Food and Agriculture Organization
of the United Nations

Farmer Water Schools: A manual for facilitators

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Contents

1. Demand Side Management of Groundwater

1.1 Introduction:

Management of groundwater continues to pose a major challenge to sustainable livelihoods. In many parts of the world, drinking water, irrigation and industrial needs are met from groundwater resources. However, these resources are depleting and degrading at an alarming rate. Therefore, increasing the supply of groundwater is very difficult. However, managing the demand for groundwater is a feasible option. Various approaches have been tried out in different parts of the world to promote sustainable management of groundwater resources, and institutional responses at different levels. It is evident, however, that unless water users themselves take the initiative in managing and regulating groundwater resources, there is little scope to reverse current trends and sustain livelihoods that are dependant upon continued access to groundwater.

For users to effectively manage groundwater resources, they need access to social and technical knowledge, support in building local level institutions, and assistance in preparation of regulatory frameworks. The Andhra Pradesh Farmer Managed Ground Water Systems (APFAMGS) Project aims to enhance the ability of farmers, water user groups and communities to manage their groundwater resources in a judicious and sustainable manner. Towards this end, the project uses an integrated multi-disciplinary approach, addressing hydrological, agro-technical, institutional and social aspects of village life and livelihoods.

The Andhra Pradesh Farmer Managed Groundwater Systems (APFAMGS) Project is a Nationally Executed (NEX) Project of the Food and Agricultural Organization (FAO) of the United Nations implemented in the southern state of Andhra Pradesh, India. The project is being implemented by a federation of nine NGOs. Bharathi Integrated Rural Development Society (BIRDS) acts as the thematic and administrative leader of the coalition. The project covers about 650 villages in seven drought-prone districts of Andhra Pradesh (South India): Anantapur, Chittoor, Kadapa, Kurnool, Mahabubnagar, Nalgonda, and Prakasam.

Sustainable change can happen only through empowering people to collectively manage their existing resources. For this, the APFAMGS Project engages all water users in a given hydrological unit in judicious use of groundwater. To reach large number of farmers, tap their existing knowledge and skills, and create a discovery and experiential learning environment the APFAGMS Project adopted the Farmer Water School (FWS) approach. FWS is an adaptation of the Farmer Field School (FFS).

An FFS is a participatory approach that enables farmers to make a choice in methods of production through discovery learning. In the Farmer Field School (FFS) a **group** of farmers

with common interests get together on a regular basis to study the "*how and why*" of a particular factor affecting crop production. The topics covered can vary considerably - from Integrated Pest Management (IPM), organic agriculture, animal husbandry, and soil husbandry, to income-generating activities such as handicrafts (Gallagher, 2003).

Groundwater availability is a critical factor in determining crop-yield in semi-arid areas. Farmers need to observe and analyze groundwater availability and discuss the situation with other farmers and make collective decisions. Over the past few years, the APFAMGS Project explored the possibility of adaptation of FFS methodology to groundwater management to enable farmers a 'hands on learning' experience on various factors influencing groundwater availability and make rational decisions on crop-water management. Furthermore, it was felt that the adaptation of FFS approach would help sensitize all the farmers in a hydrological unit that the water resources in their basin are a common resource, and that there was a need for collective management of the resource for sustainability.

The Farmer Water School (FWS) uses the year long hydrological cycle as its basis. Farmers meet once every 15 days, from June through May, to discuss concepts around groundwater management – namely, availability of water resources, impact of available water resources on crop growth, role of institutions in sustainability of groundwater management, and the role of gender equity in decision making, and farming and livelihoods in general.

To reach large number of farmers and tap the existing knowledge and skills of the farmers, the project came up with the idea of multiple cycles of implementation. In this process, the project staff facilitate a FWS at the hydrological unit (sub-basin consisting of number of habitations) level. After having participated in the session, the farmer participants form pairs to facilitate a FWS in their respective habitations with other farmer participants. The NGO staff participate in the habitation level FWS to observe and provide need-based assistance. The farmer institutions - the Groundwater Management Committees (GMCs) and Hydrological Unit Networks (HUNs) – are actively involved in the whole process. Thus in 2006-07, the NGO staff directly conducted 34 FWS. The farmer participants from the first cycle implemented 272 FWS reaching 10,000 farmers in all. From the hydrological year 2007-08, the farmer institutions and farmer facilitators have led the management and implementation of FWS while, the project staff supervised and monitored the process.

1.2 Purpose of the Manual:

The manual highlights the successful adaptation of FWS to groundwater management – FWS. It elaborates the FWS implementation process. It documents the:

- Documents the steps in FWS implementation,
- Illustrates the FWS curriculum,

- Discusses the rationale of various topics in FWS curriculum,
- Explains the steps in setting up farmer experiments, and
- Describes the facilitation process.

Thousands of farmer participants were involved in the design and development of FWS materials and models. This manual is an effort to bring forth the contributions of farmers in demystifying groundwater science and an effective adaptation of FFS to FWS.

2. Groundwater

Water is the most important input in agriculture. Understandably, agriculture continues to be the biggest user of water in spite of increased demand for other uses resulting from growing industrialization and urbanization. It is estimated that about 69% of surface/groundwater around the globe is consumed by the agriculture sector (FAO, 2002). The world over, groundwater extraction is reaching unsustainable limits in regions with fast growing population and high density of borewell/ tube wells. Declining groundwater levels, land subsidence, increasing minerals like arsenic, fluoride, salinity are the common ill effects. India, China, Pakistan, Bangladesh, Yemen, Jordan, Mexico are some of the countries already witnessing the negative consequences of groundwater over pumping. Despite the problems, groundwater provides the best opportunity for human development. Groundwater is easily accessible to a large number of users and provides cheap, convenient, individual supplies. Groundwater development is also largely self-financing. Its largely private development and use ensures automatic cost recovery. When it is not degraded by human intervention, the major advantage of groundwater is its good potable quality.

2.1 Indian Scenario:

In the past three decades, large parts of India especially the states of Punjab, Haryana, Gujarat, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu have witnessed groundwater depletion at alarming rates. Overexploitation of the available groundwater resources is the main cause for depletion. Non-performance of surface irrigation projects combined with a range of incentives offered under various developmental programs encouraged use and misuse (indiscriminate use) of the precious groundwater resources. As a result, groundwater draft has far exceeded the recharge. Most of such developmental programs have triggered steep decline in groundwater levels leading to water shortages, water quality degradation affecting the drinking water supply, and agriculture production system.

A planning commission expert committee group on groundwater (2007) observed that more than 55% of all irrigation water needs are met from groundwater, and more than 80% of all rural water supplies are groundwater dependent. Additionally, all the rural cottage and small scale industries are dependent on groundwater. Increasing demand for groundwater over the years is largely because of the failure of surface irrigation projects to deliver water to farmers/ users at the appropriate time, and in desired quantities. This has forced more and more farmers and rural water supply agencies to invest huge sums on what was thought to be a more dependable irrigation source, tube wells. It is estimated that currently there are over 20 million groundwater structures in the country. More than 15% of these structures have been abandoned due to lowering of groundwater water levels or deterioration in groundwater quality. Another 15% of the wells are functional only for 3-6 months in a year. Over-

exploitation of groundwater is thus a matter of great concern that has to be handled in a way so as to limit the serious fallouts from failing wells.

In the recent years, the emphasis has turned to sustainable management of groundwater by various stakeholders. A dwindling resource base and escalating needs of growing population are the primary reasons for increased demand for groundwater. Augmenting the supply through improved recharge and judicious use of available water are two ways of addressing the current scenario.

2.2 Supply Side Management of Groundwater:

Watershed treatment, artificial recharge, and afforestation, are examples of programs that target the supply side of the groundwater management. Such programs try to put more water into the ground, logically for more use. Watershed treatment or artificial recharge of groundwater helps the aquifer to improve its annual recharge. But, researchers find that only a marginal improvement is possible through watershed treatment. Groundwater Estimation Committee (GEC) puts the increase in annual recharge, as a result of watershed development, at 2% of the rainfall received. It is often noticed in the watershed villages that farmers resort to drilling borewells with the hope that they would find water, even if their earlier attempts were unsuccessful. Thus, increased groundwater extraction nullifies the benefit accrued by the watershed treatment.

2.3 Demand Side Management of Groundwater:

Demand side management of groundwater involves judicious use of available water. The critical technological challenge is to use less water more efficiently to produce the same or greater benefits. Demand side management requires recognition on the part of the users that co-operative alliances with fellow farmers in the upstream and downstream is critical to address the variation in groundwater resource availability with space and time. The APFAMGS Project has adopted demand side management to address the collective problem of failing wells due to indiscriminate use of groundwater. Equity, common vision, participation, transparency, and accountability are the core principles of this approach.

The Farmer Water School approach serves as a medium to demystify concepts on groundwater and agriculture science and facilitate a discovery and experiential learning process. It involves voluntary participation of all groundwater-user farmers belonging to different socio-economic strata with no financial incentives provided for participation.

A wide range of techniques in conservation practices (soil, land, water, crops) are adopted voluntarily by individual farmers from several habitations simultaneously leading to improvement in groundwater availability across the hydrological unit. Farmer institutions, such

as Hydrological Unit Networks (HUN), have emerged as the main vehicle to federate the farmers from the habitation level Groundwater Management Committees (GMC).

Farmers have adopted various strategies to get the same or greater returns/benefits pumping less water from the ground. They have demonstrated in several hundred villages (638) that Groundwater use could be reduced appreciably through relatively simple practices at the farm level and by adopting new water saving techniques. The greatest advantages with respect to Demand Side approaches have been in the form of postponement of new investments until such time when all the existing systems are operated efficiently. Elimination of the need for spending large amounts of capital for newer capacities has considerably reduced the risks on farmers at a time when suicidal deaths by farmers are on the increase.

3. Evolution of Farmer Water Schools

3.1 Introduction

Since the inception of the APFAMGS Project, attempts have been made to integrate the FFS methodology into project activities. Initially, the methodology was misconstrued to be limited to agriculture alone. The Season-Long FFS TOT on Integrated Pest Management (IPM) in vegetables organized by FAO India in May 2005 provided an ideal opportunity for a sustained exposure to FFS methodology. The learning during the Season-Long FFS TOT, and the growing knowledge on successful application of FFS methodology to non-agricultural sectors such as HIV & AIDS and protection of wild life gave the project staff the confidence and conviction to experiment the adaptation of FFS methodology to Groundwater Management.

3.2 Preliminary Discussions

A preliminary workshop was conducted on 8th and 9th June 2005 at BIRDS Training Center (Muthyalapadu, Kurnool District, Andhra Pradesh) to deliberate upon the possibility of adapting FFS approach to Groundwater Management. The outcome of the deliberations was a concept note 'Farmer Field Schools – Groundwater Management (FFS-GM)'. Later in the month of July 2005, a one-day workshop was organized to deliberate up on the content and the steps to implement FWS. The outcome of these deliberations was as follows:

Rationale for adaptation of FFS to Groundwater Management: Earlier, though the hydrological data (record of rainfall received, measurement of static, pumping and discharge of the bore wells) was collected by farmers for entire HU, data analysis and water balance estimation process was done by the staff and shared in the CWB workshop. The dissemination of this process to larger audience was also minimal.

It was believed that the participatory and the discovery learning process of the FFS methodology would enable the Groundwater Management Committee (GMC) members to:

- analyze the hydrological data;
- identify problems in groundwater management;
- understand and discuss the subsurface strata;
- estimate water balance;
- make collective decisions on managing scarce water resources;
- implement decisions;
- share the learning of each session to larger audience in the community;
- engage all farmers in a hydrological unit (through the CWB workshop); and
- disseminate key messages.

The **goal** was to enable the farmers to eventually manage their hydrological system, in a scientific way, with the participation of all stakeholders including community based institutions, government departments and other developmental agencies.

Opportunities and Challenges: Favorable factors and challenges in the adaptation of FFS methodology to Groundwater Management were identified. Factors favorable for the adaptation of FFS methodology to Groundwater Management were listed as:

1. Hydrological Monitoring infrastructure established across the project;
2. Farmer volunteers had adequately been trained to measure and record data;
3. Participatory Hydrological Monitoring (PHM) training modules were available;
4. No additional financial resources were required for the adaptation of FFS to groundwater management;
5. Staff capacities and confidence were being adequately built through the Season-Long TOT that was in progress;
6. Periodical or sequential input of groundwater management concepts through experiential and discovery learning process would enhance the ownership of the learning process and effective management of groundwater resources;
7. Farmer friendly models can be developed with active input from farmers;
8. Indigenous water management practices can be explored;
9. Higher degree of sustainability can be expected in participation and learning; and
10. Social harmony in joint management of scarce water resources would be feasible.

The challenges were identified as:

- Limited field tests in case of ground water.
- Results on water are not immediately visible as incase of agriculture.

Strategies: Several strategies were listed keeping in mind the favorable factors and challenges in implementing FWS. They are:

- One Hydrological Unit, in each PNGO operational area, would be targeted for field testing FWS.
- The duration of FFS would be one year concurring with the Hydrological year. Sessions would be organized fortnightly and each session would last for four hours.
- A workshop would be conducted to design a Training of Trainers (ToT) on FWS. It would also include: a) core message on content, and b) sequencing of content.
- Pre-FFS session meetings would be conducted to select required number of farmers based on the criteria evolved.
- Different problems on water related issues would be identified and prioritized.
- The collected information would be analyzed and an action plan prepared involving all the stake holders.
- Participants in the FWS would include Farmer volunteers (both observation wells and rain gauge stations), Owners of observation wells and rain gauge station sites, Office-bearers of Groundwater Monitoring Committee, some progressive farmers, and landless poor.

- The number of participants in a HU would be limited to 30. Efforts are to be made to ensure equal representation of male and female farmers in all these participant groups.
- Focus would be on creating functional linkages with the existing governmental and non-governmental institutional set up with the community based organizations formed for the specific purpose of sustainable groundwater management.
- Formal schools would be targeted through teacher orientations and curriculum development for school children.
- Process Documentation would be undertaken in the form of proceedings of meetings, village reports, technical reports, photographs, audio tapes, videos, etc.

3.3 Season 2005-06: FFS-CWB

In the first year, the project named this adaptation, Farmer Field Schools in Crop Water Budgeting (FFS-CWB). The current term, Farmer Water Schools, emerged over time.

Selection of Hydrological Units: Each PNGO was encouraged to identify the Hydrological Units for implementing the FFS-CWB. Selection of the HUs was based on the following criteria:

- All physical works should have been completed before June 2005.
- Hydrological data collection should have started before June 2005.
- Farmers are motivated enough to generate a continuous hydrological data record between June-October 2005.
- Farmers possess all the necessary skills to generate continuous hydrological data.

Selection of Participants: In each of the identified HU, participants (in the range of 25-30) were selected based on the following criteria (with a minimum of 40%-50% women):

- should be a resident of the HU,
- must be a groundwater user farmer,
- in the age group of 20 to 45 years,
- should have been an active participant/volunteer in project activities,
- should have ability to articulate groundwater concepts,
- should be a team player with openness to share information, and
- should be nominated by the GMC.

Assistance in FFS-CWB Session Plans: The APFAMGS Technical Support Team [TST] and World Education team visited each of the PNGO teams to:

- Assist in identifying the content to be delivered in FFS-CWB sessions;
- Facilitate incorporation of Nonformal education and participatory approaches in the delivery of the content to the farmers;
- Facilitate the preparation of session guide for FFS-CWB sessions;
- Participate in the planning of the FFS-CWB sessions;
- Assist the teams to reflect upon the process and fine tune the session plans for future FFS-CWB sessions; and

- Sensitize the teams to document the entire process for sharing learning and variations across PNGO teams at the project level.

While facilitating the planning of the sessions with respective NGO teams, Technical Support Team [TST] and World Education team:

- Did not influence the PNGO teams in identification of the content of specific sessions, as that would affect development of variant models.
- Focused on assisting the PNGO teams in visualizing and facilitating with the farmers the relevance of Farmer Field School approach to Crop-water Budgeting exercise.
- Stressed the importance of showing/demonstrating to the farmers 'how to observe' and the importance of 'observation and analysis' in decision making
- Stressed the importance of making the farmer training sessions more an exercise in discovery-learning for the farmers. Accordingly the venue for the FFS-CWB sessions was based on the kinds of geological formations and structures the farmers needed to observe in their respective hydrological units.
- Stressed the importance of recap at the start of each session to help farmers review the core learning of the previous session.

Reflections: Partner NGO teams

- Felt that farmers were showing keen interest in knowing more information about the factors that influence groundwater levels in their HUs.
- Were pleased with the efforts and innovations in presenting the data to the farmers.
- Made sincere efforts to brainstorm and experiment with various farmer-friendly ways and methods to disseminate the FFS-CWB concepts.
- Felt that they have developed more sensitivity in the delivery of the training content.
- Felt that more participatory methods need to be explored to increase farmer ownership of the process and for effective dissemination of FFS-CWB session learning to co-farmers.
- Believed that comprehensive session planning and preparatory work needs to be done prior to the actual conduct of FFS-CWB sessions and farmer trainings.
- Were pleased with the level women participation and their involvement in the FFS-CWB workshop.
- Felt that they should be conscious not to influence the farmers during decision making and analysis.

Farmer participants

- Expressed satisfaction with the knowledge gained by participating in the FFS-CWB sessions.
- Shared that they understand the concepts better if more pictures are used.
- Shared that presentation of data showing comparison between crop area and units of groundwater drawn will help farmers estimate the crop productivity per unit of water used.

- Expressed that FFS-CWB workshops should be organized in all Hydrological Units and all districts whereever water scarcity is present.
- Expressed the need for PNGOs assistance in developing linkages with other government and non-government departments.
- Wanted more information on way of improving the soil fertility
- Expressed that the CWB workshop has become a good forum, for all farmers in a particular Hydrological Unit, for collective decision making and analysis.

3.4 Season 2006-07: FFS-FMGS

Pleased with the success of FFS-CWB, the project made a decision to run a complete cycle of the adaptation i.e. June through May. The term Farmer Field School – Farmer Managed Groundwater Systems (FFS-FMGS) was coined.

Strategies for 2006-07: Partner NGO Teams came up with the following strategies to address some of the constraints in FFS-CWB implementation.

- FFS-FMGS sessions should start in the second week of July.
- The content should be spread over six sessions.
- Two preparatory sessions should take place before the conduct of the FFS-FMGS workshop
- Fifteen days time gap between each session will help farmers attend FFS-FMGS sessions regularly
- Improved rapport with the farmers will help the PNGO teams to mobilize farmers for FFS-FMGS sessions and workshop
- Sensitizing male farmers on women's role in water management would enhance women's participation in FFS-FMGS sessions.
- Smart learning objectives will help in effective facilitation of the session content.
- Farmers need to be trained on the content and usage of various methods to facilitate the sessions and the CWB workshop.
- Involvement of the farmers in the preparation of banners, development of models, and arrangements is necessary.
- Various data collection methods need to brainstormed and experimented with to identify farmer friendly methods.
- Technical information like 'infiltration rate' and 'recharge calculations' and tabular formats of data presentation need to be simplified.
- FFS-FMGS sessions and workshops need to be carried out in all HUs.
- An Orientation workshop on FFS-FMGS process for all the PNGO staff will help common understanding of the content and methods.

Highlights:

- Complete session outline was designed and sixteen FFS-FMGS sessions were planned to cover one full hydrological cycle.

- Session guides for each session were developed in Telugu and made available to farmer facilitators.
- Visuals and physical models were developed for each FFS-FMGS session for better understanding of concepts around groundwater science.
- Training modules on HIV & AIDS were developed and discussed as special topics in FFS-FMGS sessions.
- Encouraged farmers to conduct Long term and short term experiments on issues related to agriculture and groundwater.
- Group dynamics were introduced for group cohesiveness, leadership qualities, and institution strengthening.
- Centralized FFS-FMGS field days were organized by each PNGO to share the learning with larger community.
- During the FFS-FMGS Field Days, farmers coined the term 'water schools'. Accordingly, the term Farmer Water School (FWS) came into use.

3.5 Season 2007-08: Farmer Water School (FWS)

- Complete session outline was revised, and 16 sessions were conducted across all PNGOs.
- Session guides were revised and made more farmer friendly using local language.
- More innovative models were developed on groundwater recharge, crop water requirement, and crop water balance estimation.
- Hydro-Ecosystem Analysis was introduced as a key element in Farmer Water School as an analytical tool.
- HUNs and Farmer facilitators were encouraged to take lead to organize and conduct Farmer Water Schools in the respective hydrological units.
- HESA charts were developed and made available to farmer facilitators for better understanding on the concept.
- Session guides were further simplified to cater to the needs of farmer facilitators.
- HUNs were encouraged to organize FWS field days on their own.

3.6 Season 2008-09: Farmer Water School (FWS)

- FWS planning workshops were organized for HUN members and farmer facilitators to manage FWS on their own.
- Funds were transferred to HUNs for FWS management.
- HUNs and GMCs showed increased ownership and initiative in FWS management and implementation.
- HUNs were more proactive in forging new linkages with government departments and local political representatives.

4. Farmer Water Schools (FWS)

4.1 Introduction

Groundwater availability is a critical factor in determining crop-yield in semi-arid areas. Farmers need to observe, analyze groundwater availability and discuss the situation with co-farmers and make collective decisions. The APFAMGS Project has adapted the Farmer Field School (FFS) methodology to groundwater management to enable farmers a 'hands on learning' experience on various factors influencing groundwater availability and make rational decisions on crop-water management. The Farmer Water Schools (FWS) aim to sensitize all the farmers in a hydrological unit that the water resources in the basin are a common resource, and emphasizes the need for collective management of the resource for sustainability.

4.2 Farmer Field School

A farmer field school (FFS) is a participatory approach initiated in the late 80's by the Food and Agricultural Organization (FAO) of the United Nations to assist small scale rice farmers to investigate and learn for themselves the skills required to grow rice through adopting Integrated Pest Management (IPM) practices. FFS enables farmers to make a choice in methods of production through discovery-learning. In the Farmer Field School (FFS) a **group** of farmers with common interest get together on a regular basis to study the "*how and why*" of a particular factor affecting crop production. The topics covered can vary considerably - from IPM, organic agriculture, animal husbandry, and soil husbandry, to income-generating activities such as handicrafts.

4.3 Farmer Water Schools [FWS]

The Farmer Water Schools [FWS] use the year-long hydrological cycle as its basis. So, farmers meet once every 15 days, from June through May, to discuss concepts around groundwater management – namely, availability of water resources, its impact on crop growth, role of institutions in sustainability, and gender equity.

The specific objectives of FWS are:

- To empower farmers with knowledge and skills to measure recharge and discharge of groundwater
- To sensitize farmers on the need for collective action for effective groundwater management
- To sharpen the farmers' abilities to make critical and informed decisions on crop plans to match the available groundwater resources.
- To sensitize farmers on new ways of thinking and resolving issues around groundwater management.

- To help farmers learn how to organize themselves for sustainable groundwater management.

4.4 Salient features of a typical FWS

- Lasts a full hydrological year [June–May].
- Between 25 and 30 farmers participate in an FWS.
- Farmers meet once every 15/20 days.
- Primary learning material: HU and farmers' fields.
- Field school adjacent to farming plots.
- Participants learn together in small groups of five to maximize participation.
- FWS educational methods are experiential, participatory and learner-centered.
- Each FWS meeting includes at least three activities: hydro-ecosystem analysis, a special topic, and a group dynamics activity.
- FWS participants conduct a study comparing farmer and experimental plots.
- FWS often includes several additional field studies depending on local field problems.
- Ballot Box Exercise: Pre- and post-test are conducted.
- Crop-Water Budgeting (CWB) exercise is undertaken at the end of each monsoon.
- Field Days which involve farmers in sharing learning and results of their studies.

4.5 Pre-FWS activities

Prior to beginning FWS in the field, a series of meetings need to be organized involving opinion leaders, progressive farmers, sarpanch[1], and other influencing leaders of the village. The following are pre-FWS activities that are organized:

Meeting with opinion leaders: Rural communities respect suggestions given by their elders. These elders in the village are referred to as opinion leaders. Convincing them is essential to gain the confidence of the community. It will be an advantage if opinion leaders accept the concept and its dissemination in their village.

Organizing village meetings: Meetings are organized in the village involving the farming community in the presence of opinion leaders. The project staff can address the target audience and introduce the concept of FWS and its relevance to the community.

Selection of participants for FWS: After explaining the criteria for participating in FWS, enthusiastic farmers are selected to participate in the year-long FWS activities.

Orientation for the FWS participants: The selected participants are oriented by explaining the concept of Farmer Water School and the criteria for participation.

Developing curriculum: Farmers are involved in listing their training needs. Based on their requirement, an FWS curriculum is designed which is used to begin the year long FWS activities.

Selection of hydrological units: A hydrological unit is selected keeping in view the early completion of all physical works, beginning data collection and presence of enterprises farmers who are ready to generate hydrological data continuously.

4.6 Essential Elements of FWS

FWS learning group: Farmers within a hydrological unit come together to explore, discuss, experiment, and thereby, become better informed about their hydrological unit, concepts of groundwater, and crop-water management. Usually a group of 30 farmers meet once in every 20 days to engage in a discovery and experiential learning activity. The group consists of both men and women farmers. The group provides an ideal opportunity for sharing of experiences and mutual learning. Further, these periodic meetings strengthen existing farmer institutions or may lead to the formation of new institutions for sustainable groundwater management.

For effective learning, this group of farmers is further divided into small learning groups. Farmer participants remain in their small learning groups throughout the entire FWS cycle. Engaging in discussions, setting up experiments, conducting observations, sharing responsibilities (FWS management), etc. help them to become more cohesive learning groups and ensures effective participation.

Hydrological unit and the farmers' fields: FWS curriculum comprises of practical, hands-on topics. In an FWS, the hydrological unit, and the farmer's fields are the primary learning context. Farmers engage in a discovery and experiential learning process to gain a better understanding of rock formation, soil types, drainage pattern, rainfall patterns, and cropping systems. They also develop sensitivity to observe and analyze the interplay between these factors to make decisions on crop-water management.

Curriculum: The FWS curriculum follows the natural hydrological cycle. For example, in the Indian subcontinent it would start in June and continue through May – encompassing the south-west monsoon, and the north-east monsoon. This enables farmer participants to discuss all aspects of the hydrological cycle, its interplay with the physical features of the hydrological unit, factors influencing groundwater recharge and draft, and elements in crop-water management. The curriculum includes

- Long-term experiments and short studies – especially those related to crop-water, soil moisture, water-levels measurement, etc.
- Special topics based on farmers emerging needs,
- Icebreakers,
- Energizers, and
- Team building exercises.

[1] Sarpanch is a democratically elected head of a village.

The FWS curriculum reflects the local needs of the farmers and the physical features of the particular hydrological unit. Adaptation of the generic FWS curriculum to the local needs is made possible by organizing FWS planning meetings before the conduct of each FWS session. In these planning meetings, farmer facilitators:

- Identify and discuss content appropriate to local needs;
- Develop session guides - identify methods and develop appropriate models, and posters;
- Brainstorm ways of making farmer training sessions an exercise in discovery-learning;
- Identify locations where farmers could observe geological formations and structures; and
- Identify special topics relevant to the local needs.

All learning activities are based on experiential (learning-by-doing), participatory, hands-on work. This builds on adult learning theory and practice. Observation, analysis, discussion, and decision making are the key learning principles. The emphasis is not only on "how" but also on "why".

Facilitators: Active participation in FWS is a prerequisite to become a facilitator. FWS uses two simultaneous cycles of implementation to reach large number of farmers. The first cycle is facilitated by experienced facilitators. Farmer participants from the first cycle form into pairs to organize the second cycle of FWS in their habitations. This second cycle progresses simultaneously along with the first cycle; but, with gap of one week between the sessions of the two cycles.

Before the conduct of each FWS session, farmer facilitators (including participants of the first cycle) participate in a planning meeting to discuss the content, methods, materials (models, posters, etc.), and finalize session guide. Using the aid of the session guide, farmer facilitators facilitate the FWS session.

The conventional FFS model stipulates that all facilitators need season-long training to learn facilitation skills, learn to grow crops with their own hands, and develop management skills; i.e. they need to be FFS graduates. The FWS farmer participants from the first cycle shared that it is much easier for them to facilitate an FWS session immediately after participating in a session planning event, and experiencing the learning in a FWS session; all of which happen within a span of a week. This, they say, ensures effective transfer of learning. The session guides which elaborate the facilitation process serve as a ready reference to farmer facilitators. Further, an observer (experienced staff of the implementing NGO or facilitators of the first cycle) participates in the second cycle to observe and provide need-based assistance to the facilitators of the second cycle.

Crop-water Budget (CWB) Workshop: Crop Water Budget (CWB) workshop is an important milestone in the Farmer Water Schools. The CWB exercise involves estimation of the groundwater balance based on the total recharge and draft for the particular monsoon season. This estimation helps farmers make informed decisions on the crops to be sown.

FWS participants organize CWB workshops at the hydrological unit level. The workshop acts as a platform for sharing information pertaining water balance, cropping pattern, and groundwater dynamics of the HU. Following this, the farmers discuss the crop plans and make informed decisions in accordance with the available groundwater balance.

Field days: Completion of the FWS training cycle is followed by a graduation ceremony and presentation of certificates. Graduation takes place at the end of the hydrological year and this marks the climax of the learning process. During the graduation ceremony, the graduates showcase their experiences and learning from participation in FWS to the members of their community. Farmer institutions take lead in organizing and conducting the Field Day. Government officials and people's representatives are invited. Thus, the Field Day gives these farmer institutions greater visibility and provides them a platform to emerge as a critical pressure group on groundwater management in the district.

4.7 Essential Tools in FWS Process

Ballot Box Exercise: Ballot Box Exercise (BBE) is an evaluation tool. It helps assess knowledge, attitudes and skills of the participants. It is conducted at two points of time, i.e. pre-intervention and post-intervention. The pre-intervention BBE helps the facilitator make decisions on what topics/areas need more attention during the FWS. Comparison of the outputs of the pre and post intervention exercises helps evaluate the effectiveness of FWS inputs and change in farmers' knowledge, attitudes and skills.

Field Studies (long-term experiments and short studies): Farmer participants set up experiments on different aspects of groundwater management. The experiments are central to the farmers learning and typically cover various aspects of Demand Side Management of Groundwater (DSMG). The different themes considered for experiments include reduction in use of groundwater/pumping, improving the water-use efficiency (increase in output for unit water), reduction in external inputs (leading to reduced cost of cultivation), increased yield leading to increased profits.

The FWS looks beyond the soil, crop, and land in fact outside the agronomy. Softer issues such as institutions, markets, and gender equity are also considered as experimental themes as they have significant role in the successful implementation in the DSMG.

FWS methodology accepts that the DSMG cannot be implemented uniformly in all the area and needs local adaptations. The experiments test the local variations as well as demonstrate the same to large number of practicing farmers. Learning from the experiments are incorporated in the FWS curriculum in the subsequent years and thus FWS is a self-evolving process.

Hydro-ecosystem Analysis (HESA): Observation, analysis, discussion, and decision making are key learning principles of FWS. Farmers use tools in their FWS kits to:

- Observe recharge factors, like amount of rainfall, surface water, and rock & soil formation.
- Observe discharge factors – farmers earlier were focused on the water level in their own borewell.
- Analyze the data, discuss and reach decisions on crop plans to match the available groundwater resources.

The Hydro-Ecosystem Analysis (HESA) is the FWS's core activity with other activities designed to support it. The HESA process sharpens farmers' skills in the areas of observation and decision-making, and helps develop their powers of critical thinking. The process begins with small group observation of the various features of the hydrological unit, climatic conditions, and the farmer's field. During the observation process, participants collect field data such as area of the HU, slope of the HU, drainage pattern, rock formations, soil types, rainfall, soil moisture, and plant parameters. The facilitator is present throughout the observation to help participants in their observations.

Following the field observation, farmer participants return to the meeting place and, using color pens, draw what they have just observed on flipchart paper. The favorable and unfavorable factors are listed separately on either side of the diagram. The farmers discuss these factors and analyze their impact on the crop-water management. Based on their analysis, they determine a set of management decisions to be carried out. An action plan is drawn up. All of these are included on the chart paper.

One member of each small group then presents these findings and decisions to the larger group. After this brief presentation of results, there is time for open questions and discussion. Good large group discussions often involve posing alternative scenarios, for example, questions such as "how do we address or overcome this...." This cycle of presentation, question, answer and discussion is repeated until all the small groups have presented their results. Hydro-ecosystem drawings from previous weeks are kept on hand as a reference and as material for discussion later in the season.

The role of the facilitator is central to the HESA process. In the field, they guide participants to see what they may not have seen before, such as rock formations and soil profile for example. To ensure a balanced and participatory discussion, a good facilitator understands that the more participants talk, the more they learn, and encourages discussion rather than lecturing. During presentations, the facilitator ensures that all participants have an opportunity to present during the hydrological year, and that the group covers all the important issues. The facilitator needs a solid understanding of the physical features of the hydrological unit, climatic conditions, and farming practices. The facilitator also needs to know how to ask good questions, guide participants through exercises and ensure that sound management decisions are taken by the group by introducing new information when appropriate.

Quality Assurance Checklists: A set of checklists are used to ensure quality and effective implementation of FWS. The pre-session checklist helps the facilitators review their preparations for the ensuing session. It includes session guide, materials, and logistics.
Another checklist is used by an observer to evaluate the facilitation and participation in the FWS session. It includes the logistics, participation, and facilitation.

Group Dynamics: Group dynamics (GD) exercises are powerful tools to develop group cohesiveness, problem solving skills and leadership, and encourage collaboration and creativity. Additionally, they help to liven up the atmosphere and energize the participants. Many activities are physical and active, while others are brain teasers. The exercises are fun while simultaneously providing a specific experience to the participants to think about, for instance, on how they worked as a team or solved a problem together. Before introducing a group dynamics exercise, the facilitator should consider whether a specific activity is appropriate in the socio-cultural setting of a particular group at a particular time.

A group dynamics activity generally begins with an introduction by the facilitator explaining the steps of the activity and/or posing a problem or challenge for the group to work on. The facilitator should carefully observe the process and the participants' reactions. At the end of the activity, the participants are invited to reflect on the process, possible outcomes and how they felt about the exercise. Conclusions are drawn along with lessons learnt from the exercise.

5. FWS Monsoon-long Training of Trainers

A FWS Training of Trainers is organized for the Master Trainers and key implementing staff of the Farmer Water Schools. The training covers all technical aspects relating to demand-side management of groundwater, facilitation skills, and FWS content. Covering all this ensures that the Master Trainers have adequate technical knowledge, are aware of the participatory methods used in FWS, and are confident. Covering all the FWS content in the same manner that it needs to be facilitated with the farmer participants will ensure consistency in methodology and quality control in FWS implementation.

The FWS Training of Trainers is spread over several weeks and lasts at least one full monsoon season. Participants should have an opportunity to organize and facilitate FWS simultaneously. This experiential learning process helps them experience the FWS concepts and also gain critical experience in implementing FWS. The FWS participants meet for three days every fortnight during the Training of Trainers program. The rest of the period during the fortnight is used for doing the necessary preparations and organizing the FWS in their respective operational areas. Apart from learning new concepts, participants reflect upon their experiences in FWS implementation during the three days of training every fortnight.

The FWS Training of Trainers starts at least a month before the onset of the monsoon/rains. This initial period is used to cover the themes 'Introduction to Farmer Water Schools', and 'Basic concepts of Groundwater Management'. Also, this gives adequate time to install the physical equipment required for participatory hydrological monitoring, and do the necessary planning for FWS.

The topics covered in various sessions of the monsoon-long FWS Training of Trainers are as follows:

Inaugural and Introductory Session:

Session-I: Theme: Introduction to Farmer Water Schools

- Inaugural function
- Introduction of the participants and sharing of expectations
- Pre-BBE
- FWS objectives
- Norms setting
- Group formation
- Relevance of FWS to addressing farmer problems
    - Elements of farmer decision making (counting the squares)
    - Farmer decision making process and groundwater management
- FWS pledge

- BBE analysis
- Group dynamics (need for collective action)
- Homework: Crop survey *(use a format similar to Crop Adoption Survey)*
- Session evaluation

Focus: Introduction to Groundwater Management

- Rationale for groundwater management
- Demand side management
- Role of institutions in groundwater management
- Participatory Hydrological Monitoring (PHM)
- Objectives and steps in PHM process
- Reconnaissance survey
- Discovery learning and experiential learning cycle (ELC)
- Identifying farmer training needs and FWS curriculum
- Session evaluation

Session-II: Theme: Knowing the HU

- Recap
- HU walk: Field walk in hydrological unit area
    - Analysis of HU
    - Use of HESA framework
- Delineation of HU
- Water cycle and hydrological unit - causes of rainfall, and evaporation rate
- Rock formations and soil types
- Group dynamics (importance of institutions)
- Session evaluation

Session-III: Theme: Long-term Experiment

- Recap
- Farmer agriculture operations calendar,
- Topic selection and finalization of Idea
- Idea matrix
- Designing the experiment, and finalizing observations,
- Observation matrix
- Setting up LTE (selection of collaborator),
- Group dynamics: collective decision making
- Session evaluation

Session-IV: Theme: Participatory Hydrological Monitoring

- Recap

- Observation of LTE (use of HESA framework)
- Hydrological data and its relevance
- Measuring devises
- Procedures of data collection and dissemination
- Water levels (HESA)
    - Water levels,
    - Rainfall, and
    - Discharge.
- Group dynamics: book keeping
- Session evaluation

Session-V: Theme: Groundwater recharge

- Recap
- Observation of LTE and data collection Analysis
- Natural and artificial recharge
- Factors influencing recharge (HESA)
    - Rock formation,
    - Soil types, and
    - Slope and drainage
- Estimation of HU area
- Recharge rates (GEC norms) in different rock types
- Group dynamics: roles and responsibilities of GMC/HUN
- Special topic: drainage patterns
- Session evaluation

Session-VI: Theme: Estimation of groundwater recharge

- Recap
- LTE observation and data collection
- Estimation of total rainfall received (HU wise consolidated data)
- Estimation of groundwater recharge
- Group dynamics: leadership qualities
- Short study: water level fluctuations(SWL, PWL Vs rainfall)
- Home work: data collection for estimation of groundwater draft and rabi crop plans, secondary water bodies
- Session evaluation

Session –VII: Theme: Estimation of draft & projected groundwater balance

- Recap
- Observation of LTE and data collection Analysis

- Consolidation of data required for estimation draft
- Estimation of groundwater draft (June to October)
- Estimation of water requirement: conventional vs. alternate irrigation practices
- Estimation of recharge through projected rainfall (Nov to May)
- Estimation of recharge through secondary water bodies
- Crop water requirement for rabi season
- Estimation of groundwater balance by the end of May (HESA)
- Group dynamics: communication distortion
- Session evaluation

Session – VIII: Review of farmer plans

- Recap
- LTE results and analysis (HESA)
- Review of farmer rabi crop plans
- Estimation of water requirement: conventional Vs. alternate irrigation practices Preparations for CWB
- Identify logistics required for the conduct of CWB workshop
- Discuss responsibilities of HUNs and GMCs in the conduct of CWB workshop
- Identify farmer facilitators who will share their learning and facilitate discussions
- Develop models, visuals for display during CWB

Session – IX: Theme: CWB Workshop

- Registration and inauguration of exhibition stalls
- Objectives of CWB workshop
- FWS participants' experiences
- Sharing of LTE results and experiences of collaborator
- Groundwater recharge, draft and balance at the end of October
- Water requirement for rabi crops
- Projected recharge from Nov to May
- Projected groundwater situation by the end of May
- Decisions on crop-plans by respective HUNs and GMC members
- VIPs speech
- Issue of FWS graduation certificates
- Vote of thanks

6. FWS Session Content

The FWS curriculum has evolved over the years. Farmer participants have actively contributed to the content, methods, and materials. The curriculum is evolutionary and could undergo changes to meet emerging needs of the farmers. The number of sessions and the duration between the sessions could also be revised to suit farmers' needs. The curriculum presented in this manual is being used in the current hydrological year (2008-09). During the Annual FWS Plan and Review workshop, farmers revised the curriculum and scaled down the number of sessions[2] to fourteen, from sixteen in the previous year (2007-08).

Session 1: Introduction to Farmer Water Schools

Introduction of the participants: Organizing a round of introductions helps participants to get to know each other. Facilitating introductions using an interactive game helps participants overcome inhibitions, induces a sense of camaraderie, makes them feel comfortable, and creates a healthy learning environment. As part of introductions, participants should also be encouraged to share their expectations from participating in the year-long FWS. This enables the organizers to understand participants' perspectives.

Objectives of FWS: After the introductions, FWS objectives are presented to the participants. This includes 'leveling of expectations' wherein the participants' list of expectations is revisited to see which expectations are encompassed by the FWS and which are not. Participants are informed that the list of expectations will be used at later points in the FWS cycle to review progress in meeting expectations. Sharing of objectives helps participants develop an understanding and focus their attention on the purpose and components of Farmer Water School.

Relevance of FWS to farmer problems: Farmers are very concerned with depleting water levels. The Farmer Water School approach encourages farmers to reflect on the situation, develop critical understanding, explore various alternatives, and reach collective decisions for judicious and sustainable management of groundwater. The learning activities in FWS sessions sharpen farmers' observation, analytical and decision making skills. A puzzle is used to introduce these skills. The discussions following the puzzle enable the farmers to relate the usefulness of these skills in day-to-day farming. During the discussions, the facilitator encourages farmers to cite relevant examples that draw the relevance of these skills in management of problems.

[2] Including CWB workshop and Field Day

Pre-BBE: Experiential learning focuses on the need to build participants' knowledge based on their current knowledge and experience. Pre-BBE is an effective tool to assess participants' current knowledge levels. Questions are selected covering various groundwater concepts. The number of questions on each topic is based on the importance or weight given to the topic in the FWS curriculum. Questions cover the following areas:

- Rock types and soil types
- Recharge rates of different rocks
- Water use efficiency methods
- Units and quantification
- The hydrological unit
- Rainfall and causes for rainfall

Each participant is given a specific registration number and ballot slips with the same number are given to the person. The number of ballot slips should be equal to the number of participants. Each question has three options – 'Yes', 'No', and 'No Idea'. Three envelopes are pasted beneath each question with each representing one of the three options. The participant answers the question by placing his/her ballot in one of the envelopes. At the outset, the facilitator shares and clarifies the rules and regulations that the participants have to abide by during the ballot box exercise.

Later, BBE analysis is done by first counting and recording votes in the 'No idea' envelope. Both the number of participants voting for a particular choice along with the registration number is noted during counting. Among the 'Yes' and 'No' choices, the one having the least number of slips is selected for counting. Subtracting this number and the number from 'No idea' envelope from the total number of participants gives the number in the remaining envelope. BBE analysis helps ascertain the general awareness on each topic along with the individual awareness level. The facilitator does not reveal the individual performance in a group since this can undermine the individual's confidence.

Group formation and norm setting: The number of participants in a Farmer Water School is restricted to 30. For effective learning, this group of farmers is further divided into small learning groups. Farmer participants remain in their small learning groups throughout the entire FWS cycle. Engaging in discussions, setting up experiments, conducting observations, and sharing responsibilities (FWS management) enhance the cohesiveness in learning groups and ensure effective participation.

Session 2: Knowing the HU

HU walk (Hydro Eco-System Analysis – HESA): Prior to beginning a discussion on groundwater science, it is useful to take participants for a field walk in the hydrological unit.

Taking them into the field to show the boundaries of the HU and geological formations - rock formations, soil types, etc. enable them to develop a mental map, which would help them understand groundwater concepts better.

Following topics can be discussed during field walk:

- Water cycle of the HU
    - What factors influence rainfall in the HU?
    - How does rainfall occur?
- Rock and soil types
- Drainage pattern
- Runoff and evapo-transpiration
- Potential recharge zones and over exploited zones

<table>
<tr><td colspan="2"><u>Hydro Eco-System Analysis (HESA)</u>
Group Name: HU Name: Date:</td></tr>
<tr><td>+ <u>Favorable factors(Recharge)</u>
• List of their observations.</td><td>- <u>Unfavorable factors (Recharge)</u>
• List of their observations.</td></tr>
<tr><td rowspan="2"><u>Analysis</u>:</td><td><u>Decisions and Implementation</u></td></tr>
<tr><td><u>Action Plan</u></td></tr>
</table>

Water Cycle: Farmer participants know the science behind rainfall. Few might not be aware about the science of water cycle that starts with evaporation of water from oceans and large water bodies, precipitation to form clouds and the final condensation leading to rain. A visual of the water cycle is used to facilitate the session. At the end of this activity, all participants start appreciating the cyclical process involved in water cycle and that most of this water again goes back to oceans and a small fraction of it percolates into the ground based on type of soil and rocks and other factors influencing recharge in the Hydrological unit.

Session 3: Participatory Hydrological Monitoring (PHM)

Hydrological data and its relevance: Older farmers can recollect availability of surface water in tanks and canals. The present situation is different. Agriculture is becoming increasingly dependent on groundwater resource.

Since this resource is not visible, it is difficult to gauge the intensity of usage. Farmers face heavy losses during critical stages of crops due to lack of awareness or ignorance about available groundwater estimates. Therefore, it is critical for them to have an idea about water levels and the discharge of their bore wells. PHM concept enables farmers to

- Understand their present groundwater system,
- Understand the annual changes in their groundwater system, and
- Regulate the use of groundwater.

The data pertaining to water levels, bore well discharge, amount of rainfall and its relevance to groundwater system is discussed.

Procedures of data collection and dissemination: Information on rainfall and water levels in the bore wells of the HU help develop an understanding of the groundwater system in the HU. This data helps analyze the relation between rainfall, water levels, and discharge of the bore well. It is important to demonstrate ways of collecting the hydrological data in the HU.

- Measuring the static and pumping water levels,
- Bore well discharge,
- Rainfall received, and
- Frequency of data collection.

It is important to disseminate this data to the larger community for collective decision making on their cropping pattern. This helps them to:

- Explore ways of disseminating the data to larger audience, and
- Discuss responsibilities of GMCs and HUNs in dissemination of data.

Book keeping: To understand the dynamics of groundwater, hydrological data has to be collected once in a fortnight for the entire hydrological year i.e. from May through June. So, either volunteers or GMC has to take the responsibility of recording this hydrological data in HMR books and preserve them for:

- Data analysis,
- Conducting CWB exercise, and
- Estimating water balance.

The need for data recording is discussed. Participants demonstrate the use of HMR book.

Session 4: Groundwater Recharge

Natural and artificial recharge: Groundwater recharge happens naturally by rain. Discussion of the dynamics of water percolation (recharge) and the factors influencing recharge can create awareness among the participants in understanding the natural process. Discussion on how recharge occurs and what factors influence groundwater recharge will be helpful for participants to understand how rain water enters the ground and the influencing factors in groundwater recharge. Doing so, gives farmers an idea to analyse quantity of recharge versus draft.

Discussion also focuses on different ways of artificial replenishment of groundwater through human interventions like check dams and irrigation bore wells.
Discussion on groundwater recharge by rain stresses that:

1. Rain percolates where it falls and recharges the water table aquifer,

2. Rain percolates where it falls and then moves into deeper layers to recharge a confined aquifer,

3. If rain cannot infiltrate, it runs off into streams. When a stream flows through an area that allows water to percolate, some of the water from the stream may seep down to recharge the aquifer below.

Facilitators discuss all types of recharge i.e. natural and artificial recharge. While underscoring that groundwater recharge is the practice of directing water - often rainwater, but sometimes reclaimed water - into groundwater aquifers.

Recharge rates: Groundwater Estimation Committee (GEC) Norms
A common assumption among some water users is that most rain water percolates into the ground. In practice, only a small amount of water infiltrates and this is based on various factors like:

- Rock type and its extent, and
- Soil types and slope

Based on the above factors, GEC estimates the percentage of water that percolates a particular rock formation. The participants understand the type of rock formation in their HU and then estimate the recharge based on the GEC recommendation.

Facilitators point out that an additional 2% of rainfall recharge factor may be used in areas where watershed development with associated soil conservation measures is implemented. This additional factor is different from contributions due to water conservation structures such as check dams, nalla bunds, and percolation tanks for all of which the norms are defined separately.
The following norms have been recommended by GEC:

Alluvial areas

- Indo-Gangetic and inland areas - 22 %
- East coast - 16 %
- West coast - 10 %

Hard rock areas

Weathered granite, gneiss and Schist with low clay content - 11 %

- Weathered granite, gneiss and Schist with significant clay content - 8 %
- Granulite facies like charnockite - 5 %
- Vesicular and jointed basalt - 13 %

- Weathered basalt - 7 %
- Laterite - 7 %
- Semi consolidated sandstone - 12 %
- Consolidated sandstone, Quartzite, Limestone (except cavernous limestone) - 6 %
- Phyllites, Shales - 4 %
- Massive poorly fractured rock - 1 %

Session 5: Estimation of Groundwater recharge

Estimation of total rainfall received: Measurement of rainfall is critical to estimate groundwater recharge and available supplies. Doing so enables farmers to plan crops in accordance with available groundwater resources. Measuring the quantity of rainfall for a specified period of time helps in effective crop-water planning. Quantity implies the depth of rainwater accumulating on a leveled surface without infiltrating, flowing away or evaporating.
To estimate the quantity of rainfall received in a hydrological unit, it is important to measure the rainfall at all the rain gauge stations established in the HU. This data can be used to calculate the average rainfall, and the total amount of rainfall received in the HU.

Estimation of HU area: Knowledge of the rainfall received and the area of the HU is critical to calculate the groundwater recharge. A discussion on delineation of HU and its boundaries precedes the estimation of HU area.

Estimation of groundwater recharge: This discussion helps farmer participants to visualize the proportion of rainwater infiltrating into the ground and recharging the aquifer. Knowledge of the monsoon seasons – kharif (June to October), and rabi (November to May) is necessary.

Session 6: Estimation of groundwater draft and balance

Consolidation of data required to estimate draft: Estimation of groundwater for the particular season is critical to calculate the available groundwater balance for the ensuing season. To estimate the groundwater draft, it is necessary to calculate the groundwater draft of each bore well during the season. Consolidating the draft from all the bore wells in the HU will help estimate the total draft for the given season in the HU. Information required to estimate groundwater draft and the procedure for estimation during the crop season is discussed.

Estimation of groundwater balance (June to October): Groundwater balance is usually calculated at the end of a crop-season. This helps farmers plan their crops for the ensuing Rabi season and explore various water conservation practices.

Crop water requirement: In rabi (Nov to May), farmers depend mainly on groundwater for their agricultural needs. Estimating the water requirement for crops planned in the rabi season will help review the projected need against the available groundwater balance. Farmers compare the projected need with the available balance and discuss the changes they need to make in their crop plans and the types of water conservation practices they need to adopt.

Estimation of recharge through projected rainfall (Nov – May) and recharge through secondary water bodies: If the available groundwater balance is negative, projecting the expected rainfall for the ensuing crop-season and consequent recharge presents a more optimistic scenario.

Another measure could be projecting secondary recharge. Water stored in the tanks and wells recharges the bore well and thereby improves the groundwater balance. The recharge happening through these water bodies should also be considered when estimating the projected water balance by the end of May.

Session 7: Crop Water budgeting workshop (CWB)

The CWB workshop serves as a platform for sharing information pertaining to water balance, cropping pattern in a given HU, groundwater dynamics, relation between recharge and draft with all the groundwater users in a Hydrological unit. Most groundwater users assume that the groundwater in their bore well is a private resource. On the contrary, bore wells in a hydrological unit draw water from the same source. The CWB workshop drives in the key message that sustainable management of groundwater resources requires a collective and concerted effort by all the groundwater users in a hydrological basin. The CWB exercise also helps in disseminating the relation between recharge and draft to a larger audience. Farmer institutions (Hydrological Unit Networks – HUNs, Groundwater Management Committees – GMCs) and farmer facilitators are encouraged to take lead in the planning and conduct of the CWB workshop.

The CWB workshop brings all farmers in a HU together. The CWB workshop is the final step in the chain of PHM wherein farmers share the groundwater data that they have collected during the season and then proceed to discuss how to manage the available groundwater resources. As all the farmers in the entire HU are present, it is a good platform to generate awareness on the ground water dynamics in the HU, to facilitate a discussion on sustainable management of the depleting resources, and to reach concrete decisions on how to manage the available water efficiently. Organizing an exhibition using various visuals and models will help in effective dissemination of groundwater concepts.

Visuals can be developed for the following contents:

- Hydrological unit concept
- Recharge estimation
- Draft estimation
- Secondary recharge sources
- Projected rainfall
- Crop water requirements
- Projected balance

Models can be developed to demonstrate the following topics

- Estimation of HU area
- HU, inflow and outflow
- Recharge
- Quantification of water
- Crop water requirement
- Projected rain fall
- Drum discharge

CWB workshop contents are:

- Recharge (June-October)
- Draft (June-October
- Balance (kharif)
- Estimated draft for rabi season (crop plans)
- Recharge through projected rainfall
- Groundwater situation at the end of May

Crop water budget exercise planning:

Before the CWB workshop takes place in the field, a planning workshop is organized for the HUNs, GMCs, and farmer facilitators. The focus of the workshop is to brainstorm with the farmer participants' ways of presenting the crop water balance estimations (which are learnt during the FWS sessions) to the rest of the community in the HU. Organizing a mock demonstration a couple of days before the CWB workshop helps in effective conduct of the

event. This exercise provides the farmer facilitators an opportunity to reflect on the effectiveness of the methods they had used in the FWS sessions.

Logistics to be discussed in the planning workshop are:

- Venue of the workshop
- Logistics required organizing workshop
- List of invitees to the workshop
- List the information need to be shared
- Stall arrangement
- Responsibilities of each member in organizing CWB workshop
- Session guide for CWB workshop

Session 8: Review of farmer plans and design of LTE

Review of farmer decisions: The Crop Water Budgeting (CWB) workshop provides a platform to share information pertaining to groundwater recharge, draft and balance with all the farmers in the HU. This stimulates the farmers to reflect on whether the available groundwater balance can match their crop plans. The discussions that follow are aimed at reaching concrete decisions – changing crop plans, or alternate water management practices.

Sharing information on water requirement for each crop and alternate water management practices is very helpful at this juncture.

Conventional and alternate crop inputs: Sowing and harvesting crops is a routine thing for a farmer. It is important for farmers to develop an understanding of the economic impact that each input would have on the overall activity. Farmers are encouraged to discuss agricultural inputs like cost of seeds, fertilizers, pesticide, labor costs, quantity of water, electricity consumed, for conventional and alternate crop practices. This generates discussion on the interplay between various agricultural inputs and consequent costs of production. Farmers are encouraged to estimate the requirement of various inputs and the returns for conventional and alternate practices.

Design LTEs and selection of collaborator: Farmers are susceptible to being misled by the varied information on cropping practices. Also, they might not be open to test new ideas for fear of failure or because of conventional mindsets. Imparting skills of experimentation empowers them to test new information and innovations in agriculture before adapting them. Learning how to design an experiment enables farmers to test new ideas, analyze the results,

make informed decisions, and share the results with the community. Designing long-term experiments helps farmers:

- Develop critical thinking,
- Explore alternate best practices,
- Test their ideas (which work and which do not work), and
- Implement new practices.

An enterprising farmer can carry out an experiment in his/her field selecting a small portion of land at minimal cost and risk. It is critical for farmers to:

- Identify experiments on their own,
- Keep experiments simple and unbiased,
- Concentrate on one single factor for observation,
- Collect data and analyze results, and
- Share results with the larger community

Session 9: Crop adoption survey results

Sharing of crop adoption survey results: After farmers complete the sowing for rabi season, farmer participants undertake a survey of crops sown in the hydrological unit. This helps estimate the draft for the upcoming season. Also, it serves as a measure of the seriousness of the farmers in the HU to plan crops in accordance with the available groundwater reserves. Even after making commitments at the CWB forum, some of farmers might switch their plans based on the prevailing trend in market rates for the particular crops. The data is consolidated crop-wise for the entire HU

Estimation of actual water requirement: During a CWB workshop, water requirement is estimated for proposed (rabi) crops. Based on this, the proposed groundwater balance is estimated. The crop adoption survey presents the actual scenario of the crops being raised in the HU, enables a realistic estimation of actual crop water requirement, and the projected groundwater balance by the end of May.

For each crop, actual groundwater requirement is estimated taking into consideration factors like number of irrigations, time taken for each irrigation and drum discharge per hour.

Session 10: Alternate irrigation practices

Conventional and alternate irrigation practices: Usually farmers are under the misconception that providing crops with copious amounts of water gives better yields. Also, they believe that water conservation practices are more labor intensive. It is important for every farmer to have an understanding of the water consumption in conventional and alternate irrigation methods. Also, a discussion on water requirement at various stages of plant growth helps dispel some of the myths about water usage and improved yields. Some of

these alternate practices are age-old practices that have been undermined by the modernization in agriculture. The discussions help farmers develop a better perspective on water usage, labor requirements, and costs of production for the two practices. Discussion on the promotional offers and subsidies offered by the government on sprinkler, drip, rain gun, and their suitability to various crops is also very helpful.

Perceived change: Engaging farmers to estimate crop water requirements helps farmers draw conclusions on the suitability of the methods to their land, crops, and economic viability.

Session 11: Increase in soil moisture retention

Increased soil moisture retention methods: Current trends in agricultural practices (indiscriminate usage of chemical fertilizers and chemical pesticides) decrease the water holding capacity of soil. A discussion on ways of improving the soil moisture retention (mulching, application of farmyard manure/ organic manure) helps farmers make decisions to conserve water.

Composting methods: Farmyard manure and other natural manures supply most of the nutrients in limited quantities. Subjecting these organic waste materials to microbial decomposition enhances the nutritive value of the product (compost). Organic waste is piled up in a scientific and systematic way so as to encourage the growth of various microbes that would convert complex substances to simple ones. This decomposition enhances the nutritive value of the end product which can make soils more fertile. Various composting methods (pit method, heap method and Nadep method) are discussed with farmers.

Session 12: PHM data analysis

PHM data analysis: Participants consolidate and share data pertaining to the number of bore wells, average pumping days, average pumping hours per day, and average discharge. They work in small groups and compare present PHM data with the kharif PHM data, analyze and note the observations. The discussion concludes with a note that these differences can happen due to variation in rainfall and usage of groundwater. Highlighting the water conserved by alternate practices encourages farmers to integrate them into their regular farming practices.

Session 13: Actual groundwater situation

Data analysis (rainfall data): Participants calculate the recharge from the rainfall in rabi season. This discussion happens in small groups. Farmer participants recollect the method of averaging that was used in the earlier session. Data includes average of month wise data obtained from all the rain gauge stations in a HU. After obtaining the rainfall data for both kharif and rabi seasons, total recharge is calculated. This is equal to the sum of recharge from

kharif, actual recharge from rabi, and recharge that happened through secondary water bodies.

Actual balance of groundwater at the end of May: The total draft for both kharif and rabi seasons is calculated. Participants are encouraged to calculate the actual groundwater balance by the end of May which is obtained by subtracting total draft from total recharge. This gives an idea of whether the given HU is in surplus or deficit with regard to groundwater balance. A surplus situation will end on a note to continue the same good practices and a deficit should direct the participants towards using more water saving techniques.

Post Ballot Box Exercise: Another topic focusing on evaluation is the post Ballot Box Exercise. The pre-Ballot Box exercise conducted in the first session is indicative of the awareness levels of participants. The same process is repeated again. The results indicate the improvement in the awareness levels of individual participant based on their learning from FWS sessions.

Preparation for Field Day: This large group discussion highlights the importance of sharing the results of FWS sessions with the community. The responses from the group are recorded. Farmer institutions like GMCs and HUNs take a lead role in organizing the event. The event also is used as a platform to share the learning with co-farmers, government officials, and local people's representatives. Preparatory work includes printing and distribution of invitation cards, inviting officials, arranging for transport, erection of stalls, preparation and display of models, visuals, arrangement of public address system, media coverage, food and water arrangements.

Session 14: FWS Field Day

The event provides farmer participants an opportunity to share their learning and experience from Farmer Water Schools with the community. It also marks the completion of the year-long FWS. The event is organized by HUNs, GMC members and farmer facilitators. The venue has a festive environment having farmers from the entire hydrological unit. Water management concepts are highlighted using attractive models and interesting visuals. Farmers open a registration counter for documenting the details of the invitees. Stalls are arranged on various concepts displaying models. A farmer facilitator is present in each stall to explain the concepts to visitors. The day begins with inauguration of exhibition stalls by the chief guest.

Following concepts are presented through the stalls**:**

- Project objectives;
- Basic information about the Project area;
- Hydrological unit and hydro-ecosystem;

- Adaptation of FFS methodology to groundwater management;
- Groundwater concepts like recharge, draft and available groundwater;
- Water saving techniques and methods of soil moisture retention increase;
- Promote organic practices to control the pest and increase soil fertility; and
- Artificial groundwater recharge structures.

Field Day Proceedings: The ceremony starts with a prayer followed by a formal welcome to the guests and invitees. The special invitees are escorted by farmer facilitators to the dais. The HUN president takes over the proceedings of the function and shares the agenda. The ceremony moves on sequentially with role plays by FWS participants, songs highlighting the importance of groundwater management, and the objectives of the project focusing on the demand side management of groundwater. A few FWS participants are invited to the dais to share their experiences in farmer water schools from participation to graduation.

The speakers highlight the purpose of organizing the Field Day. After the chief guest's address, certificates are distributed to the farmer participants and facilitators. Certificates are designed for all the graduates and farmer facilitators and are handed over by invited guests. This ceremony gives the graduate a sense of pride and achievement while accepting it before a large gathering.

Vote of Thanks: The HUN president concludes the proceedings with a vote of thanks to all for making the event a success.

Annexure I

FWS Session Outline

Session-I: Introduction to Farmer Water schools: June 3rd week

1. Introduction of participants
2. Objectives of FWS and relevance to farmer problems
3. Pre Ballot Box Exercise (BBE)
4. Elements of farmer decision making process
5. Group formation and norms setting
6. FWS pledge

   Group dynamics: Importance of peoples' institutions

   Introduction to short studies

   Short study: Green manure

Session-II: Knowing the Hydrological Unit (HU): July 2nd week

1. Recap
2. Sharing of BBE results
3. HU walk (Hydro Eco System Analysis) Field walk in hydrological unit area

   Group dynamics: Leadership qualities

   Short study: Seed treatment & seed germination test

Session-III: Participatory Hydrological Unit Analysis: August 1st week

1. Recap
2. Relevance of hydrological data
3. Measuring devises
4. Data collection procedures and dissemination

   Group dynamics: Book keeping

   Short study: Inflow and outflow of HU

   Home work: Observation of water levels (SWL, PWL)

Session-IV: Groundwater recharge: September 1st week

1. Recap
2. Factors influencing recharge

   Group dynamics: Cooperation among Groundwater Management Committee (GMC) members

   Short study: Groundwater recharge process

Short study: Factors influencing recharge process

Home work: Collection of rainfall data (June to October), rock types and their extent

Session-V: Estimation of groundwater recharge: September 3rd week

1. Recap
2. Discussion on home work: Estimation of total rainfall received (HU wise consolidated data)
3. Estimation of HU area
4. Estimation of groundwater recharge (June – October)

   Group dynamics: Data accuracy

   Short study: Weed management

   Home work: Data collection for estimation of groundwater draft & rabi crop plans, secondary water bodies

Session –VI: Estimation of Groundwater draft & balance: October 1st week

1. Recap
2. Estimation of groundwater draft & balance by the end of October
3. Estimation of crop water requirement for rabi crops
4. Estimation of recharge through projected rainfall(Nov to May)
5. Estimation of recharge through secondary water bodies
6. Estimation of groundwater balance by end May (HESA)

   Short study: Water quality analysis

   Short study: Cooperation among committee members

   Group dynamics: Communication distortion

Session – VII: Crop Water Budget (CWB) Workshop: October 4th week

1. Inauguration of exhibition stalls and sharing farmers' learning
2. Objectives of CWB workshop
3. Basic information and area of HU
4. Groundwater recharge (June – October)
5. Estimation of groundwater draft and balance by the end of kharif season
6. Crop plans for rabi and water requirement
7. Projected recharge through rainfall and secondary water bodies
8. Projected groundwater situation by end may
9. Decisions on crop plans by HUN & respective GMC members
10. Vote of thanks

Session-VIII: Review of farmer plans and Design Long Term Experiments: November 1st week

1. Recap
2. Review of farmer decisions
3. Conventional crops: Estimation of water requirement & production costs
4. Alternate crops: Estimation of water requirement & production costs
5. Design LTE and selection of collaborator
   Home work: Crop adoption survey

Session-IX: Crop adoption survey results: November 4th week

1. Recap
2. Observation of LTE and data collection
3. Sharing of crop adoption survey results
4. Estimation of actual water requirement for the HU
   Group dynamics: Data accuracy
   Short study: Water holding capacity
   Home work: Existing alternate irrigation techniques

Session-X: Alternate irrigation practices: December 2nd week

1. Recap
2. LTE observation and analysis
3. Estimation of water requirement: conventional versus alternate irrigation practices
   Group dynamics: Linkages with line departments
   Short study: Alternate furrow irrigation method
   Home work: Interaction with farmers who have been practicing alternate irrigation techniques
   Versus vs.

Session-XI: Increase soil moisture retention: January 1st week

1. Recap
2. Observation of LTE and data collection
3. Soil moisture retention methods
4. Composting methods
   Group dynamics: Fund mobilization
   Short study: Role of organic manures in water holding capacity
   Home work: Data collection on functional bore wells, pumping hours, days and discharge

Session-XII: Participatory Hydrological Monitoring (PHM) data analysis: January 4th week/ February 1st week

1. Recap

2. LTE, data collection and analysis of results
3. Data collection and analysis
4. Perceived change (HESA)
5. FWS impact and success indicators

   Group dynamics: PHM assets maintenance

   Home work: Actual rainfall received from November till date

Session – XIII: Actual groundwater situation: March 4th week

1. Recap
2. Estimation of actual groundwater recharge based on actual rainfall received from November till date
3. Estimation of actual groundwater situation
4. Post BBE

   Short study: Soil testing

   Short study: Gender work matrix

   Home work: Collection of actual rainfall data from November

Session – XIV: FWS Field Day

1. Registration and inauguration of exhibition stalls
2. Exhibition
3. Purpose of Field Day
4. Relevance of FWS to groundwater management
5. FWS farmer experiences
6. VIP speeches
7. Issue of FWS graduation certificates
8. Vote of thanks

Annexure II

Session-I: Introduction to Farmer Water Schools (FWS) – June 3rd week

Program schedule

S. No	Time	Content	Method	Materials	Expected outcomes
1	10 min.	Introduction of participants and sharing Expectations.	Dyad	Picture charts of different fruits/ vegetables, and box.	Participants are introduced to one another.
2	30 min.	FWS Objectives.	Large group discussion	Charts, markers and pictures.	Participants list their expectations from year-long FWS and compare with FWS objectives.
3	60 min.	Pre-Ballot Box Exercise.	Demonstration	Charts, markers whistle, card boards, nails, long sticks, knife, thread, and ballot boxes.	Participants participate in BBE.
4	25 min.	Elements of farmer decision making process.	Large group discussion	Charts, markers, and visuals.	Farmers list the steps involved in decision making process.
5	20 min.	Norm setting.	Story and large group discussion	Pictures, charts, markers, and script for the story	Participants set norms for the year long FWS sessions.
6	25 min.	Group formation.	Game and large group discussion	10 stones of medium size, different varieties of stones, charts, markers and board.	• Participants identify the Importance of group formation • Participants form as small groups to learn and share their experiences in FWS sessions.
7	25 min.	FWS Pledge.	Pledge	Charts and markers	participants discuss and decide the content for FWS Pledge
8	10 min.	Group dynamics- Importance of peoples' institutions.	Game	Match sticks.	Participants understand the importance of institutions.
9	15 min.	Introduction to short studies.	Large group discussion	Charts and markers.	Participants are introduced to the concept of short

					studies.
10	20 min	Short Study- Green manure.	Large group discussion	Handouts.	Participants discuss the advantages of green manure.
11	10 min.	Evaluation.	Large group discussion.	Charts and Markers	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Introduce one another,
- Discuss objectives of Farmer Water School (FWS),
- Participate in Pre-Ballot Box Exercise,
- Discuss elements of farmer decision making,
- Form small groups and set norms for smooth and effective conduct of FWS sessions, and
- Discuss the importance of people's institutions.

Process

1. Introduction of participants and sharing of expectations Time: 10 min.

Objective : Participants introduce one another.

Content : Participant introduction.

Method : Dyad technique

Materials : Pictures of fruits, and box.

Process

- Collect two pictures of each variety of fruit. The total number of pictures should match the number of participants (Ex: For 30 participants collect pictures of 15 pairs of fruit).
- Put these pictures in a box and ask each participant to pick one picture from the box.
- Encourage participants to lookout for the other participant having the same picture and ask them to form pairs.
- Ask the participants in each pair to introduce themselves to their partner. Participants should use the following information to guide the introductions:
  - Name,
  - Village and hydrological unit, and
  - Position in GMC/HUN (spell out)or any other institution.
- Later, ask each participant in the pairs to introduce his/her partner to the large group.
- Continue the introductions till all the participants introduce one another.




Pictures of fruits and vegetables in pairs

2. FWS objectives Time: 30 min

Objective : Participants discuss FWS objectives.

Content : FWS objectives.

Method : Large group discussion

Materials : Charts, markers and pictures depicting Indian groundwater scenario.

Process

- Ask farmer participants to reflect for a minute on issues around water availability and agriculture that they wish to discuss/learn during the year-long Farmer Water Schools.
- Use the following visuals to initiate discussion on the present groundwater scenario.


Results of water levels depletion

- Keeping in view the existing groundwater situation, encourage the participants to share the issues that need to be discussed during the year long FWS sessions that can provide us a good understanding on groundwater science and water management techniques.
- Establish a norm that all ideas are welcome (no idea is a wrong one) and others should not judge an idea as it is being shared.
- Note the list of participants' ideas on a chart.
- Ensure that each participant gets a chance to share their thoughts.
- After all ideas have been shared, open the floor for discussion.
- In the large group, review the list of ideas and sequence the events.
- Thank the participants for the inputs and share the FWS objectives.
- Request the participants to compare their expectations with the FWS objectives and ask them to suggest required additions if any.
- Following these discussions, finalize the objectives for the year long FWS sessions.

The FWS objectives are as follows:

- Empower farmers with knowledge and skills in measuring recharge & draft,
- Sensitize farmers on the need for collective action,
- Sharpen the farmers' ability to make critical and informed decisions on crop plans,
- Sensitize farmers on new ways of thinking and resolving issues.

3. Pre Ballot Box Exercise (BBE) Time: 60 min.

Objective : Participants participate in Ballot Box Exercise.

Content : Ballot Box Exercise.

Method : Demonstration

Materials : Charts, markers, card boards, nails, long sticks, knife, thread, ballot boxes, and whistle.

Process

- Share the purpose of Ballot Box Exercise (BBE).The purpose of BBE is to know participants' awareness on groundwater, types of soils, rocks of HU and other water use efficiency methods. This will help determine topics that need focused attention during FWS sessions.
- After sharing the purpose of BBE, assign a registration number to each participant.
- Give each participant 30 ballot slips (number of slips should be equal to the number of questions) bearing his/her registration number.
- Ask each participant to lineup in front of one cardboard station (i.e. one participant in front of one cardboard station).
- Each cardboard station has a question and three options (yes, no, no idea).
- Beneath the question, each option has a cover.
- Ask the participants to read the question, choose the appropriate option and drop the ballot into that cover.
- On blowing the whistle, participants move to the next station to read the question and cast their votes for the question.
- Participants exercise their ballot at each station.

Tips to facilitator

- Help participants distinguish between a cardboard station, a ballot, and a ballot box.
- Before the conduct of the exercise, explain all the instructions to the participants.
- Organizing a mock demonstration before the actual conduct of the exercise will help participants.
- Assist illiterate or semi-literate farmers by reading the question and options.
- Only one participant should stand near one cardboard station.
- Do not allow two or more persons to crowd near one cardboard station.

Analysis of BBE Results

- First take out chits from 'No Idea' pocket, count them and record on a chart.
- After this, go to the pocket with least number of chits, count them and record on a chart.
- Finally record the third one by deducting the sum of the two from the total participants (There is no need to count the chits in the third pocket).
- Categorize the questions based on similarity.
- Calculate cumulative right/ wrong/ no idea question-wise and individual farmer-wise.
- Calculate percentages.
- Based on the results, determine topics that need focused attention during FWS.

4. Elements in farmer decision making process Time: 25 min.

Objective : Participants discuss steps in decision making process.

Content :

- Steps in farmer decision making process.
- Farmer's problems around groundwater and agriculture.
- Four core components of Farmer Water School.

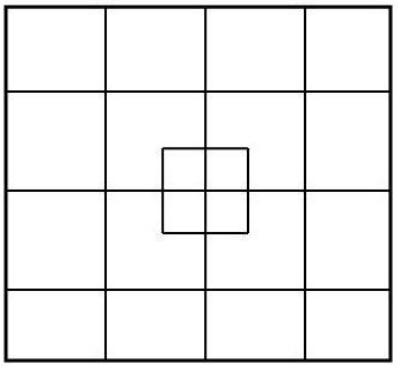
Method : Large group discussion

Materials : Charts, markers and visual having squares.

Process

Elements of farmer decision making process

- In a large group, show the following visual:



- Ask participants to observe the picture for 2 to 3 minutes and then count the number of squares in the picture. Do not lay any norms for participation in this activity.
- Later, ask a few participants to share their finding.

Tips to facilitator

- Few participants count quickly and find fewer squares.
- Others take longer time, help each other and find more.
- The more they analyze and discuss, the more clearly they arrive at the right answer.
- The correct answer is 35 squares.

- Ask them to describe how they arrived at their conclusions. List the steps involved in arriving at the said conclusions. The steps include:
  - See – observe.
  - Discuss with others.
  - Brainstorm – Think.
  - Make a decision.

Decision making process and groundwater management

- To enable better understanding, ask participants to list problems related to groundwater and agriculture.
- Take any one of the problems and ask the following question: "Assume that you do not have enough water in your borewell to irrigate the crop. How would you approach this problem and find a solution?"
- Record the participant's responses on a chart paper.
- Summarize the discussion by keeping the participants responses in mind and share that, you will 'discuss' with your fellow farmers and seek their advice. You might get various suggestions from them like shift of crop, going for a new borewell, purchasing water from other sources etc. After gathering information, you 'think' which is the best possible way to overcome the problem, and finally you take the appropriate 'decision' and implement the same.
- List the steps involved in the decision making process. They are:

- See –observation.
- Discussion- discussion with others.
- Think – analysis.
- Decision and implementation - decision making.

- Ask the participants if we could use these steps to develop strategies to address problems around groundwater availability and usage?
- Encourage participants to respond and reach consensus.

5. Norm setting Time: 20 min.

Objective : Participants set norms for smooth conduct of FWS sessions.
Content : Setting norms.
Method : Story telling and large group discussion.
Materials : Pictures, charts, markers and script of father and two son's story.
Process

- For effective and smooth conduct of Farmer Water School sessions, and to help the facilitators in the conduct of FWS sessions, encourage the participants to lay down the norms.

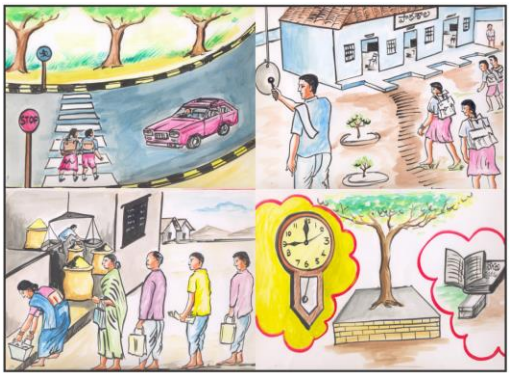
- To facilitate this, use the following pictures and generate a discussion on the norms observed in the pictures. Like wise, list the norms for effective conduct of Farmer Water Schools that evolve from the discussion on a chart paper.

Norms at various places

- Another option to set norms is to narrate the following story

Story: Father and two son's

There lived a man with his two sons. Due to financial problems, he could send only his elder son to school and kept the younger son with him to help in farm activities. On one occasion, he had to send his elder son to a nearby town to meet an official. So, he asked the younger son to go to the school in place of his elder brother. But the class teacher rejected this boy and sent him back.



After sharing the story, ask the following questions:

- What have you learnt from the story?
- Why was the younger son not allowed to sit in the class?

- List participant responses and lay down the norms for the effective conduct of Farmer Water Schools.
- Write the norms on a chart and read them aloud.

Tips to facilitator:

Encourage the participants to set the norms regarding:

- Time management.
- Transportation.
- Venue, responsibilities of host teams in the conduct of session.
- No substitute should attend the FWS session.
- Regular attendance.
- Discuss the learning of FWS session in GMCs.

6. Group formation Time: 25 min**.**

Objective : Participants form into small groups.

Content :

- Why small groups?
- Formation of small groups.

Method : Game and large group discussion

Materials : Medium size stones (ten in number), different varieties of stones.

Process

- Make the participants to play the game with 10 stones.

Game: Stone Game

- Take 10 stones of medium size.
- Divide the participants into two groups with five participants only in one group and the rest (say 25 participants) in the second group.
- Keep the 10 stones (each weighing two kilos) at one place.
- Ask the first group (five members) to move away a little and arrange the stones in order.
- Next ask the second group (25 members) to do the same a little away from the first group using the same stones.

- Ask the following questions after the game:
  - What have you observed in the game?
  - What is the difference between first group and second group?
  - Write participants responses on a chart paper and share the following advantages of having small groups.

A. Every member gets an equal opportunity to share their experiences and can articulate easily with other members in the group.
B. Every participant can improve his/ her presentation skills.
C. Enables mutual learning and promotes team work.

D. Increased camaraderie.

Encourage the participants to play the following game and form small groups.

Game: Different kinds of stones

- Take different varieties of stones available in the specific HU.
- Ensure that the number of stones is equal to the number of participants.
- Ask each participant to pick one stone.
- After the exercise, any two participants getting the same type of stone are grouped together.
- Encourage the participants in each group to read out their names before the audience.
- Encourage each group to name their group and identify a leader.

All the group leaders identified are responsible for the following:

- To ensure that all the members in that specific group are present for the session.
- To lead the discussion and ensure that there is an equal participation from every group member.
- To encourage every group member to present the groups work in large group.
- Before concluding the discussion, share that the groups will remain as a cohesive learning unit for the entire duration of Farmer Water Schools.

7. FWS Pledge Time: 25 min.

Objective : All the participants discuss and decide the content for FWS Pledge

Content : FWS pledge Content

Method : large group discussion

Process

- Ask the participants why school children take a pledge while beginning their regular day.
- Elicit responses from the large group and state that a pledge is to inculcate a discipline in our mind and enables us to take a work with more seriousness.
- State that it will be like promising ourselves that we will save our groundwater resources together.
- End the discussion by posing a question to the large group, if it will be good to start the future FWS sessions with FWS pledge.
- Encourage the participants to discuss what would be the ideal content in FWS pledge.
- Finalize FWS pledge.

8. Group dynamics- Importance of peoples' institutions Time: 10 min.

Encourage the participants to play this game. The purpose of this game is to discuss the importance of a group who has common interest to solve their issues.

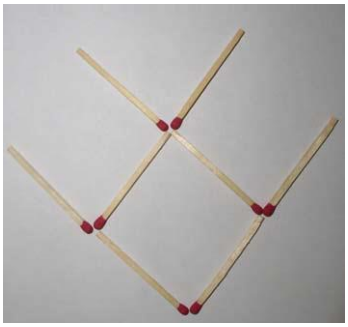
Game: Fish Game

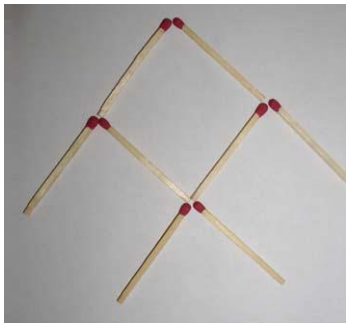
Use eight match sticks to symbolize a down ward looking fish as shown in the picture given below. Ask participants to move just three matchsticks to change the direction of the fish so that it is facing upwards.

- After the game, ask participants the following questions:
    - What is your inference regarding the downward and upward direction of fish?
    - How did you change the direction of fish?
    - Can we relate these three match sticks to collective action, Unity and Mutual assistance which are important for a people's institution?

Message: The three sticks represent the three things which one needs to progress in life:

- Collective action,
- Unity, and
- Mutual assistance.





9. Introduction to Short Studies Time: 15 min.

Objective : Participants discuss the problems they have been facing.

Content : Introduction to Short Studies.

Method : Large group discussion

Material : Charts and markers.

Process :

- In a large group, ask participants the following question.
    - You have been growing crops for many years. What are the major problems you people are facing?
- List the participant's responses on chart paper. Problems could be pest related, water related or related to marketing.
- This list should be used to provide assistance or design short studies at various stages of FWS.

10. Short study: Green manures Time: 20 min.

Objective : Participants discuss:

- Types of natural manures
- List of green manures
- Feasibility of application of green manures in the field

Content : Green manure crops

Method : Large group discussion

Material : Charts and markers

Process

- In a large group, ask participants the following question: "What are the ways of increasing soil fertility?"
- Ask the following question in large group: "What are the characteristics that should be present in a plant to be used as a Green manure crop?" Record the participant responses on chart paper.

Tips to the facilitator

Characteristics of green manure crops

- Have profuse leaves and rapid growth early in its life cycle.
- Have abundance and succulent tops.
- Be capable of making a good stand on poor and exhausted soils.
- Have a deep root system.
- Legume with good nodular growth habit.
- Examples of Green manure crops are oats, rye, mustard, clover, fenugreek, fava beans, sun hemp, alfalfa, azolla etc.

- Ask participants to list the types of plants that can be used as 'green manure'.
- Assign each group a specific plant and ask them to discuss in their groups:
- Discuss the process of converting the plants into green manures?
- What are the benefits of using 'green manures'?
- Later, ask each group to report out their discussions to the large group.

Tips to facilitator

Benefits of green manure

- Green manure offers an inexpensive way of improving crop yields and takes little effort.
- Recycle and add organic matter to soil.
- Leguminous plants help in supplying nitrogen to soil.
- Improves soil structure by letting more air and also improves drainage.
- Prevent soil erosion.
- Help in controlling weeds.
- Increases absorptive capacity of soil.
- Increases biochemical activity in soil by becoming food to micro-organisms.
- Helps in increasing crop yield.
- Can be used for mulching

11. Evaluation Time: 10min.

- Ask the following questions to evaluate the day's learning. Pose the questions to the large group:
    - What did you like about today?
    - Do you have any suggestions on the topics discussed today?
    - Do you think the steps in decision making process are relevant in daily life? How?
    - How will participation in FWS improve collective efforts for sustainability?
- Note the participants feed back and thank everyone for their active participation.

Session-II: Knowing the Hydrological Unit (HU) – July 2nd week

Program Schedule

S.No	Time	Content	Method	Materials	Expected outcome
1	15 min.	Recap.	Large group discussion	Charts, markers and clips.	Participants recollect the contents of the first session.
2	10 min.	Sharing BBE results.	Large group	Charts and markers	Participants know their awareness levels as a group on various FWS topics.
3	90 min.	HESA- HU walk	Field visit, and small group discussion	Visuals, charts and markers.	Discuss rock formations and its extent.

4	25 min.	Water cycle of the Hydrological Unit	Small group discussion	Visuals, charts and markers.	Participants discuss water cycle and its significance.
5	15 min.	Group dynamics- Leadership qualities.	Demonstration	Glass tumblers, pebbles, clay and sugar.	This game helps the participants to understand the need for leaders and the qualities s/he should have..
6	30 min.	Short Study- Seed treatment.	Large group discussion	Charts and markers.	Participants discuss the various seed treatment methods.
7	One week	Seed germination test.	Demonstration	Plant seeds, soil, water, cotton cloth, newspaper, rubber bands, gunny cloth, polythene covers, newspaper, and mug.	Participants compute germination rates.
8	10 min..	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Recap contents of the previous session,
- Share Pre-BBE results,
- Walk along the HU and discuss hydrological cycle of the HU,
- Discuss water cycle of the Hydrological Unit, and
- Understand the importance of leadership qualities.

Process

1. Recap Time: 15 min**.**

Objective : Participants recap the contents discussed in the previous session.

Content : Recap session one contents.

- Introduction of the participants and sharing of expectations,
- Pre Ballot Box Exercise,
- FWS objectives,
- Norm setting,
- Group formation,
- Elements of farmer decision making, and

- Importance of people's institutions.

Method : Large group discussion

Materials : First session contents, charts, and markers.

Process

- Welcome participants to the second session.
- Start the session with FWS pledge.

FWS pledge
We, the members of the Farmer Water School take an oath that:
The groundwater resources in our HU collectively belong to us.
Together, we will manage our groundwater resources judiciously.
We will take all the necessary measures to prevent groundwater pollution.
We will attend all the 14 sessions of Farmer Water School without fail.
We will disseminate all the learning from FWS to the larger community.
We preserve groundwater resources for our future generations and we take a pledge in this regard.

- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Briefly discuss the contents and the learning from the previous session.

2. Sharing BBE results Time: 10 min.

Share the BBE results with the participants. Explain the process of analyzing BBE results

3. HESA – HU walk Time: 90 min.

Objective : Participants walk along the HU and discuss hydrological features of the HU.

Content :

- Hydrological cycle in the HU,
- Rock formations and its extent, and
- Soil formations.

Methods : Field visit, and small group discussion.

Materials : Visuals, charts, and markers.

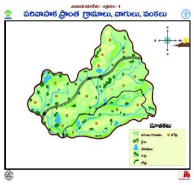
Process

- Inform the participants that they will work in their respective learning groups during this activity.

- Take the farmers to the field (HU area only) and request them to observe and analyze the different rock and soil formations, other factors that influence the hydrological cycle of the HU. Ask the farmers to work in their respective small groups.
- Suggest the farmers to note down their observations during the field walk.
- Encourage farmers to discuss about rock weathering, rock formations and its extent, soil formations, different types of soils, factors influencing groundwater recharge and relevant information. Give 30 minutes for field walk.

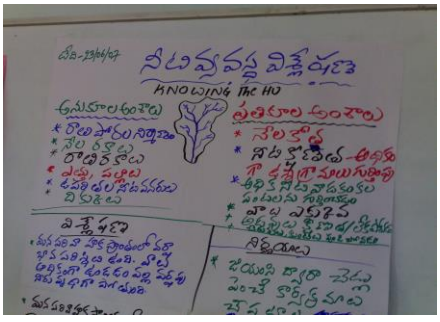
<table>
<tr><td colspan="2"><u>Hydro Eco-System Analysis</u>

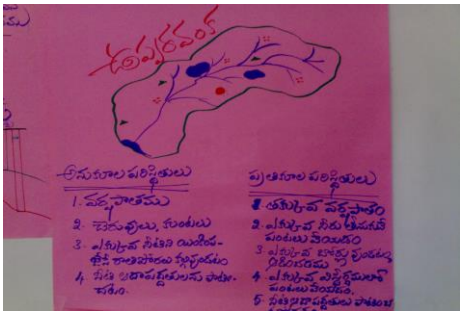
Name of the group: Date:

Place/venue:
  </td></tr>
<tr><td>+ <u>Beneficial factors(Recharge)</u>

• List of their observations.</td><td>- <u>Non beneficial(Recharge/Discharge)</u></td></tr>
<tr><td rowspan="2"><u>Analysis</u>:</td><td><u>Decisions</u></td></tr>
<tr><td><u>Action Plan (include role of HUNs/GMCs)</u></td></tr>
</table>

- Later, request farmers to work in small groups and analyze their observations. The above chart could be used to present the analysis.
- Ask the participants to share their observations and analysis in large group. Generate discussion to facilitate a good understanding of the HU.





4. Water cycle of the Hydrological Unit Time: 25 min.

Objective : Participants walk along the HU and discuss hydrological features of the HU.

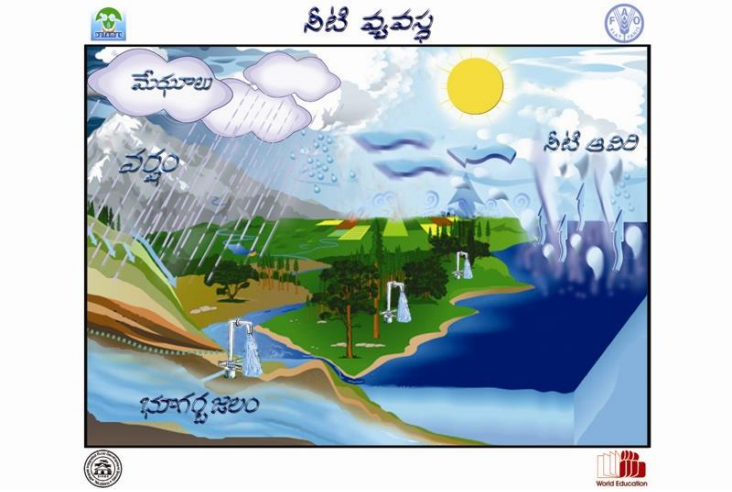
Content : Water cycle of the Hydrological Unit.

Methods : Small group discussion

Materials : Visual, charts, and markers.

Process

- Encourage participants to work in small groups.
- Show the following visual and encourage discussion on how rain occurs and percolation of water into the ground.



- Summarize the discussion by stating that water from oceans and large surface water bodies evaporates due to heat from the sun which again form clouds that condense to fall as rain.

5. Group dynamic- Leadership qualities Time: 15 min.

This game helps participants to identify leaders who:

- Trust and respect others,
- Have a vision, and
- Encourage every one's participation in GMC/HUN.

Game: Three tumblers

- Take four transparent tumblers (glass or plastic) and fill them with water.
- Ask the participants to put pebbles in the first glass, some water in the second, some wet clay in the third, and sugar in the fourth glass.
- Ask them to explain what happened in each case.

- Explain that the pebble represents the autocratic leader, who is dominating and does not mingle with other members.
- Adding water to the second glass represents the dummy leader in a group; there is no difference between the leader and other members in the group.
- The wet clay in the third glass represents the anarchic leader who often promotes chaos and dissidence in the group, making clean water muddy. The group is spoilt just as the water gets muddy.
- The sugar in the fourth glass represents the democratic leader who mingles with the group, improves its quality (sweetens the water), and functions like a genuine people's representative.

After the game, ask participants the following question:

- Who is a good leader in this game and why?

Write the responses on a chart and summarize the discussion with the list of characteristics of a good leader.

6. Short Study: Seed treatment Time: 30 min.

Objective : Participants discuss the various seed treatment methods.
Content : Seed treatment and its usage.
Method : Large group discussion
Materials : Charts and markers.
Process

- Ask participants the following question:
    - What are the ways of controlling pest and diseases at the stage of seed selection i.e. before sowing?"
- List participant's responses on a chart paper and encourage them to discuss about the importance of seed treatment. Share the following information about the importance and benefits of seed treatment.

Tips to facilitator

Information on Seed treatment

- The concept of seed treatment is the use and application of biological and chemical agents that control or contain primary soil and seed borne infestation of insects and diseases that pose devastating consequences to crop production, improving crop safety leading to good establishment of healthy and vigorous plants resulting in better yields.
- Seed treatment refers to the application of fungicide, insecticide, or a combination of both, to seeds so as to disinfect them from seed-borne or soil-borne pathogenic organisms and storage insects. It also refers to the subjecting of seeds to solar energy exposure, and immersion in conditioned water.

- Next, ask participants to discuss in small groups about the advantages of seed treatment.

- Encourage each group to present their group work to large group and summarize the discussion by sharing the following advantages of seed treatment.

Tips to facilitator

Benefits of Seed Treatment

- Prevents spread of plant diseases.
- Improves germination.
- Controls soil insects.
- Ensures uniform seedling emergence.
- Protect seeds or seedlings from early season diseases and insect pests improving crop emergence and its growth.
- Use of plant growth hormones may enhance crop performance during the growing season.
- Rhizobium inoculation enhances the nitrogen fixing capability of legume crops, and their productivity.

- Next, encourage participants to discuss on types of seed treatment. Invite one or two participants who have been practicing seed treatment and encourage them to share their experiences and request him or her to demonstrate the process of seed treatment to larger audience.

- Discuss the seed treatment practices for the major crops in the area.

7. Seed germination test Time: one week

Introduction :

Seeds are an important and critical input for getting better crop quality and maximum yield. As seed quality is the key factor in plant growth and yield, it is important to know the

germination rate by various methods before sowing. Farmers will incur losses in labor cost, seed cost, along with precious time if the seeds are of inferior quality. Therefore, in order to avoid the above inconvenience farmers should be made aware of importance of seed germination and appropriate farmer friendly methods before sowing.

Objectives :

By the end of this exercise, participants will be able to:

- Compute germination rates. and
- Select appropriate farmer friendly germination methods.

Method :

- Large group discussion to introduce the topic.
- Experimentation in small groups.

Materials :

Plant seeds, soil, water, cotton cloth, newspaper, rubber bands, gunny cloth, polythene covers, newspaper, and a mug.

Procedure :

Introduce and discuss the topic in large group. Divide the participants into groups.

Ask the groups to practice the following four methods. They are:

1. Cloth method
2. Tray method
3. Paper method and
4. Petri dish method

Below are a few alternate methods of performing seed germination test. Choose the ones feasible.

Around fifty seeds can be used for each germination test and the duration of the test will be for seven days.

Cloth method:

- Tie the seeds loosely for aeration in a wet white cloth.
- Sprinkle water regularly to maintain adequate moisture.

Tray method:

- Take well mixed soil and organic matter in the ratio of 3:1 into a tray.
- Sow the seeds in rows.
- Water the trays regularly to maintain soil moisture.

Paper method:

- Spread the plastic sheet on the ground.

- Place a wet newspaper over the plastic sheet.
- Arrange the seeds on the wet paper.
- Again, cover the seeds with wet news paper.
- Then, roll the sheet. Tie one side with rubber band for moisture retention and other side left open for better aeration.

Petri dish method:

- Spread the circular moist blotter paper in two petri dishes.
- Arrange seeds each in the petri dishes.
- Cover with lids.
- Sprinkle water regularly to maintain moisture.

8. Evaluation Time: 10min.

- Ask the following questions to evaluate the day's learning. Pose the questions to the large group:
    - What did you like about the field visit?
    - What are the factors influencing rainfall in the HU?
    - What are the different elements in the HESA framework?
- Encourage each participant to share one or two points of their day's learning and thank them for their enthusiasm during the HU walk.

Session-III: Participatory Hydrological Monitoring (PHM): August 1st week

Program Schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	10 min.	Recap.	Large group discussion	Charts, markers and clips.	Participants recollect the contents of second session.
2	20 min.	Relevance of hydrological data.	Large group discussion and pictures.	Pictures, charts and markers.	Participants identify the need to collect PHM data.
3	15 min.	Measuring devices.	Large group discussion and demonstration	Water level indicator, 100 litres drum, and stop watch.	Participants understand the application and usage of various measuring devices.
4	75 min.	Data collection procedures and dissemination.	Demonstration and large group discussion	Charts, markers, pens.	Participants measure the water levels, discharge of borewell and rainfall.
5	15 min.	Group dynamics – Book-keeping.	Game	Twenty different kinds of items.	Participants will discuss the importance of recording data in HMR book.
6	10 min.	HESA – Water Levels.	Large group discussion	Charts and markers.	Participants analyze water levels.

7	20 min.	Short Study: Inflow and outflow of the HU.	Demonstration	Soil, heap of mud.	Participants observe the inflow and outflow of rainwater and discuss the rate of infiltration into ground and the amount of out flow.
8	10 min.	Homework: PHM data measurement.			Farmers observe water levels in their respective villages.
9	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Recap the previous session,
- Discuss hydrological data and its relevance,
- Understand the usage of measuring devices,
- Discuss the procedures of data collection and dissemination,
- Understand the importance of book-keeping,
- Analyze the relationship between water levels and rainfall (HESA), and
- Discuss the need to observe water levels.

Process

1. Recap Time: 10 min.

Objective : Participants recap the previous session.

Content : Recap session two contents.

- HU walk (HESA): Field walk in Hydrological Unit area and water cycle.
- Water cycle of the Hydrological Unit.
- Importance of leadership qualities.

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome the participants to third session.
- In the large group, encourage each participant to share a topic that was discussed in previous session and the learning from that one.
- As you facilitate the recap, write participant's responses on the chart paper.
- Briefly discuss the contents and the learning from the previous session.

2. Relevance of hydrological data Time: 20 min.

Objective : Participants discuss the relevance of hydrological data.

Content :

- Timeline of depleting water levels and adaptation of tools.
- Relevance of PHM activities to water levels and rainfall.

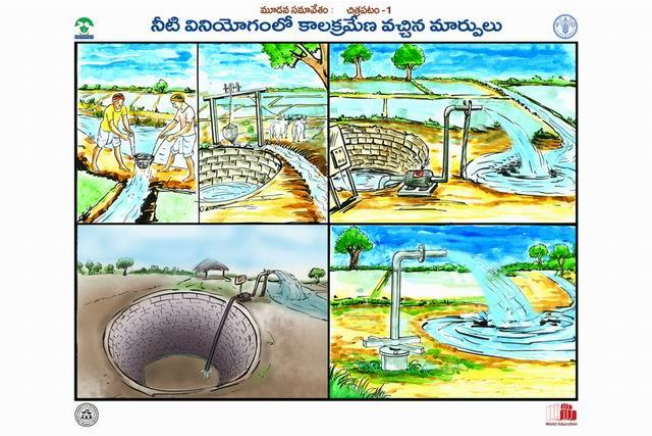
Method : Large group discussion

Materials : Picture, charts, and markers.

Process

Water level and discharge measurement

- Start the discussion stating that: "We are dependent on agriculture. Could you please recollect, what were the sources of irrigation 50 years ago?".
- Write responses of the participants on a chart paper..
- Show the picture depicting timeline of depleting water levels and irrigation practices.



- Continue the discussion stating that: "We used to raise crops based on water availability in open wells and tanks. Now, we are depending on borewells for irrigation and drinking purposes. This shift is mainly due to drying of surface water bodies, lack of adequate rainfall, and deforestation".
- Pose a question in large group if farmers are happy with the present state of agriculture using borewell irrigation and what are the challenges in it?
- List the challenges on a chart paper.
- Encourage a discussion in large group by asking the following questions:
  - "Do you think water levels remain static in your borewell?
  - How do you know at what level water is available in your borewell?
- List the participant's responses on a chart paper and summarize by sharing that it is good to measure water levels and discharge (Time required to fill 100 litres drum) of the borewell to understand water levels in a borewell.

Rainfall measurement

- Start the discussion with the following words:
- All of us are aware that the primary source for irrigation in agriculture is rainfall. We will have enough water available in tanks and borewells for irrigation when there is adequate rainfall.
- Pose the following question in large group to extract the indigenous knowledge of farmers: "How do you estimate rainfall as adequate, moderate or poor?"
- Write participants responses on a chart paper and continue the discussion stating that these assumptions cannot give the exact picture.
- Summarize the discussion by stating that it is always useful to be aware of a scientific method to measure exact rainfall received and to analyze whether the received rainfall is adequate, moderate or poor.

- Conclude the discussion by sharing that measuring water levels, rainfall will enable us to understand the groundwater dynamics and the relation between rainfall, water levels and discharge of the borewell.

Tips to facilitator Local farmer's assumptions
• Farmers in the village assume that presence of earthworms in their field is an indication of adequate rainfall. • Sprouting of mushrooms in their field's vicinity is taken as another indication. • Though these are indicative of presence of moisture in soil, it is not possible to measure the exact quantity of rainfall received by these methods.

3. Measuring devices Time: 15 min.

Objectives : Participants discuss the usage of measuring devices.

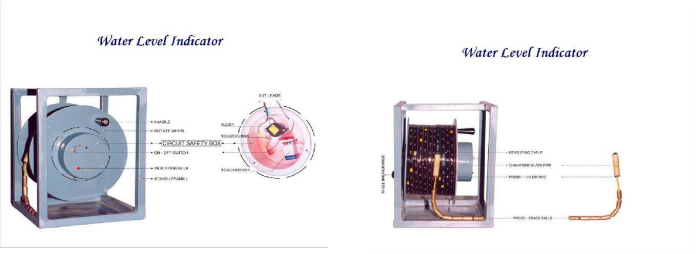
Content : Measuring devices.

Method : Large group discussion and demonstration

Materials : Water level indicator, drum, stop watch, collecting jar, measuring jar.

Process

- Start the discussion stating that: "We have just finished discussing the need to measure water levels and rainfall. Let us discuss about the methods or tools used to measure rainfall and water levels of borewells".
- Ask the following questions in large group:
  - How can we know at what level, water is in your borewell? And what are the usual methods you use to know the water levels?
- Write participant's responses on a chart and introduce Water Level Indicator (WLI).
- Demonstrate the functioning and different parts of water level indicator.
  - The WLI has a cable and numbers written on it in 'feet' or 'meters.'



  - When both ends of the probe of WLI touches water surface, it gives a 'beep' sound. At this point, we need to observe the reading on the cable and note the same in HMR book.

- Before taking the reading, ensure the exact contact point of probe with water surface.
- Next, introduce 100 lt. drum and stop watch used to measure the time taken for bore well to fill 100 lt. drum (Called 'discharge').

- Next, encourage rain gauge volunteer to share the instruments used to measure the rainfall received. Show the rain gauge, collecting jar and measuring jar. Share that the measuring jar will be calibrated into millimetres.

4. Data collection procedures and dissemination Time: 75 min.

Objective : Participants demonstrate the process of measuring water levels, discharge of the borewell and the rainfall.

Content :

- Procedures of measuring water levels, discharge and rainfall.

Method : Large group discussion and demonstration

Materials : Water level indicator, drum, stop watch, collecting jar, measuring jar.

Process

Water level measurement

- Take the participants to a nearby borewell.
- Encourage rain gauge volunteers and observation borewell volunteers to explain the process of measuring rainfall and water levels respectively.

- Explain that it is an observation borewell fitted with one inch HDPE pipe to insert WLI.

- Demonstrate how to insert the WLI and ask the participants to notice the sound when both the ends of the probe touch the water surface.
- Demonstrate how to measure the water levels.
- Discuss the time interval between Static Water Level (SWL) and Pumping Water Level (PWL). It should be minimum three hours after switching on the pump or motor.
- Ask participants in large group the reason for measuring PWL after a lag of three hours?
- Summarize the discussion by stating that water in the borewell is agitated during the pumping process. If a measurement is taken immediately after switching on the borewell, the result will be false due to accumulated water. It will take a minimum of three hours for it to settle down to a stable level. So, it is advisable to measure after three hours of pumping.
- Encourage the participants to practice measuring water levels.

Discharge measurement

- Next, ask the participants if it is possible to measure the quantity of water drawn from a borewell.
- Show the 100 litres calibrated drum and stop watch and demonstrate its usage and process of measuring the quantity of water.
- Explain that if we know the time taken to fill a 100 litres drum, we can estimate the quantity of water pumped out per hour and per day.
- Encourage the participants to practice measuring drum discharge.

Rainfall measurement

- Next, take the participants to the nearby rain gauge station and explain the process of measuring rainfall and time for measuring rainfall.
- Demonstrate the measuring of rainfall.
- Encourage the participants to practice the measuring rainfall.
- Next, Select four volunteers and explain the same.

Data dissemination – Types of data display boards

- Next, initiate a discussion on the importance of data dissemination to the larger audience in the village by posing the following questions:
  - Is the data that has been generated useful to our co-farmers (borewell users)?
- If it is useful, how can you effectively disseminate this information to our co-farmers? Write the participant's responses on chart paper.

Tips to facilitator
Encourage participant's to explore different ways like: • Sharing in women groups by women members of the GMC or FWS participants.

- Discuss and share in regular GMC meetings.
- Sharing in regular meetings of village panchayat.
- Discussion in common gatherings at village level.
- Use of posters, wall paintings.

- Introduce different kinds of dissemination boards and explain the process of recording data on them.
- Emphasize the importance of the location for displaying dissemination boards. This location should be ideally visible to everyone in the village.

Tips to the facilitator

Types of data dissemination boards:

- Water level type.
- Rain fall type.
- HU type.

5. Group dynamic: Book-keeping Time: 15 min.

Objective : Participants will discuss the importance of recording data in HMR book.

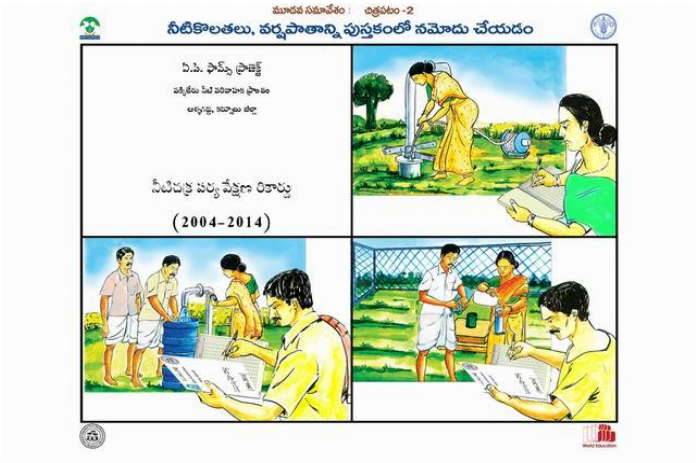
Materials : Twenty different types of items (Ex: pen, book, lid, paper, seed, stone, dried leaf etc).

Method : Game

Process

- Place the 20 different items on the floor and cover it.
- Ask the participants to watch the 20 items for two minutes and cover the items.
- Ask the participants to write the items individually on a piece of paper.
- Participants may not list all the items.
- Ask the following question to generate the discussion. "If it is difficult for us to recall the items that we have just watched, will it be possible to for us to recollect the water levels data which was collected 15 days ago?"

- Conclude by saying that it is important to maintain the record of water levels and rainfall data. It is critical for the conduct of crop water budgeting exercise and for making collective decisions around crop-plans.



- After completion of discussion on the importance of data recording in Hydrological Monitoring Record (HMR) books, introduce the HMR book and the contents in it to the participants.
- Distribute the photocopies of the HMR book and encourage the participants to practice recording of data.
- Discuss the content to be added in mentioned rows and columns of the HMR book and request the participants to record the collected data in appropriate columns.
- Initiate a discussion in large group on the frequency of measuring water levels, discharge and rainfall. Write participants responses on a chart paper and conclude by sharing the following information with the participants.
- Measure the rainfall early in the morning before 8 am whenever we receive rainfall. This is because the rain collected in the rain gauge might start evaporating and give rise to false results.
- Measure the water levels and discharge every fort night and record in HMR book for future reference.

6. HESA-Water levels Time: 10 min.

Objective : Participants analyze water levels.

Materials : Charts and markers.

Method : Large group discussion

Process

- Ask the participants in large group if they have been measuring water levels without any difficulty?
- Clarify their doubts (if any).
- Pose a question in large group: 'Did you observe any change in water levels or discharge of the borewell?
- Summarize the discussion by analyzing the reasons for these fluctuations. Use HESA frame work for analysis.

7. Short Study - Inflow and outflow of the HU Time: 20 min.

Objective : Participants will observe the inflow and outflow of rainwater and discuss the rate of infiltration into ground and the amount of out flow.

Rationale : Usually, farmers believe that a large portion of rain water infiltrates into the ground. In reality, only a small fraction percolates into ground. Most of the rainwater flows into oceans through rivers. The following experiment will help demonstrate:

- How rain water flows into a Hydrological Unit?
- How only a small percentage of it infiltrates into the ground?
- How a major percentage of water flows out of Hydrological Unit?

Here are two alternate ways of demonstrating or generating discussion on this.

Model One : Use of soil

Materials : 45 x 30 cm tray, polythene cover, empty bottle, 4 liters of water, soil, small stones, small branches of tree, and pins.

Method :

- Wet the soil with water.
- Prepare a model of the Hydrological Unit in the tray using wet soil. Use the stones to represent hills. Place leaves and small branches in the mud to represent forest area in the Hydrological Unit area.
- Put a hole to the tray towards slope portion

Usage :

- Pour 2 liters of water in polythene cover and hold it above the tray.
- Use pins to pierce the polythene cover to simulate rain.
- The water that falls on the tray comes out of it through the slope.

Note**:** Wet the soil with more water to demonstrate more out flow.

Discussion Questions:

- How does rain water flow in a Hydrological Unit?

- What percentage of it infiltrates into the ground?

Model two : Use a heap of mud

Materials **:** Plastic tray, polythene cover, vessel (to receive water), pins, mud, small stones and leaves.

Method :

- Fill the plastic tray up to the brim with wet soil.
- Arrange the soil to form slope. Use the stones to represent hills.
- Place leaves and small branches in the mud to represent forest area in the Hydrological Unit area.
- Show the origin of the stream at height, and the end point of the stream towards the slope of the tray.

Usage

- Keep the model at a height so that all the farmers can see.
- Hold the polythene cover filled with water above the tray. Use pin head to pierce the polythene cover to simulate rain.
- Rain Water (in-flow) covers most part of the area in the model, flows and comes out of the tray (out-flow).
- Explain to them that rain water falling on hills and upper reaches of the area will enter rivers via rivulets and streams and finally will enter into the seas (confluence).

Discussion Questions:

- How does rain water flow in a Hydrological Unit?
- What percentage of it infiltrates into the ground?

8. Homework – PHM data measurement Time: 10 min.

- Encourage the participants to observe the water levels in their respective villages and request them to come back to the next session with their questions and observations.

9. Evaluation Time: 10 min.

Pose the following questions to evaluate the day's learning:

- Is there a need to share the importance of measuring water levels, discharge and rainfall in GMC meetings? Why?
- Please list the measuring devices to measure water levels, discharge and rainfall.
- Please list the different types of dissemination boards and their usefulness.

Session-IV: Groundwater recharge: September 1st week

Program Schedule

S.No	Time	Content	Method	Materials	Facilitator
1	10 min.	Recap.	Large group discussion	Photos, charts, markers, charts of third session.	Participants recollect the contents discussed in third session.
2	40 min.	Factors influencing recharge.	Small group discussion	Charts and markers.	Participants identify the influencing factors of groundwater recharge.
3	15 min.	Group dynamics: Cooperation among GMC members.	Game	Thread roll, soft drink bottle, pens.	Participants understand the importance of cooperation between members to accomplish tasks.
4	20 min.	HESA – Slope.	Small group discussion	Charts, Markers.	Participants discuss about slope and suggest methods to practice to if slope is more.
5	30 min.	Short Study- (A) Groundwater recharge process; and (B) factors influencing recharge process.	Demonstration	Sponge, water, glass Plastic trays, red soil, sand.	• Participants observe and discuss rate of groundwater recharge. • Participants discuss the various factors that influence groundwater recharge.
6	10 min.	Homework: Collection of rainfall data (June-October), rock types and its extent.	Small group discussion	Charts and markers.	Discuss the ways of collecting rainfall data and rock types.
7	10 min.	Evaluation.	Large group discussion	Large group discussion.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Recap the previous session,
- Discuss the natural and artificial recharge methods,
- Discuss the factors influencing recharge (HESA),

- Discuss the recharge rates (GEC norms) in different rock types,
- Discuss the importance of cooperation among GMC members, and
- Discuss collection of rainfall data (June to October).

Process

1. Recap Time: 10 min.

Objective : Participants recap the topics discussed in the previous session.

Content : Recap session three contents:

- Hydrological data and its relevance,
- Measuring devices,
- Procedures of data collection, recording in HMR books and dissemination,
- Home work: Observation of water levels,
- Water levels (HESA), and
- Importance of Book- keeping.

Method : Using farmer participant as a resource person

Materials : Charts and pictures used during the previous sessions.

Process :

- Welcome the participants to the fourth session.
- Request one farmer to share the contents discussed in the third session.
- Ask the participants in large group to add any missing points in the recap.
- Briefly discuss the contents and the learning from the previous session.

2. Factors influencing groundwater recharge Time: 40 min.

Objective : Participants discuss the ways of recharge of water into soil and influencing factors of groundwater recharge.

Content : Natural and Artificial Recharge

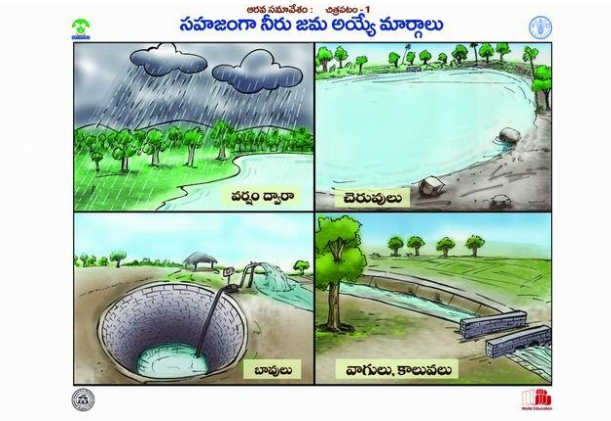
- Source of natural recharge and artificial recharge.
- Factors influencing groundwater recharge.

Method : Large group discussion

Materials : Pictures, charts and markers.

Process

- Begin a discussion with the following words. We have been discussing about groundwater since three sessions. Can you share your thoughts on how water seeps into the ground and what is the primary source?
- Write participants responses on a chart paper and identify the natural and artificial ways in which water percolates the ground.
- Use the following visuals to encourage the discussion.



Natural ways of recharge.

Artificial ways of recharge

- Summarize the discussion by stating that main source for recharge is rain, oceans and snow. Recharge can be done by building some artificial recharge structures like check dams, injection wells, contour bunds etc, but process is expensive and cannot be done on a large scale.

Factors influencing recharge

- Next, initiate the discussion by stating that till now we discussed the ways of recharge. Let us now discuss the influencing factors of recharge.
- Request participants to work in small groups to discuss the factors influencing groundwater recharge.
- Encourage participants to use the HESA frame work and present their group work.
- After presentation of all groups, write the list of factors influencing the groundwater recharge on a chart and summarize the discussion.

Tips to the facilitator
Factors influencing recharge are: • Rainfall, • Area, soil types, • Rock formation, slope and drainage.

3. Group dynamics- Cooperation among GMC members Time: 15 min.

Objective : Participants participate in a game to understand the importance of cooperation between members to accomplish tasks.

Materials : Thread roll, soft drink bottle, pens.

Process

- Cut the thread into strings of three meters long.

- The number of strings should be equal to the number of participants.
- Divide the participants into groups.
- Tie five strings of equal length.
- Ask each group to have its members stand in a circle facing inwards.
- Give one pen with strings tied to it to each group.
- Ask each group member to hold the loose end of one string.
- Place the bottle of soft drink on the ground a little away from the centre of the group.
- Ask the group members to coordinate their actions to gently drop the ball pen into the soft drink bottle.
- The first group to complete the activity will be declared as the winner.
- Ask the following questions after the game:
    - What are the reasons for winning?
    - What are the reasons for not winning?
- Encourage the farmer participants to discuss the need for same kind of cooperation among GMC members.

4. HESA – Slope Time: 20 min.

- Encourage participants to discuss in small groups about the slope in the Hydrological Unit.
- Request each group to present their group work to large group.
- After completion of all group presentations summarize the discussion by sharing that the decisions should be implemented and monitored by HUN and clear action plan need to be discussed in the group.

5. Short Study **Time: 30 min.**

(A) *Groundwater recharge process* Time: 15 min.

Objective : Participants will observe and discuss rate of groundwater recharge.

Rationale : Usually farmers assume that most of the rain water infiltrates into soil. But in reality most of the rain water flows into rivers through streams and rivulets. It will be helpful for the farmers to know about the phenomenon that only a small fraction of rain water (1-12%) infiltrates into the soil. This can be explained by conducting an experiment.

Materials : Sponge, water, and glass.

Usage

- Take a dry sponge.
- Pour 100 ml. of water on sponge like rainfall.
- Collect water into a glass by squeezing the sponge. Ask the farmers whether the amount of water collected in the glass is 100 ml.
- Discuss the relative absorbing capacity of sponge with that of the soil. Explain that all the rainfall received does not infiltrate into the soil and it depends upon the rock formation and its extent.

(B) *Factors influencing groundwater recharge* Time: 15 min.

Objective : Participants will discuss the various factors that influence groundwater recharge.

Rationale : Various factors influence rate of groundwater recharge /percolation. The percolation rate depends on slope, rock formation and soil types. The following experiment will help demonstrate this.

Materials : Three plastic trays (30 x 20cm), three big plastic trays (40 x 30 cm), two types of soil (red soil, sand), bucket full of water, and mug.

Usage

- Take three plastic trays (30 x 20 cm).
- Fill two trays up to the brim with red soil.
- Fill the third tray with sand and red soil mixed in 1:1 ratio.
- Place each of these trays in a larger tray to collect water separately.
- Keep one of the two trays filled with red soil in a slant position. Keep the other two trays one filled with red soil and the other with mixed soil (red soil + sand) in a horizontal position.
- Simultaneously pour a mug of water into each tray with uniform speed.
- Measure the water collected in the three larger trays after two minutes.
- Ask the participants to observe the quantity of water collected in each of the big trays. Usually, more water is collected from the tray with slope, less water from the tray with red soil placed horizontally and even lesser water from the tray with mixed soil.

6. Homework- collection of rainfall data and rock types Time: 10 min.

Objective : Participants discuss the ways of collecting rainfall data, rock types and its extent.

Content :

- Rainfall data (June to October).

- Rock types and its extent.

Method : Large group discussion

Materials : Charts and markers.

Process

- Encourage participants to discuss the ways to collect rainfall data received during June to October and rock types in the hydrological unit area.
- Write participant responses on a chart and request participants to get the accurate data.

7. Evaluation Time: 10 min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- What are the different sources of natural recharge?
- Assume that there is equal rainfall in two different places; does the same quantity of water percolate the ground in both the places?
- Can you list the data required to estimate the groundwater recharge?

Encourage participants to share their day's learning and thank for their participation

Session-V: Estimation of groundwater recharge: September 3rd week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	15 min.	Recap.	Large group discussion	Pictures, charts and markers.	Participants recollect the contents discussed in fourth session.
2	15 min.	Discussion on homework: Estimation of total rainfall received (HU wise consolidated data).	Large group discussion	Charts and markers.	Participants estimate total rainfall received by consolidating the data from all the rain gauge stations in the HU.
3	45 min.	Estimation of HU area.	Large group discussion and small group discussion	Graph sheets, carbon papers toposheets, pencils, scale, calculator, sketch pens, charts, pins and markers.	Participants experience the steps involved in estimation of Hydrological Unit area.
4	45 min.	Estimation of groundwater recharge (June-October).	Large group discussion, and small group discussion	Rainfall data, charts, markers and calculators.	Participants identify the information need to estimate groundwater recharge and estimate the recharge.
5	20 min.	Group dynamics-Data accuracy.	Demonstration	Three glasses, one transparent bowl, colour powder and water.	Participants will demonstrate the importance of data accuracy in estimating groundwater levels.
6	20 min	Short Study: Weed management.	Demonstration	Bottles, weed plants, rice plant, blade, kesar colour, charts and markers.	Participants discuss the need for weed management.
7	30 min.	Homework: Data collection for estimation of groundwater draft Rabi crop plans, and secondary water bodies.	Large group discussion	Charts and markers.	Participants take part in data collection, discussion for estimation of groundwater draft Rabi crop plans, and secondary water bodies.
8	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Recap the previous session,
- Estimate total rainfall received,
- Estimate the HU area,
- Estimate the groundwater recharge,
- Understand the importance of data accuracy,
- Analyze the water level fluctuations (SWL, PWL Vs rainfall), and
- Discuss the data required for estimation of draft and explore the ways to collect the data.

Process

2. Recap Time: 15 min.

Objective : Participants recap the previous session.

Content :

- Natural and artificial recharge,
- Factors Influencing recharge (HESA),
- Recharge rates (GEC norms) of different rock types,
- Importance of cooperation among GMC members, and
- Homework- Collection of rainfall data (June-October).

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome the participants to the fifth session.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

3. **Discussion on Homework – Estimation of total rainfall received** Time: 15 min.

Objective : Participants estimate total rainfall received by consolidating the data from all the rain gauge stations in the HU.

Content : Estimation of total rainfall in the HU.

Method : Large group discussion

Materials : Charts and markers.

Process

- Encourage the participants to fill in the rainfall data on the chart. Use the following chart as a reference:

S.No.	Name of the rain gauge station	June	July	Aug.	Sept.	Oct.	Total
1							
2							
3							
4							

Process of taking averages:

- Encourage the participants to calculate the average rainfall of all the rain gauge stations of the HU.
- Share that we may not receive uniform rainfall throughout our hydrological unit. The average rainfall will give the picture about the rainfall received in the entire HU. So it is useful to calculate average rainfall received at all the rain gauge stations in the HU and consolidate the data month wise.
- Demonstrate the process of taking the 'average' for each month.
    - Take four empty one litre bottles and name each bottle with one rain gauge station and the month (June).
    - Fill each bottle with water according to the rainfall received by that rain gauge station for June month.
    - Transfer the water from four bottles into a big tumbler.
    - Again fill the bottles equally using the water in tumbler.
- Explain that each bottle represents the average rainfall of the Hydrological Unit for the month of June.
- Encourage participants to make averages for the other months (Jul, Aug, Sept and Oct).
- Calculate the average rainfall received for the period June to October.

4. Estimation of HU area Time: 45 min.

Objective : Participants estimate the area of the Hydrological Unit.

Content : Area of Hydrological Unit.

Method : Large group discussion, and small group discussion.

Materials : Graph sheets, carbon papers, toposheet, pencils, scale, calculator, sketch pens, charts, pins and markers.

Process

- Remind participants that the area of the HU is critical factor in estimation of groundwater recharge. To facilitate the process of estimation of HU area, request participants to work in small groups.

- Facilitation should start with a demonstration.
- As part of demonstration, take HU map and place a tracing paper on the map.
- While observing the HU map through the tracing paper, sketch out the map outline.
- Place the tracing paper on a graph and trace the map outlines so as to appear on the graph sheet.
- Colour the full squares with red, ¾ squares with yellow, ½ squares with green and ¼ squares with blue.
- Next, count the, ¼ squares, ½ squares, ¾ squares and full squares on the graph sheet.
- Convert the part squares (¼, ½, ¾ squares) into full squares to calculate the area easily. For example: four ¼ squares make one full square; two ½ squares make one full square; two ¾ squares make 1½ squares; or four ¾ squares make 3 squares.
- Considering the scale in toposheet (1: 50,000) area of a one full square = 62.5 acres or 25 hectares. Area of HU = No. of full squares X Area of one full square.
- Encourage Participants to work in small groups and calculate the area of Hydrological Unit. Provide assistance to the groups in the process of estimation.

5. Estimation of groundwater recharge Time: 45 min.

Objective : Participants estimate the groundwater recharge through rainfall.

Content

- Average rainfall received during June – October.
- Recharge rates of different rock types.
- Estimation of groundwater recharge.

Method : Large group discussion, and small group discussion

Materials : Rainfall data, charts, markers and calculators.

Process

- Remind the participants about the amount of average rainfall received.
- Share the amount of average rainfall received once again and discuss the process of estimation of recharge.
- Ask participants the following question: "What information is required to estimate recharge of the particular Hydrological Unit?"
- List participant's responses on a chart.
- The data required to estimate the groundwater recharge is:
    - Amount of average rainfall received in that HU from June to October.
    - Area of the HU.
    - Type of rocks and it's extent.
    - Recharge rates (GEC Norms).

- Next, encourage participants to share about the rock formations and their extent. Based on the type of rock, share the recharge rate of that particular rock type and estimate the groundwater recharge of the HU.

Recharge rate (GEC norms) in different rock types .

- Begin the discussion with these words: "Now we know average rainfall received during June to October, Let us think about rate of percolation". Ask participants the following question: "Do you think rate of water percolation is same in all types of rocks?"
- Write participants responses on a chart paper and list the different kinds of rocks.
- Next, pose the question: "Do you think all the rain water that falls, percolates the ground?"
- Listen to the participants responses and encourage them to demonstrate the following experiment:

Experiment:

- Take a dry sponge.
- Pour 500 ml. of water on sponge similar to rainfall.
- Collect water into a tray by squeezing the sponge.
- Observe that less water is collected into the tray.
- Following the discussion, summarize as follows: "Rain water flows through streams, rivulets and fills the tanks, ponds before the streams join the river and then to sea. A small portion of the rain water infiltrates into the ground."
- Explain to farmers that all the rainwater does not infiltrate into the soil. Rate of infiltration depends upon rock formation, and soil structure.
- Share the recharge rates recommended by Ground Water Estimation Committee (GEC) with the participants.

Rock type	**Infiltration rate**
a. Alluvial areas	
Indo-Gangetic and inland areas	22%
East coast	16%
West coast	10%
b. Hard rock areas	
Weathered granite, gneiss and schist with low clay content	11%
Weathered granite, gneiss and schist with significant clay content	8%
Granulite facies like charnockite etc.	5%
Vesicular and jointed basalt	13%

Weathered basalt	7%
Laterite	7%
Semi consolidated sandstone	12%
Consolidated sandstone, Quartzites, Limestone (except cavernous limestone)	6%
Phyllites, Shales	4%
Massive poorly fractured rock	1%

- Next, before estimation of groundwater recharge discuss about the measuring unit of water flow and groundwater recharge and explain the process of conversion with the following example.

Cubic meter

Share the following information with the participants**:** **"**Usually, we measure rainfall in millimeters. But, the area of the HU is in Square meters. So, In order to bring all the parameters into the same type of unit and enable easy calculation, we need to convert one unit to the equivalent of the remaining.

Cubic meter is the common measuring unit for calculating water flow and recharge. Farmers estimate the amount of recharge in liters. Liters being a small measuring unit, quantification of the estimate in liters run into large numbers/figures.

Apart from reducing the numbers, as one cubic meter equals 1000 liters, it is a common measuring unit for estimation of recharge and draft. Helping farmers understand quantification of water in cubic meters will enable them to interact with other stakeholders in groundwater management".

Let us calculate the quantity of water received in an area of one acre for 25 millimeters (mm) of rainfall.

1. Convert the rainfall into metres.

25 mm = 25/1000

= 0.025 metres.

2. Convert the area into square metres (Sq.m).

One acre = 4000 sq.m.

3. Multiplication of area and rainfall will give the amount of water received in an area of one acre.

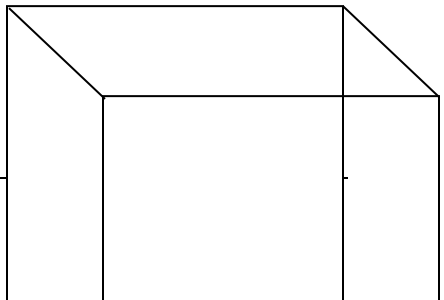
Area (sq.m) x rainfall (m) = Cubic metres (cu.m).

4000 x 0.025 = 100 cu.m.

One cubic metre = 1000 litres.

100 cu.m = 100 x 1000

= 100000 litres.



4. Explain what a cubic metre is:

Any object with the specifications of

1 metre long, 1 metre wide, and

1 metre height is called a cubic metre.

[(1m (L) x 1m (W) x 1m (H)]

5. We are all aware that all the rainwater does not infiltrate into the ground. A small portion of it (i.e. < 10%) infiltrates into the ground.

So the quantity of water infiltrated into the ground = 100000 x 4/100

= 4000 litres.

- Divide the participants into five groups.
- Assign each group one month's rainfall and ask the groups to estimate groundwater recharge.
- Visit each group and provide necessary assistance.
- Ask the small groups to report their estimation results to the large group.
- Calculate the total recharge by adding the recharge of each month.

6. Group dynamic: Data accuracy Time: 20 min.

Objective : Participants will demonstrate the importance of data accuracy in estimating groundwater levels.

Materials : Three glasses, one transparent bowl, colour powder and water.

Method : Game

Process

- Select three volunteers and give one transparent glass to each volunteer.
- Ask two volunteers to get some water and pour into the transparent bowl.
- Then, ask the third volunteer to bring coloured water and pour into the transparent bowl.
- Ask the participants to observe the colour of water in the transparent bowl after the third volunteer pours in.
- Discuss the water that was brought by first two volunteers with correct information and water brought by third volunteer with misinformation.
- Conclude that correct information is very critical for any activity, especially for Crop Water Budgeting exercise.

7. **Short study: Weed management** Time: 20 min.

Objective : Participants discuss the need for weed management.

Rationale : Weeds generally compete for the nutrients and water with the main crop. Conduct of this experiment would help participants understand the importance of weed management.

Materials : Three 100 ml. bottles, two types of weed plants, rice plant, blade, Kesar colour, one litre water, markers and charts.

Usage

- Ask the participants to bring two types of weed plants of the same height and a rice plant along with roots.
- Wash the root zone thoroughly and cut the ends of the roots with an angle.
- Fill the three bottles with 90 ml. of coloured water. Wrap cotton around and insert the plants into the bottles to avoid entry of air into the bottles.
- Write the names of the plants on the bottles.
- Observe the results after one hour.
- Discuss the competition of weeds for nutrients and water and the need for weed management.
- Next, encourage participants to discuss ways of weed management. Invite a few participants to share their experiences.

8. **Homework: Data collection for estimation of groundwater draft & Rabi crop plans, secondary water bodies.** Time: 30 min.

Objective : Participants discuss:

- Data required for estimation of draft and the ways of collection.
- Need to collect Rabi crop plans.
- Ways to collect the data on projected rainfall and secondary water bodies.

Content :

- Data required for estimation of draft during June – October,
- Rabi crop plans,
- Secondary water bodies, and
- Ways of collection of data.

Method : Large group discussion

Materials : Charts, and markers.

Process

- Begin the discussion with: "so far we have discussed groundwater recharge."

- Ask participants how we are spending this groundwater.
- Then ask the following questions in large group.
  a. What is the data required to estimate the draft?
  b. How can we collect the required data?

Tips to facilitator

- The following data is required for estimating draft:
  - Number of functioning bore wells,
  - Number of functional days of each bore well,
  - Number of functional hours on each day, and
  - Drum discharge (litres per hour).
- It is better to collect number of bore wells connected to each transformer.
- Number of functional days of each bore well and functional hours in a day should be collected from the owner of the bore wells.
- Drum discharge of an observation bore well in that village.

- Next discuss the need for Rabi crop plans to estimate draft for Rabi season.
- Encourage the participants to discuss the ways to collect the Rabi crop plan details and the role of GMCs in data collection.

Tips to Facilitator:

Data required is:

- The crop and area cultivated under each bore well in the habitation.
- Involve GMCs in data collection.

- Next discuss the need for data on projected rainfall, and secondary water bodies to estimate groundwater balance by the end of May.
- Encourage participants to discuss ways to collect the data on projected rainfall and secondary water bodies.

Tips to Facilitator:

Encourage the participants to discuss:

- Projected rainfall: To estimate projected rainfall (Nov-May) we need to collect the past 10 year's rainfall data for the same period. It can be collected from nearest Tahsildar's office.
- Secondary water bodies: The following information is to be collected from each village:
  - No. of tanks, ponds, check dams;
  - Area of water in tanks, ponds and check dams;
  - Height of water column;
  - No. of fillings; and
  - No. of days water stored in the tanks, ponds, check dams.

8. Evaluation Time: 10 min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- Why do we need to consolidate rainfall data?
- List the steps involved in the estimation of Hydrological unit area?
- Why do we need to convert the measuring units of recharge and area? And what is the common measuring unit for the amount of recharge?
- How do you plan to share this information in GMC/ HUN meetings?

Session-VI: Groundwater Draft and Balance: October 1st week

Program Schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	10 min.	Recap.	Small group discussion	List of fifth session contents, and visuals used in the seventh session.	Participants recollect the contents discussed in fifth session.
2	60 min.	Estimation of groundwater draft and balance by end of October.	Large group discussion	Charts, markers, visuals, and small pieces of paper.	Participants calculate the groundwater draft for June-October and the groundwater balance by the end of October.
3	45 min.	Estimation of crop-water requirement for Rabi crops.	Large group discussion, and small group discussion	Charts, markers and calculators.	Participants estimate the water requirement for different crops. Participants estimate the groundwater draft for Nov-May.
4	25 min.	Estimation of recharge through projected rainfall.	Demonstration, and large group discussion	10 tr10 transparent glasses, big tumbler, 10 years (Nov-May) rainfall data, calculator, data on secondary water bodies, charts and markers.	Participants discuss and estimate groundwater recharge through projected rainfall for Nov-May.
5	20 min.	Estimation of recharge through secondary water-bodies.	Large group discussion	Charts and markers.	List the secondary water bodies and discuss the process of estimation of groundwater recharge.

6	15 min.	HESA-Estimation of groundwater balance by end of May.	Large group discussion	Charts, markers, charts of previous session and calculators.	Participants analyze the relationship between amount of recharge and draft and estimate the projected balance by the end of May.
7	15 min.	Short Study- Water quality analysis	Demonstration	Transparent glasses, alum, drinking water.	Participants discuss the importance water analysis.
8	15 min.	Short Study: Cooperation among committee members.	Demonstration	Water.	Participants discuss the need for cooperation among committee members in a GMC/HUN.
9	15 min.	Group dynamics: Communication distortion.	Large group discussion	Charts and markers.	Participants identify the need to disseminate the correct information.
10	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, the participants will:

- Recap the fifth session content,
- Estimate groundwater draft and balance for the end of October,
- Estimate the crop water requirement for Rabi crops,
- Estimate the recharge through projected rainfall (Nov – May),
- Estimate the recharge through secondary water bodies, and
- Discuss about communication distortion.

Process

1. Recap Time: 10 min.

Objective : Participants will recap the learning of fifth session.

Content : Session five contents:

- Estimation of total rainfall received.
- Estimation of HU area.
- Estimation of groundwater recharge.
- Understand the importance of data accuracy.
- Short Study- Water level fluctuations (SWL, PWL Vs. Rainfall).
- Homework- Data collection for estimation of groundwater draft, Rabi crop plans, and secondary water bodies.

Method : Small group discussion

Materials : List of fifth session contents, and visuals used in the fifth session.

Process

- After formal welcome, start the session with FWS pledge.
- Request each farmer group to share at least one topic discussed in fifth session.
- Encourage each group to share the session content.
- Display the visuals used in fifth session at appropriate place so that farmers can see and recollect the contents discussed.

2. Estimation of groundwater draft and balance by the end of October Time: 60 min

Objective : Participants estimate the groundwater draft.

Content :

- Data required for estimation of groundwater draft.
- Estimation of groundwater draft.

Method : Large group discussion

Material : Charts, markers and small pieces of paper.

Process

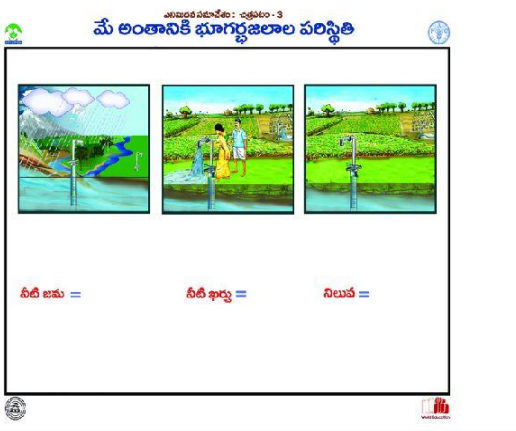
- Ask participants about the home work and request them to present the data in a large group.
- Consolidate the data and share the data required for estimation of groundwater draft. The data includes:
    - Average discharge of the bore well: A
    - Average pumping days: B
    - Average pumping hours per day: C
    - Number of Bore wells: D

Total Discharge (E) =A x B x C x D Liters.

- Accordingly, estimate the groundwater draft for June to October.
- Next, remind the participants about the groundwater recharge estimated in previous session.
- Then, ask the participants to estimate the groundwater balance by the end of October.

Groundwater balance (June –October) = Groundwater recharge (June-October) – Groundwater draft (June-October).

- Use the following visual and plot the bar chart to help participants understand how much rain water recharged into the ground and how much water used for the kharif.



3. Estimation of crop water requirement for Rabi crops Time: 45 min.

Objective : Participants will estimate the crop water requirement for Rabi crops.

Content : Crop water requirement for Rabi crops.

Method : Large group discussion and small group discussion

Material : Charts, markers and calculators.

Process

- Ask participants in large group about the crops and the area proposed under different crops in their villages. (Remind the homework).
- Encourage the participants to fill the area under each crop in different habitations of the Hydrological Unit on the chart. (Keep the following format ready before conducting the session).

S.No.	Name of crop / Name of the habitation	A (acres)	B (acres)	C (acres)	D (acres)	E (acres)	F (acres)
1							
2							
3							
4	Total						

- Read aloud the total area (acres) proposed under each crop in the Hydrological Unit.
- Next, share these words with participants: "We know the types of crops and total acreage. Now, let us discuss about the water required for these planned crops."
- Encourage participants to discuss the process of estimation of water requirement for a crop.
- Take one crop as example and estimate the water requirement for one acre.
- For example, estimate the water requirement for chilly crop per acre.
    - Number of irrigations required for the crop.

- Time taken for one irrigation (hours).
- Discharge per hour (liters per hour).

- Let the chilly crop requires six irrigations at the rate of eight hours per irrigation and the average discharge of the borewell is 16,500 liters per hour.
- Quantity of water required for one irrigation:
  - = Discharge per hour X time taken (hours).
  - = 16500 X 8.
  - = 1,48,000 liters.
- Total quantity of water required for the crop:
  - = Water required per irrigation X No. of irrigations.
  - = 1,48,000 X 6.
  - = 8,88,000 liters = 888 cubic metres.
- Next, request participants to work in small groups to estimate water requirement for all crops.
- Based on the number of Rabi crops, encourage each group to select two to three crops to estimate water requirement.
- Request each group to present their group work to large group.
- Consolidate group presentations and share the total water requirement for entire HU.

4. Estimation of recharge through projected rainfall Time: 25 min.

Objective : Participants will estimate the recharge through projected rainfall.

Content :

- Recharge through projected rainfall.

Method : Demonstration and large group discussion.

Material : 10 transparent glasses, big tumbler, 10 years (Nov-May) rainfall data, calculator,

data on secondary water bodies, charts and markers.

Process

- Remind the participants once again about the groundwater balance by the end of October and water requirement for Rabi crop plans.
- Explore the other ways of meeting water demand if the groundwater balance by the end of October is not adequate.
- Ask participants about the expected rainfall during Nov. to May.
- Discuss the estimation process of average projected rainfall using the following demonstration:
  - Take 10 transparent glasses.
  - Fill each glass with water according to rainfall received in each year.
  - Each glass represents one year rainfall (Nov – May).
  - Empty the water from all the glasses into one big tumbler.
  - Again fill the glasses equally with the water.

- Now the water in each glass represents the average rainfall which would occur for the coming Rabi season.

5. Estimation of recharge through secondary water bodies Time: 20 min.

Objective : Participants will estimate the recharge through secondary water bodies.

Content : Session content:

- Recharge through secondary water bodies.

Method : Large group discussion

Material : data on secondary water bodies, calculator, charts and markers.

Process

- Encourage the participants to share the data on secondary water bodies.
- Ask the participants how to estimate the recharge from secondary water bodies.
- Share the process of estimation of recharge from secondary water bodies.

Tips to facilitator
Recharge from secondary water bodies: = 1.4/1000 X Area of the water body (acres) X 4000 X 0.6 X No. of day's water stored.

6. HESA-Estimation of groundwater balance by the end of May Time: 15 min.

Objective : Participants estimate the projected groundwater balance (Nov-May).

Content : projected groundwater balance (Nov-May).

Method : Large group discussion.

Materials : Charts, markers, charts of previous session and calculators.

Process

- Ask the participants in large group about the amount of groundwater available with us.
- Encourage any one of the participants to explain the process of estimating groundwater balance at the end of May.
- Appreciate the participant and explain the process.
- The projected balance of groundwater at the end of May = Recharge (June-October rainfall + projected rainfall + secondary water bodies) – Draft (Kharif + projected water requirement).
- Encourage the participants to provide the data on the above items and estimate the projected groundwater balance at the end of May.

7. Short Study: Water quality analysis Time: 15 min.

Objective : Participants discuss the importance of water analysis.

Rationale : Majority of the villages do not know whether the water available from the local borewell is fit for drinking. It is important to know the quality of the water that they drink. This will help them to take necessary precautions. This exercise helps participants understand the importance of water quality analysis.

Materials : Two transparent glasses, 20 grams of alum, one litre drinking water of the village and one liter safe drinking water.

Process

- Fill one glass with drinking water of the village.
- Fill the second glass with safe drinking water.
- Grind the alum to make powder and add it equally to the two glasses.
- Observe the two glasses after 30 minutes.
- Impurities precipitate in the first glass which is filled with water from the village.
- Discuss the measures/precautions to be taken for ensuring access to safe drinking water.

8. Short Study: Cooperation among committee members Time: 15 min.

Objective : Participants will enact a role-play and discuss the need for cooperation among committee members in a GMC/HUN in decision making and implementation

Rationale : Collective decision-making is very important for effective management of groundwater resources. Decisions taken by the committee can be implemented successfully when there is a firm backing from its members and also by every groundwater user. The following role-play will help participants understand the need for cooperation among committee members.

Exercise : Use of water

Materials : Three transparent bottles with water

Role Play

- The first person introduces himself as president of the village committee and informs the villagers that due to mechanical failure, there would be no drinking water supply for the coming two days and there is a need to use water judiciously.
- Next, three persons carry three bottles of water to their work place and act as laborers.
- After a while, the first person drinks some water and washes his face with the remaining water.
- The second person does the same as the first person and empties the bottle.
- The third person drinks little and stores the rest of the water.
- After some time, the first person approaches the second person for water. The second person shows his empty bottle and expresses that he too is thirsty.
- Then the two persons go to the third person and drink from his bottle.
- After sometime, all the three feel thirsty and express their anguish showing the empty bottles in their hands.

Preparation

- Select three persons, explain the play and its importance to them and ask them to enact in the session.
- Compare the water bottles with groundwater and discuss the importance of unity and work together in managing the groundwater resources.

9. Group dynamic: communication distortion Time: 15 min.

Objective :

- Illustrate the breakdown of communication.
- Demonstrate the importance of good communication in undertaking community projects.

Materials : None

Process

- Ask all the participants to form a circle.
- The facilitator then whispers a message to the first person on his right or to his left. Pass on the message on, i.e., whisper to the next person only once and the next until the message gets to the other end of the circles.

- Request the participants not to repeat the message.
- Ask the last person to receive the message to say the sentence aloud. The first person to whom the facilitator whispered the message will verify the accurateness or correctness of the message.
- Relate the activity to good and clear communication as a significant factor in successfully carrying out community undertakings. People may view the degree of change in the original message or breakdown in communication as changes caused by certain hindrances or barriers to effective communication that affects implementation of community projects.

10. Evaluation Time: 10 min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- List the data required to estimate groundwater draft?
- How do you estimate the water requirement for a crop?
- What data is required to estimate the average projected rainfall during November to May in a given year?
- What are the factors to be considered during the estimation of recharge through secondary water bodies?

Session-VII: Crop Water Budget (CWB) Workshop: October 2nd week

Introduction to CWB workshop

Crop Water Budget (CWB) workshop is an important milestone in the Farmer Water Schools. The CWB exercise involves estimation of the groundwater balance based on the recharge and draft for the particular monsoon season. The estimation helps farmers make informed decisions on the crops to be sown.

FWS participants organize CWB workshops at the Hydrological Unit level. The workshop acts a platform for sharing information pertaining to water balance, cropping pattern, and groundwater dynamics of the HU. Following this, farmers discuss the crop plans for the ensuing season and make informed decisions in accordance with the available groundwater balance.

Program Schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	40 min.	Inauguration of exhibition stalls and sharing farmer's learning.	Gallery walk		Exhibition stalls are inaugurated by the chief guest and farmers share their learning from FWS.

2	10 min.	Objectives of Crop Water Budget workshop.	Role play	Role play script	Community/farmers see the relevance of CWB exercise.
3	25 min.	Basic information and area of HU.	Large group discussion	HU banner	Participants discuss the basic information of HU.
4	10 min.	Groundwater recharge (June to October).	Large group discussion	HU banner.	Participants discuss the amount of groundwater recharge through rainfall during Kharif season (June-October).
5	15 min.	Estimation of groundwater draft & balance for the end of Kharif Season.	Large group discussion	Banner.	Participants discuss the draft during Kharif season.
6	30 min.	Crop plans for Rabi & water requirement.	Large group discussion	Banner & crop details.	Participants discuss Rabi crop plans and water requirement.
7	25 min.	Projected recharge through rainfall & secondary water bodies.	Large group discussion	Banners.	Participants discuss groundwater recharge through projected rainfall and secondary sources of water bodies.
8	10 min.	Projected Groundwater Situation by end of May.	Large group discussion	Banners.	Participants discuss groundwater balance at the end of May.
9	15 min.	Decisions on crop plans by HUN & respective GMC members.	Large group discussion		Participants discuss about the available groundwater and take decisions on crop-plans.
10	5 min.	Vote of thanks.			

Learning objectives

By the end of the exercise, participants will be able to:

- Visit stalls,
- State the objectives of CWB exercise,
- Discuss the amount of recharge through rainfall for Kharif season i.e. June to October,
- Discuss groundwater draft during Kharif season and estimate the groundwater balance,
- Discuss crop plans for Rabi season i.e. November to May and estimate total water requirement for Rabi crops,
- Discuss the amount of recharge through projected rainfall for Rabi season,
- Discuss the amount of recharge through secondary water bodies, and
- Make decisions on Rabi crops based on the estimated groundwater balance.

Process

1. Inauguration of exhibition stalls and sharing farmer's learning Time: 40 min.

- After welcoming the chief guest to CWB workshop, request him/ her to inaugurate exhibition stalls.
- In each stall, farmer participants of FWS sessions share their experience and learning to the chief guest and other invitees.
- After the completion of gallery walk, invite all the participants to occupy the seats arranged at the venue.

2. Objectives of CWB exercise Time: 10 min.

Objective : Participants share the objectives of CWB exercise.

Content : Objectives of CWB exercise.

Method : Role-play

Materials : Role-play script.

Process

- Select two volunteers and ask them to prepare for the role. Give the script of the role play.
- Encourage them to perform the role play.

Role-play

(Ramanna is carrying the plough to the field. Venkanna notices this.)

Venkanna: Where are you going?

Ramanna : I am going to sow the seeds.

Venkanna: No doubt, sowing is important. But Sai Ganesh Hydrological Unit Network committee has

organized a meeting for the farmers. We should attend the meeting.

Ramanna : What is the use of attending the meeting? Will they give us any information on seeds?

Venkanna: They will give us more valuable information than seeds, i.e. on water. Let us go and listen to our colleagues who are the participants of FWS.

Ramanna : More value than money! What is that?

Venkanna: They will tell us the amount of groundwater recharge, the water spent during Kharif season and the balance of water available in the ground for Rabi season.

Ramanna : Looks like it is useful to farmers. If we know the groundwater balance, we can plan for Rabi crops. Isn't it? Have you informed other farmers?

Venkanna: Everyone has been informed. Most of them should be at the venue, by now.

(Ramanna hands-over the plough to the nearby house owner and they both go to the meeting.)

- Ask participants what they observed in the role play and share the objectives of CWB workshop.

3. Basic information and area of the Hydrological Unit Time: 25 min.

Objective : Participants discuss basic information of the HU.

Content :

- Boundaries of the HU.
- Streams, direction of flow.
- Number of OB wells and rain gauge stations.
- Villages in the HU.
- Area of the HU.

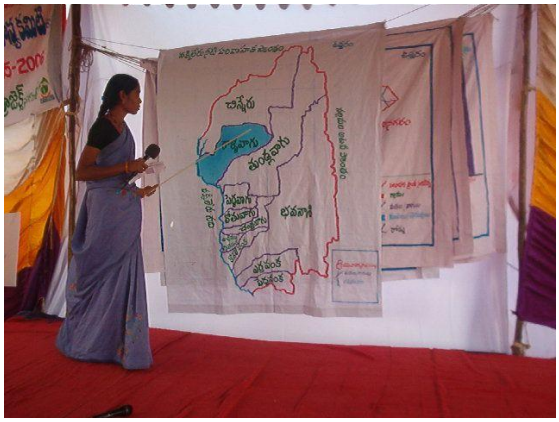
Method : Large group discussion

Materials : Hydrological Unit (HU) banner.

Process

Basic information of the HU

- Present the groundwater scenario of the HU using timeline and appeal to farmers for effective management of groundwater system.
- Use the HU banner to show the ridge portion and valley portion of the HU.
- Discuss about the physical features of the HU i.e. boundaries of the HU, major streams, direction of flow, habitations, major crops in the HU, types of soils, rock types, number of observation wells, rain gauge stations and any other land marks in the HU. (Banner should also show observation borewells, rain gauge stations, habitations, streams and rivulets).



Estimation of Hydrological Unit area

- Share the purpose of calculating the area of HU.
- Share that in order to know the amount of groundwater recharge through rainfall specific to the HU, it is critical to know the area of the HU.
- Next, share how the area of the HU was estimated during the sessions using graphs and grids.
- The grid on the graph represents a given area-250,000 square meters.
- Adding all the grids falling within HU boundary in the graph will give the total area of the HU.

4. Groundwater Recharge (June-October) Time: 10 min.

Objective : Participants discuss the amount of groundwater recharge through rainfall during Kharif season (June-October).

Content :

- Average rainfall received during Kharif season.
- Estimation of groundwater recharge (June-October).

Method : Large group discussion

Materials : Hydrological Unit (HU) banner.

Process

- Stress the need for collection of rainfall data from established rain gauge stations in the HU.
- Demonstrate ways of collecting the rainfall data and precautions to be taken in measuring the water collected in the collecting jar.
- Demonstrate the process of taking averages and share the average rainfall received for Kharif season i.e. June to October.
- Next, share the types of rock formations and its extent of the HU.

- Share the rate of infiltration in the HU. Use the banner to help farmers understand the rate of infiltration.
- Next, share the amount of groundwater recharge in terms of 'litres'. Equate the quantity of water into number of calibrated drums (100 litres) and equate these calibrated drums to the village level water tanks (one water tank = 50,000 litres)
- Use the following visuals to discuss the content.

5. Estimation of groundwater draft and balance for the end of Kharif season

Time: 15 min.

Objective : Participants discuss the draft during Kharif season.

Content :

- Data required for estimation of groundwater draft:
  - Number of functional borewells in the HU,
  - Number of pumping days,
  - Number of pumping hours in a day, and
  - Average drum discharge.

Method : Large group discussion

Materials : Banners.

Process

- Before sharing the amount of groundwater draft, share with the participants about the data required to estimate the groundwater draft for Kharif season.
- The data includes:
  - Number of functional borewells in the HU,
  - Number of pumping days,
  - Number of pumping hours in a day, and
  - Average discharge.

- Share the estimation process of groundwater draft for Kharif season.
- Use the following picture to discuss the content.

- Share that groundwater draft is a product of the number of functional wells, average number of functional days, average number of functional hours in a day, and the average drum discharge.
- Groundwater draft = no. of functional wells X average no. of functional days X average number of functional hours in a day X average drum discharge.
- Share the groundwater balance by the end of Kharif season or October.

6. Crop plans for Rabi and water requirement Time: 30 min.

Objective : Participants discuss Rabi crop plans and water requirement.

Content :

- Rabi crop plans and total crop area.
- Water requirement for Rabi crops.

Method : Large group discussion.

Materials : Banners, and crop details.

Process

- Before starting the discussion, say these words: "We know that we are dependent on ground water to grow crops. Let us discuss about our Rabi crops and total water requirement to grow the planned crops".
- Use the following pictures to share the Rabi crops planned by the farmers in the HU.
- Share the process involved in collection of Rabi crop plans and the role played by the GMC and HUN in consolidation of village wise crop plans for the entire HU.

- Discuss the area under each crop and the water required for each crop.
- Discuss the total amount of water required for Rabi crops.

7. Projected Recharge through rainfall and secondary water bodies Time: 25 min.

Objective : Participants discuss groundwater recharge through projected rainfall and secondary sources of water bodies.

Content : Groundwater recharge through projected rainfall for November to May.
Groundwater recharge through secondary water bodies i.e. tanks, canals etc.

Method : Large group discussion

Materials : Banners.

Process

- So far, we have discussed the groundwater balance by the end of October and estimated the amount of water required for Rabi crops.
- Pose the following question to the large group if the groundwater balance is in deficit,
    - How do we meet the water demand? Are there any other sources for groundwater recharge?
- Wait for couple of minutes and listen to farmer responses.
- Next, share that we may receive some amount of rainfall and there is a chance of groundwater recharge.
- Discuss about the process of estimation of average projected rainfall for the period November to May.
- State that the projected rainfall is estimated based on the average rainfall received from November through May in the past 10 years. Share the amount of projected rainfall and the amount of groundwater recharge.
- Demonstrate the process of estimation of average rainfall.

- Ask participants to state sources of recharge through other means.
- Use the banner to encourage the discussion and share the amount of groundwater recharge through secondary water bodies.

8. Projected groundwater situation by the end of May Time: 10 min.

Objective : Participants discuss groundwater balance at the end of May.

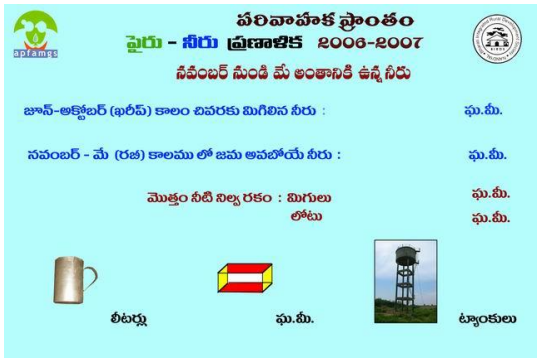
Content : Groundwater balance at the end of May.

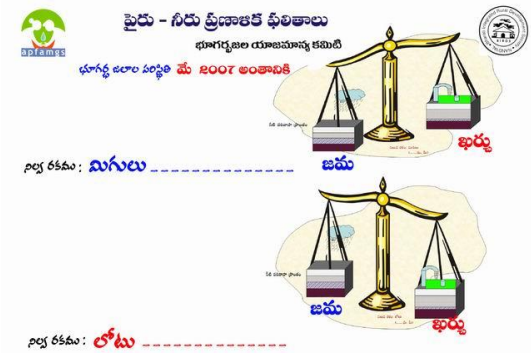
Method : Large group discussion

Materials : Banners.

Process

- Remind participants about the groundwater balance at the end of Kharif season and total water required for Rabi crops.
- If the amount of groundwater balance is negative, share the total groundwater recharge through projected rainfall and secondary water bodies, and
- Share the total water requirement for Rabi crops. Then, subtract the amount of water required from amount of recharge and share the projected groundwater balance by the end of May.





9. Decisions on crop-plans by HUN and respective GMC members Time: 15 min.

Objective : Participants discuss about the available groundwater and take decisions on crop-plans.

Content :

- Rabi crop-plans.
- Farmer decisions.

Process

- Request participants to think about the available groundwater and crops planned for Rabi season.
- Encourage them to share their ideas on change of crops or adoption of alternate irrigation techniques or reduce crop area or what ever they think.
- Request FWS participants to share their decisions on their crop-plans after knowing the deficit in water balance.
- Request GMCs to follow-up in immediate monthly meeting and encourage the farmers to take decisions on crop-plans to make use of available groundwater.

10. Vote of thanks Time: 5 min.

Thank participants for their presence in the workshop and thank each and every member who involved directly and indirectly in the conduct of CWB workshop.

Session – VIII: Review of farmer plans and Design Long Term Experiment – November 1st week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	20 min.	Recap.	Large group discussion	Charts and markers.	Participants recollect the content that was discussed in seventh session.
2	30 min.	Review of Farmer Decisions.	Small group discussion	Charts and markers.	Participants discuss decisions to be taken for Rabi crops based on available groundwater.
3	30 min.	Conventional crops: Estimation of water requirement & production costs.	Large group discussion and small group discussion.	Charts, markers and calculator.	Participants discuss conventional methods of irrigation and chemical inputs required for a major crop in the HU.
4	30 min.	Alternate crops: Estimation of	Large group discussion and small	Charts, markers and calculators.	Participants: • List the major crops

		water requirement & production costs.	group discussion.		and identify more water consuming crops grown in the hydrological unit area. • Discuss the need and advantages of irrigated dry crops.
5	45 min.	Design LTE and selection of collaborator.	Large group discussion	Charts and markers.	Participants select the topic for LTE and collaborator for the conduct of LTE.
6	10 min.	Homework: Crop adoption survey	Large group discussion	Charts and Markers.	Participants discuss ways to collect crop adoption details.
7	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session participants will be able to:

- Recap the previous session,
- Review Rabi crop plan based on available groundwater balance,
- Discuss conventional crop and estimate water requirement and production cost,
- Discuss alternate crop and estimate water requirement and production cost,
- Discuss the perceived change in terms of water requirement and production cost.

Process

1. Recap Time: 20 min.

Objective : Participants recap the contents discussed in CWB exercise.

Content : CWB workshop discussions

- Objectives of CWB workshop.
- Basic information and area of HU.
- Groundwater recharge.
- Estimation of draft and balance for the end of Kharif.
- Crop plans for Rabi and water requirement.
- Projected recharge through rainfall and secondary water bodies.
- Projected groundwater situation by end of May.

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome participants and start the session with FWS pledge.
- In large group, encourage participants to recollect the content that was discussed in CWB workshop.
- Use banners or charts (worked by participants during the session) to recollect the content of CWB exercise.

2. Review of farmers decisions Time: 30 min.

Objective : Participants discuss decisions to be taken on Rabi crop plans based on available groundwater.

Content : Change of crop plans.

Method : Small group discussion

Materials : Charts and markers.

Process

- Start the discussion with these words. ”We know the available water balance in the HU and also water requirement for Rabi crops. To meet the water demand or efficient usage of available water, will you rethink about Rabi crop-plans?”
- Request participants to work in small groups and encourage each group to think about their Rabi crop-plans.
- Distribute to each group a handout on Rabi crop plans of their HU or habitation.
- Ask participants to review the crop-plans of their respective HUs, based on the groundwater balance.
- Ask each group to use HESA frame work to present their group work.
- Later, ask each small group to report their work to the large group.

- Following the discussions in the large group, ask each group's strategy to share their analysis with the other farmers in their habitation.
- Suggest that GMC meetings would be an ideal platform to share this analysis to create awareness among the farmers in the habitation about the groundwater situation. Also, say that a discussion should be facilitated during the GMC meeting to enable the community/farmers to make concrete decisions on change or revision of crop-plans.

3. Conventional crops: Estimation of water requirement and production cost

Time: 30 min.

Objective : Participants discuss conventional crops and estimate water requirement and production cost.

Content :

- Major crops in the HU and conventional method of irrigation.
- Estimation of water requirement and production cost.

Method : Large group discussion, and small group discussion

Materials : Charts, markers and calculators.

Process

- Ask participants the following question in large group.
    - What are the major crops grown in the hydrological unit?
- List all the major crops on the chart.
- Request participants to share the conventional methods of irrigation that they have been practicing for each identified major crops.
- Write participant responses on the same chart against each major crop.
- Next, request participants to work in small groups to estimate water requirement and production cost for identified crops.
- Encourage each group to present their group work in large group.
- Write the summary of the discussion in the following table.

Conventional crop	Method of irrigation	Water requirement	Production cost

4. Alternate crops: Estimation of water requirement & production cost

Time:30min

Objective : Participants:

- List the major crops and identify more water consuming crops grown in the Hydrological Unit area,
- Discuss the need and advantages of irrigated dry crops.

Content :

- More water consuming crops in the HU.

- Need and advantages of irrigated dry crops.

Method : Large group discussion and small group discussion

Materials : Charts, markers and calculators.

Process

- Say to participants: "We have now discussed conventional crops and water required for those crops. Our Rabi crop plans are also reflecting the same. So we need to rethink about our crop plans based on groundwater balance. So, let us identify suitable alternate crops that can be grown in the HU area".
- Write participant's responses on a chart paper and request participants to work in small groups and estimate water requirement and production cost.
- Encourage each group to present their group work.
- After group presentations, present the quantity of water required and production cost for conventional crops and alternate crops and discuss the perceived change.
- Encourage participants to take decision on change of crop or alternate method of irrigation to make use of available water.
- Write decisions of participants on their Rabi crop plans on a chart and summarize the discussion.

5. Design LTE and selection of collaborator Time: 45 min**.**

Objective : Participants design LTE and select a collaborator

Content :

- Design a long term experiment.

Method : Large group discussion

Materials : Charts and markers.

Process

Selection of the topic for LTE

- Share the following words with the participants. "Now we are aware of our groundwater situation and water requirement for our crops. If we plan to use available water efficiently we won't get any loss. Let us try to identify what are the major problems in growing crops right from seed sowing to harvesting."
- Divide the participants into two small groups and request the first group to list all the agricultural operations from seed to harvest keeping in view the farmer calendar.
- Request second group to list the problems faced by them during these agricultural operations. Allow this group activity to continue for 15 minutes.
- Ask both the groups to present their group work in large group. Restrict presentation to maximum 10 minutes per group.
- Encourage the participants to arrive at a common understanding with regard to the agricultural operations as well as farmer problems.

- After the group presentation, finalize and list out all the problems on a chart paper.
- Request the participants to share the current practices to overcome these identified problems.
- List all the existing practices on one side of the chart. Then, request the participants to suggest alternate better practices which are listed on the other side of the chart.
- List out all the sources on the same chart paper.
- Request the participants to list the constraints in adaptation of alternate better practices.
    - Based on the constraints, encourage the participants to choose the topic that can be experimented in a cost effective way.
    - List all these outputs in the table given below and share with the participants.

Problems (or, causes of low yield)	Current practice	Alternate practices / potential for improvement	Constraints	Suggested topics

Tips to facilitator

In case this facilitation takes a long time, based on the situation conduct the following energizer to ease the situation and draw the participant's attention.

Occupation game:

- Divide the participants into five small groups.
- Assign a leader for each group who will act as their spokes person. The group leader will stand facing the members of his group.
- The facilitator will show to the group leaders the name of an occupation. Immediately the group leaders start to enact the occupation shown.
- The first group to name the given occupation will be given a point. The rest of the facilitators may act as the official judges.
- The group which gets the highest number of points will be declared as the winner.

Selection of ideas to be tested

- Continue the discussion after the break, and brainstorm ideas to be tested for an identified topic which can be implemented in the field.
- Ask the participants how they came to know that a particular idea is a better practice and list the source mentioned.

- Encourage the participant to select an idea which can be tested in the field.

Tips to facilitator
Always encourage farmers to consider an idea that does not incur too much expenditure and is devoid of many complications, i.e. experiment should be 'simple'.

- From the list of identified topics, ask the following questions in large group and fill in their collective responses in the table given below.

Put all the outcomes of the discussion in the table mentioned below and summarize the discussion.

Ideas ("*What possible effects will the topic of study have?"*)	Source of each idea	What do we think about each idea? ("*Does it need to be tested?"*)

- Share in the large group that the information in the table would help guide the farmers to plan their observations if the feasible idea is experimented in the field.

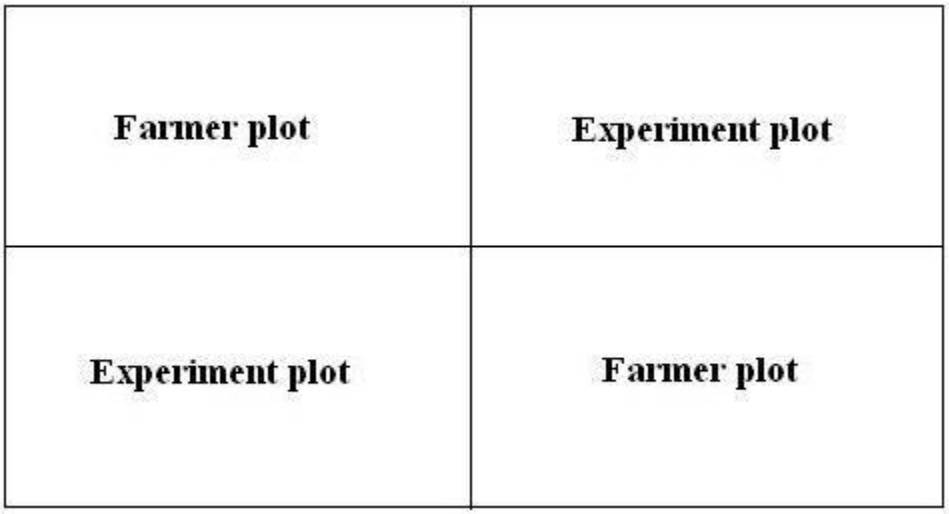
Designing the experiment

- Prior to testing the selected idea in the field, we require designing the experiment. To facilitate this discussion, ask the participants in large group, how they plan to perform this experiment in their field. Encourage the participants to implement both their conventional method and the selected experiment at the same time in the field to enable a comparison.
- Ask the participants in large group, how they plan to divide the field for the above mentioned experiment.

Tips to facilitator
Encourage the participants to think about field realities while preparing for LTE. Encourage them to share about a field being uneven with slope, variation in fertility, type of soil, intensity of sun light etc.

- Reach a conclusion on the need for replicating an experiment to overcome natural variation in a farm plot.

- Ask the following question in large group to elicit response from the participants with regard to measures to be taken while having control plot and experiment plot in the same field. List out all the measures on a chart paper.



Tips to facilitator

Encourage discussion on the following points:

- There has to be a thorough demarcation between any two plots separated by a narrow bund or trench.
- During taking test plants for observation, always leave the first and the second row to avoid effect of one practice on the other.
- The mentioned effect can be due to fertilizer, irrigation etc.
- Farmer might not agree to waste a piece of land by digging a trench/ bund. In such a case, suggest them to go for intercrop in that area to convince them.

Factors to be observed in an experiment

- In order to analyze the results, it is necessary to observe some important factors in the farmer plot and experiment plot. These observations will provide us with experimental evidence that can be shared with the larger community.
- It will be more useful for the farmer participants to observe the deciding single factor to compare and analyze the results of the experiment.
- Encourage a discussion among the participants on which is the single deciding factor and use the following table to understand the frequency and method of observation.
- List all the responses of the participants in a given table shown below:

WHAT should be observed?	HOW?	WHEN?

6. Homework: Crop adoption survey Time: 10 min.

- Discuss in large group about the need to have crop adoption details. Share that the crop adoption details will help estimate actual draft for Rabi season and the impact of CWB workshop i.e. in increase or decrease in Rabi crop plan shared during the CWB workshop.
- Request participants to collect crop adoption details by involving GMC.

7. Evaluation Time: 10 min.

Ask participants the following questions to evaluate the day's learning. Pose the questions to the large group:

- What are the alternate crops suitable to your HU area?
- List effective alternate methods of irrigation.

Thank the participants for their collective decisions on Rabi crop-plans.

Session-IX: Crop adoption survey results: November last week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	20 min.	Recap.	Large group discussion	Charts and markers.	Participants recollect the contents discussed in eighth session.
2	45 min.	Observation of LTE and data collection.	Small group discussion	FWS group kit, charts and markers.	Participants observe the changes in experimental and control plots and analyze the data.
3	30 min.	Sharing crop adoption Survey Results.	Large group discussion	Charts, markers, banner on crop plans.	Participants analyze the crop adoption survey results.
4	30 min.	Estimation of actual water requirement for the HU.	Large group discussion	Charts, markers, banner on crop plans.	Participants estimate the actual water requirement for the HU.
5	30 min.	Group dynamics: Data accuracy.	Game		Participants understand the importance of data accuracy.
6	20 min.	Short Study: Water holding capacity.	Demonstration	Three types of soils, water bottles, plastic trays, thread, water and organic	Participants discuss impact of organic fertilizers in increasing

				manure.	water holding capacity of the soils.
7	5 min.	Homework: Existing alternate irrigation techniques.	Large group		Participants collect data on existing alternate irrigation techniques in their respective village.
8	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session participants will be able to:

- Recap the previous session,
- Observe LTE and analyze data,
- Share crop adoption survey results,
- Estimate the actual water requirement for the HU, and
- Understand the importance of collective decision making.

Process

1. Recap Time: 20 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Session eight contents

- Design of Long Term Experiment.
- Selection of Collaborator.

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome participants to the ninth session.
- Start the session with FWS pledge.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one. Use pictures or banners that were used in the session.
- While facilitating the recap, write down the responses on a chart paper.
- Discuss the contents and the learning from the previous session.

2. Observation of LTE and data collection Time: 45min.

Objective : Participants observe and Long Term Experiment (LTE) and collect data.

Content :

- Observation of LTE, and
- Data collection.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process

- Enquire whether they were successful in setting up the LTE and ask whether we need to observe the LTE.
- In large group ask the participants to list the features that need to be observed. (Remind them of the list of observation items that were discussed in the previous session).
- Inform the participants that they would need work in their respective learning groups and note observations.
- Enquire if they have the necessary tools to do the observations. Discuss the usage of each tool.
- Encourage the groups to observe the items based on the type of the experiment and assist them in the process of data collection.
- Ask the groups to analyze the observations and present to the large group.
- Sum up the discussion.

3. Sharing crop adoption survey results Time: 30 min.

Objective : Participants analyze the crop adoption survey results.

Content : Crop adoption survey results.

Method : Large group discussion

Materials : Charts, markers and banner on crop plans.

Process

- Ask participants from each habitation to share their crop adoption survey details. Use the following table to summarize the data for the entire HU.

Village	Paddy (Acres)	Groundnut (Acres)	Chilly (Acres)	Black gram (Acres)	Sweet orange (Acres)	Total (Acres)
Abc						
Bcd						

- Present the banner that displayed crop plans shared during the CWB exercise.
- Compare the above output with the information in the banner and discuss the changes in crops and area.

4. Estimation of actual water requirement for the HU Time: 30 min.

Objective : Participants estimate the actual water requirement for the HU.

Content : Actual water requirement.

Method : Large group discussion

Materials : Charts, markers and banner on crop plans.

Process

- Based on the outcome of the crop adoption survey results, share with the participants about the increase or decrease in area of the crop.
- In case there is an increase/ decrease in crop area, estimate the water requirement. This will be the actual water requirement for Rabi season.
- Based on the actual draft, share the change in groundwater balance by the end of May.

5. Group dynamics: Data accuracy Time: 30 min.

Objective : Participants understand the importance of data accuracy.

Content : Data accuracy.

Method : Demonstration

Materials : Three transparent plastic glasses and color.

Process

- Ask participants to place three plastic transparent glasses on a table so that all participants can observe the process.

- Ask one participant to pour some water into first glass and some water into second glass.
- Next, ask one more participant to pour some water into third glass. But the water turns into different color.
- Encourage participants to discuss about color of water if we mix all three glasses of water into one glass.
- Summarize the discussion by sharing the following words. When we use the data to estimate groundwater recharge or draft, the data should be accurate. Even if one parameter like rainfall received or pumping days or average draft is wrong, entire calculation become wrong and gives a wrong value. So, we need to take care during data collection.

6. Short Study: Water holding capacity Time: 20 min**.**

Objective : Participants will be aware of the impact of organic fertilizers in increasing water holding capacity of the soils.

Rationale : Farmers use chemical fertilizers in large quantities the use of which changes the soil texture and decrease the water holding capacity and soil fertility. Demonstration of the use of organic fertilizers in improving the water holding capacity of the soil will help participants understand better.

Here below are two alternate ways of demonstrating this.

Model One : Use of soils in bottles and water

Materials : Transparent plastic bottles (3 No's), soil, vermi-compost, water, three pieces of cloth, physical balance, 250 grams measuring weight, 1 litre bottle, three trays and farm yard manure (FYM)

Method of Preparation:

- Take three transparent plastic bottles
- Take same type of soil and divide it into three parts

- Put 500 gm. of soil in first bottle, mix well 250 gm of soil and 250 gm vermi compost and put the mixture in second bottle. Mix well 250 gm of soil and 250 gm FYM and put this mixture in third bottle.

Process

- Pour 1 liter water in each bottle
- Cover the top of each bottle with thin cloth and tie it and keep it for 5 minutes
- Keep each bottle upside down in a tray
- Measure the water collected in each tray.
- More water will be collected from the bottle which is filled with only soil.
- From this experiment it can be demonstrated that the soils which are mixed with organic fertilizers have more water holding capacity.

Model two : Use of three types of soils and one organic manure

Materials : 6 water bottles, 6 plastic trays, cotton cloth, three types soil (each 500 grams), thread, water and organic manure

Method of Preparation:

- Remove the lower base portion of all water bottles
- Close the mouth portion of the bottle with cotton cloth tightly
- Fill three bottles with three different soils
- Fill the other three bottles with soil mixed with organic manure (3 parts soil + 1 part organic manure)
- Hang the filled bottles upside down using the thread.
- Keep a tray under each plastic bottle

Usage:

- Pour same quantity of water slowly on top of the soil in each bottle simultaneously and keep them for some time say, five minutes.

- Measure the water collected in the trays

- Discuss the difference in quantity of water collected from three bottles filled with three different soils,

- Next, discuss the difference in quantity of water collected from the three bottles filled with soil and organic manure.

- Discuss the water holding capacity of different soils and the impact of organic manure in increasing water holding capacity.

7. Homework: Irrigation practices in the village Time: 5 min**.**

Request participants to collect the data on existing alternate irrigation techniques practiced by other farmers in the village.

8. Evaluation Time: 10 min**.**

- Ask participants the following questions to evaluate the day's learning. Pose the questions to the large group:

:

- Why do we need crop adoption details?
- Why do we estimate the actual water requirement?

Encourage participants to share their learning and thank the participants for their inputs and participation in the session.

Session-X: Alternate irrigation practices: December 2nd week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	15 min.	Recap.	Large group discussion	Charts and markers.	Participants recollect the contents discussed in ninth session.
2	45 min.	LTE observation and analysis.	Small group discussion	FWS group kit, charts and markers.	Participants observe the changes in experimental and control plots and analyze the data.

3	60 min.	Estimation of water requirement: Conventional Vs. alternate irrigation practices.	Small group discussion	Charts, markers and calculators.	Participants discuss: • Conventional methods of irrigation and estimate water requirement. • Alternate methods of irrigation and estimate water requirement. • Perceived change.
4	15 min.	Group dynamics- Linkages with line departments.	Role play	Script for role play.	Participants identify the need to have good relations with government and other agencies for sustainability of HUNs and GMCs.
5	20 min.	Short Study- Alternate furrow irrigation method.	Demonstration	Plastic bottles, and chilli plants.	Participants observe the difference in water requirement between traditional method and alternate furrow irrigation method in Chilli crop.
6	5 min.	Homework: Interaction with the farmers who have been practicing alternate irrigation techniques.	Large group	Handout, Charts, Markers.	Participants will interact with other farmers in the village to know more about alternate irrigation techniques.
7	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session, participants will be able to:

- Recap the previous session,
- Observe and analyze the long term experiment,
- Estimate the quantity of water required under conventional vs. alternate irrigation practices.
- Discuss the importance of having linkages with line departments.
- Demonstrate the impact of organic matter on water holding capacity in different soils.

Process

1. **Recap** Time: 15 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Recap session nine contents

- Observation of LTE and data collection,
- Sharing crop adoption survey Results,
- Estimation of actual water requirement for the HU.
- Importance of collective decision making.

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome participants and start the session with FWS pledge.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

2. LTE observation and analysis Time: 45min.

Objective : Participants observe and analyze the Long Term Experiment (LTE).

Content :

- Observation of LTE, and
- Data analysis.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process

- Request participants to visit the filed and note their observations.
- Encourage the participants note their observations during the filed visit.

Observation sheet:

Village: Name of experiment:

Farmer: Crop:

Area:

Date	Time required per irrigation	Time taken for filling 100 lit drum (Sec, min and 1 hour)	Volume of water	Draft	Yield	Observation

- Ask the groups to come back to the training spot and analyze the observations made during the field visit. Request each group to use HESA (based on the experiment) frame work to present their group work.

- Request collaborator to implement the decisions taken by the large group in the experimental plot.

3. Estimation of water requirement: Conventional Vs. Alternate irrigation practices Time: 60 min.

Objective : Participants discuss:

- Conventional methods of irrigation and estimate water requirement.
- Alternate methods of irrigation and estimate water requirement.
- Discuss perceived change.

Content :

- Conventional methods of irrigation.
- Alternate method of irrigation.
- Estimation of water requirement.

Method : Large group discussion, and small group discussion.

Materials : Charts, markers and calculators.

Process

Conventional methods of irrigation and water requirement:

- Ask participants the following questions in large group.
  - What are the crops grown in the hydrological unit?
  - What are the conventional irrigation practices for each crop?
- Write the responses on a chart.
- Ask a participant to explain the process of estimating water requirement for a particular crop. Remind participants about the estimation of water requirement for a crop.
- Request participants to work in groups and assign one or two crops based on the number of crops in the HU, and corresponding conventional irrigation practice to each group.
- Ask each group to estimate the quantity of water required for the crops. Provide the value of average discharge to each group.
- Encourage the groups to report their group work to the larger group.
- Summarize the discussions and list the contents in the following table.

Crop	Method of irrigation	Water required (Ltrs.)

Alternate methods of irrigation and water requirement:

- Ask the participants in large group to list alternate irrigation practices for the identified crops.
- List the responses on the chart.
- Ask participants to continue working in the same groups. Assign one or two crops and relevant alternate irrigation practice to each group and ask them to estimate the quantity of water required to raise the crop.
- Provide the value of average discharge of the bore well each group.
- Ask the groups to present their group work to large group.
- Summarize the discussions using the following table.

Crop	Alternate irrigation practice	Water required (Ltrs.)

- Compare the two tables and discuss the differences in quantity of water required for the same crop.

4. Group dynamics: Linkages with line departments Time: 15 min

Objective : Participants understand the importance of linkages with line departments.
Content : Linkages with line departments.
Method : Role play
Materials : Script for role play.
Process

- Ask three participants to volunteer for a short role play.
- Inform that as a part of role play, these three participants will be meeting with the agriculture officer (facilitator will enact this role) to represent their HUN/GMC and discuss the subsidy for drip and sprinklers.
- Give the three participants few minutes to discuss how they wish to approach and discuss the issue with the officer.
- Meanwhile, share with the rest of the participants the following checklist. Ask them to use the checklist to evaluate the interaction in the role-play.
    1. Prior consultation amongst members about the subsidy.
    2. An application to the officer on the GMC/HUN letter pad.
    3. Members introduce themselves and their roles in the GMC/HUN to the officer.
    4. Members are confident in their interactions with the agriculture officer politely.
    5. One person speaks at a time.
    6. Ask relevant questions to gather necessary information.
    7. Thank the officer as they leave the meeting.

5. Short study: Alternate furrow irrigation method Time: 20 min**.**

Objective : Participants will observe the difference in water requirement between traditional method and alternate furrow irrigation method in Chilli crop.

Rationale : Demonstrating the difference between traditional method and alternate furrow method of irrigation in chilli crop using a model will help the farmers understand the quantity of water saved in alternate furrow method of irrigation**.**

Materials : Two plastic bottles of two litre capacity to water two Chilli plants.

Usage

- Take two empty plastic bottles and mark the readings from bottom to top with 10 - 20 - 30 - 40 - 50 numbers.
- Name the first bottle as traditional method of irrigation and the second bottle as alternate furrow method of irrigation.
- Place a chilli plant in first bottle and pour water up to 30 mark indicating that traditional method of irrigation requires 30 lakh liters of water.
- Place another Chilli plant in second bottle and pour water up to 20 mark indicating that alternate furrow method of irrigation requires 20 lakh liters of water
- Discuss the difference in water requirements for Chilli crop between the two methods of irrigation.

6. Homework: Interaction with farmers practicing alternate irrigation techniques

Time: 5 min.

- Request farm participants to discuss about useful ness and efficiency of alternate irrigation techniques who have been practicing in the village or neighboring villages

7. Evaluation Time: 10 min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- What are alternate methods of irrigation?
- How can we increase water holding capacity of soils?
- Which soil has maximum water holding capacity and why?

Encourage participants to share their learning and thank the participants for their participation in the session.

Session-XI: Soil Moisture Retention: January 1st week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	15 min.	Recap.	Small group discussion	Tenth session contents, charts and markers.	Participants recollect the contents discussed in tenth session.
2	45 min.	Observation of LTE and data collection.	Small group discussion	FWS group kit, charts and markers.	Participants observe the changes in experimental and control plots and analyze the data.
3	40 min.	Soil moisture retention methods.	Small group discussion	Charts and markers.	Participants list the different soil moisture retention methods.
4	40 min.	Composting methods.	Large group discussion	Charts and markers.	Participants get knowledge on different methods of composting.
5	60 min.	Short Study- Role of organic manures in water holding capacity.	Demonstration	Trays, water, measuring jar, balance, muslin cloth, rubber band.	Participants discuss the importance of organic manure addition in improving the water holding capacity of soil.
6	15 min.	Group dynamics – Fund mobilization.	Large group discussion	Charts and markers.	Participants understand the need to mobilize fund for sustainability of HUNs.
7	10 min.	Homework- Data collection on functional bore wells, pumping hours, days and discharge.	Large group discussion	Charts and markers.	Participants discuss the need to collect the basic information to study the impact of FWS.
8	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session participants will be able to:

- Recap the previous session,
- Observe LTE and collection of data,
- Discuss various soil moisture retention methods,
- Discuss different methods of composting and the uses,
- Discuss importance of fund mobilization, and

- Discuss the ways of collecting data on functional bore wells, pumping hours, days and average discharge.

Process

1. Recap Time: 15 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Session ten contents

- Observation of LTE and analysis.
- Estimation of water requirement by conventional vs. alternate irrigation practices.
- Importance of linkages with line departments, and
- Short study on usage of organic manures to improve water-holding capacity of soil.

Method : Small group discussion

Materials : Tenth session contents, charts and markers.

Process

- Before the start of the session, display visuals used in the tenth session at appropriate place to aid farmers in recap.
- Welcome participants and start the session with FWS pledge.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

2. Observation of LTE and data collection Time: 45 min.

Objective : Participants observe and analyze the Long Term Experiment (LTE).

Content :

- Observation of LTE, and
- Data analysis.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process

- Request participants to visit the filed and note their observations.
- Encourage the participants note their observations during the filed visit.

Observation sheet:

Village:	Name of experiment:
Farmer:	Crop:
	Area:

Date	Time required per irrigation	Time taken for filling 100 lit drum (Sec, min and 1 hour)	Volume of water	Draft	Yield	Observation

- Ask the groups to come back to the training spot and analyze the observations made during the field visit.
- Request each group to use HESA (based on the experiment) frame work to present their group work.
- Request collaborator to implement the decisions taken by the large group in the experimental plot.

3. Soil moisture retention methods Time: 40min.

Objective : Participants discuss various soil moisture retention methods.

Content : Soil moisture retention method.

Method : Small group discussion

Materials : Charts, and markers.

Process

- Ask participants about the types of soils available in the HU.
- Write participants responses on a chart paper.
- Pose the following questions in large group.
  - Are there any methods to improve the soil moisture retention capacity?
  - If yes, what are the methods?
- List participant's responses on a chart.

Tips to facilitator:

Soil moisture retention methods:

- Application of farm yard manure (FYM)/ compost,
- Mulching,
- Application of green manures, and
- Application of Vermicompost.

- Request each group to take one soil moisture retention method and discuss about the application process.
- Ask small groups to report their discussions in the large group.
- Summarize the discussions.

Tips to facilitator

Here below are some of the merits and demerits of each method.

I. FYM/compost

Merits:

1. Low cost material.
2. Maintains soil quality under continuous cultivation.
3. Improves the soil moisture retention capacity.

Demerits:

1. Bulk in nature.
2. Less available due to decreased livestock population.

II.Mulching(Paddy straw/husk, groundnut husk, saw dust, dried leaves)

Merits:

1. Wide range of raw materials for mulching.
2. Suppress the weed growth.
3. Improve the soil moisture retention capacity.
4. Some mulching material add nutrients to soil.

Demerits:

1. Some times plant debris (stubs, plant parts) may carry pests and diseases to the existing crop.

III.Green manures (Sun hemp, dhaincha, Leguminous crops)

Merits:

1. Provide large quantities of nitrogen for the soil.
2. Improves topsoil depth, water-holding capacity, nutrient content, and texture of soil.
3. The cover they provide for the soil protects the soil from wind or water erosion.
4. Green manure crops provide generous amounts of high protein fodder for animals.
5. Some green manure crops provide human food (edible beans, peas, and pods).

Demerits:

1. It is suitable for Kharif season, and where water is available in abundance.
2. It should be properly decomposed. Wait for 7-10 days to decompose.

4. Composting methods Time: 40min.

Objective : Participants discuss different methods of composting and its advantages.

Content : Composting methods, and uses.

Method : Large group discussion

Materials : Charts and markers.

Process

- Ask participants the following question.
    - What kind of treatment our fathers or elders applied to increase the fertility of soils or to provide nutritive values to soils?

- Write participants responses on a chart.
- Ask participants to list different composting methods.
- List the participant's responses on the chart.
- Ask participants to share the process of different methods of compost making and explain each method.

Tips to facilitator

Following are some of the methods of preparation

1. Pile method.
2. Pit method.
3. Nadep method.

1. Pile method:

This method of composting can be done on any hard surface of the ground

Materials : Dung (cow, pig or poultry),Green plant waste materials, kitchen waste. This is wet organic matter, Dried organic matter. Take equal proportions of all the three materials.

Process

- Clear the space on the ground.
- Collect all the materials and pile them separately.
- Spread dried leaves to 6" height, sprinkle water (If the dung is dry, it can be laid first. If the dung is wet spread the dried leaves as the first layer).
- Spread the dung 1" high over the dried leaves.
- Spread the green matter 6" high on it. Sprinkle water. Repeat the process till all the material is used and the pile is 4 ft high.
- Cover the pile with plastic paper. It should be air tight. Put weights on the cover so that the paper is not displaced.
- After two days the pile becomes warm, which indicates that the decomposition process has

started. To check that a stick can be sent inside the pile and it would be hot at the tip of the stick.

- If the process has not started, it indicates that the pile is not covered properly. The air has dried the water. So the pile has to be done again.
- Mix all the ingredients again and spread the layers, sprinkling water and cover it properly air tight.
- To get the compost to be ready it takes 8 weeks.
- The ready compost is dark brown in color and porous and fine textured.

2. Pit method:

Dig a pit of 2 m X 2 m X 1 m dimensions.

Materials: As in the case of pile method.

Process As in the case of pile method. Fill the pit with the materials and cover it soil.

3. Nadep method:

Construct a tank of 2.5 m X 1.5 m X 1 m dimensions with holes on to the walls

Materials: As in the case of pile method.

Process: As in the case of pile method. Fill the tank with the materials and cover it soil. Wet the bed twice a week with sufficient water.

5. Short Study: Role of organic manures in improving water holding capacity (WHC)

Time: 60 min.

Introduction:

The application of organic manures is decreasing in the recent years. Organic manures not only serve as a source of nutrients but also play an important role in improving the soil's physical condition. Organic manure increases the water holding capacity of soil. This study has been conducted to learn about the effect of organic manures on water holding capacity.

Objective:

At the end of the activity participants will be able to:

- Find out the water retention/holding capacity of different soils.

- Discuss the importance of organic manure addition in improving the water holding capacity of soil.

Method:

- Large group discussion to introduce the topic
- Establishment of the study in small groups

Materials: Trays, water, measuring jar, two types of soil, chimneys/pots, balance for weighing, muslin cloth, rubber band/thread

Procedure

- Introduce and discuss the topic in large group.
- Divide the participants into small groups.

Ask the groups to adopt the following process:

1. Collect two different types of soils (clay loam and sand) of one kg each (care should be taken not to collect clay soil, where addition of organic manures will decreases the WHC and improves the drainage).
2. Divide clay loam soil into two parts of 500 grams each.
3. Take 500 grams of clay soil and add organic matter to the soil in the ratio of 5:1 and adjust the quantity to 500 grams.
4. Repeat the same procedure for sandy soil also.
5. Now there are four types of soils i.e., Clay loam, clay loam with organic manure, sandy soil and sandy soil with organic manure.
6. Take four chimneys or transparent bottles with both open.
7. Cover the bottom side of the chimney/bottle by using muslin cloth and tie with rubber band.
8. Now pour the four types of soils into four chimneys/bottles.
9. Keep all the chimneys in the tray.
10. Add 500ml of water to each chimney/bottle and keep the set up for 30 minutes to allow the water to leach down into tray.
11. After 30 minutes collect the water from the trays and measure the quantity by using a measuring jar.
12. Calculate the percentage of water held in the soil / soil + organic matter.

Accordingly each group observed and recorded their observations and shared the results in large group.

6. Group dynamics- Fund mobilization Time: 15 min.

Objective : Participants understand the importance of Fund mobilization.

Content : Importance of Fund mobilization.

Method : Story.

Materials : Script of the story, Charts and markers.

Process

- Long ago, there lived three families in a village.
- Ramana, Surya and Krishna were the Head's of the three families respectively.
- One day, a Bank officer happened to visit their village and offered a certain amount as loan to each family towards the government's initiative to help families progress.
- All the three families were awarded the loan based on their poor financial condition.
- Ramana's family was very happy seeing the amount at a time. They divided the amount equally and spent the amount lavishly in a short time without thinking that loans are meant to be returned.
- Surya and his family members did not understand what to do with the money and kept the entire amount in the cupboard. One day, a thief broke into their house and stole the amount. The family could not repay the loan to the bank.
- Krishna on the other hand held a meeting with his family members and decided to start mushroom cultivation at home along with his regular agriculture activities. All the family members supported him and helped him in the initiative.
- Their business eventually started growing. They paid the loan within the deadline and the bank officer this time visited them and readily agreed to give a larger amount as loan to start a new livelihood.
- Krishna's family expanded their agriculture activities, eventually acquired more land and even bought a new house. They invited Ramana and Surya's families for their house warming ceremony.

After narrating the story, pose the following question in large group:

- "Which family utilized the loan amount in the best possible way?"
- List out the participants responses on a chart paper
- Summarize the discussion by stating that "any institution will run successfully when funds are mobilized and utilized carefully to expand businesses."

7. **Home work: Data collection on number of functional bore wells, pumping hours, pumping days and discharge** Time: 10 min.

Objective : Participants discuss ways of collecting data on functional bore wells, pumping hours, days, and discharge.

Content : Ways of collecting data on functional bore wells, pumping hours, days, and rate of discharge.

Method : Large group discussion

Materials : Charts and markers.

Process

- Start the discussion with the following words: "In each session we are conducting HESA. In next session we are going to conduct HESA on PHM data. Ask the following questions in large group."

c. What is the data required to conduct HESA?

d. How to collect the data?

Tips to facilitator

- The following data is required to estimate the draft for the Rabi season.
  - Number of functional bore wells,
  - Number of functional days for each bore well,
  - Number of functional hours in each day,
  - Drum discharge (litres per hour).
- It is better to collect number of bore wells connected to each transformer.
- Number of functional days and hours per day of each bore should be collected from the owner of the borewell.
- Drum discharge of an observation borewell in that village.
- GMC services should be utilized to collect the data.

8. Evaluation Time: 10min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- Can you list the different types of soil moisture retention methods?
- Can you list different kinds of composting methods?
- What are the advantages of compost?

Session-XII: PHM data analysis: January last week or February 1st week

Program schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	15 min.	Recap.	Large group discussion	Eleventh session contents, charts and markers.	Participants recollect the contents discussed in eleventh session
2	45 min.	LTE data collection and analysis of results.	Large group discussion	FWS group kit, charts and markers.	Participants observe the changes in experimental and control plots and analyze the data.
3	20 min.	Data collection & analysis.	Small group & Large group discussion.	Charts and markers.	Participants analyze PHM data.
4	45 min.	HESA- Perceived change.	Small group discussion	Charts and markers.	Participants analyze the perceived change using HESA format
5	10 min.	FWS impact and success indicators.	Large group discussion	Charts and markers	Participants identify change or impact of FWS and list success indicators
6	15 min.	Group dynamics- PHM assets maintenance.	Story	Script of the story- The guru and his disciples	Participants understand the importance of maintaining PHM assets
7	10 min.	Homework: Actual rainfall received(Nov-May)	Large group discussion	Charts and markers	Participants collect actual rainfall received for Nov-May.
8	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their opinions on the conduct of FWS sessions and methods used in the session.

Learning objectives

By the end of the session participants will be able to:

- Recap the previous session,
- Observe LTE and collect data,
- Discuss and analyze PHM data,
- Identify perceived change and analyze using HESA,
- Discuss importance of PHM assets maintenance.

1. Recap of the previous session Time: 15 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Contents of session eleven

- Observation of LTE and analysis,
- Soil moisture retention methods,
- Composting methods.
- Importance of fund mobilization.

Method : Small group discussion

Materials : Eleventh session contents, charts, and markers.

Process

- Before the start of the session, display visuals used in the 11th FWS session at appropriate place to help farmers in recap.
- Welcome participants to the 12th session and request participants to start the session with FWS pledge.
- After the FWS pledge, in the large group, encourage each participant to share a content that was discussed in 11th session and the learning from that one.
- As you facilitate the recap, write participants responses on the chart paper.
- Discuss briefly the contents and the learning from the previous session.

2. **LTE data collection and analysis of results** Time: 45 min.

Objective : Participants analyze the results of LTE.

Content : Results of LTE.

Method : Large group discussion

Materials : Charts and markers.

Process

- Start the discussion stating that we have successfully completed our Long Term Experiment. It is time for us to analyze the results of the experiment.
- Encourage the collaborator to share the practices followed in the experiment.
- Encourage the participants to discuss the differences between experimental plot and farmer practice plot.
- Encourage the participants to list out the factors that influenced the results.
- Analyze the factors that influenced the results.

3. **Data collection and analysis** Time: 20 min.

Objective : Participants discuss home work and analyze the PHM data.

Content :

- PHM data.
    - Number of functional wells.
    - Average water levels, pumping hours, pumping days and discharge.
- Analysis.

Method : Small group discussion and large group discussion

Materials : charts and markers.

Process

- Remind participants about the home work with regard to collection of PHM data.
- Request participants to work in small groups to discuss and list the reasons for increase or decrease in the PHM data on:
    i. Number of functional borewells.
    ii. Average water levels and discharge of the borewells.
    iii. Pumping hours per day and average pumping days.
- Request each group to present their group work and reasons for increase or decrease in the said data.
- Next, in large group consolidate the data for entire HU. And share the basic data that was collected before the start of FWS sessions.

4. HESA-Perceived change Time: 45 min.

- Encourage participants to list the reasons for fluctuations in water levels and discharge of the borewells. This will help facilitators understand the impact of farmer water schools and the concrete reasons for change.
- Use HESA chart for analysis. Discuss in detail. For ex: Number of bore wells increased. List the reasons for the increase and discuss whether it is beneficial or non beneficial. And why it is beneficial/non beneficial. List all the analysis on HESA chart and encourage participants to take decisions to reduce the loss.

5. **FWS Impact and success indicators** Time: 10 min.

Objective : Participants discuss the impact of FWS and identify success indicators.
Content : FWS Impact and success indicators.
Method : Large group discussion
Materials : Script for the story, charts and markers.
Process

- Ask participants the following question in large group. "What is your opinion on Farmer Water School and its approach? Do you feel FWS approach is useful in increase of knowledge and skill?"
- List participant's responses on a chart paper.
- If participants share that FWS approach is useful and successful, encourage them to identify changes in terms of quality and quantity.
- Share that these indicators will help to share with larger audience during field days and other public forums on the effectiveness of FWS approach in management of groundwater resources.

Tips to facilitators:

FWS impact in:

- Monitoring PHM data by HUNs and GMCs.
- Organizing Crop Water Budget exercise at HU level by HUNs.
- Decision making in GMCs and HUNs around groundwater and agriculture.
- Number of women facilitators in a HUN.
- Number of men and women farmer who are able to measure water levels and rainfall.

6. Group dynamic-PHM assets maintenance Time: 15 min.

Objective : Participants understand the importance of maintaining PHM assets.

Content : Importance of PHM assets maintenance.

Method : Story

Materials : Script for the story, charts and markers.

Process

- Long ago, there lived a guru who had three disciples.
- Once day, the guru decided to go on a pilgrimage.
- The guru's only property was three sacks of paddy which he decided to give one each to his three disciples.
- While giving a sack of paddy to each of his disciples, the guru suggested them to use it in the best way possible with out wasting it and left on a pilgrimage.
- The first disciple assumed that his guru might take a long time to return from pilgrimage or not return at all. With this idea, he milled the paddy and ate up all the rice.
- The second disciple was worried that some animal might eat the paddy or a thief would steal it. So, he kept it beside him all the time and even slept on it. The paddy gradually deteriorated and was destroyed.
- The third disciple sowed the paddy. By the time the Guru returned from his pilgrimage, he was able to harvest two crops, producing 40 bags of paddy.
- Pose a question in large group: "Which disciple utilized the paddy in the best possible way?"
- List out the participants responses on a chart paper.
- Summarize the discussion by stating that 'any asset is useless if it is spent or kept idle. It will give us maximum benefit generating revenue only when utilized in a productive way'.

7. **Homework: Actual rainfall data received (Nov-May)** Time: 10 min.

- Discuss the need for actual rainfall received from Nov-May.

- Share that the data will help to estimate actual groundwater recharge for Nov-May and the change in estimated groundwater balance at the end of May during the CWB workshop.

8. **Evaluation** Time: 10 min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- Why do we analyze the data?
- What are the methods used to analyze the data?

Session-XIII: Actual groundwater situation: March last week

Program Schedule

S.No	Time	Content	Method	Materials	Expected outcomes
1	15 min.	Recap.	Large group discussion	Twelfth session contents, charts and markers.	Participants recollect the contents discussed in 12th session.
2	30 min.	Data analysis (Rainfall data).	Large group discussion	Charts and markers.	Participants estimate total rainfall received by consolidating the data from all the rain gauge stations in the HU.
3	20 min.	HESA - Estimation of actual groundwater situation by the end of May.	Small group discussion	Charts and markers.	Participants calculate actual groundwater situation by the end of May.
4	60 min.	Post- BBE.	Large group discussion	Charts and markers.	Participants participate in Post BBE and assess their knowledge on groundwater science.
5	20 min	Short Study- Soil testing.	Demonstration	Soil testing kit, soil sample, coloured paper strips to represent the quantity of the available nutrient.	Participants discuss the process of soil testing and the nutrients present in the soil.
6	30 min.	Gender work matrix.	Small group discussion	Charts and markers.	Participants discuss the need to empower women in decision making by involving them in FWS / Trainings.
7	10 min.	Homework: Collection of actual rainfall data from Nov to May.	Large group discussion	Charts and markers.	Participants will collect actual rainfall received (Nov to May).
8	10 min.	Evaluation.	Large group discussion	Charts and markers.	Participants share their learning.

Learning objectives

By the end of the session participants will be able to:

- Recap the previous session,
- Analyze LTE results using HESA,

- Analyze rainfall data,
- Estimate actual groundwater situation by the end of May, and
- Participate in post- BBE.

Process

1. Recap Time: 15 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Session twelfth contents:

- LTE observation and data collection,
- PHM data analysis:
  - Number of functional borewells,
  - Average water levels, pumping hours, pumping days and discharge,
  - Perceived change (HESA), and
- Understand the importance of PHM assets maintenance.

Method : Small group discussion

Materials : Content of 12th FWS session, charts and markers.

Process

- Welcome participants and start the session with FWS pledge.
- In large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, write participants responses on the chart paper.
- Discuss the contents and the learning from the previous session.

2. Data analysis (Rain fall data) Time: 30 min.

Objective : Participants estimate total rainfall received by consolidating the data from all the rain gauge stations in the HU.

Content : Estimation of total rainfall in the HU.

Method : Large group discussion

Materials : Charts and markers.

Process

- Encourage the participants to fill in the rainfall data on the chart.
- Remind the process of taking averages discussed in 5th session and encourage the participants to calculate the average rainfall of all the rain gauge stations of the HU.
- Emphasize that we may not receive uniform rainfall throughout our Hydrological Unit. It is better to average the rainfall of all the rain gauge stations in the HU month wise.
- If necessary, once again conduct the following experiment to understand the process of average for each month.
  - Take four empty one litre bottles and name each bottle with one rain gauge station and the month (June).

- Fill each bottle with water according to the rainfall received by that rain gauge station for June month.
- Transfer the water from four bottles into a big tumbler.
- Again fill the bottles equally using the water in tumbler.

- Explain that each bottle represents the average rainfall of the Hydrological Unit for the month of June.
- Encourage to make averages for the other months (Nov, Dec, Jan, Feb, Mar, Apr and May).
- Encourage participants to state the steps in estimation of recharge using rain fall data.
- Appreciate the participants and correct the information if required.
- Estimate the actual recharge and share with the participants.

3. Estimation of actual groundwater situation by the end of May Time: 20 min

Objective : Participants estimate the actual groundwater situation by the end of May.

Content : Actual groundwater situation by the end of May.

Method : Large group discussion

Materials : Charts, markers, and calculators.

Process

- Ask the participants, how do we estimate groundwater balance based on recharge and draft?
- Remind them of the draft during Kharif and Rabi.
- Encourage one of the participants to explain the process.
- Total draft = Kharif draft + Rabi actual draft.
- Appreciate the participant and share the actual balance of groundwater by the end May.
- Actual groundwater balance by the end of May.

  = Recharge through actual rainfall – Actual draft.

  = Surplus / Deficit.
- Discuss increase or decrease in water balance and the encourage participants to share the reasons for change.
- Sensitize participants on adoption of water saving techniques and water use efficiency methods.

4. Post-BBE Time: 60 min**.**

Objective : Participants participate in Ballot Box Exercise.
Participants answer based on their knowledge.

Content : Ballot Box Exercise.

Method : Demonstration

Materials : Charts, markers, card boards, nails, long sticks, knife, thread, ballot boxes, and whistle.

Process

- Remind participants about the BBE conducted in the first session and discuss with them the purpose of conducting the exercise again.

Tips to facilitator

- The purpose of post-BBE is to know the increased knowledge and skills learnt by FWS participants.
- The present score will be compared with pre-BBE score, and
- Based on the increase in the score graduation certificates will be issued to eligible farmer participants.

- Assign a registration number to each participant.
- Give each participant 30 ballot slips (number of slips should be equal to the number of questions) bearing his/her registration number.
- Ask each participant to lineup in front of one cardboard station (i.e. one participant in front of one cardboard station).
- Each cardboard station has a question and three options (yes, no, no idea).
- Beneath the question, each option has a cover.
- Ask the participants to read the question, choose the appropriate option and drop the ballot into that cover.
- On blowing the whistle, participants move to the next station to read the question and cast their votes for the question.
- Participants exercise their ballot at each station.

Tips to facilitator

- Help participants distinguish between a cardboard station, a ballot, and a ballot Box.
- Before the conduct of the exercise, explain all the instructions to the participants.
- Organizing a mock demonstration before the actual conduct of the exercise will help participants.
- Assist illiterate or semi-literate farmers by reading the question and options.
- Only one participant should stand near one cardboard station.
- Do not allow two or more persons to crowd near one cardboard station.

Analysis of BBE Results

- First take out chits from 'No Idea' pocket, count them and record on a chart.
- After this, go to the pocket with least number of chits, count them and record on a chart.
- Finally record the third one by deducting the sum of the two from the total participants (There is no need to count the chits in the third pocket).
- Categorize the questions based on similarity.
- Calculate cumulative right/ wrong/ no idea question-wise and individual farmer-wise.
- Calculate percentages.

5. Short Study- Soil testing Time: 20 min.

Objective: Participants discuss the process of soil testing and the nutrients present in the soil.

Rationale: Soil testing is very important in crop production. Growing high yielding varieties and indiscriminate use of chemical fertilizers results in decreased productivity. It is essential to know the nutrients available in the soil by testing and the application of the nutrients based on the results.

Materials: Soil testing kit, soil sample, coloured paper strips to represent the quantity of the available nutrient.

Usage

Determining the quantity of nitrogen available in the soil

- Take one gram of soil sample into the beaker.
- Add 10 millilitres of nitrogen-1 solution to the beaker.
- Cap the beaker tightly and shake the beaker horizontally for 3 minutes. Then keep it on a stand for 3 minutes and again shake for 2 minutes.
- Pass the solution through a filter paper.
- Take 5 ml. of filtered solution to another beaker and add a pinch of nitrogen -2 powder using a spoon and shake for 2 minutes.
- Keep the beaker on a stand for 10 minutes.
- Compare the colour of the solution with standardized colour strips of nitrogen to know the nitrogen level of the soil.

Determining the quantity of phosphorous available in the soil

- Take 2 grams of soil sample into the beaker.
- Add a pinch of charcoal powder to soil in the beaker.
- Add 20 ml. of phosphorus solution -1 to the beaker.
- Cap the beaker tightly and shake the beaker in horizontal position for 3 minutes. Then keep it on a stand for 3 minutes and again shake for 2 minutes.
- Pass the solution through a filter paper.

- Take 5 ml. of filtered solution to another beaker and add 3 to 4 drops of phosphorus solution -2 using a dropper and shake for 5 minutes in vertical position.
- Again add 4 ml. of phosphorus solution -3 and add phosperous powder -4. Shake the beaker well.
- Keep the beaker on a stand for 10 minutes.
- Compare the colour of the solution with standardized colour strips of phosphorus to know the phosphorus level of the soil.

Determining the quantity of Potash available in the soil

- Take 2 grams of soil sample into the beaker.
- Add 10 ml. of Potash solution -1 to the beaker.
- Cap the beaker tightly and shake the beaker in horizontal position for 2 minutes.
- Pass the solution through a filter paper.
- Take 5 ml. of filtered solution to another beaker and add 3 to 4 drops of potash solution -2 using a dropper and shake well.
- Keep the beaker on the stand for 2 minutes.
- Compare the colour of the solution with standardized colour strips of potash to know the potash level of the soil.

6. Short Study- Gender work matrix Time: 30 min.

Introduction:
People tend to not recognize the important role of women, who are actively participating in agriculture as well as in domestic work. Therefore, to learn about the participation of women in agriculture, this study has been conducted.

Objective:
By the end of the exercise, participants will able to:

1. Discuss the involvement of both women and men in bhindi cultivation.
2. Discuss the need to empower women in decision making by involving them in FWS / Trainings.

Process
Ask the following questions in the large group

a. List out the activities in which women are involved in agriculture practices?

b**.** Why women involvement is needed in agriculture?

- Encourage the farmers to list all the agricultural activities in which women are involved. After consensus, list them on the board and summarize.

- Divide the participants into small groups and ask them to work on the following questions in their respective groups:
    - What is the time spent by men and women on each activity in agricultural practices (matrix form)?
    - How much time is required for each activity for men's and women's involvement in domestic work (matrix form)?

Given below is a sample format. Adapt this to your context.

Gender Work Matrix in crop Production:

S.no	**Operation**	**No of days (8 her/ day)**		**Decision**	
		Women	**Men**	**Women**	**Men**
1	Ploughing / Harrowing				
2	Cleaning field				
3	FYM - Transport - Application				
4	Seed selection				
5	Seed purchase				
6	Ridge & furrow preparation				
7	Sowing				
8	Irrigation				
9	Weeding				
10	Fertilizer/ purchase				
11	Fertilizer application				
12	Pesticide selection				
13	Pesticide purchase				
14	Pesticide application				
15	Harvest				
16	Marketing transport				
17	Marketing				
18	Money transaction				

7. **Homework** Time: 10 min.

- Request participants to discuss and get the actual rain fall data from November to May. Ask them to take the assistance of respective GMCs.
- Ask them to collect data on secondary water bodies (Total area of the tank or channel, water column).

8. **Evaluation** Time: 10min.

Ask the following questions to evaluate the day's learning. Pose the questions to the large group:

- What are the parameters required to calculate the total recharge?
- Why we need to estimate recharge again using rain fall data received during Nov to May?
- What is the purpose of the post- BBE?

Session-XIV: FWS Field day: April 1st or 2nd week

Program schedule

S.No	Time	Content	Materials	Expected outcomes
1	45 min.	Registration and inauguration of exhibition stalls.		• FWS participants share the learning pf FWS with the visitors.
2	30 min.	Exhibition.		• Farmers from all HUs will visit each stall.
3		Purpose of Field day.		
4		Relevance of FWS to groundwater management.		
5		FWS farmer experiences.		
6		VIPs speech.		
7		Issue of FWS graduation certificates.		
8		Vote of thanks.		

Objectives:

By the end of the day, participants will be able to:

- Discuss the main themes of the exhibition stalls,
- Understand the purpose of Field day,
- Discuss the relevance of FWS to groundwater management,
- Share their FWS experiences, and
- Participate in issue of graduation certificates.

Process

1. Registration and inauguration of exhibition stalls

Field day should begin with registration of the farmer participants. Separate stalls need to be maintained to register the name of each invitee. After each farmer completes registration, they are requested to go for a gallery walk and interact with the farmers who represent the stalls. Encourage farmers to ask probing questions during the gallery walk. At each stall,

farmers who represent that stall should share the theme of the stall, farmer experiences, and learning from FWS sessions.

Inauguration of stalls

After the arrival of VIPs, have the exhibition inaugurated by one of the VIPs. It would be nice if GMC/HUN leaders accompany VIPs during gallery walk. This is a great opportunity for farmers and GMC/HUN members to project themselves before district officials and local political leaders.

2. Exhibition of stalls

The exhibition stalls are organized in a sequence to help visitors to gain a fair understanding of FWS concepts and core messages. It will be beneficial for the farmers to organize the stalls in the following sequence:

- FWS objectives;
- Basic information about the project area;
- Hydrological Unit and Hydro-Eco System;
- FWS methodology and it's relevance to groundwater management;
- Groundwater concepts like recharge, draft, and groundwater balance;
- Water saving techniques, and soil moisture retention methods;
- Organic practices to control the pest and increase soil fertility;
- Artificial groundwater recharge structures;

3. Purpose of Field day

After the gallery walk, NGN President or Secretary has to request all the participants to be seated in the space provided at the venue. Then, invite all the VIPs onto dais and garland them. Next, NGN president or Secretary has to request one of the VIPs to lead the programme. Give the program sheet to all VIPs. The chief guest requests NGN members to start the programme with prayer.

Next, play a small role play to share the purpose of FWS Field day. The script should include the following few things.

- *Introduction to current groundwater scenario*

  Water is the main source for sustenance of life. 30 years back, we had surface water bodies like wells, tanks and canals. Increased population, industrialization, and deforestation have resulted in indiscriminate use. Also, the monsoon has become erratic. As a result, most surface water bodies dried up. Farmers started to drill bore wells for assured water supply for agriculture and drinking water. Presently, the groundwater levels are depleting at a faster rate due to increase in number of bore wells and indiscriminate

exploitation of groundwater. In most places, small and marginal farmers are migrating to nearby towns and cities for livelihood opportunities.

- *Why FFS approach to groundwater management?*

Farmer Field School is an effective tool to sensitize the community of farmers. Also, it provides a platform for collective action to find solutions to problems. A group of farmers will 'observe' a problem, 'analyze' it (why is this occurring?), and 'discuss' with co-farmers and make 'collective decision' to solve or manage the problem.

4. Relevance of FWS to groundwater management

Share these lines with participants and explain the relevance of FWS to the groundwater management: The decision making process in FFS approach is useful in observation of water levels and discharge of the bore wells. It helps groundwater users to analyze the reasons for fluctuations in water levels and discharge of the bore well. Then, they share this information with other farmers in the village or HU to understand the groundwater dynamics and estimate water balance. These water balance estimations help farmers to make informed decisions on crop-plans to meet the water demand.

All the above information will be discussed during FWS sessions and prepare the community to adopt water management techniques to make use of available groundwater.

5. FWS Farmer experiences

Next, NGN President or Secretary has to invite FWS farmer participants to share their experiences and learning.

It would be useful if farmers share the following:

- FWS methodology and groundwater management;
- Groundwater recharge and influencing factors;
- Groundwater draft, and information required to estimate the draft and balance;
- Water saving techniques, and quantity of water saved;
- Organic practices to control the pest incidence, and reduce investments;
- Collaborator farmers share experiences with long-term experiments; and
- 2007-2008 FWS plan and linkages with line departments.

Ideally, each farmer should restrict their speech to five minutes. After sharing of farmers experiences, request the VIPs to speak for a few minutes.

6. VIPs speech

Next, request VIPs to speak to farmers and share their observations and suggestions to farmer participants. Give five minutes to each VIP. If the number of VIPs is more, restrict the number of speakers.

7. Issue of FWS graduation certificates

NGN president/secretary has to share the importance of FWS graduation certificate and request chief guest to handover the importance of the FWS graduation certificates and request one of the VIPs to issue FWS graduation certificates to HUN Presidents and Secretaries on behalf of the FWS participants. HUNs will distribute the graduation certificates to facilitators and participants of FWS sessions during the HUN meetings.

8. Vote of thanks

A member of the NGN committee should be invited to make a brief vote of thanks to all those who graced the event and those who have helped organize the Field Day. Inform the participants that lunch has been organized for all.

Annexure III

FWS Monsoon-Long Training

Inaugural and Introductory Session:

It is a platform to begin the monsoon-long training for implementing staff of the Farmer Water Schools. Government officials, elders and project staff are invited to the function. The following topics are discussed at the function:

- Concept of Farmer Water School,
- Rationale for FWS monsoon-long training for staff, and
- Logistics for FWS monsoon-long training.

Session-I: Theme: Introduction to Farmer Water Schools

1. Introduction of the participants and sharing of expectations Time: 10 min.

Objective : Participants introduce one another.
Content : Participants introduction.
Method : Dyad technique
Materials : Pictures of fruits, and box.
Process

- Collect two pictures of each variety of fruit. The total number of pictures should match the number of participants (Ex: For 30 participants collect pictures of 15 pairs of fruit).
- Put these pictures in a box and ask each participant to pick one picture from the box.
- Encourage participants to lookout for the other participant having the same picture and ask them to form pairs.
- Ask the participants in each pair to introduce themselves to their partner. Participants should use the following information to guide the introductions:
    - Name,
    - Village and Hydrological Unit, and
    - Position in GMC/HUN or any other institution.
- Later, ask each participant in the pairs to introduce his/her partner to the large group.
- Continue the introductions till all the participants introduce one another.

Pictures of fruits and vegetables in pairs

2. Pre-Ballot Box Exercise Time: 60 min.

Objective : Participants participate in Ballot Box Exercise.

Content : Ballot Box Exercise.

Method : Demonstration

Materials : Charts, markers, card boards, nails, long sticks, knife, thread, ballot boxes, and whistle.

Process

- Share the purpose of Ballot Box Exercise (BBE).The purpose of BBE is to know participants' awareness on groundwater, types of soils, rocks of HU and other water use efficiency methods. This will help determine topics that need focused attention during FWS sessions.
- After sharing the purpose of BBE, assign a registration number to each participant.
- Give each participant 30 ballot slips (number of slips should be equal to the number of questions) bearing his/her registration number.
- Ask each participant to lineup in front of one cardboard station (i.e. one participant in front of one cardboard station).
- Each cardboard station has a question and three options (yes, no, no idea).
- Beneath the question, each option has a cover.
- Ask the participants to read the question, choose the appropriate option and drop the ballot into that cover.
- On blowing the whistle, participants move to the next station to read the question and cast their votes for the question.
- Participants exercise their ballot at each station.

Tips to facilitator

- Help participants distinguish between a cardboard station, a ballot, and a ballot box.
- Before the conduct of the exercise, explain all the instructions to the participants.
- Organizing a mock demonstration before the actual conduct of the exercise will help participants.

- Assist illiterate or semi-literate participants by reading the question and options.
- Only one participant should stand near one cardboard station.
- Do not allow two or more persons to crowd near one cardboard station.

3. FWS Objectives Time: 30 min.

Objective : Participants discuss purpose of FWS.

Content :

- Objectives of FWS.

Method : Large group discussion

Materials : Charts, markers and Pictures depicting Indian groundwater scenario.

Process

- Ask participants to reflect for a minute on issues around water availability and agriculture that they wish to discuss/learn during the year-long Farmer Water Schools.
- Use the following visuals to initiate discussion on the present groundwater scenario.


Results of water levels depletion

- Keeping in view, the existing groundwater situation, encourage the participants to share the issues that need to be discussed during the year long FWS sessions that can provide us a good understanding on groundwater science and water management techniques.
- Lay down a norm that all ideas are welcome (no idea is a wrong one) and others should not judge an idea as it is being shared.
- Note the list of participants' ideas on a chart.
- Ensure that each participant gets a chance to share their thoughts.
- After all ideas have been shared, open the floor for discussion.
- In the large group, review the list of ideas and sequence the events.
- Thank the participants for the inputs and share the FWS objectives.
- Request the participants to compare their expectations with the FWS objectives and ask them to suggest required additions if any.
- Following these discussions, finalize the objectives for the year long FWS sessions.

The FWS objectives are as follows:

- Empower participants with knowledge and skills in measuring recharge & draft,
- Sensitize participants on the need for collective action,
- Sharpen the participants ability to make critical and informed decisions on crop plans, and
- Sensitize participants on new ways of thinking and resolving issues.

4. Norms setting Time: 20 min.

Objective : All the Participants:

- Set norms for smooth conduct of FWS sessions.

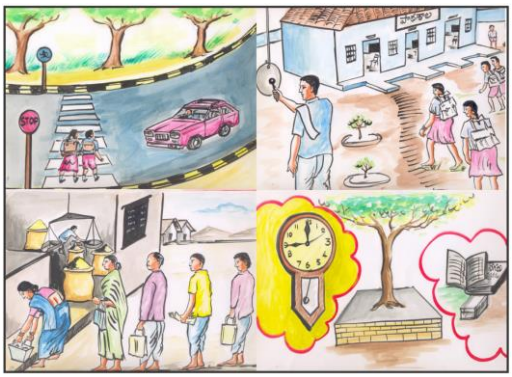
Content : Norms setting.

Method : Story telling and large group discussion.

Materials : Pictures, charts, markers and script of father and two son's story.

Process

- For effective and smooth conduct of Farmer Water School sessions, and to help the facilitators in the conduct of FWS sessions, encourage the participants to lay down the norms.
- To facilitate this, use the following pictures and generate a discussion on the norms observed in the pictures. Like wise, list the norms for effective conduct of Farmer Water Schools that evolve from the discussion on a chart paper.



Norms at various places

- Another option to set norms is to narrate the following story:

The story: Father and two son's

There lived a man with his two sons. Due to financial problems, he could send only his elder son to the school and kept the younger son with him to help in farm activities. On one occasion, he had to send his elder son to a nearby town to meet an official. So, he asked the younger son to go to the school in place of his elder brother. But, the class teacher rejected this boy and sent him back.

After sharing the story, ask the following questions:

- What have you learnt from the story?
- Why was the younger son not allowed to sit in the class?

- List participant responses and lay down the norms for the effective conduct of Farmer Water Schools.
- Write the norms, on a chart and read them aloud.

Tips to facilitator

Encourage the participants to set the norms regarding:

- Time maintenance.
- Transportation.
- Venue, responsibilities of host teams in the conduct of session.
- No substitute should attend the FWS session.
- Regular attendance.
- Discuss the learning of FWS session in GMCs.

5. Group formation Time: 25 min.

Objective : Participants form into small groups.

Content :

- Why small groups?
- Formation of small groups.

Method : Game and large group discussion

Materials : Medium size stones (ten in number), different varieties of stones.

Process

- Make the participants to play the game with 10 stones.

Game: Stone Game

- Take 10 stones of medium size.
- Divide the participants into two groups with five participants only in one group and the rest (say 25 participants) in the second group.
- Keep the 10 stones (each weighing two kilos) at one place.
- Ask the first group (five members) to move away a little and arrange the stones in order.
- Next ask the second group (25 members) to do the same a little away from the first group using the same stones.

- Ask the following questions after the game:
    - What have you observed in the game?
    - What is the difference between first group and second group?
    - Write participants responses on a chart paper and share the following advantages of having small groups:
        1. Every member gets an equal opportunity to share their experiences and can articulate easily with other members in the group.
        2. Every participant can improve his/ her presentation skills.
        3. Enables mutual learning and promotes team work.
        4. Increased camaraderie.

- Encourage the participants to play the following game and form small groups.

Game: Different kinds of stones

- Take different varieties of stones available in the specific HU.
- Ensure that the number of stones is equal to the number of participants.
- Ask each participant to pick one stone.
- After the exercise, any two participants getting the same type of stone are grouped together.
- Encourage the participants in each group to read out their names before the audience.
- Encourage each group to name their group and identify a leader.

All the group leaders identified are responsible for the following:

- To ensure that all the members in that specific group are present for the session.
- To lead the discussion, and ensure that there is an equal participation from every group member.
- To encourage every group member to present the groups work in large group.
- Share with the participants that this group would be there for the complete hydrological year.

Before concluding the discussion, share that the groups will remain as a cohesive learning unit for the entire duration of Farmer Water Schools.

6. Relevance of FWS to farmer problems Time: 25 min.

a. Elements of farmer decision making

b. Farmer decision making process and groundwater management

Objective : Participants discuss steps in decision making process.

Content :

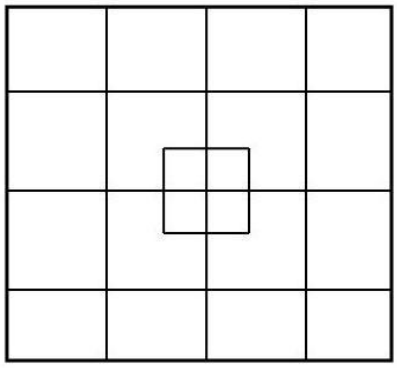
- Steps in farmer decision making process.
- Farmer's problems around groundwater and agriculture.
- Four core components of Farmer Water School.

Method : Large group discussion

Materials : Charts, markers and visual of tree having national leaders.

Elements of farmer decision making process

- In a large group, show the following visual:



- Ask participants to observe the picture for 2-3 minutes and then count the number of squares in the picture. Do not lay any norms for participation in this activity.
- Later, ask a few participants to share their finding.

Tips to facilitator

- Few participants count quickly and find fewer squares.
- Others observe longer, help each other and find more.
- The more they analyze and discuss, the more clearly they arrive at the right answer.
- The correct answer is 35 squares.

- Ask them to describe how they arrived at their conclusions. List the steps involved in arriving at the said conclusions. The steps include:
    - See – observe
    - Discuss with others
    - Brainstorm – Think
    - Decision

Decision making process and groundwater management

- To enable better understanding, ask participants to list problems related to groundwater and agriculture.
- Take any one of the problems and ask the following questions:
- Assume that you do not have enough water in your borewell to irrigate the crop. 'How would you approach this problem and find a solution?
- Record the participant's responses on a chart paper.
- Summarize the discussion by keeping the participants responses in mind and share that, you will 'discuss' with your fellow participants and seek their advice. You might get various suggestions from them like shift of crop, going for a new borewell, purchasing water from other sources etc. After gathering information, you 'think' which is the best possible way to overcome the problem and finally you take the

appropriate 'decision' and implement the same. List the steps involved in the decision making process. They are:

- See –observation.
- Discussion- discussion with others.
- Think – analysis.
- Decision and implementation - decision making.

- Ask the participants if we could use these steps to develop strategies to address problems around groundwater availability and usage?
- Encourage participants to respond and reach consensus.

7. FWS pledge Time: 5 min.

- Ask the participants why school children take a pledge while beginning their regular day.
- Elicit responses from the large group and state that a pledge is to inculcate a discipline in our mind and enable us to take a work more seriously.
- State that it will be like promising ourselves that we will save our groundwater resources together.
- End the discussion by posing a question to the large group, if it will be good to start the future FWS sessions with FWS pledge.
- Encourage the participants to discuss what would be the ideal content in FWS pledge.
- Finalize FWS pledge.

FWS pledge

We, the members of the Farmer Water School.
The groundwater resources in our HU collectively belong to us.
Together, we will manage our groundwater resources judiciously.
We will take all the necessary measures to prevent groundwater pollution.
We will attend all the 14 sessions of Farmer Water School without fail.
We will disseminate all the learning from FWS to the larger community.
We preserve groundwater resources for our future generations and we take a pledge in this regard.

8. BBE Analysis Time: 15 min

Objective : Participants analyze BBE results.
Content : BBE analysis.
Method : Demonstration

Materials : Charts, and markers.

Process

Ask participants about sharing of BBE results. Share with the participants that before we share the results with participants we need to analyze the results.

Encourage participants to think about analysis of BBE results. Demonstrate the process.

Analysis of BBE Results

- First take out chits from 'No Idea' pocket, count them and record on a chart.
- After this, go to the pocket with least number of chits, count them and record on a chart.
- Finally, record the third one by deducting the sum of the two from the total participants (There is no need to count the chits in the third pocket).
- Categorize the questions based on similarity.
- Calculate cumulative right/ wrong/ no idea question-wise and individual participant-wise.
- Calculate percentages.
- Based on the results, determine topics that need focused attention during FWS.

9. Group dynamic – Need for Collective action Time: 10 min.

Encourage the participants to play this game. The purpose of this game is:

- To make participants to take collective action.
- To develop planning skills among the members
- To develop co-operation and co-ordination
- To discuss factors affecting group work

Game: Water brigade:

- Divide the participants into two groups and ask each group to form a line. All the groups should have equal number of persons.
- Provide a bucketful of water at the front end of each line. Put the empty buckets at the other end of the lines. The distance between the full and empty buckets should be constant for each line.
- When the signal is given to start, the persons at the front end of the line collect water in the cup of their palms and transport it to the next person. This person passes the water to the next person in the line.
- Thus, transporting the water down to the last person who fills the empty bucket. This process continues for a stipulated period of time.
- At the stop signal, the first persons in all groups should stop collecting water. Persons in the rest of the group can continue to transport the water already present in their hands to the empty bucket.
- Later, the water filled in the bucket by the group members is measured.
- The group which is able to transport more volume of water is the winner.

After the game, pose the following questions to the participants:

a) For the group which fills up maximum water in its empty bucket:

   i) Why do you think you were able to finish first?

   ii) Did your group plan on any strategy or method to achieve the goal? What was that?

b) For the group which finished second:

   i) Why do you think you were not able to finish first?

   ii) If you were given another chance to go through the game, do you think your group would make it? What would be the reason for this?

c) What factors determine success of group work?

10. Homework: Crop Survey Time: 10 min.

Objective : Participants collect the information about the major crops.
Content : Crop survey.
Method : Large group discussion
Materials : Charts, markers and banner on crop plans.
Process :

- Ask participants to collect crop details during their field visits using the format given bellow.

Village	Paddy (Acres)	Groundnut (Acres)	Chilly (Acres)	Black gram (Acres)	Sweet orange (Acres)	Total (Acres)
Abc						
Bcd						

11. Session Evaluation Time: 10 min

Ask participants the following question to evaluate the day's learning.

- How did you feel today?
- Can you share the steps in decision making process?
- How do you propose to share the four core components of FWS in your respective GMCs?
- What is your opinion on the methods used in the session?

- Note the participants feed back and thank everyone for their active participation.

Focus: Introduction to Groundwater Management

1. Rationale for groundwater management Time: 30 min.

Objective : Participants discuss the need for managing groundwater resources.
Content : Groundwater management.
Method : Large group discussion
Materials : Charts and markers.
Process

- Ask the following question in large group: "List the chronology of various tools and machinery used for groundwater extraction over the past hundred years. How and why did they change?"
- List the participant's responses on a chart paper.
- Later ask participants to work in small groups to discuss the following question: "How do we address the issue of depleting groundwater resources?"
- Following the small group discussion, ask each group to report out their discussion. Summarize the discussion by sharing the depleting groundwater level statistics and its impact on the water user.

Tips to the facilitator
• Depletion of water tables, drying of aquifers, groundwater pollution, water logging and salinity, etc. is major consequences of overexploitation and intensive irrigation. It has been reported that in many parts of the country the water table is declining at the rate of 1-2 m/year.
• If this trend continues unchecked, India is going to face a major water crisis in the near future.

2. Demand side management Time: 25 min.

Objective : Participants discuss the importance of demand side management of groundwater.
Content : Demand side management.
Method : Large group discussion
Materials : Charts and markers.
Process :

- Ask the following question in large group: "List the factors that influence groundwater recharge".
- List the participant's responses on a chart paper.
- Later, ask the participants to work in small groups to discuss the following question: "What proportion of rainwater infiltrates and recharges the aquifer? Why?"

- Following the small group discussion, ask each group to report out their discussion. Summarize the discussion by stating that "Replenishment of groundwater resource is an extremely slow process. This natural process cannot measure with the huge demand for this resource for agricultural and domestic needs. The only option left is to use the resource carefully.

Tips to the facilitator

Supply side management

- Recharge is known to be increased by artificial means like Check dams, Irrigation bore wells. This recharge is a slow process and cannot satisfy an indiscriminate water users demands for ever. This is an example of Supply side management.

Demand side management

- There are technologies that are beginning to be exploited that produce more by pumping less. We call this judicious water usage as Demand side of water management.
- Managing the demand for groundwater is the only way to curb excessive usage.
- Unless the users themselves take the initiative in the management and regulation of groundwater resources, there is little scope to reverse current trends and sustain the livelihoods that are dependant upon continued access to groundwater.

3. Role of institutions in groundwater management Time: 30 min.

Objective : Participants discuss the role of institutions in groundwater management.
Content : Role of institutions in groundwater management.
Method : Large group discussion
Materials : Charts and markers.
Process

a. Ask the following question in large group: "Are the water levels in the neighboring/adjacent borewells related? Why?
b. List the participant's responses on a chart paper.
c. Show the model of a Hydrological Unit (HU) to demonstrate that groundwater is a collective resource and effective management of the resource needs a collective effort.
d. Later, ask the participants to discuss in small groups: "What are the effective ways of managing the collective resource in your area of operation?"
e. Share the APFAMGS institutional model. Summarize the discussion by sharing that farmer institutions play a vital role in sustainable management of groundwater resources.

Tips to the facilitator

Groundwater Management Committee (GMC) in APFAMGS

- Farmers in each habitation have been organized into GMCs. They take up responsibility of monitoring the groundwater level, rainfall, discharge and inform them to the community.
- They deliberate on the data collected and all critical issues related to water and agriculture during their regular monthly meetings.
- They address issue of groundwater depletion and identify appropriate strategies to handle them.

Hydrological Unit Network (HUN) in APFAMGS

- GMC's within a Hydrological Unit come together to form a Hydrological Unit Network (HUN).
- HUNs elect their leaders and conduct meetings on regular basis.
- Registers like minutes of meeting, accounts books etc. are maintained at HUN level.
- Larger issues that extend beyond habitations are addressed at HUN level apart from sharing GMC experiences.
- HUNs act as pressure groups to address issues related to groundwater depletion in the HU, price for agriculture produce, farm inputs, and actively bargain for power in local elected bodies. They are registered under societies registration act.

4. Participatory Hydrological Monitoring (PHM)

Time: 60 min.

Objective : Participants discuss about Participatory Hydrological Monitoring.
Content : Participatory Hydrological Monitoring.
Method : Lecturette
Materials : Computer, LCD Projector, charts, and markers.
Process : Use the following information to make a presentation on PHM.

Participatory Hydrological Monitoring (PHM)

PHM is an effort to sensitize the individual groundwater users on judicious use of groundwater. It improves the user's understanding of local groundwater resource characteristics. This helps the local communities to form a community opinion to support appropriate measures for managing the available resources equitably.

Objectives of PHM

PHM concept relies on creating awareness among local populations:

- On groundwater resource availability,
- On rainfall-recharge relationship (local micro catchment's level),
- On the need to develop water use plans matching with the utilizable groundwater resources,
- On the need for conservation of groundwater, and
- On ways of augmenting recharge.

The primary objective of PHM activity is to build capacities of participants and their ability to manage local groundwater systems. The first step of PHM relates to improving participants understanding of the local groundwater system, rainfall pattern, recharge, draft and calculation of overall balance. The awareness of the ground water system is expected to create an interest in monitoring the local geo-hydrological system.

Identification of Stakeholders

Primary stake holders in the PHM are: individual groundwater users, data collection volunteers, opinion leaders of the village/habitation, community workers, hydrologists and agricultural facilitators. Government and nongovernmental (NGO) organizations working on water-related issues become secondary stake holders in PHM. To start with, farmers, Volunteers and Opinion leaders need to be targeted for knowledge transfer and implementation of physical works. At a later stage, they are expected to turn into facilitators in the replication of the concept to a wider audience.

Hydrogeologists provide inputs related to delineation of watershed/ aquifer system, training participants, identifying observation bore wells, installing scientific equipment & documenting and disseminating PHM activities.

Delineation of the hydrological unit

Groundwater operates in a larger arena of Hydrological system. Topography, rock type and status for development govern the occurrence of groundwater. The best unit to manage groundwater is the Hydrological Unit area. To understand the aquifer system, the project area is delineated into number of Hydrological Units. This delineation is done based on the assumption that the inflow into the HU is equal to the outflow from it.

Resource inventory

Prior to implementing PHM, an exhaustive resource inventory is prepared in all the hydrological units which become critical information for the activities to be carried during CWB phase. This available information is updated at the end of the monsoon to ensure valid CWB estimations. There are three main components of resource inventory: water, agriculture and livestock. Under the water component, a random well inventory of surface water bodies is carried out. Specific data collection formats can be used for the well inventory that includes information on well type, location, well depth, well yield, number of pumping hours, static water level and pumping water level.

Agriculture and livestock

PNGO teams carry out agriculture assessment survey and collect information pertaining to the existing agricultural practices. Specific data collection formats are used for this survey that includes the following parameters:

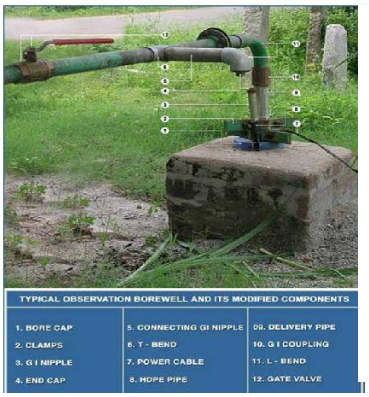
- Total irrigated land under tanks and bore wells,
- Major crops in the area,
- Area under each crop,
- Agronomic practices,
- Usage of pesticide and fertilizers, and
- Crop yield particulars.

Identification of observation (OB) wells

Groundwater is under constant hydrostatic pressure as a result of the underground water movement. When groundwater draft is more than the recharge, pressure tends to decrease resulting in lowering of water levels. Water level in a well is the direct indication of the status of the groundwater resource. Production wells are selected as observation wells, so as to gather data under pumping conditions.

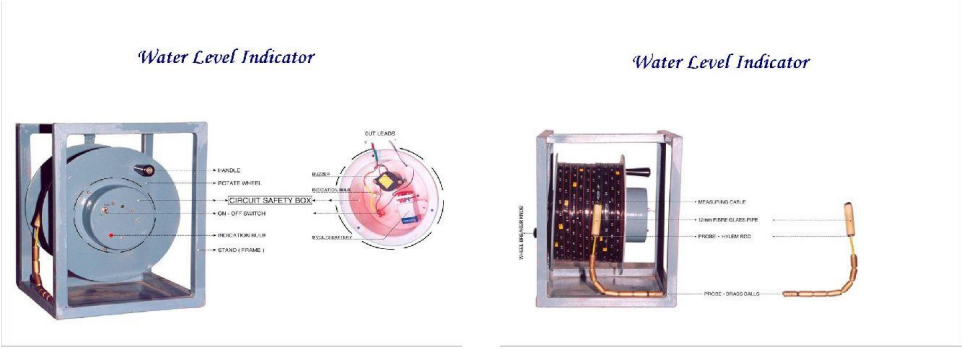
A complete inventory of wells in the hydrological unit targeted for PHM is to be carried out during the PHM exercise. The following steps become a part of the OB well identification process:

- A centimeter graph is used to divide the watershed into 100 ha grids. That means four centimeter boxes would make one 100 ha grid.
- For each of the 100 ha grid units, one bore well (failed or successful), if available is selected as an observation bore well. It is a good practice to select at least one failed bore well in each watershed.
- In the absence of even a single bore well in the 100 ha grid, dug-wells can be selected.
- It is ensured that observation bore wells are equally spread over the drainage basin. At least two wells are located in the recharge area, two in the watershed's central part and one at the mouth of the watershed. Care is taken to ensure that the highest yielding, the lowest yielding and failed bore wells are included.



Installation of Rain Gauges

Collection of rainfall data from a rain gauge station is another important activity. For this purpose, rain gauge stations can be established with the cooperation of farmers in the project area. Farmers can volunteer in identifying and donating the land for establishing rain gauge stations. Farmer volunteers can record the rainfall received in HU and display the same on the 'rainfall type' display boards.



Instruments for Monitoring

The following is the equipment required for monitoring

Water level measuring equipment

They may be made using several types of equipment. The choice of equipment depends on several factors, including the accuracy or ease of measurement required, type of structure (bore well/ open well), and pumping activity of near by wells. A commonly used water level indicator is assembled using a steel frame.

The electronic parts are housed in a cylindrical metal box. A handle and handle lock is provided. The cable used is of superior TV antenna quality. The measuring cable is calibrated using paint and screen printing technology. The probe consists of liquid sensitive metal cylinders connected to the measuring cable through internal wiring. When the indicator is lowered into the OB well through the HDPE pipe, a beep sound can be heard after the probe touches the water surface. The water level is measured by noting the reading on the cable.

Rain gauge

A commonly used Rain Gauge for PHM pilot is the Symon's non-recording type that consists of a cylindrical vessel with an internal diameter of 127 mm and an enlarged base with a 210 mm diameter. In this cylinder, a rain collecting bottle made of glass or plastic is placed. Over the top of this bottle, a glass or plastic funnel is inserted. The top section of the funnel is provided with a circular brass ring of exactly 127 mm internal diameter. The capacity of the bottle is up to a rainfall of 75 mm to 100 mm.

Calibrated drum and stopwatch

Calibrated drum with a capacity of 100 or 200 liters is used along with a stopwatch to measure the discharge of the observation bore well. Ready reckoning conversion tables are provided to participants for converting the discharge in terms of liters per minute.

Data collection by participants

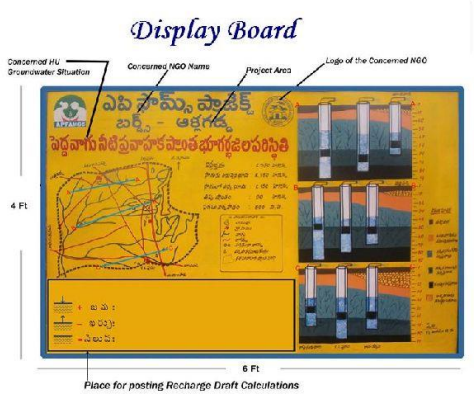
Participants are trained to systematically measure the data pertaining to static pumping water levels in an observation bore well, Measurement of discharge from an OB well and the rainfall received from rain gauge stations. This data is then recorded in Hydrological Monitoring Record (HMR).

Display Boards

They are crucial for generating interest in the community. Four types of display boards should be used in the PHM pilot phase for awareness generation:

1. Water level type.
2. Rainfall type.
3. Water shed type. and
4. Signboard type.

The display boards are erected at central sites. Walls of building can also be used to paint a table making provision for updating of SWL and PWL in the observation bore wells.



Groundwater Management Committees

In the village context, several people's institutions exist due to the intervention by government and non-governmental organizations, mostly groups formed with an activity specific objective. Wherever possible, PHM can use existing institutions dealing with the concept and content of the activity. Where there are no institutions working for sustainability of water resources, a new groundwater management committee (GMC) can be initiated.

Crop-Water-Budget (CWB) Exercise

Crop water budgeting (CWB) exercise is a critical component of the PHM activity. It is considered as final step in the chain of PHM aiming at sustainable groundwater management by the farmers themselves. The CWB exercise involves estimation of the groundwater balance based on the total annual recharge and draft. This estimation helps farmers make informed decisions on the crops to be sown.

5. Reconnaissance Survey Time: 20 min.

Objective : Participants discuss the purpose of reconnaissance survey.
Content : Reconnaissance Survey.
Method : Large group discussion
Materials : Charts and markers.

Process :

- Ask the following question in large group: "What are the advantages of exploring the delineated Hydrological Unit?
- List out the participants responses on a chart paper.
- Summarize by stating that Reconnaissance of the delineated Hydrological Unit provides the opportunity to appreciate the complexities of the watershed and groundwater occurrence and movement in the area.

6. Discovery Learning and Experiential Learning Cycle (ELC) Time: 90 min.

Objective :

By the end of the exercise, participants will:

1. Discuss the concept of Experiential Learning Cycle (ELC); and
2. Apply the concept of ELC to analysis of own learning experiences.

Materials :

- A4 handouts of "man learns to ride a bicycle".
- Overhead sheets with ELC model (concept & practical example).
- Handouts of 'short notes on ELC".

Procedure

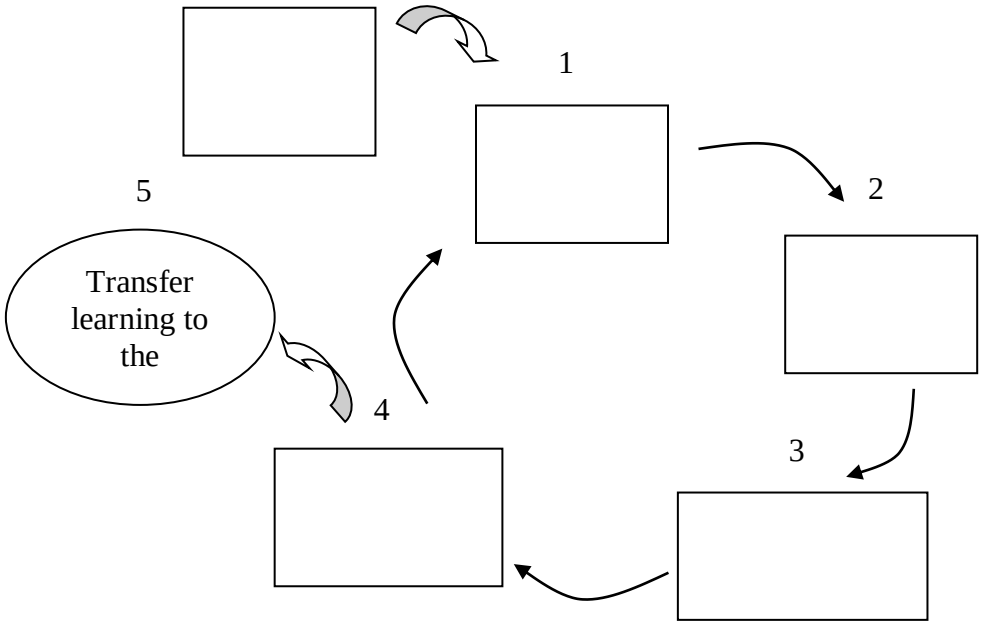
- The facilitator briefs participants about the learning objectives of the exercise.
- The facilitator asks the participants to form into small groups. S/he hands out the A4 handouts of "man learns to ride a bicycle" to each group; and asks the groups to discuss "how the man learns to ride the bicycle" and to put the handouts in a logical order.
- Each group is allowed to shortly present its findings and the facilitator facilitates a summary of the findings.
- The facilitator highlights the importance of learning from own discoveries (focus on the heavy experience and subsequent learning as a result of the man falling off his bicycle).
- The facilitator introduces the Experiential Learning Cycle and highlights the importance of ELC for adult education.
- The facilitator then presents a practical example of how an FWS trainer has gone through the ELC himself/herself while learning through own discoveries.
- Participants are then given the task to reflect on their own learning from discoveries during the first season of FWS and other special topics/activities in the TOT (e.g., concept of HESA, HU Walk, etc.).
- Outputs of homework task need to be reviewed and further discussed later during the workshop.

Man learns to ride a bicycle handout

Handout : *Experiential learning cycle*

The experiential learning process ensures effective and participatory learning. It ensures active involvement of both the participants and the facilitators in the learning process. The experiential learning process is as follows:

Experiential Learning Cycle



Learning needs assessment:

- The learning process is preceded by a learning needs assessment.
- It helps determine the types and levels of learners' needs concerning a given issue or topic.
- Through this assessment, we can find out "where the learners are".

- This is the crucial starting point of all information dissemination or awareness building activities.

Step One: Introduce new concepts and content:

- A topic can be introduced through a guided group discussion where the facilitator uses one of a variety of participatory teaching aids — for example, visuals that are related to the topic under discussion, a role play, or a demonstration.
- It starts with a discussion that brings out their level of familiarity and knowledge, both correct information and incorrect information about the new content being presented.
- During the discussion the participants sometimes may tell some correct information and sometimes may not.
- Reinforce the correct information and correct the misinformation in a respectful manner.

Step Two: Clarify concepts and content:

- The facilitator provides clarification on views that participants have expressed and "new information" on the content or concept that is being presented.
- Learners discuss how the new information introduced about the topic/concept can help improve the existing situation. They discuss, as well, how these changes could be recognized in their lives and in their communities.
- At the same time, they begin discussing what resources are available locally to assist individual learners and the group or community in addressing a specific problem and how one could access those resources.

Step Three: Apply new content/concepts to a concrete issue:

- Participants are provided with an opportunity to apply what they have discussed and learned in the first two steps to a concrete development issue in their immediate environment.
- In a Farmer Field School, farmers are in the rice paddy collecting information about the existing ecological system, studying the relationship between a variety of factors influencing the rice crop at its present stage of development, and carefully examining the balance between harmful and beneficial insects.
- On the basis of the information collected and analyzed in the rice paddy, decisions are made about actions that need to be taken—on the spot and at that time, rather than in a classroom setting removed from the rice paddy.

Step Four: Reflect and identify new issues:

- In this step, the facilitator organizes an activity or set of activities that help learners individually and collectively reflect on and assess what they have learned and how the learning activities have helped them achieve the goals (indicators of change) identified during the third step of the learning process.

- At this point of the process learners are engaged in the identification of new learning needs that have emerged as a result of past learning and the application of that learning to specific development issues.

Step Five: Transfer learning to the community:

- This community outreach and education activity is an IEC[3] activity, in which the program participants themselves disseminate the "message" to a broader spectrum of the community.
- In taking this approach, we are taking a critical step in helping build the sustainability of educational activities at the community level as well as transferring learning abilities to others in the community.

7. Art of Asking Questions: Helping Farmers to Learn by Discovery and Analysis – "What is this? What is that?"

Introduction:

The goal of training is to provide an educational opportunity for learners. The methodology of training is very important for achieving the goal of education. One important method of training is to ask questions that allow the participants to develop their own analysis and understanding. A straight forward answer would steal an opportunity for education. Instead, ask questions. Lead the participants to the 'answer' by asking questions.

While observing a 'farmer plot' or while undertaking a 'HU walk', a common question that participants ask is: "what is this?" There are many ways to answer the question "What is this?" For most of us, the natural response is to give the name of the object often in a foreign language (English or Latin). The question is often answered by saying "Oh that is *an igneous rock*" or "This is *metamorphic rock*"? The result of this answer is that an educational process has been stopped. A better way to answer the question is to ask a question; "Where did you find it? What was it doing? Were there many of them? Have you seen this before?" The idea is to promote learning by discovery and to lead the person toward their own analysis.

Lecturette: Use this introductory piece to give a short lecturette.

Role play: Ask the participants to enact a role play using relevant examples to demonstrate "what is this/what is that". One participant could act as a FWS trainer and a couple of other participants could act as farmers. The farmers should show a sample or specimen and pose a question to the FWS trainer.

The FWS trainer should be able to give several kinds of responses to the question "What is this?"

The 'FWS trainer' should respond with one of the following type of responses; "That is a good question. Where did you find it? Did you ever see it before? What do you think it is? (Keep

asking questions)". Use this especially when you know what the specimen is. Try not to give the answer!

If the question is to be answered, the 'FWS trainer' should avoid answers which give more emphasis to identification. Rather, the functional role of the object should be emphasized.

"This is an insect that feeds on the plant. It is not really a problem insect until there are very many. There are many organisms which eat this insect including spiders and parasitoids. (OR) This is a spider that eats insects and is a friend. It happens to be called a hunter because it moves around the field searching for insects." Or some other response that only give biology/ecological information.

After the role play, use the following questions to generate discussion in large group.

1. How often do you usually give just a name for an answer? Do you think it is helpful in training to ask questions to assist in learning?
2. In your usual job, is helping farmers learn an important aspect in day to day work? Do you think it would be useful to answer questions with questions to help farmers?
3. Many field workers think they have to be smarter than farmers, even though the farmer is much older and more experienced. Do you think this method can help you in working with older farmers by facilitating educational process? Can you also learn from farmers by asking questions? Do farmers think respect, a desire to learn, or an instant answer is most important for an extension worker?
4. Conclude by emphasizing that:

"Never give the answer with a name. that only kills the question. the question is a chance to learn! every question answered directly is an opportunity lost for learning"

Share these follow-up questions that could be asked by the facilitator:

- Where did you find it? (location).
- What was it doing? (function).
- Were there many like this?(density and diversity).
- Have you seen this before (farmer's previous experiences).
- Did you find other things? (diversity).
- What did it look like (shape, color, size).

8. Identifying farmer training needs and FWS curriculum Time: 30 min.

Objective : Participants identify farmer training needs and FWS curriculum.
Content : Farmer training needs and FWS curriculum.
Method : Small group discussion
Materials : Charts and markers.

Process

- Encourage one participant to describe the hydrological cycle and its relation to rural communities.
- Participants work in small groups to prepare a farmer activity calendar in a hydrological year.
- Derive FWS training content in relation to hydrological year
- Participants compare 14 session plans of FWS with the derived training content.

Session-II: Theme: Knowing the HU

1. Recap Time: 10 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Session one contents:

- Introduction of the participants and sharing of expectations,
- Pre Ballot box exercise,
- FWS objectives,
- Norms setting,
- Group formation,
- Elements of Farmer decision making, and
- Need for collective action.

Method : Large group discussion

Materials : First session contents, charts, and markers.

Process

- Welcome participants to the second session.
- Start the session with FWS pledge.

FWS pledge
We, the members of the Farmer Water School.
The groundwater resources in our HU collectively belong to us.
Together, we will manage our groundwater resources judiciously.
We will take all the necessary measures to prevent groundwater pollution.
We will attend all the 16 sessions of Farmer Water School without fail.
We will disseminate all the learning from FWS to the larger community.
We preserve groundwater resources for our future generations and we take a pledge in this regard.

- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

2. HU walk: Field walk in Hydrological Unit area Time: 90 min

a. Analysis of HU.
b. Use of HESA framework.

Objective : Participants walk along the HU and discuss hydrological features of the HU.

Content :

- Hydrological cycle of HU
- Analysis of HU

Methods : Field visit, and small group discussions.

Materials : Visuals, charts, and markers.

Process

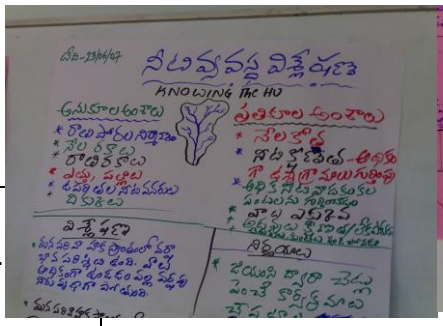
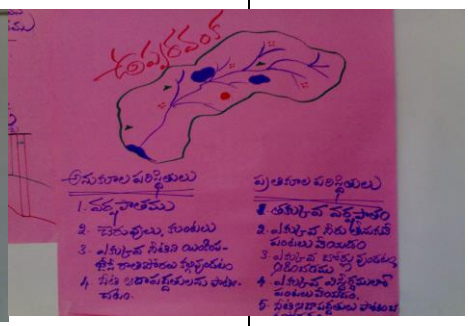
- Inform the participants that they will work in their respective learning groups during this activity.
- Take the participants to the field (HU area only) and request them to observe and analyze the different rock and soil formations, other factors that influence the hydrological cycle of the HU. Ask the farmers to work in their respective small groups.
- Suggest the participants to note down their observations during the field walk. Give 30 minutes for field walk.

<table>
<tr><td colspan="2">Hydro eco-system analysis

Name of the group:

Date:

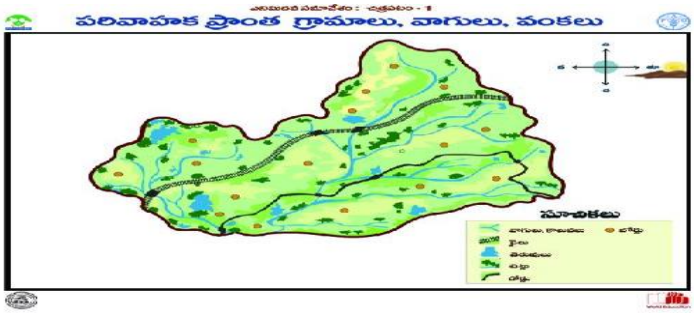
Place/venue:

+ Beneficial factors(Recharge)

• List of their observations.</td></tr>
<tr><td>Analysis:</td><td>Decisions and Implementation</td></tr>
</table>

- Later, request participants to work in small groups and analyze their observations. The above chart could be used to present the analysis.
- Ask the participants to share their observations and analysis in large group. Generate discussion to facilitate a good understanding of the HU.



3. Delineation of HU Time: 30 min.

Objective : Participants discuss the purpose and process of delineating the HU.

Content : Delineation of HU

Methods : Large and small group discussion.

Materials : charts and markers.

Process

- Ask the following question in large group: "How do we understand a larger area like a Hydrological Unit?
- List the participants responses on a chart paper.
- Summarize the discussion by stating that delineation of Hydrological Unit is necessary for understanding the aquifer system.
- Divide the participants into small groups and give a survey of India toposheet to each group.
- Encourage the participants to study the drainage pattern and define independent units that converge to form independent drainage networks.
- The boundaries of the Hydrological Unit need to be defined and the same examine in the field to visualize the ridge points and the basin outlet.

4. Water cycle & Hydrological unit Time: 25 min

Objective : Participants walk along the HU and discuss water cycle of the HU.

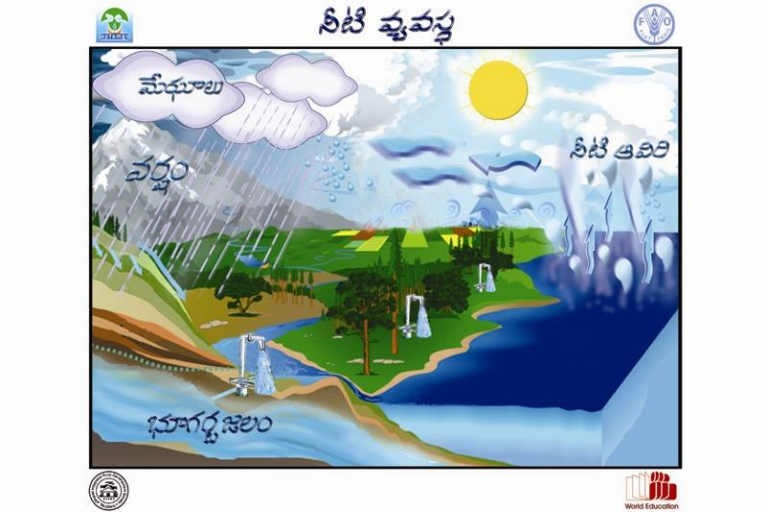
Content : Water cycle of the Hydrological unit.

Methods : Small group discussion.

Materials : Visual, charts and markers.

Process

- Encourage participants to work in small groups.
- Show the following visual and encourage discussion on how rain occurs and percolation of water into ground.



- Summarize the discussion by stating that water from oceans and large surface water bodies evaporates due to heat from the sun which again form clouds that condense to fall as rain.

5. Rock formations and soil types Time: 20 min

Objective : Participant's discuss various rock formations and soil types and their significance in the HU.

Content : Rock formations in HU; and soil types in HU.

Methods : Large group discussion

Materials : Charts and markers.

Process

- Remind the participants of their field walk experience and then encourage them to discuss about rock weathering, rock formations and its extent, soil formations, different types of soils, factors influencing groundwater recharge and relevant information.
- Summarize the discussion by stating that rock formations and types of soil are important since groundwater percolation rate depends on them.

6. Group dynamic – Importance of Institutions Time: 30 min.

Encourage the participants to play this game. The purpose of this game is to discuss the importance of a group who has common interest to solve their issues.

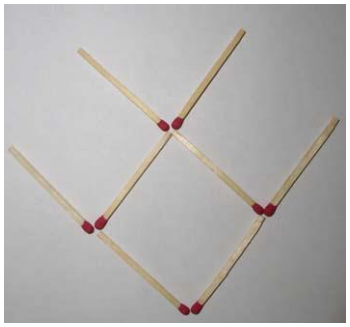
Game: Fish Game:

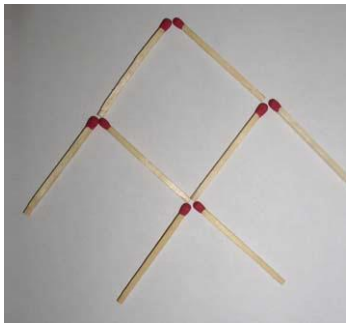
Use eight match sticks to symbolize a down ward looking fish as shown in the picture given below. Ask participants to move just three matchsticks to change the direction of the fish so that it is facing upwards.

- After the game, ask participants the following questions:
  - What is your inference regarding the downward and upward direction of fish?
  - How did you change the direction of fish?
  - Can we relate these three match sticks to collective action, unity and mutual assistance which are important for a people's institution?

Message: The three sticks represent the three things which one needs to progress in life:

- Collective action
- Unity and,
- Mutual assistance





7. Session Evaluation Time: 10 min

Ask participants the following questions to evaluate the day's learning.

Ask the following questions to the participants:

- How was your field visit?
- Can you list the types of soil and rock types and formations in your HU?
- Can you share the factors influencing rainfall in the HU?
- What are the different elements in the HESA framework?

Encourage each participant to share one or two points of their day's learning and thank the participants for their enthusiasm shown during HU walk.

Session-III: Theme: Design Long-term Experiment

1. Recap Time: 10 min.

Objective : Participants recap the contents discussed in the previous session.

Content : Session two contents:

- HU walk-Field walk in the HU area,
- Delineation of HU,
- Water cycle and Hydrological Unit,
- Rock formations and soil types, and
- Importance of people's institutions.

Method : Large group discussion

Materials : Second session contents, charts, and markers.

Process

- Welcome participants to the third session.
- Start the session with FWS pledge.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one participant to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

2. Farmer agriculture operations calendar Time: 25 min

Objective : Participants list agriculture operations based on farmer calendar.

Content : List of agricultural operations.

Method : Large group discussion

Materials : Charts and markers.

Process

- Pose the following question in large group: "When does the New year start and what is the financial year? Like wise, when does farmer works starts in a year?
- Write participants responses on a chart, and reach consensus on farmer calendar.
- Encourage participants to list all the agricultural operations from seed to harvest keeping in view the farmer calendar.
- Encourage discussion among participants about the sequence of agricultural operations. And write all the operations on a chart paper.

3. Topic selection Time: 45 min

Objective : Participants select the topic for the conduct of LTE.

Content :

- List of agriculture problems.
- Current practices to overcome the problems.
- List of alternate better practices.

Method : Large group discussion

Materials : Charts and markers.

Process

- Brainstorm participants to list the problems faced by the farmers during from seed to harvest. Write participant's responses on a chart paper.
- Encourage the participants to arrive at a common understanding with regard to the agricultural operations as well as farmer problems. Keep both the charts before the large group for effective discussion.
- Continue the discussion and request participants to share the current practices to overcome these identified problems.
- List all the existing practices on one side of the chart. Then, request the participants to suggest alternate better practices and list them on the other side of the chart.
- Then, request the participants to list the constraints in adaptation of alternate better practices.
- Based on the constraints, encourage participants to choose the topic that can be experimented in a cost effective way.
- List all these outputs in the table given below and share with the participants.

Problems (or, causes of low yield)	Current practice	Alternate Practices / Potential for improvement	Constraints	Suggested topics

Tips to facilitator

In case, this facilitation takes a long time, based on the situation conduct the following energizer to ease the situation and draw the participants attention

Occupation game

- Divide the group into five small groups.
- Assign a leader for each group who will act as their spokes person. The group leader will stand facing the members of his group.
- The facilitator will show to the group leaders the name of an occupation. Immediately the group leaders start to enact the occupation shown.

- The first group to name the given occupation will be given a point. The rest of the facilitators may act as the official judges.
- The group which gets the highest number of points will be declared as the winner.

4. Idea matrix Time: 30 min

Objective : Participants list the ideas to be tested for a selected topic.

Content :

- List of Ideas.

Method : Large group discussion

Materials : Charts and markers.

Process

- Continue the discussion after the break, and share that we have now selected a topic for the conduct of experiment. But we have to be specific in selection of idea for the conduct of LTE in the field. Let us discuss about the ideas to be tested in the filed.
- Brainstorm participants to share ideas to be tested for an identified topic which can be experimented in the field.
- Ask participants how they came to know that a particular idea is a better practice and list the source of each idea.
- Encourage participants to select an idea which can be tested in the field.

Tips to facilitator

Always encourage participants to consider an idea that does not incur too much expenditure and is devoid of many complications, i.e. experiment should be 'simple'.

- From the list of identified ideas, ask the following questions in large group and fill in their collective responses in the table given below.

Put all the outcomes of the discussion in the table mentioned below and summarize the discussion.

Ideas (*"What possible effects will the topic of study have?"*)	Source of each idea	What do we think about each idea? (*"Does it need to be tested?"*)

Farmer plot	**Experiment plot**
Experiment plot	**Farmer plot**

- Share in the large group that the information in the table would help guide the farmers to plan their observations.

5. Designing the Experiment Time: 30 min

- Prior to testing the selected idea in the field, we require designing the experiment. To facilitate this discussion, ask the participants in a large group, how they plan to perform this experiment in their field. Encourage the participants to implement both their conventional method and the selected experiment at the same time in the field to enable a comparison.
- Ask the participants in large group, how they plan to divide the field for the above mentioned experiment.

Tips to facilitator

- Encourage the participants to think about field realities while preparing for LTE. Encourage them to share about a field being uneven with slope, variation in fertility, type of soil, intensity of sun light etc.
- Experiment should not be biased

- Reach a conclusion on the need for replicating an experiment to overcome natural variation in a farm plot.
- Ask the following question in large group to elicit response from the participants with regard to measures to be taken while having control plot and experiment plot in the same field. List out all the measures on a chart paper.

Tips to facilitator

Encourage discussion on the following points:

- There has to be a thorough demarcation between any two plots separated by a narrow bund or trench.
- During taking test plants for observation, always leave the first and the second row to avoid effect of one practice on the other.
- The mentioned effect can be due to fertilizer, irrigation etc.
- Participants might not agree to waste a piece of land by digging a trench/ bund. In such a case, suggest them to go for intercrop in that area to convince them.

6. Observation matrix Time: 30 min

Factors to be observed in an experiment

- In order to analyze the results, it is necessary to observe some important factors in the farmer plot and experiment plot. These observations will provide us with experimental evidence that can be shared with the larger community.
- It will be more useful for the participants to observe the deciding single factor to compare and analyze the results of the experiment.
- Encourage a discussion among the participants on which is the single deciding factor and use the following table to understand the frequency and method of observation.
- List all the responses of the participants in a given table shown below:

What should be observed?	How	When?

7. Setting up LTE (selection of collaborator) Time: 30 min

Objective : Participants select a collaborator.
Content : Selection of collaborator.
Method : Large group discussion
Materials : Charts and markers.
Process

- After all the participants arrive at a consensus with regard to setting up of LTE, encourage the participants to suggest a collaborator who will implement the experiment in his own field.
- Encourage the participants to list the qualities of a collaborator. Summarize the discussion write the qualities of a good collaborator on a chart.

Tips to facilitator

The following should be the qualities of collaborator:

- The collaborator should allow the participants to enter into the field.
- The collaborator should record the data regularly and share the same with participants and at the time of CWB workshop/Field day.
- Practices adopted in the experiment plot should not be adopted in the control plot.
- The collaborator should implement group decisions.

- Ask participants the following question in large group.
    - What kind of requirements we need to have to begin an experiment?
    - What are the norms you would like to set-up in conducting this experiment?
- List the responses of the participants on a chart paper. Norms should include:
    - The land should be accessible to all participants.
    - The land should have bore well near to it with drum discharge Provision to measure the water quantity.

8. Group dynamic: Collective decision making Time: 30 min

Objective : Participants understand the importance of taking decisions collectively.
Content : Collective decision making – stone and scissor game.
Method : Game
Materials : None
Process

- Divide the participants into two groups.
- Ask the groups to form two lines and stand facing each other.
- Instruct them that they should show the following signs represent paper, stone or scissors:
    - paper - open palm of the hand,
    - Stone – closed fist, and
    - Scissors – index and middle fingers indicating a scissor.
- Share with them that:
    - Stone is greater than a scissors as it can be crushed,
    - Scissors is greater than paper as it can cut the paper,

- Paper is greater than the stone as it can be used to wrap a stone.

- Instruct the groups that when the facilitator calls for both the groups to 'show', they will have to show simultaneously the symbol of the item they have decided upon in their groups.

- Suppose one group shows stone, and the other group shows paper. Group two which shows paper gets a point because paper is greater than the stone. On the other hand, if group two had shown scissors then group one gets the point because stone crushes the scissors.

- Suppose group one shows paper and group two scissors, the group which shows scissors gets a point, since scissors can cut the paper.

- Continue the game for a few rounds and mark the scores.

- The group that scores more points is declared a winner.

- After the game discuss the importance of collective decision.

9. Session Evaluation Time: 10 min

Appreciate the participants for their desire to learn new things while attending FWS sessions and share in large group that any learning followed by evaluation provides us an opportunity for improvement in the future:

Pose the following questions to the participants in large group:

- Can you share the reasons for having a demarcation between the farmer plot and the experiment plot?
- Why we should conduct an experiment?
- Why should we divide the filed to conduct an experiment and why?
- Can you share the responsibilities of a collaborator who implements LTE in the field?

Session-IV: Theme: Participatory Hydrological Monitoring

1. **Recap** Time: 10 min.

Objective : Participants recap the topics discussed in the previous sessions.

Content : Session three contents:

- Farmer agriculture operations calendar,
- Topic selection.
- Idea matrix,
- Designing the experiment,
- Observation matrix,
- Setting up of LTE and
- Importance of collective decision making.

Method : Using participant as a resource person

Materials : Charts, and pictures used during the previous sessions.

Process

- Welcome the participants to the fourth session.
- Request one participant to share the contents discussed in the third session.
- Ask the participants in large group to add any missing points in the recap.
- Thank the participant for volunteering the recap.

2. **Observation of LTE (HESA)** Time: 15 min

Objective : Participants observe LTE.

Materials : Charts and markers.

Method : Small group discussion

Process

- Inform the participants that they will work in their respective learning groups during this activity.
- Encourage the participants to discuss the various benefits and challenges during LTE observation.
- Later, request participants to work in small groups and analyze their observations using the HESA framework.
- Ask the participants to share their observations and analysis in large group.

3. **Hydrological data and its relevance** Time: 20 min.

Objective : Participants discuss the relevance of hydrological data.

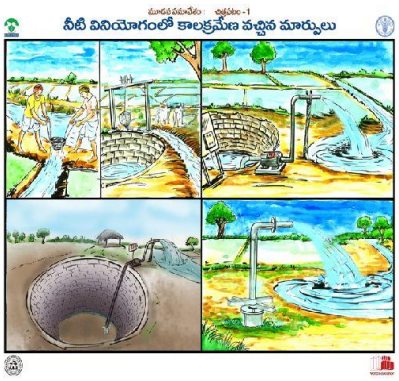
Content :

- Timeline of depleting water levels and adaptation of tools.
- Relevance of PHM activities to water levels and rainfall.

Method : Pictures, and large group discussion.

Materials : Picture, charts, and markers.

Process



Water level and discharge measurement

- Start the discussion stating that "We are dependent on agriculture. Could you please recollect, what were the sources of irrigation 50 years ago?
- Write the responses of the participants on the chart.
- Show the picture timeline of depleting water levels and irrigation practices.
- Continue the discussion stating that: "We used to raise crops based on water availability in open wells and tanks, now we are depending on borewells for irrigation and drinking purposes. This shift is mainly due to drying of surface water bodies and lack of adequate rainfall, deforestation etc.
- Pose a question in large group if farmers are happy with the present state of agriculture using borewell irrigation and what are the challenges in it?
- List the challenges on a chart paper.
- Encourage a discussion in large group by asking the following questions:
    - "Do you think water levels remain static in your borewell?
    - How do you know at what level water is available in your borewell?
- List the participant's responses on a chart paper and summarize the sharing that it is good to measure the water levels and the discharge (Time required to fill 100 litres drum) of the borewell to understand the water levels in the borewell.

Rainfall measurement

- Start the discussion with the following words:
- All of us are aware that the primary source for irrigation in agriculture is rainfall. We will have enough water available in tanks and borewells for irrigation when there is adequate rainfall. Pose the following question in large group to extract the indigenous knowledge of farmers:
- How do you estimate rainfall as adequate, moderate or poor?
- Write participants responses on a chart paper and continue the discussion stating that these assumptions cannot give the exact picture.

- Summarize the discussion by stating that it is always useful to be aware of a scientific method to measure exact rainfall received and to analyze whether the received rainfall is adequate, moderate or poor.
- Conclude the discussion by sharing that measuring water levels, rainfall will enable us to understand the groundwater dynamics and the relation between rainfall, water levels and discharge of the borewell.

Tips to the facilitator

Local farmer's assumptions

1. Farmers in the village assume that presence of earthworms in their field is an indication of adequate rainfall.
2. Sprouting of mushrooms in their field's vicinity is taken as another indication.
3. Though these are indicative of presence of moisture in soil, it is not possible to measure the exact quantity of rainfall received by these methods.

4. Measuring devices Time: 15 min.

Objectives : Participants discuss the measuring devices.

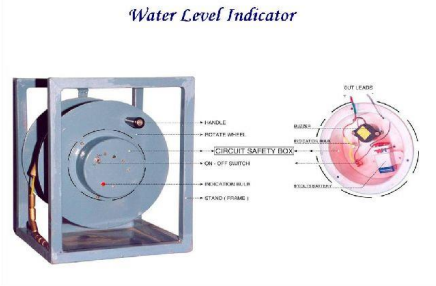
Content : Measuring devices.

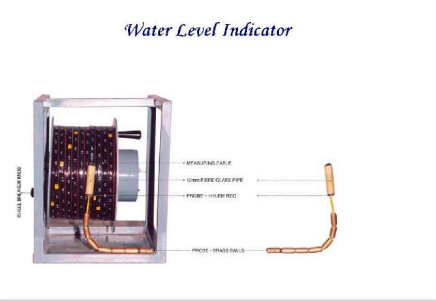
Method : Large group discussion and demonstration.

Materials : Water level indicator, drum, stop watch, collecting jar, measuring jar.

Process

- Start the discussion statimg that "We have just finished discussing the need to measure water levels and rainfall. Let us discuss about the methods or tools used to measure rainfall and water levels of borewells."
- Ask the following questions in large group:
    - How can we know at what level, water is in your borewell? And what are the usual methods you use to know the water levels?
- Write participant's responses on a chart and introduce water level indicator.
- Demonstrate the functioning and different parts of water level indicator.
    - The WLI has a cable and numbers written on it in 'feet' or 'meters.'





- When both ends of the probe of WLI touches water surface, it gives a 'beep' sound. At this point, we need to observe the reading on the cable and note the same in HMR book.
- Before taking the reading, ensure the exact contact point of probe with water surface.
- Next introduce 100 lt. drum and stop watch used to measure the time taken for bore well to fill 100 lt. drum (Called 'discharge').

- Next, encourage rain gauge volunteer to share the instruments used to measure the rainfall received. Show the rain gauge, collecting jar and measuring jar. Share that the measuring jar will be calibrated into millimetres.

Rain gauge

5. Procedures of data collection and dissemination Time: 75 min.

Objective : Participants demonstrate the process of measuring water levels, discharge of the borewell and the rainfall.

Content : Procedures of measuring water levels, discharge and rainfall.
Method : Large group discussion and demonstration
Materials : Water level indicator, drum, stop watch, collecting jar, measuring jar.
Process

Water level measurement

- Take the participants to a nearby borewell.

- Encourage rain gauge volunteers and observation borewell volunteers to explain the process of measuring rainfall and water levels respectively.
- Explain that it is an observation borewell fitted with one inch HDPE pipe to insert WLI.

Measuring water levels

- Demonstrate how to insert the WLI and ask the participants to notice the sound when both the ends of the probe touch the water surface.
- Demonstrate how to measure the water levels.
- Discuss the time interval between Static Water Level (SWL) and Pumping Water Level (PWL). It should be minimum three hours after switching on the pump or motor.
- Ask participants in large group the reason for measuring PWL after a lag of three hours?
- Summarize the discussion by stating that water in the borewell is agitated during the pumping process. If a measurement is taken immediately after switching on the borewell, the result will be false due to accumulated water. It will take a minimum of three hours for it to settle down to a stable level. It is advisable to measure after three hours of pumping.
- Encourage the participants to practice measuring water levels.

Discharge measurement

- Next, ask the participants if it was possible to measure the quantity of water drawn from a borewell.
- Show the 100 litres calibrated drum and stop watch and demonstrate its usage and process of measuring the quantity of water.
- Explain that if we know the time taken to fill a 100 litres drum, we can estimate the quantity of water pumped out per hour and per day.
- Encourage the participants to practice measuring drum discharge.

Measuring discharge

Rainfall measurement

- Next, take the participants to the nearby rain gauge station and explain the process of measuring rainfall and time for measuring rainfall.
- Demonstrate the measuring of rainfall.
- Encourage the participants to practice the measuring rainfall.
- Next, Select four volunteers and explain the same.

Rainfall measurement

Next, initiate a discussion on the importance of data dissemination to the larger audience in the village by posing the following questions:

- Is the data that has been generated useful to farmers (borewell users)?
- If it is useful, how can you effectively disseminate this information to other farmers? Write the participant's responses on chart paper.

Tips to the facilitator

Encourage participant's to explore different ways like:

- Sharing in women groups by women members of the GMC or FWS participants.
- Discuss and share in regular GMC meetings.

- Sharing in regular meetings of village panchayat.
- Discussion in common gatherings at village level.
- Use of posters, wall paintings.

- Introduce different kinds of dissemination boards and explain the process of recording data on them.
- Emphasize the importance of the location for displaying dissemination boards. This location should be ideally visible to everyone in the village.

Tips to the facilitator

Different kinds of dissemination boards:

- Water level type.
- Rain fall type.
- HU type.

6. HESA-Water levels Time: 20 min.

Objective : Participants analyze water levels.

Materials : Charts and markers.

Method : Large group discussion

Process

- Ask the participants in large group if they have been measuring water levels without any difficulty?
- Clarify their doubts (if any).
- Pose a question in large group: 'Did you observe any change in water levels or discharge of the borewell?
- Summarize the discussion by analyzing the reasons for these fluctuations. Use HESA frame work for analysis.

7. Group dynamic: Book keeping Time: 15 min.

Objective : Participants will discuss the importance of recording data in HMR book.

Materials : Twenty different types of items (Ex: pen, book, lid, paper, seed, stone, dried leaf etc).

Method : Game

Process

- Place the 20 different items on the floor and cover it.
- Ask the participants to watch the 20 items for two minutes and cover the items.
- Ask the participants to write the items individually on a piece of paper.
- Participants may not list all the items.
- Ask the following question to generate the discussion.
- If it is difficult for us to recall the items that we have just watched, will it be possible to for us to recollect the water levels data which were collected 15 days ago?
- Conclude by saying that it is important to maintain the record of water levels and rainfall data. It is critical for the conduct of crop water budgeting exercise and for making collective decisions around crop-plans.

After completion of discussion on the importance of data recording in Hydrological Monitoring Record (HMR) books, introduce the HMR book and the contents in it to the participants.

- Distribute the xerox copies of the HMR book and encourage the participants to practice recording of data.

Discuss the content to be added in mentioned rows and columns of the HMR book and request the participants to record the collected data in appropriate columns.

- Initiate a discussion in large group on the frequency of measuring water levels, discharge and rainfall. Write participants responses on a chart paper and conclude by sharing the following information with the participants.
    - Measure the rainfall early in the morning before 8 am whenever we receive rainfall. This is because the rain collected in the rain gauge might start evaporating and give rise to false results.
    - Measure the water levels and discharge every fort night and record in HMR book for future reference.

8. Session Evaluation Time: 10 min

Pose the following questions to evaluate the day's learning:

- How would you share the importance of measuring water levels, discharge and rainfall in GMC meetings?

- Can you list/share the measuring devices to measure water levels, discharge and rainfall?
- Can you share the different types of dissemination boards and its importance?

Encourage few participants to share their learning and thank them for their participation

Session-V: Theme: Groundwater recharge

6. Recap Time: 10 min.

Objective : Participants recap the topics discussed in the previous sessions.

Content : Session four contents:

- Hydrological data and its relevance,
- Measuring devises,
- Procedures of data collection, recording in HMR books and dissemination,
- Home work: Observation of water levels,
- Water levels (HESA), and
- Importance of Book keeping.

Method : Using participant as a resource person

Materials : Charts, and pictures used during the previous sessions.

Process

- Welcome the participants to the fourth session.
- Request one participant to share the contents discussed in the third session.
- Ask the participants in large group to add any missing points in the recap.
- Thank the participant for volunteering the recap.

2. Observation of LTE and data collection analysis Time: 45 min

Objective : Participants observe and analyze the Long Term Experiment (LTE).

Content :

- Observation of LTE, and
- Data analysis.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process

- Request participants to visit the filed and note their observations.
- Encourage the participants note their observations during the filed visit.

Observation sheet:

Village: Name of experiment:

Farmer: Crop:

Area:

Date	Time required per irrigation	Time taken for filling	Volume of water	Draft	Yield	Observation

		100 lit drum (Sec, min and 1 hour)				

- Ask the groups to come back to the training spot and analyze the observations made during the field visit. Request each group to use HESA (based on the experiment) frame work to present their group work.
- Request collaborator to implement the decisions taken by the large group in the experimental plot.

3. Natural and Artificial Recharge

Time: 20 min.

Objective : Participants discuss the ways of recharge of water into soil.

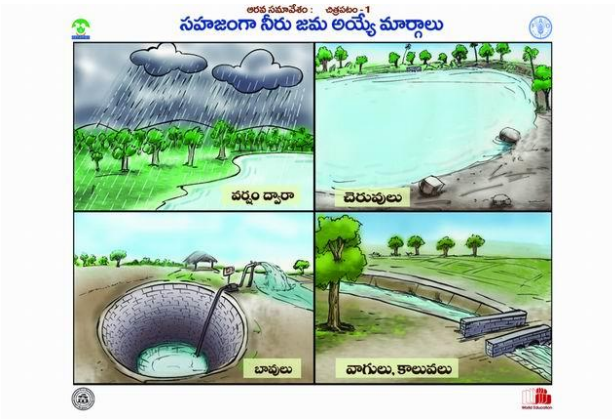
Content: Natural recharge, and artificial recharge.

Method : Large group discussion

Materials : Pictures, charts, and markers.

Process :

- Begin a discussion with the following words. We have been discussing about groundwater since three sessions. Can you share your thoughts on how water seeps into the ground and what is the primary source?
- Write participants responses on a chart paper and identify the natural and artificial ways in which water percolates the ground.
- Use the following visuals to encourage the discussion.



Natural ways of recharge

artificial ways of recharge

- Summarize the discussion by stating that main source for recharge is: rain, oceans and snow. Recharge can be done by building some artificial recharge structures like

check dams, injection wells, contour bunds etc, but process is expensive and cannot be done on a large scale.

4. HESA-Factors influencing recharge Time: 20 min.

Objective : Participants discuss the factors influencing recharge.

Content : Factors influencing recharge.

Method : Large group discussion

Materials : Charts and markers.

Process

- Initiate the discussion by stating that till now we discussed the ways of recharge. Let us now discuss the influencing factors of recharge.
- Request participants to work in small groups to discuss about the factors influencing the groundwater recharge.
- Encourage participants to use the HESA frame work and present their group work.
- After presentation of all groups, write the list of factors influencing the groundwater recharge on a chart and summarize the discussion.

Tips to the facilitator

Factors influencing recharge are:

- Rainfall,
- Area, soil types,
- Rock formation, slope and drainage.

5. Estimation of HU area Time: 45 min

Objective : Participants estimate the area of the hydrological unit.

Content : Area of Hydrological Unit.

Method : Large group discussion, and small group discussion.

Materials : Graph sheets, carbon papers, toposheet, pencils, scale, calculator, sketch pens, charts, pins and markers.

Process

- Remind participants that the area of the HU is critical factor in estimation of groundwater recharge. To facilitate the process of estimation of HU area, request participants to work in small groups.
- Facilitation should start with a demonstration.
- As part of demonstration, take HU map and place a tracing paper on the map.
- While observing the HU map through the tracing paper, sketch out the map outline.

- Place the tracing paper on a graph and trace the map outlines so as to appear on the graph sheet.
- Colour the full squares with red, ¾ squares with yellow, ½ squares with green and ¼ squares with blue.
- Next, count the, ¼ squares, ½ squares, ¾ squares and full squares on the graph sheet.
- Convert the part squares (¼, ½, ¾ squares) into full squares to calculate the area easily. For example: four ¼ squares make one full square; two ½ squares make one full square; two ¾ squares make 1½ squares; or four ¾ squares make 3 squares.
- Considering the scale in toposheet (1: 50,000) area of a one full square = 62.5 acres or 25 hectares. Area of HU = No. of full squares X Area of one full square.
- Encourage Participants to work in small groups and calculate the area of hydrological unit. Provide assistance to the groups in the process of estimation.

6. Recharge rate (GEC norms) in different rock types

Time: 30 min.

Objective : Participants demonstrate the rate of infiltration.
Content : Rate of infiltration and GEC norms.
Method : Large group discussion, and demonstration
Materials : Dry sponge, water, glass and handouts on GEC norms.
Process

- Begin the discussion with these words: Till now, we have discussed how rain water percolates the ground.
- Do you think rate of water percolation is same in all types of rocks?
- Write participants responses on a chart paper and list the different kinds of rocks.
- Next, pose the question: 'Do you think all the rain water that falls, percolates the ground'?
- Listen to the participant responses and encourage them to demonstrate the following experiment:

Experiment:

- Take a dry sponge.
- Pour 500 ml. of water on sponge similar to rainfall.
- Collect water into a tray by squeezing the sponge.
- Observe that less water is collected into the tray.
- Following the discussion, summarize as follows: Rain water flows through streams, rivulets and fills the tanks, ponds before the streams join the river and then to sea. A small portion of the rain water infiltrates into the ground.

- Explain to participants that all the rainwater does not infiltrate into the soil. Rate of infiltration depends upon rock formation, and soil structure.
- Share the recharge rates recommended by Ground Water Estimation Committee (GEC) with the participants.

Rock type	**Infiltration rate**
a. Alluvial Areas	
Indo-Gangetic and inland areas	22%
East coast	16%
West coast	10%
b. Hard rock areas	
Weathered granite, gneiss and schist with low clay content	11%
Weathered granite, gneiss and schist with significant clay content	8%
Granulite facies like charnockite etc.	5%
Vesicular and jointed basalt	13%
Weathered basalt	7%
Laterite	7%
Semiconsolidated sandstone	12%
Consolidated sandstone, Quartzites, Limestone (except cavernous limestone)	6%
Phyllites, Shales	4%
Massive poorly fractured rock	1%

7. Group dynamic: Roles and responsibilities of GMC/ HUN

Time: 30 min

Objective : Participants discuss about the importance of delegation of roles and responsibilities to members in GMC/ HUN

Content : Roles and responsibilities of GMC/ HUN members

Method : Game and Large group discussion

Materials : Locally available materials

Process

- Divide the participants into three groups.
- Nominate one person from each group as a group leader.

- Give the task of building the form of a house with locally available materials to each group. Encourage the participants to collect materials within the training premises.
- Share with the participants that the group leader will help the participants in each group with taking up specific responsibilities during the task.
- Give 20 min. to each group to complete the task. After the task, all the participants visit the group that has built the best form of a house in the given time.
- Pose the following question in large group: "What are the roles and responsibilities required for the effective functioning of GMCs and HUNs."
- List out the participants responses on a chart paper.

8. Special topic: Drainage pattern Time: 15 min.

- Encourage participants to discuss about the drainage pattern of the hydrological unit.
- Write participants responses on chart paper and summarize the discussion sharing how drainage patters influences the recharge in that hydrological unit.
- Use toposheet to facilitate the discussion.

9. Session evaluation

Time: 10 min

Evaluate the day's learning using the following questions:

- Can you list the different sources of natural recharge?
- Assuming that there is equal rainfall in two different places; does the same quantity of water percolate the ground in both the places?
- Can you list the data required to estimate the groundwater recharge?
- Was the session useful in understanding the factors influencing groundwater recharge?

Encourage participants to share their day's learning and thank for their participation.

Session-VI: Theme: Estimation of groundwater recharge

1. Recap Time: 15 min

Objective : Participants recap the previous session

Content :

- Natural and artificial recharge,
- HESA-Factors influencing recharge,
- Estimation of HU area,
- Recharge rates (GEC norms) in different rock types,
- Roles and responsibilities of GMC/ HUN

Method : Large group discussion

Materials : Charts and markers.

Process :

- Welcome the participants to the sixth session.
- In the large group, encourage each participant to share a content that was discussed in previous session and the learning from that one.
- As you facilitate the recap, ask one of the participants to list the contents on the chart paper.
- Discuss the contents and the learning from the previous session.

2. LTE observation & data collection Time: 45 min

Objective : Participants observe LTE and collect data.

Content :

- Observation of LTE, and
- Collection of data.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process

- Enquire whether they were successful in setting up the LTE and ask whether we need to observe the LTE.
- In large group ask the participants to list the features that need to be observed. (Remind them of the list of observation items that were discussed in the previous session).
- Inform the participants that they would need work in their respective learning groups and note observations.
- Enquire if they have the necessary tools to do the observations. Discuss the usage of each tool.

- Encourage the groups to observe the items based on the type of the experiment and assist them in the process of data collection.
- Ask the groups to analyze the observations and present to the large group.
- Sum up the discussion.

3. Estimation of total rainfall received (HU wise Consolidated data) Time: 15 min

Objective : Participants estimate total rainfall received by consolidating the data from all the rain gauge stations in the HU.

Content : Estimation of total rainfall in the HU.

Method : Large group discussion

Materials : Charts and markers.

Process

Encourage the participants to fill in the rainfall data on the chart. Use the following chart as a reference:

S.No.	Name of the rain gauge station	June	July	Aug.	Sept.	Oct.	Total
1							
2							
3							
4							

Process of taking averages:

- Encourage the participants to calculate the average rainfall of all the rain gauge stations of the HU.
- Share that we may not receive uniform rainfall throughout our hydrological unit. The average rainfall will give the picture about the rainfall received in the entire HU. So it is useful to calculate average rainfall received at all the rain gauge stations in the HU and consolidate the data month wise.
- Demonstrate the process of taking the 'average' for each month.
    - Take four empty one litre bottles and name each bottle with one rain gauge station and the month (June).
    - Fill each bottle with water according to the rainfall received by that rain gauge station for June month.
    - Transfer the water from four bottles into a big tumbler.
    - Again fill the bottles equally using the water in tumbler.

- Explain that each bottle represents the average rainfall of the hydrological unit for the month of June.
- Encourage participants to make averages for the other months (Jul, Aug, Sept and Oct).
- Calculate the average rainfall received for the period June to October.

4. Estimation of groundwater recharge Time: 45 min

Objective : Participants estimate the groundwater recharge through rainfall.
Content : Rainfall received during June – October.
Groundwater recharge.
Method : Large group discussion and Small group discussion
Materials : Rainfall data, charts, markers and calculators.
Process

- Remind the participants about the amount of average rainfall received.
- Share the amount of average rainfall received once again and discuss the process of estimation of recharge.
- Ask participants the following question.
    - What information is required to estimate recharge of the particular hydrological unit?
- List participant's responses on a chart.
- The data required to estimate the groundwater recharge is:
    - Amount of average rainfall received in that HU from June to October
    - Area of the HU
    - Type of rocks and it's extent
    - Recharge rates (GEC Norms)
- Next encourage participants to share about the rock formations and their extent. Based on the type of rock share the recharge rate of that particular rock type and estimate the groundwater recharge of the HU.
- Discuss about the measuring unit of water flow and groundwater recharge and explain the process of conversion with the following example.

Cubic meter

Share the following information with the participants: "Usually, we measure rainfall in millimeters. But, the area of the HU is in Square meters. So, In order to bring all the parameters into the same type of unit and enable easy calculation, we need to convert one unit to the equivalent of the remaining.

Cubic meter is the common measuring unit for calculating water flow and recharge. Farmers estimate the amount of recharge in liters. Liters being a small measuring unit, quantification of the estimate in liters run into large numbers/figures.

Apart from reducing the numbers, as one cubic meter equals 1000 liters, it is a common measuring unit for estimation of recharge and draft. Helping farmers understand quantification of water in cubic meters will enable them to interact with other stakeholders in groundwater management".

Let us calculate the quantity of water received in an area of one acre for 25 millimeters (mm) of rainfall.

1. convert the rainfall into metres:

25 mm = 25/1000

= 0.025 metres.

2. Convert the area into square metres (Sq.m)

One acre = 4000 sq.m.

3. Multiplication of area and rainfall will give the amount of water received in an area of one acre.

Area (sq.m) x rainfall (m) = Cubic metres (cu.m)

4000 x 0.025 = 100 cu.m

One cubic metre = 1000 litres

100 cu.m = 100 x 1000

= 100000 litres.

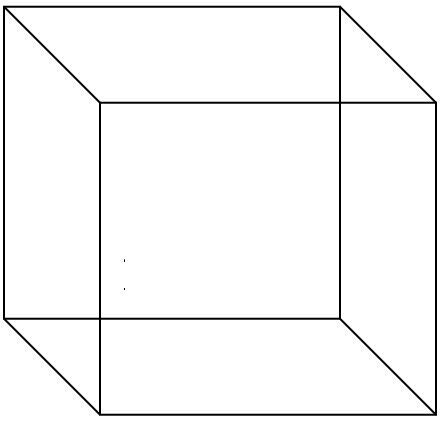
4. Explain what a cubic metre is:

Any object with the specifications of

1 metre long, 1 metre wide, and

1 metre height is called a cubic metre.

[(1m (L) x 1m (W) x 1m (H)]



5. We are all aware that all the rainwater does not infiltrate into the ground. A small portion of it (i.e. < 10%) infiltrates into the ground.

So the quantity of water infiltrated into the ground = 100000 x 4/100

= 4000 litres.

- Divide the participants into five groups.
- Assign each group one month's rainfall and ask the groups to estimate groundwater recharge.
- Visit each group and provide necessary assistance.
- Ask the small groups to report their estimation results to the large group.
- Calculate the total recharge by adding the recharge of each month.

5. Group dynamic-Leadership qualities Time: 15 min

This game helps participants to identify leaders who:

- Trust and respect others,
- Have a vision, and
- Encourage every one's participation in GMC/HUN.

Game: Three tumblers

- Take four transparent tumblers (glass or plastic) and fill them with water.
- Ask the participants to put the pebble in the first glass, some water in the second, some wet clay in the third, and sugar in the fourth glass.
- Ask them to explain what happened in each case.
- Explain that the pebble represents the autocratic leader, who is dominating and does not mingle with other members.
- Adding water to the second glass represents the dummy leader in a group; there is no difference between the leader and other members in the group.
- The wet clay in the third glass represents the anarchic leader who often promotes chaos and dissidence in the group, making clean water muddy. The group is spoilt just as the water gets muddy.
- The sugar in the fourth glass represents the democratic leader who mingles with the group, improves its quality (sweetens the water), and functions like a genuine people's representative.

After the game ask participants the following question:

- Who is a good leader in this game and why?

Write the responses on a chart and summarize the discussion with the list of characteristics of a good leader.

6. Short Study: Water level fluctuations(SWL,PWL Vs Rainfall) Time: 30 min

Objective : Participants analyze water level fluctuations.

Material : Charts and markers.

Method : Large group discussion

Process

- Encourage participants to collect the water levels data i.e. static water level, pumping water level and discharge of the borewell and the rainfall data received.

- Request them to use HESA frame work. First ask them to list their observations and analyze the reason for the changes or fluctuations in water levels and the relation between rainfalls.

- Request participants to present their observations and analysis in large group in next session.

7. Home work: data collection for estimation of groundwater draft & Rabi crop plans, secondary water bodies Time: 30 min

Objective : Participants discuss:

- Data required for estimation of draft and the ways of collection.
- Need to collect Rabi crop plans.
- Ways to collect the data on projected rainfall and secondary water bodies.

Content :

- Data required for estimation of draft during June – October,
- Rabi crop plans,
- Secondary water bodies, and
- Ways of collection of data.

Method : Large group discussion

Materials : Charts, and markers.

Process :

- Begin the discussion with: "so far we have discussed groundwater recharge."
- Ask participants how we are spending this groundwater.
- Then ask the following questions in large group.
  e. What is the data required to estimate the draft?
  f. How can we collect the required data?

Tips to facilitator

- The following data is required for estimating draft:
  - Number of functioning bore wells,
  - Number of functional days of each bore well,
  - Number of functional hours on each day, and
  - Drum discharge (litres per hour).
- It is better to collect number of bore wells connected to each transformer.

- Number of functional days of each bore well and functional hours in a day should be collected from the owner of the bore wells.
- Drum discharge of an observation bore well in that village.

- Next discuss the need for Rabi crop plans to estimate draft for Rabi season.
- Encourage the participants to discuss the ways to collect the Rabi crop plan details and the role of GMCs in data collection.

Tips to Facilitator:

Data required is:

- The crop and area cultivated under each bore well in the habitation.
- Involve GMCs in data collection.

- Next discuss the need for data on projected rainfall, and secondary water bodies to estimate groundwater balance by the end of May.
- Encourage participants to discuss ways to collect the data on projected rainfall and secondary water bodies.

Tips to Facilitator:

Encourage the participants to discuss:

- Projected rainfall: To estimate projected rainfall (Nov-May) we need to collect the past 10 year's rainfall data for the same period. It can be collected from nearest Tahsildar's office.
- Secondary water bodies: The following information is to be collected from each village:
    - No. of tanks, ponds, check dams;
    - Area of water in tanks, ponds and check dams;
    - Height of water column;
    - No. of fillings; and
    - No. of days water stored in the tanks, ponds, check dams.

8. Session Evaluation

Time: 30 min

To evaluate the day's learning pose the following questions to participants:

- Why do we need to consolidate rainfall data?
- List the steps involved in the estimation of Hydrological unit area?
- Why do we need to convert the measuring units of recharge and area? And what is the common measuring unit for the amount of recharge?
- How do you share this information in GMC/ HUN meetings?

Session –VII: Theme: Estimation of draft & projected groundwater balance

1. **Recap** Time: 10 min.

Objective **:** Participants will recap the learning of sixth session.

Content : Session six contents:

- Estimation of total rainfall received.
- Estimation of groundwater recharge.
- Understand the importance of leadership qualities.
- Short Study on Water level fluctuations (SWL, PWL Vs Rainfall).

Method : Small group discussion

Materials : List of sixth session contents, visuals used in the sixth session.

Process

- After formal welcome, start the session with FWS pledge.
- Request each participant group to share at least one topic discussed in sixth session.
- Encourage each group to share the session content.
- Display the visuals used in sixth session at appropriate place so that participants can see and recollect the contents discussed.

2. **Observation of LTE and data collection Analysis** Time: 45 min.

Objective : Participants observe and Long Term Experiment (LTE) and collect data.

Content:

- Observation of LTE, and
- Data collection.

Method : Small group discussion

Materials : FWS group kit, charts and markers.

Process :

- Enquire whether they were successful in setting up the LTE and ask whether we need to observe the LTE.
- In large group, ask the participants to list the features that need to be observed. (Remind them of the list of observation items that were discussed in the previous session).
- Inform the participants that they would need work in their respective learning groups and note observations.
- Enquire if they have the necessary tools to do the observations. Discuss the usage of each tool.
- Encourage the groups to observe the items based on the type of the experiment and assist them in the process of data collection.

- Ask the groups to analyze the observations and present to the large group.
- Sum up the discussion.

3. **Consolidation of data required for estimation draft** Time: 20 min.

Objective : Participants consolidate the data required for draft estimation

Content:

- Data required for estimation of groundwater draft.

Method : Large group discussion

Material : Charts and Markers and small pieces of paper.

Process :

- Ask participants about the home work and request them to present the data in a large group.
- Consolidate the data and share the data required for estimation of groundwater draft. The data include:
    - Average discharge of the bore well: A.
    - Average pumping days: B hrs.
    - Average pumping hours per day: C.
    - Number of Bore wells: D.

Total Discharge (E) =A x B x C x D Liters.

4. **Estimation of groundwater draft (June to October)** Time: 40 min

Objective : Participants estimate the groundwater draft.

Content:

- Estimation of groundwater draft.

Method : Large group discussion

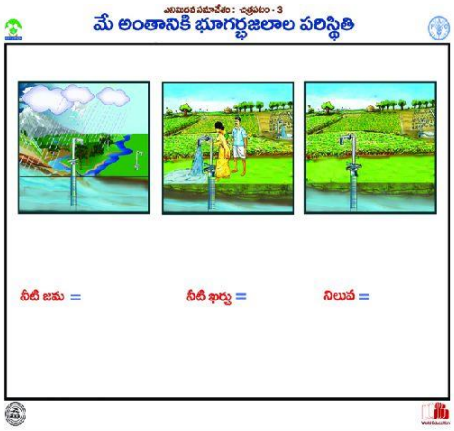
Material : Charts and markers

Process :

- Using the consolidated data, estimate the groundwater draft for (June to October).
- Next remind the participants about the groundwater recharge, estimated in previous session. Then ask the participants to estimate the groundwater balance by the end of October.

Groundwater balance (June –October) = Groundwater recharge (June-October) – Groundwater draft (June-October).

- Use the following visual and plot the bar chart to help participants understand how much rain water recharged into the ground and how much water used for the kharif.



5. **Estimation of water requirement: Conventional vs. Alternate irrigation practices**

Time: 60 min.

Objective : Participants discuss:

- Conventional methods of irrigation and estimate water requirement.
- Alternate methods of irrigation and estimate water requirement.
- Discuss perceived change.

Content :

- Conventional methods of irrigation.
- Alternate method of irrigation.
- Estimation of water requirement.

Method : Large group discussion, and small group discussion.

Materials : Charts, markers and calculators.

Process

Conventional methods of irrigation and water requirement:

- Ask participants the following questions in large group.
    - What are the crops grown in the hydrological unit?

- What are the conventional irrigation practices for each crop?

- Write the responses on a chart.
- Ask a participant to explain the process of estimating water requirement for a particular crop. Remind participants about the estimation of water requirement for a crop.
- Request participants to work in groups and assign one or two crops based on the number of crops in the HU, and corresponding conventional irrigation practice to each group.
- Ask each group to estimate the quantity of water required for the crops. Provide the value of average discharge to each group.
- Encourage the groups to report their group work to the larger group.
- Summarize the discussions and list the contents in the following table.

Crop	Method of irrigation	Water required (Ltrs.)

Alternate methods of irrigation and water requirement:

- Ask the participants in large group to list alternate irrigation practices for the identified crops.
- List the responses on the chart.
- Ask participants to continue working in the same groups. Assign one or two crops and relevant alternate irrigation practice to each group and ask them to estimate the quantity of water required to raise the crop.
- Provide the value of average discharge of the bore well each group.
- Ask the groups to present their group work to large group.
- Summarize the discussions using the following table.

Crop	Alternate irrigation practice	Water required (Ltrs.)

- Compare the two tables and discuss the differences in quantity of water required for the same crop.

6. **Estimation of recharge through projected rainfall (Nov to May)**

Time: 25 min.

Objective : Participants will estimate the recharge through projected rainfall.

Content :

- Recharge through projected rainfall.

Method : Demonstration and large group discussion.

Material : 10 transparent glasses, big tumbler, 10 years (Nov-May) rainfall data, calculator,

Data on secondary water bodies, charts and markers.

Process

- Remind the participants once again about the groundwater balance by the end of October and water requirement for Rabi crop plans.
- Explore the other ways of meeting water demand if the groundwater balance by the end of October is not adequate.
- Ask participants about the expected rainfall during November to May.
- Discuss the estimation process of average projected rainfall using the following demonstration.
    - Take 10 transparent glasses.
    - Fill each glass with water according to rainfall received in each year.
    - Each glass represents one year rainfall (Nov – May).
    - Empty the water from all the glasses into one big tumbler.
    - Again fill the glasses equally with the water.
    - Now the water in each glass represents the average rainfall which would occur for the coming Rabi season.

7. **Estimation of recharge through secondary water bodies** Time: 20 min.

Objective : Participants will estimate the recharge through secondary water bodies.

Content : Recharge through secondary water bodies.

Method : Large group discussion

Material : data on secondary water bodies, calculator, charts and markers.

Process

- Encourage the participants to share the data on secondary water bodies.
- Ask the participants how to estimate the recharge from secondary water bodies.
- Share the process of estimation of recharge from secondary water bodies.

Tips to facilitator
Recharge from secondary water bodies: 1.4/1000 X Area of the water body (acres) X 4000 X 0.6 X No. of day's water stored.

8. **Crop water requirement for Rabi season** Time: 45 min.

Objective : Participants will estimate the crop water requirement for Rabi crops.

Content : Crop water requirement for Rabi crops.

Method : Large group discussion and small group discussion

Material : Charts, markers and calculators.

Process

- Ask participants in large group about the crops that the area proposed under different crops in their villages. (Remind the home work).
- Encourage the participants to fill the area under each crop in different habitations of the hydrological unit on the chart. (Keep the following format ready before conducting the session).

S.No.	Name of crop / Name of the habitation	A (Ha.)	B (Ha.)	C (Ha.)	D (Ha.)	E (Ha.)	F (Ha.)
1							
2							
3							
4	Total						

- Read aloud the total area (ha.) proposed under each crop in the hydrological unit.
- Next share these words with participants. We know the types of crops and total acreage. Now let us discuss about the water required for these planned crops.
- Encourage participants to discuss the process of estimation of water requirement for a crop.
- Take one crop as example and estimate the water requirement for one acre.
- For example estimate the water requirement for chilly crop per acre.
    - Number of irrigations required for the crop.
    - Time taken for one irrigation (hours).
    - Discharge per hour (litres per hour).
- Let the chilly crop requires six irrigations at the rate of eight hours per irrigation and the average discharge of the borewell is 16,500 litres per hour.
- Quantity of water required for one irrigation:
    - = Discharge per hour X time taken (hours).
    - = 16500 X 8.
    - = 1,48,000 litres.
- Total quantity of water required for the crop:
    - = Water required per irrigation X No. of irrigations.
    - = 1,48,000 X 6.
    - = 8,88,000 litres = 888 cubic metres.
- Next request participants to work in small groups to estimate water requirement for all crops.

- Based on the number of Rabi crops, encourage each group to select two to three crops to estimate water requirement.
- Request each group to present their group work to large group.
- Consolidate group presentations and share the total water requirement for entire HU.

9. **HESA-Estimation of groundwater balance by the end of May** Time: 15 min.

Objective : Participants estimate the projected groundwater balance (Nov.-May).
Content : projected groundwater balance (Nov.-May).
Method : Large group discussion.
Materials : Charts, markers, charts of previous session and calculators.
Process

- Ask the participants in large group about the amount of groundwater available with us.
- Encourage any one of the participants to explain the process of estimating groundwater balance at the end of May.
- Appreciate the participant and explain the process.
- The projected balance of groundwater at the end of May = Recharge (June-October rainfall + projected rainfall + secondary water bodies) – Draft (Kharif + projected water requirement).
- Encourage the participants to provide the data on the above items and estimate the projected groundwater balance at the end of May.

10. **Group dynamics- Communication distortion** Time: 15 min.

Objective :

- Illustrate the breakdown of communication.
- Demonstrate the importance of good communication in undertaking community projects.

Materials : None
Process

- Ask all the participants to form a circle.
- The facilitator then whispers a message to the first person on his right or to his left. Pass on the message on, i.e., whisper to the next person only once and the next until the message gets to the other end of the circles.
- Request the participants not to repeat the message.
- Ask the last person to receive the message to say the sentence aloud. The first person to whom the facilitator whispered the message will verify the accurateness or correctness of the message.

- Relate the activity to good and clear communication as a significant factor in successfully carrying out community undertakings. People may view the degree of change in the original message or breakdown in communication as changes caused by certain hindrances or barriers to effective communication that affects implementation of community projects.

11. **Session Evaluation** Time: 10 min.

To evaluate the day's learning, ask participants the following questions.

- What is the data required to estimate the groundwater draft?
- Can you share the estimation process of water requirement for crop?
- What is the data required to estimate the average projected rainfall received during November to May?
- What are the factors to be considered during the estimation of recharge through secondary water bodies?

Encourage participants to share on how they want to discuss this information in GMC meeting and why? Later, thank the participants and request the participants to think about Rabi crop plans based on the available water balance.

Session – VIII: Theme: Review of farmer plans

1. **Recap** Time: 20 min

Objective : Participants recap the contents discussed in the previous session.

Content :

- Groundwater draft and balance by the end of October.
- Crop water requirement for Rabi crops.
- Estimation of Recharge through projected rainfall.
- Estimation of Recharge through secondary water bodies.
- Estimation of Groundwater balance by the end of May (HESA).
- Understand about communication distortion.

Method : Large group discussion

Materials : Charts and markers.

Process

- Welcome participants and start the session with FWS pledge.
- In large group, encourage participants to recollect the content that was discussed in seventh session.
- Encourage them to state the amount of groundwater recharge, draft and balance at the end of May.
- Use banners or charts (worked by participants during the session) to recollect the content of seventh session.

2. **HESA-LTE results and analysis** Time: 45 min

Objective : Participants analyze the results of long term experiment.

Content : Results of long term experiment.

Method : Large group discussion

Materials : Charts and markers.

Process

- Start the discussion stating that we have successfully completed our Long Term Experiment. It is time for us to analyze the results of the experiment.
- Encourage the collaborator to share the practices followed in the experiment.
- Encourage the participants to discuss the differences between experimental plot and farmer practice plot.
- Encourage the participants to list out the factors that influenced the results.
- Analyze the factors that influenced the results.

3. **Review of farmer Rabi crop plans** Time: 30 min

Objective : Participants discuss decisions to be taken on Rabi crop-plans based on available groundwater.

Content : Change of crop plans.

Method : Small group discussion

Materials : Charts and markers.

Process

- Start the discussion with these words. 'We know the available water balance in the HU and also water requirement for Rabi crops. To meet the water demand or efficient usage of available water, will you rethink about Rabi crop-plans?
- Request participants to work in small groups and encourage each group to think about their Rabi crop-plans.
- Distribute to each group a handout on Rabi crop plans of their HU or habitation.
- Ask participants to review the crop-plans, of their respective HUs, based on the groundwater balance.
- Ask each group to use HESA frame work to present their group work.
- Later, ask each small group to report out to the larger group.
- Following the discussions in the large group, ask each group's strategy to share their analysis with the other participants in their habitation.
- Suggest that GMC meetings would be an ideal platform to share this analysis to create awareness among the farmers in the habitation about the groundwater situation. Also, say that a discussion should be facilitated during the GMC meeting to enable the community/farmers to make concrete decisions on change or revision of crop-plans.

4. Estimation of water requirement: Conventional Vs alternate irrigation practices

Time: 60 min.

Objective : Participants discuss:

- Conventional methods of irrigation and estimate water requirement.
- Alternate methods of irrigation and estimate water requirement.
- Perceived change.

Content :

- Conventional methods of irrigation.
- Alternate method of irrigation.
- Estimation of water requirement.

Method : Large group discussion, and small group discussion.

Materials : Charts, markers and calculators.

Process

Conventional methods of irrigation and water requirement:

- Ask participants the following questions in large group.
    - What are the crops grown in the Hydrological Unit?
    - What are the conventional irrigation practices for each crop?
- Write the responses on a chart.
- Ask a participant to explain the process of estimating water requirement for a particular crop. Remind participants about the estimation of water requirement for a crop.
- Request participants to work in groups and assign one or two crops based on the number of crops in the HU, and corresponding conventional irrigation practice to each group.
- Ask each group to estimate the quantity of water required for the crops. Provide the value of average discharge to each group.
- Encourage the groups to report their group work to the larger group.
- Summarize the discussions and list the contents in the following table.

Crop	Method of irrigation	Water required (Ltrs.)

Alternate methods of irrigation and water requirement:

- Ask the participants in large group to list alternate irrigation practices for the identified crops.
- List the responses on the chart.
- Ask participants to continue working in the same groups. Assign one or two crops and relevant alternate irrigation practice to each group and ask them to estimate the quantity of water required to raise the crop.
- Provide the value of average discharge of the bore well each group.
- Ask the groups to present their group work to large group.
- Summarize the discussions using the following table.

Crop	Alternate irrigation practice	Water required (Ltrs.)

- Compare the two tables and discuss the differences in quantity of water required for the same crop.

5. Preparations for CWB Time: 30 min.

Before the conduct of CWB workshop, it is good to discuss or brainstorm with the participants on ways of presenting the crop water balance estimations (which are learnt during the FWS sessions) to the larger community in the HU.

Encourage or brainstorm participants:

- To identify logistics required for the conduct of CWB workshop at HU level,
- To list the responsibilities of HUN/GMC members,
- To identify farmer facilitators who will share their learning and facilitate discussions and
- Prepare models, visuals for display during CWB.

Encourage participants to form as committees for effective conduct of CWB workshop.

The following models can be used for display during CWB workshop.

Session – IX: Theme: CWB Workshop

1. Registration and inauguration of exhibition stalls Time: 40 min

- After welcoming the chief guest to CWB workshop request him to inaugurate exhibition stalls.
- In each stall farmer participants of FWS sessions share their experience and learning to chief guest and other invitee farmers.
- After the completion of gallery walk invite all the participants to occupy the seats arranges at the venue.

2. Objectives of CWB workshop Time: 10 min

Objective : Participants share the objectives of Crop Water Budget exercise.
Content : Objectives of Crop Water Budget exercise.
Method : Role-play
Materials : Role-play script.
Process

- Select two volunteers and ask them to prepare for the role. Give the script of the role play.
- Encourage them to perform the role play.

Role-play:

(Ramanna is carrying the plough to the field. Venkanna notices this.)
Venkanna: Where are you going?
Ramanna : I am going to sow the seeds.
Venkanna: No doubt, sowing is important. But Sai Ganesh Hydrological Unit Network committee has organized a meeting for the farmers. We should attend the meeting.
Ramanna : What is the use of attending the meeting? Will they give us any information on seeds?
Venkanna: They will give us more valuable information than seeds, i.e. on water. Let us go and listen to our colleagues who are the participants of FWS.
Ramanna : More value than money! What is that?
Venkanna: They will tell us the amount of groundwater recharge, the water spent during Kharif season and the balance of water available in the ground for Rabi season.
Ramanna : Looks like it is useful to farmers. If we know the groundwater balance, we can plan for Rabi crops. Isn't it? Have you informed other farmers?
Venkanna: Everyone has been informed. Most of them should be at the venue, by now.
(Ramanna hands-over the plough to the nearby house owner and they both go to the meeting.)

- Ask participants what they observed in the role play and share the objectives of CWB workshop.

3. FWS participant's experiences Time: 20 min.

Next, invite FWS participants to share their experiences and learning.
It would be useful if they share the following:

- FWS methodology and groundwater management;
- Groundwater recharge and influencing factors;
- Groundwater draft, and information required to estimate the draft and balance;
- Water saving techniques, and quantity of water saved;
- Organic practices to control the pest incidence, and reduce the investments;
- Experiences with long-term experiments; and

Ideally, each participant should restrict their speech to five minutes. After sharing of participant experiences, request the VIPs to speak for a few minutes.

4. Sharing of LTE results and experiences of collaborator Time: 15 min.

Objective : Participants share LTE results and experiences of collaborator
Content : Sharing of LTE results and experiences of collaborator
Method : Large group discussion
Materials : Charts and markers
Process

- Encourage one of the participants to come forward and share results of the Long Term Experiment.
- Next, encourage a collaborator to share experiences of setting up LTE.

5. Groundwater recharge, draft and balance at the end of October
Time: 25 min.

Objective : Participants discuss the amount of groundwater recharge, draft and balance through rainfall during Kharif season (June-October).
Content :

- Average rainfall received during Kharif season.
- Estimation of groundwater recharge (June-October).
- Data required for estimation of groundwater draft.
  - Number of functional borewells in the HU,
  - Number of pumping days,
  - Number of pumping hours in a day, and
  - Average drum discharge.

Method : Large group discussion

Materials : Banners

Process

- Stress the need for collection of rainfall data from established rain gauge stations in the HU.
- Demonstrate ways of collecting the rainfall data and precautions to be taken in the measuring the water collected in the collecting jar.
- Demonstrate the process of taking averages and share the average rainfall received for Kharif season i.e. June to October.
- Next share the types of rock formations and its extent of the HU.
- Share the rate of infiltration in the HU. Use the banner to help farmers understand the rate of infiltration.
- Next, share the amount of groundwater recharge in terms of 'litres'. Equate the quantity of water into number of calibrated drums (100 litres) and equate these calibrated drums to the village level water tanks (one water tank = 50,000 litres)
- Use the following visuals to discuss the content.

- Before sharing the amount of groundwater draft, share with the participants about the data required to estimate the groundwater draft for Kharif season.
- The data include:
    - Number of functional borewells in the HU,
    - Number of pumping days,
    - Number of pumping hours in a day, and
    - Average discharge.

- Share the estimation process of groundwater drfaft for Kharif season.
- Use the following picture to discuss the content.

- Share that groundwater draft is a product of the number of functional wells, average number of functional days, average number of functional hours in a day, and the average drum discharge.
- Groundwater draft = no. of functional wells X average no. of functional days X average number of functional hours in a day X average drum discharge.
- Share the groundwater balance by the end of Kharif season or October.

6. Water requirement for Rabi crops Time: 30 min

Objective : Participants discuss Rabi crop plans and water requirement.

Content :

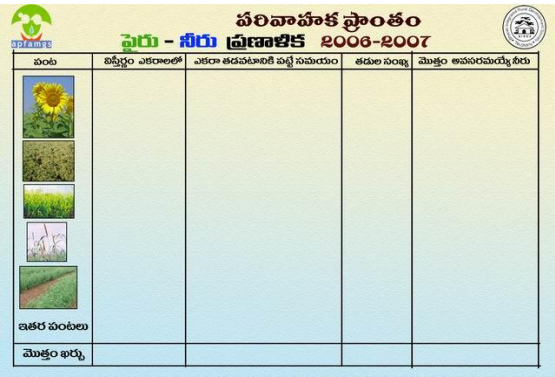
- Rabi crop plans and total crop area.
- Water requirement for Rabi crops.

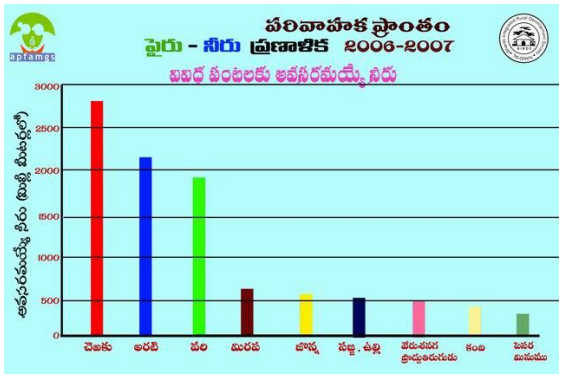
Method : Large group discussion

Materials : Banners, and crop details.

Process

- Before start of the discussion say these words: as we know that we are dependent on ground water to grow crops. Let us discuss about our Rabi crops and total water requirement to grow the planned crops.
- Use the following pictures to share the Rabi crops planned by the farmers in the HU.
- Share the process involved in collection of Rabi crop plans and the role played by the GMC and HUN in consolidation of village wise crop plans for the entire HU.





- Discuss the area under each crop and the water required for each crop.
- Discuss the total amount of water required for Rabi crops.

7. Projected recharge from Nov to May Time: 25 min

Objective : Participants discuss groundwater recharge through projected rainfall and secondary sources of water bodies.

Content : Groundwater recharge through projected rainfall for November to May.

Groundwater recharge through secondary water bodies i.e. tanks, canals etc.

Method : Large group discussion

Materials : Banners.

Process

- So far, we have discussed the groundwater balance by the end of October and estimated the amount of water required for Rabi crops.
- Pose the following questions to the large group if the groundwater balance is deficit:
    - How do we meet the water demand? Are there any other sources for groundwater recharge?
- Wait for few seconds and listen to participant responses.
- Next, share that we may receive some amount of rainfall and there is a chance of groundwater recharge.
- Discuss about the process of estimation of average project rainfall for the period November to May.
- State that the projected rainfall is estimated based on the average rainfall received from November through May in the past 10 years. Share the amount of projected rainfall and the amount of groundwater recharge.
- Demonstrate the process of estimation of average rainfall.

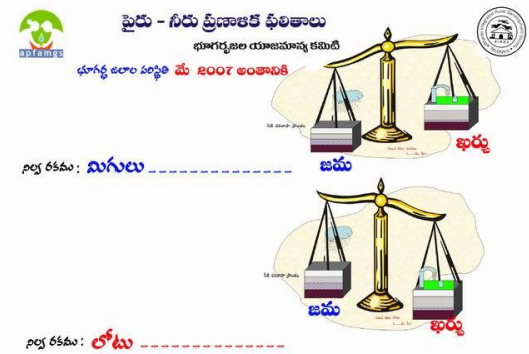
- Ask participants to state sources of recharge through other means.
- Use the banner to encourage the discussion and share the amount of groundwater recharge through secondary water bodies.

8. Projected Groundwater situation by the end of May

Time: 10 min

Objective : Participants discuss groundwater balance at the end of May.
Content : Groundwater balance at the end of May.
Method : Large group discussion
Materials : Banners.
Process

- Remind participants about the groundwater balance at the end of Kharif season and total water required for Rabi crops.
- If the amount of groundwater balance is negative, share the total groundwater recharge through projected rainfall and secondary water bodies, and
- Share the total water requirement for Rabi crops. Then, subtract the amount of water required from amount of recharge and share the projected groundwater balance by the end of May.



9. Decisions on crop-plans by respective HUNs and GMC members

Time: 15 min

Objective : Participants discuss about the available groundwater and take decisions on crop-plans.

Content :

- Rabi crop-plans.
- Farmer decisions.

Process

- Request participants to think about the available groundwater and crops planned for Rabi season.
- Encourage to share their ideas on change of crops or adoption of alternate irrigation techniques or reduce crop area or what ever they think.
- Request FWS participants to share their decisions on their crop-plans after knowing the deficit in water balance.
- Request GMCs to follow-up in immediate monthly meeting and encourage the farmers to take decisions on crop-plans to make use of available groundwater.

10. VIPs speech

Next, request VIPs to speak to farmers and share their observations and suggestions to participants. Give five minutes to each VIP. If the number of VIPs is more, restrict the number of speakers.

11. Issue of FWS graduation certificates

Request Chief Guest to handover the FWS graduation certificates to all the participants.

12. Vote of thanks Time: 5 min

Thank participants for their presence in the workshop and thank each and every member who involved directly and indirectly in the conduct of CWB workshop.

Annexure IV

Glossary

A

Aquifer: It is an underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using water well.

Agro Ecosystem Analysis (AESA): Methodology for zoning and analyzing agricultural systems in order to plan and prioritize research and development activities in the fields of agriculture and natural resource management.

Artificial Recharge: It is the process by which ground water is augmented at a rate much higher than those of natural condition of replenishment.

B

Bio-fertilizer: a large population of a specific or a group of beneficial microorganisms for enhancing the productivity of soil.

Balance, Groundwater: The remaining groundwater after extracting available water by users for various purposes. It is estimated based on the difference between net recharge and net discharge.

C

Crop water budgeting (CWB): A critical component of the PHM activity, It is considered as final step in the chain of PHM aiming at sustainable groundwater management by the farmers themselves. The CWB exercise involves estimation of the groundwater balance based on the total annual recharge and draft. This estimation helps farmers make informed decisions on the crops to be sown.

Canal: It is an artificial channel for water.

Catchment: Refers to any structure that captures water. It also sometimes referred to as Basin or Water Shed.

Check Dam: A small dam constructed in a gully to decrease the flow velocity, minimize channel scour, and promote deposition of sediment.

Contaminant: A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful effects to humans or the environment.

D

Drought: It is an extended period of time when a region notes a deficiency in its water supply. Generally, this condition occurs when a region receives consistently below average rainfall.

Display Board: Is a format used for dissemination of data to a larger audience. Usually made up of wood, these boards can be kept for display in central locations for capturing the interest of more people.

Draft, Groundwater: Refers to the discharge of groundwater. It is estimated based on well discharge and the total number of pumping days.

Drainage: natural or artificial removal of surface and sub-surface water from a given area. Many agricultural soils need drainage to improve production or to manage water supplies.

Drainage Basin: It is an extent of land where water from rain or snow melt drains downhill into a body of water, such as a river, lake, dam, estuary, wetland, sea or ocean

E

Ecosystem: natural unit consisting of all plants, animals and micro-organisms in an area functioning together with all of the non-living physical factors of the environment.

Evaporation: process by which molecules in a liquid state (e.g. water) spontaneously become gaseous (e.g. water vapor). It is the opposite of condensation.

F

Farmer Field School: group-based learning process that has been used by a number of governments, NGOs and international agencies to promote Integrated Pest Management (IPM). The first FFS were designed and managed by the UN FAO in Indonesia in 1989

Farmer Water School: An adaptation of the Farmer Field School approach to groundwater management. An initiative of the FAO funded APFAMGS project

G

Green Revolution: ongoing worldwide transformation of agriculture that led to significant increase in agricultural production between 1940s and 1960s. The term "Green Revolution" was first used in 1968 by former USAID director William Gaud

Groundwater: Water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations.

Groundwater Management Committee: A farmer institution promoting interaction among farmers in a village with an objective of groundwater management for sustainability of groundwater resource.

H

Hydrological Unit: The area drained by a river system

Hydrological Monitoring Record (HMR): A book meant for recording data obtained from rain gauge stations, and measuring water levels.

Hydrological Unit Network: A farmer institution promoting interaction among farmers in a Hydrological unit comprising of many villages with an objective of groundwater management for sustainability of groundwater resource.

Hydro Ecosystem Analysis (HESA): Methodology for analyzing hydrological systems in order to plan and prioritize research and development activities in the fields of hydrology and groundwater resource management.

Hydrogeology: It is the study of water flow in aquifers and their characterization

Hydrologic Cycle: Also known as water cycle, it describes the continuous movement of water on, above, and below the surface of the Earth. Since the water cycle is truly a "cycle," there is no beginning or end.

Hydrology: is the study of the movement, distribution, and quality of water throughout the Earth

I

Inflow: refers to the flow of water into the Hydrological unit

Infiltration: This is the downward movement of water into the soil. This finally becomes groundwater.

Integrated Pest Management (IPM): pest control strategy that uses an array of complementary methods: natural predators and parasites, pest-resistant varieties, cultural practices, biological controls, various physical techniques, and the strategic use of pesticides. It is an ecological approach that can significantly reduce or eliminate the use of pesticides.

Injection Bore well: A bore well that is meant to directly recharge the aquifer

Infiltration rate: It is the rate at which water percolates into the ground. It depends on rock and soil type.

Irrigation: artificial application of water to the soil usually for assisting in growing crops.

K

Kharif crop: Is the autumn harvest. Kharif crops are usually sown with the beginning of the first rains in July, during the south-west monsoon season.

L

Lake: Body of water or other liquid of considerable size contained on a body of land. The vast majority of lakes on Earth are fresh water.

M

Monitoring: to observe a situation for any changes that may occur over a period of time

O

Organic fertilizer: Fertilizers are compounds that are given to plants to promote growth. Naturally occurring organic fertilizers include manure, slurry, worm castings, peat, seaweed, sewage, and guano.

Observation bore well: A bore well having attached devices for measuring water levels and discharge of water.

Outflow: Refers to the flow of water out of the hydrological unit.

P

Participatory Hydrological Monitoring: refers to the effort to sensitize the individual groundwater users on judicious use of groundwater.

Pumping Water Level: It refers to the water level measurement that is taken three hours after pumping water from a bore well. This time is sufficient for the well to recoup (from aquifer) itself the water that has been taken out.

Potable water: Water of sufficient quality to serve as drinking water is termed potable water whether it is used as such or not.

Porosity: It is a measure of the void spaces in a material, and is measured as a fraction, between 0–1, or as a percentage between 0–100%

Precipitation: It refers to any product of the condensation of atmospheric water vapor that is deposited on the earth's surface. Occurs when the atmosphere becomes saturated with water vapor and the water condenses and falls out of solution.

R

Rivulet: a small stream

Rabi: Rabi sowings of different crops start in the month of September in some areas while it extends up to November ending in some other areas. Mostly the southern districts of the Coastal Andhra and all the districts of Rayalaseema receiving the North-East monsoon rains have the maximum cropped area during this season. The cropping season extends up to February-March.

Recharge Groundwater: It is the process by which groundwater is replenished.

Rain Gauge: type of instrument used by meteorologists and hydrologists to gather and measure the amount of liquid precipitation over a set period of time.

Run off: term used to describe the flow of water, from rain, snowmelt, or other sources, over the land surface, and is a major component of the water cycle

S

Session Guide: A user's guide that has the sequence of activities to be followed during organizing FWS session to enable easier facilitation

Stream: a body of water with a current, confined within a bed and banks

Seed Treatment

Static Water Level: The undisturbed water level when the bore well is not functioning

Soil

Surface Water: Water collecting on the ground or in a stream, river, lake, wetland, or ocean is called surface water;

T

Tank: A man made water collecting body

W

Water: common chemical substance that is essential to all known forms of life

Water Cycle: It describes the continuous movement of water on, above, and below the surface of the Earth. Since the water cycle is truly a "cycle," there is no beginning or end.

Water Analysis: It is the analysis of both drinking water and water that is used for irrigation. While drinking water is checked for chemical and microbial contamination, checking is also done prior to using it for irrigation.

Water Level Indicator: An instrument that is used for monitoring the water levels of an observation bore well.

Water Table: surface where the water pressure is equal to atmospheric pressure.

Well: artificial excavation or structure put down by any method such as digging, driving, boring, or drilling for the purposes of withdrawing water from underground aquifers.

Annexure V

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