WATER CONSERVATION

Irrigation Practices

for more produce out of crops

Irrigation Practices For Secure food production for global population.

CHALLENGES

And

GOALS

In

IRRIGATION PRACTICES

GACSA

GLOBAL ALLIANCE FOR CLIMATE-SMART AGRICULTURE

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KEY MESSAGES

1. PRECIPITATION ESTIMATIONS HAS TO BE MODERNIZED.USE MOODERN TECHNOLOGY FOR ESTIMATING MAXIMUM FLOODS BY USING UAV
2. RIVER BASINS PROTECTION BY TRANSPLANTING TREES AT UPPER REACHES IS A NECESSITY.Mangroove forests at meeting points of Rivers and Sea
3. PROTECTION OF RIVER BANKS,CREATING RESERVIORS ALONG THE BASIN AREAS IS A IMMEDIATE NECESSITY
4. CANAL LINING and Branch Canal with PVC pipes and fittings saves water excess use or flow to fields.

Systems and Practices to Meet Present Day Productivity Requirements

[Irrigation systems Modification in Centuries]

We have water bodies everywhere on the continents. The soils in each region or the country are suitable for growing some or the other types of plants, except when it is rocky. We have started using many types of fruits, vegetables, or some seeds. In the process we found some types of grains can be used as main food daily, that is Wheat and Rice now days in half the world. In older systems it was barley, maize and some millets. Sometimes we have left behind some of the crops as we have not felt comfortable with the grains that were in use then. This could be for various reasons including taste, digestion adaptability, availability and versatile and might not be cost effective.

We as a international society have set up market mechanisms for pricing of the grains, seeds etc based on the systems of agriculture and the mechanisms adopted by each country, region and the Governments. While Human systems wants betterment by productivity, the combination of water, soil and organic matter gives way for production of many pest, worms, and breeds mosquito to a large extent.

The combination of man animal as life support systems is most predominant by virtue of which man is accustomed to the milky cows and or such animal milk, and has started to cook and eat several birds.Several Big animal mutton has also started creeping in to food habits,along with the Goats and Sheep which have started finding as a farm animal.

Over years fish and other sea foods cooking and eating have increased to meet the dietary requirements of increasing humanity and their hunger..

We are on a Planet called earth which itself has life and is supporting all types of biological forms.

We are yet to come across such a planet in the Universe. These biological forms sometimes turn nature against the humans and produce virus, bacteria and pathogens. Such of these viral attacks can be life threatening and can endanger human lives. The elimination of such is time consuming. The planet has its soil conditions, it has water coming from aquifer, it has its own trade winds and consequently it has a system of rains in each of the five continents where life is fully supported. When the Barter system prevailed money exchange systems were not known.

People used more of copper vessels for storing water in which some bacteria was eliminated.Lead or an alloy of lead was used to store butter milk.Bronze and its alloy were used for cooking and storing food and water.With less technology was available then and so also with less chances of mitigating the adverse effects of disasters were with the generation of that time.

Now the money as a medium, with Banking as a system and currency as a product, the agriculture produce is traded across countries on the earth.

Under increased stress because of population increase we have to find the ways to enhance the food production by using less water .The Idea is to feed the present 7.6 billion population and to the population which might be increasing to around 9 billion by 2050.The necessity to understand the storage

of water and using treated waste and sea water for livelihood are imminent.

The water and oxygen support the plant life. The Agriculture practices in the given area and the soil fertility are important spatial dimensions for plant life.

The slope of the terrain and the changes in basin are most warring limitations on the systems of irrigation and its practices. Human consumption's also subscribe to the change of food habits while making the farmer to have a ecological and seasonal variations in systems of production.

Irrigation

Introduction

While discussing the systems and patterns for ‘irrigating the lands’ an in depth analysis of the ‘components of irrigation’ is needed. The component for irrigation is water which is

generally coming from Rain, which is called as precipitation.

Water-Water is responsible for civilization and the process it has made possible several cultures, based on the economic growth and enhanced living standards. Earth has 1386 million cubic kilometers of water which includes liquid and frozen forms of ground water includes seas, oceans, lakes, streams.Salt water accounts for 97.5% of total water and the rest 2.5% is fresh water. Of this 2.5% around 68.7% is locked in glaciers and remaining 29.9% or 0.265 of total water is the fresh water on the planet. This renewable energy is the main source for Industries, for drinking and for farming.[17]&[2]

Hydrology- This is a term which implies water and its features. There are new terms added to that to make it more scientific. **Climatology or the climatic conditions affecting the water are its availability based on weather conditions is a present day study**. **This refers to the intensity of sunshine, ocean currents, trade winds and 'Coriolis forces' on the sea**. The term 'Coriolis' refers to the curving motion of winds caused by the rotation of earth. The climates can be wet, or dry depending on the regions. Various places on the globe have their tropical systems where rain occurs. The term Monsoon may be predominant in the Indian sub-continent. However the term is also used for winter rains of Mediterranean sea, and the summer rains of South USA storms.

Water vapor [H_2O] generally is about 4% present in general at all places which is the meaningful necessity for clouds and rains. Dry air comprises of about 78% nitrogen and 21%oxygen.[1]The density of such gas is very less. This lies within 2 kms of earth surface before slowly merging with others and going to outer boundary of say 30 km from the surface of earth. The Water Vapor is the source of precipitation, giving raise to rains which can some times be Cyclonic or Thunder storms associated with large intensity rain or winds in a small time frame with huge rains.

The constant motion of earth, oceans and the winds makes large parts of eastern sides of American rains. Euro Asia receive their summer or after summer rains based on humidity released in to the atmosphere. The relatively interior areas receive less rain due to the trade off between the water vapor and similarly the western portions of the continents receive very less rains.

Precipitation and Rains

While the normal precipitation could be a force of water dropping from air, aerosol[s]makes clouds denser white and more reflective. Aerosol is a substance enclosed under pressure and released as a fine spray by means of a propellant gas. The organisms are spread in aerosols generated by showers. 'Cloud albedo' affects the presence or absence of aerosol's. They can influence size and density of water droplets and their colour, transparency.Now we see a 'reflective' sometimes 'neon type' sky or clouds or even lights even during rains.

For the northern hemisphere the Pacific Ocean plays a vital role. The axis inclined and just moving away from the Sun sets its own period of trade winds because it is away from the sun's influence.[Wikipedia] The trade winds and other forces set in the winds and draw the clouds and the rainy season starts. This process generally sets typically in June and ends by September end.

Rain Water

By nature rain water as it travels down wards from the clouds, gets associated with winds.The combination of the clouds with the winds try to travel further distances. Depending on climate or temperatures at the time and place of pour of rain the winds gather further momentum to travel. Water resource availability will be altered by changed rainfall patterns and increased rates of evaporation. Rain-fed farming will become more precarious in the mid and low latitudes, while productivity may rise for a time in the higher latitudes.

The water so poured can be intensive or modest or little. By nature water travels along slopes, till such time 'at any given storage place its momentum or force or velocity is zeroed'. This can happen when it is contained. The container can be leak proof. But water more than wind creates thrust on the walls. 'It has also a potency to soak inside the porous particles and gives way for piping action under the foundations'.

Thus any water retaining structure needs a careful 'analysis and design to with stand the forces of water, pressure gradient excerted by water, the seepage pressure and be earth quake resistance'.

As water strikes ground the dissolved and or prevalent salts along with some pollutants may start traveling on surface. 'The travel of water on ground along a natural slope is identified as a basin'.

Numbers of rain gauge stations have been established with automatic measurement sensors. The rain fall is measured as millimeters in a span of 24 hours from morning to next day. The identified water shed area which mixes all the surface water is called a basin. Depending on the size [in square kilometers] of the area the numbers of gauges are decided. If there are already prevailing rain gauges then the quantity of water is measured with reference to the area and multiplying with the observed rainfall.

In computer analysis the mean of all rain gauge observations is taken as a possible yield. This can vary on many variables, such as percolation in to soil, the duration and intensity of storm, and the slope of basin, that drains out the water. The influencing area for each rain gauge station is measured as per the polygon methods.[1]

Now that the precipitation or the rain water has taken to two branches, one is flowing below ground level and the other accumulating on the ground in to rivers and streams. These rivers, streams, and sometimes ponds and lakes store the water. This water is used by humans after due process of filtration and sedimentation etc for their drinking and other needs, throughout the year. The normal rain fall in any place along any country is generally 4 months in a year.

Modern systems of computing the precipitation and flood discharges

Most of our computing systems since last 250 years is based on empirical formulas correlated with the practical observed data at the Rivers. The discharges in rivers are based on the area of cross sections, and the heights observed by use of Gauges. The velocity of the water flows and the time taken for the water to reach the river is as measured is plotted as a Hydro-graphs. The so called unit hydro graph is used to estimate the floods.

'Using modern computing techniques', by using 'sensors to understand the physical time taken for travel', and the actual velocities at various depths in the river are yet to be programmed for general use. In the older computation systems where the mean is more important, the flood discharges are a neglected quantity. But in the water starved climate systems a real computing system for understanding the runoff is very important to arrive at the storage systems, in lower and upper catchment areas.

ADVANCED TECHNOLOGIES FOR UNDERSTANDING THE WATER SHEDS

Watersheds and their sub watersheds require much more detailed spatial analysis, by both the geological surveys and Hydrologists. Meteorologists have to place proper or appropriate Rain gauge stations across the water sheds or river basins, so that the polygon systems of computing the areas, and average rain falls are equally placed. This shall give a better understanding of the streams and their catchment areas which may be migrating by ways of soil erosion.[26][27]

Spatial observations, and the coefficients of percolation coefficient of friction the soils offer and the total contour map, are needed to arrive at the water available for flow at the start of the river as well at each point on the total stretch of river. This is very important for estimating each drop of water.[26][27]

'Drones and UAV applications can give the contour maps and discharges, while the sensor based equipment can register the velocity data in the cross sections of rivers'.

Irrigation

'This is a practice of taking water to such of fields or farming area where plants or crops are grown'. The Hydro-logical cycle is the basis for precipitation on the grounds. This precipitation may contain along with water vapor substances in the air such as sulfur, nitrogen, carbon, which may mix with the oxygen and mineral water and sometimes may rain with more hydrogen concentration.

'This or mass stored water systems were more developed and used from 16 th century on wards' for irrigating the farms and crop lands.The revenue to the kingdoms was more from Agriculture and trade then. These systems were serving the needs of agriculture for the fields. 'The water travels by a reliable and still in contained way so that in the length of travel the water do not loose its properties as well it retains its energy'. For keeping modest energy with water

and allow it to flow, it needs a slope. Some places where ever the soils are percolative in nature then the water needs to travel in a 'lined channels' or needs to be routed through 'pipes'. The losses in evaporation have to be minimized based on the climate inputs. The main sources of water are detailed below.

In USA the National Climate Data Center [NCDC] of the US department of commerce located in Asheville North Carolina, has information from satellites and maintains world data center for Meteorology. Numerous weather and climate related reports and serial publications are available from them and sometimes from NASA earth observatory also.[1]

Irrigation as a necessity

When looking at the geographical map of India, it can be concluded that during last 50 years many improvements have taken place in installing many rain gauge stations and collecting wide data across the catchment area of many rivers. Detailed contour maps of the areas of the catchments are made available to the departments by NRSA [national remote sensing agency, using stationary satellites] and the Geological Survey of India. India has around 16% of world population and have 4% of water in the world. India has only 2% of land in the world. The rain fall is 4000km^3,of this 3000km^3 is the down pour from monsoon June to September.[17]

INDIA

The average water resource potential of the country 'India' is 1869km^3.Of this only 0.33% is utilized by conventional storage and diversion structures.India uses 1123 BCM water annually,that is 690 and 433 from surface and ground water respectively.Due to the increasing population in the country, the national per capita annual availability of water has reduced from 1,816 cubic metre in 2001 to 1,544 cubic metre in 2011.2 This is a reduction of 15% India is among the users of 1700m^3 and1000m^3 which is annual water per-capita [AWR], which is indicative that India is not among the water stressed countries in the world.[Sources: Water and Related Statistics, April 2015, Central Water Commission; PRS.]

World

Many places receive water through rains. Brazil receives from Dec to April about 39″ to 59″ or 1000 mm to 1500mm.Chile Has the lowest average rain fall of 0.03″.Antarctica rain never happens. India the average rainfall is 12″ to 26″ depending on the regions. Normally the west sides of USA and India receiving less rain fall.

Systems of Irrigation

Irrigation direct to the farms from ponds is most desired system. There are Barrage or Dams constructed across rivers. In both the cases the river water is ponded and elevated so as to allow diverted water to flow in to the canal systems. The 'water in canals is by gravity the energy is because of heading of water and then the slopes in the canals'.

There could be some unfeasible areas where a dam construction will still not elevate the waters, then pumping by use of Horizontal centrifugal pumps or by using vertical turbine pumps is resorted to. This needs electrical energy as a supplement.The water from the river is channeled in to a intake well adjoining the river bund. From there the water enters in to the Sump well where the pumps are installed. The pumps raise the water to the elevation and water is pumped in to a water stilling basin. 'This facilitates the loss of energy and then the water travels in canals under gravity'. Water is a basic necessity of human life, human body contains lots of water. Water for all 'life needs has to be stored treated and supplied up to the houses'.

Ground water Engineering

The present life patterns are more dependent on Ground water in Arid or semi Arid area,where the storm water discharges are not fully stored to the very extent they are available.Va-dose is a zone with that peculiar name which is a porous zone above the ground water table.An aquifer in a geological formation may have Aquiclude on the upper and lower strata.These are the porous strata of some magnitude.The aquifers can be confined or open depending on the Aquiclude.The aquifer is a geological formation that contains and transmits ground water.Aquifer are saturated permeable formations such as unconsolidated sands ,gravels,sand stones,lime stones,fractured rock which can store and transmit some amount of water depending on permeability.Aquicludes are impermeable geological formations such as clay,shale,and dense crystalline rocks that are not capable of transmitting significant amounts of water.Generally the assumption made in computing the water travel is by use of Darcy law,assuming a laminar flow and momentum equation.

The flow of water and the aquifers capacity are estimated by using several wells in each aquifer.

Flow net analysis by using pumping wells and observation wells is done to obtain the capacity of

recharge for an aquifer.Laplace equations are used for such computations.The draw down curves are an indication of the capacity of recharge.Horizontal flow of water and as well the vertical flow are plotted by using a computer programme.Some of the ground water wells may be near to the flow streams of surface water,hence when the river is subsiding the water from the aquifer may be discharged in to the river.Normal construction of recharge wells is the responsibility of states to avoid consequential problems of depletion of ground water beyond certain limits.
Ground water at some places may be highly turbid depending up on the soil and recharge conditions.Nitrogen from plant roots,or the penetration of salt when the water table is depleted due to over use from the aquifer.
In ground water movement contamination can effectively close the pores of the soils and in long run the capacity of aquifer gets depleted.Hence treating removing the the sledge/or the solute from the recharge water is important before the water is sent through the recharging wells.Ground water Modeling is well done at IGWMC,which is a center for ground water modeling.Many countries have license for use of their technology.MODFLOW of US geological survey is extensively used in many countries.Most of these flow nets are built mathematically either based on partial differential equations,Laplace equations or computer program based on linear equations.

GREEN HOUSE EFFECT

Earth's temperature depends on the balance between solar energy entering and leaving the planet's system . When incoming energy from the sun is absorbed by the Earth system, Earth warms. When the sun's energy is reflected back into space, Earth avoids warming. When energy is released back into space, Earth cools. Many factors, both natural and human, can cause changes in Earth's energy balance, including,"The Greenhouse Effect causes the atmosphere to retain heat. Changes in the green house affects the amount of heat retained by Earth's atmosphere, Variations in the sun's energy reaching Earth. Associate with it are changes in the reflectivity of Earth's atmosphere and surface.These factors have caused Earth's climate to change many times. Scientists have pieced together a picture of Earth's climate, dating back hundreds of thousands of years, by analyzing a number of indirect measures of climate such as ice cores, tree rings, glacier lengths, pollen remains, and ocean sediments, and by studying changes in Earth's orbit around the sun.[FAO]

The historical record shows that the climate system varies naturally over a wide range of time scales. In general, climate changes prior to the Industrial Revolution in the 1700s can be explained by natural causes, such as changes in solar energy, volcanic eruptions, and natural changes in greenhouse gas (GHG) concentrations.Recent climate changes, however, cannot be explained by natural causes alone. Research indicates that natural causes are very unlikely to explain most observed warming, especially warming since the mid-20th century. Rather, human activities can very likely explain most of that warming.[FAO]

When sunlight reaches Earth's surface, it can either be reflected back into space or absorbed by Earth. Once absorbed, the planet releases some of the energy back into the atmosphere as heat (also called infrared radiation). Greenhouse gases (GHGs) like water vapor (H_2O), carbon dioxide (CO_2), and methane (CH_4) absorb energy, slowing or preventing the loss of heat to space. In this way, GHGs act like a blanket, making Earth warmer than it would otherwise be. This process is commonly known as the "greenhouse effect".[FAO]

'The evidence for climate change is now considered to be unequivocal, and trends in atmospheric carbon dioxide (CO_2), temperature and sea-level rise are tracking the upper limit of model scenarios elaborated in the Fourth Assessment (AR4) undertaken by the International Panel on Climate Change (IPCC). There remain many scientific questions related to cause and effect that are not yet fully explained, but the probable future costs of climate change are so significant that action now is considered to be a prudent insurance. Current negotiations focus on stabilizing end-of-century temperatures at no more than 2 $^{\circ}$C to minimize negative impacts. The criticism that climate science has recently taken does not detract from the reality nor the gravity of the clear trends in global climate.[FAO]

As the global population heads for more than nine billion people by 2050 (under medium growth projections), the world is rapidly becoming urbanized and wealthier. Food preferences are changing to reflect this, with declining trends in the consumption of staple carbohydrates, and an increase in demand for

luxury products – "milk, meat, fruits and vegetables" – that are heavily reliant on irrigation in many parts of the world. The production efficiency of animal products is lower than for crops and so extra primary production from pastures, range lands and arable farming is needed to meet food demands. Future global food demand is expected to increase by some 70% by 2050, but will approximately double for developing countries. All other things being equal (that is a world without climate change), the amount of water withdrawn by irrigated agriculture will need to increase by 11% to match the demand for biomass production.[FAO]

UN Frame work on climate change convention has the ultimate objective (UNFCCC) is to achieve "... stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.[FAO-UNFCCC &IPCC discussions and COP21]

Climate Changes

'By 2050 the amount of water used by irrigated agriculture will to increase by 11% to 15% to match the demand of Irrigation for food production and other allied biomass production. Stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'."Earth's temperature depends on the balance between energy in the planet's system. When incoming energy from the sun is absorbed by the Earth system, Earth warms. When the sun's energy is reflected back into space, Earth avoids warming. When energy is released back into space, Earth cools".[FAO]

Storage of water in reservoirs and ponds

This is another form of irrigation practiced earlier and still continuing at some places. For such storage reservoirs the study of water basin is very essential. Each basin is separated from the other by virtue of the highest contour or the ridges of the plains. Some lakes or ponds are made naturally, when water has to come back to earth surface from the aquifers below the earth. These are 'Lake Victoria' in Africa, from which many rivers were born, including the massive 'Nile River'.

With the system of unpredictable rains each stream in the upper reach, which is part of a sub water shed shall have a water storage reservoir. This reservoir can supplement and substitute the water for ground water recharge at time of distress, and gets filled when floods occur.

Ground water use

India has 63.2 MHa [Million Hectares] of land under surface and ground water for Irrigation. Of this 30.5MHa is under well irrigation. Tube wells and other wells are dug below the water table and water is pumped out and sent to the Main canal where from it takes in to the fields. Normally each tube well can irrigate around 10Ha [Hectare] of land but they cultivate two to three crops in that.It is because power is either free or subsidized. This is increasing the salinity of soils, requiring large investments for reuse of the land.The mapping of such wells spatially and monitoring the ground water movement from land observation wells and as well from satellites is still to be done

Pumping water

How ever since water for agriculture is free and drainage of the field is un-cared the resultant water logging is giving rise to low yields. The prime way to describe such is that the water is over used or applied more than required.The use of Pumping systems during rainy and or flood seasons gives a boost to storage reservoirs.

The Depth below pump level is called the suction head, while the height above the pump level or the place to where the water is pumped is called delivery head.The suction head has certain participles of gravity and hence it shall be below 9.84 Meters or 32 ft approximately.

By providing multiple pumps and impellers in series we can increase the quantum of height of pumping, for which specific pumps are available in the world markets including in India. In Irrigation and drinking water works we follow the hydraulic and fluid mechanic principles. Water is called some times as fluid or liquid and its characters in flow are called hydraulics. Turbines which we are using for aero plane jets, as well for electricity production are also used here for lifting water.

Generally we try to connect number of pumps with a single delivery pipe to economize the costs and to reduce the exit velocity of water at out let. This system of connection is called manifold. The sizes are determined based on the internal velocity of water. We need to avoid turbulence and formation of eddies inside the pipe.We can not have air relief valves in these lines as water is let out at high velocity more

than one meter per second. The velocities generally in manifolds and pressure mains are at 4kg/cm^2.

Canal Systems

Making lined main canals is what is practiced in USA.US bureau of reclamation makes canals in porous and desert conditions totally lined till the extreme end.This lining can allow us to have a speed of 1m per second while in non lined channels we restrict to 0.3 m per second. We can have a more speed of water to the farm to meet the demand.

The study of the above subjects was vastly undertaken in 19th Century. Manning's empirical formulas are used for Canal flows.

India was the major source of research in Irrigation. Kennedy, Lacey & Khosla have done extensive research in Punjab on alluvial soils to arrive at a non silting non scouring velocities in channels.The final systems adopted world wide are Trapizoidal sections,with intermediate banks and extra free board above the contemplated section of canal for flow.The most common designs are for 1 ft/sec.,or 0.3m/sec velocity of water in non lined canals.Khosla substantiated what hitherto was used as an apron at the lower side of spill way for arresting the pressure exerted by the freely falling water from heights.

The requirements to have 'cut off walls ,at the upper stream,at lower side and below a barrage' or a dam to avoid the 'up lift hydraulic static pressure' and some times the 'tilting forces of waters flowing under high velocities' is also well arrived at for safety.This system is abundantly used in almost all dams now a days.

Spatial systems for measurement of Floods-NRCS Methodology

The USDA Natural Resources Conservation Service (NRCS) methodology is perhaps the most widely used method for computing storm water runoff rates, volumes, and making hydrographs. It uses a hypothetical design storm and an empirical nonlinear runoff equation to compute runoff volumes and a dimensionless unit hydrograph to convert the volumes into runoff hydrographs. The methodology is particularly useful for comparing pre- and post-development peak rates, volumes, and hydrographs. The key component of the NRCS runoff equation is the NRCS Curve Number (CN), which is based on soil permeability, surface cover, hydrology condition, and antecedent moisture. Watershed or drainage area time of concentration is the key component of the dimensionless unit hydrograph. Several runoff computation methods use the overall NRCS methodology [1].

Photo graphic systems by using Drones and UAV to measure the precipitation

Rains gauges are established all along the catchment areas and actual daily and yearly statements are obtained for at least 20 years. Now a days we have 50 years records everywhere. In a cycle of 8 years gauging on rivers were conducted to establish dependable rainfall and run off. The flatter the slope of basin the discharge from the river is slow and dependable.

The use of unmanned aerial vehicles (UAVs) or drones for management of crops, livestock, fisheries, forests and other natural resource-based activities represents a new technological frontier and opens up a range of exciting opportunities. The latest issue of **ICT Update,** a bi-monthly magazine published by the Technical Centre for Agricultural and Rural Cooperation ACP-EU (CTA) is dedicated to the use of this technology and associated systems in different parts of the world. [24]

Crops and pattern

Irrigation systems prevailed from ancient times but their systems were consistent with the requirements by the societies at large. The kingdoms were small, the towns were modular and the crop requirements were modest in a sense they need to meet the then populations. The mass transport systems were nonexistent then.

From 1960-70,the world started seeing the increasing of population from 3 billion to 7.6 billion present day. Wheat is used as a more secure and safe food by many populations while Asian population is relatively dependent on use of Rice. Green Revolution in India was pioneered by Dr.M.S.Swaminathan by introducing more yielding short tenure rice variety. His research on wheat variety and pest control has made the availability of food from 350 million Indians on that day to 1.30 billion today. Similar systems were adopted

done by Norman Ernest Borlaug who was an American biologist and humanitarian who led initiatives worldwide that contributed to the extensive increases in agricultural production termed the Green Revolution.[Wikipedia].The main development was higher-yielding varieties of wheat, which were developed by many scientists, including American agronomist Dr. Norman Borlaug[1914-2009], Indian geneticist M.S.Swaminathan, and others. The Indian Council of Agricultural Research also claims credit for enabling the Green Revolution, in part by developing resistant strains of wheat.[Wikipedia]

The changes from use of Barley and Ragi which were much in use prior to world war -1,have subsequently left the way for Wheat and Rice with abundant storage water available during the cropping period.

Worldwide cereal yields are expected to decline by 5 percent for a 2 °C rise in temperature and by 10 percent for a rise of 4 °C. Grain yields should decline above certain temperature thresholds, with grain number in wheat falling in temperatures above 30 °C and flowering declining in groundnut when they are above 35 °C.Production precautions are necessary for cereals and for rice and ground nut with these environmental changes.So the consumption and habits also needs a change.

Soils and their strength

Soils confined relatively offer cohesion and serve as good model for oxidation at root zone. The 'surrounding trees' 'around the farming fields' 'confines the soil movement' to a large extent thus offering a relative strength, cohesion and oxidation. The practice of putting 'Palm Trees'[also called locally Tadi-which absorbs lots of nitrogen at root level] along the long and lengthy borders of the farm or the field area was time tested in the early nineteenth century. Which latter gave way and is diminishing in the cultivated areas. Mango trees were never planted near the crop area because of its pest nature but Coconut and Cashew were practiced to a larger extent. 'These types of trees were reducing the effects of sun induced heat on cultivation'.

Many soil preserving trees have either been disbanded or cut to make way for 2 or 3 crops in an year. Two rice crops and one pulse or mustard crop have been in practice at many places. Where mustard was not much used it was sesame or gingelly oil seeds crop, both used for extracting oil and making a sort of pickles which can be preserved over an year. Ground nut was one of the best crop which the population wanted socially because of its flavor.

The communities of practice and societies used to keep small land for planting Banana, Papaya, and sometimes vegetables as needed. The Bunding of the fields was done keeping in view retaining water to less than 6 inches in filed, and subsequently draining it to the next set of field or to the drainage channel. Till such time reservoir waters were available the system of ponding fields for rice did not exist.

The growth of Jute plants were predominant in the near highland areas and in two months the crop was cut and a bund across small streams were placed and the plants were kept in water. That system permitted them to extract the jute from the plants which was sold to the Jute mills.

Millets such as Ragi, Jowar and such or even black gram Dal was grown in the fields. Where the fields have a little sand and have red earth, the Ground nut crop was grown.Ragi grain is higher in protein, fat and minerals than rice, corn, or such.millet.Cotton Groundnut and Pulses are in dry land agriculture practices more often. Thus the extensive farming techniques with their limited knowledge and no communication systems, or even radio were most prevalent during early 1960.

Traditionally, man, animals, trees (including grass lands) and agricultural fields were inseparable and harmonious components of a single system. The villager looked after the trees on his fields and also contributed to the maintenance of the community grazing land. He looked after the animals owned by him, sometimes with the assistance of a grazing hand and cultivated the fields owned by him, by following social practices.

Protecting Fresh Water Ponds and Aqufiers at Intersection of Seas and Oceans

Against the sea waves and dynamics of erosion **mangrove forest** protect the hinder lands. In delta areas of Ganga, Sundri trees are found, which provide durable hard timber. Palm[also called as Tadi], Coconut, also present in many

Delta areas, protecting the Estuaries..**Bi**g fruits help in saving hunger, as well sea water can supplement the needs of irrigation. But now a days, Mango, Banana, Cashew nut, Jackfruit, papaya, tress also are transplanted along with betel nut and other leafy creepers in the delta areas.

'Betel nut is extensively used in tropical countries for digestive purposes.Arecoline is responsible for some of the effects of betel quid chewing, such as alertness, increased stamina, a sense of well-being, euphoria, and salivation. Chewing the nuts stimulates the flow of saliva to aid digestion. Betel nut also has been used to stimulate the appetite'. Pan leaves are another which are used extensively for digestion and are cultivated in delta regions near sea.

In Diabetics one can use papaya, which was previously exotic and rare fruit, and is now readily available at most times of the year'. 'Papayas grow in tropical climates and are also known as papaws or pawpaws. Their sweet taste, vibrant color and wide variety of health benefits are just a few reasons to add them to your diet.

Jackfruit comes from mulberry family. It has thorny projections outside and soft flesh, inside which is intensely sweet and delicious in taste. It is typically found in South East Asia and finds its origins in India. Thailand and Vietnam are the largest producers and exporters of this fruit'.

'Jackfruit is found in many varieties across countries and continents and is classified based on the softness of its flesh. The raw fruit can be used as a vegetable after cutting to a fine dust particle and cooking with water. Jack fruit's flesh is very high in fiber content. The taste and texture makes it a great fruit for jams, chutneys, candies, cakes and other sweet preparations. Unripe raw jack fruit is used in savory dishes and is cooked in gravies and spicy curries. The texture of unripe jackfruit is like mutton and so is its taste when cooked in spices which makes it popular among vegetarians and non vegetarians alike. The seeds of Jackfruit are also eaten in boiled form as a snack in some countries'. There are other corn and fruits developed and used by all of us, which use plenty of nitrogen and give good carbohydrates in a small time, with very less water.

Today humans have many health conditions which the other generations might not have known, in that Diabetics is one. This can be overcome by changing to a mixed grain diet.High intakes of mixed grains and fish were found to be reducing the asthma and other factors by 54 and 66%.

The probability of having asthma with bronchial hyper responsiveness (BHR), defined as having an increased sensitivity to factors that cause narrowing of the airways, was reduced by 72 and 88% when children had a high-intake of mixed grains and fish, respectively.

Food and Habits

Pastoral farming (also known in some regions as livestock farming or grazing) is a form of agriculture aimed at producing livestock, rather than growing crops. Examples include dairy farming, raising beef cattle, and raising sheep for wool. In contrast, arable farming concentrates on crops rather than livestock.

Food preferences are changing to reflect this, with declining trends in the consumption of staple carbohydrates, and an increase in demand for luxury products such as milk, meat, fruits and vegetables that are heavily reliant on irrigation in many parts of the world. Found alternative fruits which are naturally grown with less water and are useful to human consumption.

Production is switched over to the cheaper variety of food grains, the millet, and the good old type of mass produced fruits. All these concentrates to meet the future global food demand which is expected to increase by some another 40% by 2050, but will approximately double for developing countries'.

Drainage of Irrigated Land [Ayacut]

Drainage of the irrigated land [ayacut] for which water is supplied is most important. The drains have to cater for flow of excess water from crop roots and for any storm water in the [ayacut] farming area during the period of crop. Also roads for movement of tractors during sowing time and harvesting time are very important network to be created.

Any flow or lift irrigation contemplated shall also cater to the drinking water needs of the villagers in the farm land[ayauct] area, proper storage, treatment (by clarifloculators and water treatment systems such as gravity filters) and mixing of proper chlorination to avoid bacteria and finally pumping to over head tanks for supply to house hold needs through gravity are important. This is a need for rural water supply.

The designs are based on (a) requirements for crops (b) the requirements for human consumption

including future population (c) to meet for needs of grass vegitation,flowers etc for recreation parks for the beneficiaries. The requirements of upper catchment and lower riparian rights[which will be subjective discussion] are to be properly balanced while contemplating any new project.

Water under Pressure

When water is drawn out from wells and pumped to a matching contour canal it is under pressure of approximately 4 kg/m^2.

Type designs for layout of pump houses for centrifugal and Turbine pumps and design of pumps are to be worked out using standard formula.

The design of intake wells and supply pipes are checked for hoop stress (PD/T). [Pressure x Diameter / thickness of pipe]

The required water hammer devices such as non return valve, Air relief valve, pressure relief valve, sluice valve, Gate valve, foot valve (most of them are diaphragm valves) etc., are to be met in the line for safety.

The pipes can be with internal cement lining or RCC Hume pipes depending on pressure they have to with stand.

Suitable, relays, load centers, Transformers, manifolds etc., are to be designed and installed.

The necessary flow diagram for the fluid with the required ROW [Right of Way]and other contour maps are to be arrived at.

A manifold is used to connect the water form number of pumps to a pressure main. The pressure of water in the manifold which connects number of pumps is 3 to 4 Kg. Cm2. Pre-stressed concrete pipes or steel pipes with cement lining inside and tar felt coating outside are used to covey water, up to to a ridge, or a storage reservoir. For irrigation this water is led into branch channels and field channels.

For flows through pipes where the water is for domestic use or irrigation the supply and the discharge can be computed using formula. This is essential to meet the drainage requirements.

$$Q=f\ lv^2/2gd$$

Where f is a friction coefficient based on pipe material

L is length of pipe

V is velocity of water in pipe less than 1 kg/cm2

G is gravitational force

D is dia of pipe

In such a case construction of a dam or a weir is economical for storage of water and diverting water along contours and uses it by gravitational channels as flow irrigation.

The design of hydraulic structures is through Bernoulli's equation.

used the quantum theory that quantity of flowing water at any place shall be constant.

Discharge quantity divided by the silt factor of the soils from a predictable table is used for estimating scour depth.

That quantity under triple root is the scour depth.$[Q/f]^{1/3}$

This is used to estimate the foundations depth at the river banks.

More reasonable is the availability of bore logs and the quantity of rock and its depth.

The immediate measures normally to meet normal monsoon are using contour drains, avoid over flows by estimating both the hourly rainfall and the duration needs for drainage.

Providing wells with underground drainage and connecting them by using an upper layer drain is best suited when contours does not match.

But it is important to have a sophisticated recording system of water from rains, and system of roads, as well internal drainage connected with video or photographic medium to guide the city citizens to help in their routine work, and keep them safe. Water is tremendously obtained on the earth surface in sea, river, lake, and pond. Underneath the earth surface it is in the well. Spring water comes out from the earth. Earth's crust contains porous and non-porous rocks. The porous stratum percolates Water and non-porous strata hold the water underneath the ground. It is better to develop suitable ponds to store excess runoff of water.

Water is found in the form of ice on the mountains, in the form of clouds in the sky.Rain fall replenishes water.

It is obtained by the chemical combination of hydrogen and oxygen.

clariflocculators is a circular settlement chamber, where water is drawn to sedimentary tanks from the bottom and all vegetable matter is removed on top with a scrapper. The bottom sledge is drained from the bottom most point.

Irrigation and Agriculture and India

General Sir Arthur Thomas Cotton [1803-1899] was a British general and irrigation engineer. Cotton devoted his life to the construction of irrigation and navigation canals throughout British India. [Wikipedia]Archimedes of Syracuse was an Ancient Greek mathematician, physicist, engineer, he was not the only one who bathed in water, but he was the one who found logic and reasoning for buoyancy.W.M.Ellis has made extensive surveys on Cauvery basin in India.Kanuru Lakshmana Rao, B.E., Ph.D.[1902-1986] was an Indian engineer [and a Padma Bhushan] who involved himself in design of major irrigation projects across India. [Wikipedia]

According to 2009 Indian statistical society only 63.2million hectares of land was actually irrigated in India. The total arable land in India is 160 million hectares (395 million acres). According to the World Bank, only about 35% of total agricultural land in India was reliably irrigated in 2010.

India's irrigation is mostly groundwater well based. At 39 million hectares (67% of its total irrigation), India has the world's largest groundwater well equipped irrigation system (China with 19 mha is second, USA with 17 mha is third).[WIKIPEDIA]

Irrigation quantum and Reservoir and canal silting in India

The decrease in the rate of irrigated area has stabilized during last 15 years. The fall from 4.23 % per year during the 1970s to 3.08% per year in 1980s and to 2.56% in the 1990s. This has come down to less than 1.5% during last 10 years.This fall in surface irrigated area are due to silting of canals,reservoirs,and application of more water for irrigation than contemplated.

At present, with almost one fifth of worlds net irrigated area (63.2 Mha); India has the highest irrigated area in the world today.
India's ultimate irrigation potential was estimated at 140 Mha, comprising of 58.46 Mha through major irrigation, medium irrigation schemes. 22.03 Mha and from minor irrigation schemes,and from ground water another 64 MHa.Recently some positive steps were also taken to long-awaited inter-basin water transfer, aiming at adding 35 Mha to India's irrigated area. The implementation of the inter-basin water transfer link schemes are taken up in a phased manner depending on the priorities of the Government. The links namely (i) Ken-Betwa link (ii)Parbati-Kalisindh-Chambal link (iii) Godavari(Polavaram) – Krishna(Vijayawada) link (iv) Damanganga-Pinjal link and (v) Par-Tapi-Narmada Link have been identified as priority links for consensus

building amongst concerned States for taking up preparation of Detailed Project Reports (DPR). The upper and lower catchment areas, which receive the run off, are called the river basins.
Run off depends on duration and intensity of storm, slope of basin, the upper soils which account for precipitation and bottom rock (previous or impervious) which contributes for ground water stability. [sorce-http://www.indianstatistics.org/irrigation.html].

ADOPTION NEEDS FOR FOOD SECURITY

We are in to a new state of undeclared circumstantial un-preparedness in terms of food security and Mitigation.
The only way out is to mitigate the hardships by adopting new innovative technologies.
Nature has taught all biological forms to with stand the vagaries of climate. The Mosquito getting strength and returning back with one or other varieties of Virus is most common. There might be very large creatures which have found their way out and have become non extinct today, but humans have inbuilt stamina and so the plants and agriculture.
[1]Making all major or main canals lined is important to contain percolation so that more timely water reaches tail end fields.
[2]Minor branch canals up to 0.6 m dia can be with plastic pipes which are available worldwide. These small pipes controlled with field valves with reduce methane emissions to a large extent at the source of production.
[3]Making solar energy available for pumping systems, such as heavy use pumps, sprinkler, drip irrigation systems
[4]Making a study of wetting systems, and using minimum irrigation as the slogan, for getting the returns on investment of money and labour.
[5]Making Gender equality in law and allowing women to own till and transplant will make the families to prosper.
[6]Making manures at the farm field, and using small less intensive plow machines, make the land useful for future crops and avoid salinity.
[7]Storage systems needs to be improved
[8] Marketing systems have to be developed
[9] Food wastage at market yards, at farm level can be minimized.
All counties have to follow a biannual statistical approach for agriculture, crop pattern and irrigation, statistics.Because it is incomparable with different years of statistics in publication. A base year and a review year shall be decided as a code of ethics by the
[A]Nations at large to assess the impacts of climates and to take proper actions at regional levels.
[B]Computation of runoff has to be done systematically using meaningful modern systems for protecting crops. Use of UAV, drones, Sensor based rainfall gauges and proper computer models are a necessity.
[C]Introduction of modern crops and their usage shall mitigate the people from disasters.
[D]Employing and training man power in large scale about use of water techniques etc.
[E] We need more forest and forest type plants[not eucalyptus and casuarina because they consume lots of water at roots and the roots go deep in to soil]. Whereas the Palmyra or Toddy Palm (Borassus flabellifer L.) has long been one of the most important **trees** of Cambodia and India, where it has over 800 uses, Coconut spread the roots and take the saline water to their stem.

Public health systems

Ensuring water does not persist on pastures and in row crop channels for more than 5 days will usually prevent mosquito production. Effective slope drainage, and infiltration and evaporation rates associated with the soil, must be considered with respect to the water application rates and frequencies. Ensuring free flow of water in the delivery and (particularly) the drainage channels, by clearing emergent and floating vegetation, will help to prevent buildup of mosquito populations.[19,20,21,22,23]
With respect to rice fields, it is the persistent presence of water on the crop that provides the habitat. In parts of eastern Asia, where mosquito-borne disease (Japanese encephalitis) is associated with rice field habitats, cultivation practices (wherein water is drained repeatedly from the fields during the mosquito season) have been developed to control the peak buildup of mosquito populations. This strategy may be successful in parts of Australia if appropriate varieties of the crop that can sustain this periodic drainage can be planted.[19]
The Consultative Group on International Agricultural Research (CGIAR) is building research and capacity through its System, wide Initiative on Malaria and Agriculture (SIMA), a

network of partners studying the relationship between malaria and a range of farming systems in seven African countries. The initiative is also building capacity into curricula at selected African universities.

Water development projects bring important benefits locally and globally. Yet it is often assumed that irrigation will bring health benefits to all, regardless of their socio-economic standing within a community. In reality, the economic and social impacts of irrigation are diverse and widespread, and neither costs nor benefits are evenly distributed among community members. In Sub-Saharan Africa, as elsewhere in the world, there is increasing recognition of the need to reduce the negative impacts of agricultural development on 'ecosystems' and peoples' health.

The cause of Chagas disease is the parasite Trypanosoma cruzi, which is transmitted to humans from a bite from an insect known as the triatomine bug.These insects can become infected by T. cruzi when they ingest blood from an animal already infected with the parasite.

Major intestinal parasitic infections found are cryptosporidiosis, cyclosporiasis, and giardiasis are mostly acute diarrheal illnesses without significant links to poverty or neglected populations.[23]

The other is helping farmers adapt to the impacts of climate change, as the farming also produces Methane gas[FAO].

There is that extraordinary methane emission from the cattle, dung, and human excreta, which is in open areas almost daily 1000 tonnes.

Among the increasing number of "neglected tropical diseases" findings about the countries where transmission of these neglected tropical diseases, are possible and trying to track these epidemiological issues. Some of those like Schistosomiasis and geohelminths, are integrated with rapid diagnostic tests for detection of infections and morbidity, and are made available by the institutes. Some of the Tropical neglected diseases is Onchaerciasis, or river blindness, and Lymphatic Filariasis, occurring because brugia malayi larvae inside the Mosquito leading to a name elephantiasis. It is very difficult to trace them in human body, immediately.

As much the drugs are developed, that much the drug tolerance and drug resistance are cultivated by the microbes in question.[23]

.Clean **pineal gland** and strong mental health are most important to tell the truth from the lies and take control of your life back to your own hands. .

The pineal gland, or **third eye**, is located in the geometric center of the **brain**.The pineal gland was called the "third eye" by ancient people. It was thought to have mystical powers.The theory that **stomach ulcers** were caused by spicy foods has been replaced by the discovery that many ulcers are caused by a **bacterium**.**Cesium-134 of less than 147 is expected in Human body. This gives an indication of Radiation. The Testosterone, levels below 270 shows men and women in inactive conditions.**

The deadliest disease from Sudan which can spread any where is Mycetoma, which is a flesh eating, bone destroying disease whose prevalence and etiology are not known even today. This could be a modification of TB, which attacks the bones.[23]

2.The concepts of irrigation efficiency and water productivity and how these parameters can be used to optimize water use.

A.INDIA

[1]Former engineer-in-chief and former consultant to UN, T Hanumantha Rao has said the 'Four Waters Concept' watershed programme, which is his brainchild, is cost effective. This would recharge ground water and provide irrigation to three crops in a year, he added.

Why are the governments keen on long gestation mega irrigation projects that guzzled hundreds of crores and electricity and did not give commensurate benefits to people while ignoring eco-friendly concepts like watershed development technology with proven results? He raised the questions in the course of an interactive memorial lecture the Centre of Economic and Social Studies.[25]

Former chairman of Press Academy Potturi Venateswara Rao, presided and said policy making was not the prerogative of those in the government alone. Time has come for the political establishment at the national and state level to listen to experts and intellectuals while formulating river water policies.

The 'Four Water Concept' developed by retired Engineer-in-Chief and UN consultant T. Hanumantha Rao found an effective solution for not only drought-proofing the area through harvesting rain water and recharging water table,

but also for providing water to three crops in a year. A feat even major projects could not accomplish.

The proof was in the nearby Gottigaripalli village of Medak, and more than 4,000 villages in Rajasthan and some villages in Chittoor and Kurnool that were reported widely in the media, secretary of the Trust said.

When the expensive conventional watershed programmes involving cement works and big check dams failed due to lack of proper technology, the "**Four Waters concept comprising rain water, surface water, ground water and soil moisture, succeeded in recharging the groundwater table",** he said. Rajasthan was one State that promoted the concept in mission mode, he added.

The objective of creating awareness among all was 'Water for All and No Water Wars' and chose it as the theme for the memorial lecture, Mr. Reddy explained.[The Hindu | October 16, 2016][25]

[2]The ways the crops of Swarna-Sub1, a flood-tolerant rice variety, were in use and its enhanced productivity are a boon from nature .These have helped to ease the burden of women farmers in Bangladesh.While normal rice wears itself out in floods, eventually dying and leaving a brown field of stubs, this "scuba rice" as it is often called goes dormant in floods, waiting out for the high water to drain out before stretching its green stems towards the sky.[**rice**plusmagazine.blogspot.com/.../11th-june2016-daily-globalregional-a...]

The submergence tolerant rice is emerging as one of the more powerful examples of the two major pillars that form the Bill & Melinda Gates Foundation's strategy for agricultural research and development.The idea is more productivity and less risk. When combined, they can enhance farmers' resilience to floods.[https://www.devex.com/.../why-the-**gates-foundation**-is-**flooding**-a-new-**r**...]

[3] Pulichinthala Project also called as called as KLRao Sagar multipurpose irrigation project, was first conceived in 1911 by British engineer Col Ellis. The reservoir is to prevent impounding of water and flood waters going as waste to the sea. It has to create irrigation facility and or balance the existing farm lands stability with assured irrigation for 13 lakh acres. It has 24 gates in all with balancing reservoir with a capacity of 46Tmcft[thousand million cubic feet of water].[2] The project started impounding the water in August 2014 and by 2016 rainy season it was full to the extent needed.

[4] The "burning of rice straw residues emits trace gases like carbon dioxide, methane, carbon monoxide, nitrogen oxide, sulfur oxide and large amount of particulate matter. These create high levels of green house gasses (GHG) resulting pollution in the atmosphere far beyond the acceptable levels, adversely affecting human health and the environment."India produces 98 million tones rice straw, second only to China, most of which is burnt by farmers in their fields after the harvesting of the crop to sow the next crop and save on labour.

Late Dr O P Rupela, soil microbiologist at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), burning in Punjab leads to nutrient loss from the rice straw produced of about $18 million worth of urea. Rupela, after retirement working with scientists of Punjab Agricultural University (PAU), together developed a simple and rapid 45 days composting system for converting the rice straw into organically rich compost (soil nutrition) and increases crop yield by 4 to 9 percent and contains in available form: 1.7 to 2.1 per cent of Nitrogen, 1.5 percent phosphorous, and 1.4 to 1.6 percent potassium.

The hard working Punjab farmers will adopt this low cost low risk labour intensive solution when subsidy from synthetic fertilizers is withdrawn and given for compost produced from bio mass and animal droppings. ["environment and science magazine" 'Down To Earth'] Progressive farmers in Punjab, Telangana, Andhra Pradesh, etc., have adopted this successfully and the department of agri research and education (DARE) along with the concerned Central & State Govt Ministries need to subsidise and take this low risk/ cost method to farmers nationally and in mission mode, providing knowledge/ know how, creating capacity to follow their agro ecology, set up their producer orgs/ company (PC) staffed by professionals, if we are to ensure their access to own requirements of nutritious food and stop all bio mass burning on farm, contributing to economic development and growth whist ensuring their long term sustainability. Burning of all field waste will release about 15% of the world's total of "black carbon" or emitting 330,000 metric tons black

clouds of smoke every year, the second-largest global warming source after CO2.

[5] Agricultural 'Biochar' or 'Super charcoal' is climate and producer friendly clean carbon negative process (removes CO2 from the atmosphere – cools not warms the earth) for rice straw, corn cobs, maize stalks, etc.(waste), at high temperature but without oxygen.Increases soil fertility, water penetration and retention, especially in hilly and arid drought prone areas, also reduces acid levels. Works as a natural water filter, aids in decontaminating soil near landfills, toxic waste dumps and mines; areas worked by the poor. Making it is low-cost low-tech and using it goes beyond reducing the effects of climate change to improving nutrition, health and food security for the growing future population.

Densely-populated conventional rice growing areas produce high levels of methane, a hydrocarbon gas, responsible for twenty-five times warming compared to CO2. Conventional flooded paddy applying agro chemicals account for up to fifteen percent of total GHG emissions from agriculture. These agricultural practices are bad for human health and the environment..["Subhash Mehta" icapsm@gmail.com]

[6] From traditional ragi (finger millet), which was more suited to the Mandya region of Karnataka, the farmers shifted to more remunerative but water-intensive paddy and sugarcane crops post 1970. Such variance in crops and agro-climatic zones is evident across India, which is why we should not be surprised if more water conflicts rise in the near future in different regions.

Since early 1960s when green revolution was introduced in India, four kharif crops have marched to newer grounds. Paddy, cotton, soybean, and sugarcane covered over 60 percent of the total sown area this year. "These are all cash crops taking over the area traditionally devoted to millets, oilseeds and pulses which were more suited to the local climate and soils. Except soybean, all these commercial crops are water-intensive and a drain on the soil health. These are also high-risk crops due to changing climate and unsure markets which decide the productivity and price respectively." [Dr G.V. Ramanjaneyulu, executive director of Centre for Sustainable Agriculture.]

One of the reasons for the expansion of irrigation-heavy crops is building of dams and expansion of canals besides increased accessibility to groundwater. With water more readily available, farmers shifted from semi-arid cereals to high-yielding varieties of cash crops, which require heavy dose of agrochemicals and assured irrigation. As the scale got bigger, the impact on natural resources became more evident. Soil fertility declined while groundwater receded. Chemical pollution and changing food habits impacting human health are direct manifestations of this change in crop patterns.

A wide network of sugar mills has made Maharashtra the highest producer of sugar and the second highest producer of sugarcane after Uttar Pradesh. Sugar industries secure bail out packages from the state governments on one or the other reason. Most of the water saved in dams is used by these sugar mills. Historically, Bihar and eastern UP were the seats of sugarcane before. Licenses were given on priority to cooperatives, and cooperatives had their roots in western India. But western India, especially Maharashtra, is not blessed with natural endowment of water, as Bihar or eastern UP.

Even though sugarcane takes just four percent of the total farmed land in the state, it consumes 71.5 percent of irrigated water. On the other hand, pulses occupy 16.8 percent gross cropped area in the state but get only 3.4 percent irrigation water. Sugarcane is also being grown in drought-prone regions of the state making matters worse. While Bihar manages water efficiently, consuming just 822 litres of water to produce a kilogram of sugar, Maharashtra requires over 2,100 liters due to inefficient use of water and lack of rainfall.

The area under sugarcane rose from 3,24,000 hectares in 2004 to 9,37,000 hectares by 2014. The cost of cultivation was the highest among all the top sugarcane-producing states. The cost of cultivation per hectare was Rs 1,65,962 per hectare which was the highest among all the top sugarcane-producer states. This can, to some extent, explain the growing farm distress and suicides by farmers in the state.Sugarcane has also been steadily increasing (from 5.36 lakh ha to 10.99 lakh ha during the last 25 years). Traditionally, Marathwada grew millets and oilseeds which require less water.

Paddy in Punjab-The semi-arid Punjab was never known for paddy cultivation. This is why paddy was traditionally grown mostly on floodplains of rivers and around drains in Punjab. Expansion of irrigation canals and

accessibility to groundwater through pumpsets meant more area could be brought under this crop.The green revolution came with high-yielding varieties of wheat and paddy meant to make the country self-sustaining in food production. Assured procurement of these two crops by government agencies for distribution to other states fetched better prices for farmers. Over time, paddy dovetailed well with wheat, a major winter crop of Punjab. Consequently, machinery was also specifically designed for wheat-paddy cycle, which further pushed the combination. From 2,27,000 hectares in 1960, the area under paddy rose to 26,12000 hectares by the year 2000. A growth rate of 1,050 percent!

Allowance of free power to operate these pumpsets furthered the cause even though it came at the cost of receding groundwater table. As many as 81 percent blocks in the state are either over exploited or critical. Data shows that Punjab has consistently registered below normal rainfall since 1998, thus putting additional strain on the groundwater resource. Estimates by the Commission for Agricultural Costs and Prices suggest that to grow one kilogram of rice, 5337 litres of water is required in Punjab, which is double the figure for West Bengal (2605 litres), a more conducive habitat for the crop due to its heavy rainfall.

Mentha in Bundelkhand-Cultivation of menthol, mint or metha in Bundelkhand region of Uttar Pradesh is another crop that contrasts with the agro-climatic zone. As its roots do not penetrate deep into the soil, this crop requires 18 to 22 rounds of irrigation, which is a luxury in the region known for severe and persistent droughts. A study by Gorakhpur Environmental Action Group found that around 1,75,000 litre of water is required to produce 1 kg menthol.

Mentha oil is used in several medical and cosmetic industries besides pan masala and gutka-making industries.Mentha has also given rise to water conflicts. The farmers in Jalaun district growing mentha have to siphon off water from the canals resulting in frequent standoffs with downstream farmers.

Arecanut in Karnataka -Arecanut [betel nut] is being grown in the hilly tracts of Kerala and Karnataka, but its expansion to semi-arid plains has tilted the balance. Around 2.15 lakh hectares in the state are under arecanut plantations. However, the trees require constant watering during the April-May period. A study done in 2013 found that the average cost of production of arecanut was Rs 60,7279.70 per acre due to long gestation period of seven years and huge investment is required to establish the garden. In addition, areca's average daily requirement of water is 21 litres, which is a big burden. However, a high price of Rs 250-300 per kg has lured farmers to dig deeper borewells to nurture this unsustainable model. "Farmers are planting arecanut in Chitradurga and Davangere and Tumkur districts which are not heavy rainfall areas".The natural hazard protection tress of India,which have sustained salinity of lands that is the Palmyra or Toddy Palm (Borassus flabellifer L.)is totally forgotten.

The department of horticulture has started advising farmers to move to cashew plantations which are more suited to the local climate and need less water The crop is turning out to be a burden even in its native region. Sree Padre, who grows arecanut in Kasaragod district of Kerala, says the plantation is seen by many as a problem. "At some point in time, farmers had shifted to rubber plantation as that requires less water," he says.

Due to reduced rainfall over the years, arecanut's yield is declining. The department of horticulture, Karnataka, has started advising farmers to move to cashew plantations which are more suited to the local climate and need less water.

Coconut which is mostly grown in coastal areas has also become widespread in Tumkur and Honsur regions of the state. In Karnataka, the percentage share of coconut of the net sown area increased from 13.65 per cent in 1960 to 19.14 per cent in 2002. However, each palm requires 55 to 120 litres per day, thus depending on excessive withdrawal of groundwater.

A positive change with soybean-While most of the cash crops have impacted local ecology, soybean is turning out to be a beneficial crop comparatively. Being a legume, it fixes nitrogen and also requires less water, in arid regions. The crop is also blessed with a very good marketing system as oil mills buy the harvest and de-oiled cakes are exported to Europe. In Marathwada, one of the most drought-prone regions in Maharashtra, soybean has expanded from 2.01 lakh hectare in 1990-91 to 35.20 lakh hectare in 2013-14.

South Rajasthan was known for its production of pulses. However, water-guzzling sugarcane found

favours due to better remunerations. But now, soybean and wheat have replaced sugarcane to a great extent. From 28.3 lakh million tonne in 1978, the sugarcane production in the state dropped down to 2.8 million tonne by 2003. The crop does not require assured irrigation and can do well in rainfed areas. "The only problem is that when grown in light soil, the crop can't withstand a gap of 15 days in rainfall. In comparison, jowar (great millet) and toor dal (pigeon pea) can take 25 days' deficit."[Dr Ramanjaneyulu]

The need, hence, is to learn from the past and shift to those crops which can withstand the local environment. Climate change is good at turning off the knobs for unsustainable crop patterns whether it's mentha in Bundelkhand or arecanut in Karnataka. Short-term financial gains can't be a justification for long-term impacts on the environment and the farmer.[India water portal,Authored By ,Manu Moudgil,Posted By : Manu Moudgil,Posted Date : Tue, 2016-11-15 10:48]

B.International Center for Tropical Agriculture (CIAT),Enhancing Rice Productivity through Big Data Approaches.*COLOMBIA*-CIAT**[*September 3, 2013][Farming first]***

In Colombia, the climate is becoming increasingly unpredictable, particularly with regard to rainfall and temperature extremes. This has resulted in average rice yields falling from six to five tonnes per hectare in less than five years.

It means traditional calendar-based decisions about when to plant are no longer reliable. CIAT scientists mined 10 years of weather and crop data to understand how climatic variation impacts rice yields in the country. In 2014, following roughly a year of data analysis, the team were able to predict a forthcoming drought in the country's Caribbean department of Córdoba, a major rice-growing area. Using the information, the country's rice growers' association recommended that farmers could save themselves from crop failure by not planting rice at all. The drought came, and those who planted harvested nothing, but the 179 farmers who followed the advice, saved approximately USD 3.6 million in averted costs. The following season, again following advance warning – this time of delayed rains – the farmers postponed planting by two months. They were able to produce a good harvest, and take advantage of higher prices. "It turned out perfectly," commented Oscar Lopez, a rice farmer who benefited. "We got good production and good prices."

The project is considered climate-smart because it has helped farmers both adapt to climate variability by helping them plant (or not plant) at the best possible time, and also improve the sustainability of production through "data-driven agronomy".

This Big Data project has the potential to be scaled-up for application in other countries, thereby increasing agricultural resilience to climate change.[Farming First]

C. **Mitigating methane emissions through new Irrigation Schemes (Bohol, Philippines)**

Bohol Island is one of the biggest rice-growing areas in the Philippines' Visayas regions. Before the completion of the Bohol Integrated Irrigation System (BIIS) in 2007, two older reservoirs (Malinao and Capayas Dam) were beset by problems and unable to ensure sufficient water during the year's second crop (November to April), especially for farmers who live farthest downstream from the dam. This problem was aggravated by the practice of unequal water distribution and a preference by farmers for continuously flooded rice growing conditions. In the face of declining rice production, the National Irrigation Administration (NIA) created an action plan for the BIIS. This included the construction of a new dam (Bayongan Dam; funded by a loan from the Japan Bank for International Cooperation) and the implementation of a water-saving technology called Alternate-Wetting and Drying (AWD) which was developed by the International Rice Research Institute (IRRI) in cooperation with national research institutes. The visible success of AWD in pilot farms, as well as specific training programmes for farmers, were able to dispelled the widely held Perception of possible yield losses from non-flooded rice fields. Ample adoption of AWD facilitated an optimum use of irrigation water, so that the cropping intensity could be increased from ca. 119 % to ca. 160 % (related to the maximum of 200 % in these double-cropping systems). Moreover, according to the revised IPCC methodology (IPCC 2006), 'multiple aeration', to which the AWD corresponds, potentially reduces methane emissions by 48 % compared to continuous flooding of rice fields. AWD therefore generates

multiple benefits related to methane emission reduction (mitigation), reducing water use (adaptation where water is scarce), increasing productivity and contributing to food security (Bouman *et al*. 2007).

3.Sustainable water allocation – a river basin perspective

The soils and water absorb all human excreta, and even human Skeleton. Still the soils yields food grain and the rivers carry water for living. It is good to have the knowledge about water and its purification for human drinking and industries. The need is to plan about preserving rain water, storage, and supply. Hence the need to rationalize the city water supply. In the beginning of creation there was water only on the earth Water is said to be our life. It is indispensable for plants and animals also. It is an essential to maintain life line of agriculture and industries.

Water is as important as air.

The water resources, irrigation and agriculture for each country are as follows

INDIA

ANNUAL REPORT 2015-16-Ministry of Agriculture

As per the land use statistics 2012-13, the total geographical area of the country is 328.7 million hectares, of which 139.9 million hectares is the reported net sown area. 194.4 million hectares is the gross cropped area with a cropping intensity of 138.9%. Indian area is 3.28 Billion Hectares, of this around 12% yearly is flood damaged area, another 1.08 billion hectares do not receive proper rains. Again the systematic review comes to use of the surface water, supplemented by ground water. Use of modern technical low cost engineering techniques for irrigation is a must. The workers in agriculture sectors are slowly diminishing, because of low output, means of mechanization.Low market rates for the seller. The support systems are not time bound, nor do they understand market storage and sales at the right time. Mediators buy at low cost and store in their grain yards and sell them at exorbant prices when demand and supply do not match. The governments and social leaders are yet to come to terms as to how to help the small farmers in community. Many loans to the agriculture is either fictitious or manipulated by the media and Lords.

ETHIOPIA

IRRIGATION DEVELOPMENT

2.1 **Traditional Small scale Irrigation Development**

Based on regional reports, 166634 hectares of small scale irrigation have been developed traditionally by farmers during the budget year. This makes the total hectare of traditional small scale irrigation developed up to the end of the budget year to 346.3 thousand, with beneficiaries of 1.33 million households.

2.2 **Modern Small scale Irrigation Development**

Study and design of 48 small scale irrigation projects and design of 15 small scale irrigation projects have been carried out. More over Preliminary study of 63 small scale irrigation projects have been conducted. Most of the study and design work of the modern small scale irrigation projects have been carried out in Tigray, Amhara, SNNP and Oromiya regions.Similarly constructions of 8338 hectares of 21 modern small scale irrigation projects have been completed in the budget year, which benefits 33 thousand households.

In general, the main reasons that are related to the low level of performances are low implementation capacity including shortage of heavy machineries and equipment, lack of capable and efficient contractors and their poor managerial experiences, as well as shortage of skilled manpower. Besides poor geological formations, shortage of cement, early rain, etc have contributed to the low performance of irrigation development.

Average annual precipitation on the central plateau is roughly 122 cm (48 in). The northern provinces receive less rainfall, and the average annual precipitation in the Ogaden is less than **10 cm** (4 in). The westernmost region of Ethiopia receives an annual rainfall of nearly 200 cm (80 in).

NIGERIA

This country is on the west side of African continent,and is adjoining the Sahara desert.Average rainfall along the coast varies from **about 180 cm** (70 in) in the west to **about 430 cm** (170 inch) in certain parts of the east. Inland, it decreases to around 130 cm (50 inch) over most of central Nigeria and only 50 cm (20 inch) in the extreme north.

Some of the main crops grown in Africa include cereals and **grains**, such as **corn**, **wheat** and **rice**,

and legumes and fodder, such as beans, groundnut and cowpea. Agriculture employs 65 percent of Africa's labor force and is responsible for 32 percent of its gross domestic product.

PHILIPHINES

Surface water-125,790,Ground water is 20,200.Total water resources is 145,990MCM[million cubic meters] Water availability, in MCM,(Source: Philippines Environment Monitor 2003)

The report also mentions that groundwater contributes 14 percent of the total water resource potential of the country. This same report projects that by year 2025, water availability deficit would take place in several river basins such as in Pampanga and Agno, in Pasig-Laguna, in Cagayan Valley, all other regions in Luzon, in Jalaur and Ilog Hilabangan, and in the island of Cebu in Visayas.In general, water deficits are said to be time and site-specific.Data from the JICA Master Plan on Water Resource Management in the Philippines estimate that only 1,907 cubic meters of fresh water would be available to each person each year, making the Philippines second to the lowest among Southeast Asian countries with fresh water availability (PEM 2003).

USA

As per 2007 survey around 28.376 MHa is the total irrigated area.Of this from Ground water is 18.384 Mha,and from Surface water is around 10 MHa.Roughly 56 million acres that is 7.6 percent of all U.S. Crop land and pasture land were irrigated in 2012. Nearly three-quarters of irrigated acres are in the 17 western-most contiguous States (referred to as the Western States hereafter). From 2007 to 2012, irrigated acres declined by nearly 0.8 million acres across the United States. Most of the area decline occurred in the Western United States where drought conditions contributed to water-supply scarcity across the region.USDA's Farm and Ranch Irrigation Survey (FRIS) reports that in 2013, irrigated agriculture applied 91.2 million acre-feet of water nationally, with over four-fifths occurring in the West. (An acre-foot of water is equivalent to 325,851 gallons.) The U.S. Geological Survey (USGS), which monitors water use by economic sector, estimates that irrigated agriculture accounted for 38 percent of the Nation's freshwater withdrawals in 2010. Agriculture, however, accounts for approximately 80 to 90 percent of U.S. consumptive water use.[US-DA-Economic research service]

USDA Reports 55.3 Million Acres of Irrigated Farmland in U.S. [2013 Farm and Ranch Irrigation Data Now Available][WASHINGTON, Nov 13, 2014]

There were 229,237 farms with 55.3 million irrigated acres in the United States, according to the 2013 Farm and Ranch Irrigation Survey results, published by the U.S. Department of Agriculture's National Agricultural Statistics Service (NASS). According to the 2008 irrigation survey results, there were 235,715 farms with 55.5 million irrigated acres."The 2013 irrigation survey expands on the data collected about irrigation during the 2012 Census of Agriculture and provides the most comprehensive source of up-to-date information regarding on-farm irrigation in the United States," said NASS Administrator Joseph T. Reilly. "The latest report reveals key data on the agriculture industry's use and stewardship of our nation's water resources."

CHINA

China's 2015/16 Winter Wheat Crop

Background: China is one of the world's most important wheat-producing countries. In 2014/15, China's wheat area (24.1 million hectares) ranked third behind India (30.6 million) and the EU (26.8 million). However, China's wheat yield (5.23 MT/Ha) is among the highest in the world, and its estimated production (126.0 million tons) put it in second place after the European Union (EU). Winter wheat accounts for about 95 percent of China's total wheat output, with more than 75 percent of the crop produced in 5 provinces located on the North China Plain (Henan, Shandong, Hebei, Anhui, and Jiangsu).

China's winter wheat crop is planted from late September through October and harvested in May/June the following year. Although most of the crop is grown on the North China Plain, winter wheat is also produced in western China and parts of the Yangtze basin and southwest China. A small spring wheat crop (less than 5 percent of total production) is grown in northern and western regions. A majority of the crop receives irrigation at some point during the growing season, and average yields are significantly higher than the world average. [Paulette Sandene, USDA-FAS, Office of Global Analysis]

China's water resources include 2,711.5 cubic kilometers of mean annual run-off in its rivers and 828.8 cubic kilometers of groundwater recharge. As pumping water draws water from nearby rivers, the total available resource is less than the sum of surface and groundwater, and thus is only 2,821.4 cubic kilometers. 80% of these resources are in the South of China.

Demand

As per china official agriculture and irrigation web sites it is having Surface water irrigation to 43.24 MHa, and 18.67 MHa irrigation with Ground water. Thus the total is coming to 61.90 MHa, in that year of 2005, which is equivalent to India Irrigated area. The figures are as of 2005 for both countries.However the latest figures place India on top of China and USA raking third shows around 28.4MHa as per their 2007 statistics. Total water withdrawals were estimated at 554 cubic kilometers in 2005, or about 20% of renewable resources. Demand is from the following sectors:65% agriculture,23% industry,12% domestic. In 2006 626,000 square kilometers were irrigated.Groundwater has been over-exploited with an average annual groundwater depletion of more than 10 billion cubic meters are a factor which the government recognized. As a result, more than 60,000 square kilometers of ground surface have sunk with more than 50 cities suffering from serious subsidence. Flooding also still is a major problem.

Water transfers

Large-scale water transfers have long been advocated by Chinese planners as a solution to the country's water woes. The South-North Water Transfer Project is being developed primarily to divert water from the Yangtze River to the Yellow River and Beijing.The development or diversion of major transboundary rivers originating in China, such as the Brahmaputra River and the Mekong River, could be a source on tension with China's neighbors. On a smaller scale, some of the waters of the Irtysh River, which would otherwise flow into Kazakhstan, Russia, and the Arctic Ocean, have been diverted into the arid areas of north-central Xinjiang.

Sea water desalination is being tried extensively tried, while water pollution from Industries ia a constant threat to china.The industrial pollution is highest and needs several treament plants to make quality water for any use.

According to China's State Environmental Protection Administration (SEPA) in 2006, 60% of the country's rivers suffer from pollution to such an extent that they cannot be safely used as drinking water sources. According to the 2008 State of the Environment Report by the Ministry of Environmental Protection, the successor agency of SEPA, pollution of specific rivers is as follows:The Pearl River and the Yangtze River had "good water quality";The Songhua River was "slightly polluted" (it was "moderately polluted" in 2006);The Liaohe River, the Huai River, and the Yellow River were "moderately polluted" (another translation says they "had poor water quality"); and the Haihe River which flows through Beijing and Tianjin was "badly polluted".[Wikipedia]

Sustainable water allocation – a river basin perspective

The soils and water absorb all human excreta, and even human Skeleton. Still the soils yields food

grain, and the rivers carry water for living. It is good to have the knowledge about water and its purification for human drinking and its utilization for industries. The need is to plan about preserving rain water, storage, and supply for city water supply or otherwise. Hence the need to rationalize the city water supply .In the beginning of creation there was water only on the earth Water is said to be our life. It is indispensable for plants and animals also. It is an essential to maintain life line of agriculture and industries.

The design of hydraulic structures is through the Continuity Equation and the Bernoulli's Equation. Normally the quantum theory is used to find out the quantity of flowing water at any place which shall be constant as per the above equations.

Discharge quantity divided by the silt factor of the soils from a predictable table is used for estimating scour depth.The flood discharge divided by the silt [capacity] factor under triple root gives the scour depth .This is used to estimate the foundations depth at the river banks.More reasonable is the availability of bore logs and the quantity of rock and its depth.Clariflocculator is a combination of flocculation and clarification in a single tank. It has two concentric tanks where inner tank serves as a flocculation basin and the outer tank serves as a clarifier. is a circular settlement chamber used for treatment of water.The water is drawn to sedimentary tanks from the bottom of the Clariflocculator and all vegetable matter is removed on top with a scrapper. The bottom sledge is drained from the bottom most point.

RIVER BASIN MANAGEMNT

This system involves in the development by planting large forests and plating trees that control emissions and produce useful food for the population. The second is conservation by providing protective bunds across the areas so as to avoid soil erosion, and migration of waters in to other basins.

The third is control of excessive use of the waters, or construction of more than required reservoirs.This needs an audit every third month in an year. The fourth is regulation. The existing laws on water use are disputable, because they deprive the rights of people living in the hilly areas and could be mostly tribal.The upper reaches shall have a right based on either equitable distribution or water is owned by the community where it falls. This is another human living system based on which laws needs to be developed so that people are encouraged to protect their environment.

The water allocation systems presently under operation do not recognize the fact that the upper reach waters flows down because of terrain slope. Hence development of proper storage systems at upper reaches and releasing water on equitable use basis is a need for future humans.

A total river basin may contain many sub basins, which we can also call 'Water Sheds'.

While there is no way the industrial activity or its use of water shall be curtailed along the river course, the same goes with the municipal use of water by the residents of towns. Developing separate systems of drains and making initial filtration, ponding and aeration are not thought by the municipal administrative systems. The need to understand that very high capacity sledge pumps and heavy water treatment plants using Clariflocculator for municipal and industrial wastes are readily available in markets.The treated waters are finally sent for storage outside towns for use in horticulture.[1]The problems are population density, and no public places contemplation in initial stages of planning.In populated countries finding a waste water treatment plants is becoming a mirage.

Dams, Reservoirs and Other Facilities [1]

Reservoir systems are essential to river basin management. The Hydrographs of each of the rivers in a basin gives time verses flow in any river.However no standard equation to give perfect model to measure flows on any specific days, or for a period of time. It is the duration and intensity of storm that makes the flood. The process of establishing rain gauges to have accuracy in the flood discharges, and the water level measurements on river cross sections continuously is important to obtain a unit hydrograph.

Mathematical modeling for surplus in rivers gives only 80% accuracy on lower side and 120% on the higher sides.Providing a ground water recharge systems at the middle of basins is important.This can be done by constructing reservoirs made by barrages or dams.These water storage dampens the speed and sediment of the river waters and could help in recharges in surface and ground

waters.Spill ways on dams and barriers help in release of surplus waters to the lower reaches of the river.

WATER LAW

Water Law is a social aspect. It is allocation and administration of rights based on measured quantities. Surface water rights to use of stream flow are based on riparian rights based on the lands near to the rivers and prior aapropriation.Water disputes centre on the appropriation systems with human Habitat increasing in upper reaches or in concerned high reach states. Thus the lower riparian states which have an appropriation goes around courts for settlement [Cauvery river waters in India].Ground water Rights in many countries are very much under discussion. There are no monitoring mechanisms either to put "absolute ownership" or "reasonable use" systems. The permit system use shall be better system for use by the users of ground water. The legal and monitoring mechanisms are to be made.

Today among the top 9 countries China tops with around 26500 large Dams,Followed by USA with 6820 and India 4400 large dams. Japan in Fourth place has 2700 large dams followed by south korea 950 nos.Turkey has well developed the Tigris-Euprates river basin, with 22 dams and 19 hydro electric projects. Ethiopia and near nations which are on the banks of Nile look for Nile development in similar fashion. China has three Gorges Projection Yangtze [Chang Jing] rivers. [1]

The relative problems of dams, reservoirs are sedimentation of fine silts. Now we are having dredgers which can be dissembled and brought to the sites. We can use hydraulic jack or the floating platforms and such and use sledge pumps to de-silt the reservoirs. Which when done the reservoir capacity goes on increasing to the contemplated depths.

Barrages the silt removal is small problem because most of barrages are either rock fill, or earth dam, with a small spill way where a inter locking, buttressed, diaphragm wall is used to make the core portion of the spill way.

[ii]the concept of water auditing as a way to monitor water use and plan sustainable allocation,

The ground water in each basin has to be monitored monthly, and any fall in levels beyond has to be notified for the farmers. The statutory systems can be devised to regulate beyond certain limits the ground water.

There has to be third party audit, with powers bestowed on them for determining the extent to which each river basin ground water can be used.

Making an equity based solar power for all the tube wells and connecting the major river basins by using mass pumping schemes to divert surplus or excess rain water to the fields, and to the reservoirs, dams, and such storage places which enhances the ground water also.

Surface water basins inspection and restoration has to be done quarterly. This audit shall comprise of several agencies, including agriculture, irrigation, forest, environments and socially responsible committee.

Controlling the water out lets of field and branch canals with regulatory valves, recording extents of water used in a block and the farm extent and changing crop patterns will enhance the local studies and give better knowledge to the farmers. Use of bio pesticides. Growing trees all along farm bunds to reduce the effect of sun. Stopping haze, vapor in air by stopping sprinkler irrigation systems.Legal aspects of making audit of water issues with a third party have to be examined.

Deficit irrigation

This is a practice which has to be advocated where the temperatures are modest, and the soil will not become dry. In mild winters in the south 15^0 areas of south india, some crops which are for less than 100 days crop period is to be advocated.Change in crop pattern and avoiding rabi[2 nd season] rice crop certainly leaves scope for better earnings by farming community.

Treated waste water irrigation

The practice is not a possibility in major river basins in the present systems. But in the coastal regions the industries release lots of water which needs to be treated and on application of oxidation this may be used for vegetable growth.This is a place where large investments can take place with modern technologies.The treated waters can be used for recharging ground water and for horticulture or other industries.

Solar irrigation

This practice needs to be implemented; this energy may be safe and timely during day time for people of the South Asia region. Tube wells and river water lift irrigation systems are to be fitted with solar power at source to reduce the burden of producing power from coal and such fuels.

Alternate wetting and drying

Rice feeds more people than any other crop, but each kilogram of rice is responsible for substantially more greenhouse gas (GHG) emissions than other key staple foods. The System of Rice Intensification (SRI) has recently received considerable attention for its ability to increase yields while using less water. Yet so far there has been little research into the GHG emissions associated with SRI production systems, and how they compare to those from conventional flooded-rice production techniques.[13] While the System of Rice Intensification is under studies to assess the GHG emissions, other benefits at large are good produce. The present practice of flooding and using high water is still considered safe with Punjab in India using 5337 liters water per KG of rice production and achieving 5.8 Ton yield per Hectare as per the Prices. However the production trends of west Bengal, Assam, Bihar Indicate that almost around 4 tons per hectare is produced with use of around 3200 litres of water per K.G of rice. This is an encouraging sources from where SRI,and ADW policies can take off. Rice [**Developing an Action Program for Farm-level Impact in Rice-Wheat Systems of the Indo-Gangetic Plains, and** Agricultural Situation in India [2000] and March, 2014 - Publications of Economic and Statistics department of agriculture and co-operation ministry of GOI.The two publications give water and crop produce statistics, for farm level inputs.]

Most of the world's rice grows in inundated conditions, and one of the most promising techniques for reducing rice-related emissions is to reduce or interrupt the periods of flooding. The production of rice in flooded paddies produces methane because the water blocks oxygen from penetrating the soil, creating conditions conducive for methane-producing bacteria. Shorter flooding intervals and more frequent interruptions of flooding lower bacterial methane production and thus methane emissions.[7].The SRI is tested more in India, while ADW is tried at IRRS at Manila, and worldwide.

The practices have to reach the class room, agriculture research and extension centers and as well the field farmers. The district level co-operatives and the irrigation departments are still not equipped with the understanding.

Carbon Reduction Methods and Alternate Systems of Agriculture &Irrigation to Mitigate the Climate Changes

Andre, IFOAM, President made a presentation in Delhi early last month providing some doable solutions to reverse climate change (CC) by following agro ecological cultivation systems, my inputs on the subject trailed below for circulation to all concerned.

Warm regards,Subhash-According to WMO Secretary-General Michel Jarraud:

"Carbon dioxide remains in the atmosphere for hundreds of years and in the ocean for even longer. Past, present and future emissions have a cumulative impact on both global warming and ocean acidification. The laws of physics are non-negotiable."

Regenerative Grazing increases soil Carbon: In USA, soil degradation in the southeastern states, was evaluated for soil Carbon accumulation for 3

years over a 7-year chromo sequence of three farms converted to intensive grazing,the result was farms accumulated soil Carbon at 8.0 Mg ha/yr, increasing water holding capacity by 95% and 34%, respectively.' (Machmuller et al. 2015).These regenerative grazing practices on the world's grazing lands would sequester 98.5 gt CO2/yr (Grasslands: 3,356,940,000 ha x 29.36 = 98.5 gt CO2/yr)946.72 gt of CO2 could be removed in 10 years and climate change reversed.

[Journal of Environmental Quality. 2007 Oct 24; 36(6):1821-1832.Soil Science Society of America 677 S. Segoe Rd., Madison, WI 53711 USA **PDF]**Reversing Climate Change With Regenerative Organic Agriculture,www.nofamass.org/sites/.../2016%20**Climate**%20**Change**%20NOFA.pdf Andre leu ifoam--agroecology by World Agroforestr... 84 ... - SlideShare,www.slideshare.net/agroforestry/andre-leu-ifoamagroecology]

Conclusions

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[1] Changing rice production systems with use of less water.
[a]Changing the dietary requirements of families by reducing 10% rice consumption each day in the first year to 20% reduction in next 10 years.
[b]Use of other millet and fruits as a substitute, may be adding some wheat quantity in daily routine can change the decease routine and or cycle in human body.Changes of crop pattern.

[2]Protect the water sheds by
[a]Planting trees and forests
[b]by developing impounding reservoirs at start and at middle of water basins.Making ground water recharge wells in the basin.
[c]developing proper river bank protection systems

[3]Installing modern rain gauges with perceived systems of rainfall, and integrating and
[a]computing flood discharges in rivers realistically along the 12 month periods.
[b]Employing many lift irrigation schemes to utilize for storage during floods,
[c] storing the water in protected pools, reservoirs and geo-membrane treated water ponds for drinking and other activities.

[4]Using lined or piped channels for flow from barrage and or dams so as to avoid heavy losses at the first stretch of the irrigation systems.
[a]Providing proper soils for embankments in the middle and train or trim the canals yearly for proper flow of water.
[b]End water release shall be with reliable economical by use of plastic/PVC pipes with valves to calibrate.
[c]The system of weekly allotment of water is not followed at many places due to which the tail end even do not receive the drainage water as the drainage system is mostly non functional.

[5]Estuaries at the end of rivers joining the sea are most important sources of marine life for mankind.
[a] Protecting them with mangrove and other coconut, banana, and cashew plantation has to be encouraged.
[b]The aquaculture has to be somewhat interior as any direct interface with sea will be a threat at the time of Tsunami.

[6]The data on Irrigation actually done by each country do not give a real time picture of the world.
This and agriculture data of first 10-20 major countries shall be correlated along with population census, or economic census or the Habitat census. A starting year for estimation of surface waters, 'ground water data' its use its depletion, crops, pattern sowing seasons and yields will give a comparable results.

[7] Develop as many water storage reservoirs as possible, check the soils and use geo-membranes and keep water for industry, drinking etc.
[a]Use the water for second crops judiciously..Use the soil water and moisture in weather and two or three wetting by drip irrigation are sufficient.
[b]Just discourage sprinkler irrigation in these parts due to temperatures.water becomes vapor quickly and creates more problems of haze in summer.

[8]The economics of the farmer is as much needed as that of the nation,just encourage solar power with one time installation cost and maintenance by communities for farming, irrigation etc.
Encourage to plant trees that reduce sunlight on to the fields in cropping time,the directions have to be worked out at fields and the types of tress shall sustain other oxidants and absorb the nitrogen.

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Chennai and Tamil Nadu - On 28–29 November, another system developed and arrived over Tamil Nadu on 30 November, bringing additional rain and flooding. The system dropped 490 mm of rainfall at Tambaram in 24 hours starting 8:30 am on 1 December. Very heavy rains led to flooding across the entire stretch of coast from Chennai to Cuddalore.

[20]07:03 PM (IST), Sep 25-change? With another depression forming in west-central Bay of Bengal, the Indian Meteorological Department has said Hyderabad is

will have to brace for five more days of rain, before a lull for some time.News reports-about 24 cm rain in 24 hours in a day.

[21]Crawls, Delhi | Press Trust of India | Thursday September 1, 2016,Heavy rains continued to lash the national capital for the second consecutive day today leading to water-logging and traffic jams in many areas of the city.

[22]Dr. Robert McDonald is Lead Scientist for the Global Cities program at The Nature Conservancy. He researches the impact and dependences of cities on the natural world, and help direct the science behind much of the Conservancy's urban conservation work. More from Rob

[23]William (Bill) Brieger,Professor, Dept. International Health,JHU Bloomberg School of Public Health ,on maleria,Dieseses and Neglected tropical dieseses.

[24]Drones 4 Agriculture,#UAV,[PDF version of this issue via this link: http://bit.ly/24mvNLQ Selected articles are featured on the magazine portal: http://ictupdate.cta.int where you can subscribe to the magazine at no cost.] Giacomo Rambaldi,Senior Programme Coordinator | join the community on DGroups.CTA | P.O. Box 380 | 6700AJ Wageningen |The Netherlands | www.cta.int |

[25]'Four Water Concept' developed by retired Engineer-in-Chief and UN consultant T. Hanumantha Rao:http://www.thehindu.com/news/cities/Hyderabad/call to promote four waters Concept/article 9226266ece?ref=tpnews

[26]Flight performance assessment of land surveying trajectories for multiple UAV platforms:Andres Mora, Sai Vemprala, Adrian Carrio, Srikanth Saripalli,Earth and Space Exploration, School of (SESE).,ASU.

[27]I-Corps: 3D Mapping and Monitoring using an Autonomous Kite UAV ,Saripalli, Srikanth , Arizona State University, Tempe, AZ, United States.

[28]International Food Policy Research Institute www.ifpri.org 2033 K Street, N.W. • Washington, D.C. 20006-1002 • U.S.A. Phone: +1-202-862-5600 • Fax: +1-202-467-4439 • Email: ifpri@cgiar.org.

[29]Wikipedia on China water resources.

[30]Ethiopia- Water resources and Irrigation-Ministry of Water resources.

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Rice Crop in OCTOBER2016 at North Coastal Andhra,Vizianagram,with deficit irrigation.

Rice Crop Under a Pond,with principles of Deficit Irrigation.

Closer look at crop yield of rice,where assured irrigation is very partial.

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