 of MP Municipalities Act, 1961 in March, 2001)

HYDERABAD (ANDHRA PRADESH)

• Rainwater harvesting has been made mandatory in all new buildings with an area of 300 sqm or more irrespective of the roof area.

•Tentative date for enforcing this deadline was June 2001.

• Mandatory to provide RWH in all Group Housing and Commercial Complexes

• Mandatory for all categories of buildings including residential

• All existing buildings in Municipalities/Municipal Corporations shall construct rain water harvesting structures within a period of one year from issue of this GO. Competent authority shall insist on implementation of RWH in all layouts and sub divisions for sanctioning the same.

Hyderabad Metropolitan Water Supply and Sewerage Board (HMWS&SB) has special Cells at their office where people can get information regarding RWH In critical areas, HMWS&SB has constructed nearly 14,000 RWH structures

TAMIL NADU

Through an ordinance titled Tamil Nadu Municipal Laws Ordinance, 2003, dated July 19, 2003, the Government of Tamil Nadu has made rainwater harvesting mandatory for all the buildings, both public and private, in the state. The deadline to construct rainwater harvesting structures was August 31, 2003. Municipal Administration and Water Supply (WS1) Department through a Government Order dated Nov. 2002, assigned Municipal Administration and Water Supply Department as the Nodal Departments for RWH, proposed setting up of State level and District Level Coordination Committees and propagated RWH in Government Buildings. It made it mandatory for Chennai Metropolitan

Development Authority, all MCs, Municipalities, etc to sanction building plans only after implementation of RWH. Water and sewer connection would not be given to new buildings without RWH.

• Government of Tamil Nadu published a notification in the Tamil Nadu Gazette to make amendments to Chennai City MunicipalCorporation Act 1919, TamilNadu District Municipalities Act 1920, Madurai City Municipal Corporation 1971 and Coimbatore City Municipal Corporation Act 1981 to make RWH mandatory. Under these amendments RWH was also made mandatory for all Government buildings.

• RWH has been made mandatory in three storied buildings irrespective of the size of rooftop area State Government proposed phase wise implementation of RWH. Under Phase I the Tamil Nadu Municipal and Panchayat Laws Ordinance was issued in July, 2003 which made RWH mandatory for all buildings in the State by Aug. 2008. Under Phase II, the scope of RWH was expanded from buildings to roads, ponds, streets, National and State Highways, road margins and open areas. By the end of October 2003, more than 48 lakh Non Government buildings in urban areas had installed RWH. More than 1.72 lakh Government sector buildings have been provided with RWH Building assessment for tax computation is done only for buildings with RWH structures.

Involvement

Multimodal communication techniques have been adopted and measures to spread awareness have been taken through involvement of several sections of society including NGOs, school and college students. Street plays, Road shows, advertisements in TV, cinemas, print Media are conducted Students, Government Officials are invited to RWH Workshops Seminars have been held for Government Officials, Students, Women and Self Help Groups. CMWSSB field staff and 55,000 students were involved in one day door to door campaign on RWH More than 25,000 youngsters were trained in implementation of RWH techniques by TWAD Board all over the Sate to promote and implement RWH Information centers have been set up in all District Collectorates to provide information on RWH. RWH projects implemented in State Level Government buildings including CM's residence

Incentives/Penalties

In case, the deadline for implementation of RWH structures (Aug. 2003) was not met, the Executive Authorities were to provide the structure and recover the cost from the owner in a manner similar to Property Tax Prizes have been given to students who motivate their parents to implement RWH and to schools, teachers in each district who implement RWH Water and sewer connections to new buildings are provided only after implementation of RWH.

KANPUR (UTTARPRADESH) • Rainwater harvesting has been made mandatory in all new buildings with an area of 1000 sq m or more.

RAJASTHAN • The state government has made rainwater harvesting mandatory for all public and establishments and all properties in plots covering more than 500 sq m in urban areas.

MUMBAI •The state government has made rainwater harvesting mandatory for all buildings that are being constructed on plots that are more than 1,000 sq m in size. The deadline set for this was October, 2002.

GUJARAT • The state roads and buildings department has made rainwater harvesting mandatory for all government buildings

HIMACHAL PRADESH •All commercial and institutional buildings, tourist and industrial complexes, hotels etc, existing or coming up and having a plinth area of more than 1000 square metres will have rain water storage facilities commensurate with the size of roof area. *No objection certificates* required under different statutes and will not be issued to the owners of the buildings-unless they produce satisfactory proof of compliance of the new law. Toilet flush systems will have to be connected with the rainwater storage tank. It has been recommended that the buildings will have rain water storage facility commensurate with the size of roof in the open and set back area of the plot at the rate of 0.24 cft. Per sq m of the roof area.

AHMEDABAD• In 2002, the Ahmedabad Urban Development Authority (AUDA) had made rainwater harvesting mandatory for all buildings covering an area of over 1,500 square metres. According to the rule, for a cover area of over 1,500 square metres, one percolation well is mandatory to ensure ground water recharge. For every additional 4,000 square metres cover area, another well needs to be built.

BANGALORE• In order to conserve water and ensure ground water recharge, the Karnataka government in February 2009 announced that buildings, constructed in the city will have to compulsorily adopt rain water harvesting facility. Residential sites, which exceed an area of 2400 sq ft (40 x 60 ft), shall create rain harvesting facility according to the new law.

PORT BLAIR • In 2007, Port Blair Municipal Council (PBMC) directed all the persons related to construction work to provide a proper spout or tank for the collection of rain water to be utilised for various domestic purposes other than drinking. As per the existing building by-laws 1999 the slab or roof of the building would have to be provided with a proper spout or gutter for collection of rain water, which would be beneficial for the residents of the municipal area during water crisis. The PBMC had advised all the owners of buildings in the Municipal area to comply with the provisions within four months failing which action would be taken against them by the Council.

The Government of Meghalaya has taken necessary steps on Rain Water Harvesting and initiative was given through the Planning Department whereby the Governor has issued order which has been notified in an office memorandum vide **Meghalaya Water Harvesting Mission No. PLR 92/2006/40 dated Shillong the 4th March,2008**. This notification includes the following points

I. Background/Introduction:

1. Though the state of Meghalaya receives heavy rainfall during the monsoon period, the state faces acute water shortage during the lean season due to lack of water storage systems. Considering the limitations of surface and ground water in the state, the most reliable source of water for drinking, cooking and irrigation in the dry months is harvested rainwater The immense possibilities of water harvesting however remain largely unexplored in the state. The state should therefore lay emphasis on rain water harvesting. However as no particular Department is entrusted with the responsibility of promoting water harvesting it is therefore necessary that the state should start a Water Harvesting Mission in the shape of a project type organization to promote water harvesting as a movement. This will be a registered society.

2. The Government of Meghalaya has decided to launch the **Meghalaya Water Harvesting Mission** with the following objectives:-

(i) To improve round the year availability of water through water harvesting through ponds, tanks, check dams and other methods.
(ii) To involve communities directly in water harvesting.
(iii) To build capacity at every level for creating a state-wide water harvesting movement.
(iv) To put in place institutional arrangements for the self sustaining management of water harvesting structures and systems.

3. The Water Harvesting Mission will be a State Plan scheme for which resources have to be channelized for the purpose from various schemes of other departments. The resources available from the Central Government, Institutions and from other sources will also be explored The Mission Authority should be a semi – autonomous body having strong linkages With local communities. The Planning Department of the state will be the Nodal Department. The implementation of the schemes will be through the local village communities. The schemes will also be proposed by them as per their needs. The NGOs/ technical officials will help them in preparing plan and estimates.

II. Strategy:

1. Rain Water Harvesting would be adopted and implemented as a State programme.
2. The scheme should be planned and executed on scientific principles and integrated with suitable land-use practices.
3. Need to build data base on rain water harvesting and dissemination of data/information on available technology and recent advancements to the users at grass root level.
4. The prioritization of areas for implementation should be identified on the basis of declining water table, quality degraded areas and vulnerable areas.
5. Traditional rain water harvesting techniques should be revived, supported and developed taking into account the recent advancements.
6. Proactive approaches such as mass awareness programmes and training programmes would be undertaken by government agencies in association with NGOs, SHGs and Voluntary Organisations
7. Roof top rain water harvesting should be taken up in urban areas. Suitable legislative measures would be proposed for inclusion of rain water harvesting in building byelaws in urban areas.
8. Techno-economic evaluation of rain water harvesting would be taken up for large harvesting projects.
9. The water harvesting schemes would be implemented through people's participation. The funds for the purpose would be given to village committees/groups for implementation.
10. Suitable and competent NGOs would be identified for providing support to the village committees.

III MISSION INTERVENTIONS:

• IN- SITU HARVESTING– Wherein the rainfall precipitation is collected from streams, nalahs, surface runoff, roof top collection for direct utilization in domestic, irrigation and other uses.
• CONSERVATION OF RAINFALL PRECIPITATION IN AQUIFERS- Through tanks, check dams etc.
• STORAGE IN SOIL PROFILE- For soil moisture build up through afforestation, gully plugs, contour building etc.
• Restoration, revival, revitalization and upgradation of existing/ traditional rain water harvesting structures
• Using and propagating Traditional and modern methods of water harvesting in the state.

IV. MISSION STRUCTURE:

1. STATE LEVEL.

(a) **State level Water Harvesting Mission Steering Committee**- At the State level, a State Water Harvesting Mission Steering body will be formed under the chairmanship of the Chief Secretary. The line Departments of water resources (Minor irrigation, Soil and Water Conservation, PHE and Agriculture departments) Planning, Finance and Rural Development would be members of the steering committee as government nominees. This committee would be serviced by the Planning department until such time a suitable switch over is considered necessary. The State Mission Executive would be the senior most Secretary in the
Planning department assisted by the Mission Director who will also be the member convener. The committee will have representation from Research institutes, prominent NGOs,. The Central Government may also be represented. This committee will be responsible for broad policy guidelines, approving the action plans, approving sanctions and releases, ensuring effective implementation and monitoring of the schemes.

(b) **State Water Harvesting Agency** - Water Harvesting Agency will be set up in the state. The Meghalaya Water Harvesting Agency (MWHA) will be the mission implementing agency to which the fund will be authorized and released by the State Government/Central Government/other funding agencies for onward distribution to the field District Water Harvesting Coordinators. The Meghalaya Water harvesting Agency will have representatives from concerned Government Departments, NGOs , Institutions. The Meghalaya Water Harvesting Agency will be responsible for implementation and overall coordination of Meghalaya Water Harvesting Mission within the state. Ordinarily it would be a Society registered under Society Registration Act etc The Meghalaya Water Harvesting Agency will have the following functions :-

1. Prepare perspective and annual state level action plan in consonance with mission goals and objectives.
2. Receive fund from the state, other sources, maintain proper accounts, thereof and submit utilization certificates to the concerned authority.
3. Furnish periodic progress report to the State level Water Harvesting Mission steering committee.
4. Release funds to the District Water Harvesting coordinators and monitor and review the implementation of the programmes.
5. Organize base line survey and feasibility studies in different parts (District, Sub-Division, Blocks) to determine the status of progress of the Water Harvesting Mission.
6. Assist and oversee the implementation of the mission programmes in the states
7. Organize Workshops, Seminars and training programmes for all interest groups/ Associations at the state level.
8. Planning and formulation of water harvesting projects with available and established technologies,
9. Coordinate with different line departments/ agencies/organizations during the execution.
10. Resource mobilization, allocation and channelisation of funds.
11. Scrutiny and give technical and financial approvals of projects. The Chief Secretary will be the chairman of the Agency and the senior most Secretary in the Planning department will be the vice chairman. An officer selected by the government will be the Mission Director who will be equivalent to a Chief Engineer or Director level officer and may be a retired officer of requisite level and expertise. He will be assisted by 3-5 Technical subject matter specialists and other supporting office staff.

2. DISTRICT LEVEL

The Deputy Commissioner of each district would be the District Mission Promoter. He will be assisted by a District Water Harvesting Coordinator equivalent to an Superintending Engineer or Joint Director selected by the State Level Mission The District Promoter and the Coordinator will also oversee, coordinate and guide all activities at the District level. They will also jointly monitor the progress of implementation. The District Coordinator would be responsible for the activities of the Water Harvesting Mission in the district under the guidance of the DC and will be responsible for interaction with the District / State administration / District Councils / Traditional Institutions and coordination in the district. He would be exclusively for District Water Harvesting mission works and may be located in the DPOs/ DRDA office with staffs drawn from these as well as from development branch of the DCs office or on contract basis. The district water harvesting coordinator would scrutinize and recommend proposals received from Block level and recommend them through the DC to State Water Harvesting Agency/ Mission director for approval.

3. BLOCK LEVEL –

An Assistant Engineer who will be the Project Officer at the Block Level will be responsible for submission of proposals to the District Coordinator and to oversee implementation in the field through grassroots organizations such as traditional and local authorities, village councils, established cooperatives, SHGs, and established NGOs with good track record and establishing appropriate system of ownership and maintenance of assets by local communities other essential staff to assist the Project Officer at the Block Level will be taken on deputation /on contract basis. The structure of the Mission will be as follows:-

Mission Steering body (under Chief Secretary)
Mission Director
District Coordinator,
Project Officer
NGOs"!SHGs/ Village Committee (the implementing agencies)

V. PERSONNEL POLICY OF THE WATER HARVESTING AGENCY:

The Water Harvesting Agency should not have permanent staff. The employees should be on deputation/ on contract to the Water Harvesting Agency for specific periods. A minimum number of core staff may however be maintained. The Mission Director, Subject Matter Specialists, the District Coordinator and other essential staff would be selected by a committee headed by the Chief Secretary with the State Mission executive processing the selection. The senior most Secretary, Planning Department would be overall in charge of the personnel of the Water Harvesting Agency. The controlling authority of the Mission Director/Project Coordinator/Other Officers may place the service of the concerned officers at the disposal of the Planning Department for appointment to the concerned post in the mission. Posting orders of the Mission Director, District Coordinators, other Officers and staff would be issued by the Mission executive with the approval of the chairman i.e. Chief secretary. The Planning Department through the chairman would also be responsible for making in charge arrangements when any personnel go on long leave. The officials of the Water Harvesting Agency should be continually trained on the subject and there should be a system of in house-training.

VI. ADMINISTRATIVE COST:

The Administrative cost ceiling fixed will be met by the State Government/other sources. The State should follow its own salary structure. A maximum of 30% of the salary cost may be allocated towards contingencies including rents, P.O.L., office expenses etc. The ceiling will be raised every year on a compounding basis to set off the increases due to inflation etc. The Mission will initially set up district and block level bodies in a few locations. After evaluating the performance, the concept will be extended all over the state in phases.

VII. PROCEDURE FOR APPROVAL AND IMPLEMENTATION:

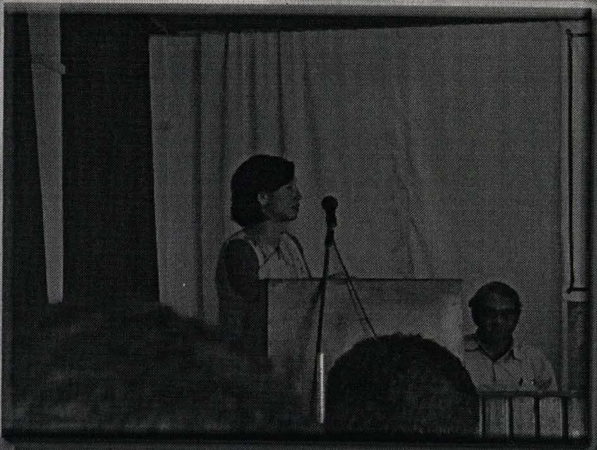
The Project Officer at the Block level will initiate the plans and draw up schemes and send to district coordinator. The Project Officer will consult the grassroot organizations/ Stake holders in the process. The District Water Harvesting Promoter and Co-ordinator will prepare and submit the Annual Action Plan (AAP) to the State Water Harvesting Agency which will in turn present the same before the State Water Harvesting Mission steering Committee. The State Water Harvesting mission steering Committee will approve the proposal of the State Water Harvesting Agency. On approval, the mission director would submit the demand for release of fund to the mission executive in the planning department and the fund will be released to the mission director. The clearance of the steering committee would be deemed to have the approval and concurrence from planning and finance department based on which bulk sanctions would be issued and acted upon by the planning department for release. The State Water Harvesting Agency with the approval of chairman would release the funds to district promoter and coordinator who in turn would pass the fund to the Project Officer/ and consequently to the water harvesting implementing organization/NGOs at the village level. No contractors will be involved, in the implementation. At the project level, a project implementation committee would be formed which will open joint account with the Stake holders/ SHG/ Traditional Institutions/ VECs etc as the case may be with Project Officers at Block levels. The release of 1st installment will be made after the Annual Action Plan is approved. The second installment shall be released on the request of the District Water Harvesting coordinator subject to satisfactory report of utilization of the 1st installment.

VIII. MONITORING AND EVALUATION:

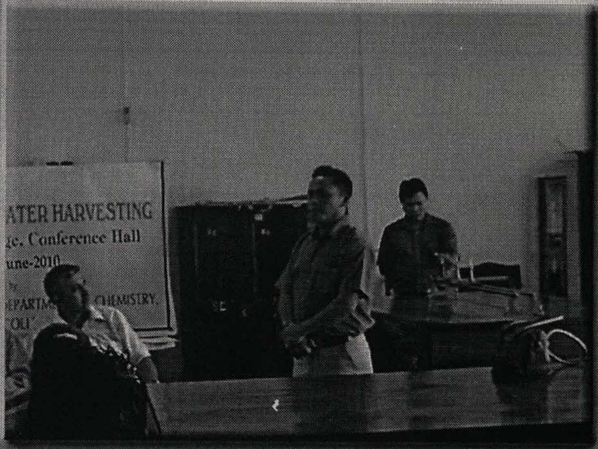
There shall be continuous in house monitoring by the State Water Harvesting Agency/ District Water Harvesting promoter and a third party independent evaluation as approved by the State Water Harvesting Committee.

Conclusion:

According to the various steps initiated by the Government the implementation of the system through enactment of the bye-laws had materialized. The need of the hour is the cooperation of the public at large with the government in the implementation process. As already mentioned, the Government and Non-Government organizations have implemented the system to an extent in the urban and rural areas of several states.




WORKSHOP ON RAINWATER HARVESTING
Venue - Shillong College, Conference Hall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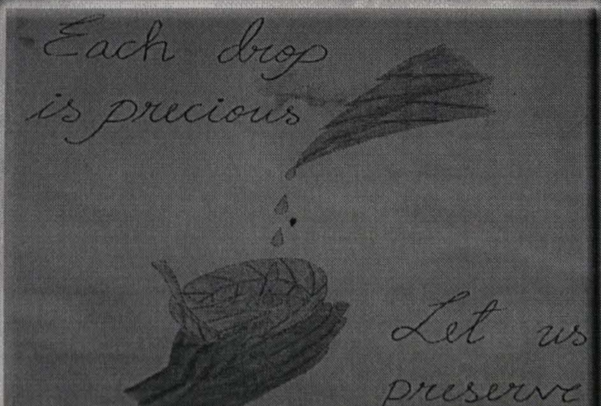
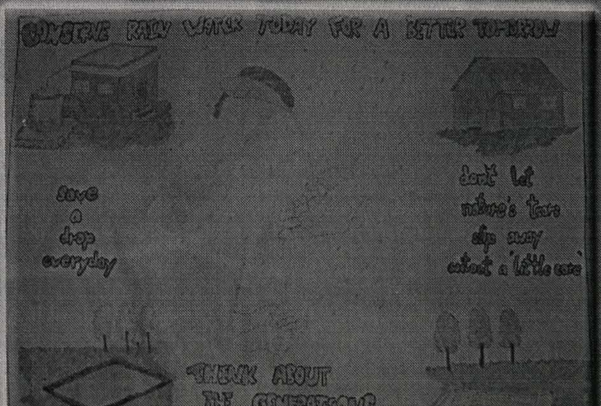

Each drop is precious
Let us preserve it


CONSERVE RAIN WATER TODAY FOR A BETTER TOMORROW
save a drop everyday
don't let nature's tears slip away without a 'little care'
THINK ABOUT THE GENERATIONS TO COME

"Rainwater Harvesting"—A Report

Sri A. Dkhar
Department of Physics

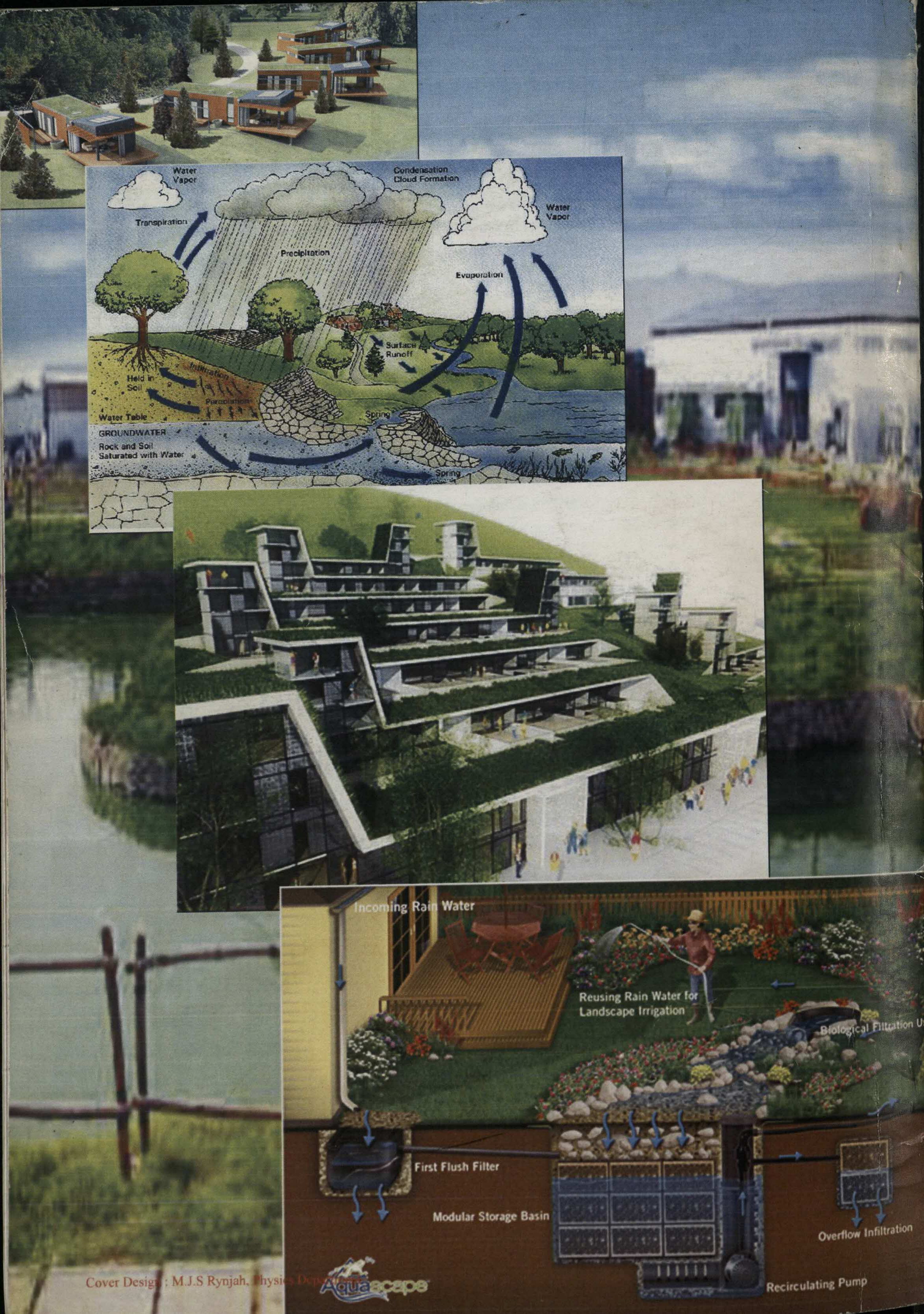
The Physics Department and Chemistry Departments, Shillong College organized a one-week programme on 'Rainwater Harvesting' from the 18th June-23rd June, 2010 to sensitize and create awareness amongst the staff and students of the college, particularly those who are from the rural areas on this very important subject, which is also the need of the hour due to the ever changing climatic conditions and the ever decreasing intensity of rainfall every year. The programme was sponsored by the University Grants Commission (UGC), through the College, under specific location curricula. The weeklong programme was started with a one day workshop on the theme on the 18th June '10. The workshop was graced by the Principal of the College who was the Chief Guest of the day, and also by the vice-Principals of the College, both Regular and Professional courses. The Principal in her message lauded the two departments for the efforts put in and also wished them success in the weeklong programme. Two of the resource persons on this day, Shri. A.Das and Shri. B.U.Choudhury were scientists from the Indian Council of Agricultural Research (ICAR), North Eastern Region, Umiam and the third one, Br.C.Noronha is the Director, Bethany Society, Shillong who is also actively engaged in such activities relating to water management and water harvesting particularly in semi-urban and rural areas of the state.

In the first session of the workshop, Shri. A.Das presented his paper by using power point presentation. His paper was on 'Rainwater Harvesting and Its Diversified Uses' in which he deliberated on the whole process of rain water management, the different methods of conserving and preserving rain water and how this conserved water can be used for different purposes such as lavatory, drinking, agriculture etc. He adopted a holistic approach to the whole subject which was very enlightening to the audience. After the interesting lecture by Shri. A.Das, the other scientist from ICAR, Shri.B.U.Choudhury presented his paper with the help of power point presentation. His presentation was on 'Rainwater harvesting and Water Resource Management— A Remote Sensing Approach'. The paper was highly technical but also of great importance in the context of modern day approach towards this very important and demanding goal. He showed that how the advent of modern day technology could greatly help to manage the water resources which could then be used to meet the greater demand of water, particularly for agricultural purposes.

At the end of the first session, the audiences were treated to a light refreshment after which, the second session was taken over by Br.C.Noronha who completely enthralled the students with his quizzes based on the theme and the prizes that he presented to those who could give the correct answer. He then showed a documentary film about the success story of a Self Help Group in a remote area of Gujarat, which, through the collective efforts of the people of the area could develop a sustainable water resource for drinking and agriculture by tapping, conserving and harvesting rainwater. It was a very encouraging story and also challenging to everyone present in the audience to do their bit to preserve and manage the beautiful drops from heaven.

The workshop was a huge success in which the students actively participated in both the sessions. Queries were being put forward to the resource persons who also enjoyed responding to the various questions coming their way.

On the 21st and 22nd June, the two departments distributed pamphlets to the staff and students of the college to further facilitate the awareness campaign. The contents of the pamphlets were based on the theme itself and were designed with an aim to help anyone and everyone to understand about the necessity and utility of rain water harvesting. The pamphlet was designed by Shri.M.J.Rynjah and assisted by Shri.L.Khongiang, both of which are the faculty of the Physics Department. A few hundred pamphlets were purposely kept back and distributed until the 25th June '10 when a National Conference was held in the college. The pamphlets were distributed to the participants in the conference most of whom are from outside the state. On the 22nd a poster display competition on the theme was also held for the students of the college. A total of about thirty posters were submitted by the students of the college out of which eight were selected and considered for award of prizes. Three judges comprising of Shri.S.K.Roy, Department of Botany, Smt S.Pandey, Department of Hindi and Smt.L.M.Jyrwa, Department of Zoology carefully selected the three best posters for award of 1st, 2nd and 3rd prizes and five others were considered for consolation prizes. The weeklong programme culminated with the prize distribution function on the 23rd June in which prizes were given to the winners of the poster competition and also the consolation prizes. The 1st, 2nd and 3rd prizes along with certificates were handed over to the winners by the Principal, and the consolation prizes along with certificates were handed over by the Vice-Principal (Regular Course). Certificates were also given to all the students' participants. Both the Principal and Vice-Principal in their respective speeches congratulate the two departments for the wonderful programme which has really helped the participants to understand better the importance of rain water, the need to conserve and manage every drop of it particularly in the context of the present day climate change which has had a global impact on the duration of rainfall and its intensity. The one-week programme was a grand success.



Cover Desig : M.J.S Rynjah, Physi Dep