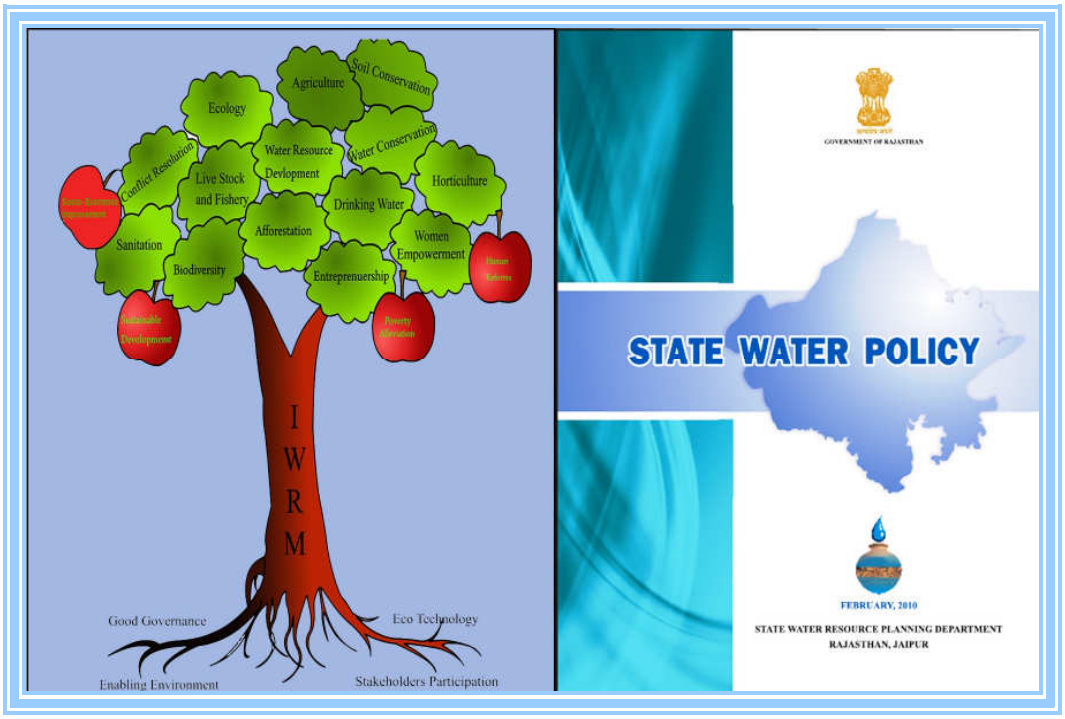
CAPACITY BUILDING MANUAL
ON
INTEGRATED WATER RESOURCES MANAGEMENT



Prepared by:

Jheel Sanrakshan Samiti

and

India Water Partnership

December, 2011

Capacity Development Manual on IWRM

Supported By : **India Water Partnership (GWP-India)**

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References : Various publications of the Government of India, Government of Rajasthan, WHO, GWP, CapNet, UNICEF, UNDP, UNEP, UNESCO, ADB, GWP, World Bank, FAO; and the Manuals developed by the authors for GLOWS.

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CAPACITY BUILDING ON IWRM

BASED ON

STATE WATER POLICY OF RAJASTHAN,

2010

…..This Training Manual is developed for capacity building of different stakeholders involved in effective implementation of New State water Policy (NWSP), which is based on IWRM approach. The manual is comprised of four modules. Module one explains the basic concepts and different components of IWRM. Module two describes various social and technical aspects of water resource development and management. Module three deals with potable water and safe sanitation aspects of IWRM. Module four is on livelihood generation, since poverty alleviation and socio-economic development of all sections of community is one of the major objectives of IWRM process. Each module is sub divided into related chapters. The IWRM Tree Model, developed by Mr. Anil Mehta is useful to understand the entire approach of IWRM. The use of manual will help build the capacity of different and diverse stakeholders in catalyzing the process of integrated management of water resources based on NSWP, and ensure equitable, inclusive sustainable development; ecological sustenance; poverty alleviation and re-evolution of water-reliant society…..

FOREWORD

The New State Water Policy (NSWP) of Rajasthan, approved on February 18, 2010 outlines the Government's development framework for long term & sustainable development; and management of water resources in the State of Rajasthan. In the NSWP, the State Government has first time admitted major role of people in management of water resources. As per the NSWP, Integrated Water Resource Management (IWRM) is likely to be the key to the success of NSWP. Hence, for creating an effective IWRM plan, it requires inputs and buy-in from all sectors that impact and impacted by water development and management; for example: agriculture, forest, health, sanitation, tourism, industry and environment.

In 2010, India Water Partnership (GWP-India) initiated a process to involve all stakeholders to review the NSWP keeping in view the role of Non-Governmental Organizations (NGOs) for effective implementation of NSWP in the State. Based on the desk review of NSWP and two workshops held in West Rajasthan and Sub-Humid Southern Plains & the Aravalli Hills, it was felt that there is strong need to define the clear cut role of NGOs and all other stakeholders in its implementation. Further, Concept and Principles of IWRM are to be disseminated effectively up-to the ground level. The NSWP lacks in recognizing the various agro-climatic, social and cultural diversity in the State that governs the water use and management practices. The NSWP also did not take seriously the

existing legal provisions of natural resource management. The study also recommended that the definition and understanding of IWRM is very context specific and needs to consider local realities as per the needs and requirements of the communities. While Water Plans tend to be driven principally by water issues, an IWRM approach looks at water in relation to other ingredients needed for larger development goals to achieve water challenges.

Realizing these challenges, Jheel Sanrakshan Samiti, Udaipur with the support of India Water Partnership organized capacity building programme on IWRM for NGOs, water user groups in 2011 wherein it was felt that a comprehensive manual for IWRM stakeholders covering broader aspects of IWRM in context of Rajasthan is important to orient the community. This manual not only covers IWRM strategy but also focuses on the other aspects which need to be taken into account while preparing IWRM Plans.

I hope that this manual would be helpful for water professionals to understand and to make the goals of IWRM an attainable ideal. This manual explains IWRM theory based on international perspective as well as provides understanding on how State specific issues of water in community in a social, environmental and economic context integrate IWRM.

Veena Khanduri,

Executive Secretary,
India Water Partnership

Acknowledgement

I express my humble gratitude towards India Water Partnership (GWP-India) for providing financial assistance to bring out this IWRM Capacity Building Manual. I am especially thankful to Professor S.R. Hashim, President, India Water Partnership (GWP India) and Dr. Veena Khanduri, Executive Secretary, India Water Partnership (GWP India), for their time to time guidance and support. I express my thanks for the strategic partnerships and material support provided by Dr Mohan Sinha Mehta Memorial Trust, ALERT Sansthan, Gandhi Manav Kalyan Samiti, Vidya Bhawan Society, Sewa Mandir, Wells for India, CASA, SPWD, Foundation for Ecological Security; and participation provided by the Water Resources Department, Government of Rajasthan, Public Health Engineering Department, Government of Rajasthan, Department of Forests, Government of Rajasthan and European Union State Water Partnership Programme(EU-SPP), in bringing out this Manual. The team of authors including *Dr. Tej Razdan, Dr. P.K. Singh, Dr. K.C. Malu, P.C. Bhatnagar, Dr. Hakimuddin, M.S. Rathore, Dr. V.K. Saini, A.S. Jodha, S.N. Bhise, Nand Kishor Sharma, Dr. L.L. Sharma, Dr. Deepak Sharma, Dr. Satish Sharma, Shailedra Tiwari, Jitendra Mehta, Madan Nagada, Mohan Dangi, Yash Sethia and Dr J C Dube deserve all appreciation for developing and compiling material for this Manual.* Various publications of the Government of India, Government of Rajasthan, WHO, GWP, Cap-Net, UNICEF, UNDP, UNEP, UNESCO, ADB, GWP, World Bank, FAO and many other national and international organizations; and the Manuals developed by the same authors for GLOWS, have been used in developing he manual. I acknowledge all these agencies.

Anil Mehta

Principal, Vidya Bhawan Polytechnic, Udaipur
Joint Secretary, Jheel Sanrakshan Samiti

CONTENTS

Process

1. Background

The new Rajasthan State Water Policy, which came into force on 18th February, 2010 has adopted Integrated Water Resource Management (IWRM) as guiding principle and umbrella approach for water resources development and management in the state. India Water Partnership, with the support of one of its zonal water partners, first organized two consultation meetings in Jaipur, Rajasthan in 2010 in order to review the new State Water Policy, keeping in view the role of Non Governmental Organization in its implementation. During these consultations, it emerged that though New Water Policy principally adopted IWRM approach, there is very little understanding of IWRM among the key stakeholders in the State. The recommendations of these two meetings suggested that capacity building of NGOs, PRI members and key stakeholders, working at ground level, is urgently needed. At the same time, dissemination of knowledge on IWRM to Water User Groups, Farmers, Village Community, Women Self Help Groups is necessary for better and effective implementation of the policy. In continuation of India Water Partnership efforts during 2010; and for building capacity of all key stakeholders, IWP with the support of its partner organization Jheel Sanskaran Samiti (JSS), Udaipur organized various activities for the capacity building of diverse stakeholder groups, including those who contributed in the review of new water policy and are being involved in implementation of IWRM and State Water Policy, 2010.

2. Objectives of the Project

The IWRM capacity development project was launched with the objectives to review and disseminate various key IWRM provisions of

Rajasthan State Water Policy,2010; creating awareness about IWRM and its implications in terms of new roles and responsibility of NGOs, Engineers, PRIs; build capacity and enhance understanding of various stakeholders, including Panchayat Raj Institutions, Non-Government Organizations , Engineering and Administrative Organisations and Women Self Help Groups, on IWRM and State Water Policy.

3. Approach & Methodology

In order to build capacity of different and diverse stakeholder groups on various components and aspects of IWRM, encapsulated in the State Water Policy, 2010, number of seminars, workshops and consultation meetings were held in the state of Rajasthan by the Jheel Sanrakshan Samiti(JSS). In all the programmes orgainsed, the NGOs/speakers / trainers / facilitators who are practitioners in respective water sector ; and involved in dissemination, development and implementation of IWRM strategies & plans were invited. The interactive sessions provided the opportunity to mutually learn and understand IWRM. The medium of instruction and interactions was mainly in Hindi as well as in local dialect. There was simultaneous focus on management tools and behavioral psychology aspects of IWRM in all activities and programmes. The mass media was involved in order to spread the message to millions.

4. Outcome of Workshop

Outcome of Workshop I

The outcomes of the earlier IWP supported project, implemented in the year 2010, were used to draw the approach and methodology of this capacity building project. The expertise and earlier experiences of JSS and its strategic partner organizations on IWRM formed the sound basis

for determining guiding principles and tools to achieve the project objectives.

4.1 Workshop I: Review of Status of IWRM & State Water Policy of Rajasthan

A one day Seminar-cum-Workshop on Status of Integrated Water Resource Management (IWRM) in the State of Rajasthan; and for effective implementation of New State Water Policy was organized on World Water Day i.e. 22nd March, 2011. This one day workshop was the continuation of India Water Partnership (IWP) efforts during year 2010 for promoting IWRM in the State of Rajasthan. In the second phase during 2011, IWP supported Jheel Sanrakshan Samiti, Udaipur to further work on strengthening the Water User Groups (WUGs), NGOs, PRI members, Engineers, Administrative officers, Women Self Help groups by building their capacity for proper and effective implementation of new State Water Policy and promoting IWRM. Towards this endeavor, the JSS organized the above Workshop-cum-Seminar along with its other strategic partner organizations, Dr. M. S. Mehta Memorial Trust and Vidya Bhawan Polytechnic College. Former Foreign Secretary, Government of India, Mr. Jagat S Mehta, Padam Bhushan Award Winner inaugurated the workshop.

The workshop was attended by fifty participants including representatives of the State Government, Experts and other Key Stakeholders. Dr R. C. Purohit, Dean, College of Technology and Engineering(CTAE), Mr. B.R. Khaturia, IWRM Nodal Officer of Water Resources Department, Government of Rajasthan, Mr. Maqbul Khan Pathan, Executive Engineer, Water Supply Department, Government of Rajasthan, Mr. G. P. Soni, Former Supdtt. Engineer, Water Resources, Department, Govt. of Rajasthan, Mr. O. P. Mathur, Former Director, Central Ground Water Board, Government of India, Dr. Satish Sharma, ACF, Department of Forests, Dr P K Singh, Associate Professor, CTAE, Mr. Jitendra Mehta, Director, ALERT, Mr. Madan Nagda, Director, Gandhi Manav Kalyan Samiti, Mr. A. S. Jodha , KVK Udaipur were the eminent experts who actively participated in the workshop. Mr. Jagat S. Mehta emphasized the need of synergic and continued efforts of government, civil society and PRIs for effective implementation of Rajasthan New Water Policy. He appealed to the Government that the proposed water regulatory authority shall have representation of the civil society. Mr. Anil Mehta explained the concept

दि.23 मार्च 2011 को राष्ट्रदूत में प्रकाशित

'जल स्वावलम्बी समृद्ध समाज के लिए मिलकर करेंगे कार्य'

दि. 23 मार्च 2011 दैनिक भास्कर से प्रकाशित

विश्व जल दिवस के मौके पर सेमिनार

सामुदायिक प्रयास से भूजल पुनर्भरण संभव

हर व्यक्ति बचाए जल

'आयड़ नदी सुधार' फिल्म का प्रदर्शन

दि. 23 मार्च 2011 राजस्थान पत्रिका से प्रकाशित

हर व्यक्ति बने जल प्रहरी

of IWRM tree. He said that in order to grow and strengthen the IWRM approach, four essential nutrients/inputs are required viz.

(1) Stakeholder Participation,

(2)Enabling Environment,

(3)Eco-technology and

(4) Good Governance.

Mr. Mehta conveyed the message of Prof. S.R. Hashim, President, IWP and Dr. Veena Khanduri, Executive Secretary, IWP who took the initiative to take up first review of State Water Policy of Rajasthan, status of IWRM in Rajasthan and effective implementation of the new water policy as a part of India Water Partnership Strategic Plan to focus on how IWRM can be translated effectively by empowering and capacity building of all stakeholders.

During seminar the participants formed separate groups and reviewed various provisions of the new State Water Policy and expressed gratitude towards the Rajasthan State government for including the IWRM as guiding approach for the water resource development in the state. It was unanimously agreed that to develop better understanding of IWRM in the context of Rajasthan, the foremost need is to bring together governmental and administrative authorities and all other key stakeholders at interactive platforms for effective planning of IWRM plans and strategies and subsequently, better implementation. It was recommended (a) To develop a simple, user friendly manual in Hindi language for effective and better understanding of IWRM

(b)To bring together Government Authorities and key stakeholders at one platform in order to improve planning and management practices through synergic efforts. The seminar concluded with the recommendation that to

get the State Water Policy implemented at grass root level, and eventually get reflected in all development plans, the capacity building of all stakeholders is a pre- requisite. The participants unanimously recommended that JSS and IWP should organize capacity development workshops for different stakeholder groups in three months.

The expert participants developed material in the form of draft chapters for the proposed IWRM Manual. The chapters were developed with the focus on the IWRM tree model; and suggestions & recommendations of the workshop I.

4.2 Workshop II: Capacity Building on IWRM

In continuation of GWP/IWP project of Capacity Development of different stakeholders, a workshop was organized on 22nd April,2011 at Udaipur by the Jheel Sanrakshan Samiti(JSS) and it's strategic partners- Vidya Bhawan Polytechnic and Dr. Mohan Sinha Mehta Memorial Trust. The workshop was attended by nearly 200 participants representing NGOs, Water User Associations, PRIs and Farmers. The officials of European Union- Rajasthan State Partnership Programme(EU-SPP) and Water Resources Department, Government of Rajasthan actively participated in the Workshop. The schedule of the workshop was divided into seven sessions viz.

(i) Inaugural Session

(ii) Technologies of Watershed Management and Water Resources Development

(iii) Panchayat Raj System & IWRM

(iv) Inclusive & Paricipatory Development, Water Ethics of Rajasthan, Mechanisms for Conflict Management & Resolution

(v) Livelihood Issues

(vi) IWRM & Ecological Concerns

(vii) Valedictory Session.

All sessions were highly interactive, conducted by the panel of expert who authored different chapters of the IWRM Capacity Building Manual. The workshop was inaugurated jointly by Ms. Neelima Khetan(Former CEO, Sewa Mandir),Mr. Riaz Tehsin(President, Vidya Bhawan),Prof. Jagat S. Mehta(Former Foreign Secretary, Government of India & President, JSS) and Mr. J. M. Roussel (Team Leader – EU SPP). Ms. Khetan explained various provisions of the State Water Policy in the context of IWRM and appealed for effective strategies and partnerships for successful implementation of IWRM. Mr. Anil Mehta gave his interactive presentation on "Understanding IWRM"; and elaborated GWP/IWP activities in the field of IWRM capacity building. Mr. Tehsin shared the achievements of Vidya Bhawan in the field of capacity building of PRI elected representatives on governance and natural resources management.

Mr. J M Roussel and Ms. Julie Ladel (IWRM expert EU-SSP) discussed

the strategies for effective implementation of IWRM in the state of Rajasthan and thanked JSS/GWP/IWP for their initiatives and sustained efforts. Ms. Magalie Vuillet(Junior IWRM expert- EU SPP) appreciated the presence of women participants in the workshop. In second session, Dr. P K Singh(Associate Professor, College of Technology and Engineering, Udaipur) demonstrated various technologies of watershed management and water resourses development, Mr. Jitendra Mehta (Founder Director, ALERT) explained the rotational distribution system of irrigation water management.

The third session was on “Panchyat Raj System & IWRM”. In this session Mr. Hemraj Bhati(Deputy Director, Vidya Bhawan School of Local Self Government & Responsible Citizenship),Mr. Madan Nagada(Founder Director, Gandhi Manav Kalyan Samiti),Mr. Mohan Dangi (Director, Prayatna Samiti) and Rajkaran Yada (President, Hanuman Vikas Samiti) interacted with the participants on list of subjects transferred to the PRIs in Rajasthan and explained the role of Gram Sabha(Village Assembly) and Gram Panchayat(Village Council) in constructing IWRM plans based on river basin and watershed approaches.

During fourth session, the participants interacted on inclusive & participatory development;water ethics of Rajasthan; conflict management and resolution. The learned panel included Mr. Mahendra Mehta(Former Water Commissioner, Government of India), Mr. O. P.

Sharma(Director,Wells for India), Dr. J. C. Dube (Eminent Hydrogeologist, Member,JSS) and Dinesh Sharma(Director, CASA,Udaipur). Mr. Mahendra Mehta discussed the traditional wisdom on water management while Mr. Dube presented the SWOT analysis of community managed water management project funded by Swiss Agency for Development Cooperation's (SDC) Global Environment Facility Fund and facilitated by a multi-stakeholder group, consisting of National and International Consortiums. Mr. Dinesh Vyas discussed on conflict resolution mechanism vis-a-vis concept of IWRM.

The fifth session was on livelihood issues. The participants shared and discussed various means and oppourtunities of livlihood enhancement in the ambit of IWRM approach. Mr. Shailendra Tiwari(Programme Officer, NRM, Sewa Mandir) , Mr. A. S. Jodha,Mr Praful Bhatnagar, Dr. V. S. Saini, Mr. Moti Singh Rathor(All Scientists at KVK , Vidya Bhawan) guided the participants on Scientific Agriculture, Horticulture, Animal Husbandry, Poultry, Fisheries etc.

In the sixth session, the participants shared their understanding and experiences on the subject "IWRM & Ecological Concerns". The panel included Dr. Satish Sharma (Forest Officer, Government of Rajasthan) , Dr. Jagdish Purohit (SPWD) and Mr. Yash Shethia(Unit Head, Foundation for Ecological Security). Mr. Yash and Dr. Purohit, while elaborating on IWRM, guided the participants on various methods and techniques of biodiversity conservation and management.

The valedictory session was graced jointly by Ms Priyanka Singh(CEO Sewa Mandir), Mr. V. S. Mehta(President, Dr. M. S. Mehta Trust) and Mr. J. M. Roussel(Team leader, EU-SPP).Ms. Priyanka expressed the need of synergic efforts and collaborations for the successful implementation of IWRM. Mr. Roussel expresssed EU-SPP's willingness to partner in capacity development programmes of JSS & GWP (IWP). The workshop was convened by Mr Anil Mehta and Mr Nand Kishor Sharma. A 125 page comprehensive user friendly, "IWRM Capacity Development Manual" jointly edited by Mr. Anil Mehta and Dr. Veena Khanduri, and authored by many prominent experts, was given to every paricipant at the time of registration. The participants extensively discussed various chapters of the manual in different related session. Mr. Mehta practically demonstrated the Pot Method of disinfection of open wells and water tanks.

Outcome of Workshop II

The capacity building workshop paved the way for adoption of a strong IWRM and effective implementation of new Rajasthan Water Policy in the State. It was first time in the state of Rajasthan that all key stakeholders came on common platform and shared, discussed and learnt how to implement IWRM approach right from the bottom grass root level to top policy planning level. The authors of different chapters of the IWRM Manual personally interacted with the diverse groups of the stakeholders. The material developed by the JSS/IWP was highly

appreciated by the EU- SPP team and is helping them further in developing strategy for effective implementation of IWRM State Water Partnership Programme. The Chief Minister of Rajasthan office considered the event worth and forwarded the workshop proceeding to the Water Resource Department for necessary action.

4.3. Workshop III: IWRM and Drainage Planning

'तब सुधरेगा ड्रेनेज सिस्टम'

On 24th June 2011, a workshop cum consultation meeting was organized for senior engineers of Water Resources Department, Urban local bodies and other agencies. The prominent participants were Additional Chief Engineer of Water Resources Department (WRD), Mr. A. B. Mathur, Superintending Engineer ,WRD, Mr. D.L. Dangi, Executive Engineer, Urban Improvement Trust ,Mr Anil Nepalia, Executive Engineer , Municipal Council ,Mr. Rajiv Garg, Prominent engineers from Institution of Engineers(india) , Mr. G. P. Soni, Mr B. L. Mantri, Mr. S. L. Godawat Mr. Anil Mehta explained the IWRM approach and Tree model. The participating engineers discussed in detail how to address drainage aspect while developing IWRM plans. Dr. Kapil Gupta, Professor at IIT

Mumbai and Member on National Committee on Disaster Management, and Convener (drafting committee) of revised drainage manual of Government of India, delivered his expert lecture on "Urban Drainage in the context of IWRM".

Outcome of Workshop III

The participating engineers agreed that IWRM is not just limited to the water resource development and irrigation water distribution. They arrived on the understanding that IWRM is about coordinated development and management of water, land, forest, livestock and human resources. They also understood the principles of sustainable development, good governance and conflict management. The river basin approach was explained in detail and based on the basin approach, urban drainage principles and techniques were discussed. The participants expressed that the workshop would help them in developing IWRM plans.

4.4. Workshop IV : IWRM and Eco- Techniques

On 27th July 2011, an interactive seminar cum workshop was held on behalf of IWP with members of Yamuna Pollution Control Unit (YPCU) and re-presentatives of NGOs working on Yamuna. Mr. Anil Mehta gave presentation on river basin management approach and explained eco-remediation techniques to treat and improve polluted river basins. It was agreed that in order to work on

integrated lake basin management approach and IWRM, the active and dynamic participation of civil society and citizen groups is the first and foremost requirement. JSS has installed an unique treatment project in Ahar river of Udaipur based on the approach of ILBM ,which is further extension and sub set of IWRM approach. The representatives of Rajasthan Chamber of Commerce and Industry and Udaipur Chamber of Commerce and Industry also participated in the programme.

आयड़ नदी सुधार पहल यमुना तक पहुंची

आयड़ नदी की ग्रीन ब्रिज तकनीक का यमुना नदी में भी होगा प्रयोग

प्रात:काल

नदियां प्रदूषण मुक्त हो तो पर्यावरण सुधरे

आयड़ नदी सुधार योजना का अवलोकन

4.5. Workshop V - Workshop on Water and Health

A seminar cum workshop on IWRM (focusing human health hazards) was organized on 1st September, 2011 at Udaipur, Rajasthan. In the workshop, Mr. Anil Mehta, Joint Secretary, JSS invited the Doctors, especially the lady nurses to generate mass awareness among the people regarding water borne diseases. Mr. Mehta further said that by providing safe drinking water and community toilets, water borne diseases can be minimized by 50 %. He also said that personal hygiene and community hygiene is important for avoiding human health hazards. The participants were shown the demonstrations on proper hand washing and solar disinfection.

जलजनित रोगों को पनपने से रोके

'दूषित पानी से महिलाओं का स्वास्थ्य सर्वाधिक प्रभावित'

समग्र जल संसाधन प्रबंधन पर कार्यशाला

Outcome of Workshop IV and V

These two activities were in continuation of capacity building of different stakeholder groups on various aspects of IWRM. The main focus was on basin approach, eco-technology and sanitation. The participants are forwarding the education and information gathered in the respective workshops**.**

4.6. Workshop VI - IWRM Capacity Building Workshop for Women Self Help Groups

A workshop for Women Self Help Groups on Integrated Water Resource Management (IWRM) was conducted on 10th Oct 2011 by Jheel Sanrakshan Samiti, Vidya Bhawan Polytechnic and Dr. Mohan Sinha Mehta Memorial Trust under the banner of Global Water Partnership and India Water Partnership. The workshop held at Vidya Bhawan Polytechnic College was attended by Self Help Women Group of 21 towns and villages situated in the basins of Wakal and Banas rivers ; and representatives of Anganwadis of Southern Rajasthan. Many prominent personalities, who dedicated their life in preserving and managing water resources, were present in the workshop and shared their suggestions on the subject. The participants raised the point that though the State Water Policy underlined the participation and involvement of women in all policies and plans including management and operation, right from small village hamlet to

the cities, the role of women in water resources management is very meager. Mr. Anil Mehta emphasized that the management of various water related crisis, including growing poverty, need involvement of women in all aspects of water usage and management. Mehta said that role of women should be recognized in planning, construction, management and safeguarding of water resources. The Dublin principle also underlines the importance of women in integrated management of water resources. The women play a key role in the collection and safeguarding of water for domestic use and agricultural use. The burden of water collection falls on women and girls, who generally expend considerable time and energy on this activity.

Mehta shared that the marginalized role of women in water resources management is related to social, educational and cultural traditions. Therefore, there is an urgent need to give attention to the specific needs of women and evolve strategies to empower them so that they become able to play effective, competent, sustained and dynamic role at all levels of water resources management.

The President of M. S. Mehta Memorial Trust, Mr. Vijay S. Mehta said that it is necessary that society provides equal opportunity of development to women, seek their suggestions and treat them at par with men. To attain the goal of integrated and inclusive development the women need to have equal access and participation at all levels. He emphasized that health and education of women are the key factors to enhance and ensure their dynamic participation in all IWRM processes and plans.

Mr. Nand Kishor Sharma, Social Scientist, said that the effective, efficient and equitable management of water resources is only achieved when both women and men are involved in consultation processes; and in the management and implementation of water-related services.

The women present in the workshop agreed to increase their role and participation in the implementation of State Water Policy and projects held in the region. The women representatives of Self Help Group said that one of the major causes of their low interest is lack of education and awareness. Ms. Parvati Bai of village Ogana, Ms. Kalibai of village Kotadi, Ms. Shanti Devi of village Pipawas said that Women's convenience, in terms of time and distance, should be first criterion while deciding the time and place for Gram Sabha and WUA Meetings. The participant women further revels that out of them only 8 % women have so far attended the meetings of Gram Sabha. In the meetings of SHG, no fruitful discussions are held. The hand-pump and other water supply schemes are sanctioned near places of influential persons only. The women have to bring water on head from 2 to 3 kilometer distances. The WUAs meant for distribution of irrigation water functions arbitrarily and there is no voice of women in those meetings. We, the women members of the community, are most susceptible to water borne diseases due to our role in water collection, washing and other domestic activities. We have

to travel long distances to fetch water and carry it on our heads, which leads to diseases related to spine, neck, shoulders etc.

'जल प्रबन्धन महिलाओं की सहभागिता के बिना असम्भव'

जल प्रबंधन में महिलाओं की भूमिका अहम

उदयपुर में सोमवार को आयोजित जल संसाधन प्रबंधन कार्यशाला में भाग लेते प्रतिनिधि।

The participant women further shared that if any member of the family suffers from any water borne disease, then the responsibility to take care of the diseased member falls on them .Women and girls feel unsafe when they have to go far from their houses to defecate since no nearby toilet facilities are available. Women and girls suffer from problems like malnutrition, illiteracy and anemia.

Mr. Madan Nagda, Secretary of Gandhi Manav Kalyan Samiti; Dr. Tej Razdan of JSS, Dr. L.L. Sharma, Limnologist, Member of JSS; Jitendra Mehta, Director of Alert Organization; Mr. Mohan Dangi, Secretary of Prayatn Samiti; Ms. Haribala Sharma of Vidya Bhawan Angan Badi and Ms. Jyotsna Jhala of Pahal guided the participants on various aspects of integrated water resources management mainly on Warabandi, Irrigation Water management, Prevention of Water Borne Diseases, Role of Panchayati Raj Institutions, Livelihood Generation, Conflict Management etc.

Outcome of Workshop VI

(1) Village women got the chance to articulate their problems and suggestions.

(2) The leaders of women SHGs understood the need and importance of participation of women in village councils in general and in WUA in particular.

(3) The participating women were given orientation on personal and community hygiene, nutrition, rotational distribution of water, women literacy etc.

5. Results and Discussion

The project has achieved the targets far more than conceived while formulating the project. The participation of diverse stakeholder groups in large number in all activities conducted is indicator of success. The project has also lead to synergic networking of different stakeholders involved in IWRM process. The material developed during the project is being used and practiced by various agencies including European Union. The project has given great recognition to GWP- India efforts in implementing IWRM in the state of Rajasthan for sustainable water resource development and socio-economic up-lift of all sections of the society.

The mass media coverage spread the GWP/IWP/JSS initiative and efforts to millions of the people across the state of Rajasthan.

The efforts and action need to be continued in future also as IWRM is not fix set of rules and methods. We need to consistently work on this and continue to improve our manuals and capacity building methods and tools. This manual based on various workshops, consultations would certainly help all stakeholders to understand IWRM and translate IWRM approach in action.

Module 1

Basics of IWRM

1. Understanding IWRM
2. Water and Women
3. Policies and Legislative Framework
4. Good Governance & Conflict Management
5. Biodiversity Conservation

1

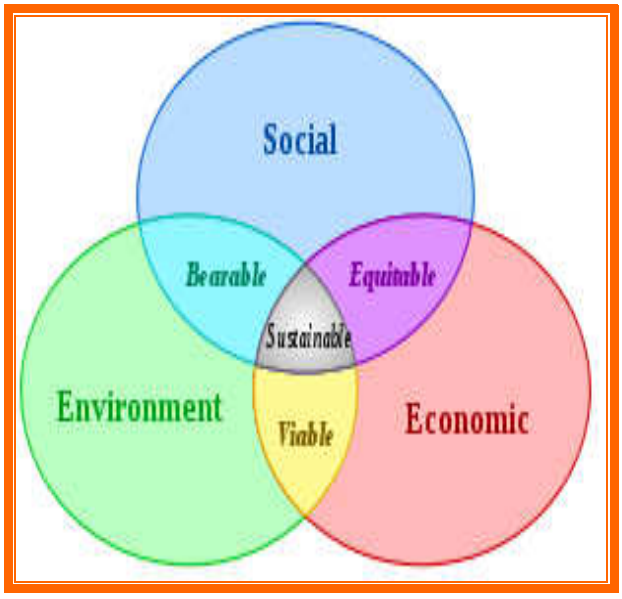
Understanding IWRM

1. What is IWRM

An IWRM approach promotes the coordinated development and management of water, land, and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. This includes more coordinated development and management of land and water, surface water and groundwater, the river basin and its adjacent environment, upstream and downstream interests. IWRM is also about reforming human systems to enable people to benefit from those resources.

1.1. What is Sustainable Development?

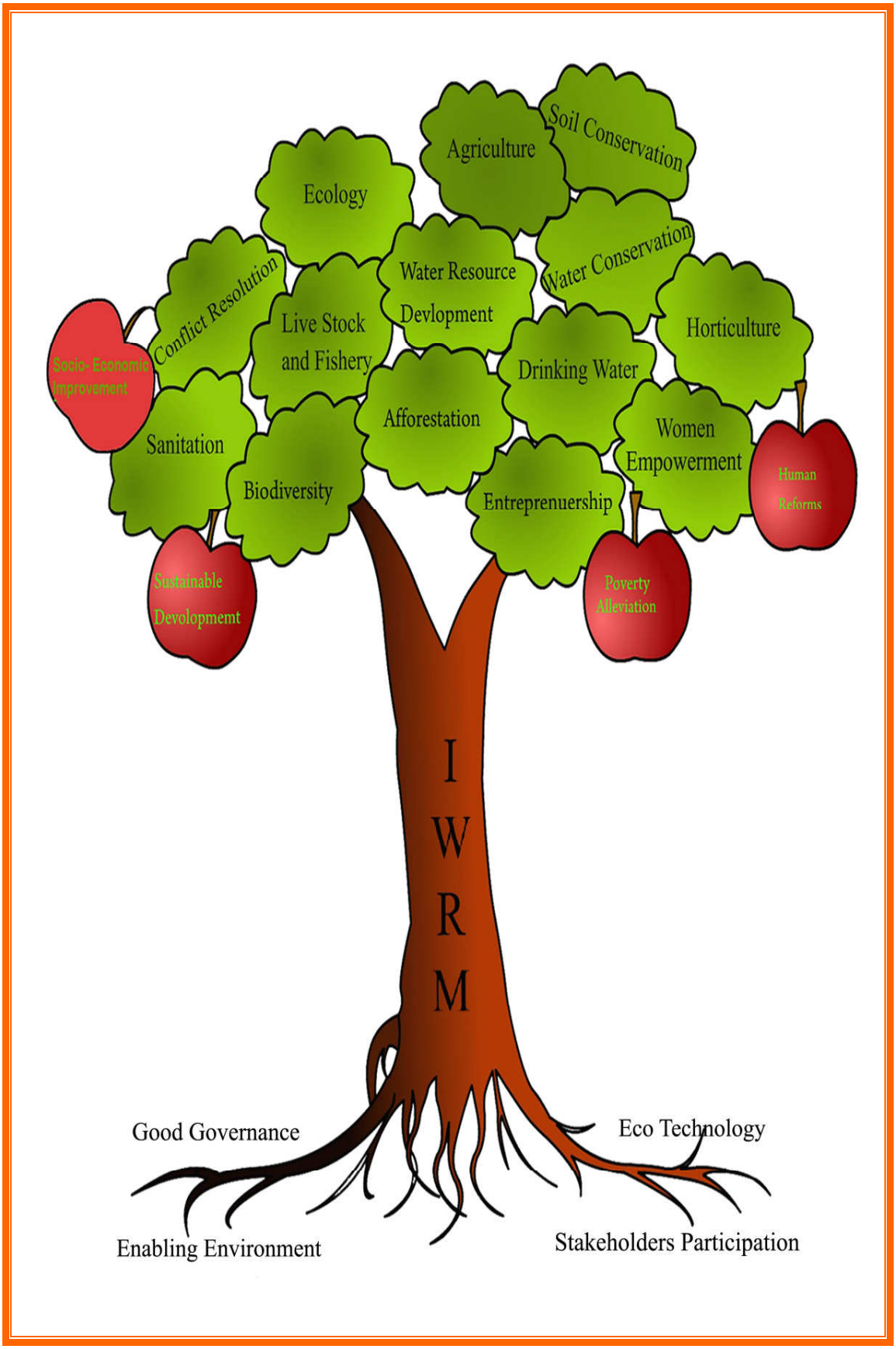
The sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.



Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment.

1. 2. Basics of IWRM: Dublin Principles

There are no fix set of IWRM "rules". The approach is founded on the Dublin Principles, which assert that:



Anil Mehta IWRM Tree Model

(i) Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment - Since water sustains life; effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchments area or groundwater aquifer.

(ii) Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels - The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

(iii) Women play a central part in the provision, management and safeguarding of water - This pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programs, including decision-making and implementation, in ways defined by them.

(iv) Water has an economic value in all its competing uses and should be recognized as an economic good - Within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognize the economic value of water has led to wasteful and environmentally

damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

2. SWP 2010 and IWRM

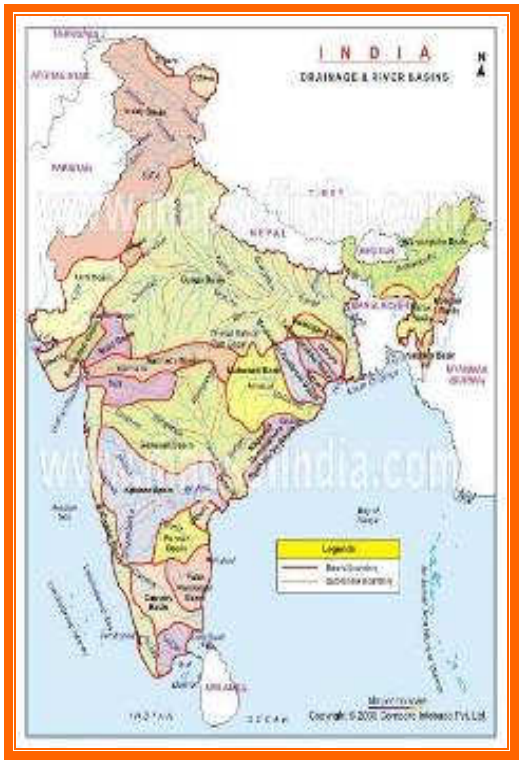
The IWRM approach, which ensures effective, long lasting solutions to water problems, requires positive changes in the enabling environment, in institutional roles, and in management instruments.

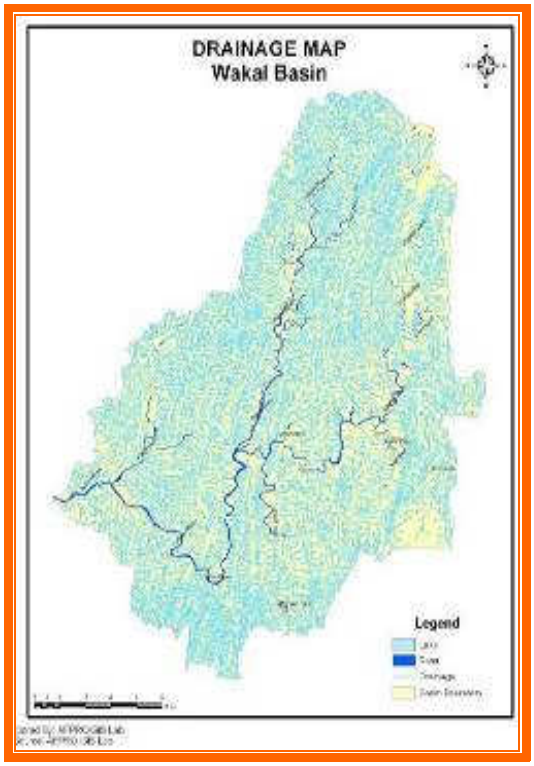
In proper enabling environment, the rights and assets of all stakeholders are safeguarded and environment is protected. The Rajasthan State Water Policy 2010 enable all stakeholders to play their respective roles in the development and management of water resources of the state. The policy also underlines that In order to achieve efficient, equitable and sustainable water management within the IWRM approach, major institutional changes are needed in the state. The policy promotes, both top-down and bottom-up, participation of all stakeholders from state level to the catchments or watershed level. Further, the decision making would be governed by the principle of subsidiary, which drives down action to the lowest appropriate level i.e. Ward Sabha and Gram Sabha.

The policy also ensures effective participation of private sector, NGOs, community-based organizations, women, disadvantaged groups, and all sections of civil society in the management and conservation of water resources. Therefore, there is a need to build the capacity of all stakeholders, in order to enhance easy and equitable access to water to all; and bring a balance between ecological conservation and sustenance; and treating water as a social, cultural and economic good (beyond basic needs).

3. What is River Basin?

The SWP 2010 talks about river basin approach. Let us understand the meaning of river basin. It is that piece of land from where the rain water flows to join a main river through different big and small rivulets and streams.





There may be several villages, towns, wells, ponds and lakes in a river basin area. One river basin can be divided into several big and small sub basins. These sub basins can also be termed as watersheds.

3.1. River Basin Organizations

There is great need to create basin level organizations with well-defined functions and adequate technical and financial resources. The functions of River Basin Organizations (RBO) range from water allocation, resource management and planning; to education of basin communities; to developing natural resources management strategies and programs of remediation of degraded lands. They may also play a role in consensus building, facilitation, and conflict management.

RBOs should be formed by restructuring field offices of the water-related departments, especially irrigation, ground water, soil and water conservation, agriculture and PHE departments. An advisory committee composed of the representatives of the political leadership, PRIs, local self government bodies, experts and NGOs should be constituted to guide RBOs. Proper representation of women, SC and ST members and other disadvantaged groups must be ensured in the RBOs. River basin organizations will ensure integrated management across sectoral and administrative lines. River basin or catchment agencies will also serve as linking mechanisms between state level plan and decision making at Gram Sabha level.

3.2. Key characteristics of effective river basin management organizations

(1) An ability to establish trusted technical competencies.
(2) A focus on serious recurrent problems such as flooding or drought or supply shortages, and the provision of solutions acceptable to all stakeholders.
(3) Broad stakeholder involvement, catering for grassroots participation at a basin wide level (e.g. through water forums).
(4) The capacity to collect fees, and attract grants and/or loans.
(5) Clear jurisdictional boundaries and appropriate powers.
(6) Encouraging meaningful participation.

3.3. What is Meaningful Participation?

For ensuring an effective, active and meaningful participation of stakeholders, communication & mutual dialogue are must. Communication activities help all stakeholder groups to construct a realistic picture of water resource use and arrangement, keep them up-to-

date on strategy preparation and understand how they can contribute and how their contributions will be used. Communication among stakeholders must be two-way and be "bottom up" as well as "top down." The process for that is to develop a "participatory platform" entailing a wide range of forums, informal meetings, workshops, consultation processes, public meetings, focus group interviews, policy dialogues, round tables, and media events can help different groups meaningfully contributes to the development process. At all levels, active participation of women should be ensured.

3.4. Core Stakeholders to be Included

(a) Government Ministries and related organizations/departments involved in development planning and policy making, domestic water supply and sanitation, irrigation, agriculture, energy, health, industry, transport, fisheries and tourism.

(b) Local communities and community based organizations (Sarpanchs, Pradhan, religious leaders etc).

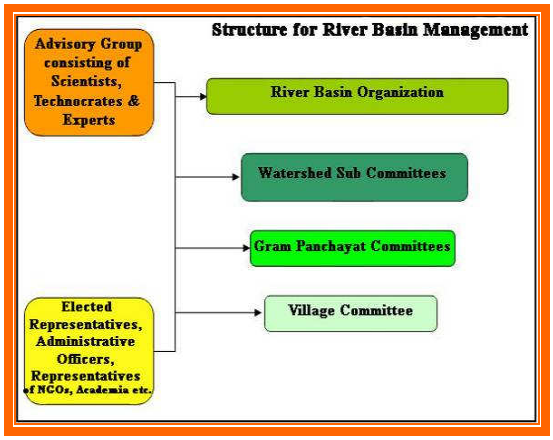
(c) The private sector, including but not limited to water supply and sanitation service providers.

(d) Financial agencies (e.g. donor agencies, international banks, micro credit institutions).

(e) Sectoral interest groups such as farmers and fishermen.

(f) Women's groups and associations.

(g) Representatives of indigenous communities.



(h) Non-governmental organizations.Media representatives.

(i) Research and training institutions, including Universities.

2

Water and Women

1. Why Participation of Women Essential in Water Resources Management?

The effective, efficient and equitable management of water resources can only be achieved when both women and men are involved in consultation processes, and in the management and implementation of water-related services. Striking a gender balance ensures that the roles and responsibilities of women and men are mobilized to best effect. The creativity, energy and knowledge of both sexes contribute to making water schemes and eco-systems work better.

2. Water and Women Relationship

The women play a key role in the collection and safeguarding of water for domestic use and agricultural use. The burden of water collection falls on women and girls, who generally expend considerable time and energy on this activity. Women and girls are the most susceptible to water borne diseases due to their role in water collection, washing and other domestic activities. Women have to travel long distances to fetch water and carry it on their heads, which lead to diseases related to spine, neck, shoulders etc. If any member of the family suffers from any water borne disease, then responsibility to take care of the diseases member falls on women .Women and girls feel unsafe when they have to go far from their houses to defecate, as toilet facilities are not available nearby. Women and girls suffer from problems like malnutrition illiteracy and anemia.

Despite these, women are less instrumental than men in management, problem analysis and the decision making processes related to water

resources. The marginalized role of women in water resources management is related to social, educational and cultural traditions. Therefore, there is an urgent need to give attention to the specific needs of women and evolve strategies to empower them so as to play effective, competent, sustained, dynamic role at all levels of water resources management.

It is necessary that society provides equal opportunity of development to women, seek their suggestions and treat them at par with man. To attain the goal of integrated and inclusive development, both man and woman should have equal access and participation at all levels, and should be equally benefited.

2.1. How to Enhance the Effective Participation of Women?

- ✓ Formal education up to standard XII should be made compulsory for girls and to ensure this, necessary facilities are developed.
- ✓ The medical facilities should be approachable, and attention should be given on health and nutrition conditions of girls and women.
- ✓ Home based self employment schemes should be formulated for women. This will help in economic empowerment of women.
- ✓ Women's convenience, in terms of time and distance, should be first criterion while deciding the time and place for committee meetings.
- ✓ Women's capabilities should be increased through formal and informal trainings, workshops etc.

3

Policies and Legislative Framework

1. New State Water Policy, 2010

SWP 2010 provides the IWRM framework within which the state water resources are to be managed, developed and conserved. The New State Water Policy of Rajasthan is framed on the lines of National Water Policy with the state perspective of community based management. The policy has provisions for an integrated and multi disciplinary approach to planning, evaluation, approval and implementation of irrigation, drainage, water supply projects; river basin management; management of surface and ground water etc. The policy emphasizes stakeholder's participation in all aspects of water planning and management.

2. Other Associated Policies

2.1. National Water Policy (NWP 2002)

It contains provisions for developing, conserving, sustainable utilizing, governing and managing important water resources with national perspectives. The NWP recognize the need of IWRM in the preamble of the policy itself.

Protection of Environment: Provisions in Indian Constitution

- Article 48A enjoins the state to protect and improve the environment and safeguard the forests and wildlife in the country.
- Article 51A (g) states that it is the fundamental duty of every citizen is to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures.

2.2. National Environment Policy, 2004

The National Environment Policy addresses the issue of water in detail. The policy recognizes water as invaluable natural resource and gives various action plans for integrated management water. The policy states that the state is not an absolute owner, but merely a trustee of all natural resources, which are by nature meant for public use and enjoyment, subject to reasonable conditions.

2.3. National Women Policy

The advancement, development and empowerment of women are of highest importance in achieving the IWRM. The National women policy specifically addresses the issue of women's health and empowerment in the context of water. The policy while recognizing the role and importance of women ensure their effective participation in all water related development activities.

2.4. National Forest Policy, 1988

This policy is aimed towards maintenance of environmental stability through preservation and restoration of the ecological balance and conserving the natural heritage of the country by preserving the remaining natural forests and checking soil erosion and denudation in the catchments areas of rivers, lakes and reservoirs.

2.5. The National Tribal Policy

Government of India has drafted a national tribal policy aimed at providing an enabling framework for the tribal people to progress, develop while retaining the best elements of their tradition, cultural life and ethos. The policy states that for tribal, access to health care services, safe drinking water and improved sanitation will be ensured. The Government will endeavor to improve health, drinking water supply,

hygiene and sanitation by Improving overall awareness about health, hygiene and improved sanitation among tribal community and empowering them to plan, implement, operate and maintain their own water supply and sanitation systems, encourage rainwater harvesting and development of gravity-based small water supply systems, which are easy to operate and maintain by the local tribal community at low O&M cost for assured availability of safe drinking water throughout the year in all tribal habitations.

3. Legislative Framework: National Laws and Acts

3.1. The Inter State Water Dispute Act 1956

This is an act provided for the adjudication of disputes relating to waters of inter-State rivers (like Sabarmati) and river valleys.

3.2. The River Boards Act 1956

This is an act provided for the establishment of river boards for regulation of inters state rivers and river valleys. As per this act, the central Government can take under its control the development and regulation of inter state rivers.

3.3. Environment Related Provisions of Indian Penal Code

Provisions relating to offences related to the environment and affecting the public health, safety, convenience, decency and morals (public nuisance) contemplated in the Indian Penal Code (IPC). The provisions of Sections 120A and 120B IPC are also relevant in the context of water. The other important offences are : fouling water of public spring or reservoir (Sec. 277), making atmosphere noxious to health (Sec. 278), acts endangering life or personal safety of others (Sec. 336 to 338), mischief by injury to works of irrigation or by wrongly diverting water (Sec. 430), mischief by injury to public road, bridge, river or channel

(Sec. 431), mischief by causing inundation or obstruction with the public drainage, attended with damage (Sec. 432), The code of criminal procedure dealing with maintenance of public order and tranquility has relevance to the subject of environment by virtue of section 10(4) of the present environment act.

3.4. Environment (Protection) Act, 1986

Environment (Protection) Act, 1986 has a broad coverage in which 'Environment' includes water, air and land and there exists an interrelationship among water, air, land, human beings and other creatures. It empowers to take measures in protecting and improving the quality of the environment through preventing, controlling and abating environmental pollution.

3.5. The Water (Prevention and Control of Pollution) Act, 1974

The Water (Prevention and Control of Pollution) Act, 1974 is an act to provide for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water.

3.6. Water Cess Act, 1977

This Act empowers the Central Government to impose a cess on water abstracted from natural resources by industries and local authorities.

3.7. The Forest (Conservation) Act, 1980 and Rules 2003

The National Forest Policy pays significant concern on protection and preservation of water bodies. The forest (conservation) act, 1980 and rules 2003 are enacted with the purpose of the conservation of forests and for matters connected therewith or ancillary or incidental thereto.

3.8. The Biological Diversity Act, 2002 and Rules 2004

Water is of prime importance for sustenance of biological diversity. This is an act to provide for conservation of biological diversity, sustainable use of its components and fair and equitable sharing of the benefits arising out of the use of biological resources.

3.9. The Scheduled Tribes (Recognition of Forest Rights) Act, 2006

This is an Act to recognize and vest the forest rights and occupation in forest land in forest dwelling scheduled tribes who have been residing in such forests for generations but whose rights could not be recorded and to provide for a framework for recording the forest rights so vested (See Annexure-2).

3.10. Right to Information Act

It comes into force on the 12th October, 2005. As per this act information means any material in any form including records, documents, memos, e-mails, opinions, advices, press releases, circulars, orders, logbooks, contracts, reports, papers, samples, models, data material etc. It includes the right to inspect works, documents, and records; take notes, extracts or certified copies of documents or records; take certified samples of material. Any person can take information from any department through application and by depositing fees of Rs. 10. No fees will be charged from people living below the poverty line. The concerning Information officer has to provide the information within 30 days from the date of application.

3.11. Panchayat Raj Act 1994

This act leads towards village governance and establish the bottom up approach. There is three tier systems for village development and governance. The institutions established under this act are Panchayat,

Panchayat Samiti, and Zila Parishad.

3.12. National Wetland Conservation and Management Act 2010

This act is drafted for the conservation and management of wetlands(lakes, ponds, reservoirs etc)

4. Legislative Framework: State Laws and Acts

4.1. Rajasthan Irrigation and Drainage Act, 1954 and Rules

The act provides the detailed provisions for regulating and controlling the irrigation and drainage activities other then minor irrigation activities.

4.2. The Rajasthan Minor Irrigation Works Act, 1953 and Rules 1956

This is an act to provide for the construction, improvement and maintenance of minor irrigation works in the state of Rajasthan. The rules are applicable to the minor irrigation works like construction of small Bunds and Nadas; construction and improvement of water-courses, whether defined artificial channels or natural channel; Construction of masonry wells; conversion of Kham wells into masonry wells; construction of Kham wells; Improvement of masonry wells which are out of use and the lands where under have been classed as Barani during the current settlement; and boring of wells.

4.3. The Rajasthan Soil and Water Conservation Act, 1964

This is an Act to provide for the conservation and improvement of soil and water resources in the State of Rajasthan.

4.4. Farmers Participation in Management of Irrigation Systems Act, 2000

The objects of the Farmers' Organization shall be to promote and secure distribution of water among its users, adequate maintenance of the

irrigation system, efficient and economical utilization of water to optimize agricultural production, to protect the environment, and to ensure ecological balance by involving the farmers, including a sense of ownership of the irrigation system in accordance with the water budget and the operational plan.

(I) Functions of the Water Users' Association

The Water Users' Association shall perform the following functions, namely:

(a) to prepare and implement a warabandi schedule for each irrigation season, consistent with the operational plan, based upon the entitlement, area, soil and cropping pattern;

(b) to prepare a plan for the maintenance, extension, improvements, renovation and modernization of irrigation system in the area of its operation and carry out such works of both distributary system and field drains in its area of operation with the funds of the association from time to time;

(c) to regulate the use of water among the various outlets under its area of operation according to the warabandi schedule of the system;

(d) to promote economy in the use of water allocated ;

(e) to prepare demand and collect water charges;

(f) to maintain a register of land owners as published by the revenue department;

(g) to prepare and maintain an inventory of the irrigation system within the area of operation;

(h) to monitor flow of water for irrigation;

(i) to resolve the disputes, if any, between its Members and water users in its area of operation;

(j) to raise resources;

(k) to maintain accounts;

(l) to cause annual audit of its accounts;

(m) to assist in the conduct of elections to the Managing Committee;

(n) to maintain such other records, as may be prescribed;

(o) to abide by the decisions of the Distributary and Project Committee;

(p)to conduct General Body meeting in the manner, as may be prescribed;

(q) to encourage avenue plantation on canal bonds and tank bonds by leasing such bonds, and

(r) to conduct regular water budgeting and also to conduct periodical social audit in the manner, as may be prescribed.

(II) Functions of the Distributary Committee

The Distributary Committee shall perform the following functions, namely:

(a) to prepare an operational plan based on its entitlement area, soil, cropping pattern at the beginning of each irrigation season, consistent with the operational plan prepared by the Project Committee;

(b) to prepare a plan for the extension, improvements, renovation, modernization and annual maintenance of both distributaries and medium drains within its area of operation;

(c) to regulate the use of water among the various Water Users' Associations under its area of operation;

(d) to resolve disputes, if any, between the Water Users' Associations in its area of operation;

(e) to maintain a register of Water Users' Associations in its area of operation;

(f) to maintain an inventory of the irrigation system in the area of its operation, including drains;

(g) to promote economy in the use of water allocated;

(h) to maintain accounts;

(i) to cause annual audit;

(j) to maintain such other records, as may be prescribed;

(k) to monitor the flow of water for irrigation;

(l) to conduct General Body Meetings in the manner, as may be prescribed;

(m) to abide by the decisions of the Project Committee;

(n) to cause regular water budgeting and also the periodical social audit in the manner, as may be prescribed;

(o) to assist in the conduct of elections of the Managing Committee; and

(p) to encourage avenue plantations in its area of operation.

(III) Power to levy and collect fee

A Farmers' Organization may, for carrying out the purposes of this Act, achieving the objects of the organization and performing its functions, levy and collect such fees as may be prescribed from time to time.

(IV) Power to remove encroachments

A Farmers Organization shall remove encroachments from property attached to the irrigation system within its area of operation in accordance with the procedure as may be prescribed.

(V) Resources

The funds of the Farmers' Organization shall comprise of the following, namely:

(i) grants received from the Government as a share of the water tax collected in the area of operation of the Farmers' Organization;

(ii) such other funds, as may be granted by the State and Central Government for the development of the area of operation;

(iii) resources raised from any financing agency for undertaking any economic development activities in its area of operation;

(iv) income from the properties and assets attached to the irrigation system within its area of operation;

(v) fees collected by the Farmers' Organization for the service rendered in connection with better management of the irrigation system; and

(vi) sums received from any other source.

(VI) Offences and Penalties

Offenses and Penalties - Whoever, without any lawful authority, -

(a) damages, alters, enlarges or obstructs any irrigation system;

(b) interferes with, increases, or diminishes the water supply in, or the flow of water from, through, over or under any irrigation system;

(c) being responsible for the maintenance of the irrigation system neglects to take proper precautions for the prevention of wastage of the water thereof or interferes with the authorized distribution of water there from, or uses water in an unauthorized manner or in such manner so as to cause damage to the adjacent land holdings;

(d) corrupts or fouls, water of any irrigation system so as to render it less fit for the purposes for which it is ordinarily used;

(e) obstructs or removes any level marks or water gauge or any other mark or sign fixed by the authority of a public servant; and

(f) opens, shuts or obstructs or attempts to open, shut or obstruct any sluice or outlet or any other similar contrivance in any irrigation system; shall, on conviction, be punished with imprisonment which may extend to two years or with fine which may extend to rupees five thousand or with both.

(VII) Composition of Offences

(1) A Farmers' Organization may accept from any person who has committed or in respect of whom a reasonable belief can be inferred that he has committed an offence punishable under this Act , a sum of money not exceeding rupees one thousand by way of composition for such offence.

(2) On payment of such sum of money, the said person, if in custody, shall be discharged and no further proceedings shall be taken against him in regard to the offence, so compounded.

(VIII) Other Important Acts

Fisheries Act, Rajasthan Forest Act, 1953 and Rajasthan Land Revenue Act, Section 173.

(IX) Draft Acts

Draft act on Drinking Water and Sanitation, Draft Bill for Regulation and Control of Ground Water are under the consideration of the Government.

4

Good Governance and Conflict Management

1. IWRM and Conflict Resolution

It is the fact that conflict exists at all levels of water management, individual level to the levels of community. Conflicting goals turn into personal disliking, breaking of team work and may collapse the entire strategy of IWRM. But, if resolved effectively, it can lead to easy and sustainable management of water resources. The Integrated Water Resources Management is much of good governance and conflict management. Further, the approaches and strategies adopted taken for water governance should be transparent, inclusive, coherent and equitable. The governance system should be accountable, efficient and responsive. This requires the collaborate participation of government, industries and the civil society.

2. Good Governance

Good governance is an essential precondition for sustainable development. Poor governance stifles and impedes development. Where there is corruption, poor control of public funds, lack of accountability, abuses and neglect of basic human rights, development inevitably suffers. 'Governance' is the exercise of power or authority – political, economic, administrative or otherwise – to manage resources and affairs. It comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences.

Steps for Effective Implementation of SWP 2010

(1) Delegation and Decentralization

(2) Holistic Approach

(3) Integration, Coordination and Linking of different Policies/ Programmes

(4) Policies and action must be Coherent and Integrative

(5) Open and Transparent Approach

(6) Inclusive, Communicative and Responsive Actions

(7) Equitable, Ethical and Efficient Actions

(8) Accountability

(9) Basin Level Planning

(10) Sense of Ownership among Stakeholders

2.1. The 10 Principles of Good Governance - An UNDP Normative Framework

a. **Participation -** To encourage all citizens to exercise their right to express their opinion in the process of making decisions concerning the public interest, both directly an d indirectly.

b. **Rule of Law** -To realize law enforcement which is fair and impartial for all, without exception, while honoring basic human rights and observing the values prevalent in the society.

c. **Transparency** - To build mutual trust between the government and the public through the provision of information with guaranteed easy access to accurate and adequate information.

d. **Equality** - To provide equal opportunities for all members of the society to improve their welfare.

e. **Responsiveness** - To increase the sensitivity of government administrators to the aspirations of the public.

f. **Vision** - To develop the region based on a clear vision and strategy, with participation of the citizenry in all the processes of development so that they acquire a sense of ownership and responsibility for the progress of their regions.
g. **Accountability** - To increase the accountability of decision-makers with regard to decisions in all matters involving the public interest.
h. **Supervision** - To increase the efforts of supervision in the operation of government and the implementation of development by involving the private sector and the general public.
i. **Efficiency & Effectiveness** - To guarantee public service delivery by utilizing all available resources optimally and responsibly.
j. **Professionalism** - To enhance the capacity and moral disposition of government administrators so that they are capable of providing easy, fast, accurate and affordable services.

3. Conflict Resolution: Interest-Based Relational (IBR) Approach

This conflict resolution strategy respects individual differences while helping people avoid becoming too entrenched in a fixed position.

- Make sure that good relationships are the first priority
- Keep people and problems separate
- Pay attention to the interests that are being presented
- Listen first; talk second
- Agree and establish the objective
- Explore all options together

3.1. Conflict Resolution Process

It's good to recognize when this style can be used effectively, however make sure that people understand that different styles may suit different situations. The process below to resolve the conflict is as follows:

Step One

Use active listening skills to ensure you hear and understand other's positions and perceptions. Restate, Paraphrase, Summarize.

Step Two

Try to understand the conflict in objective terms. Listen with empathy and see the conflict from the other person's point of view, Identify issues clearly and concisely, remain flexible and Clarify feelings.

Step Three

Agree the Problem.

Step Four

Brainstorm possible solutions and be open to all ideas.

Step Five

Negotiate a solution

5

Biodiversity Conservation

1. What is Biodiversity?

Bio-diversity sustenance is an important component of integrated water resource management. Different living forms present in nature plays an important role in maintaining the bio diversity. Water and biodiversity are intimately linked. Water is the basic requirement for sustenance of bio diversity whereas good bio-diversity guarantees well being of surface and ground water resources.

- Biodiversity is the "totality of genes, species, and ecosystems of a region". It is the variety of life forms at all levels of biological systems i.e., molecular, organismal, population, species and ecosystem.
- Biological diversity is the variability among living organisms from all sources, including, 'inter alia', terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.
- Biodiversity is "variation of life at all levels of biological organization".

1.2. Dangers to Biodiversity

Increasing population and unplanned, haphazard development are endangering the bio-diversity. Various plant and animal species are either extinct or on the verge of extinction.

The factors that threaten the biodiversity are identified as habitat destruction, poaching, exotic species, over population, over grazing, over exploitation, forest fire, drying of surface water resources and depletion of ground water table.

1.3. Some Small Methods to Conserve Biodiversity?

(i) Conservation of Water and Soil.

(ii) Fence Non-Dense Forests.

Fencing is the first and most necessary step for the protection of forests. Various types of fencings like (a) Vegetative Fencing (c) Stone Wall Fencing (d) Angle and Barbed Wire Fencing can be used.

(iii) Afforestation with Seed Sowing

Prior to the rains, saw the seeds on the borders of the contour trench.

(iv) Afforestation by Tree Plantation

(a) Construction of Nursery

The success of tree plantation depends upon good saplings. This requires development of nursery at-least one and half year prior to the afforestation programme. The trees are selected on the basis of terrain, soil type, climate etc.

(b) Digging Pits

Pits of 45cm x 45 cm x 45cm should be dug before the rainy season (i.e. till April-May). For the areas, totally devoid of trees, 1100 pits, at a distance of 3 meter, are dug. Otherwise, 500 pits, at a distance of 5 meter, are sufficient. Further, stumps of trees, which may sprout, in rainy season should also be traced out properly.

(c) Sowing Seeds

Seeds can be sown in one or two rows.

(d) Tree Plantation

Tree should be planted in the second week of the June. A couple of days before the rains, the pits should be half filled with soil. This will help in

moistening of the soil in first rain. The trees should be selected on the basis of terrain, slope and soil depth. Where earth is rocky, kher, churel, neem, amaltas etc. can be planted. On middle slopes and plain lands, bamboo, jamum, karanj etc. can be planted.

(e) How to Transfer the Plant?

The saplings in the polythene bags should be little watered so that the lump of mud gets wet. The sapling should be planted in the pit along with the lump of mud after carefully removing the polythene cover. Care should be taken that lump of mud does not get removed. Around the plant, soil should be laid and gently compacted all around. The trunk (collar) should be vertical and above the ground. After planting a sapling, the pit must be completely filled with earth and then boundary should be made around it so that it can get rain water.

(v) Pasture Development (Silvipastural Plantation)

Technique of plantation is same as of forest plantation. The number of plants is less and more grass, fodder crops are grown.

(vi) Plantation on Private & Agricultural Lands

(a) Farm Forestry

Farm forestry is people's participation in tree planting. It involves an integration of farming with forestry practices on the farm to benefit agriculture. This can be done by planting fruit and forest trees on the periphery of the farm.

(b) Agro Forestry

Agro forestry is a form of multiple cropping in which at least one of the plant species is managed for forage, annual or perennial crop production; at least one of the plant species is a woody perennial. Agro forestry is an

efficient land use system where trees or shrubs are grown with arable crops.

(vii) Use Bio-Gas and Improved Stoves

Biogas is a useful domestic fuel. Use of this stop cutting of forests, Food for eight people can be easily cooked from a plant of 2 cubic meter capacity light like petromax lamp can be achieved by directly burning bio-gas in menthol lamps light from this lamp is equivalent to that of a 40 watt bulb. The compost is of a better quality.

The traditional Chula commonly used at present, have low thermal efficiency. About 7 to 10% of the potential energy in wood is utilized in the cooking process and consequently consume more fuel, besides emitting a lot of smoke. This causes indoor air pollution to which women and young children are exposed, besides requiring more time for cooking and hazardous as sparks can cause fire to thatched roof. An increase of one percent on efficiency of existing Chula can result in saving energy equivalent to 4 millions ton coal in the country in a year. Introduction of improved Chula may fulfill several important social and economic benefits, like:

(i) Reduction of wood requirement for cooking by way of cooking efficiency improvement.

(ii) Improvement in cooking process and environment by providing mechanism for control of fire intensity and in many cases smokeless operations, permit safe disposal of smoke out of kitchen.

(iii) Multiple cooking pots for can perform cooking at least two or more items simultaneously with the same fuel amount.

(iv) Reduction in the drudgery of women and children from cooking in smoky kitchen and collection of lesser fuels.

(v) Employment opportunity to the rural poor.

There are about 250 designs available in the country with variations in them to suit local or regional needs, availability of raw material, cost, social considerations, etc.

1.4. Joint Forest Management

Joint forest management is participation of local people in development, protection, conservation and management of forest. Gram Panchayat can play effective role in meaningful participation of villagers. In each village, forest protection committee should be formed and registered with forest department. The forest protection committees should be involved in protection of forests, pasture development, control on forest fire and conservation of biodiversity.

1.4.1. Responsibility of Panchayats

- To control/stop illegal cutting of trees and protect forest from forest fire.
- To extend full co-operation in the formation of forest protection committees. At lease one member from each house should be made a member of this committee.
- To encourage villagers to volunteer to guard forests in nights.
- To manage and maintain forests which are transferred to Panchayats,

after five years of the development, under social forestry scheme. The Panchayat should ensure the equitable forest produces.

- To stop and eradicate ill traditions like forest fire discourage tribal having practice of burning forests.

1.4.2. Responsibility of People Representatives to Conserve Environment

(a) Development of Pastures

The state Government reserves half bigha of land per cattle (excluding sheep and goats) for pasture. It is Panchayat's responsibility to protect, manage and develop it. It should be properly fenced and protect from encroachments. After the rainy season is over, pastures should be opened for grazing with some suitable fees.

Panch, Sarpanch and members of Panchayat Samiti/Zila Parishad should inspect and ensure that no one occupies pasture land illegally. The offenders are liable to cash fine of Rs. 20,000 and/or three months prison.

(b) Development of Barren Lands

Panchayats should develop barren lands of their jurisdiction and plant more and more and trees on it. The farmers should be educated on integrated farming, organic farming etc.

Module 2

Water Resources Development & Management

1. Watershed Management
2. Water Resource Development
3. People's Participation

1

Watershed Management

1. What is Watershed?

Watershed is that area from which all precipitation flows to a single stream. Synonyms are “catchment area” and “drainage basin”. The boundaries of watershed are known as drainage divide; and precipitation falling on opposite sides of a drainage divide falls into different watershed. The part of the precipitation, that falls on a watershed, and ultimately gets into the stream is known as runoff and amount of which varies widely among different watersheds. The general definition of watershed is “a unit of area which covers all land and water areas which contribute runoff to a common point”. A watershed may be of only a few hectares or hundreds or thousands of hectares.

1.1 Watershed Management

“Watershed Management” is an integration of technologies within the natural boundaries of drainage area for optimum development of land, water and plant resources to meet the basic needs of the people in sustained manner, while preserving the ecological balance of the area.

Each watershed has a distinct individuality to various parameters which impart specific characteristics to the watershed and define its potentialities and problems. The data on size, shape, relief, drainage, geology, soil, climate, surface, condition and land use, ground water and socio-economic status of the watershed are required to determine runoff and its potential for development as a water resource, soil and moisture conservation measures to be adopted, proper land use planning and other development programmes. The people and animals constitute the

watershed community.

Watershed is not confined just to agricultural lands alone but covers the entire watershed area, starting from the highest point (ridge line) to the out let of the nallah or natural stream. The activity involves implementation of ameliorative measures on barren hill slopes, marginal lands, privately owned lands and badly cut nallahs and river courses.

1.2. Principles of Watershed Management

The main principles of watershed management are:

- Utilizing the land according to its capability.
- Maintaining adequate vegetative cover on the soil mainly during rainy seasons for controlling erosion.
- Conserving maximum possible rainwater at the place where it falls.
- Draining out excess water with a safe velocity and storing it in ponds for future use.
- Preventing erosion in gullies and increasing ground water recharge by putting nallah bunds and gully plugs at suitable intervals.
- Controlling floods and reducing sediment production.
- Maximizing productivity per unit area, per unit time and per unit of water.
- Increasing cropping intensity.
- Proper utilization of marginal/waste lands through alternate land use systems.
- Ensuring ecological balance.
- Maximizing the combined income form the interrelated crop-livestock-tree-labour complex over years.
- Stabilizing income even under unfavorable weather conditions.

1.3. Components of Watershed Management Projects

Watershed management programmes have following major components:

(a) Treatments for land and water resources mainly in agricultural lands such as diversion bunds, contour, graded and vegetative bunds, terracing, check dams including vegetative barriers and grassed waterways.

(b) Water storage structures including nallah bunds, gully plugs ponds, anicuts, khadins and percolation tanks etc. for efficient utilization of available rainwater.

(c) Alternate land uses, afforestation and plantation of fodder and fuel trees, pasture development supported by rainwater conservation measures, viz., contour trenches, contour furrows, sub-soiling and vegetative and mechanical barriers.

1.4. Land-Use Capability Classification

The land use capability classification is a systematic arrangement of different kinds of land according to their properties that determine the ability of land to produce on virtually permanent basis.

Selecting the proper use of different kinds of land is the first and most important step in soil and water conservation. The success of all conservation programmes depend on the judgment used in selecting proper land use pattern that is within the capability of land. Selecting a good land use for each field is partly a matter of deciding whether the field is suited for crops, for pasture, for woods or for wild life recreation.

1.5. Importance of Land use Capability Classification

Land capability is the suitability of land for use without damage. In soil and water conservation planning, land capability classification is very important aspect because all measures are recommended on the basis of

the land use capability of the soil. Certain lands are suited to cultivation, while others are not. The natural limitations on the use of land constitute the basis for all soil and water conservation measures.

2. Technical Information

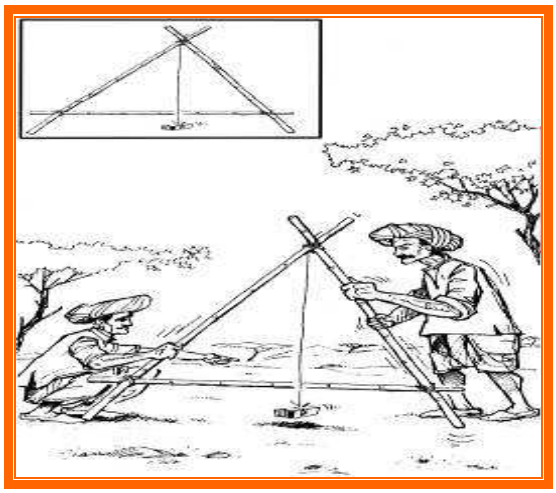
2.1. Area of Watershed

To plan watershed programmes, the convenient size adopted is 500 hectares. However, if the area is large, then it can be subdivided into different units each having size of 500 hectares.

2.2. Methods for Marking Contour Lines

The planning and implementation of soil and water conservation measures and rainwater harvesting structures require information regarding the relative elevation of points on the earth's surface. Contour is that imaginary line which shows points of same elevation.Leveling is the term for this procedure.

2.2.1. A - Frame Level

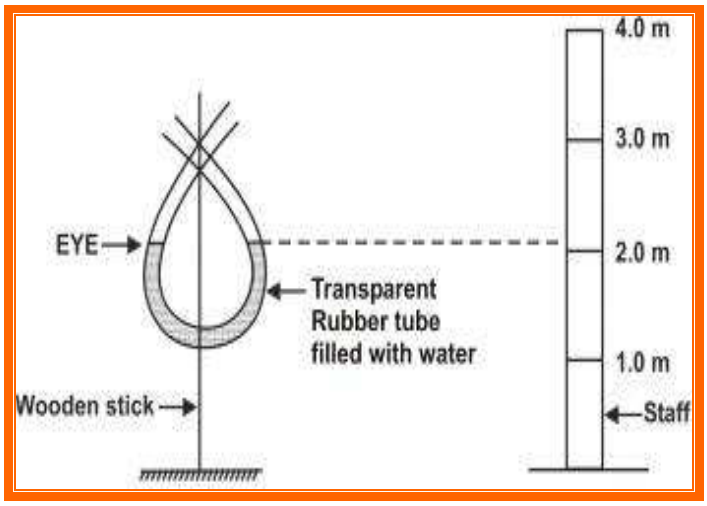


This device consists of a triangular wooden iron frame with a base of 2-3 meter and of a convenient height. In the cross bar, a plumb with a string is hung at ‘A’ or a level tube is fixed at the centre of the cross bar. A centre point is marked on the cross bar by standing the A-frame in one position, marking the cross bar with the position of the string. Then reverse the legs of the A-frame and mark the new position of the string. The exact plumb line is in the exact centre between the two marks.

To use this A -frame, select a starting point on the slope at one edge of the field. Place a marker at the starting point. Hold one leg of the A-frame at the marker and rotate the other leg until the plumb or level tube is at the centre. Stop and mark the point of the rotated leg. Repeat the same action by rotating the first leg 180^c around the second until the level tube is at the centre again and mark the new point again. Continue the process across the slope until the contour line is completed. Similarly, the alignment of the subsequent contours may be done by fixing the requisite horizontal interval between the contours.

2.2.2. Rubber Tube Level

This device consist of as straight wooden stick in which at the upper end a transparent rubber tube filled to by water is tied with the help of a nail.



Due to the atmospheric pressure, the water column on both end of the tube will stand on the same level. After coinciding these two points in the rubber tube, the third point on the staff can be read horizontally and by joining that particular point the contour line may be drawn by moving the staff for a distance of about 5 to 8 meter. The total distance covered for marking contour line from one point should not exceed 40 meter for accurate measurement. Afterwards, the point should be shifted just near on the staff for extending that contour line. After the completion of the first contour, the alignment of the subsequent contours may be started by fixing the requisite vertical or

horizontal interval between the contours.

3. Soil and Water Conservation Measures on Arable Lands

3.1. Contour Cultivation:

Cultivation operations across the slope, i.e. keeping the furrow on the contour as far as possible forms a multitude of mini barriers across the flow path of the runoff which vastly improve the detention/ storage in situ. This, in turn, increases the opportunity time and hence the infiltration of rain water into the soil profile. The quantity and velocity of run-off and resulting erosion are thereby greatly reduced. Further, when cultivation is done on the contour, instead of against it, much less power is required to be exerted by humans, animals and machines. The wear and tear of mechanical parts of the agricultural implements is also less and the job is done in less time.

Effectiveness of contour cultivation varies with slope, crop cover and soil. Contour cultivation is most effective on moderate slope of 2-7%, effective on slopes less than 1% or between 7% and 15% and not effective at slopes more than 18%. Furrow breakage during larger storms and on higher slopes results in excessive soil loss owing to cumulative failure of ridges. On long slopes, where bunding is done to reduce the length of run, the bunds serve as a guide for contour farming. Cultivation can be done parallel to these bunds. On gentle slopes where bunding is not essential,

contour guidelines are to be marked on the field. A hand level or A - frame level may be used for this purpose. Contour farming is an effective technique of in-situ moisture conservation on moderately sloping, deep and permeable arable soils of semi-arid and humid areas. This system of farming can also suitably be employed on non-arable lands where over seeding of grass is possible. Contour farming is also an efficient method of *in-situ* moisture conservation on lands where other engineering/mechanical measures such as contour bunding, terracing, etc., have been adopted for soil and water conservation.

3.1. Vegetative Barriers or Live Bund

Vegetative barriers or contour vegetative hedge or live bunds are a low cost technique, which are proved useful in preventing soil erosion and conservation of soil moisture.

3.2. Bunding

In order to control soil erosion & conserve rain water, several approaches are under use in areas with different slopes. A common one is to construct bunds across the slope. These can be either on contour or on a grade. In Rajasthan the rainfall is low, therefore, in most of the areas, only contour bunds are recommended to conserve rain water & check soil erosion.

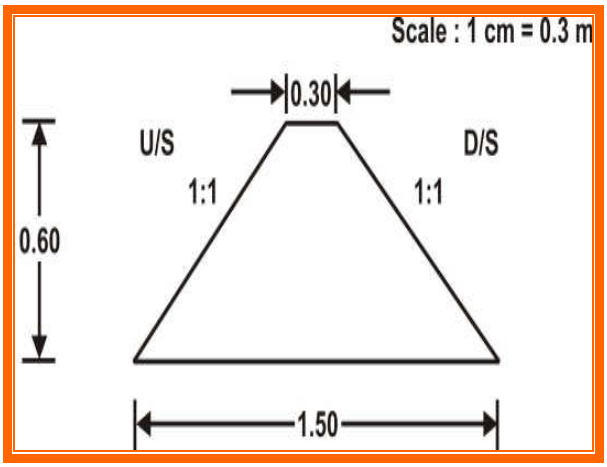
3.3. Contour Bunding

Contour bunds are small earthen bunds constructed along the contour on agricultural lands so as to reduce length of run of runoff water. These are

constructed so as to retain major part of the rainwater in the fields by preventing it from running down the slope; to check soil erosion and conserve sufficient moisture to grow crops. It also prevents the washing away of manure and fertilizers applied to the fields.

3.4. Earthen Field Bunds

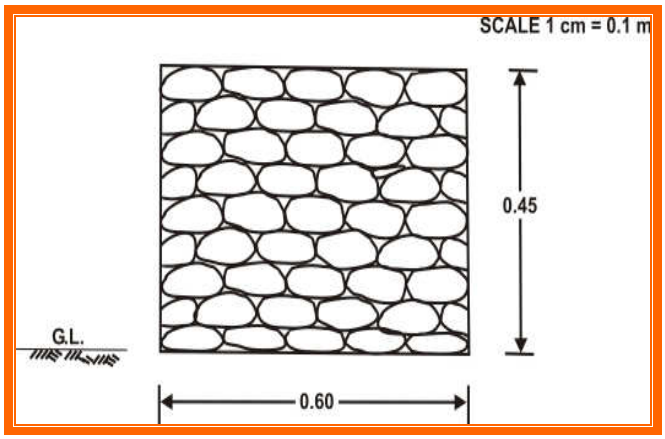
It is one of the most commonly adopted indigenous technology for in-situ moisture conservation. Earthen field bunds of varying cross-sections are commonly found almost in all moderately sloping rainfed arable lands in India. Locally this practice is known as Medbandi, Palabandi or Dhorapali.



Earthen field bunding is one of the most common soil and water conservation practice adopted in relatively less sloping (<6 per cent) arable lands of semi-arid regions. In this technique, earthen bunds of about 45-60 centimeter height are constructed and are generally aligned on the field boundaries. These bunds are being stabilised by transplanting grass slips/sowing of grass seeds of local palatable and perennial species. Initially, during the first two years these bunds are properly maintained. These bunds enhance in-situ conservation of moisture, reduce soil erosion and also supplement fodder for animals.

3.5. Stone Bunds-Puerto Rico Terraces

The stone bund or barrier, or Puerto Rico Terrace (PRT), is a commonly and effectively used, very adaptable indigenous soil and water conservation technique on moderately sloping (more than 6 per cent slope) arable lands and where the depth of the soil is also a limiting factor for the cultivation of crops. PRTs are made by first providing a barrier along the contours (sometimes across the slope) at the desired spacing and then cultivating in such a way so as to encourage downward movement, whereby the soil gets settled behind the barriers.



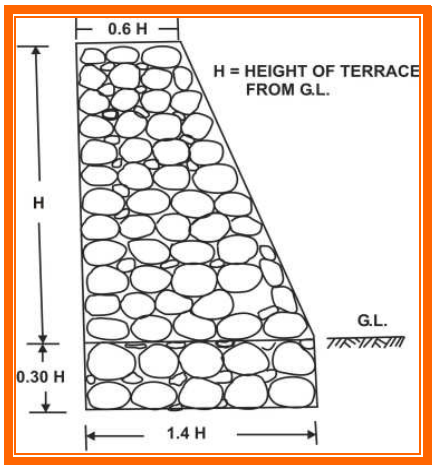
These are constructed in moderately sloping areas where stones are available at the site or very close-by. Stone bunds/barriers of smaller size (0.60 m x 0.45 m) are erected at field boundaries or at suitable sites at an appropriate horizontal interval across a slope almost matching the contours.

3.6. Stone Wall Terraces

Stone wall terracing is also an indigenous technique of soil and water conservation in hilly tracts. A Stone Wall Terrace (SWT) is a stone barrier placed across a small gully or in a cultivated valley. Such terraces are also constructed across the slope almost on the contours. Downward movement of soil is induced in a fashion similar to the Puerto Rico terraces. The cross-section and spacing of an SWT is decided after taking into account the slope of the land, rainfall, height, expected depth of flow and future prospects of increasing the height. Stone wall terraces are

provided to impound water temporarily and to arrest the sediments on the lower side of the field. The impounded water enhances the conservation of moisture in the soil, which may be helpful in increasing the productivity of crops as well as in augmenting groundwater recharge.

Stone wall terraces are also commonly constructed by tribal on hilly areas to create additional cultivable land, particularly in the valley portions, by cutting the hillside slopes and to concentrate the eroded soil from the adjoining fields at an appropriate site. Sometimes, these terraces are reinforced with vegetative barriers adjacent to the stone barriers on the upward slope.



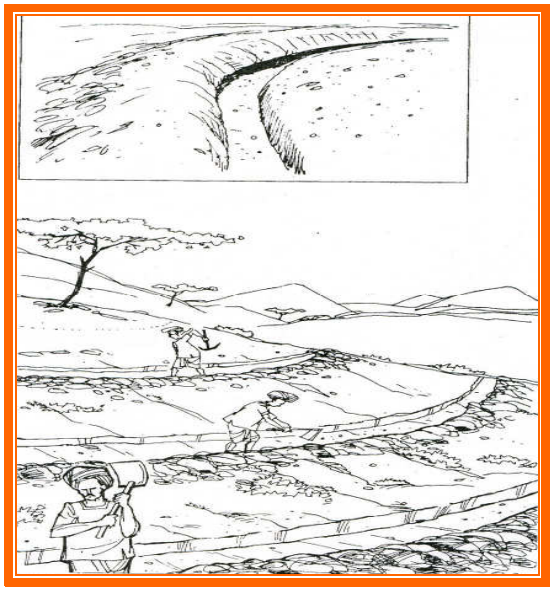
The basic difference between an SWT and a PRT is that the SWT is constructed in the cultivated valley lands across the slope, whereas a PRT is constructed on the arable lands on both sides of the valley on the contours. In general, the cross-section given in the figure is followed.

Initially the height of the SWT should range between 0.6 and 1.0 m, depending on the slope of the valley. Over time, a gradual increase of height is adopted depending upon the settlement of sediments and other site conditions. The spacing adopted for SWT need not be very rigid and suitable spacing can be adopted depending on the local conditions. Generally, it varies from 10-30 m depending upon the slope.

4. Soil and Water Conservation Measures for Non-Arable Lands

The upper reaches of the watershed usually consist of hilly areas. These areas have an undulating topography; often barren steep slopes and are foci to soil erosion. In such areas vegetation do not get established because of steep slope and severe soil erosion. The uncontrolled runoff from the sloping lands also causes excessive damage to the adjoining agricultural lands. The measured described below are effective in controlling erosion and conservation of moisture.

4.1. Contour Trench or Contour Furrow

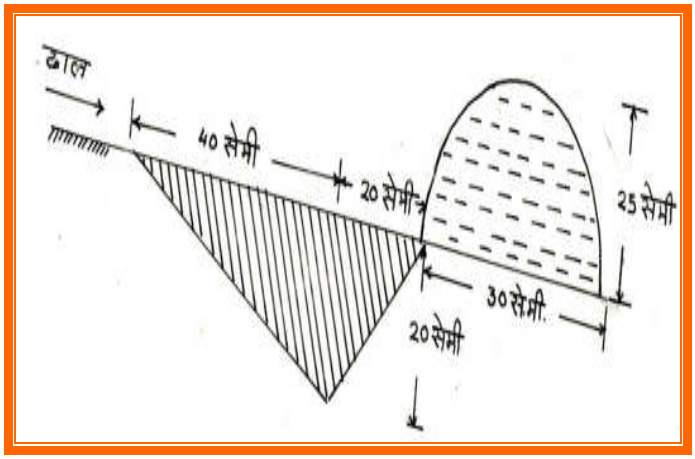


Contour trench is an excavated trench constructed along the contour across the slope of the land in the upper and middle reaches of watershed. It is constructed both on hill slopes as well as on degraded and sloping wastelands for soil and water conservation and generating vegetative cover. Trenches are constructed below the contour line in such a way that its upper edge exactly coincides with the contour line. Bunds are formed downstream along the trenches with excavated material taken out of them. It breaks the slope lengths, reduce the velocity of flowing water and retard its scouring action. The rainwater retained in the trenches help *in-situ* conservation of moisture, which travels down and also benefits the better types of land in the lower reaches of the watershed. These trenches are constructed either in trapezoidal shape or rectangular shape.

4.2. Staggered Trenches

Staggered trenches are excavated trenches of shorter length in a row along the contour with inter space between them, constructed in a staggered manner. The vertical interval between the rows is restricted to impound the runoff expected from the catchment area without overflowing the trenches. The cross sectional area of these trenches is designed to collect runoff expected from most intense storms having recurrence interval of 10 years. The dug out soil is heaped up on the downstream side of the trench leaving a berm of 15 centimeter. These trenches perform very well in improving the moisture regime of the highly sloppy, denuded lands, which help in quick growth and survival of plants and grasses.

4.3. V-ditches

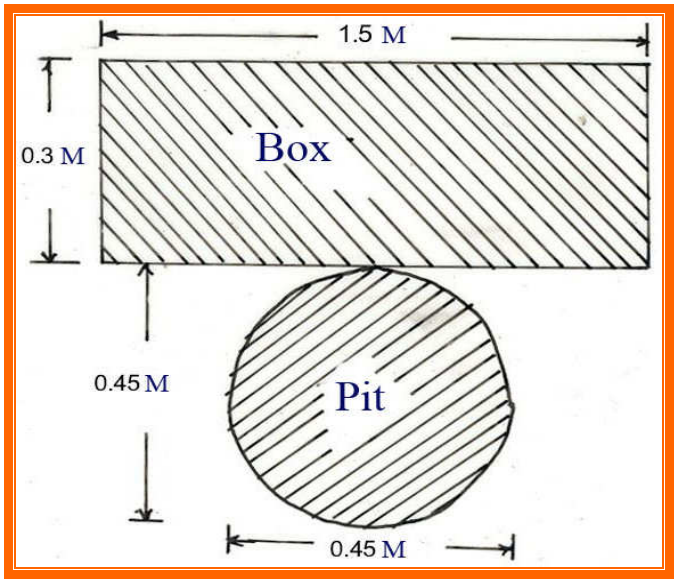


These are constructed on contours by excavating a "V" shape trench and forming bund on downstream of the trench. This ditch laid across the slope, breaks the length of the slope and thereby checks the velocity of runoff. The usual recommended size of "V" ditch is 0.60 m top width and 0.20 m depth so as to form a triangle shape and total capacity per running meter of V-ditch comes to be 0.06 m^3. The interval between the two adjacent V-ditches should be so designed that the quantity of water coming from the intervening area in V-ditch is not more than 0.06 m^3. V-ditch is recommended to be constructed for the area having land slope upto 15 per cent only.

4.4. Gradoni

These are steeply inward sloping; very narrow bench terraces constructed on contours. They are suited for afforestation in uniformly steep sloping areas, because they have enough capacity to retain water and at the same time plants grown in these and in the inter space of two gradonies will get more moisture. It is recommended to be constructed economically for the area having slope up to 20 per cent only with considerable soil depth. The vertical interval varies from 1.0 m to 2.0 m depending upon the steepness of slope and the horizontal interval is calculated by the formula earlier mentioned in contour trench.

4.5. Box cum Pit



This method has also been found very effective in controlling erosion, conserving moisture and raising of trees particularly in the areas which are severely degraded and where soil depth is limiting factor. In this system, box type trenches of size 1.5 meter x 0.30 meter x 0.30 meter are excavated. Box to box distance is kept 2.5 meter and spacing is maintained 4 m from centre to centre. Contour lines are based for row of the boxes. On an average 1000 boxes per hectare may be constructed. The excavated soil is heaped on down slope to form a berm. For afforestation purpose each box is provided with a pit of size 0.45 meter x 0.45 meter x 0.45 meter on the downstream side.

5. Fencing for Regeneration of Degraded Lands

Fencing is required to protect the production measures carried out on non-arable lands from stray cattle for at least three years after the production measures were adopted or till the plants grow to such a height that the cattle are unable to reach the plant leaves. The fencing can also be designed is such a way that it conserves rain water also. Fencing can be done in many ways depending on the availability of local resources and local site conditions.

5.1.Types of Fences

- Ditch cum Bund Fencing
- Line Fencing (Babool, Juliflora etc.)
- Stone Wall Fencing

6. Drainage Line Treatment/ Gully Control Measures

The upper reaches of the watershed usually consist of hilly and non-arable areas. These areas have an undulating topography and are foci for soil erosion in which small quantity of runoff is conserved. Therefore, considerable amount of runoff flows through drainage lines at high velocities. Due to this, deep nalla or rivulets are formed which further leads to soil erosion in the adjoining fields. To check the erosive velocity of runoff and further enlargement of gully or nalla drainage line treatments are essential. It will also conserve the moisture and trap the sediment to ensure the eventual growth of vegetation. Various methods that are widely used are as follows:

6.1. Developing Temporary Structures

6.1.1. Vegetative Check Dam

Vegetative & low cost temporary structures are usually preferred in rills/gullies with smaller catchment. These should be extended

sufficiently into the banks of gully to avoid washing out of structure around the ends. The vegetation used for check dams are grasses, shrubs and trees across the drainage line, like Agave, Ipomea, Ratanjot, Vetiver, Sacramoonja etc. Bushes/trees are also to be planted in two three rows on both banks of the nallah.

A small bund or single row of loose stones is to be provided down stream of such barriers to facilitate initial establishment of vegetation. The middle row of the vegetation is to be extended up to the top of the banks or even one meter beyond on both sides.

6.1.2. Brush Wood Dams

Brushwood dams are the least permanent of all type of check dams. They are relatively cheaper and can be constructed with country wood stakes and brushes/branches of trees and the vegetation available locally. They are suited for gullies with small drainage areas and soil conditions that permit the driving of necessary anchoring stakes. .it is important that the centre of the dam is kept lower than the ends to allow water to flow over the dam rather than around it.

For a distance of 3 to 4.5 meter along the side of structure, the sides and bottom of the gully are covered with a thin layer of straw or similar fine mulch which is slightly counter sunk, in order to form a bond between the structure and the soil. Brush with butts pointing upstream is packed closely together over the mulch to about one half of the proposed height of the dam. Several rows 60 meter apart and the stakes 30 to 60 centimeter apart in the rows should be provided. The stakes should extend up the sides of the gully and should be driven only partly in, at first. The brush fill is then completed and heavy galvanized wire stretched along the rows of stakes and fastened to them. The stakes are then driven down until the wire firmly compresses the brush in place. Large stones are

sometimes placed on top of the brush to keep it compressed and in close contact with the bottom of the gully. The centre of the dam should be made low enough to provide the necessary spillway capacity.

6.1.3. Loose Rock Dams

If loose stones of fairly good size are available in large quantities, they can be used for construction check dams. The site where the check dam is to be constructed is cleared and the sides sloped to 1:1. The bed of the gully is excavated to a uniform depth of about 0.3 meter and dry stones are packed from that level.

In the centre of the check dam, sufficient weir size for water-way is provided to discharge the peak runoff from the catchment. The stone filling should go up to 0.3 - 0.6 meter into the stable portion of the gully side to prevent end cutting. In the rear, sufficient length and width of apron has to be provided to prevent scour. The thickness of the apron packing should not be less than 0.15 meter and the gully sides above the apron have to be protected with stone pitching to a height of at least 0.3 meter above the anticipated maximum water level to prevent side scours from being formed by the falling water. Care should be taken to place bigger sized stones on top to prevent the pitching being dislodged or carried away by the current.

6.2. Developing Semi Permanent Structures

6.2.1. Earthen Gully Plugs

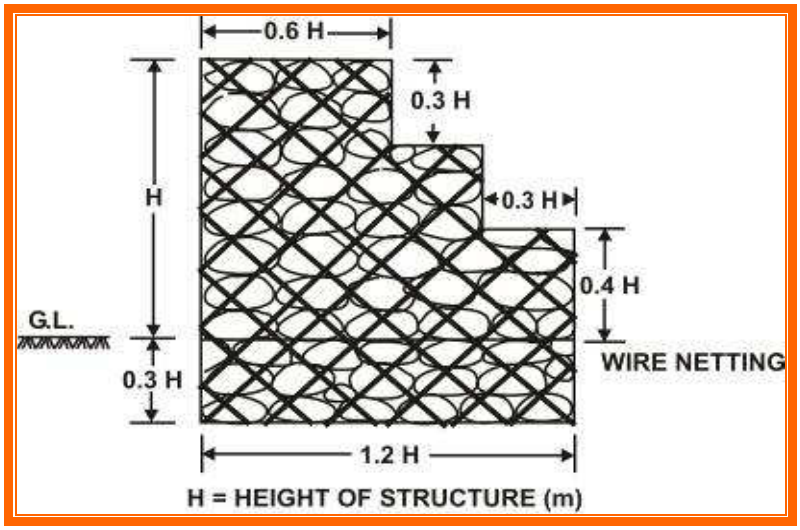
The earthen gully plugs are constructed in the streams to check the velocity of the flowing water and also to check the erosion as well as conserving moisture. These are provided where separate surplus arrangement is available at site.

6.2.2. Dry Stone Masonry

Following design criteria of dry stone masonry structure has been in practice and has been found to be suitable for adoption:

i. The maximum height of structure should not be more than 1.0 m
ii. Base width = 1.4 Height
iii. Top width = 0.4 Height
iv. Depth of foundation = 0.4 Height
v. Downstream slope = 1:1
vi. Earth backing on the upstream vertical face of the wall is provided at a slope of 4:1 or 5:1 depending on the soil type & the bottom width of earth backing be kept so that the seepage line remains within the earth backing.

6.2.3. Gabion Structure



If abundant stones are available, but their shape makes them unsuitable for loose stone construction, or if the expected water velocity is very high, gabions can be used. A gabion is a rectangular shaped cage made of galvanized wire, which is filled with locally found rocks or stones. To facilitate the transport, gabions are conveyed flat and are folded to shape at the construction site. The gabion check dam is made by connecting several gabions in both horizontal and vertical direction. Usually, gabions are 1 meter wide and 1 or 0.5 meter high; their length can vary from 2 to 6 meter.

7. Bank Stabilization Works

Bank stabilization activity in a watershed is generally taken to stabilize the banks of drains/nallah in the watershed, so that it is not further eroded. Following works as per site conditions and availability of local material can be undertaken for bank stabilization:

a. Earthen bund with safe disposal structure for run-off water be constructed at the points from where surplus rain water is to be released.

b. Planting vegetation on the bank of nallah with concentrate plantations at the points where the flow of water is striking is also beneficial. The vegetation for this purpose can lpomea. Agave Sachra Munja, Vetiver, Ratanjot etc. This is a low cost work.

c. Stone pitching at vulnerable points.

d. Spurs: If nallah is of relatively big size, then earthen spurs/Brush wood spur/Gabion spurs fortified with vegetation can be constructed where flow of water strikes on the banks of nallah.

Measurement -To measure heights, at least three measurements should be taken from different places and averaged. To measure the quantity of soil, the size and depth of borrow pits should be measured. The measurements should be taken at regular intervals. Quantity of work (Cubic Meter) = Length (Meter) x Width (Meter) x Average Depth/ Height (Meter)

8. Planning and Designing of Selected Micro Watershed

The planning and designing of a watershed is generally done on micro basis in which 500 ha land area is considered as a convenient unit. The planning of the watershed can be categorized in the following two groups:

8.1. Consolidated Project Report

In this project report the basic information and proposed treatment

measures along with per hectare cost of the treatment are described and accordingly the cost of the entire watershed is worked out. This report can be prepared after gathering of data through reconnainance survey.

8.2. Detailed Project Report

The detailed project report is prepared after the topographical survey and preparation of contour map. With the help of contour map the various slope groups can be identified which are helpful in deciding the type of structure proposed to be recommended for *in situ* conservation and controlling the erosion. Various treatment measures along with the length per ha can be estimated with the help of contour map and accordingly the actual cost of treatment measures can be worked out. The treatment measures and crop production measures are proposed on the basis of Participatory Rural Appraisal (PRA) conducted in the watershed area.

2

Water Resources Development

1. Rainwater harvesting

The harvesting of surface rainwater should be planned with lot of precision and accuracy. How much water will flow; from what distance; how much force is to be applied in halting the flow of water and up to what depth will the water percolate into the ground; and in case the quantity of water is too much then how and at what height this water is to be taken out without causing any damage to the main structure - all the aforesaid information are required to be collected, and village community can significantly help in providing the primary information. Various techniques used are as follows:

Terms Used By Village Community

Agor: The area from which water flows into the structure i.e. catchment.

Aagar: The area where the water is stored i.e. tank bed.

Pal: The structure t which holds the water in place i.e. embankment.

Apara: The area from which excessive water drains off i.e. waste weir.

1.1. Dug Out Pond (Nadi /Talai)

It is a water harvesting structure to store surplus run off water to provide live saving irrigation to the crops during dry spell. Farm ponds can be dug out ponds or embankment cum dug out ponds. The pond should be located where largest storage volume could be obtained with least amount of earth work; it should be located close to the point of use.; it should not be located in an area which remains under submergence during rainy season.; natural depression if any should be considered for economical

construction; possibility of flow irrigation should be considered; pond site should be in relatively impervious soils so that seepage losses are minimized; Good earth fill material should be available for constructing embankment.

1.2. Low Cost Rainwater Harvesting Structures

Selection of an appropriate site of Water Harvesting Structures (WHS) is very important since the cost of construction as well as storage volume depends on it. The following points should be given due importance while selecting a suitable site.

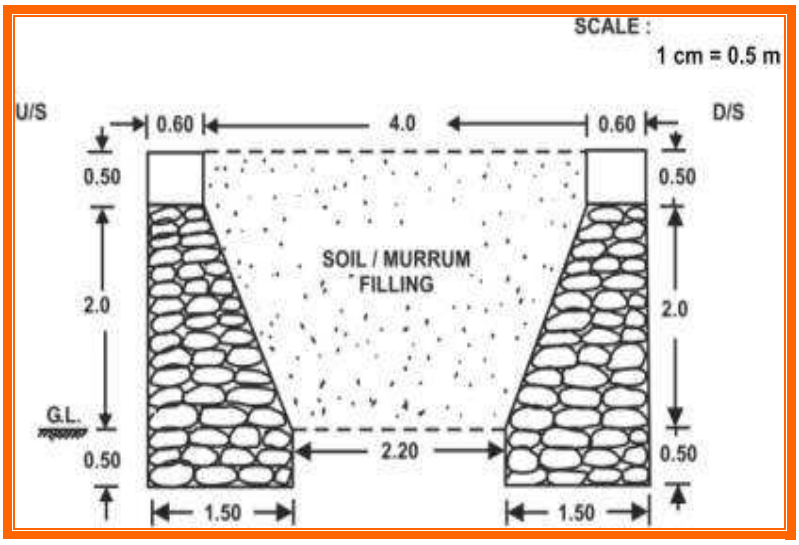
- The site should be located at such a place where maximum storage is possible with minimum crest length of weir. A deep and narrow section of valley having hard rock on one or both the sides of valley is considered to be the best site for constructing WHS.
- The slope of the nalla bed should be less than 2 per cent to store a large volume of water. It should not be constructed at the turn of the nalla.
- Large submergence area with shallow depth of water is required to be avoided to reduce evaporation losses.
- Structures should be located near to the area where efficient utilization of the stored water is possible.
- The site should be accessible so that the transportation of material required for construction is easily made.

1.2.1. Dry Stone Masonry Pond (Sandwich Dam)

Dry stone masonry pond, between 1.5 and 2.5 meter high, are constructed to collect and store water. In this type of structure, the upstream and downstream walls are constructed 3-4 meter apart by dry stone masonry after excavating a foundation of appropriate depth. The space in between

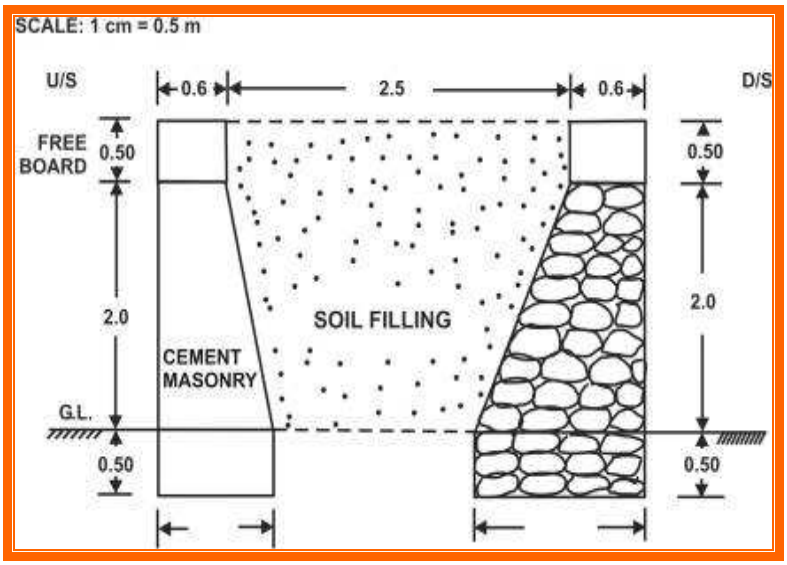
these two walls is filled with locally available murrum or soil with proper compaction.

A properly designed waste weir is provided for safe disposal of excess water. Sufficient free board is kept to check flows from the top of the structure. The size of the catchment area should not be more than 50-60 hectares for such types of ponds.

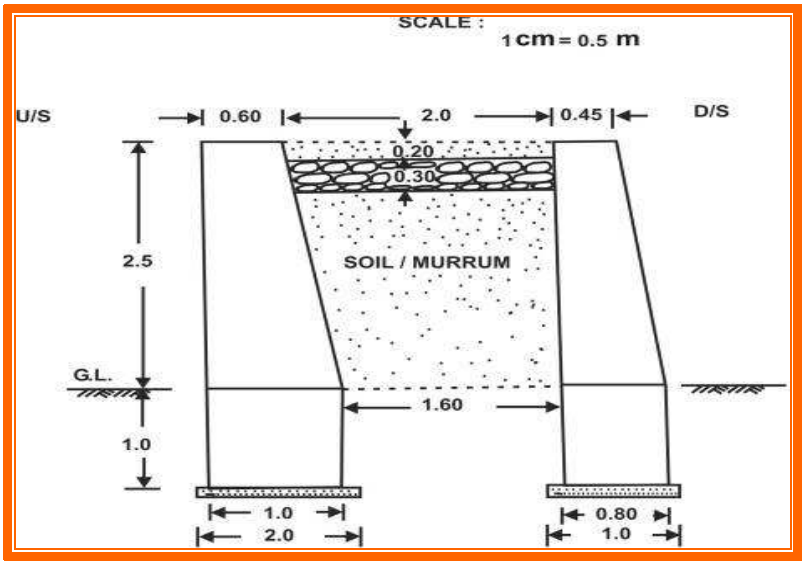


1.2.3. Single Wall Cement Masonry Dam

In the type of pond the upstream well is constructed with cement masonry whereas the down-stream well is constructed with dry stone masonry. In between two walls murrum/soil is filled at an appropriate interval to provide stability to the structure. The catchment area for this structure should not be more than 100 hectare. A provision of side waste weir/pipe outlet is necessary to dispose the excess runoff received during erratic and unexpected rainfall conditions.



1.2.4. Double Wall Cement Masonry Structure



This type of structure looks like an anicut. Both the up- stream and downstream walls of the structure are constructed with cement masonry. The height of the structure and catchment area is usually restricted up to 2.5 - 3.0 meter and 100-150 hectares respectively.

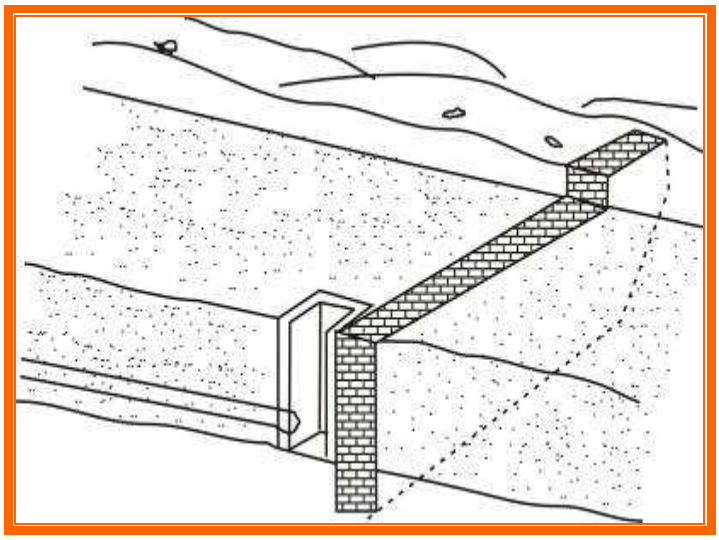
The stored water is mainly used for life saving irrigation during Kharif season; pre-sowing/life saving irrigation in Rabi season as well as for domestic purposes.

1.3. Anicut

Anicut or Check Dam is a masonry structure that intercepts the water from the local catchment and stores it for optimum utilization. It is constructed by providing a weir across a Nalla or natural drainage line, for holding the runoff. Such structures not only reduce the erosive velocity of runoff but also prevent the gullies from further enlargement. The water retained on the upstream side or behind the structure can be used for lift/ gravity irrigation and as drinking water for people, as well as for cattle and other animals. Anicuts or check dams also help in recharging the wells downstream.

1.4. Subsurface Barriers

Subsurface barriers are used to retain or arrest the seasonal subsurface flows and facilitate the abstraction of water through lined shallow wells, especially during periods of water scarcity.



A trench of the required width is dug across the flow direction of the groundwater. The earthwork involved may be carried out by manual labour since the excavation depths are generally not more than 3-6 m. subsurface dams are generally constructed at the end of the dry season, when there is little water in the aquifer. There is usually some flow, however, and this must be pumped out during the construction work. After the construction of dam, the trench is refilled with the excavated material. It is important that the refill is properly compacted by mechanical means and watering.

1.5. Surface-cum-Subsurface Masonry Dam

A surface-cum-subsurface masonry dam is an alternative involving slightly more advance engineering for which skilled labour (mason) is needed. In this system one advantage is that it is raised above the level of river bed up to the height of one mater to act as a temporary reservoir of water and down below the bed level up to the availability of bed rock or solid impermeable layer to arrest the subsurface flow. For construction of such type of dams stones are generally used.

1.6. Naal Bandhana (Sub Surface Well Recuperation Channel)

Naal bandhna is an indigenous technology of recuperation or increasing the yield of wells situated on the banks of non-perennial streams, small rivers or rivulets with enough depth of sand (sediments) deposits. This technique is more commonly found in southern Rajasthan and adjoining areas of Aravalli region. A subsurface tunnel/channel is installed across the river bed to carry the stored water of sand deposits on the upstream side in the link well. A 45-60 centimeter wide and 1-1.5 meter high loose stone masonry channel with a very gentle slope towards the link well is constructed at 2-3 meter or deeper below the surface of the river bed, depending on the sand deposits. The end of the channel is directly joined with the well. Sometimes, in wide streams, the channels are constructed to cover only half or three-fourth of the total width of the stream, depending on the requirement of water in the well to irrigate the adjoining arable land and also on the one-time investment capacity of the farmer. A trench 2-2.5 meter wide (depending on the depth of excavation) is dug across the river-bed, reaching down to the bedrock or some other solid impervious layer. A very gentle slope is maintained in the bed to direct the flow towards the link well. Dry stone masonry walls of 60-75 centimeter width are constructed 45-60 centimeter apart to retain the sand. Sometimes, the wall erected on the upslope side is made more stable by increasing the width. The height of the wall is generally kept as 1-1.5 meter. The top of the channel is always kept at least 1 meter below the surface of the river bed in order to bear the human activities on the riverbed. The top of the channel is covered with rough stone slabs or wooden logs to prevent sediments from entering the channel. Generally, logs of the dhak/palas (Butea monosperma) tree are used. The rainwater retained/stored by sand/sediments (about 30-45 percent by volume of sand deposits) in the upward side of the river slope seeps through the

loose stone wall/subsurface channel and clean water flows towards the linked well. It maintains a continuous supply of water in the well for irrigation and other uses for months together during dry winters and summer months. The water of these wells can also safely be used for drinking purpose.

1.7. Roof Top Rain Water Harvesting

The rain water falling on pucca roofs can be collected through the simple network of pipes. The water so collected can either be poured into ground water through tube well/ hand pump, open well or can be collected in open tank. The water collected should be treated by sand gravel filter and disinfected by bleaching powder (a7 to 10 mg per liter).

3

People's Participation

1.1. Community Involvement

The success of all watershed management and development activities mainly depends on an active involvement and participation of the local people, voluntary organization and Panchayat bodies etc. The involvement of watershed community is essential, right from the planning stage so that they become a partner in the entire exercise. This also helps in exercising restrain on the community in exploiting of the natural resources; and for equitable sharing of the multiple benefits, other than just crop yield, like grass produced on community land, utilization of harvested water and other resources developed in the area.

1.2. Rapid Rural Appraisal (RRA)

The RRA is a social science methodology in which a multidisciplinary team makes use of simple non-standard methods and the knowledge of local people to quickly understand, analyze and evaluate information and hypothesis about rural life and rural resources that are of relevance for taking action.

1.3. Participatory Rural Appraisal (PRA)

The PRA is a further evolutionary stage of RRA approach, which emphasis on empowering of the local people to assume and active role in analyzing problems and drawing up plans, with outsiders mainly acting as “facilitator”. This approach enables them to assume responsibility for implementing the activities based on them.

1.4. Micro Level Planning Guidelines

1. Resource inventory using PRA techniques.
2. Minimum 3-4 meetings in the village.
3. Separate survey of the land.
4. Village meetings to explore possible solutions to problems.
5. Technical survey by project staff with financial estimates.
6. Discussion of draft plan with villagers and local contribution determined.
7. Training on technical aspects and exposure trips of village level committees (VLC's).
8. Implementation by village level committees.

Annexure

Measurement of Different Levels of Construction Work

S.No.	Description	Unit Rate	Amount of Work
1.	Layout of work	Meter	
2.	Excavation Work including excavation, lifting, dressing of foundation. Lift up to horizontal distance 50 meters and height 1.5 meters. It also includes dewatering. • Soft soil • Hard soil • Hard soil with kankar • Hard murrum (soil gravel mix) • Soft rock • Hard rock requiring blasting Hard rock does not requiring blasting	Cubic Meter	
3.	Cement mortar and masonry 1:4 Mix 1:6 Mix 1:8 Mix (This means 1 part cement and 4 parts sand)	Cubic Meter	
4.	Cement concrete in foundation of thickness 1 foot generally. The proportion of mix varied. 1 : 2 : 4 Mix 1 : 3 : 6 Mix 1 : 4 : 8 Mix Here the first part is cement, second is sand and third is concrete (20 mm to 40 mm)		
5.	Plastering including joint filling, leveling and curing. For 20 mm thick plastering: 1 : 4 Mixture 1 : 5 Mixture 1 : 6 Mixture	Square Meter	
6.	Pointing and curing 1 : 3 : 6 Mix 1 : 4 : 6 Mix	Square Meter	

Example 1

Name of Work - Medbandi (Earth)

Shape:	Top width	=	0.30 meter
	Height	=	0.60 meter
	Bottom width	=	0.50 meter
Cross sectional area		=	$\frac{(UpperWidth + BaseWidth)}{2} x height$
		=	$\frac{0.30 + 1.50}{2} x 0.60$
		=	0.90x 0.60
		=	0.54 square meter
Daily wages		=	Rs. 60 per person
Daily work to be finished per person		=	$\frac{60}{14.58} = 4.11 meter$

Example 2

Description of work - Contour trench

Shape Width = 0.30 meter

Depth = 0.30 meter

Area of the trench = Width x Depth

= 0.30 meter x 0.30 meter

= 0.09 Square meter

The rate for digging (as per BSR) = Say Rs. 37 per cubic meter.

Unit rate of digging = Rate per cubic meter x Area of the trench

= 37 x 0.09

= Rs. 3.33 per meter

Daily wages per person = Say Rs. 60 per person

The work to be done by each person daily = $\frac{60}{3.33} = 18 meter$

Annexure

Participatory Rural Appraisal (P.R.A.)

Questions, which may help in collecting information related to village and evolve participation of villagers.

1. What are the problems of your area or village?
2. What could be the possible solutions of the problems mentioned by you?
3. If you know the solutions, why don't you apply them?
4. Do you need any outside help to solve your problems? If yes, what type of help you require?
5. Would you support outside help and co-operate?
6. How much and what type of co-operation can you provide?
7. Would you accept solutions provided by the external agencies?
8. What is the total area of your village?
9. How much of that is used for farming?
10. Why is no farming being done on the remaining part?
11. Can this remaining part be improved and used for farming?
12. If this remaining part is not used for farming, what alternative uses can be put?
13. Does your village have a water supply for drinking and irrigation?
14. How many crops do you take in a year?
15. Why is it not possible to take more than one crop in a year?
16. Do you know the rain water flowing pattern of your area?
17. If you make arrangements to collect this rain water by making structures, would you get support from the villagers?
18. Which place would be ideal to make rain water harvesting structures?
19. How will the villagers use the harvested water?
20. How the cooperation of those people, who will not use water can be taken?

21.If construction of the structures requires acquisition of private land, will the owner provide it?

22.Who will do the maintenance of the structure after its construction?

23.How many cattle are there in the village?

24.How can the production potential of animals be improved?

Module 3

Drinking Water & Sanitation

1. Water Contamination & Prevention
2. Sanitation

1

Water Contamination & Prevention

1. Water-Borne Diseases

Water-borne diseases are transmitted by use of contaminated water.The main water borne diseases are:

(a) Hepatitis - Hepatitis is transmitted via fecal oral route most often through contaminated water and contaminated food. Hepatitis is a inflammation of the liver.

(b) Typhoid - It is caused by bacteria salmonella *typhi*. These germs pass in the faeces and urine of infected people and communicate this disease to others. Symptoms can be mild or severe and include high fever, anorexia, headache constipation or diarrhea, red spots on the chest area and enlarged spleen and liver.

(c) Diarrhea - The Diarrhea is generally caused by bacterial, protozoal, amoebical and viral infections. The common causes are drinking unclean water, poor sanitation, poor hygiene and suppressed immune system.

(d) Schistosomiasis - It is caused by contact with contaminated water bodies.

(e) Cholera - Cholera is caused by the bacteria *vibro cholera*. It is an acute infection of the intestine which begins suddenly with painless watery diarrhea, nausea and vomiting.

(f) Dysentery - It is diarrhea containing blood. Several organisms like Shigella cause epidemic dysentery. The illness includes abdominal cramps, fever and rectal pain.

(g) Ascariasis - Ascariasis is an infection of the small intestine caused by Ascaris umbricoides, a large roundworm. The first sign may be the passage of a live worm, usually in the faeces. In a severe infection,

intestinal blockage may cause abdominal pain, particularly in children. People may also experience cough, wheezing and difficulty in breathing and sometimes fever.

(h) Fluorosis - Ingestion of excess fluoride, most commonly in drinking-water, can cause fluorosis which affects the teeth and bones. Chronic high-level exposure to fluoride can lead to skeletal fluorosis. Abdominal pain, excessive saliva, nausea and vomiting, Seizures and muscle spasms may also occur.

(i) Methaemoglobinemia - Methaemoglobinaemia caused by the decreased ability of blood to carry vital oxygen around the body. One of the most common causes is nitrate in drinking water. It is most important in bottle fed infants and water from wells in rural areas is of special concern. Controlling nitrate levels in drinking water sources to below around 50mg/litre is an effective preventive measure. Boiling water does not remove nitrates.

2. Water-washed Diseases

Water-washed diseases are spread when people do not use enough water for personal cleanliness. The important type of these infections is those of eyes, skin or the intestinal tract. The important water washed diseases are:

(a) Trachoma - Trachoma is a contagions eye disease that can result in blindness.

(b) Cyanobacterial Toxins - Cyanobacteria or blue-green algae occur worldwide especially in calm, nutrient-rich waters. Some species of cyanobacteria produce toxins that affect animals and humans. People may be exposed to cyanobacterial toxins by drinking or bathing in contaminated water. Humans are affected with a range of symptoms including skin irritation, stomach cramps, vomiting, nausea, diarrhea, fever, sore throat, headache, muscle and joint pain, blisters of the mouth

and liver damage.

(c) Guinea-Worm Disease (Dracunculiasis) - Guinea worm disease is a debilitating and painful infection caused by a large nematode (roundworm), Dracunculus medinensis. It begins with a blister, usually on the leg. Around the time of its eruption, the person may experience itching, fever, swelling and burning sensations.

(d) Japanese Encephalitis - Japanese encephalitis is a viral disease that infects animals and humans. It is transmitted by mosquitoes and in human causes inflammation of the membranes around the brain.

(e) Leptospirosis - Leptospirosis is a bacterial disease that affects both humans and animals. The early stages of the disease may include high fever, severe headache, muscle pain, chills, and redness in the eyes, abdominal pain, jaundice, hemorrhages in skin and mucous membranes (including pulmonary bleeding), vomiting, diarrhea and a rash.

(f) Ringworm (Tinea) - Ringworm or Tinea is a typically mild disease of the skin, scalp or nails caused by a fungus. Personal hygiene, supported by availability of adequate quantities of water are important preventive measures.

3. Vector Diseases or Water-Site Related Diseases

Such diseases are spread by organisms like mosquitoes and flies (vectors) that breed in or near the water.

(a) Malaria - Mosquitoes are the vector responsible for malaria transmission. It is a parasitic disease caused by the bite of an anopheles mosquito. Anopheles breeds in relatively unpolluted surface water like puddles, slow-flowing streams and wells.

(b) Lymphatic Filarisis - Lymphatic filarisis is transmitted by *Culex* mosquito which breed in stagnant water loaded with organic matter such as human excreta.

(c) Dengue Fever - Dengue is also mosquito borne infection. Dengue viruses transmitted to humans through the bites of infective female aedes mosquito, which breed in water receptacles such as bottles, buckets, tyres.

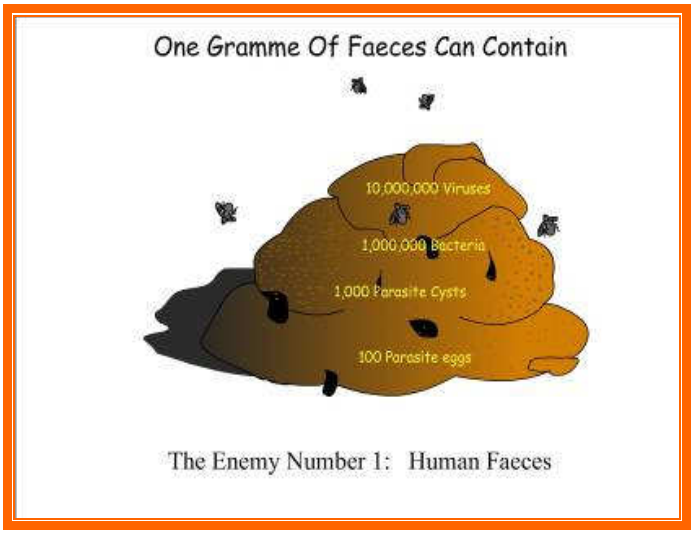
4. Other Diseases and Problems Related to Water

(a) Drowning - Drowning can be avoided by some safety measures and through environmental and behavioral modifications and regulations.

(b) Spinal injury - Deformities of spine occur when water has to be fetched and carried long distances over a considerable period of time.

(c) Malnutrition - Childhood underweight caused about 35% of all deaths of children under the age of five years. An estimated 50% of this underweight or malnutrition is associated with repealed diarrhea or intestinal diseases.

(d) Anemia - The main cause of anemia is iron deficiency. Anemia affects all population groups. However the most susceptible groups are pregnant women and young children. Anemia is associated with fatigue, weakness, dizziness and drowsiness. The signs include loss of normal colour in the skin (in fair skinned people) and also in the lips, tongue nail beds and the blood vessels in the white of the eye. Low birth weight infants, young children and women of childbearing age are particularly at risk of anemia. Diseases like malaria, hookworm infections, schistosomiasis, gastro-intestinal infections and diarrhea are some of the reasons of anemia.



5. Prevention of Diarrhea and Other Diseases

Among all diseases diarrhea is one of the top three killer diseases in developing countries, claiming the lives of more than three million children a year and 443 million missed school days. Diarrhea is loose watery stools. A person with diarrhea possess stool more than three times a day.

5.1. Symptoms of Diarrhea

1. Stomach aches and cramping.
2. Frequently watery stool.
3. Irritability
4. Loss of appetite.
5. Vomiting.
6. Dry mouth.
7. Decreased urination.
8. Sluggishness and decreased energy
9. Absence of tears when crying
10. Tiredness

The microbes of diarrhea take from faeces, through the environment, to a new person. For example; microbes in faeces on the ground by a well can get into the water (fluids) and be drunk by a child, hands that have not been washed after going to the toilet can carry microbes onto foods, which are then eaten, infecting another child, who gets diarrhea and spreads more microbes. The use of oral re-hydration salt (ORS) is the quickest and most effective in treatment of diarrhea.

6. How Water Gets Contaminated

Unprotected water sources like rivers, streams and wells are easily contaminated by animals drinking or defecating in the water, washing of clothes and utensils on the shores of water sources, bathing, defecating

and disposing waste, dead animals in and around the water sources, runoff from sewage pits and agricultural fields etc. Even if the water is drawn from protected source like borehole or covered well, the water may get re-contaminated during transport and at the household level. People with faecelly contaminated hands touch water stored in wide mouthed containers. The faeces of animals like pigs, cows and chickens can also carry diarrhea microbes. Poor food handling practices contribute to diarrhea infection largely because they offer bacterial pathogens the opportunity to multiply. This way, people can consume much greater doses of microbes. Diarrheas often peak in warm, humid seasons in the tropics, when conditions are favorable to the multiplication of bacteria on food. Food stored in a warm place is an environment that microbes like, where they can multiply easily. Feeding bottles are especially dangerous because they are hard to sterilize and bacteria grow quickly in warm milk. Poor handling of bottles and child food are therefore major risk factors for diarrhea diseases in young children.

6.1. How to Break the Transmission Chain?

Vector-borne and other water borne diseases can be controlled through a variety of initiatives, including appropriate site selection and shelter provision, appropriate water supply, excreta disposal, solid waste management and drainage, the provision of health services (including community mobilization and health promotion), the use of chemical controls, family and individual protection and the effective protection of food stores. If we can prevent faecal material from getting into the environment in the first place then we do not have to worry so much about purifying water, storing food correctly or keeping away flies. Therefore, our first priorities should be safe stool disposal and proper hand washing after stool contact. Ideally, adult and child stools should be

disposed of in toilets or latrines, where this is not possible, stools should be buried. As a last resort, it is better to carry stools to a place far from play areas or water sources and cover with earth, than to leave them lying in the yard. While feeding infants, a bowl cup and spoon is preferable to a bottle, both for infant milk and semi-solid food.

Mosquitoes Control

- Removal of aquatic plants from water bodies where mosquito larvae may find shelter.
- Introduction of predators such as larvivorous fish in ditches where water is stagnated (Gambusia).
- Use of mosquito nets.
- Elimination of standing water which are breeding sites.

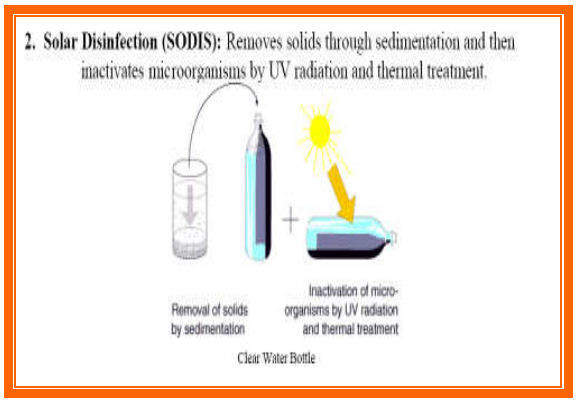
6.2. Water Storage and Hygiene at Household Level

Each household should have at least two to three clean water collecting earthen and copper pots of 10-20 liters, plus enough clean water storage containers to ensure there is always water in the household. There is at least 250g of soap available for personal hygiene per person per month. Where soap is not available or commonly used, alternatives can be provided such as ash, clean sand, soda etc for washing and/or scrubbing. Washing clothes is an essential hygiene activity, particularly for children, and cooking and eating utensils also need washing. Water can be made safe for human use by the following ways:-

(i) Boiling for 12 minutes.

(ii) Solar disinfection.

(iii) Use of chemicals by adding bleaching powder



(i) Using water containers having a narrow mouth (to prevent hands from reaching and re-contaminating the water) and a tap or other safe water

containers are covered buckets with a tap, covered clay pot, jerry cans.

Proper Hand Washing Technique:

Hands readily become contaminated with faecal material after anal cleansing or after cleaning children's bottoms and stools. Rinsing fingers with water is not enough to remove sticky particles which contain microbes. Hands need to be well washed after contact with faeces; either rubbed with an abrasive such as ash or mud, or with a detergent such as soap. Hand washing can reduce diarrhea by 42-47%.

1. Place hands together under water
2. Rub thoroughly with soap or ash or clean sand or soda covering all surfaces including under nails for 15 seconds.
3. Rinse hands
4. Dry your hands completely with a clean towel if available, or air dry

7. Sanitary Protection and Disinfection of Wells

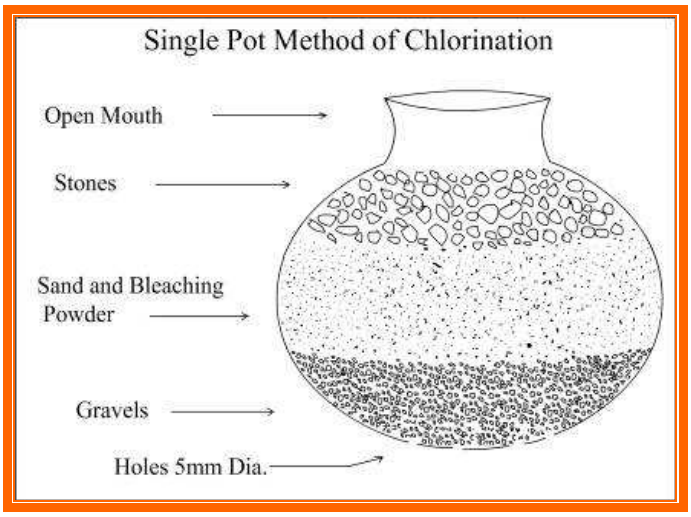
To protect open wells from contamination, the provision should be made

for parapet walls and proper covering of wells. The distance up to at least 2 meters from the periphery of the well should be sanitary protected by constructing RCC platform or by blanket of gravel and sand. The stray animals can be stopped using fencing around the well area. The installation hand pump on covered wells is an effective method to protect the well; and to withdraw water.

For disinfection, bleaching powder or potassium paramagnet solution is used. A small teaspoon of bleaching powder, dissolved in a cup of water, can disinfect 250 liter of water. The water can be used after half an hour of disinfection. To estimate the quantity of Alum powder required, the volume of water in well is to be estimated by measuring depth and diameter of well.

7.1. Pot Chlorination

(a) Single pot system



An earthen pot or a plastic container of 2 to 2.5 liters capacity with 3-5 mm dia holes at the bottom is half filled with gravels of 8 to 20 mm size. Bleaching powder and sand (1:2 proportion) is placed on top of the gravels and is further filled with gravels up-to the neck. The pot is then lowered into the well with its mouth open.

For a well from which water is taken at a rate of 1000-1200 liters/ day, a pot containing about 50-55 gm of bleaching powder could provide

adequate chlorination for about 1 week. Often over chlorination may result from single pot chlorination system.

(b) Double pot system

A unit consisting of two cylindrical pots inside the other with openings (top side opening of inner pot and bottom side opening of outer pot) may be used as double pot chlorinator. The inner pot is filled with bleaching powder and coarse sand (1:2) to the level just below the opening. It is then placed inside the outer pot. The top of the chlorinator is covered by polythene sheet. The unit is lowered into the well with the help of a rope. The single pot or double pot chlorination will be effective, once the dug well has been disinfected properly.

8. Removal of Fluoride

There are various methods to remove fluoride from water:

1. Use of Alum and Lime
2. Reverse Osmosis Method
3. Activated Alumina Method
4. Use of Pipal (Ficus R.) leaves powder has been found effective in removal of fluoride.

2

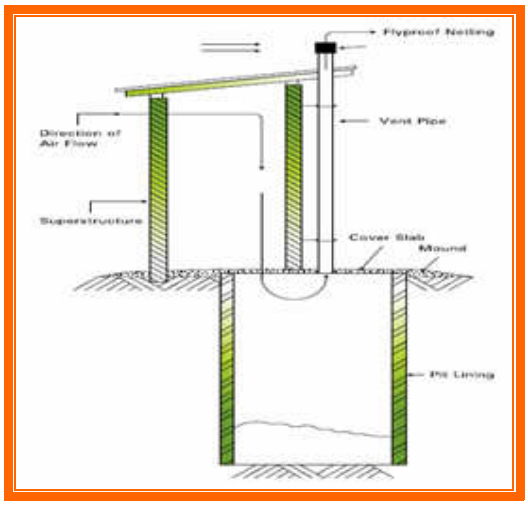
Sanitation

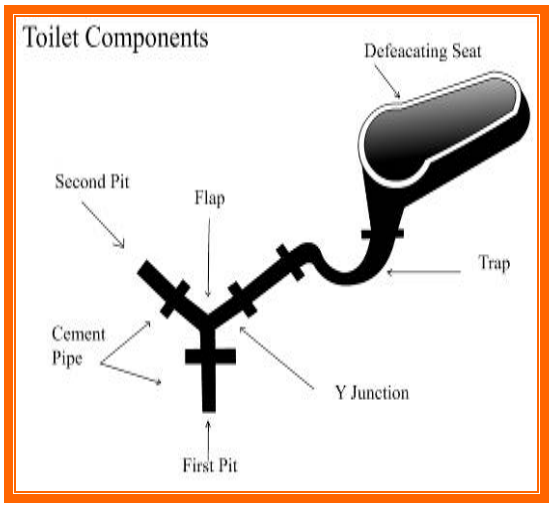
1 What is Sanitation

The term ‘sanitation’ refers to excreta disposal, vector control, solid waste disposal and drainage.

2 Excreta Disposal

The community shall be provided adequate numbers of toilets, sufficiently close to their houses and in order to facilitate them rapid, safe and acceptable access at all times of the day and night.





3. Latrines: Technological Options

3.1. Ventilated Improved Pit Latrine

A VIP latrine is a non-water dependent latrine, which doesn’t require water for functioning, though a small amount of water can be used to clean the squat plate occasionally. These groups of latrines are suitable for water-scarce areas. A ventilated improved pit latrine is an improved conventional pit latrine, slightly offset from the pit and having a tall vertical (gradually tapered towards the pit) vent pipe with a fly-screen

fitted outside the superstructure to trap flies and reduce odor nuisance.

3.2.Twin Pit VIP Model

VIP toilets can also be constructed with a double pit system. The toilet has two shallow pits, each with their own vent pipe but only one superstructure. The cover slab has two drop holes, one over each pit. Only one pit is used at a time. When one is full, its drop hole is covered and the second pit is used. After a period of at least one-year, the contents of the first pit can be removed safely and used as soil conditioner. The pit can be used again when the second pit is filled up. This alternating cycle can be repeated indefinitely.

3.3. Pour Flush Latrine

This is water dependent latrine that relies mainly on the usage of water. Without water, these latrines fail to operate. The water flushes out excreta from bowl, which consists of a water-seal generally known as a trap. The water dependent latrines can be further categorized on the basis of: Flushing (pour flush or mechanical flush). Pour flush, though, is more operational and suitable to the conditions of rural areas.

The pour flush latrine is a specially designed water-sealed bowl, which requires 1-2 liters of water for flushing the excreta. Some water always remains at the bottom of the pan after it has been used. This water seal latrine eliminates the entry of odor and prevents rodents to the latrine room from pit through the bowl. This pour flush latrine consists of a single pit either just below the bowl (onset type) or may be offset from the bowl (offset type) using the pour flush type bowl (pan and trap).

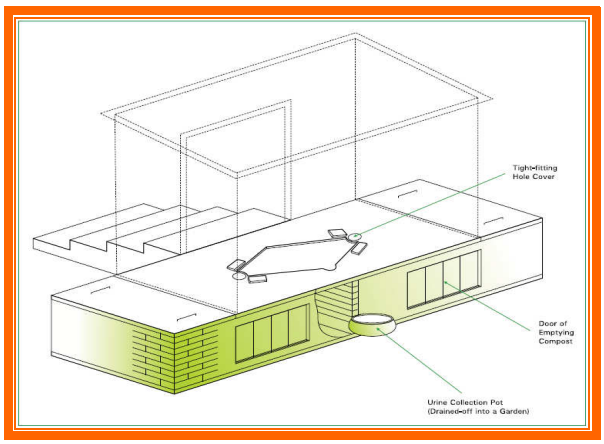
After defecation, 1-2 liters of water is poured to flush the excreta out of the pan, which accumulates in the pit where decomposition takes place. The gas formed during decomposition escapes through the joints/

openings of the pit lining and is absorbed by the surrounding soil. The effluent is leached out and absorbed by the soil while the solid part (sludge) accumulates in the pit. Thus, on prolonged use, the pit gets filled up. When this happens, a second pit is constructed and the squatting slab and superstructure are shifted over it. The filled up pit is covered with a thick layer of soil and allowed to be stabilized for about two years. During this time the contents of the filled-up pit will have become organic humus and safe for handling. When the second pit also gets filled up, after two years or so, the first pit is cleaned, the squatting slab and superstructure is shifted back over it and thus a continuous operation of a direct pit toilet is achieved. Since the superstructure has to be shifted repeatedly, only a temporary construction is recommended for this type of a toilet.

3.4. Twin Pit Water Seal Toilet

The 'Twin Pit Water Seal Toilet' is a complete excreta disposal system which, on one hand fulfills all the sanitary requirements and on the other hand, provides continuous operation with minimal effort. The main components of such a toilet are the water seal pan/ trap arrangement, squatting platform, junction chamber, two pits and a superstructure.

3.5. Eco-san Toilet



Ecological sanitation (Double Vault Compost Latrine) is based on recycling principles. In this approach, the excreta and urine are separated for disposal. The eco-san model consist the double-vault compost latrine consists of two water-tight

chambers (vaults) to collect faeces. Urine is collected separately as the contents of the vault have to be kept relatively dry. Initially, a layer of absorbent organic material is put in the vault and after each use, the faeces is covered with ash (or saw-dust, shredded leaves or vegetable matter) to deodorize the faeces, soak-up excessive moisture and improve carbon/nitrogen ratio, which ensures that sufficient nitrogen is retained to make a good fertilizer. When the first vault is three quarters full, it is completely filled with dry powdered earth and sealed so that the components can decompose anaerobically. The second vault is used until it is also three quarters full and the first vault is emptied by hand, the contents are used as a fertilizer.

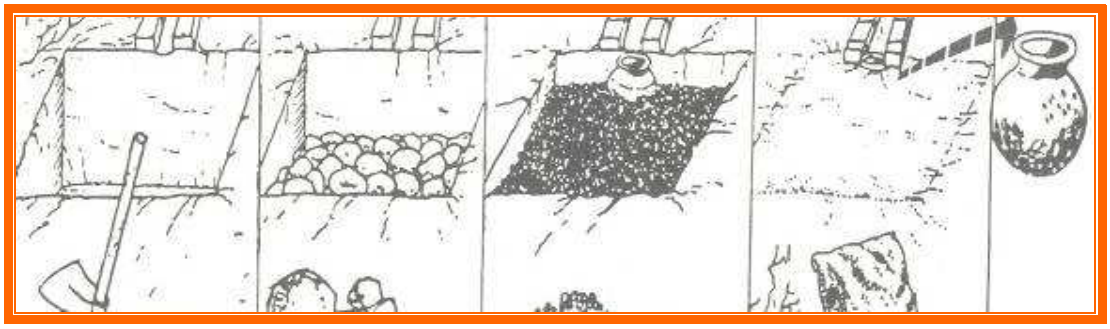
The vaults have to be large enough to keep faeces for at least a year in order to become pathogen free. The superstructure is built over both the vaults with a squat-hole over each vault which can be sealed-off. The latrine can be built everywhere as there is no pollution coming from the water-tight chambers to pollute the surroundings.

It is most ideal for areas where water is scarce and pour-flushing implies water to be carried from source, or areas where water table is high such as flood plains or coastal areas and densely populated areas where risks of ground water pollution from pits to drinking water sources is assessed high.

4. Disposal of Waste Water

4.1. Soak Pit

Soak Pit is constructed by filling gravel and brick bats in a ditch. The size of the ditch is generally 1 meter x 1 meter x 1 meter. The entire depth is divided into three equal horizontal sections. The bottom most one third portion is filled with stone pieces of 10-15 centimeter diameter. The next one third portions are filled with stones of 5-10 centimeter diameter.



Now, an earthen pot with small holes is kept on this layer. The area surrounding pot is filled with stone pebbles of one centimeter diameter up to a mark 10 centimeter below from the mouth of the pot. The bottom periphery of pot is covered by leaves. The top 5 centimeter depth is also filled with jute cloth, tree branches.

4.2. Oxidation Ponds and Stabilization Ponds

Stabilization ponds are open flow-through earthen basins, specifically designed and constructed to treat sewage and biodegradable wastewaters. Oxidation pond is an earthen pond, dug into the ground, with shallow depth. Usually, to treat waste water of 200 houses, an oxidation pond of size 100 feet x 50 feet x 6 feet is sufficient. The detention time in the pond is usually 2 to 6 weeks, depending upon sum light and temperature.

4.3. Disposal of Organic Garbage

A pit of size 1 meter x 1 meter x 1 meter is used to dispose of organic waste. The waste is covered by an earthen layer of one inch. When the pit gets filled, a thick soil is laid on it. The garbage will convert into manure after three months.

Module 4

Livelihood Generation

1. Scientific Agriculture
2. Horticulture
3. Water efficient Methods of Irrigation

1

Scientific Agriculture

1. Scientific Agriculture

1.1 How to Increase Crop Production?

- ✓ Testing of field soil samples and application of manures and fertilizers as per the scientific recommendations.
- ✓ Deep summer ploughing to control harmful insects, pests, crop diseases and weed problem.
- ✓ Use of compost, super compost, Nadap, PROM (Phosphorous Rich Organic Manure) and vermicompost instead of direct application of raw dung.
- ✓ Use of high yielding variety seeds obtained from reliable sources/vendors and seed treatment through appropriate materials.
- ✓ Line sowing; recommended row to row, plant to plant distances, appropriate seed rate and ten percent higher seed rate in case of late sowing.
- ✓ Timely weed control and hoeing as per scientific recommendations.
- ✓ Use of bio-fertilizers in recommended doses.
- ✓ Controlled irrigation and efficient use of water. Application of water on critical stages of plant growth.
- ✓ Protection of Rabi (winter) crop from frost.
- ✓ Use of appropriate hand operated, bullock drawn and tractor drawn agricultural tools and implements.
- ✓ Application of appropriate agro-chemicals to control diseases and pests.
- ✓ Crop rotation. Sowing of leguminous crop at least once in a year.

- ✓ Inter-cropping during Kharif (monsoon) season in order to minimize risks.
- ✓ Soil and water conservation.
- ✓ Reclamation of saline soils and acidic soils through gypsum and lime respectively.
- ✓ Application of gypsum to increases quality and yield of oilseeds and leguminous crops.
- ✓ Use of agro-waste to prepare organic manure.
- ✓ Sowing and ploughing across the slope on sloppy lands.
- ✓ Protect beneficial insect/eco-friendly insects. Use light trap and pheromone for control of harmful insects.
- ✓ Safe storage, cleaning and grading of produce before marketing.

1.2. Soil and Water Testing for Increased Qualitative Yield

To increase and sustain the productivity of the land; and to get good yield, 16 to 21 essential nutrients in the right proportion are required. The soil and water scientists after testing soil and water samples recommend the treatments that are required. Soil should be tested before every time the seeds are sown i.e. before every crop season. The samples of soil should be collected from different places of the field

1.3. What is Vermicompost?

Vermicompost is the valuable organic manure, formed by biological conversion of solid animal and plant wastes through the activities of earthworms. Along with earthworms, bacteria, fungi and actinomycetes participate in the process of vermicompost. The crops produced with vermicompost are of good quality. A large quantity of animal waste and plant residue is produced in agriculture but is not utilized productively.

The farmers usually burn all this useful biomass which can be used as raw material for vermicompost.

1.3.1. Earthworms

There are around 3000 types of species of the earthworms in the world out of which more than 350 species have been identified in India. Epigeics type of earthworms is effective in composting.

1.3.2. Benefits of Using Vermicompost

- The actinomycetes present in vermicompost, improves the immunity of plants to fight the diseases. Actinomycetes are not found in cow dung.
- Water retention ability and fertility of soil get improved, which in turn retard the process of soil erosion.
- Humus is conserved which reduces quantum of irrigation water.
- The plants get a balanced supply of nutrients.

1.3.3. How to Prepare Vermicompost?

- To prepare vermicompost, a shady place is required. The site should be free from the problem of water logging and source of water is available.
- The area of the shed depends upon the availability of quantum of solid organic wastes.
- The size of beds depends upon availability of cow dung. Its length depends upon the amount of waste. Width should be at least three feet to make troving over convenient.
- Spread a thin layer of neem tree leaves, on top of it put four to five days old cold cow dung and put some water to moist it. Above this, spread one inch thick layer of vermi culture which has earth worms. The earthworms will move down in search of dampness.

- On top of this, spread dried leaves etc and then cover it properly with gunny bags and keep it wet by sprinkling water.
- Within 2-3 months, this mixture turns into vermicompost. Earthworms eat organic materials and leave their casting on top of the heap.

1.3.4. Precautions to be taken while doing Vermi culture

- The beds should be protected from direct sunlight and rain, otherwise earthworms will die.
- Water should be sprinkled twice in summer and as per the need in other seasons.
- Time required in vermicompost depends upon the number of earthworms and their care.
- Once vermicompost is ready, a fresh bed of four to five days old dung should be kept ready so that earthworms can be transferred to it. Otherwise earthworms will die out of hunger.
- For seasonal crops, apply 2.5 to 3.0 tons of vermicompost per hectare of sown area.
- For fruit trees, use 3 to 5 kg of vermicompost per plant.

2

Horticulture

1. Horticulture

The traditional crops like wheat, maize, oil seeds etc require relatively more water. The farmer is not able to get appreciable yields of these crops because of small land holdings and adverse, unpredictable climatic conditions. Horticulture is an area where the farmer can grow fruits and vegetables along with other traditional crops in the same field. These interfaces not only raise income through the same land holding, but fulfill the nutritional requirements of the family also. There is need to train the farmer community on following aspects of horticulture:

- ✓ Selection of crop species as per local agro climatic coalitions, soil type and water availability.
- ✓ Seed treatment.
- ✓ Pest, insect and diseases control.
- ✓ High tech agriculture, improved methods of irrigation.
- ✓ Processing and preservation.
- ✓ Marketing.

The amount of water required to grow 1 kilogram fruits is one fourth of water required to grow the same quantity of grain.

1.1. Nursery Management

The person who develops and manage nursery has a kind of emotional attachment with the plant; and the experience and knowledge acquired helps in upkeep of the plants and trees of the entire area. The training of

farmers on grafting, budding and cutting etc helps in increased production.

Moringa (Drum Stick) is one of the most nutritious vegetable and can grow in almost all types of climatic and soil conditions. All parts of drumstick are useful. The months of June-July and November-December are suitable for seed sowing. About 500 gram seeds are required for one hectare area. Before sowing, 45 cm X 45 cm X 45 cm size pit at 2.5 meter spacing are dug one week before sowing. The seeds are sown in the centre of the pits. The seeds germinate after 7 to 9 days. The field should be maintained weed free for initial two months. One tree provides 200 fruits per year. The organic manure @ 75 kg per plant can be given to one year old plants during June in trenches, one meter away from the plants.

1.2. Mixed Farming

Animal Husbandry can play a significant role in the livelihood improvement of the farmers. The marginal and poor farmer can benefit themselves by adopting mixed farming i.e. agriculture, animal husbandry, poultry, fish culture etc. as all these are supplementary to each other.

3

Water Efficient Methods of Irrigation

1.1. Sprinkler Irrigation

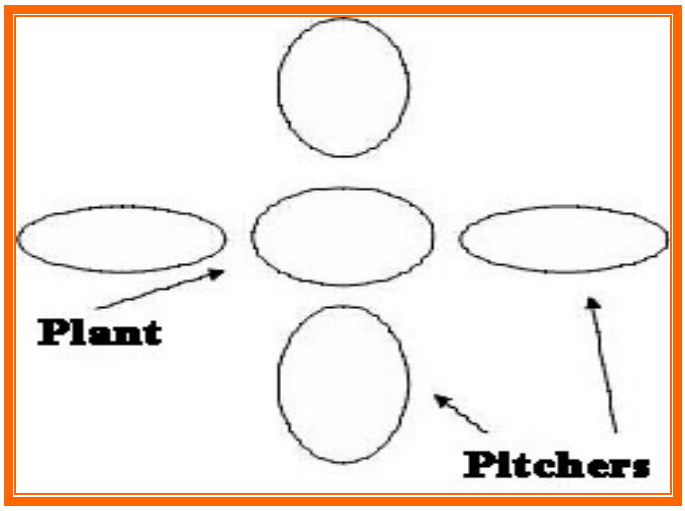
In Sprinkler irrigation water is sprayed in the form of rain uniformly over the land surface. The application efficiency in sprinkler irrigation is higher than in surface irrigation. When the ground water is saline and the water resources are limited, sprinkler irrigation may be preferred. There is almost 50 percent saving of water.

1.2. Drip and Trickle Irrigation

Under favorable soil conditions and when water is extremely scarce, water can be supplied within root zone through specially designed emitters or nozzles. The evaporation from water and soil surface is reduced and very high application efficiencies can be obtained. The water saving is about 70 to 80 percent.

1.3. Pitcher Irrigation Method

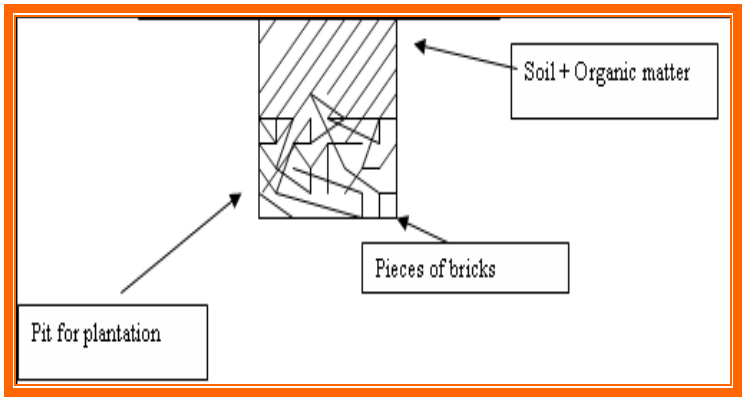
In the pitcher method of irrigation, clay pots are used for irrigating the plants. While planting the fruit orchards, at the nascent stage of plants (when plant age is between 3 to 12 months) only one pot is placed at the root zone of the plant. This pot is filled with water every two to three days. Root zone of the plant sucks required amount of water from this



pot. These pots are made from a mixture of sand and clay. Sand is added to increase the porosity of the pot to facilitate the easy flow of water towards root zone. As plant grows another pot is placed at the opposite side of the previously placed pot. This is done as plant grows the water requirement of plant increases and more water is needed that can be met through this additional pot. As plants grow further, two additional pots are placed for each plant crossing the line of previously placed pot.

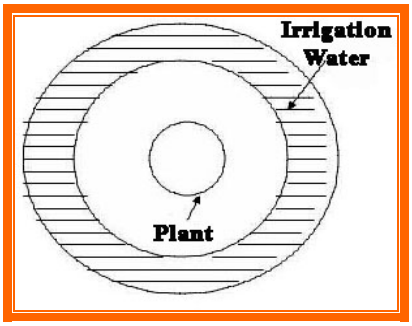
This method of irrigation also saves about 50 per cent over the conventional method. Problems of weed growth is also reduced as there no moisture available on the ground to induce the growth of weeds.

1.4. Crumbled Brick Pieces in the Pit Method



In this method, after digging the pits, the lower half of the pit is filled with the crumbs of the broken bricks. As bricks are having good void ratio, it has better water holding capacity than the texture of the soils generally. This provides more amount of water available to the root zone of the plants. This reduces the amount of loss due to water percolation. This saves the water.

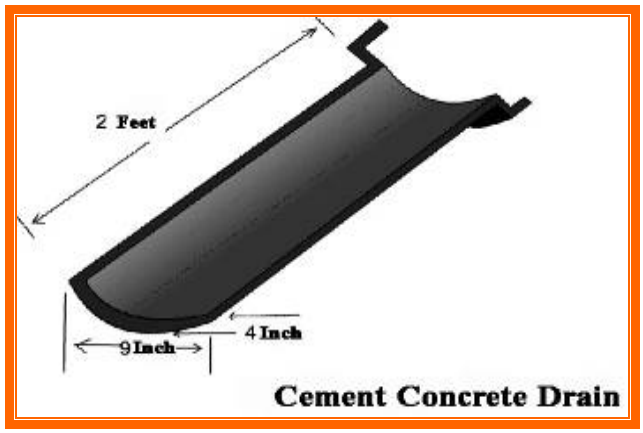
1.5. Ring Method



In yet another method of Irrigation to the orchard plant, two rings (1 feet apart) are made at the outer periphery of the plant shadow at the afternoon. This shadow

exactly gives the information about the formation of roots of plants. Tap roots send water to all parts of the plant. So water is required on tap root part of the plant. Instead of filling the whole ring of the plant, water should be given to this part of the plant. This saves about 60% of the total water required for plant. It also reduces the potential of weed growth.

1.6. Pre Cast Irrigational Channels



Almost 50% of the water is wasted in seepage while it conveyance to the sown area through field drains. During summer, the water level in the wells reduces drastically and less quantity of water is available for irrigation. The water quantity gets further reduced by the time it reaches to the fields. This problem can be overcame and water be conserved by laying precast cement concrete channels.

The single piece is of nine inch diameter and two feet long. It is prepared by casting cement and sand mixture in a mould. The channel so molded is cured for 8-10 days. One end of the channel is made like a socket so that two pipes can be joined together.

Established on 28th November, 2001, India Water Partnership (IWP) is a non-profit organization with a goal of promoting Integrated Water Resources Management (IWRM). It is also accredited by the Global Water Partnership (GWP) headquartered at Stockholm, Sweden as GWP Country Water Partnership known as GWP-India. The mission of IWP is to support action of sustainable and integrated development and management of water resources at national, regional river basin/sub-basin and local levels in India through promotion of Integrated Water Resource Management.

Addressing adaptation to climate change with the support of zonal water partners across the country; encouraging use of innovative low cost water saving technologies by the farming communities; sustainable natural resource management; integrated domestic water management; promoting Area Water Partnership (AWP) for river basin management; conflict resolution on water sharing; inter-state trans-boundary water sharing issues, gender mainstreaming, etc. are some of the core priority areas of IWP.

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