WATER SAVING TECHNOLOGIES
IN
EASTERN INDIA

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For

INDIA WATER PARTNERSHIP, NEW DELHI

October 2009

Water Saving Technologies in Eastern India

I. Introduction

Different regions of India are characterized by varying degrees of surface and ground water availability. In general the eastern region has adequate rainfall and favorable ground water reserve. However, the amount and timing of precipitation is highly erratic. Some areas do not have enough rainfall, and many areas have scarce ground water. Large temporal and spatial variations with co-existence of acute scarcity and excess of water call for immediate action. If the present situation is allowed to continue uncontrolled, sustainability of agriculture, food and livelihood security will be in serious danger. Problems include lack of awareness about the availability of water saving technologies, distorted price policies inducing wastage of water and over exploitation of ground water leading to depletion of aquifer. Apart from rural and agricultural needs, water insecurity is a serious problem also for urban slum dwellers. The present study seeks to address this issue.

The core of the study plan and activities proposed by the India Water Partnership (IWP) to deal with the problem of water resources consists of the following components: (i) creation of awareness of maintenance of water sources and minimizing wastage; (ii) promotion of water saving sanitation technologies; and (iii) organizing group ownership and management of water resources by the community.

Focusing on the eastern region of India comprising the states of Bihar, Jharkhand, Orissa, and West Bengal, the present study explores the need, availability, appropriateness, feasibility and adoption of water saving technologies in the region indicating how far and how many of the technologies have been adopted by farmers and other users, and why some technologies have not been found acceptable. Generally, rich farmers can easily adopt the technologies developed. But millions of small and marginal farmers, particularly in rain fed areas are poor and averse to taking risks of adopting new technologies. To facilitate transfer of water saving technologies to such small and marginal farmers, it is necessary to look at technology especially from the points of its *appropriateness* and *feasibility.* Simple, convincing, need based, location specific, socially and economically acceptable and environment friendly technologies are more easily acceptable to small and marginal farmers.

II. Water Scenario in the Eastern States

The strategic plan of the IWP mentioned above are quite relevant for sustainable agricultural development in the eastern region of India where water stress and water logging are common problems due to erratic nature of onset, distribution and withdrawal of monsoon. Besides, majority of the farmers of this region belong to small and marginal categories. In the eastern region, rainfall varies from **1100mm** to more than **1500mm**. Even with this adequate rainfall, drought is a frequent calamity in the plateau areas due to the erratic distribution of rain. Water logging occurs in the deltaic alluvial area near the coast due to high rain fall, reverse flow from canal irrigated high land and the saucer shaped physiographic nature of the land. Poor ground water availability and exploitation further aggravates the problem. Although water resources are sufficient, the region suffers from proper and efficient management. This weakness renders agricultural production unsustainable in the region.

State wise water scenario

West Bengal: Despite abundant rainfall (1,800 mm annually) and available surface water per capita (7,000 cubic meters), the state of West Bengal faces alarming water prospect .This is primarily due to increasing dependence upon groundwater for both drinking and irrigation. West Bengal has 2.746 mhm of net ground water availability and 1.165 mhm of gross annual groundwater draft. The overall state of ground water development is at 42 % of net ground water availability.

There is serious concern about the depletion of ground water storage causing lowering of water table in different parts of the state. This has caused intrusion in coastal aquifers and increasing menace of arsenic, fluoride and iron contamination in ground water. Chemical analysis of water samples shows alarming occurrence of arsenic and fluoride in many areas of the Gangetic plains and large numbers of people in West Bengal are already suffering from arsenic related diseases, attributable to drinking water from contaminated wells, and that the likely cause of this contamination is heavy withdrawal of ground water. This critical issue needs to be addressed by removing the increasing dependency on ground water, through alternative sources of safe arsenic free surface water for drinking. For irrigation purposes, effective management of surface water including rivers, canals, water bodies, lakes, ponds and rain water are the only options to reduce ground water dependency and to save and conserve water through low cost technology interventions. In order to regulate utilization of ground water resources, the West Bengal Ground Water Resource (Management, Control and Regulation) Act, 2006, effective since August 1, 2006 should be enforced.

Jharkhand: The state of Jharkhand is endowed with water resources of 28,781 million cubic meter (mcm) of which surface water is 83 % and ground water 17 %. Large proportions of ground water in the state is yet unutilized.

Total rainfall in the state is 1200 mm, but its distribution is highly skewed with more than 80 % of the rain occurring during June – September. During the whole year irrigation is available to only 1.5% of cultivated land. Farmers can raise only one crop during the rainfall season and for the rest of the year (October through May) the land remains virtually fallow. Although 16 large and 102 medium and minor irrigation projects have been completed in the state, irrigation water is yet to reach most of the cultivable land in the state.

Bihar& Orissa: In the states of BIHAR and ORISSA, level of ground water development is only 19.19% and 8.42% respectively. Gross draft is relatively less in Bihar (0.78mhm per year), and (0.20mhm per year) in Orissa. There seems to be no immediate threat of depletion of ground water reserves in these two states. In Bihar, ground water reserve for the future is 2.30mhm per year while in Orissa it is 1.56mhm per year. However, the necessity of surface water utilization for drinking and irrigation purposes should not be minimized.

To sum up, the overall lesson from a brief review of water scenario in the eastern Indian states of Bihar, Jharkhand, Orissa and West Bengal is that despite generally abundant rainfall and favorable soil and agro-hydro-climatic conditions in the region, the states face water shortage at present, and their future prospect of water availability is indeed acute. This has serious implications for environmental quality, soil conservation, agricultural production and health and welfare. In order to successfully deal with this problem, immediate application of appropriate eco-friendly, low cost technologies and management practices for saving water at national, regional, community and household levels is an imperative need. Various such technologies have been designed and some of these have been implemented in different parts of the region. We have made an inventory of these technologies (Appendix A), and a few of them that are adopted successfully by farmers are discussed below.

III. Focus on selected low cost eco-friendly water saving technologies

In the first phase of the study we made an inventory of available water saving technologies in the region briefly indicating their effectiveness and acceptance. A list of more than thirty such technologies has been studied and presented in the Appendix. This phase was followed by an in-depth review of technologies on the basis of field studies and close and focused interviews with farmers seeking their response to the technologies. We identified about a dozen of the technologies which were found particularly appropriate and adoptable and for which the benefit-cost ratios are high.

An analysis of these selected technologies is presented below.

(a) "Moisture Storage Pits Technology" in the Sunderbans coastal areas of West Bengal (Sagar, Basanti and Gosaba blocks in the 24 parganas(S),District).

The coastal areas of the eastern region, particularly the Sundarban area in south Bengal suffer chronically from scarcity of sweet water for drinking, washing and irrigation purposes. It is characterized by large scale poverty, malnutrition and unemployment. Until very recently, driven by poverty and lack of livelihood, every year people used to migrate from the island in large numbers in search of jobs in neighboring villages on the mainland.

The new technology is part of a project sponsored by the Government of West Bengal Sunderban Development Board. It has been implemented by a local NGO, "Tagore Society for Rural Development", in Sundarban area development activities. The project involves excavation /re- excavation of ponds /tanks for harvesting rain water. So far more than 1,000 ponds, tanks, canals, nullahs, etc. have been excavated in the area and water storage capacity has been substantially enhanced. In addition to excavation and re-excavation of ponds, tanks, etc, the society has adopted small plots for "moisture storage pits technology" for uplands and midlands by dividing large stretches of land into small plots. The moisture storage pits are dug at the lower most corner of each plot to collect run off rain water. Through farmers' initiative, large numbers of such run off water storage pits have been dug all over the islands.

The technology has yielded several <u>benefits</u>:

- *Improved ground water level in low lands.*
- *Harvested rain water for most part of the year.*
- *Increased irrigation and farm productivity.*
- *Promotion of sweet water fishery.*
- *Employment opportunities created.*

The technology has been effective through organization and participation of farmers of contiguous plots. All the Village Users Committees /SHGs have now taken over the use and maintenance of community assets ensuring sustainability of the project.

(b). "Rainwater Harvesting Technology in Low Land Coastal Region"(Sundarban Area, West Bengal)

Ramkrishna Ashram KVK conceptualized and developed the **"Land Shaping Technology"** in 1980 to address the twin problems of raising the level of cultivable land and harvesting rain water for multiple cropping.

Over the years, the technology has undergone modifications and fine tuning through collaborative participation of the farmers and KVK scientists. This is a multi-faced method by which HYV rice replaces low yielding indigenous rice in rainy season and make growing of high value vegetable crops possible during winter season. At the same time pisciculture and duck rearing in ponds and growing of fruit crop plants are possible on the embankment developed by the dug up soil.

<u>Principles of land shaping:</u>

- Excavation of 1/5 the area of the low lands up to a depth of 9 ft.
- Adjoining low land raised up to 1.5 ft.
- Pond embankment—5 ft. wide and 4 ft. high;
- Land embankment around the area 3 ft. wide and 2 ft. high;
- 6-9 acres inch of rain water can be harvested and stored in the pond.

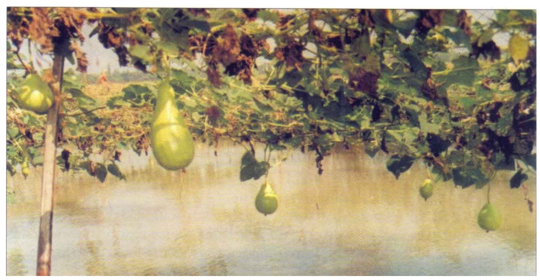
<u>The following points can be attributed to the technology:</u>

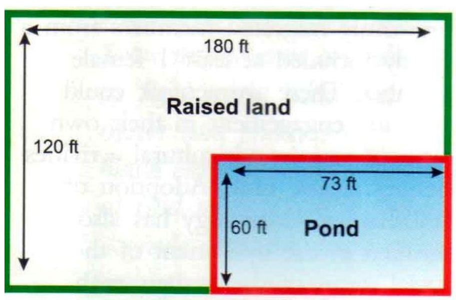
- Engineering solution for productive use of low land;
- Three dimensional (land, water and air) cropping option.
- Diversified cropping possibilities with integrated approach;
- Introduction of double and triple crops;
- Additional crop in ponds and land embankments;
- Off season crops fetching higher market price;
- Water and energy saving module.

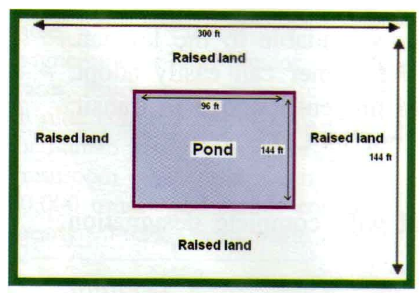
Experience has shown that for coastal areas in the Sundarban in West Bengal *"Rainwater Harvesting through Land Shaping and AIL Technology"* has significant positive impacts on agriculture, ecology and economy. It has led to replacement of traditional, low yielding mono- cropped farm area into modern high yielding multi-activity farms. Farm income has increased several times. Out migration of labor has been virtually eliminated. Land erosion has been reduced, communication and access to markets and outside world has improved.

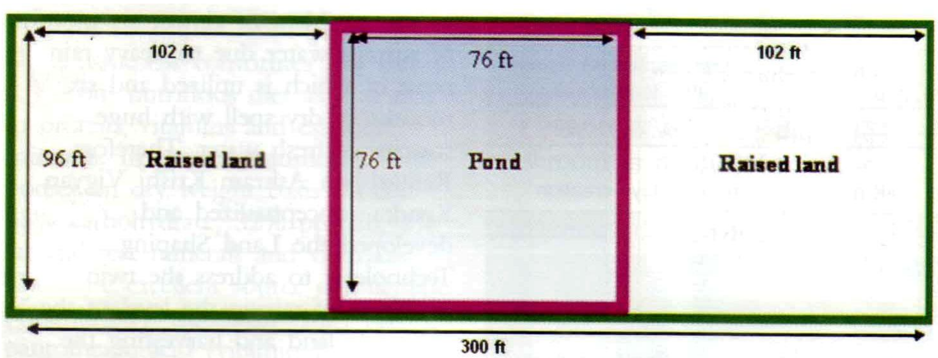
The RKM-KVK has been implementing the Land Shaping and Ail technology for several years with impressive success. Local farmers have been working on the project and enjoying the benefits. However, they have not adopted the technology on their own and the technology has not spread very widely among farmers in the Sundarban island area. This is because local residents are not only extremely poor, they live virtually on the brink of livelihood and life. Natural hazards and major calamities frequently visit the area and the uncertainty renders people highly risk-averse, rarely daring to take loans from government or non-government sources. The technology requires an investment of about R.20,000 for a farm of 1.5 bighas (less than one-third hectare). This is beyond the ability of farmers to invest.

Interestingly, while on the islands the technology remained confined to the initiatives of the RKM-KVK, many farmers in villages on the mainland in the neighbourhood adopted the technology as soon as they were exposed to the R.K.Ashram experiment. This is due to the relatively higher economic and ecological security of people outside the high risk coastal island zone.









(c)."Heerbandh Development Board : Rain Water Harvesting And Water Conservation Technology in Bankura District of West Bengal"

The "Heerbandh Development Board" is located in the dry late rite zone in Bankura District, West Bengal. The Board has introduced this technology by encouraging farmers to harvest rain water, excavating small tanks under 30-40 model (i.e. 30'x 40' plots) on their own land. Following effects of the technology have been recorded:

- During the monsoon season, rain water is harvested in small tanks dug and used to irrigate the rabi season crops. As result of introduction of the method, an area of around 100 acres have been brought under double cropping-- first of paddy during kharif season, then followed by low water intensity- crops such as oil seeds, during rabi season.
- Tube wells which were sunk in the area five years earlier became dry and rusted due to lowering of water level. These tube wells have started functioning now, because ground water level has gone up from what it was five years ago.
- Using the technology many farmers are now raising mango orchards to augment income;
- The technology has provided farmers with means not only for a better livelihood but also for water conservation and green cover development.

(*d*) "Rainwater Harvesting Technologies in Purulia District, West Bengal : "Jaldhar" Models"

Purulia District is located in eastern Indian plateau region, characterized by soil with low water retention capacity, low and erratic rain fall, undulating landscape with high runoff, high soil erosion and depleted vegetative cover. All the factors have caused frequent water stress/draughts affecting agriculture.

In this soil and agro climatic situation, rain water harvesting and moisture conservation through "Jaldhar 30X40 Model" and "Jaldhar 5% Model" have been found to the effective, encouraging farmers to adopt the technology in their own field.

The Jaldhar Models have been designed and implemented by a Non Government Organisation, PRADAN. PRADAN has been working in the dry land Plateau areas particularly in the eastern region. They originally designed the Jaldhar Model more than a decade back. Since then the Model has undergone modifications and its utility has been continually enhanced. These technologies are user friendly and within the financial reach of poor farmers. The Jaldhar Model technologies have large scale replication potential in water scarce plateau land. The technologies have the additional advantage, especially for the poor, for whom the technologies can be implemented in various poverty alleviation programmes of the Government (e.g. EAS, JRY, DPAP, NWDP etc.).

Salient features of the Jaldhar Water Saving Technologies:

(i) Jaldhar 30 x 40 model:

In this technology un-terraced and un-bunded upland (with varying degrees of slopes) is divided into smaller plots, each 30ft along and 40ft across the land slope. Hence each plot will be 1200 sqft. In each plot water collection pits are dug at the lowest point of the plot. The volume of each pit is about 100 - 110 cft. The earth excavated out of the pit is used to construct bunds on the plots. The pit area should not be more than 3 -4 % of the individual plot. The lay out of the plot is designed in a staggered fashion so that the pits are also staggered as far as possible. This is done to facilitate uniform seepage of water collected in the pits across the slopes. This technology helps to arrest run off rain water from the plots. The run off water gets deposited in the pits. The water from a large number of such plots travels below the earth down stream to recharge the aquifer. With this technology large parts of waste lands in the arid zone have been brought under productive use. It has made possible growth of permanent agro-forestry as well as raising of upland paddy, vegetables, pulses, oilseeds and several other crops.

(ii) Jaldhar 5 % model

This technology envisages that every plot should have its own water body capable of holding rain water in pits. This harvested water is used to irrigate the crops during water stress seasons. Besides, water held in the pits facilitates sub-surface flow of water to downstream plots and recharge moisture, benefiting the area as a whole.

In this technology water bodies (i.e. pits) are dug at the lowest point of each plot covering only 5% of its area. The minimum depth of each pit is 5ft. But most farmers who are raising a second crop after paddy may choose to dig pits with the depth of even 10 ft. Such pits of larger depths under 5% model have been preferred for implementation under Government programmes of NREGA, Special SGSY, RSVY, RKVY and others.

Benefits of Jaldhar Technology

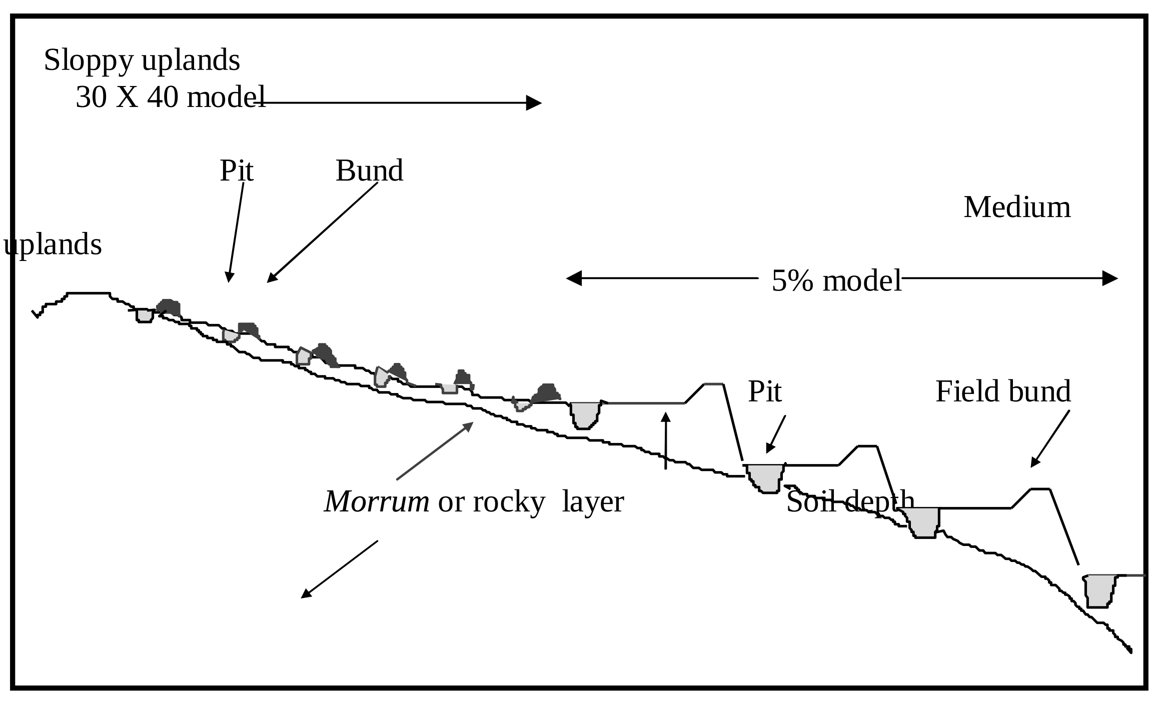
The Jaldhar water saving technologies are user friendly and within the financial reach of poor farmers. The technologies have large scale replication potential in water scarce plateau land. Especially for the poor, the Jaldhar technologies have the additional advantage. Projects using this model can be implemented in various poverty alleviation programmes of the Government (e.g. EAS, JRY, DPAP, NWDP etc.).

Large numbers of farmers in the districts of Purulia and Bankura, both in the dry zone of eastern India, have adopted the Jaldhar technology. Interviews of farmers and PRADAN officials suggest that with small pits in 5 % of the area of a farm of 1200 ft.-2000 ft. may increase farmers' income by 40-50% and yield revenue of Rs.15,000-Rs. 25,000, through multiple crops (intensified cultivation of rice and vegetables). Many farmers have even switched from low yielding kharif rice to high value vegetables, with higher income. Another externality from large scale adoption of water harvesting pits technology is that its application in large numbers of contiguous plots enhance moisture regime in the area and often pits at the lower reaches show characteristics of perennial water sources.

Jaldhar Model of in situ rain water conservation

. "*Jaldhar* 30 X 40 model" and "*Jaldhar* 5% model".

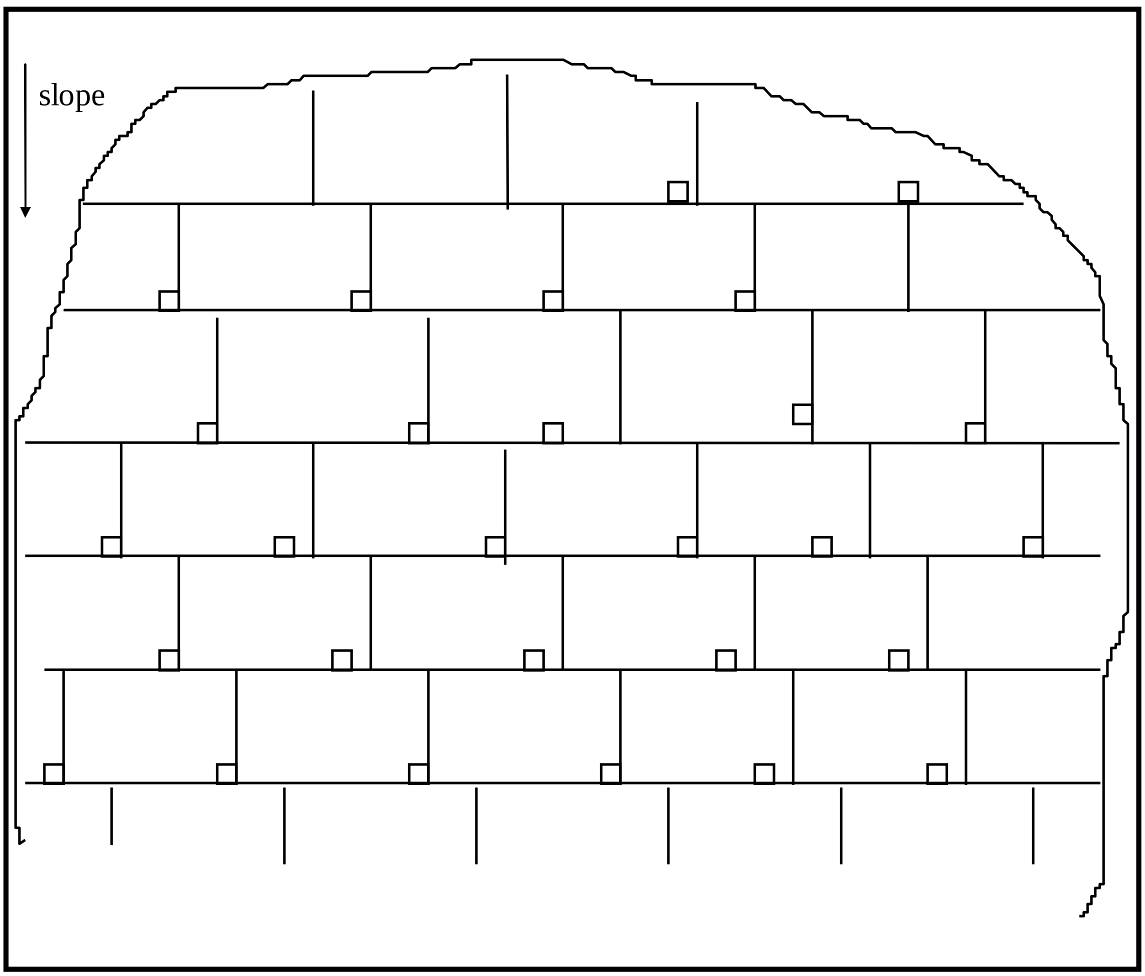
Ideally, in a typical micro watershed, these two techniques should go together. "30 X 40" model should be adopted at the upper reaches to be followed by "5% model at the lower reaches, to get maximum benefit. The diagram below shows the cross section of a typical landscape in the plateau and appropriate location of the proposed alternative new techniques:



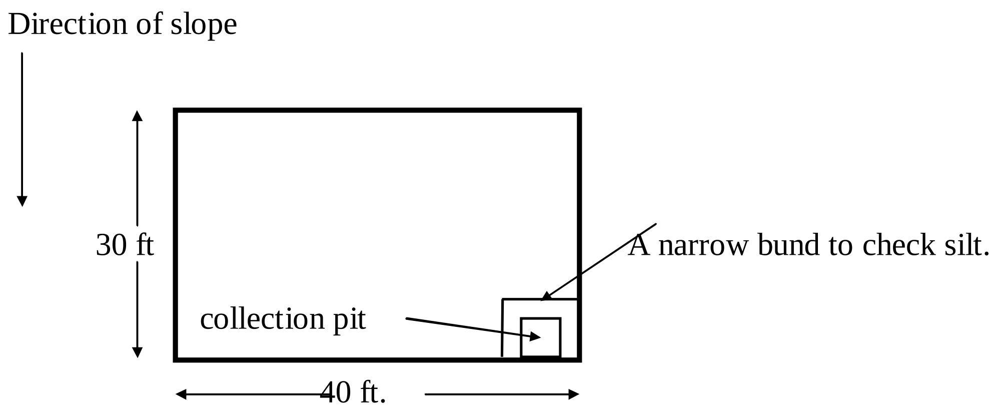
Jaldhar 30X40 techniques:

The design principle: It involves plotting of uplands into smaller plots and digging collection pits in each plot. When the slope of the land is more than 8%, the design needs some modification. In this design elaboration we shall limit our discussion to lands having an average slope of 3% to 5% percent. Each plot is maintained at 30 - 35 ft X 40 ft. 30-35 ft (along the slope) X 40 ft. (Across the slope). Hence the area of each plot will be 1200 t0 1400 square feet. The volume of each collection pit is kept 100 to 110 cubic feet. The earth excavated from the pit is used to construct the *bunds* of the plots. The pit should be at the lowest point of the plot.

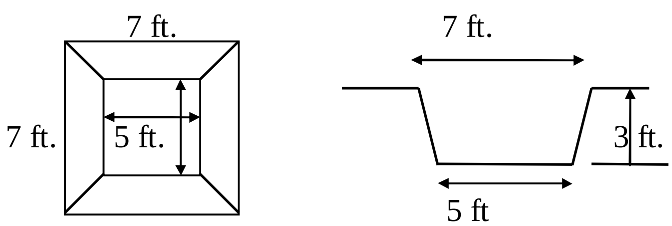
Lay out:



Design of a plot:



A standard pit design:



Design of the bunds:

(Note: The sketches are not to scale)

(e) “Zero-Tillage Technology for Water Management”

The technology has been promoted through an ICAR Co-ordinated Project for Research on Water Management conducted at Bidhan Chandra Krishi Viswa Vidyalay.

The technologies have been implemented in low land areas in the District of Nadia, West Bengal.

Zero tillage technique used in conservation agriculture, which aims to enhance and sustain farm production by conserving and improving soil, water and biological resources. Essentially, it maintains a permanent or semi-permanent organic soil cover (e.g. a growing crop or dead mulch) that protects the soil from sun, rain and wind and allows soil micro-organisms and fauna to take on the task of "tilling" and soil nutrient balancing. After harvesting Aman Rice, Wheat is sown on the rice field with minimal or no tillage. This is facilitated by the increased moisture content in the soil due to the mulch debris kept on the field from the preceding crop. It also helps minimizing soil erosion.

Benefits to farmers adopting this technology:

- Farmers reported that before they were exposed to this technology, they had to face the problem of late sowing of wheat beyond November because they could not prepare the land with the help of conventional tillage system due to excess soil moisture content in the low land situation. The zero tillage technology helped retaining soil moisture content at 26 to 32%, which is right for wheat seed germination within the normal sowing period, and farmers could use the technology successfully.

- Irrigation water can now be saved by 25 per cent compared to environmental tillage system.

- Grain yield also increased by more than 50 per cent.

(f) "Micro Level Water Resource Development through Tank-cum-Well Technology"

This rain water harvesting and water conservation technology has been designed by the Water Technology Centre, Bhubaneswar.

Salient features of the Technology:

- The technology involves a system of Tanks and Dug Wells in sequence.
- While tanks store run off water which is recycled for irrigation, the open dug wells harvest water seeped in from tanks.

Benefits:

- Reports on the basis of experience of farmers implementing this technology in Keonjhar District of Orissa show that they have been able to raise a second crop through the irrigation facility created by the harvested rain water in tanks and wells.
- Farmers could recover about 80 per cent of total invested made for the technology by the second year.
- The technology can be constructed and maintained by locally available skill rendering it easily adoptable.

(g) "On farm rain water management technology"

In this technology, rainwater is harvested through construction of small scale Water Harvesting Structures (WHS) called On Farm Reservoirs (OFRs) along the slope of farmers' fields for storage of excess rain water. Ground water structures like dug wells and ditches are also excavated to store in runoff rain water.
The project has been implemented in Keonjhar block of Orissa and Darisai block of Jharkhand.

Benefits of the technology

- The (OFR) technology helps conservation and utilization of harvested rain water. Ground water level in the project area has improved due to recharge. Water is now available for a second crop.
- Stored water in the ORFs can be used both for saving the kharif rice during drought and also to raise rabi crop, thus increasing cropping intensity.
- The technology increases agricultural productivity.
- The cost of this technology could be recovered by additional income generated from the project in three years with adoption of improved packages of practice for kharif paddy and rabi crops like gram, wheat and vegetables.

(h). “Vegetable Cultivation on Bunds Utilizing Retained Soil Moisture”

Nimpith Krishi Vigyan Kendra, 24 Parganas (S),West Bengal.
Nimpith Krishi Vigyan Kendra provided technical support to farmers for growing vegetables on the Ail (Bund) of paddy fields.The Ails (Bunds) previously used to demarcate an area were raised and broadened to conserve soil and water. On an average 5-10% of the fields was available for vegetable cultivation.The farmers modified and developed some practices including crop varietal, nutrient use, intercropping and multi-tier cropping system according to their individual situation.Being highly convinced and motivated, some of the farmers formed farmer extension groups and undertook across-group exposure visits. As a result, farmers in neighboring villages and onlookers also adopted the practice.An annual income of Rs 15000/-per Ail (Bund) measuring 1x400 meter is reported

V. Participatory Management Practices for Saving Water

Water Management by farmers

For efficient management of water resources a useful institution is Water Users' Association (WUA's). Water Users' Associations) are Farmers' Associations registered under Co-Operative Societies Act or Societies Registration Act. Specific clauses of the Act differ in details among states, but Associations in each state are primarily involved in operation, maintenance and management of various ground water and other on-farm development projects executed by the state Governments.
Amongst the eastern states, Bihar is witnessing a slow but steady progress to ensure participation of farmers in water management, irrigation scheduling, distribution and maintenance of the system at micro level through WUAs. For this purpose the state enacted the Bihar Irrigation Act, 1997. As per this act, the government may transfer any ‘distributory” or “minor water course” to the Water Users' Association (WUA) formed by the beneficiaries or to a group of persons who may be considered fit by the government to be owners of the system for maintenance and operation. The Act also assures adequate water supply to WUAs.

In West Bengal, efforts are being made to promote participatory management of irrigation projects and various schemes are being handed over to beneficiary committees constituted by panchayat samitis for operation, maintenance and management. These committees are given the authority to collect water charges from the beneficiaries.

Benefits from WUAs:

Experience of Bihar and West Bengal suggests the following benefits:

- Involvement of WUA's in management of irrigation, significant cost savings can be made.
- More area can be brought under irrigation.
- Upkeep of canal and other irrigation systems can be improved.
- Collection of Water fees can be better.
- Conflict resolutions can be easier.

In view of the benefits gained from WUAs, state governments are gradually giving them more responsibilities in saving water resource systems and protecting members' interests efficiently.

VI. Water Status in Peri-Urban communities

In order to examine the status of water in peri-urban localities we conducted a focused study of the issues through field surveys in seven periurban communities. We present a summary of the findings of this study.

- As reported by the residents, scarcity and poor quality of water is the most crucial need of the communities. Driven by scarcity, people use poor quality water for drinking and polluted pond water for bathing and other purposes.

- Lack of proper sanitation and drainage was reported as a serious health hazard. More than thirty per cent of people interviewed have no sanitary toilet and they practice open defecation. Even existing toilet facilities are not properly cleaned and maintained due to scarcity of water and awareness. Wherever there is drainage facility the dirty water is channeled into the nearby pond polluting its water.

- Low livelihood, poor quality water and lack of sanitation and drainage expose the people to diseases, most common of which are stomach-related. Frequent illness causes poor general health, high morbidity and low life expectancy.

- Despite these problems, our study suggests that there is excellent potential among the communities, especially the quality of human resources. The young and women population showed keen eagerness to acquire awareness and new skills which they could utilize to improve their life quality.

- Major vehicle for attaining these goals are: 'Awareness generation about low cost Water Technologies" and "Maintenance of Water

Sources for Ensuring Water and Food Security". These can be pursued through "participation of Local Groups and Local Governments in practicing IWRM".

Status of Water in peri-urban areas

Water and sanitation security in urban and peri-urban areas by Community Led Total Sanitation (CLTS) in urban slums of Kalyani

This programme was implemented by Kalyani Municipality in more than fifty slums in the urban/peri-urban areas around Kalyani town with the objective of eliminating the water, soil and environmental pollution caused by large-scale open defecation practiced by slum residents. We reviewed the results of this project. We found that whereas earlier efforts based on subsidies and loans to residents to construct toilets and avoid their polluting practice failed to achieve the desired results, the CLTS project based on awareness generation and community mobilization by participatory method succeeded in generating awareness and empowering the slum dwellers to make their colonies free from open defecation by taking initiatives to build simple low cost toilets on their own premises.
The uniqueness of the project earned it the **"National Water Award - 2009 by the President of India".**

The method used in the CLTS model discussed above can be used for generation of awareness for maintenance of water sources and promotion of water saving technologies to reduce water insecurity of the poor in such peri-urban communities.

VII. Summary of Conclusions

1. Eastern India is characterized by a contrasting combination of relatively high water resource endowment on the one hand and water scarcity in some areas and seasons. West Bengal is facing serious depletion of ground water reserves while Jharkhand is not using enough of ground water. Rainfall in most states is confined to only three to four months of the year while during the rest of the year the region suffers from water stress. Another problem is that large proportions of water used are wasted and little attention is paid to saving water resources. Technological and management interventions must be used in order to deal with this situation.
2. Our study makes a review of water saving technologies available and used in the region. It shows that technologies are available for harvesting, saving and management of water in the region. However, only a few of them are used in practice and that also not by all farmers. We have identified the technologies used and the extent of benefits accrued from their use. This leads to the question of why the other farmers are not using the technologies and how they can be made to overcome their resistance.
3. We have discussed this area of weakness in water resources policy by presenting two case studies of management practices in water saving used by farmers and urban water users.
4. The review shows that three aspects of water saving are perhaps more important than the availability of technologies. These are: (a) Creation of awareness of innovative technologies and maintenance of water sources, (b) Promotion of water saving sanitation technologies by users in urban and peri-urban areas, and (c) Creation of group ownership of water resources through participation of local groups and local governments.
5. Adoption of such practices is likely to help amelioration of water problem to a large extent. Adequate emphasis needs to be given in water policies in the region for wide application of these suggested management practices

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