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1.1 MEANING OF WATER HARVESTING

"Water harvesting" is the general term used for all the different techniques to collect runoff or flood water for storage in the soil profile or in other storage structures so that it can be used not only for the production of crops, tree or fodder but also for human and livestock consumption. Except the benefit of water harvesting to secure and boost crop production in semi-arid regions where rainfall is normally high enough for crop production or to make crop production possible in regions were rainfall is normally not sufficient, it also prevents soil erosion, recharges aquifers and enhances soil fertility due to gathering of silt; manure and other organic matter in place together with the water. Water harvesting makes the soil moist thus stimulating soil life, so that the formation of stable humus, the nutrient availability, and the water holding capacity are improved. In this context the situation in the delta of the river Nile before the Aswan dam was constructed, can be cited. The yearly flooding of the agricultural field of this delta by the river Nile made possible permanent agriculture even in this arid region. But after the construction of Aswan dam the situation has changed. Though the water was available for the farmers, but the problem to keep the land fertile was created. Water harvesting systems with a "within-field" catchment area, have the advantage of erosion control in situ. So harvesting of water not only solves the problem of water scarcity but also makes the land fertile and controls soil erosion (Coen Reijntjes, 2008).
Water harvesting (WH) can also be defined as the process of collection and concentration of runoff water into a run-on area where the accumulated water is either directly applied for cultivation or stored in the soil profile for immediate use by the crop (Prinz and Singh, 2000). As such, WH has been employed by different community around the world due to its accessibility, continuity and local specificity for thousands of years for irrigation purposes both for household activity and cultivation, to improve soil quality, to minimize the risk of water scarcity in drought prone areas, to recharge ground water and to reduce flood.

At the dawn of civilisation, people started to harvest water from various sources like streams, rivers and rainfall. When the water bodies dried up or the flow was dwindled due to vagaries of nature, people started to move in search of water sources. In due course of time, they settled along the banks of perennial rivers to meet the necessity of water and gradually settlements developed into towns and cities. When people settled in a place permanently, expansion of agriculture took place. Understanding the value of water, it was treated as precious and its conservation was sanctified by the religion. Various religious, cultural and social rituals prescribed purification and cleansing with water. Different techniques to harvest water like rain water harvesting, stream water harvesting, spring water harvesting etc were developed. Water itself had many applications in different rituals. Without water no ritual is completed. The kings and emperors also emphasized on development of reliable sources of water such as storage reservoirs, ponds, lakes, irrigation canals etc that was a part of good governance (Central Ground Water Board, 2011). Water harvesting structures are prevalent throughout the world depending on the local environmental conditions. Being local
specific these systems can be effectively used to meet the demand of water at a particular place.

1.2 TYPES OF WATER HARVESTING

There are different types of water harvesting which can be categorised into the following four main types-

A. Rainwater Harvesting

“Rainwater Harvesting uses a wide range of techniques for concentrating, collecting and storing rainwater and surface runoff for different uses by linking a runoff producing area with a separate runoff-receiving area” (Mbilinyi et al., 2005). Rain water harvesting is mainly of four types which are as follows-
a) Water collection – This method is in situ method of water harvesting used to prevent the net runoff from a given area by retaining rainwater and prolonging the time for infiltration (Mbilinyi et al., 2005). Examples of water collection include deep tillage, mixed cropping, ridges, bunds, terraces, trash lines, ponds, well, fog harvesting and rooftop harvesting.

b) Rooftop Harvesting - This method involves a relatively small catchment area, like the roofs of individual houses. Roofs are connected with gutters and pipes to guide the water into a tank on the ground. Often a tap is attached to the tank for individuals to access this water. It is a common and easy method of rain water harvesting. In the Aizawl town of Mizoram rooftop harvesting is widely used. Gutters are fitted along the...
sides of the roof to collect water which it carries to the storage tanks or wells. Government now provide loans to buy the accessories of rooftop harvesting. The harvested water can be used for different household activities.

c) Micro catchment Water Harvesting - Micro-catchment water harvesting is a method of collecting surface runoff from a small catchment area to store it in the root zone of an adjacent infiltration basin which is planted with trees, bushes or with annual crops. (Learnium school, New Delhi, 2007). There are multiple advantages to this water harvesting system than the others in that the design is simple and cheap and there is a higher efficiency of runoff than larger scale water harvesting systems that can prevent erosion and can be implemented on almost any slope and most level planes, (Prinz, 1996).

d) Macro-catchment Water Harvesting – This is the method of water harvesting from a large external catchment area like hill slope to the agricultural area located in at the foot of a hill on flat terrain. Zabo system of Nagaland is an example of this type where runoff from the forest catchment area at the hill top are collected in small ponds called ‘zabo’ on the lower terraces from where water is taken to the paddy fields and vegetable garden.

B. Flood Water Harvesting.

Flood water harvesting is involved in the collection and storage of water flow by diverting the flow to a valley floor where runoff is stored in soil profile. (Critchley and Siegert, 1991). In Flood Water Harvesting within a stream bed, the water flow is blocked
to flood the valley of an entire floodplain and the water is forced to infiltrate the ground. The wetted area is used for crop production or pasture improvement. Floodwater Diversion is another method in which water in a river, stream (wadi) or spring water is diverted from its natural course and used to irrigate the nearby cropping areas. Apatanis of Ziro valley of Arunachal Pradesh, use this type of water harvesting. Apatanis divert the streams that originate in the mountain and flow to the valley with the help of pine wood and use to flood the paddy fields where they practice paddy cum fish cultivation system. Dong irrigation system that is practiced in the plains of Assam is also an example of flood water harvesting where water from natural streams or the springs is diverted to the paddy fields by constructing bunds. Flood water harvesting is of two types—

a) In case of ‘floodwater harvesting within stream bed’, the water flow is dammed and thus, inundates the valley bottom of the flood plain which causes percolation of water and the wetted area can be used for agriculture or pasture improvement (Learnium school, New Delhi, 2007).

b) In case of ‘floodwater diversion’, the wadi or stream water is forced to leave its natural course and diverted to nearby cropping fields. It is practiced in Africa, Middle East Asian regions and also in Ziro valley.

C. Ground water harvesting

Ground water harvesting is a new term employed to mean all traditional as well as conventional methods of harvesting ground water that includes the use of dams, wells, cisterns and aquifers. Obstruction to the flow of ephemeral streams in a river bed is done using sub surface dam and sand storage dam to store the water in the sediment
below the ground surface and can be used for aquifer recharge (Prinz and Singh, 2000).

A hole is excavated on the surface to extract ground water which is called well and it is the most common method of water harvesting that has been using since the time of 8100–7500BC. Cisterns are man-made caves or underground constructions to store water, the walls of which are plastered to prevent water loss, deep percolation and evaporation. Uttarakhand is a home to a large numbers of cisterns which continues to supply water even today, after hundreds of years of construction of these structures. These are ornamented with various designs. These structures are given religious status. Value of these structures is reflected in their rituals like the prayer at the village naula by a new bride on first reaching of her husband’s home. Aquifers are underground layer of water which supplies other water sources such as streams, rivers, and springs. Rain water harvesting in different types of structures not only recharges the depleting groundwater layer but it also makes the water available for different activities. Water tunnels called ‘Qanats’ are widely used in Iran, Pakistan, North Africa and even in Spain, that consists of a horizontal tunnel to trap underground water to the surface due to gravitational effect. Qanat tunnels have an inclination of 1-2% and a length of up to 30 km and are still maintained and used to supply water to fields for agriculture production and villages for drinking water supply (Prinz and Singh, 2000).

D. Fog and Dew harvesting

Fog harvesting requires a nearly vertical surface as catchment area for its collection while dew harvesting requires a horizontal surface. For dew harvesting, a gravel layer is commonly used in agricultural areas to maintain soil moisture, minimize evaporative losses and increase soil temperature. Fog and dew harvesting is practiced in
Gansu Province, in Northwest China, where melons are cultivated with supply of water using dew harvesting techniques. These farms are well known as the ‘gravel fields for melons’ in China (Learnium school, New Delhi, 2007).

1.3 WATER HARVESTING PRACTICES IN THE WORLD

In Tanzania water harvesting is widely accepted to improve the agricultural sector. Rain water harvesting has become a key element in the agriculture sector development strategy implemented by the Tanzanian Government. Here emphasis is given to rejuvenate the traditional systems so that these can be incorporated in the new strategies to solve the water scarcity problem at the present time (Mbilinyi et al., 2005).

PumpAid is an international charity on water and sanitation based in Africa and UK. PumpAid’s mission is a major step to alleviate poverty by providing communities with reliable access to clean, safe drinking water and irrigation in rural Zimbabwe and neighbouring countries. It is focused on providing appropriate, sustainable water systems to school and communities using the elephant pump which is a rejuvenation of 200 years old technology adopted from China. This system has several benefits like providing clean drinking water at a rate of extraction of 1 litre per second, reliable cost of construction, low maintenance cost, easy operating for children and the elders and is suitable for extraction from depth of up to 30 meters (PumpAid, 2007).

The Greater Horn of Africa Rainwater Partnership (GHARP), a regional network of National Rain Water Associations (NRWA) established in 2001, is an association of several regional organisations which uses rain water harvesting
techniques to improve the quality of lives of people living below poverty line in the Greater Horn of Africa (GHARP, 2005). Members of GHARP include water harvesting associations from countries like Ethiopia, Kenya, Somalia, Tanzania and Uganda.

Another project of GHARP is “Integrated Rainwater Harvesting and Management Systems and Complementary Technologies for Improving Water Supply, Food Security and Sustainable Livelihoods in Semi-Arid Districts of Kenya” which is designed to alleviate poverty and promote sustainable development by encouraging rain water harvesting systems and complementary technologies in districts of Kenya.

The Southern and Eastern Africa Rainwater Network (SEARNet), is an international NGO presently consists of 10 partner nations, Botswana, Ethiopia, Kenya, Malawi, Rwanda, Somalia, Tanzania, Uganda, Zambia and Zimbabwe as well as three affiliates, Eritrea, Mozambique and South Africa (Ibid, 2005). The aim of this organization is to encourage rain water harvesting and other water harvesting practices to meet the demand of water and to improve the livelihood of people through community involvement and to promote sustainable development.

1.4 WATER HARVESTING PRACTICES IN INDIA

In India traditional practices are prevalent in different regions since the time of immemorial. Zings are traditional water harvesting tanks found in the Ladakh region. Zings are used to store glacier melted water. Kuls and Naulas are found in the Himalayan region to harvest water for different day to day activities. Kuls are water cannals found in Himachal Pradesh and Naulas are ponds found in Uttaranchal. Khatris are water harvesting structures found in Himachal Pradesh, carved out in rocks to store
rain water for drinking and other activities. A typical community ‘kul’ can irrigate an area of about 20 ha (Central Ground Water Board, 2011).

In desert areas like Rajasthan, underground water harvesting structures called ‘tanka’ or ‘kund’ are used to store rain water. These are constructed near houses or near temples. The base of the tanks is plastered to avoid seepage. These are concrete or kutcha tanks where rain water is stored for individual and community use.

Harvesting of rain water in ponds is practiced in different parts of the India which are known by different names. Water harvesting ponds are known as Johads in Rajasthan, Ahars in Bihar and Talab in Uttar Pradesh. Rain water harvesting ponds are known as Zabo in Nagaland. Pynes are channels to draw water from Ahars. Ahar pynes are also found in West Bengal. These are known as Munda in Orissa, Jheels in Gujrat, Bandhara in Maharashtra and Tanka in Andhra Pradesh.

Khadins are rain water harvesting structures used in Jaisalmer district of Rajasthan. These are generally practiced in valleys where the valley slopes are used as catchment area. Khadin water is used for agricultural purposes.

Baoris are very old community wells that are used for drinking purposes in Rajasthan. Baoris can store water for long time as evaporation of water is very negligible (Central Ground Water Board, 2011).

Virdas are shallow water harvesting tanks used by the nomadic tribes of Rann of Kutch to store rain water. The rain water accumulates above the salty ground water level which is used for different activities.

Naada or bandhas are found in the Mewar region of the Thar desert which is a stone check dam, constructed across a stream to capture monsoon run off. The land that
is submerged in water becomes fertile due to deposition of silt and retention of water (Central Ground Water Board, 2011).

1.5 WATER HARVESTING SYSTEMS IN NORTH EAST INDIA

In North East India, the hill tribes and indigenous people of Assam practice traditional water harvesting. Apatanis of Ziro valley, Chakhesangs of Nagaland and different hill tribes in Mizoram, Manipur and Meghalaya use traditional water harvesting systems for various farming.

The Apatanis of Ziro valley trap stream water and divert this to the field. Apatnis use the stream water for wet rice cum fish cultivation system. The water is distributed through different channels and passes through terraces and finally drain out to the river Kille, the only river that flows through the valley.

In Meghalaya a century old system named ‘Bamboo drip irrigation’ is used by Khasis and Jayantias to irrigate the betel nut and black pepper cultivation. It is mainly found in Dawki, Muktapur, Hatmawdon and Lynkhat areas of Khasi and Jayantia hills where this cultivation is done. They trap natural stream water using bamboo pipes which have to repair yearly. Due to the use of bamboo, the system is called ‘bamboo drip irrigation’. They use this system mainly in dry season when rainfall is scanty. About 18-20 litre of water per minute enter at the starting point and is transported through the network of bamboos over several hundred meters. At the site water amount is reduced to 20-80 drops per minute (Agarwal and Narayan, 1997).
Rain water harvesting is practiced in large scale in Meghalaya, Mizoram and Nagaland. The zabo system of Kikruma village of Nagaland is a system to trap rain water in ponds called ‘zabo’ which means impounding of water. Rain water harvesting is practiced in Mizoram in a wide range. In Aijwal rooftop harvesting is practiced in almost every household. In a village named Reik, 12 km away from Aijawl where every household traps rain water and uses it. In Meghalaya also, rain water is used for various household activities. Though Meghalaya receives a large amount of rainfall still it faces the problem of acute shortage of water in dry season. They collect the rain water using gutters and store them in earthen ponds which are covered by opaque plastics, straw or any locally available material to check evaporation. The floor of the pond is compacted to avoid seepage. The side of the tank is framed with bamboo. All these works are done at low cost due to use of local materials. They use rain water not only for household activity but also for drinking purpose. (Angkita and Goswami, 2015).

Dongs are water canals constructed by the indigenous people of Assam to harvest stream water or river water for irrigation in the paddy field. The word ‘dong’ was originated in the Bodo language though in Bodo language it is also called Doisa. These are community oriented systems where the distribution of water is supervised by the local dong committee. The sources of dongs are natural streams, rivers and springs from which canals are cut to divert water to the fields. Water in the field is accumulated in a pond like structure from where water is lifted and taken to the required area by a device called “lahoni”. Another structure called “koon” is also used to harvest water from pond to the field. Koon is a wooden boat like structure handled with leg. With the help of Koon about 25 litres of water is harvested per time that is sufficient to irrigate a plot of land of 4-5 bigha in one day. With lahoni about 10 litres of water can be
harvested per stroke and a plot of 2-3 bigha can be irrigated in a day. Most of the dongs are perennial. Some of the existing dongs are Bordong, Salana dong and Lungsom dong of Dimoria block of Kamrup, Suti doisa, Nepalpara to Narabari doisa, Jumfoi-Bima dong, Jorakia-Buri dong, Kungreb doisa of Kokrajhar district, Ahopa-Oronga dong, Palasguri dong of Baksa district etc. Dongs are also called ‘jan’ in Nalbari and Kamrup district. In the western side of Assam, dongs are the only source of irrigation for cultivation (Angkita and Goswami, 2015).

In Mizoram roof top harvesting is practiced by every household as acute shortage of water occurs in the dry season. Now the Government of Mizoram has a policy to replace the roofs of houses with GCI sheet roof to improve collection of rain water. Government also provides loan for roof top harvesting (Satapathy et al, 2001).

In the Kikruma village of the Phek district of Nagaland, an indigenous system of farming is found which is called Zabo. ‘Zabo’ means impounding of water. It is a century old farming system which is a combination of forest, land and water management along with agriculture, horticulture and animal husbandry. The whole system covers an area of 957.9 ha. Forest cover with an area of about 1.5 ha or more is used as catchment area. Water harvesting tank covers an average area of .2 ha and paddy fields which are individually owned varies in size from .2 to .8 ha (Debral, 2002).
1.6 REVIEW OF LITERATURE

1.6.1 WORK DONE IN INDIA

Pandey et al, (2003) have discussed about the need of water harvesting to cope with the climate change. They have discussed about the effort of human throughout the human history in response to drought condition and acidity. The Mayan civilization that developed around 3000 years ago in Mesoamerica (Hodell et al, 1995), faced drought due to solar forcing (Hodell et al, 2001), before it collapsed due to climatic change (Haug et al, 2003). The water harvesting structures in Maya civilization indicate that rain water harvesting was practiced there in large scale. Existence of more than 2.6 million men made water bodies in North America which account for 20% of the standing water of USA (Smith et al, 2002), indicates the adaptation to the climate change. In India, the traditional ponds, water harvesting tanks numbering more than 1.5 million those still harvest rain water in 660,000 villages in India (Pandey, 2001), denotes the trend of water harvesting in this region.

Choudhary, K., (2000) has discussed in his paper about the historical social movements in India related to water management. In the paper it is also discussed about the role of Government, civil society and the NGOs in tackling the problem of water crisis in the country. Arthashashtra of Koutilya describes that water harvesting has been practising since the time of Moryan Empire. Canal and drip irrigation was practiced at that time. Kings took taxes from the people for building water storage tanks. Reservoir, tanks and embankments were also owned personally and owners could give water to others in return for a share of produce. People of India have been using the knowledge
of water harvesting since the time immemorial. Social movements against construction of large dams are also discussed in the paper.

Ghosh, K. and Ghosh, S., (2004), in their paper has discussed about the historical perspective of water management. They have discussed about the use of water in Egypt, India and Venice. Recycling of waste water is done in many countries like China, Vietnam, Korea, Cambodia etc. In Kolkata recycling of water is done in large extent in which waste water is treated with sunlight for algal growth. Water hyacinth is used to clean water where fish is cultivated. Rain water harvesting is revived in many places. In Delhi, Chennai and some places of Indonesia legislation has passed for compulsory rain water harvesting. In Japan a rain water museum is established.

Gupta, S. K., (2007) discussed about the Indian water resources including surface water, ground water and water management issues relating to irrigated agriculture. India has 12 major river basins each having a catchment area exceeding 20,000 sq km and 8 composite river basins the water potential of which is about 187.9 million ha m. Replenishable ground water is mostly derived from 215 million ha m of rain water, percolated into the ground, out of which only 50 million ha m joins the ground water. Discussion is also made about categorization of water like blue water which means surface water, green water which means soil moisture and water in plants, ground water, waste water and domestic sewage water and their potential role in agriculture.

In the National Training course manual on ‘On- farm land and water management’, Central Soil Salinity Research Institute (2007), several authors have discussed about land and water management. Keshari (2007) has discussed about interlinking of rivers and diversion of water to yield meaningful, feasible and viable
solution on environmental, social and economic issues. He has also discussed about recharging of ground water by reclaiming waste water.

Ghosh, P.K, (2004) has discussed about the rain water harvesting and its necessity in day to day activity. Rain water harvesting is the principle of collecting and using precipitation from a catchment surface. He has discussed about the essentiality of rain water harvesting and its techniques. Rain water harvesting can reduce the use of energy for pumping water and consequently the cost for it. It improves the water quality and increases ground water level.

Narain, Khan and Singh, (2005) have discussed about the need of water harvesting in Rajasthan. Rajasthan is the largest state of India covering an area of 34.22 million ha but sharing only 1.15 % of its water resources. They have discussed about the potentiality for water harvesting and conservation against drought in Rajasthan which indicates that despite of depletion of water resources, the state still has significant potentiality for harvesting and conservation of water if an integral management approach is adopted. It has the possibility of harvesting and conserving 90-145 million cubic metre of runoff annually by developing suitable rain water harvesting structures. The estimated ground water resource is limited due to deep aquifer and low recharge. In Rajasthan several rain water harvesting structures are found of which ‘bawri’ and ‘jahara’ depend on ground water while ‘nadi’, ‘tanka’, ‘kund’ and ‘khadin’ are based on harnessing surface runoff (Khan,1995; Khan and Narain 2000). Modern structures of rain water harvesting and ground water reclamation like percolation tank, subsurface barrier and pond with infiltration wells have been adopted to rejuvenate the depleted fresh water aquifer (Khan, 1996a, Khan 1996b, Narain and Khan, 2000; Narain and
Run-off farming and ground water recharging system is beneficial for crop production and increasing ground water availability respectively even in drought (Singh and Khan, 1999).

1.6.2 WORK DONE IN NORTH EAST INDIA

Das et al, (2011) have discussed about the recent facts and events of climate change in North East India and about management of natural resources for agricultural purpose. There is an immediate need to popularize rain water harvesting to mitigate the impact of climate change. Though the rainfall and temperature regime of NE is neither increasing nor decreasing appreciably as a whole( Das and Goswami, 2003), but some parts of the region covering parts of Manipur, Mizoram, Tripura and Nagaland show significant change in rainfall pattern. Flood has caused havoc especially in NE India affecting vast area by erosion. About 1 million ha in Assam, 815,000 ha in Meghalaya, 508,000 ha in Nagaland and 14,000 ha in Manipur (Venkatachary et al, 2001) are affected by flood. In situ and ex situ rain water harvesting can mitigate the problem of water scarcity and soil erosion.

Rai, S.C., (2005) focussed on the paddy cum fish cultivation of Apatanis where he states that Apatanis wet rice cum fish cultivation is an advanced cultivation process. He has discussed about the economic value, energy input-output and ecological suitability of the system. As much as 40% of the rice produced is sold to the neighbouring Nyshi and the Hill Miris. Introduction of agro forestry can act as a buffer and provide resilience to the system.
Jeeva et al, (2006) discussed in their paper about the traditional agricultural practices in Meghalaya where they have described the bamboo drip irrigation used for pepper and betel nut cultivation. Crops such as areca nut, betel nut, betel vines and black pepper are irrigated with bamboo drip irrigation (Sharma and Prasad, 1994). Bamboo drip irrigation system helps in conservation of environment and preservation of natural resources (Mishra and Sharma, 2001).

Debral, (2002) in his paper described about the ‘zabo’ cultivation of Nagaland and ‘wet rice cum fish cultivation’ in Ziro valley of Arunachal Pradesh. He examined the process of Apatanis water harvesting system. Zabo is practiced by the Chakhesang tribe of Phek district which is a combination of soil, forestry and water management. He has also discussed about the Alder based farming where Alder tree is cultivated and its twigs and leaves are burnt in the soil to increase its fertility.

Awasthi, Bundala and Satapathy, (1997) explained the agricultural production in N.E India and harvesting of water in this region. They have discussed about the water resources in N.E India and different water harvesting practices. Water harvesting systems of Apatanis in Ziro valley, Zabo farming of Kikruma village of Nagaland and annual water budget of the North East region are discussed. Minor irrigation projects should give priority as there are constraints of constructing major irrigation projects in the hills. On-farm water management in hills are efficient in land development, in-situ retention of rainfall and management of runoff on slopping land.

Dollo et al, (2009) in their paper discussed about the sustainable traditional management and conservation of natural resources of Ziro valley. They have discussed about the historical and cultural background of Apatanis and their traditional land use systems. Apatanis have different farmer groups and every group has defined function.
The integrated paddy cum fish cultivation system is a traditional practice which assures higher per hectare economic productivity and year round employment opportunity for farmers.

Kala et al, (2008) described about the wet–rice cultivation system, practiced by the Apatanis of Arunachal Pradesh. They have discussed about the social cohesiveness associated with the management of land, water and agro bio diversity. About sixteen varieties of paddy are cultivated in wet rice cultivation using traditional system of water harvesting. By trapping water from the streams near the forest in the foot hills of the valley, it is channelized and distributed via numerous small canals to every agricultural plot. They have discussed about the ingenuity of the Apatani tribe in management of natural resources in traditional way.

Dollo, (2009) focussed on the energy and economic efficiency of sustainable agro-ecosystem management practice in Ziro valley. The Apatanis irrigation system is a century old system which is perfected through involvement and equitable sharing of water resources. The irrigated water carries bio degradable waste materials from the village and decomposed leave litter, which is a good source of fertilizer.

Dollo, (2007) in his paper ‘Traditional farmers groups supporting sustainable farming’ explained the traditional farmer groups including Bogo Agoh that supervises the traditional irrigation practices. Traditional village council called ‘Bulyang’ ensures equal distribution among the farmers.

Chaudhry et al, (2011) discussed in their paper about the natural resource management systems of some tribes of Arunachal Pradesh where they have discussed about wet rice cultivation of Apatani plateau. Once upon a time the Apatani valley was covered with marshy lands and the ancestors of Apatanis with their effort made it
suitable for rice cum fish cultivation. Wet rice cum fish cultivation covers an area of about 3300 ha. Their excellent resource management practices and traditional ecological knowledge have drawn the attention of UNESCO to declare the Apatani landscape as 'World Heritage Site'.


Ghosh et al, (2009) described the participatory rain water harvesting in the North Eastern hill region. They discussed the components of rain water harvesting and the success story of this process in various selected villages of the area.

Ngachan, Mohanty and Pattanayak (2012) on their paper ‘Status paper on Rice in Northeast India’ described the various components of zabo cultivation system of Kikruma. They discussed about the use of green manure like Albizia lebbeck and mekhonu tree leaves, application of cow dung and diversion of run off through open cattle yard for paddy cultivation.

1.7 SIGNIFICANCE OF THE STUDY

Water is the key resource of North East India which accounts for about 40% of the total water resources of India. The average annual rainfall is 2450 mm accounting for 10% of country's total water resource. The per capita and per ha availability of water in this region is the highest in the country. The surface water resources availability in the region amounts to 653 billion cubic meters (BCM) that accounts for 34% of the country's total surface water resources potential (Goswami, 2005). In spite of its huge water resources, the utilisation of water in this region is not satisfactory. A large amount
of water is lost in runoff which causes flood downstream. The North East region is occupied by a large numbers of ethnic groups for whom agriculture and allied sectors is the main source of livelihood. On the other hand this area is unique in its geophysical setting. About 72% of the area is hilly and most of the areas are remote. Due to unique geophysical setting this area is prone to natural hazards like earthquake, flood and landslides. If all these situations are taken into account, then construction of large power and irrigation projects is found to be not suitable for this region. In the hilly regions practice of Jhum cultivation is common. But in some areas the indigenous people are harnessing water for irrigation purposes in the traditional way quite skilfully. Even modern methodologies seem to have no match for it. The tribes like Apatanis of Ziro valley of Arunachal Pradesh, Chakhesangs of Kikruma village of Nagaland, Khasi and Jayantias of Jayantia hills of Meghalaya, Mizos in Aijawl and indigenous communities of Assam are utilising available surface and rain water to meet their demand for irrigation and for other day to day activities. They use locally available resources to harvest water and the harvesting systems are community based and ecofriendly. In the plains of Assam due to large discharge in the streams and rivers in the monsoon season, the existing bunds breach every year. So, the Irrigation Department of the Government and some NGOs have constructed concrete head works which relieve the farmers from the extra burden of work and to avoid recurrent losses. Therefore it is very significant to bring the traditional systems of water harvesting in focus and to make optimum use of surface water and rainfall so that rest of the people living under similar settings can take a lesson from them. It is important to focus on their management skills and to examine how these systems can be made more productive through further research and development.