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WATER REUSE AND ENVIRONMENTAL CONSERVATION PROJECT

CONTRACT NO. EDH-I-00-08-00024-00 ORDER NO. 04

WADI MOUSA PILOT PROJECT TRAINING PLAN

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Submitted to:
USAID Jordan

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AECOM

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LIST OF ACRONYMS

CP	Crude Protein
CWR	Crop Water Requirement
DEAK	Fat Soluble Vitamins
HFDB	Hashemite Fund for the Development of Jordan Badia
IOM	Inorganic Matter
IRR	Internal Rate of Return
JS	Jordanian standards
Kg	Kilo gram
MoH	Ministry of Health
NCARE	National Center of Agricultural Research and Extension
NPV	Net Present Value
OM	Organic Matter
RIAL	Water Reuse for Agriculture, industry and Landscaping Project
VFA	Volatile Fatty Acids
WRECP	Water Reuse and Environmental Conservation Project
WRIP	Water Reuse Implementation Project
WUA	Water Users Association
WWTP	Wastewater Treatment Plant

1 INTRODUCTION AND SUMMARY

1.1 Background

The USAID Water Reuse and Environmental Conservation Project (WRECP) works throughout Jordan in institutional capacity building, pollution prevention for industries, solid waste and wastewater management, and water reuse. The project goal is to protect and conserve scarce resources through regulation, education, and coordination with industry, local communities and the private sector. The project is implemented by AECOM and a team of international and Jordanian partner firms. This five-year project has four primary tasks:

- Task 1 – Institutional and Regulatory Strengthening
- Task 2 – Pollution Prevention and Industrial Water Management
- Task 3 – Disposal sites Rehabilitation and Feasibility Studies
- Task 4 – Water Reuse for Community Livelihood Enhancement, including biosolids

As part of Task 4, the project has supported the USAID pilot project at Wadi Mousa and is now preparing to provide training to the farmers and Water Users Association (WUA) Board, to make the pilot sustainable and provide a model for replication across Jordan. This report explains the planned training and provides detailed instructions for the trainers.

Previous USAID projects at Wadi Mousa. Before planning for new water reuse projects, the project team reviewed previously established pilots in Jordan. A landmark water reuse pilot project had been established by the USAID Water Reuse Implementation Project (WRIP, 2002-2004) in Wadi Mousa, aimed at enhancing livelihood in the local community. This pilot project was later expanded during the USAID Water Reuse for Agriculture, Industry and Landscaping Project (RIAL, 2004-2007). The previous USAID Jordan interventions were successful in establishing concepts, but had limited success from a sustainability perspective.

Site information. The project site is adjacent to the Wadi Mousa wastewater treatment plant (WWTP). Currently, up to 70 ha are irrigated with reclaimed water for growing fodder crops - mainly alfalfa and barley - in addition to some fruit crops.

WUA. Farmers practicing reclaimed water irrigation are members of Sad Al-Ahmar Association, commonly known as the Water Users Association (WUA). The association has 120 members (over 200 people including their families), of which about 42 members are directly engaged in the pilot agricultural activities.



Alfalfa seeds production farm at Wadi Mousa Pilot

WRECP activities to date. Achieving sustainability has been at the forefront of all the WRECP activities at the site. To date, the project's technical assistance activities include irrigation system rehabilitation, training the farmers and WUA members on irrigation optimization, best farming practices, and agribusiness planning, building marketing chains and infrastructure, establishing seeds production farm. USAID and the Hashemite Fund for the Development of Jordan Badia (HFDB) signed an MOU confirming support for increasing and improving management of water reuse in Wadi Mousa and other regions of the country.

The WUA signed an MOU with a private company specialized in importing and exporting forage crops. The MOU will enable the WUA to sell the pilot bulk production of alfalfa at local market prices to sustain the financial security of farmers and the WUA. The forage marketing center was established this quarter. WUA staff will be trained on handling and storing alfalfa, and on management of the center.

The integrated seeds production farm has been established, so the pilot project can produce its own alfalfa seeds at a lower price than local market prices. The farm will also work as a demonstration site for training the farmers on irrigation optimization and best on-farm practices.

The team also developed a preliminary hydraulic simulation model for the pilot irrigation system. This will help improve the pressure and flow delivery to the farms and reduce water and energy losses.

The project is now working to provide training across a range of topics that can permit improved, sustained management of the WUA and the pilot.



Mission Director Beth Paige reads project sign at Wadi Mousa pilot project.

Training plan. The training plan should result in a USAID Jordan success that could be readily replicated and implemented across the kingdom. The primary objective of the training plan is to enhance the sustainability of the existing 8-year old reuse pilot project by implementing lessons learned from the previous years of experience at this location. These lessons are essential to establishing best practices for the long-term sustainability of farming with reclaimed water irrigation in Jordan.

The primary focus will be on training farmers in best on-farm practices and management and irrigation optimization, and on increasing farmer understanding of how such changes can either make their crops more marketable or enable them to produce a self-sustaining year-round supply of feed for their own livestock. There will also be training for the WUA and farmers on fiscal responsibility, accountability, transparency, and planning, as needed, to achieve economic sustainability.

1.2 Scope

Training is the core activity of the technical assistance plan. The training will focus on capacity building for all involved stakeholders. The holistic approach will enable the farmers and the WUA to sustain the pilot. The methodology of the training plan depends on training the farmers on state of the art practices and management skills. These practices and skills are developed with attention to technical applicability,

financial feasibility, and social acceptability by the local community, to achieve sustainability.

The main objective of this training plan is to introduce and train the farmers on best on-farm management practices to increase the yield production and reduce the water consumption. Also, the WUA staff will be trained on best financial and administrative practices in addition to fiscal responsibility, accountability, transparency, and planning, as needed, to achieve socio-economic sustainability of the WUA and the pilot.

1.3 Objectives

The main objective of this training plan is to enable the reuse community (farmers and WUA) to sustain the pilot, and to transfer and share the knowledge and experience gained from the training plan to other reuse projects within the kingdom.

This will be achieved through working on three main levels; On-farm level will enhance the farmer's knowledge on using reclaimed water to produce forage crops; irrigation optimization "drop per crop", best on-farm management, increase land productivity, and safe use of reclaimed water. Pilot level will develop the WUA capacities on financial and administrative practices to promote the pilot sustainability. National level will support the farmers and the WUA to network with other reuse projects to enable the environment for establishing a reuse knowledge center.

1.4 Training Topics

This training plan outlines the farmers' needs and the methods adopted to implement the training. Needs assessment was conducted through several field investigations and meetings with the farmers and WUA. All farm units were visited and evaluated for the current practices. As a result, the WRECP in cooperation with the farmers identified the main topics needed to be included in the training plan as summarized below:

- Laws and standards guiding safe use of reclaimed water in agriculture
- Benefits and risks of using reclaimed water
- Agribusiness planning
- Farm management
- Subsistence livestock management
- Pre-planting practices
- Pest and weeds control
- Harvesting practices
- Post-harvesting practices
- Crop rotation
- On-farm irrigation networks: operation, maintenance, and efficiency
- Irrigation optimization
- Scheduling irrigation
- Alfalfa seeds production



The on-farm irrigation networks at Wadi Mousa were rehabilitated in on-the-job training (standing from the right, Ali Mohammad with workers).

In addition, the WUA board members will be trained on the following skills:

- WUA budget development
- Revolving fund management
- Financial management (bookkeeping, accounting, etc.)
- Asset management (machinery, office, other WUA assets)
- Financing opportunities (bank loans, international grants and funds)
- Investments management (developing basic business plans)
- Marketing development
- Tendering for procurement
- Operating and maintaining agricultural machines



Irrigation networks kit delivered to the board of WUA of Sad Al-Ahmar (Ali Mohammad, the secretary of the WUA).

The training plan covers all those topics in the field and indoor training sessions. Field training covers for all skills that the direct users will be trained on. The training efforts will be coordinated with the relevant stakeholders. For example, training on the risks of using reclaimed water and safe reuse will be coordinated with the Ministry of Health (MoH), and the agricultural practices will be coordinated with the National Center for Agricultural Research and Extension (NCARE).

2 TRAINING SUBJECTS AND SKILLS

2.1 Introduction

Interactive training is to be provided for the direct water users. The training will be implemented indoors and on-field. It will include study tours to forage farms planted under reclaimed water and managed through WUAs in different regions of the country.

The farmers will learn from the experiences of others and share their own experiences in growing forages. Training will be implemented through constructive interactive discussions between the farmers and the trainers.

The indoor training will consist of ten training modules, summarized below and discussed in detail in Section 5 of this plan. The outdoor training will reinforce the indoor training and will cover specific skills, also summarized below.

2.2 Indoor Training - Subjects

Based on the needs assessment, the project team developed ten training modules, addressing the pilot's sustainability. The indoor training sessions will include presentations, exercises and live discussions. The training will also include short videos developed to train people on various agricultural practices. The videos will foster better understanding of the presented topics. Participants will be encouraged to share their current practices through interactive discussions. In addition, they will work in groups and as individuals to work on exercises and case studies.

The ten modules are to train farmers in the best practices on safe reuse of water in forage production. The modules are designed to provide complete information, knowledge and skills for successful production of forage crops using reclaimed water. Once farmers have gained this knowledge, they will be urged to share the knowledge and skills they have gained with other farmers in the area.

The training modules are:

1. Laws and Standards for Using Reclaimed Water
2. Benefits and Risks of Using Reclaimed Water
3. Irrigation Scheduling and Crop Water Requirements
4. Proper Land Preparation for growing Forages
5. Crop Rotation
6. Forage Harvest Management
7. Basics of Livestock Management



Visitors to the seeds production farm at the pilot included (Left to right) Nime Klepcek (Bhutan), Steve Daniel (Barbados), Bwalya John Mwansa (Barbados), and Sonam Gyaltshen (Bhutan).

8. Financial Management for Water Users Associations
9. Cooperative Farming Society
10. Producing Alfalfa Seeds

Module 1: Laws and Standards for Using Reclaimed Water: This module will introduce participants to the local laws, standards and guidelines for reusing water. Participants will learn the importance of following standards and guidelines in sustaining forage production under reclaimed water irrigation. In addition, they will be introduced to the guidelines for safe reuse and their importance in improving the quality and quantity of the farmers' products.



Project staff provide on-farm training.

Module 2: Benefits and Risks of Using Reclaimed Water: Health and environmental benefits/risks of reusing water in agriculture will be introduced to participants. The main objective of this module is to raise awareness of reclaimed water irrigation. The goal is to gain their commitment to following the safe reuse guidelines presented in previous modules.

Module 3: Irrigation Scheduling and Crop Water Requirements: Being aware of the requirements and suitability of different irrigation techniques is important in planning for new cropping patterns. The main objective of this module is to clarify safe irrigation techniques suitable for reclaimed water irrigation. Participants will learn the importance of scheduling irrigation in enhancing crop growth during different growth stages.

Module 4: Land Preparation: Scheduling for planting practices is very important for optimizing seed germination. Participants will learn the best schedule/practices for land preparation (pre-planting) to achieve successful seed germination, which leads to successful crop growth. The best schedules for common forage crops planted at the target area will also be discussed.

Module 5: Crop rotation: Different crops will be introduced that should be planted in the same field in rotation. Participants will learn about proper scheduling for seeding and harvesting selected forage crops to maintain the soil fertility and productivity.

Module 6: Forage Harvest Management: Scheduling for pre- and post-harvesting practices is critical for optimizing forage production. Participants will learn the best schedule/practices to ensure successful production. In other words, participants will learn how to enhance production quality and quantity. Being committed to these practices, participants will improve the marketability of their forage production.

Module 7: Basics of Livestock Management: Participants will learn about different growth stages of sheep and goats. Being aware of the differences in nutritional needs during these stages will foster successful animal raising. This means less disease, lower costs and higher benefits.

Module 8: Financial Management for Water Users Associations: This module presents fundamentals of financial management to successful water users associations. Participants will learn basic accounting and financial reporting skills as well as elements of short term and long term business planning principles. A

successful/sustained water users association means a successful/sustained farms under reuse activities.

Module 9: Cooperative Farming Society: The module focuses on the formation and development of cooperatives, to enable the groups to build their own organizations in ways that meet the farmers' shared agribusiness needs. It will also enable them to form partnerships with government in service delivery.



Project field engineer talks with farmers at Wadi Mousa.

Module 10: Producing Alfalfa Seeds: This module introduces a model farm for producing alfalfa seeds. The module presents most proper schedule for agricultural practices needed to grow profitable and healthy alfalfa seeds. During the training, the participants will learn about land preparation practices needed to grow alfalfa crops; proper planting schedules; scheduling alfalfa cuts; pre-harvesting practices for alfalfa seeds; and harvesting and marketing alfalfa seeds

Section 5 of this report explains the indoor modules' structure, objectives, tools, and subjects in detail. They are the main subject of this report.

2.3 Field Training - Skills

The second technique of the training is implementing and reinforcing what participants learned through the indoor training. Working together with professional trainer's on-field will achieve follow-up on the main training goals. That's where applying best practices on farm management can enhance the forage production. By the end of the training sessions, the Wadi Mousa Pilot can be introduced as a model for safe forage production under reclaimed water.

Field training will be conducted through one growing season of each planted crop at the pilot. For example, barley is an annual crop with a growing season from November through June. Farmers will be trained on proper agricultural practices to be implemented, starting with land preparation and going through planting, growing, harvesting, storage, and, finally, marketing the production.

The main idea behind the field training is to support knowledge gained from the indoor training. Moreover, it will improve participants' learning skills through field observations (the technique is called "look and learn"). The training will allow participants to learn by doing as groups. Trainers will join groups investigating their fields and will encourage brainstorming when facing an urgent problem there.

Skills to be covered through the field training are:

- Tendering for procurement
- Operation, monitoring and maintaining on-farm irrigation networks
- Operation and maintenance of agricultural machines
- Integrated crop management for already planted crops at Wadi Mousa reuse site (alfalfa, barley, maize and wheat)

- Harvesting techniques
- Crop rotation management
- Integrated management of alfalfa seeds production
- Developing marketing protocol and schedule

These skills will allow farmers to participate in observations, discussions, analysis, decision-making and implementing appropriate actions for a successful crop growth.

Tendering and procurement. Monitoring and preventive maintenance are critical to achieving the project's sustainability. Regular monitoring is expected to show that some components of the pilot will need to be repaired or even renewed. As the operator of the pilot, the WUA is responsible for the maintenance work for most pilot components. In addition, future plans for expansion and establishing new projects will go through the WUA. This means that they will be responsible for requesting price quotations and following up with contractors to do so. The board members of the WUA of Sad Al-Ahmar will be trained on tendering and purchasing agricultural materials and equipment.

Participants will learn the most appropriate procedure for developing tender documents, following up with contractors, documenting purchasing, and considering it when developing the annual budget. This activity aims at enhancing the board's financial management skills and decision making when implementing new projects. Skills gained through this activity can support the financial sustainability of the association.

Operation, monitoring and maintenance of on-farm irrigation networks.

Proper operation and maintenance of the irrigation networks can significantly minimize malfunctions and maintenance needs. In other words, it can decrease the operational cost of the farms. Participants will learn how to assess the maintenance needs of their on-farm irrigation networks, working together with the trainers. Trainers will join farmers in regular inspection for mainlines, head units, manifolds, laterals and emitters.

Farmers will have the chance to learn about most common maintenance needs of the on-farm network. Also, they will learn about the span life for the different components of the network, and how to define and schedule future rehabilitation needs.



Rusted valves at manholes in main irrigation network, New valves were installed at the manholes before rehabilitation

Farmers will practice installing pipes of the drip irrigation network in an appropriate way during the rehabilitation of the on-farm irrigation networks. They will learn how to lay out laterals properly, and how to decide proper spacing of the laterals. Participants will learn by doing solving urgent problems they may face when operating their networks. This will teach the importance of these skills in enhancing the efficiency of the irrigation networks, improving water productivity, and enhancing the



Alfalfa harvesting

quality and quantity of their production thus, increasing their benefits. Also, this approach will also increase the farmers' sense of ownership.

Operation and maintenance of machines. Through several investigations, the machines used at the pilot were found to be costing too much for maintenance. However, it was critical to build the capacity of the driver and the operators on proper operation and maintenance of these machines. Being aware of common mistaken practices can minimize the maintenance needs and costs for the machines.

Participants will work side by side with the trainers in developing a proper schedule for the agricultural machines' operation and maintenance. They will also learn how to plan for purchasing new machines when needed. The schedule will consider the cropping pattern already planted at Wadi Mousa pilot. The main objective of this session is to maximize benefits of renting machines, and minimize costly losses caused by improper machine operation.

Integrated crop management for already planted crops at Wadi Mousa reuse site. Managing all controllable agricultural production factors in one integrated program is critical to growing sustainable, profitable and ecological crops. An integrated crop management program includes:

- Proper land preparation
- Seed verity selection
- Appropriate planting techniques
- Appropriate planting dates and rates
- Adopting proper plan for crop rotation
- Weed control
- Pest control
- Irrigation scheduling during different growing seasons
- Fertilization needs and application
- Appropriate harvesting techniques and schedules
- Appropriate storage strategies

Participants will be involved in drawing a scheduled plan for the agricultural practices needed for successful and beneficiary growth of the crops planted at their farms. Such practices include pre-planting, planting, post-planting, pre-harvesting, harvesting, post-harvesting and proper storage of the produced forages. This activity aims at optimizing farm productivity, in other words, maximizing benefits. The training

will be conducted through different growth stages of the planted crops. Throughout the training period, trainers will assist participants in developing plans for their farms, including schedules for those practices.

Integrated management for alfalfa seed production. As part of the technical assistance plan developed for the pilot, an alfalfa seed production farm was established in September 2013. The farm will be used as a demonstration site for training purposes. In addition, it is considered an extra income resource, supporting the financial sustainability of the WUA. Trainers will work side by side with farmers in developing an integrated plan for the farm. The plan will consider the same activities stated in the previous session.

The activity aims at improving participants' skills in managing seed production. This activity is considered on-going training, starting at land preparation and continuing until the marketing of the produced seeds.

Financial management for the water association.

Building the capacity of the WUA operators can dramatically improve the management of the pilot. Enhancing their financial management skills and agribusiness planning will help in achieving economic sustainability.



The project team explained the Wadi Mousa Pilot as a reuse model to a group from WHO and JU as well as a delegation from Bhutan and Barbados. WRECP staff Ala'a Homaidan led the presentation and discussions to address the visitors' questions and concerns.

Improving the managerial skills of the board members in achieving financial sustainability of the WUA will enhance the income generated. This will enable the WUA to support farmers by covering some of the costs of operating and managing their farms. In addition, the board will be trained on developing proper strategies for operating the revolving fund. Also, the board will be training on developing the annual budget of the association, side by side with the trainers.

Developing marketing schedule and protocol. The project's field investigations showed that farmers found it challenging to market their produced forage. Thus, it is important to define and follow the market needs. Enhancing the quality and the quantity of the production will facilitate improving the marketing strategies followed at the pilot. Participants will learn about the cooperative structure of associations in order to manage the pilot as one market center.

This session will provide the board with the needed skills to develop a marketing plan for the forages produced at the pilot. The plan will consider the production quality and quantity, market needs, market prices, potential customers and proper storage of the forages. This will smooth marketing the forages produced at the pilot.

Having learning this concept, farmers will be motivated to manage their farms properly, following what they have learned through the training to enhance the forage production. This will enhance the sustainability of the pilot.

2.4 Study Tour

Almost 90% of the produced effluent is being used for agricultural irrigation around Jordan. Several forage projects and farms irrigated with reclaimed water were established around WWTPs. Within these farms, forages are being produced under different agricultural practices. Farmers operating those farms are using different harvesting and storage strategies. Learning by seeing is the main goal of conducting study tours to these sites. The training plan will facilitate visits to different locations, so the farmers can discover different experiences and share knowledge.

Participants will be introduced to different agricultural practices adopted at selected sites. Also, they will be introduced to various strategies in managing and operating a forage farm. During the tour, participants will have the chance to discuss and chat with the operators of those farms. For instance, they will discuss different challenges facing other farmers, and how they mitigated them.

The tours will be organized in cooperation with various organizations operating and managing forage farms. During different growing seasons, participants will learn about the best practices needed, depending on the growth stage of the forage crops. In addition, they will learn about new species and varieties of forage crops that can be feasibly planted under reclaimed water, and their best management practices.

Being introduced to success stories and challenges, participants will learn the needed effort and proper strategies to ensure successful and sustainable forage production under reclaimed water.

3 GENERAL METHODOLOGY

3.1 Introduction

This section explains the methodology used in developing the training modules.

The content of each module will be covered in PowerPoint presentations and handouts, but group discussions are the heart of the indoor training. This will help identify other training needs to be covered under the on-field training.

During the field training, farmers will work as groups, side by side with trainers. The field training is an effective training technique to achieve implementation of the recommended agricultural practices learned during the indoor training.



Updating the irrigation system

3.2 Targeted groups

Targeted groups are those persons who can benefit applying the content of the modules. This training plan is targeting the following groups:

- Farmers planting crops under reclaimed water irrigation
- Board members of Water Users Associations
- Significant stakeholders

3.3 Trainers

The project expects to use various people involved in water reuse and forage production as trainers. These will include extension engineers, academics, private sector personnel, and staff from international development agencies. However, the focus is on the extension staff from the public sector, such as engineers from NCARE, HFDB, MoA, JCC, and off course WUA board members and staff. Also, the project is promoting farmers to farmers approach. Therefore, some of the farmers will also be considered as trainers.

3.4 Preparation of modules

Training needs were explored through site investigations and through meeting farmers and the involved stakeholders. These meetings and investigations helped in developing the training objectives, expected outputs, topics, and inputs to the training modules. Accordingly, training sessions were designed as activities to be introduced to participants. The modules address techniques and approaches to facilitate conducting those activities.

Each module explains one training topic. The modules were set in a sequence that allows applying them anywhere. However, trainers should consider the unique environment of the targeted areas for the training.

Under each training module, the various training activities will be prepared by trainers. Trainers should decide the following for each training topic:

- The most appropriate training method to use (explained later)
- Additional local information to be considered
- The most appropriate training tools (explained later)

Ten indoor training modules were developed under this training plan. The modules present a tool and a guide for training on best practices in safe water reuse for forage production. Local standards and laws should be considered when applying the training.

3.5 Structure of the modules

The training modules were designed as series of steps which integrate training techniques with training tips. The modules present a tool for iterative learning. In addition, they encourage consultation, group work, and the approach of “learning by doing.”

The training modules are structured in a way that helps trainers cover the subject of the training session in a consistent way. This can be achieved by explaining a series of key statements on the subject and carrying out a training activity to reinforce each statement, before going on to the next one. Each module also includes useful tips to trainers that facilitate delivering knowledge to attendees in an effective way. The tips suggested several training tools and methods under each session.

Training modules present different exercises, to ensure that participants truly understand what they have learned throughout each topic. At the end of each module, participants will discuss knowledge they gained; discussion is to be listed on a Flipchart, focusing on the activities that the farmers intend to adopt and implement at their farms in the near future.

3.6 Objectives

The main goal of developing these training modules is to provide an easy read/use manual for training on most proper practices in forage production under reclaimed water irrigation. In addition, it introduces the Jordanian standards, guidelines and laws controlling the reuse activities in agricultural irrigation. The modules can be used anywhere and anytime, considering the unique environment of the targeted locations.

3.7 Significance

Implementing this training is expected to improve the commitment of participants to follow safe procedures and guidelines in using reclaimed water in forage production. Also, it is expected to raise their awareness regarding the most proper agricultural activities in forage production. As a result, it will enhance forage production quality and quantity. As an allover benefit, water productivity will be improved, and environmental risks will be minimized. This will support the sustainability and profitability of water reuse activities in Jordan.

4 TRAINING TOOLS

Training tools are those tips, activities, and methods that will make each training session memorable. The tools described in this section present a guide to facilitate planning, preparing, and conducting training sessions. The chapter describes each training tool and how to use them.

The training tools are: training toolbox, tips to trainers, training activities, training methods, and key statements.



Alfalfa harvesting in May 2014

The training toolbox includes tools that can facilitate presenting the subject. The suggested training toolbox includes the following:

4.1 Presentation

A simple and easy to read presentation describes the training topics, using Microsoft PowerPoint. The presentation will include simplified bullet points and colorful illustrations and photos: “a picture is worth a thousand words.” Each slide of the PowerPoint presentation should be presented with a simple explanation of its content. An interactive discussion of the described topics will be very useful in delivering the targeted information and knowledge to participants.

PowerPoint presentations will be in the standard USAID-approved project template and will follow these guidelines:

- Explain acronyms and abbreviations fully
- Use the correct project name: Water Reuse and Environmental Conservation Project. After first use, say “the project”
- Make eye contact with distinguished guests and audience; do not read slides
- Select “Custom slide” for images, tables, charts
- Use predetermined areas for text entry
- Titles and text should be typed into areas provided
- Capitalize title words except “of”, “the”, etc.
- All text must be in Arial font
- Titles of the slides must be in 28 pt, subtitles in 24 and text in 20 pt
- Condensed fonts are not allowed
- All text should be black
- Keep bullets brief
- Be sparing and consistent in animation
- Use blue-grey color palette in tables

4.2 Flipcharts

Flipcharts are a simple tool used to write down comments and draw charts during discussion. Both the trainer and participants can write on the flipchart and use



Farmers at Wadi Mousa walk the fields in May 2014

colored pencils to highlight headlines and key points. Trainers can use this tool to write note comments and structure discussion through writing questions and participants' answers of participants.

The following are tips for developing a written discussion or exercise on a flipchart:

- Plan the lesson to express:
 - Select an upcoming lesson or exercise to be presented on flipchart interactivity
 - Sketch it out. Write down ideas and/or create a simple paper-and-pencil draft of how you want your flipchart to look
 - Remember, everything participants see in the flipchart should add meaning
- Create your Flipchart
 - Review use of tools as needed
 - Add content to your Flipchart during the session
 - Do a run-through at the board to make sure everything works the way you want it to
- Share your Flipchart
 - Draw the planned charts, lists, and tables during the discussion
 - Ask participants to write and fill the tables and lists as a practice
 - Ask participants to express solutions of exercises on the Flipchart

4.3 Handout

Handout is a hard copy text which supports, expands on, organizes and provides follow-up to the training. The handout will present simple reference guidance on safe use of reclaimed water. The written summary can be passed between persons by the mean of sharing knowledge. In addition, the simple portable structure of the handouts can make it used anytime and anywhere. Three types of handouts are suggested to be developed for the training:

- Summary documents: a summary of the presented subjects will be handed to participants.
- Work sheets: simple worksheets will be developed to practice monitoring and operating the on-farm irrigation network. Describe how these sheets can help

farmers record any failure or maintenance needs for their networks. Other work sheets will help farmers recording all agricultural practices and production. These sheets will also help them scheduling their farm management.

- Leaflets: present a sample leaflet that describes one of the training topics. Explain that these leaflets will be distributed during the related training sessions. Clarify how simple are their design and how to use them.

4.4 Others

In addition to the above mentioned training tools, trainers can figure out what participants learned during each session through practicing what they have learned. Practicing can help deliver the knowledge to participants and fulfill the objectives of each training topic. Trainers are recommended to develop exercises, worksheets and checklists for each session. Participants can work on these tools either in groups or as individuals.

Trainers should carefully choose training activities that fit the group and time frame. It is critical to give enough time for the participants to complete the activity. But, they should remember not to give too much time, or participants will wander around.

4.5 Tips to trainers

Tips to trainers were divided into “prior to training,” “starting training,” and “during training.” This subsection presents skills that include planning training session and facilitating and moderating training activities.

1. Prior to Training

Prepare “stories” based on your own experience to illustrate the key statements and concepts. For example, tell about incorrect practices in other farms and explain how these practices affected the production. Describe what practices you would recommend differently as the most proper ones to follow. These stories would facilitate justifying practices and knowledge that will be presented within the training. In addition, it will help participants recall the training later on. Make a list of things you need to have with you for the training: handouts, flipchart, overhead pens, markers, laptop, name tags, etc.

Review all the content and key statements. It would be useful collecting case studies of activities practiced by participants. You can request them to present their case study in front of other participants and open a discussion among them. Promise them to support them when needed in explaining and justifying their presentation.

Check out equipment you will be using. If you are using a data show, make a “trial run” to work out any glitches. Double check all needed tools, one day before training, with the person on site who will be setting up the equipment. Make a plan in case the equipment doesn't work! Make hard copies of yours slides and notes.

2. Starting Training Session

Be there before participants, put up a welcome slide or write a welcome message on the flipchart. Once participants arrive, start chatting, have a cup of coffee, and introduce yourself. Address all participants, if possible.

Once all participants arrived, stand in front of the main chair and attract their attention by welcoming them using a high voice tune. Introduce yourself and your colleagues, if there are, participating or assisting the training. Do not forget to thank them for their support.

Distribute agenda before presentation, and remember to distribute copies/hand-out. Present the schedule of the training regarding the table of content. Mention that they will have a coffee break during the presentation, and they will have launch after it.

Remind participants to shut off or mute mobile phones before starting the session. Thank them for doing so.

3. During sessions

Start explaining the training subject and objectives. Get participants involved actively by asking each of them to raise one question they want to learn its answer during the training. Note down the questions on the flip chart. Mention that the training will try to answer most of their questions and concerns. Use different icebreakers all around the training.

Inform participants about the presentation and encourage them to interrupt you for questions for clarification. If they state comments that require longer discussions, note them on the Flipchart, and promise to address them right after the presentation.

 *Ask the participants frequently during the training “has your question been answered?”*

Your body language is important. Maintain eye contact with the group. If possible, move around instead of only standing behind a podium. Remember not to read overheads or handout material. Face the audience - not the screen or chart.

 *Frequently ask participants how they are doing with questions such as “How are we doing? Does that make sense? How are you feeling? Am I going too fast?”*

Finally, thank participants for their interaction, and for muting their mobile phones. Remind them to turn them back on.

4.6 Training Activities

The training activities are intended to make the participants justify introducing the mentioned key statements. Also, it would give them an opportunity to challenge key statements. The activities allow trainers to:

- Make the reasoning and information relevant to their particular region, country, or product
- Involve the participants in thinking about the reasons behind the key statements
- Encourage the participants to challenge and debate the more difficult issues

4.7 Training Methods

The trainer should use different training activities throughout the session. The modules provide suggestions on which techniques to use for particular exercises. They do not have to be followed; trainers can make their own choices about what is most suitable.

Techniques that might be used include:

Brainstorming: Trainer can write questions and answers, or describe a case study on the flipchart to start a brainstorming. Let participants work as one group to define the stated problem. This technique can motivate participants to discuss their thoughts loudly. Also, it will help trainer to lead participants in defining the most proper solution for the given case.

Individual listing: This is a variant of brainstorming that makes every participant contribute. Individuals make their own lists and the trainer asks participants to contribute to the group list in turn.

Group discussion: This is useful when ideas need to be debated rather than a specific list compiled. It is ideal for situations where individual views may differ.

Working groups: This is ideal where more thought is required to produce an action plan rather than a list. Participants are divided into small working groups (ideally 3 or 4) and given a fixed time in which to consider answers and then report back to the whole group. Different groups can work on different problems. The reporting session can then develop into a general group discussion (see above) out of which new ideas may often arise.

Work sheets: The modules have been designed to include a work sheet for use by individuals where group training is not possible. The key statements can be listed with sufficient space in between for the participant to provide the relevant linking information.

Here again the format can be varied and could include:

Multiple choice selections: Providing a multiple choice selection exercise can be used as a technique to assess the knowledge acquired by participants. Trainer can use it by asking participants to select the most appropriate answers from a list.

True or False statement: Selection of true or false statements from a provided list can be used as exercise to ensure that participants clearly understood the training objectives. For example: Show, by marking with a tick, which of the following practices is complying with the local standards for forage production under reclaimed water irrigation.

Brief written answers: Explain to participants a case study and ask them to answer some questions related to the training topic. Write the questions on the Flipchart and ask all participants to write answers on a paper. Then, trainer can answer the questions either through group discussion or by clarifying the most proper answer. This could ensure understanding the topics covered by the training.

4.8 Other Activities

Icebreaker: Ice Breakers can be an effective way of starting a training session or team-building event. As interactive and often fun sessions run before the main proceedings, they help people get to know each other and buy into the purpose of the event. The key to a successful ice breaker is to make sure the ice breaker is specifically focused on meeting your objectives and appropriate to the group of people involved.

Study tour: Study tours can present a practical interactive learning experience. A visit to one of the farms operated by participants can help them experience what they are learning.

4.9 Key Statements

The key statements are designed to be relevant to the topic in any country, in any language. They should be prepared in advance on an overhead sheet and revealed one by one as the session proceeds (see below). Or they can be written up one by one on a flipchart. At the end of the session, the complete sequence of key statements gives the trainer the opportunity to review and summarize before drawing the conclusions.

5 INDOOR TRAINING MODULES

This section presents the training modules for best agricultural practices in safe water reuse. Ten modules were developed; they cover defined training topics to be introduced to the direct users of reclaimed water, to build their capacity to support safe and sustainable reuse activities. Each module includes suggested training activities, methods and exercises. The modules are applicable anywhere, anytime, and in any language. However, trainers should consider the unique environment of the reuse site to be reflected on the modules.

The modules are presented as training activities, where each activity describes at least one topic. For each activity, tips and training tools are suggested to trainers, in order to facilitate the training and simplify the explanation of those topics for attendees. Trainers can apply some changes to the tips and tools, to reflect the unique environmental and social characteristics of the targeted area.

The ten modules are:

Module 1: Laws and Standards for Using Reclaimed Water

Module 2: Benefits and Risks of Using Reclaimed Water

Module 3: Irrigation Scheduling and Crop Water Requirements

Module 4: Proper Land Preparation for growing Forages

Module 5: Crop Rotation

Module 6: Forage Harvest Management

Module 7: Basics of Livestock Management

Module 8: Financial Management for Water Users Associations

Module 9: Cooperative Farming Society

Module 10: Producing Alfalfa Seeds

Module 1: Laws and Standards for Using Reclaimed Water

Introduction

The international guidelines and local standards for wastewater reuse were developed to protect public health and the environment. Awareness of these guidelines and standards will enhance safe reuse practices and thus enable the environment for sustaining the farming practices under reclaimed water. This module introduces best practices in reclaimed water use in agriculture, according to the Jordanian standard (JS839/2006).

The participants will learn about:

- Best practices in safe use of reclaimed water
- Jordanian standards for reclaimed water use

Significance

This training will inform the participants and improve their commitment towards the safe and sustainable wastewater reuse practices. Leading to improve the quality and quantity of agricultural products and reduce water consumption. In addition, participants will learn how to sustain their farms under reclaimed water irrigation.

Module 1 Table 1. Laws and regulations for wastewater reuse are developed to protect public health and to ensure full reuse benefits

Activity	Toolbox
<p>Trainer to initiate a discussion on reclaimed water use within the local standards framework.</p> <p>Explain: What are standards</p> <p>Answer: Required or agreed level of quality for specific uses</p> <p>Highlight the importance of complying with the local standards for wastewater reuse, and emphasize the consequences of not doing so. The end user can experience the following:</p> <ul style="list-style-type: none"> - Health issues - Legal accountability - Unsuccessful crop growth and production - Difficulties in marketing the production 	<p>On the Flipchart:</p> <ul style="list-style-type: none"> • Draw a table with two columns: “Do” and “Do Not” practices in forage production under reclaimed water use, according to JS 893/2006 • Let participants fill in it
<p>Suggested Method: <i>Group Discussion</i></p>	

Module 1 Table 2. Controls on the use of reclaimed water for irrigation purposes consist of two main groups: Standards and Guidelines

Activity	Toolbox
<p>Explain the Jordanian standards that regulate the use of reclaimed water in agriculture. Present the types of crops permitted in accordance to the reclaimed water quality.</p> <p>Clarify that controls on the use of reclaimed water for irrigation purposes consist of two main groups: standards and guidelines:</p> <ul style="list-style-type: none"> - Standards oblige the operating agency to be committed to producing water conforming to those standards according to the uses mentioned in the specification. - Guidelines are rules and principals recommended by a relevant organization. <p>Present the type of crops allowed to be planted under reclaimed water depending on its quality:</p> <ul style="list-style-type: none"> - Class A: Cooked vegetables, parks, playing ground and sideways in populated areas - Class B: Fruit trees, highway trees and green areas - Class C: Field crops, industrial crops and forest trees 	<p>During the training, ask participants to fill in the Table developed on the Flipchart. They can add the current planted crops planting on their farms as Do plant and Do not plant under reclaimed water</p> <p>The necessary changes to this module to consider the local Standards and regulations of the country this training is held in</p>
<p>Suggested Method: <i>Individual Listing</i></p>	

Module 1 Table 3. Appropriate training on basic hygiene is essential, and should include practices to avoid dermal and aerosol exposure to lower quality water

Activity	Toolbox
<p>Describe possible risks associated with reclaimed water use in agriculture:</p> <ul style="list-style-type: none"> - Direct contact for reclaimed water could expose users to health issues such as hepatitis. - Reclaimed water has nutrients that are needed by plants, thus reducing the needs of chemical fertilizers. Unplanned addition of fertilizers can reduce plants' production. <p>Explain practices required for safe use of reclaimed water:</p> <ul style="list-style-type: none"> - Users should have Polio- Diphtheria – Tetanus vaccination. “Mention that these 	<p>Mention that the quality of the reclaimed water being used at site follows local standards</p> <p>🗨️ Ask participants the following questions. Write the answers on the Flipchart.</p> <p>“According to what you have learned, do you think that you are following JS in using reclaimed water at your farm?”</p>

<p>vaccinations are available at MoH free of charge”</p> <ul style="list-style-type: none"> - Users should contact their doctor in case of unusual symptoms and have a check-up at least once a year - Users should wear boots and gloves during work. - After work, users should bathe. - Pesticides should not be diluted or mixed with reclaimed water - Heating ,cooking and cleaning of crops prior consumption - Avoiding contact between crops and reclaimed water after harvesting - The irrigation system should be checked regularly for spraying or broken emitters and pipe leaks - Products that have fallen or are hanging on the ground or the cover mulch should not be marketed - Irrigation should be stopped two weeks before reaping (harvesting) the harvest if reclaimed water was used to irrigate fruitful trees. - Falling fruits and those touching the soil should be eliminated. - Water samples should be analyzed to assure that its quality complies with the required specifications. - Reclaimed water must not be used near water resources, unless it complies with the local standards for groundwater recharge. 	
<p><i>Suggested Method: Group Discussion</i></p>	

EXERCISE

Suggested Exercise: Do/Do NOT Practices for Reclaimed Water Use

Key Statements

- Laws and regulations for wastewater reuse are developed to protect public health and to ensure full reuse benefits
- Controls on the use of reclaimed water for irrigation purposes consists of two main groups: Standards and Guidelines

Appropriate training on basic hygiene is essential, and should include practices to avoid dermal and aerosol exposure to lower quality water

Module 2: Benefits and Risks of Using Reclaimed Water

Introduction

Reclaimed water is the end product of the wastewater reclamation process that meets specific quality standards. Using reclaimed water for agricultural irrigation can mitigate water scarcity and reduce water pollution. Reclaimed water can be considered a safe water resource if used properly under controlled procedures. However, direct users should be aware of the benefits and risks of using reclaimed water to ensure safe, sustainable and reliable reuse practices.

This module addresses the benefits and risks of reclaimed water use from an environmental and health perspective. It is closely related to Module 1 (Laws, and Standards). However, this module focuses on recommendations (rather than restrictions) to help farmers overcome common problems with water reuse. The module aims at encouraging farmers to use reclaimed water most efficiently within a safe environment.

The participants will learn about:

- Advantages of having irrigation water available whole year long
- Elevated nutrient value of effluent that can be partly substitute artificial fertilizers
- Elevated salt concentration and its consequences
- Role of heavy metals in reclaimed water
- Pathogenic load of reclaimed water and simple but effective measures to reduce the health risks for humans and animals. (hygienic practices)

Significance

This training session will build the participants' confidence in using reclaimed water to produce forage crops. Moreover, it will encourage participants to comply with the local standards and guidelines presented in the previous module, in order to ensure safe water reuse. It also will raise the participants' awareness level regarding both the quality of reclaimed water used for irrigation and the crop produced.

Module 2 Table 1. Reclaimed water is being used as a substitute for groundwater in agricultural irrigation. Organic content of reclaimed water provides for crops' nutrient needs

Activity	Toolbox
<p>Trainer to overview the relevant characteristics of reclaimed water.</p> <p>Explain: What is the origin of reclaimed water, and describe its characteristics.</p> <p>Answer: Origin of reclaimed water: Reclaimed water is treated wastewater.</p> <p>Explain that the mechanical-microbiological treatment process removes large amounts of the organic pollution and the storage in large ponds and a subsequent chlorination is reducing the pathogen load to an acceptable level.</p>	<p>Start with a question to get the attention of the audience:</p> <p>🗣️ “What do you know about the quality of the irrigation water you receive?”</p> <p>“What are your main concerns with regard to the water?”</p> <p>Note down the answers on the Flipchart and promise the</p>

<p>Explain that the treatment process cannot remove salt and heavy metals, but that users should be concerned about heavy metals in reclaimed water only if the source of wastewater contains industrial wastes.</p> <p>Explain: The benefits of using reclaimed water in agriculture.</p> <p>Answer: The main advantages are:</p> <ul style="list-style-type: none"> - Its availability all year round - The use of reclaimed water substitutes for ground water, which is important to save and protect an important drinking water resource in Jordan. 	<p>participants that you will review the concerns after the training and see if all concerns were addressed</p> <p>Mention that the specific environment of the town of Wadi Mousa does not have big industries and therefore has moderate pollution loads. Thus, they do not have to be concerned about heavy metals. Make sure that you're mentioning the origin of the reclaimed water used at the site you are providing training for</p>
<p>Suggested Method: Group discussion</p>	

Module 2 Table 2. Reclaimed water contains salt that needs proper management to avoid affecting agricultural production when used for irrigation

Activity	Toolbox
<p>Clarify salt content in reclaimed water. Some salts like Nitrogen, Phosphorus and Potassium are considered nutrients and are beneficial for the plants' growth. They are considered "added value to irrigation water."</p> <p>Other salt like Sodium, Chloride, Sulphates and Carbonates cannot be used by plants. They can cause salt accumulation in soils and reduce plant productivity if not managed properly.</p> <p>Explain: What are proper practices to decrease salt accumulation on both plants and irrigation system.</p> <p>Answer: It is recommended to leach salt in order to decrease its accumulation in the root zone. Adding an estimated extra amount of water to the irrigation water can help wash salt out of the root zone.</p> <p>As for the irrigation networks, flushing the irrigation pipes can remove the accumulated salt inside the irrigation pipes.</p>	<p>Mention that next training session will introduce irrigation techniques and scheduling. The sessions will include the importance of considering leaching factors in irrigation scheduling in decreasing the effects of salt accumulation in the root zone</p> <p>Let participants talk about their own experience in washing out salt from their irrigation networks.</p>
<p>Suggested Method: Group Discussion</p>	

Module 2 Table 3. Reclaimed water produced from treating domestic wastewater does not contain significant concentrations of heavy metals and pathogens

Activity	Toolbox
<p>Trainer to explain that heavy metals and pathogens are not found within significant ranges in reclaimed water produced from treating domestic wastewater. Thus, users do not have to be concerned about them.</p> <p>Pathogens are mainly bacteria and viruses that are harmful to humans (and partly animals). They are present in raw wastewater and detected and measured as e-coliform counts. The treatment of domestic wastewater in WWTPs reduces the pathogen concentration to almost zero.</p> <p>Explain: Best Practices to protect workers, animals and crops.</p> <p>Answer: Trainer to introduce the following practices as the best ones to ensure safe water reuse, according to the WHO guidelines:</p> <ul style="list-style-type: none"> - Use reclaimed water to irrigate fodder crops or crops that humans do not consume directly without being cooked - Wear safety clothing when working in fields - Hand washing after each irrigation - Avoidance of direct contact with reclaimed water or wet soil - Production exposure to sun after harvesting - Using drip irrigation for reclaimed water application into farms - Ceasing reclaimed water application at least two weeks before cattle are allowed to graze - Sprinklers should not be installed for irrigation 	<p>Present the Risk Reduction Model through “barriers” and present some of these barriers (e.g. drip irrigation, hand washing, sun exposure before harvesting).</p> <p>Remind participants about what they had learned from training module 2 regarding following the Jordanian standards in selecting crops to be irrigated under reclaimed water. Explain that this module will facilitate following laws and standards presented in the previous module.</p>

Exercise

Suggested Exercise: *Workgroups to draw barriers chart*

Key Statements

- Irrigation should be stopped two weeks before reaping (harvesting) the harvest if reclaimed water was used to irrigate fruitful trees
- Falling fruits and those touching the soil should be eliminated
- Water samples should be analyzed to assure that its quality complies with the required specifications
- Reclaimed water must not be used near water resources, unless it complies with the local standards for groundwater recharge

References

- World Health Organization. 2006. Guidelines for the safe use of wastewater, excreta and greywater. Volume 2: Wastewater use in agriculture

Module 3: Irrigation Scheduling and Crop Water Requirements

Introduction

The irrigation requirements can be defined as the amount of water needed to meet the water loss through evapotranspiration from a cropped field. Determining the frequency of applying the required water amount is expressed as irrigation scheduling. Proper scheduling can maximize benefits of reuse through saving energy and water, and maximizing the productivity of the planted crops. However, the irrigation method, crop type, climate, and crop type should be considered for irrigation scheduling.

This module introduces factors affecting crop water requirements and discusses how to consider them in scheduling irrigation. It also summarizes the different irrigation methods and their suitability to be used for irrigating using reclaimed water. This module clarifies the importance of planning an effective irrigation scheduling in maximizing the benefits for farmers in terms of yield production and water consumption.

During this module, the participants will learn about:

- Crop water requirements
- Irrigation methods
- Pros and cons of each irrigation methods

Significance

Determining the crops' water requirements and identifying the appropriate irrigation methods will help participants to increase their forage production and improve the water productivity.

Also, participants will learn the importance of proper irrigation scheduling. This will help them to sustain the irrigation networks and reduce the operation and maintenance costs. Accordingly, they will learn how to maximize benefits of reusing water.

Module 3 Table 1. Estimating crop water requirements is important for irrigation scheduling. These requirements differ among different crops and are affected by several factors

Activity	Toolbox
<p>Trainer to describe all factors affecting crop water requirements (CWR). In addition, trainer should clarify differences in seasonal variation in water requirements.</p> <p>Explain: What are crop water requirements?</p> <p>Answer: Crop water requirement is the amount of water required to compensate the evapotranspiration loss from the cropped field. Evapotranspiration stands for both water evaporation from the soil and transpiration of plants (Allen <i>et al.</i>, 1998).</p>	<p>Start with a question to get the attention of the audience:</p> <ul style="list-style-type: none"> ☛ What irrigation techniques do you know? What have you heard about the different irrigation techniques? <p>What problems you are facing with your current irrigation network? Why?</p> <p>How it was rectified? When?</p>

<p>Explain: Factors affecting CWR (Brouwer and Heibloem, 1986).</p> <p>Answer:</p> <ul style="list-style-type: none"> - Weather: Dry, hot and windy weather increases the irrigation water requirements - Type of crop: Different crops require different amounts of water to grow. Give examples: Sudan grass needs more water to survive than Barley - The growth stage of each crop also affects the irrigation water needs. A crop’s growth stages can be classified as Initial stage, Crop development stage, Mid-season stage, and Late season stage. The initial and late season stages need the less water than the crop development stage and the mid-season stage. This is because in the stages with a small leaf area, evapotranspiration is predominantly from water evaporation from soil. The late season stage begins at maturity start till harvesting. During this stage, the crop is harvested, dries out naturally, and reaches full senescence or experiences leaf drop. - Ground Slope: Steeper land needs more water due to less absorption time for the soil. - Type of Soil: In sandy soil, water percolates easily, so more water is required. In clayey soils, less water is required. - Method of Application of water: In drip and sprinkler methods, less water is required than in surface methods. - Method of Ploughing: In deep ploughing, less water is required, because the percolation of water is faster, and vice versa. 	<p>Ask them to justify their answers</p> <p>Discuss with participants the differences in CWR of the different crops planted at their farms, and how they manage it.</p>
<p>Suggested Method: <i>Group Discussion</i></p>	

Module 3 Table 2. Scheduling irrigation is important to keep the root zone wet, which means enough moisture to facilitate the up-take of nutrients

Activity	Toolbox
<p>Clarify how CWR should be reflected in irrigation scheduling to reach the optimum crop production.</p> <p>Explain: Why irrigation scheduling is important for growing crops in arid countries.</p> <p>Answer: First of all, clarify that the purpose of irrigation is to provide the plants with the needed water to compensate for CWR. Define irrigation scheduling as determining the frequency and duration of irrigation (Broner, 2013).</p> <p>Explain that the goal of scheduling irrigation is to apply enough water to fully wet the plant's root zone, while minimizing overwatering, and then allow the soil to dry out in between watering, to allow air to enter the soil and encourage root development (Kumar and Shivay, 2008).</p> <p>Advantages (Broner, 2013):</p> <ul style="list-style-type: none"> - Enables the farmer to schedule water rotation among the various fields to minimize crop water stress and maximize yields. - Reduces the farmer's cost of water and labor through less irrigation, thereby making maximum use of soil moisture storage. - Lowers fertilizer costs by holding surface runoff and deep percolation (leaching) to a minimum. - Increases net returns by increasing crop yields and crop quality. - Assists in controlling root zone salinity problems through controlled leaching. - Results in additional returns by using the "saved" water to expand the irrigated areas. 	<p>Discuss with participants the differences in CWR of the different crops planted at their farms, and how they manage it.</p> <p>Discuss with the participants how they schedule irrigation at their farms.</p> <p>🗣️ Ask the participants what they believe about the effects of irrigation scheduling, over-irrigation and under-irrigation on their crops' production</p>
<p>Suggested Method: Group Discussion</p>	

Module 3 Table 3. Farmer can decide the irrigation technique to be installed according to the farming scheme he or she is planning to use

Activity	Toolbox
<p>Trainer to present a summary of irrigation techniques:</p> <ul style="list-style-type: none"> - Surface irrigation - Drip irrigation - Sprinkler irrigation <p>Explain: Different irrigation methods.</p> <p>Answer (Brouwer <i>et al.</i>,1988):</p> <ul style="list-style-type: none"> - Surface irrigation: Surface irrigation refers to the application of water by gravity flow to the surface of the field. Either the entire field is flooded (basin irrigation) or the water is fed into small channels (furrows) or strips of land (borders). - Sprinkler irrigation: Similar to natural rainfall. - Drip irrigation: With drip irrigation, water is conveyed under pressure through a pipe system to the fields, where it drips slowly onto the soil through emitters or drippers. <p>Clarify that drip irrigation is the safest method to reduce contamination risk. Drip irrigation is particularly suitable for water of poor quality (saline water or treated wastewater). However, sprinkler irrigation is not allowed for reclaimed water irrigation according to the local standards.</p> <p>Irrigation at low efficiency contributes to increasing drainage requirements and causes waterlogging and salinity build-up in many irrigation projects of the world.</p>	<p>Again: Remind participants of what they have learned in module 2 about laws and standards for reusing water. Sprinkler Irrigation is not allowed for the irrigation with reclaimed water and therefore not recommended. The main reason behind this is that direct contact with reclaimed water can cause health problems.</p>

Module 3 Table 4. Proper operation and maintenance is needed for the different irrigation techniques in order to get maximum benefits in producing crops

Activity	Toolbox
<p>Trainer to illustrate possible problems that participants can face operating their irrigation networks.</p> <p>Explain: Problems of irrigation techniques.</p> <p>Answer: According to FAO Salinity Brochure (2005), the following can be considered the main problems of the different irrigation techniques:</p>	<p>Let participants talk about their own experience in maintaining their irrigation networks, and discuss it with all participants.</p> <p>As an exercise, present a case study to the participants including problems in the irrigation network.</p>

<ul style="list-style-type: none"> - Improper irrigation scheme management can cause deterioration of the irrigation network. - Water quality greatly depends upon type and quantity of dissolved salts. - Salts can cause clogging of the nozzle in both drip and sprinkler irrigation techniques. - Damage in the irrigation network <p>In order to solve breaks in irrigation networks, several actions can be taken (Ayers and Westcot, 1994):</p> <ul style="list-style-type: none"> - Fencing the farm can avoid having parts broken by animals - Monitoring and regular maintenance of the irrigation network - Good farm management practices can avoid damaging parts by human activities 	<p>Divide them as groups, and let one of each present the results in front of the other groups to be discussed. Ask for justification for each solution.</p>
<p>Suggested Method: <i>Group discussion</i></p>	

Exercise

Suggested Exercise: Worksheet

Key Statements

- Estimating crop water requirements is important for irrigation scheduling. These requirements differ among different crops and are affected by several factors.
- Scheduling irrigation is important to keep the root zone wet, which means enough moisture to facilitate the up-take of nutrients.
- Farmer can decide the irrigation technique to be installed according to the farming scheme he is planning to use.
- Proper operation and maintenance are needed for the different irrigation techniques in order to get maximum benefits in producing crops

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Module 4: Land Preparation

Introduction

Proper land preparation for growing crops is critical to ensure successful crop growth and profitable production. Land preparation can be referred to establishing a suitable soil environment for healthy seeds germination and a strong stand growth. Land preparation covers a wide range of practices starting from de-stoning, zero tillage through deep ploughing. However, being aware of all needed factors to be considered when planning for planting growth can maximize farms productivity.

This module introduces best practices in land preparation for forage production under reclaimed water. Field preparation includes plowing, de-stoning, weeding, amending soil fertility, leveling, and proper irrigation scheduling.

During this training module, the participants will learn about:

- Factors to be considered in growing forage crops
- How to prepare the land for planting forages
- Scheduling pre-planting activities
- Seeding
- Scheduling irrigation for seeds germination

Significance

Successful forage production requires strong planning for land preparation, to guarantee a successful crop growth. Participants will learn the most proper pre-planting activities needed to grow forages under reclaimed water to maximize benefits. Learning how to schedule and implement all needed activities is essential for a successful, profitable and sustainable forage production.

Module 4 Table 1. It is essential to consider your field environment prior to planning for growing crops

Activity	Toolbox
<p>Trainer to clarify that different forage crop species can be planted under reclaimed water irrigation. For each crop, several requirements are needed for a successful crop growth and robust production.</p> <p>Explain: What are the factors to be considered in growing forage crops?</p> <p>Answer: The following should be considered when planning for growing forages:</p> <ul style="list-style-type: none"> - Land requirements: In general, forage crops grow better in deep soils. - Climate requirements: Forage crops differ in climatic conditions for better growth. Annual forages “<i>give examples, alfalfa</i>” survive both summer and winter seasons. 	<p>🗨️ A proper entry point to initiate a fruitful discussion is asking participants “Why are you growing alfalfa, barley and other forage crops?”</p> <p>Is it the suitability of these forage crops to your farm conditions (soils, irrigation water, labor, available machinery, necessity for your animals)?</p> <p>Is it the marketability of forage produced?</p> <p>Is it the profitability of forage production?</p> <p>The responses will be listed using a chart.</p>

<ul style="list-style-type: none"> - Irrigation water requirements: Forages have different growing seasons, which can affect its irrigation requirement. - Soil properties (texture, depth, drainage, fertility). - Climate requirements (temperature, humidity, frost). - Water requirements which are affected by climate, plant life cycle and length of growing season. - Potential marketing of produced forage. 	<p>Provide examples for each presented factor under (soil properties).</p> <p>Furnish examples to explain that forage plants differ in adaptability to climatic conditions.</p> <p>Give examples to clarify the idea that forage crops have different water requirements.</p> <p>Discuss market demand and desirable attributes of marketable forage.</p>
<p>Suggested Method: Group discussion</p>	

Module 4 Table 2. Preparing your field for planting crops can create a favorable environment for successful crop growth

Activity	Toolbox
<p>Pre-planting activities are needed to create a favorable planting environment for successful establishment and growth of forage plants</p> <p>Explain: What are the pre-planting practices? Answer: Pre-planting practices are all implemented operations before the establishment of forage stand and concluded on the day of seeding. The pre-planting practices include:</p> <ul style="list-style-type: none"> - De-stoning - Weeding - Plowing (deep, surface) - Leveling of fields - Designing and installing irrigation network - Amending soil fertility, if necessary 	<p>Present a table showing the most proper seed depth for different forage crops.</p> <p>The trainer and participants collaborate to summarize the pre-planting practices in a table format</p>

Module 4 Table 3. Proper seeding scheduling can guarantee a successful crop stand

Activity	Toolbox
<p>Trainer to clarify importance of proper seeding to successful establishment and production of forage crops.</p> <p>Explain: What is proper seeding?</p> <p>Answer: Proper seeding is the adherence to the guidelines of seeding operation which specify:</p> <ul style="list-style-type: none"> - Seeding date: The planting date is dictated by the plant's tolerance to the climate conditions prevailing in the targeted area. - Seed placement (seed depth) is positioning seeds in the soil at a specified depth to achieve vigorous, healthy seedlings. - Seeding rate refers to the weight of pure live seeds per unit area (kg per dunum). Proper seeding rate, if properly distributed, usually results in a uniform forage stand without empty spots. - Seeding method refers to the mechanism of placing seeds in the soil. In small-muddy fields, the manual broadcasting method is preferable whereas seed-drilling is more suitable for large fields. <p>Trainer to highlight the importance of keeping soils saturated with moisture before and after seeding to promote seed germination and emergence of the newly developed plantlets.</p> <p>Explain: How is irrigation managed prior to seeding until seed germination?</p> <p>Answer: The recommended irrigation schedule is:</p> <ul style="list-style-type: none"> - On the day preceding seeding date, irrigate the field until soil saturation. - On the day of seeding, irrigate the field for one hour to keep the soil surface wet before sowing. - Seeds of forage crops need around 10 days for full germination. During this germination period, the soil should be kept wet. - After reaching full germination, the fields of newly established plantlets will be irrigated once a week and modified according to weather conditions. 	<p>Present a table showing the most proper seed depth for different forage crops.</p> <p>The trainer and participants collaborate to summarize the seeding schedule adopted by participants prior presenting the most proper one. This table to be used for comparison after discussing the proper one.</p> <p>Discuss with participants the current irrigation schedule they are following at their farms for seeds germination. Draw a list presenting the schedule, and clarify the differences (if any) on schedules followed by participants.</p> <p>Draw a list of the most proper schedule to be followed, and discuss it with participants as to show differences with the schedule they are following.</p>
<p>Suggested Method: Group discussion</p>	

Exercise

Suggested Exercise: Worksheet and solve a case study

Key Statements

- It is essential to consider your field environment prior planning for growing crops.
- Preparing your field for planting crops can create a favorable environment for successful crop growth.
- Proper seeding scheduling can guarantee a successful crop stand.

Module 5: Crop Rotation

Introduction

Crop rotation is defined as the planting of a series of different crops in the same field, following a defined order. Adopting proper crop rotation plan improves the soil structure and fertility. To do so, farmers should be aware about the right varieties of crops and the right schedules for planting and harvesting them.

This module introduces proper post planting practices to ensure the establishment of good crop stands. The essentials to achieve this task include: selection of high-quality seed of an adapted variety, proper seeding (seed placement, seeding rate, seeding method, and timing of seeding), irrigation, fertilizing, weeding and pest control).

This training will provide both on-field and indoor training for the farmers. During the indoor training, the participants will learn about:

- Post-planting activities to grow good stands
- The importance of post-planting activities
- Benefits and types of crop rotation
- Factors considered in rotation planning

The on-field training will allow farmers to practically apply what they have learned during this indoor training. Trainers will work side by side with farmers on their fields in implementing the most proper crop rotation plans.

Significance

Successful crop rotation plan can enhance the agricultural production through proper planning for crop varieties selection and the needed post-planting practices for each crop. Participants will learn the most proper agricultural activities needed to grow selected forage crops under reclaimed water to maximize benefits. In addition, they will learn how to plan for a crop rotation considering all given environmental factors. Accordingly, they can maintain the soil fertility to ensure a profitable agricultural production.

Module 5 Table 1. Proper post-planting plan is important to guarantee a good stand

Activity	Toolbox
<p>Trainer to discuss the importance of post-planting practices to the establishment of forage stand.</p> <p>Explain: What are the post-planting practices?</p> <p>Answer: Post-planting practices are all operations needed to maintain the established forage stands starting from initial growth till the first harvest. The Post-planting practices include the following operations:</p> <ul style="list-style-type: none"> - Applications of fertilizers 	<p>The trainer and participants discuss the post-planting activities and then summarize the outcomes in a table format</p> <p>Divide participants into workgroups. Let groups work on developing scheduled plans for forage rotations.</p>

<ul style="list-style-type: none"> - Weeding - Pest control - Irrigation of established plants - Scheduling forage harvests 	
<p>Suggested Method: <i>Individual Listing, workgroups</i></p>	

Module 5 Table 2. Crop rotation can be planned using different crops as annual and perennial annual rotations in order to improve the soil environment

Activity	Toolbox
<p>Trainer to discuss with participants the concept, benefits and types of forage crop rotations.</p> <p>Explain: What is meant by forage crop rotation?</p> <p>Answer: Forage crop rotation is the practice of growing different forage crops in a preplanned succession on the same land chiefly to preserve the productive capacity of the soil (Florentín et al., 2011).</p> <p>Explain: What are the advantages of forage crop rotation?</p> <p>Answer (Florentín et al., 2011): The main advantages are</p> <ul style="list-style-type: none"> - Improve the fertility of the soil which increases forage production. - Helps in saving on N fertilizers. - Helps in weed control and pest control (breaking the disease cycle). - Diversifies forage production at the farm. <p>Explain: What are the types of forage crop rotations?</p> <p>Answer: In areas using reclaimed water for forage production, two types of forage crop rotations can be distinguished:</p> <ul style="list-style-type: none"> - Annual Forage Rotations: The rotation cycle is one year. <ul style="list-style-type: none"> - <i>Crops:</i> leguminous annual forage in winter (e.g. vetches) and an annual forage grass in summer (e.g. Sudan grass) at the same field. - <i>Main problem:</i> high input costs associated with field preparation (labor, machinery...). - <i>Advantage:</i> production of winter forage (mainly from barley and ryegrass) when other forage sources are not producing. 	<p>Ask participants: Who is adopting crop rotations plans? What plans are they following? Write their answers on flipchart. Promise to discuss their plans at the end of the session.</p> <p>On the flipchart, list the crops that participants are already planted on their fields as rotation.</p> <p>During discussion, illustrate examples for different types of rotations. Ask participants to match the rotation they are following with the illustrated rotation types.</p>

<ul style="list-style-type: none"> - Perennial-Annual Forage Rotations or Alfalfa Forage Rotation: The rotation cycle lasts for five years. <ul style="list-style-type: none"> - <i>Crops:</i> annual forage grass in winter (barley or ryegrass) and an annual forage grass in summer (Sudan grass) at the same field in rotation with alfalfa. <p>It is a dominant rotation in areas using reclaimed water for forage production because of its longevity which reduces costs of inputs</p>	
<p>Suggested Method: <i>Individual Listing, workgroups</i></p>	

Module 5 Table 3. Planning for a proper crop rotation should consider all given conditions

Activity	Toolbox
<p>Trainer to emphasize the factors needed to adopt forage crop rotations.</p> <p>Explain: What are the factors that should be considered to adopt a forage crop rotation?</p> <p>Answer (Florentín et al., 2011): The following factors should be considered:</p> <ul style="list-style-type: none"> - Resources (<i>farm area, amount and timing of available irrigation water, availability of labor...</i>). - Marketing (<i>market capacity, prices of the different forage types, capacity of storing harvested forage...</i>). - Others (<i>climate and anticipated diseases and pests</i>). 	<p>Divide participants into groups and let them draw a plan for crop rotation under given conditions. Draw their plans on flipchart and start discussing them one by one. Let participants from each group evaluate the plans drawn by the other groups.</p>

Exercise

Suggested Exercise: Worksheet and solve a case study

References

- Florentín, M., Peñalva, M., Calejari, A. and R. Derpsch. 2011. Green /manure/Cover Crops and Crop Rotation in Conservation Agriculture on Small Farms. FAO Integrated Crop Management, Vol. 12-2010.

Module 6: Forage Harvest Management

Introduction

Assuring the quality and the quantity of the agricultural production can guarantee a profitable farming business. Both quantity and quality can be affected between the time of harvest and consumption. Losses in quality and/or quantity can decrease the marketability of the agricultural production. For an instance, those losses can decrease edibility, nutritional quality, caloric value, and consumer acceptability of the fresh forages produced. Minimizing pre-post-harvesting losses through following proper harvesting plans is important in reducing those losses and maximizing farming economic benefits.

This module clarifies the different growth stages for common forage crops, to achieve better understanding of crop maturation and readiness to be harvested. In addition, it explains proper schedules and strategies for forage harvest to ensure high-quality marketable forage production. Scheduling harvesting forages should consider the stage of crop maturity, moisture content, and stubble height.

This training will provide both on-field and indoor training for the farmers. During the indoor training, the participants will learn about:

- Pre-harvest practices
- how to know that the crop is ready to be harvested
- Scheduling clipping and harvesting selected forage crops
- Post-harvesting practices to ensure high quality production

Significance

It is important to adopt proper harvesting management strategies to ensure a marketable quality and quantity of forages. Knowing exactly when to harvest can maximize the agricultural production quality and quantity. Participants will learn the most proper pre-post-harvesting activities needed to guarantee a successful agricultural production.

Module 6 Table 1. It is critical to follow a proper harvesting strategy to obtain good yield quality

Activity	Toolbox
<p>Trainer to explain the importance of following the basics of forage harvest management to obtain a good yield of a quality product.</p> <p>Explain: What are the pre-harvest practices?</p> <p>Answer: The pre-harvest practices include the following operations:</p> <ul style="list-style-type: none"> - Stop irrigation at least two days before the intended harvesting date. - Before forage harvest, clear fields of debris (plastic sheet, remnants of irrigation pipes...) that could damage the machinery. - Use sharpened knives on the forage chopper 	<p>Discuss with participants their recommendations for harvesting common crops planted at their farms.</p> <p>Trainer to consider variety of forage crops at the local environment of the study area.</p>

<p>and adjust the cutters to the proper height.</p> <p>Activity Trainer to discuss the importance of following recommendations for harvesting forage plants based on stage of maturity at harvest time and the stubble highest to be remained after harvest.</p> <p>Explain: When to harvest forage stands?</p> <p>Answer: The decision on when to harvest forage stands depends on:</p> <ul style="list-style-type: none"> - <i>Desired forage quality (nutrients content):</i> Determined by the stage of maturity at harvest time. Grasses should be harvested in the vegetative stage and legumes in the late bud stage. <p><i>Persistence of forage plants:</i> Forage plants depend on cutting or stubble height which affects the recovery of cut plants.</p>	
<p>Suggested Method: <i>Workgroup</i></p>	

Module 6 Table 2. Understanding the maturity stage at the harvest time, and the stubble height is critical in deciding harvesting time

Activity	Toolbox
<p>Explain to participants the maturity stage and the stubble height.</p> <p>Explain: What is maturity stage?</p> <p>Answer: Maturity stage is one of the growth stages when forage plant can be harvested without causing detrimental effects on regrowth potential and at the same time optimizing yield and quality of forage.</p> <p>Explain: What is a stubble height?</p> <p>Answer: Stubble height is the height of plants remaining after forage harvesting. It determines the amount of residual leaf area, number of buds and number of stem bases that store food reserves needed for vigorous recovery.</p>	<p>Illustrate both maturity stage and stubble height for different crops. Try to get feedback from participants on the illustration before explaining them.</p>
<p>Suggested Method: <i>Workgroup</i></p>	

Module 6 Table 3. Harvesting techniques and scheduling vary among different forage crops

Activity	Toolbox
<p>Trainer to discuss the flexibility of certain plant species to produce forage, seeds or grains and straws to suit market demand.</p> <p>Explain: What are the practices for production of forage, grains and straws from certain plant species?</p> <p>Answer: The practices are summarized below:</p> <ul style="list-style-type: none"> - Alfalfa for herbage production <ul style="list-style-type: none"> - Seeding date: September - Number of cuts: 8 to 9 cuts per year (yield vary according to plant age, growth stage and climate conditions) - First cut: November - Cuts: 25-30 days interval (depending on regrowth of plants after defoliation) - Alfalfa for seed production <ul style="list-style-type: none"> - Seeding date: September - Number of cuts: 8-9 cuts during each season for 3-4 years. In the fifth year, the number of harvests is reduced to 3, the third cut should be accomplished in late March, and then the plants are left to grow for 45 to 60 days without irrigation till seed maturity - When to harvest seeds: at seed moisture content of 15% or below - Harvesting date: late June to early July - Barley for herbage production <ul style="list-style-type: none"> - Seeding date: September-October - Number of cuts: 4 times during the growing season. The plants should be severed at the vegetative stage. The expected dates of cuts are November, March, April and May. - Barley for hay production <ul style="list-style-type: none"> - Seeding date: September-October - Number of cuts: one time in November to enhance tillering - The plants are left to grow until reaching the heading stage (Flower head emerging or emerged from flag leaf sheath but not shedding pollen) to produce good quality hay 	<p>Discuss with participants their recommendations for harvesting alfalfa, clover, barley, ryegrass and Sudan grass forage crops</p> <p>Explained harvesting barley for producing herbage, grains and straws as an example: If barley was sown in September-October, then the first cut to obtain green herbage could be in January. Grains and straws of barley could be obtained in May after plants reach full maturity</p>

<ul style="list-style-type: none"> - Barley for production of herbage, grains and straws <ul style="list-style-type: none"> - When to cut: at the vegetative stage to obtain fresh herbage, then left to reach the grain production stage - Harvesting mature barley plants will provide grains and straws. - Ryegrass for forage production <ul style="list-style-type: none"> - Seeding date: September - When to harvest: can be harvested when plants reach the boot to early head stage. - First cut: when the plants are in the late vegetative to early boot stage of maturity. <p>The second cut: is expected after 20-30 days if nitrogen fertilizers were applied immediately after the first cut</p>	
<p>Suggested Method: <i>Workgroup</i></p>	

Module 6 Table 4. To increase the marketability of your crop production it is important to follow proper harvesting practices

Activity	Toolbox
<p>Trainer to discuss the post-harvest practices needed to produce quality forage.</p> <p>Explain: What are the post-harvest practices?</p> <p>Answer: The following practices are performed on the harvested forage:</p> <ul style="list-style-type: none"> - Windrowing - Racking - Baling - Marketing <p>Activity</p> <p>Trainer to highlight the importance of producing a marketable forage crop to maximize benefits.</p> <p>Explain: What is marketable forage crop?</p> <p>Answer: The criteria of a marketable forage crop include:</p> <ul style="list-style-type: none"> - Leafiness - Greenish color - Good smell - Free of foreign materials 	<p>At the end of the training session, participants will be given an exercise to plan and schedule harvesting for a demo farm. Participants will be provided with all needed information for the plan. Let them work in groups</p> <p>Trainer to consider variety of forage crops at the local environment of the study area.</p>
<p>Suggested Method: <i>Workgroup</i></p>	

Exercise

Suggested Exercise: Worksheet and solve a case study

Key Statements

- It is critical to follow up a proper harvesting strategy to obtain good yield quality.
- Understanding the maturity stage at the harvest time, and the stubble height is critical in deciding harvesting time.
- Harvesting techniques and scheduling vary among different forage crops.
- To increase the marketability of your crop production, it is important to follow proper harvesting practices.

Module 7: Basics of Livestock Management

Introduction

Livestock management aims at ensuring the safety and profitability of the goods produced from animals. Management strategies may involve different animal growth stages, products and requirements. Proper management can control animal health, animal welfare, biosecurity and traceability. Knowing that livestock is an important part of the agricultural business where it represents the market for the forage production.

This module aims to analyze current feeding practices of sheep and goats, highlight limitations and suggest alternative practices suitable for sustainable animal production. Participants will learn about nutritional issues in using the available feedstuffs during the different physiological stages of does and ewes.

The potential use of alternative feedstuffs will be discussed to improve feeding practices in order to generate more income from sheep and goat production.

During the indoor training, the participants will learn about:

- Traditional management of sheep and goats
- Traditional nutrients for sheep and goats during different physiological stages
- Nutrient requirements of ewes and does during different physiological stages
- Proper nutrition for sheep and goats
- Feed calendar and potential interventions
- Feedstuff: amount, quality, seasonality and types
- General feeding guidelines for sheep and goats

Significance

Participants will learn the differences in nutrition needs through different growth stages of these animals. This will help them plan the road map for a successful business. In addition, it will maximize their benefits through avoiding costly mistakes caused by poor animal nutrition and management.

Optimizing nutrition supply for animals will decrease their susceptibility to diseases. Growing healthy animals will ensure a successful business.

Module 7 Table 1. Good timing of scheduling practices in managing sheep and goats rising can be a key factor in success production

Activity	Toolbox
<p>Trainer to explain that a good management is needed for a successful sheep and goat production. Also, trainer to clarify the traditional management of sheep and goats in Jordan. Management of sheep and goats includes managing their growth, health, breeding, and production.</p> <p>Explain: Why raise sheep and goats?</p> <p>Answer:</p> <ul style="list-style-type: none"> - Adaptability of sheep and goats to local conditions (feed resources, climate 	<p> <i>Asking questions in the following way will attract the attention of the audience:</i></p> <p><i>“Why do farmers raise sheep and goats? What are the main characteristics of these animals??”</i></p> <p><i>Participants will be given the opportunity to discuss the obstacles that face the production of sheep and goats to agree on practical</i></p>

<p>conditions...).</p> <ul style="list-style-type: none"> - Financial limitations do not promote large scale animal-enterprise (e.g. dairy cattle). - High potential for marketing animal products in local markets. <p>Explain: The traditional management of sheep and goats in Jordan.</p> <p>Answer:</p> <ul style="list-style-type: none"> - Sheep and goat production is concentrated in Jordan Badia. - Ewe-lamb and doe-kid production are the dominant animal enterprises or practices. - The main outputs of these practices are: selling of young animals (lambs and kids) and milk production after weaning of young. - Lambs and kids are weaned at 45-75 days old (depending on prices of milk and lambs, financial situation of farmers....). - Weight of weaned lambs ranges between 13 to 17 kg. - The weaned lams and kids are marketed in late winter and early spring (December to February). - Milk production, excluding the amount used for home consumption or for suckling the young, is around 90 to 120 kg per lactating female. - Milk sales continue from early spring to early summer (February to May). - The majority of milk produced is sold to merchants for making cheese and jameed. - In general, production levels (milk production, fertility...) of sheep and goats are low compared to those of the regional and international levels. - Sheep and goats are routinely handfed on barley grains, straws and wheat bran for most of the year. - Limited grazing resources (degraded rangelands, stubble of cultivated fields, and range reserves). <p>Explain: What are the main constraints to sheep and goat production?</p> <p>Answer:</p> <ul style="list-style-type: none"> - Shortage of forage resources (energy source). - Low protein content in feedstuffs (unbalanced feeds). - Poor animal health (lack of vaccination programs). 	<p><i>solution(s) or potential entry points to alleviate some of these constraints. Summarize the answers on the Flip chart, and categorize in (social, economic, experience, financial limitations...)</i></p> <p><i>Trainer to consider the local traditions and environment to be changed in the module</i></p>
<p>Suggested Method: Group discussion</p>	

Module 7 Table 2. Management of sheep and goats nutrition should be efficient and economical, and should support optimum production

Activity	Toolbox
<p>Trainer to explain the nutrition requirements of sheep and goats, and their function.</p> <p>Explain: What are the nutrient requirements for sheep and goats?</p> <p>Answer:</p> <ul style="list-style-type: none"> - Sheep or goat (host animal) provides the rumen microbes (bacteria, yeast...) with ideal continuous fermentation conditions: nutrients, water, waste removal. - Microbes ferment plant fiber and starch to produce energy to make new cells. The fermentation by-products are: volatile fatty acids (VFA), carbon dioxide and methane. - VFA absorbed by host via rumen papillae and used to supply energy or for synthesis of fat or glucose. - Besides energy, the host animal obtains the following: Vitamins (B-complex, K), essential amino acids from microbial cells. - It is a tradeoff relationship between the host animal (ruminant) and rumen microbes. - There are three main groups of rumen microbes: <ul style="list-style-type: none"> • Bacteria carry out most of the digestion of sugars, starch, fiber, and protein. • Protozoa swallow and digest bacteria, starch granules and some fiber. • Fungi make up only a small fraction of the rumen microbial population and appear to be important in splitting open plant fibers to make them more easily digested by the bacteria. <p>Explain: What is the composition and function of feedstuffs?</p> <p>Answer:</p> <ul style="list-style-type: none"> - Feeds consist of water and dry matter. - Dry matter of feed can be divided into two groups: Organic Matter (OM) and Inorganic Matter (IOM) - Organic Matter in feed consists of: <ul style="list-style-type: none"> - Nitrogenous compounds (crude protein, CP) 	<p>Show figure for Ruman Microbes and explain it to participants</p> <p>Show tables of Local feedstuffs and daily nutrient requirements</p>

<ul style="list-style-type: none"> - Nitrogen-free compounds (Energy) - A shortage of protein in animal feed will result in: <ul style="list-style-type: none"> - Low milk production in lactating animals - Loss of body weight in early lactation - Increased risk of infections and metabolic diseases. - Low fertility. - Nitrogen-free compounds (Energy) can be subdivided into two groups: <ul style="list-style-type: none"> - Carbohydrates (crude fiber and nitrogen free extract): provide energy for maintenance and production. A surplus of energy is stored as body fat. - Lipids (fats): provide energy and fat soluble vitamins (DEAK) - Inorganic Matter <ul style="list-style-type: none"> - Inorganic matter is called ash or minerals which are important for animals. <p>Minerals can be provided to animals with mineral blocks or with mineral mixture in concentrates.</p>	
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Module 7 Table 3. Proper nutrition plan can maximize benefits for those rising sheep and goats

Activity	Toolbox
<p>Proper nutrition of sheep and goats (young, dams and males) will be discussed to highlight general feeding guidelines to be adopted by individual farmers or a group of farmers to promote the idea of cooperative work.</p> <p>Explain: What do we mean by proper nutrition?</p> <p>Answer: Meeting nutrient requirements of animals during the different physiological stages.</p> <p>Explain: What are requirements for proper nutrition?</p> <p>Answer:</p> <ul style="list-style-type: none"> - Knowing the nutrient requirements of animals. - More dependence on local feedstuffs if possible. - Flexibility in using alternative feedstuffs taking into consideration the quality and economic dimensions. <p>Provision of high quality roughages (forage crops) as a source of fiber.</p>	<p>Show tables of “daily intake of feedstuffs” on dry matter basis, and as is basis. Show tables of daily intake of nutrients for example forage crops</p> <p>Draw a table on the Flipchart, and ask participants to fill in it with feeding stuff they are using. Try to address all kinds of feeding stuff they are using locally. Then, ask them to classify this stuff according to the nutrient contents</p>
<p>Suggested Method: Workgroup</p>	

Exercise

Suggested Exercise: Workgroups to classify local feed stuff according to the nutrition content

Key Statements

- Good timing of scheduling practices in managing sheep and goats rising can be a key factor in success production
- Management of sheep and goats nutrition should be efficient and economical, and should support optimum production
- Proper nutrition plan can maximize benefits for those rising sheep and goats

Module 8: Financial Management for Water Users associations

Introduction

Financial management refers to direct accounting, investing, banking and all other financial activities. Proper financial management is considered a tool to ensure the sustainability of co-operatives through maintaining sufficient levels of equity capital.

This module presents fundamentals of financial management to water users associations. In addition, it will provide basic accounting and financial reporting skills as well as elements of short term and long term business planning principles.

During the training, the participants will learn about:

- Foundations of Accounting Cycles and Records.
- Internal Control Policies and Procedures.
- Costing and Break Even Analysis.
- Cash Forecasting and Management.
- Operational Budgeting.
- Capital Budgeting.
- Guidelines for Funds Management such as Revolving Funds.

Significance

The training aims to provide the association administrative body with a toolbox for use in costing analysis, identifying optimal use levels, and using the results of these analyses in pricing the current and future services. Furthermore, trainees will be introduced to fundamentals of budgeting and long term planning. As a result, the association is expected to improve its return on assets and capital employed, and to venture into new business initiatives. The association's success in improving the rewards to its members and local community in general will allow the association to expand its services umbrella and access new funding opportunities.

Module 8 Table 1. Reviewing current financial status and developing new accounting cycle will support planning the next steps in Association's management

Activity	Toolbox
<p>Trainer to initiate a discussion on issues noted in prior year's performance and emphasize the relevance of training agenda to problems encountered in the past.</p> <p>Explain: Clarify the training objectives, agenda and elements of accounting cycle and books.</p> <p><i>Accounting cycle refers to "the collective process of recording and processing the accounting events of a company."</i></p> <p>The nine steps of the accounting cycle are:</p> <ol style="list-style-type: none"> 1. Collecting and analyzing data from transactions and events. 2. Putting transactions into the general journal. 3. Posting entries to the general ledger. 4. Preparing an unadjusted trial balance. 5. Adjusting entries appropriately. 	<p>Present an overview of accounting records, ledgers, statements, terminologies and definitions that will be used throughout the training</p> <p>Clarify that participants will receive the most appropriate procedures in financial management</p> <p>On the Flipchart, write down a list of the current procedures followed in financial management of the association.</p> <p>Explain that by the end of the training, participants will be asked to decide which procedure they will</p>

<p>6. Preparing an adjusted trial balance. 7. Organizing the accounts into the financial statements. 8. Closing the books. 9. Preparing a post-closing trial balance to check the accounts.</p> <p>High level briefing on historical accounts of society and issues that require the WUA board members attention and how training can address issues identified.</p> <p>Trainees encouraged suggesting other areas with potential room for improvement.</p>	<p>keep following from the list</p>
<p>Suggested Method: Group discussion</p>	

Module 8 Table 2. Tracking the association cash flow using a simple tool of breakeven analysis (Hollans, 1998)

Activity	Toolbox
<p>Illustrate the use of breakeven analysis in performance evaluation and pricing decisions.</p> <p>Explain: What is break-even analysis?</p> <p>Answer: “<i>The break-even analysis calculates the point where your business has reached a zero balance. And it is based on two types of costs (Holland, 1998):</i></p> <ul style="list-style-type: none"> - Fixed costs: overhead-type expenses that are constant and do not change as the level of output changes. - Variable costs: expenses that are not constant and that do change with the level of output. <p>Describe the basic equation for the break-even analysis. Explain that the calculation of break-even considers the following:</p> <ul style="list-style-type: none"> - Time frame - Average price of each product/service sold - Average cost of each product/service to make/deliver - Fixed costs 	<p>Present real-life examples from the association’s historical accounts on the application of breakeven analysis.</p> <p>Discussion will encompass an overview of fixed vs. variable costs, break even analysis, and its use in service pricing.</p> <p>Introduce a simple worksheet as a break-even calculation tool. Explain all items included in the calculation.</p> <p>In order to teach participants how to use it, ask them to give a real example from their association and start filling the worksheet with them. At the end, let participants express and interpret results.</p>
<p>Suggested Method: Group discussion</p>	

Module 8 Table 3. Budgets for sales, manufacturing costs, merchandise purchases, selling expenses, general and administrative expenses are estimated within operational budgets (Plyman, 2009)

Activity	Toolbox
<p>Trainer will present elements of revenue projection including demand, pricing from current and future services. Furthermore, session will include presentation of major elements of operating expenses as wages, fuel, maintenance and how to forecast in line of revenues projected.</p> <p>Explain: What is an <i>operating</i> budget?</p> <p>Answer (Pylman, 2009): <i>Operational budget is “the annual budget of an activity stated in terms of Budget Classification Code, functional/sub-functional categories and cost accounts.”</i></p> <p>It contains estimates of the total value of resources required for the performance of the operation including reimbursable work or services for others. It also includes estimates of workload in terms of total work units identified by cost accounts.</p> <p>Explain: Importance of operational budgeting as (Pylman, 2009):</p> <ul style="list-style-type: none"> - Provide a forecast of revenues and expenditures - Enable the actual financial operation of the business to be measured against the forecast <p>Trainer to present the types of operational budgeting:</p> <ul style="list-style-type: none"> - Line Item - Program - Performance - Zero-Base 	<p>Present elements of revenue projection including demand, pricing from current and future services.</p> <p>Present major elements of operating expenses as wages, fuel, maintenance and how to forecast in line of revenues projected.</p> <p>Throughout the training, develop a list of recent activities included within the annual budget of the WUA. At the end of the session, divide participants into groups and let each group develop a budget for one of the listed activities. Finally, discuss their results among participants.</p>
<p>Suggested Method: <i>Group discussion</i></p>	

Module 8 Table 4. Capital budgeting is the process of deciding whether or not to undertake an investment project

Activity	Toolbox
<p>Trainer will start by presenting the concept of time value of money and its significance in capital budgeting, followed by illustrating the concept of capital project and the difference from an operating expenditure.</p> <p>Trainer will introduce the capital budgeting decision rules as payback period, Internal Rate of Return and Net Present Value.</p> <p>Explain: The two standard concepts used in capital budgeting</p> <p>Answer (Benninga, 2010):</p> <ul style="list-style-type: none"> - <i>Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV analysis is used in capital budgeting to assess the profitability of an investment or project.</i> - <i>Internal rate of return (IRR) is the discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero.</i> <p>Illustrate how to calculate NPV and IRR.</p> <p>Explain: How to use NPV and IRR</p> <p>Answer:</p> <ul style="list-style-type: none"> - <i>Choosing whether or not to undertake a single project</i> <ul style="list-style-type: none"> - <i>Only projects with NPV >0 should be undertaken</i> - <i>Only projects with IRR exceeds an appropriate discount rate, should be undertaken</i> - <i>Comparing two mutually exclusive projects</i> <ul style="list-style-type: none"> - <i>Project A is preferred to project B if NPV (A) > NBV (B)</i> - <i>Project A is preferred to project B if IRR (A) > IRR (B)</i> 	<p>Trainer to ask participants to provide real examples of some investments already made by the association. Start applying the capital budgeting on these examples as a tool for explaining. At the end of the session, give participants an exercise on the listed investments to work on as groups.</p> <p>Trainer will Illustrates cash flow estimation, which is composed of measuring costs incurred in capital projects and benefits expected.</p> <p>Finally trainer will show a consolidated capital and operational budgets for the aim of identifying cash surpluses or shortages and amount of external funding needed if any.</p>
<p>Suggested Method: Group discussion</p>	

Module 8 Table 5. Cash budgets are often used to assess whether the entity has sufficient cash to fulfill regular operations and/or whether too much cash is being left in unproductive capacities

Activity	Toolbox
<p>Trainer will introduce the concept of cash flow projection and illustrate a number of funding options available to finance capital projects.</p> <p>Explain: What is cash budgeting</p> <p>Answer (Fabozzi and Petrerson, 2003): <i>“Cash budgeting is an estimation of the cash inflows and outflows for a business or individual for a specific period of time.”</i></p> <p>Explain: Importance of Cash budgeting</p> <p>Answer (Fabozzi and Petrerson, 2003): <i>“A cash budget is extremely important, especially for small businesses, because it allows a company to determine how much credit it can extend to customers before it begins to have liquidity problems.”</i></p>	<p>Trainer to suggest an evaluation and ranking criteria of potential projects.</p> <p>Develop a simple business plan for a desired project, asses and recommend necessary steps to implement the project.</p>
<p>Suggested Method: Group discussion</p>	

Exercise

*Suggested Exercise: Suggested Exercises: Break-even analysis (for individuals)
Budgeting (working groups)*

Key Statements

- Reviewing current financial status and developing new accounting cycle will support planning the next steps in Association’s management
- Tracking the association cash flow using a simple tool of breakeven analysis
- Budgets for sales, manufacturing costs, merchandise purchases, selling expenses, general and administrative expenses are estimated within operational budgets

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Module 9: Cooperative Farming Society

Introduction

Agribusiness encompasses many aspects of the economy: agricultural production, businesses that provide supplies and services to the producers, businesses that add value to agricultural products, and those that facilitate the marketing of agricultural products to an ever-growing marketplace. All these functions require management. Co-operatives can be established to manage one or more agribusiness functions, from production to marketing.

This training module covers skills that will assist farmers in forming co-operatives. This module presents the basics of agricultural cooperatives and their governance. It also describes the services provided by cooperatives and the short-term and long-term benefits to be gained by forming cooperatives. Among the many benefits of operating together, forming cooperatives will enable farmers to acquire assistance from various government departments and programs.

During the training, the participants will learn about:

- Basics of agricultural cooperatives
- Types, principles and levels of agricultural cooperatives
- Pillars of a successful cooperatives
- Cooperative service provision
- Economic, environmental, and social benefits of agricultural cooperatives

Significance

The training aims to trigger a paradigm shift from tradition to business. It will enhance participants' capacity to plan, establish, and manage an agricultural cooperative. It also will improve participants' potential and readiness to exchange knowledge and experience concerning the business activities of agricultural cooperatives.

This module focuses on the formation and development of cooperatives, to enable the groups to build their own organizations in ways that meet the farmers' shared agribusiness needs. It will also enable them to form partnerships with government in service delivery and to use these organizations for mutual support and information dissemination. The formation and development of farmer organizations/co-operatives is important, so they can have sustained livelihoods, create jobs, mobilize resources, generate investments, and gain economic empowerment. It will also enhance social reform and food security.

Module 9 Table 1. Agricultural cooperatives can be considered a form of "Economic Synergy" where "two or more farmers work together to produce a result not obtainable by any of the farmers independently"

Activity	Toolbox
<p>Trainer will introduce the concept of a Cooperative association and explains the types.</p> <p>Explain: What is a cooperative association?</p> <p>Answer: <i>"A cooperative is an autonomous</i></p>	<p>Explain that cooperative development is tailored to the needs of the group members and designed to be appropriate to the development context.</p>

association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly owned and democratically controlled enterprise”

Explain: What is an *agricultural* co-operatives association?

Answer (GEAC, 2010): An agricultural co-operative is a co-operative that produces, processes, or markets agricultural products and that provides agricultural supplies and services to its members.

Agricultural co-operatives are based on the values of self-help, self-responsibility, democracy, equality, equity and solidarity. In the tradition of their founders, co-operative members believe in the ethical values of honesty, social responsibility and caring for others.

Explain: Principles of the agricultural co-operatives

Answer (GEAC, 2010):

- Democratic member control
- Voluntary and open membership
- Autonomy and independence
- Educational training and information
- Co-operation among co-operatives
- Concern for the community
- Economic participation of members

Explain: Types of agricultural Cooperatives?

Answer (GEAC, 2010):

1. *Production co-operatives* permit farmers to organize their farms as co-operative corporations.
2. *Supply co-operatives* purchase products and services and required inputs for agricultural production for their members.
3. *Service co-operatives* provide a wide variety of services and were initially formed to serve farmers with services, such as horticultural advice, that are otherwise very expensive for an individual farmer to obtain.
4. *Agricultural marketing co-operatives* are frequently organized according to farm

Provide state of the art case studies, to illustrate that cooperatives help to professionalize management, scale up production and apply quality control standards.

Trainer to illustrate how cooperatives develop human capital by encouraging the participation of women and youth.

<p>commodity or groups of commodities, such as sugar, grains, maize and poultry; their function is to produce or (usually) store and market agricultural products. Marketing co-operative structures may also function as contract- and price-bargaining co-operatives, or may be involved in processing, assembling, packaging, and selling members' products to both domestic and foreign markets.</p> <p>5. <i>Purchasing co-operatives</i> buy supplies and goods and sell these at a reduced price to members. These services reduce costs for members. This type was first used by farmers to gain access to affordable and quality supplies such as feed and fertilizers.</p>	
<p>Suggested Method: <i>Group discussion</i></p>	

Module 9 Table 2. Cooperatives can be a strong source of credit to subsistence and small-scale farmers

Activity	Toolbox
<p>Trainer to explain how can agricultural cooperatives play an important role in supporting small agricultural producers and marginalized groups such as young people and women.</p> <p>Explain: Cooperatives are pillars for agricultural development and food security</p> <p>Answer (FAO, 2012): Cooperatives offer small agricultural producers opportunities and a wide range of services, including improved access to markets, natural resources, information, communications, technologies, credit, training and warehouses.</p> <p>They also facilitate smallholder producers' participation in decision-making at all levels, support them in securing land-use rights, and negotiate better terms for engagement in contract farming and lower prices for agricultural inputs such as seeds, fertilizer and equipment.</p> <p>Through this support, smallholder producers can secure their livelihoods and play a greater role in meeting the growing demand for food in local, national and international markets, thus</p>	<p>Cooperatives can achieve sustainable livelihoods, improve food security in their communities and play a greater role in meeting the growing demand for food in local and national markets.</p>

contributing to poverty alleviation, food security and the eradication of hunger.	
Suggested Method: Group discussion	

Module 9 Table 3. Through cooperatives, farmers can mobilize capital, pool knowledge, create greater leverage in the marketplace and the policy arena, attract private sector investment, and more efficiently link to local markets

Activity	Toolbox
<p>Trainer to explain the different levels of agricultural co-operatives and the strong points of each. Discuss with participants what level of co-operatives they are in (if any), and ask whether they plan to join other levels. Ask them what challenges they have when planning for new co-operative level.</p> <p>Explain: Levels of agricultural co-operatives</p> <p>Answer (GEAC, 2010):</p> <ul style="list-style-type: none"> • Primary agricultural co-operatives • Secondary agricultural co-operatives • Tertiary agricultural co-operatives (Apex) <p>Explain: What is a <i>primary agricultural co-operative</i> and what are its purposes?</p> <p>Answer: A primary agricultural co-operative is a co-operative in which all the members are individuals. The purpose of a primary agricultural co-operative is to provide employment or services to its members and to promote community development. Members pool their resources to offer services to others. Members can raise funds for the benefit of their colleagues. Mostly, primary co-operatives exist at the local level.</p> <p>Explain: What is a <i>secondary agricultural co-operative</i> and what are its purposes?</p> <p>Answer: A secondary agricultural co-operative is a co-operative in which two or more primary co-operatives, including juristic persons, can form a secondary co-operative. The members are primarily agricultural co-operatives. The purpose of a secondary co-operative is to provide services to its members relating to the sector in which they</p>	<p>Emphasize how farmers can be empowered by being a part of a larger group; farmers can negotiate better terms in contract farming and lower prices for agricultural inputs like seeds, fertilizers and equipment</p> <p>Explain how cooperatives can cooperate with policy makers in the design and implementation of policies, laws, regulations and projects that take into consideration the needs and concerns of farmers</p>

<p>are active. Most of secondary co-ops exist at the district level.</p> <p>Explain: What is a <i>tertiary agricultural co-operative</i> and what are its purposes?</p> <p>Answer: A tertiary agricultural co-operative is a co-operative in which two or more secondary co-operatives, including juristic persons, can form tertiary co-operatives. The purpose of a tertiary agricultural co-operative is to advocate the interests of the member co-operatives to government bodies, the private sector and other stakeholders.</p>	
<p>Suggested Method: <i>Group discussion</i></p>	

Module 9 Table 4. Pillars of successful cooperative are: members' shared vision and goals, branding, competitiveness, and building alliances

Activity	Toolbox
<p>Explain: Why adopt cooperatives?</p> <p>Answer (GEAC, 2010):</p> <ul style="list-style-type: none"> • Improved bargaining power • Reduced purchasing power • Obtain market access or broaden market opportunities • Improve products or service quality • Obtain products or services otherwise unavailable • Reduce cost/increase income <p>Explain: Benefits of forming cooperatives?</p> <p>Answer (GEAC, 2010):</p> <ul style="list-style-type: none"> • Achieve what one cannot achieve on his or her own • Provide easy access to needed services • Pay less for inputs, marketing, distribution and selling of produce • Process products if necessary 	<p>Ensuring regular, frequent, and meaningful interaction between members will promote members harmony</p> <p>Branding will effectively promote the quality and fair prices of the cooperative products and services.</p> <p>To stay competitive, cooperatives need a responsive governance structure that is able to make rapid business decisions.</p>
<p>Suggested Method: <i>Group discussion</i></p>	

Exercise

Suggested Exercises: Basic practices of an agricultural cooperative (working group)

Key Statements

- The cooperative can be considered a form of “Economic Synergy” where “two or more farmers work together to produce a result not obtainable by any of the farmers independently”
- Cooperatives can be a strong source of credit to subsistence and small scale farmers
- Through cooperatives, farmers can mobilize capital, pool knowledge, create greater leverage in the marketplace and policy arenas, attract private sector investment, and more efficiently link to local markets
- Pillars of successful cooperative are: shared visions and goals, branding, competitiveness, and building alliances

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Module 10: Alfalfa Seeds Production

Introduction

Alfalfa (*Medicago sativa*) is a deep rooted perennial forage crop with a growing season of five years. It is considered one of the major forage crops grown under fresh and reclaimed water. The produced alfalfa hay is being used as feed stuff for dairy cattle, horses and small ruminants.

The variety and quality of alfalfa seeds can affect the strength and health of the crop stands. The different characteristics of each variety can affect stand persistence and productivity. Good alfalfa stands that already showed a successful growth can guarantee producing seeds that can be replanted to grow other successful plants (Alfalfa Production Handbook).

This module introduces a model farm for producing alfalfa seeds. The module presents most proper schedule for agricultural practices needed to grow profitable and healthy alfalfa seeds.

During the training, the participants will learn about:

- Land preparation practices needed to grow alfalfa crop
- Most proper planting schedules
- Scheduling alfalfa cuts
- Pre-harvesting practices for alfalfa seeds
- Harvesting and marketing alfalfa seeds

Significance

Participating this training, farmers will learn best agricultural practices and schedules to grow alfalfa. They are expected to start harvesting alfalfa seeds at their farms by the end of their crops season. Part of the produced seeds will be replanted to establish new alfalfa stands. In addition, selling the rest of the seeds can offer an extra income resource for the farmers. Producing alfalfa seeds by the end of the crop season can save farmers cost and effort in finding good ones at the local market.

Module 10 Table 1. For a successful alfalfa production, growth requirements should be considered. To establish a strong stand, choose a good quality seed

Activity	Toolbox
<p>Trainer to introduce alfalfa as a forage crop that can be grown under reclaimed water.</p> <p>Explain: Alfalfa is the most preferable forage crop that can be grown for up to 6 years when establishing properly.</p> <p>Answer: Alfalfa is the most preferable forage crop as it is considered as the most profitable. Besides, it is the most favorite forage crop to feed livestock.</p> <p>For a long-term profitable alfalfa production, it is important to plan to initially obtaining a strong stand.</p>	<p>Ask participants: What are the most favorable forage crops at the local market?</p> <p>Discuss with them the availability of the seeds at the local market. Ask them if they tried different varieties of alfalfa seeds, and whether they found any differences on the crop growth or not. Address the reasons with their perspectives on the flipchart. Promise to discuss them at</p>

<p>Take advantage of the productive capabilities of alfalfa by establishing a thick vigorous stand of seedlings.</p> <p>Explain: what are the growing requirements for alfalfa?</p> <p>Answer (Paul <i>et al.</i>, 2005): Alfalfa grows better on deep soils that have adequate drainage. However, deep soils encourage development of extensive tap-root system of alfalfa, which helps the plant utilizing water and nutrients from a large volume of soil. A soil pH range of 6.5 to 7.0 is ideal for establishment and development of alfalfa, although the plant can be established and can thrive at a higher pH. In order to establish a good stand, two critical requirements are needed; a firm, clean seedbed (relatively free of residue) and a smooth, uniform surface. As described below, the pre-post planting activities are reflecting these two requirements.</p> <p>Explain: Common alfalfa variety already showed successful growth in Jordan under reclaimed water.</p> <p>Answer (Alfalfa Production Handbook): Alfalfa (<i>Medicago sativa</i>) is a purple-flowered, predominantly upright. This variety is being grown successfully in Jordan as a forage crop. Good quality and healthy plants surviving a unique environment can guarantee producing seeds with high germination percentages at that environment.</p>	<p>the end of the training session.</p> <p>Discuss with participants the challenges they are facing while establishing new alfalfa stands. Let them draw a list for their answers to be discussed in groups at the end of the session.</p> <p>Justify presenting a model farm for producing alfalfa seeds.</p>
<p>Suggested Method: Group discussion</p>	

Module 10 Table 2. Proper planning for planting dates and rates of alfalfa crop can guarantee a successful growth and healthy production

Activity	Toolbox
<p>Trainer to discuss the most proper schedules for planting alfalfa. Show the differences in crop growth, and challenges adopting both schedules.</p> <p>Explain: Most proper planting schedules for alfalfa.</p> <p>Answer: Alfalfa can be planted either in the spring (April) or late summer (September):</p> <p><i>Spring plantings</i> allow the establishment without the risk of freezing. There is a high chance of weed competition with spring plantings. Thus, increasing the need for using incorporated herbicides before planting</p>	<p>Discuss with participants their farming plans and schedules for alfalfa crop. Again, let them write their answers as individuals to be discussed later.</p> <p>Address challenges that farmers may experience adopting improper planting dates and rates for alfalfa.</p> <p>Illustrate the recommended agricultural practices for developing</p>

<p>alfalfa seeds in order to reduce weeds. The crop yield during the establishment year (first year) is considerably lower than those planted late-summer.</p> <p><i>Late summer plantings</i> usually have fewer weeds growth competition. The soil moisture would be with a limited availability for germination and establishment prior to frost. A late-summer planting should be done in mid-September, as moisture and temperature conditions are suitable then.</p> <p>Explain: The importance of preparing the seedbed for seeds germination prior planting.</p> <p>Answer (Paul et al., 2005): The perfect alfalfa seedbed should be firm to reduce air pores, can provide an even covering of seed, and can be leveled with no water runoff. Soil surface should be cleaned for weeds that compete with seedlings for moisture and plant nutrients. It is important to prepare the seedbed following the most proper schedule to reduce establishment costs, moisture loss, and to maximize crop productivity.</p> <p>Explain: Clarify the land preparation activities needed to produce alfalfa seeds (seed bed preparation).</p> <p>Answer:</p> <p>For spring plantings, seed bed preparation should take place in April. And for late summer plantings, seed bed preparation should start on August. Land preparation for seed bed preparation to grow alfalfa can be summarized as:</p> <ol style="list-style-type: none"> 1. Leveling the field using a grader 2. Deep plowing using a moldboard plow to break the hard pan, expose buried roots to the surface and facilitate stone-picking. 3. Wetting the field to stimulate the germination of seeds present in the soil as a preventive measure to control the weeds. This step is important to avoid the use of herbicides that probably affect the flowering and seed formation of alfalfa plants. 	<p>a strong alfalfa stand. Make sure that you leave a space for other practices to be added later during the session. Draw the schedule as time frame table.</p>
<p>Suggested Method: Group discussion</p>	

Module 10 Table 3. Alfalfa seeds are recommended to be planted either in April or September to ensure good seed germination and strong stands.

Activity	Toolbox
<p>Trainer to clarify best seeding rates and strategies to guarantee strong alfalfa stands.</p> <p>Explain: What important issues are to be considered prior planting alfalfa seeds</p> <p>Answer (Alfalfa Production Handbook): Alfalfa roots fix nitrogen through <i>Rhizobium</i> bacteria. Common commercial alfalfa seeds are available in a pre-inoculated form. Thus, seeds should be inoculated with inoculum prior to planting.</p> <p>Explain: Most proper planting rates to establish strong stands.</p> <p>Answer: The recommended rates ensure adequate stands knowing that not all seeds will germinate. In addition, the plant population will decline with the age of the stand. The recommended seeding rate for alfalfa is 3-4 kg per ha.</p> <p>Seedling diseases can have a devastating effect on stand density and uniformity. Diseases will be a greater problem in fields that have had alfalfa previously. This makes it significant to implement a crop rotation plan for the alfalfa field (Alfalfa Production Handbook).</p> <p>Explain: Planting strategies for alfalfa seeds.</p> <p>Answer: For spring plantings, seeds are recommended to be sowed in April. While for late summer plantings, September would be perfect. Planting alfalfa seeds is advised as follow:</p> <ol style="list-style-type: none"> 1. Sowing alfalfa seeds using seed drill at 50 cm between rows, or manual broadcasting. 2. Application of 50 kg per ha of ammonium sulphate (NH₄)₂SO₄ as a starter nitrogen fertilizer. 	<p>Discuss with participants schedules adopted at their farms for planting their seeds. What challenges did they experience adopting different planting dates? Discuss the results with the group at the end of the training sessions.</p> <p>Continue adding agricultural activities into the time table frame table you started earlier. Ask participants some questions before writing down the activities. Discuss them if they provided different schedules to justify the most proper activities.</p>
<p>Suggested Method: Group discussion</p>	

Module 10 Table 4. Post-planting activities are important for guaranteeing a successful crop growth. Those activities should be scheduling considering the planting dates.

Activity	Toolbox
<p>Trainer to clarify most proper post planting practices needed to enhance alfalfa seeds production.</p> <p>Explain: Clarify the post planting activities needed to grow healthy alfalfa crop.</p> <p>Answer: Weeds begin to invade alfalfa stands with less than 20 or 30 plants per square meter, resulting in decreasing the hay yield and quality. Weeds can be reduced using herbicides and frequent weeding. Weeding schedule is recommended as:</p> <ul style="list-style-type: none"> - Spring plantings: May - Late summer plantings: October <p>Explain: what is the best plan for harvesting alfalfa hay (cutting)?</p> <p>Answer:</p> <ol style="list-style-type: none"> 1. The 1st cut is known as “cleaning cut” and is expected to be collected as: <ul style="list-style-type: none"> - For late summer plantings: mid-November - For spring summer plantings: mid-June 2. This cut is very important to get rid of weeds, insects and at the same time stimulate more branching. 3. The plants will have enough time to recover from clipping and produce vigorous vegetative growth that withstand wintering. 4. For spring plantings, the collected forage contains substantial amount of weeds. 5. The second cut is expected to be on 15-20 of March for late summer plantings. Weeding is necessary to make sure that the alfalfa stand is pure. 	<p>Frequently get back to the participants with answers to your previous questions and relate them to the recommended practices and schedules you are presenting.</p>
<p>Suggested Method: Group discussion</p>	

Module 10 Table 5. Proper pre-harvest planning is critical for healthy seeds formation. Understanding full seeds maturation can promote a successful seeds production.

Activity	Toolbox
<p>Trainer to present best pre-harvesting and harvesting schedules and techniques for alfalfa seeds.</p> <p>Explain: Clarify the pre-harvesting activities needed prior harvesting alfalfa seeds.</p> <p>Answer:</p> <ol style="list-style-type: none"> 1. Application of an insecticide (contact type such as chlorovet) as a preventive measure as: <ul style="list-style-type: none"> - Late summer plantings: March-April, depending on weather conditions. - Spring plantings: July 2. Application of potassium fertilizer to stimulate more flowering as: <ul style="list-style-type: none"> - Late summer plantings: April - Spring plantings: July 3. Most probably, full blooming will occur in May and August for late summer and spring plantings respectively. 4. It is harmful to spray plants with any insecticide which will harm the pollinating insects. <p>Explain: Expected dates for the formation and maturation of alfalfa seeds</p> <p>Answer: Formation of seeds starts in June for late summer plantings, and in August for spring plantings. Heat waves may be detrimental to seed development. The seeds may be vulnerable to predation by birds.</p> <p>Alfalfa seeds are expected to be fully matured as:</p> <ul style="list-style-type: none"> - Late summer plantings: July-August - Spring plantings: September <p>Matured seeds are fully matured. The color of pods turns from green to yellow and then to brown. Seed harvest should be performed early in the morning to avoid shattering of pods. The collected seeds should be dried immediately to avoid the growth of molds.</p>	<p>Ask participants if they ever produced alfalfa seeds. If they did, let them stand and present their farm as a case study.</p>
<p>Suggested Method: Group discussion</p>	

Exercise

*Suggested Exercises: Listing currently adopted practices (for individuals)
Discussing case studies (working groups)*

Key Statements

- For a successful alfalfa production, growth requirements should be considered. To establish a strong stand, choose good quality seeds.
- Proper planning for planting dates and rates of alfalfa crop can guarantee a successful growth and healthy production.
- Alfalfa seeds are recommended to be planted either in April or September to achieve good seed germination and strong stands.
- Post-planting activities are important to a successful crop growth. Those activities should be scheduling considering the planting dates.
- Proper pre-harvesting planning is critical for healthy seeds formation. Understanding full seeds maturation can guarantee a successful seeds production.

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