Ties that Bind

UNITED ARAB EMIRATES
MINISTRY OF CLIMATE CHANGE
& ENVIRONMENT

ICARDA
Science for Better Livelihoods in Dry Areas

United Arab Emirates and ICARDA

Highlight of 20 years of Collaboration and Achievements

IFAD
Investing in rural people

Contents

Executive summary

In 1988, ICARDA began a special program for the Arabian Peninsula (AP) countries called Arabian Peninsula Regional Program (APRP). The partnership with AP specially United Arab Emirates (UAE) became stronger in 1995, when ICARDA established its regional Office in Dubai, UAE which hosted by Ministry of Climate Change and Environment (previously known as Ministry of Agriculture and Fisheries)

Since 1995, ICARDA carried out several projects in AP and UAE in close collaboration with National Agricultural Research and Extension Systems (NARES). Outputs of these collaborations are demonstrated by the useful technology packages developed by APRP in rangeland rehabilitation, irrigated forages, on-farm water management, and protected agriculture. ICARDA-APRP adopted and tested the developed technology packages at a number of pilot private farms. These packages have positive impacts on welfare of poor farmers in the region, and on management of natural resources, and the environment. The packages include:

1. Increasing adoption of high intensity techniques for more water use efficient production of high quality cash crops (soilless production system).
2. Increasing adoption of IPPM for high quality cash crops, reducing pesticide residue and hazardous chemical use.
3. Promoting an integrated production system for indigenous forage species with high water use efficiency for AP farmers.
4. Developing an integrated production system for spineless forage cactus.
5. Enhancing adoption of new forage and rangeland production systems by providing large quantities of seeds of suitable species.
6. Developing participatory technology for rangeland rehabilitation through water harvesting and re-seeding techniques.

In UAE, these technology packages adopted by a good number of local growers. Only in 6 northern emirates (not including Abu Dhabi) number of soilless greenhouses and farms adopted Buffel grass has reported more than 1000 and 100 respectively by the Ministry officials.

Some of the achievements include:

- The adoption of protected agriculture instead of open field has showed that, despite the high initial cost of investment and the high level of management skill required, it permits higher water productivity (28.2 versus 2.8 Kg/m3 for tomatoes and 16.7 versus 1.2 K/m3 for pepper), higher quality of crop and easier control of pesticides and diseases.
- More crop per drop: The records obtained in UAE confirmed that hydroponics permitted to save about 120m3 of water respectively for producing each ton of tomato as compared to conventional soil systems under protected agriculture.
- Soilless production system in UAE, would increase grower's income for cucumber production by two fold compared to traditional soil based growing system under greenhouse.
- As direct impact, large number of growers in UAE adopted Buffel grass "Libid" are saving

roughly 850 m3 of water for each ton of dry matter produced compared to Rhodes grass. Based on published data by ADFCA, if all farms in Abu Dhabi change Rhodes by Buffel grass, up to 50% of its irrigation water or 375 million m3 will be saved annually.

Capacity building also is a major target of ICARDA in AP. Since 1995, APRP conducted 50 specialized training courses, 17 workshops and more than 300 field days. During this period about 400 researchers and extension agents (more than 80 from UAE) attended ICARDA-APRP specialized training courses.

These achievements would not have been possible without the unwavering support of the program donors: the Arab Fund for Economic and Social Development (AFESD), the International Fund for Agricultural Development (IFAD) and at lesser degree the OPEC Fund for International Development (OFID).

In addition UAE is also covered by ICARDA Date palm project "Development of Sustainable Date Palm Production Systems in Gulf Cooperation Council Countries", which financially supported by the GCC. Within the frame of this project, several efficient technology packages like liquid pollination and draying dates were developed and highly adopted by farmers in the GCC countries particularly in UAE.

Recently (2015), Abu Dhabi Emirate, represented by Abu Dhabi Food Control Authority (ADFCA) has joined to the CGIAR members' club. As a result, ICARDA is carrying out a specific project for agricultural development including enhancement of agricultural extension in Abu Dhabi emirate. Within this very short period (less than 2 years) several achievements including the development Smart Extension Diary, technical field manuals for many crops and human resources capacity development, were obtained.

For the future, ICARDA will continue to seek new horizons for supporting agricultural development and natural resource management in the Arabian Peninsula including UAE, through scientifically sound research and development activities. As in our previous work, modern state-of-the-art technology will be used to achieve this important goal. The work is continuing on:

1. New greenhouse design and cooling system utilizing renewable energy;
2. Strengthening the Seed Technology Unit and enhancing the production of seeds of low water consuming forage species.
3. Introducing new fodder species with high nutritive value and resistant to salinity and lack of irrigation water.
4. Safe use of Treated Waste Water for irrigation of forage crops;
5. Develop balanced animal diet based on alternative feed resources (including feed blocks) through the valorization of local agricultural byproducts mainly of date palms;
6. Elaborate the rangeland map of UAE and develop the appropriate adaptation strategy to cope with the climate change and improve the natural vegetation resilience capacity.
7. Concerning the date palm sector, the following topics constitute major concerns for UAE and have to be addressed:

- Vulnerability of the date palm to climate change (production, management, pests, etc) and adaptation measures;
- Determination of date palm water requirements under changing climate;
- Develop the best tools for improving the post-harvest practices
- United Arab Emirates and ICARDA

LONG AND FRUITFUL PARTNERSHIP

Since its establishment in 1977, ICARDA has actively collaborated with the Arabian Peninsula (AP) countries through technical backstopping in its mandated crops and areas of research, exchange of germplasm, and human resource development through training and visiting scientists.

ICARDA's partnership with AP including United Arab Emirates (UAE) became stronger in 1988, when ICARDA began a special program for the Arabian Peninsula (AP) countries called Arabian Peninsula Regional Program (APRP).

The collaborative research program, conducted jointly by ICARDA and the national agricultural research systems (NARS) of the seven AP countries including UAE, addressed some of the major problems facing the region: scarcity of renewable water sources combined with the inefficient use of water; degradation of the large areas of rangeland and resulting desertification; and the need to develop a resource-efficient protected agriculture industry that generates high quality high-value produce and ensures there is no environmental and product contamination by agricultural chemicals. In response to the collective priorities determined by the seven countries of the Arabian Peninsula, APRP expanded its scope to encompass the three principal themes: (i) rangelands, (ii) on farm water management, and (iii) protected agriculture. These were supported by activities in agro-ecological characterization and research on abiotic stresses, which contributed to the major research themes.

In addition to APRP, UAE is also covered by ICARDA Data palm development project in the "Cooperation Council for the Arab States of the Gulf" also known as GCC.

Furthermore, appreciations are in order for The hosting of ICARDA-APRP office in Dubai since 1995 by the Ministry of Climate Change and Environment (former Ministry of Agriculture and Fisheries) of the United Arab Emirates.

HIGHLIGHTS OF UAE AND ICARDA JOINT COLLABORATION ACHIEVEMENTS AND ACTIVITIES

Optimizing the use and efficiency of scared water and land resources in vegetable production (protected agriculture)

Moving from open field to protected agriculture production system

Protected agriculture, the production of crops under protective housing (plastic houses or greenhouses), represents an intensive and dynamic form of crop production in which both the environment and timing of production can be controlled and yields can be substantially

improved. In UAE, where arable land is limited and water is scared, protected agriculture offers an opportunity for vertical expansion and for generating returns per unit of land and of water from the production of high value crops which cannot be produced otherwise. Soilless production system, as an PA associated production techniques, would improve the land and water productivity even further. The following figures presents the productivity of different selected vegetable crops under open field (of) and greenhouse (GH) production systems in UAE. These figures are based on Ministry of Climate Change and Environment (previously known as Ministry of Environment and Water) published data in 2005.

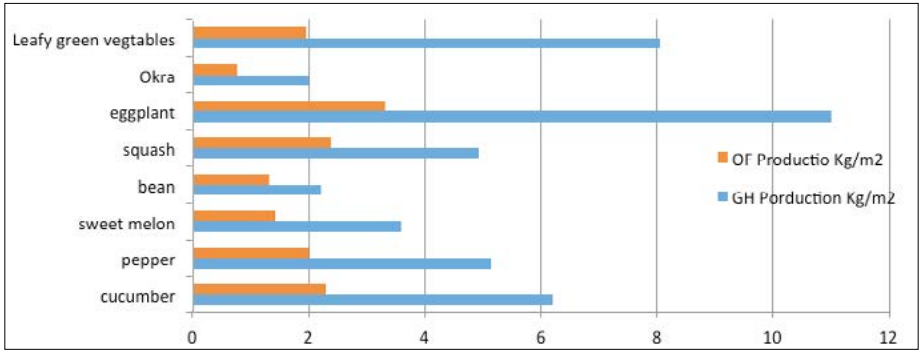

***Figure 1**- Productivity (kg/m2) of selected vegetables crops in Open Field (OF) and Greenhouses (GH) in UAE. source MEW, UAE, published data 2005.*

Other studies conducted in Al Dhaid research station, have confirmed that moving from open field to protected agriculture has showed that, despite the high initial cost of investment and the high level of management skill required of the greenhouses, the protected agriculture production system permits higher water productivity (28.2 versus 2.8 Kg/m3 for tomatoes and 16.7 versus 1.2 K/m3 for pepper), higher quality of crop and easier control of pesticides and diseases.

Soilless growing techniques (hydroponics)

Soilless production systems, as an associated technique with greenhouses, would further increase water and land productivity of vegetable crops. In UAE, ICARDA research for development activities shows tomato and cucumber yield has increased at least by two fold after adoption of soilless production systems at the farmers filed compared to conventional soil based production system under greenhouses.

To answer the constrains related to scared water resources, harsh environment and low soil fertility; ICARDA and NARS developed/simplified number of soilless production system. These activities started by end of 90s and when prove successful are moving forward very fast. Soilless production system is based on the use of inert growing media with controlled nutrient solutions. With circulating and reusing the irrigation water, this system, significantly reduced the water consumption and improves water productivity compared to conventional soil system.

Among the beneficial impact of the ICARDA-APRP in the region, soilless production (hydroponics) has received good acceptation by growers in all AP countries. For instance, in UAE, where Ministry of Environment and Water was covered 50% of growers cost for establishment of hydroponics systems, total number of greenhouses with soilless system has exceeded 1000.

The main reasons for the increased adoption rate are the high yield and therefore income and the high water productivity. For instance, in Oman the production of cucumber reached a record of 17.3 kg/m2 for a single crop. In UAE, records revealed that water productivity for tomato reached 48 kg/m3 under soilless culture as compared to 7 kg/m3 under traditional soil system. In Saudi Arabia the average water productivity for tomato crops reached about 40 kg/m3 under soilless culture versus only about 9 kg/m3 under soil system.

Table 1 presents the cost benefit analysis and comparison between soilless and soil system in UAE for the production of cucumber crop.

***Table 1** - Cost Benefit Analysis table and comparison between soil and soilless system in UAE for production of cucumber*

Cost of the production	**soil**	**soilless**
Capital Cost (calculated based on depreciation)		
Production system (US$/m2)	0.68	2.77
Running Cost		
production materials (US$/m2)	5.65	3.17
water (US$/m2)	2.96	1.92
labor (US$/m2)	4.77	4.77
Electricity (US$/m2)	0.12	0.30
sub Total Running Cost (US$/m2)	13.50	10.16
Total cost of production per season/m2 (US$)	**14.18**	**12.93**
Annual growth Income US$/m2		
annual average production Kg/m2	22.23	30.53
Average annual income US$/m2 (1.10 US$/kg in 2012)	24.45	33.58
Income/cost average in US$/m2	**Soil**	**Soilless**
Annual Income (US$/m2)	24.5	33.6
Annual Cost (US$/m2)	14.2	12.9
Annual Profit (US$/m2)	10.3	20.6

3 cropping seasons is considered per year

To be able to compare different items costs, all expenses translated to US$/m2/cropping season. Three crops per seasons are considered for both soilless and soil based systems. However, in reality with soilless system a good grower with good management can produce 4 crops. For production system, the economic life of different part such as irrigation network, pumps, etc. and their depreciation were calculated. The cost of greenhouse structure is not included as it is the same for both systems. The cost of cubic meter of water is calculated based on operation, maintenance and depreciation of a desalination unit with 100m3 per day. Establishment cost of the hydroponics production system is much higher than conventional soil system. While the running cost is relatively lower mostly due to saving in water and fertilizer. Hydroponics using less fertilizer and agro-chemical compare to soil based systems especially regarding soil sterilization. On the other hand, yield in soilless is significantly higher thus higher income. Overall, soilless culture generates more benefit per m2 of greenhouse by two times compared with conventional soil based production systems.

More crop per drop: The records obtained in UAE confirmed that hydroponics permitted to save about 120m3 of water respectively for producing each ton of tomato as compared to conventional soil systems under protected agriculture.

Figure 6 - *high quality crops in hydroponics production systems under greenhouse condition, UAE*

Integrated Production and Protection Management (IPPM);

The extensive use of chemicals to control diseases and pests in greenhouses results in complex problems of insect resistance to chemicals, and health and environmental hazards. Crop protection can be achieved by using control measures other than relying mainly on pesticides, thereby reducing the use of hazardous chemicals. These control measures are part of an Integrated Production and Protection Management (IPPM) program developed by ICARDA in collaboration with NARS in all AP countries. In UAE, IPPM received a major attention where at the moment hardly greenhouses can be fined which at least don't have basic IPPM techniques including double doors and insect proof net covered all ventilation and cooling systems. Studies carried out have shown that the application of IPPM in protected agriculture have led to 80% reduction in agrochemical use, 61% increase in yield and more than 50% water saving.

ICARDA works on IPPM are in progress with more focus on greenhouse structures as well as biological control. As part of IPPM and as an alternative cooling system for greenhouses, ICARDA introduced net houses (greenhouse all covered by insect proof net) in 2008 which has well adopted in UAE.

In UAE, study on 18 cooled and net houses shows that during winter season, cucumber production in net houses are as high as cooled greenhouses. However due to major saving on water and electricity for cooling system, the net income is significantly higher in net houses.

Figure 7 *- As part of the IPPM package, using double doors and covering all ventilation with insect proof net are widely accepted and adopted in UAE*

Irrigated Forages and Rangeland Management

Collection Missions and Identification of the Indigenous Forage Species;

Utilization of the indigenous species as alternative forages is one of the main objective of the APRP. Followed by number of collection missions and research activities, rangelands & forages priority grass species were identified in all countries of the Arabian Peninsula.

In UAE, collection missions were conducted in 1998 and about 100 plant species samples collected. Cenchrus ciliaris, Coelachyrum piercei, Lasiurus scindicus and Panicum turgidum were identified as priority indigenous grass species for UAE and number of research studies on water use efficiency and palatability using indigenous knowledge of local farmers.

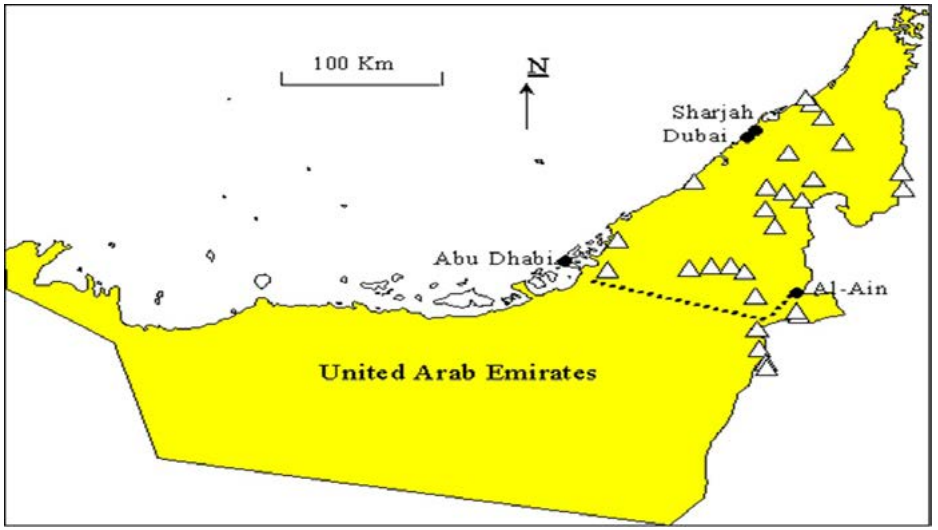

Figure 1 *- collection sites in UAE, 1998*

The outputs of the experiments conducted in Al Dhaid during the period 2000-2003 showed that Buffel grass or Lebid (Cenchrus ciliaris) has been identified as forage which offers high quality feed and high water-use efficiency. The forage can be harvested ten times a year, with an average dry matter yield of up to 20 t/ha. The water-use efficiency of Lebid (amounts of water to produce one kg of dry matter) ranges between 0.81 and 1.88 m3 compared with Rhodes grass at 1.18 and 2.13 m3, widely used by farmers in the past.

As direct impact, large number of growers in UAE adopted Buffel grass are saving roughly 850 m3 of water for each ton of dry matter produced compared to Rhodes grass, translating to an average annual increase of USD 545/ha

The constraint of seed availability from these species was addressed in all Arabian Peninsula countries and more specifically in UAE where significant steps have been made in seed production from Cenchrus ciliaris and Lasiurus scindicus, which allowed for forage demonstrations on farmers' fields.

Figure 2 *- Seed Multiplication field and Joint research activities identified 23 priority range and forage species in UAE*

Figure 3 *- Evaluation of indigenous forages water requirements and other agronomic traits.*

Establishment of Seed Technology Unit (STU)

The seed production was enhanced by the establishment of Seed Technology Units (STU) in UAE. The STU, first of its kind in the region, was equipped with state of the art machinery for producing high quality seed. ICARDA organized number of specialized training courses on seed processing in the STU for the young scientists in the region. The major duties of STU are to assist multiplication of foundation seed, processing, storage, and quality control for all rangeland and forage species.

Within only few years, the newly established Seed Technology Unit in UAE produced more than 1000 kg of Buffel grass and more than 700 kg of Da'e seed.

Spineless cactus and feed blocks

Spineless cactus is one of the most adapted plants to arid and desert environments. It is a good source of energy for livestock with relatively low price and cost of production. About 38 accessions were introduced by ICARDA-APRP in UAE and showed very high performance of adaptation both in term of pads and fruit production at very low level of irrigation. Nurseries were established at Diba, Al Dhaid, Al Ain and Bani Yass-where research activities are in progress. Growth and fruit production are also being monitored and assessed at 5 pilot farms in Al Ain and Dubai.

Research and development activities on alternative feed resources including feed blocks and cactus were identified as a priority for the region in order to face high water requirement forage species. In addition, there is a need for a source of energy besides Buffel grass as source of protein for a complete diet for animals.

Figure 4 *- Feed block unit in Al Dhaid*

A feed block unit has also been established at Dhaid research station and a training course with practical sessions was organized in 2016.

There is great scope to reduce areas under fodder crops with cereals for human population by using, innovating and developing alternate animal feed resources; utilizing agricultural and agro-industrial by-products as feed blocks, silage and/or mixed with the ration. Feed block technology is simple and does not require sophisticated equipment. Blocks are easy to handle, transport and can be made at the farm levels using the family labor. Different formulae with different levels of urea, binders and a wide range of agro-industrial by-products, which are available locally mainly date palm by-products are under study in close collaboration between ICARDA and the Department of Agricultural Research in the MOCCE.

Safely utilize and improve efficiency of TWW for irrigation the forages (soil, water and plant sample analysis)

In UAE, in order to investigate the effect of recycled wastewater effluent on soil chemical properties and heavy metal uptake of selected forages, an experiment was conducted at Dhaid Research Station, UAE since 2014. Alfalfa, Rhodes and Buffel grass were irrigated using recycled wastewater and grown in a randomized complete block design with four replications. Four composite soil samples from three random positions from three soil layers (0-25, 26-50 and 51-75 cm) were collected from the experimental site before the start of the study and after 21 months after establishment to assess the status of macro and heavy elements in the soil, and in forage tissues and measure yields. Chemical analysis included soil nutrients and wastewater

parameters (EC, Na, Ca, Mg, OM, P and K) and heavy metals (Cu, Pb, Zn, Ni, Cr, Co, Fe, Hg). Recycled wastewater irrigation significantly increased soil chemical properties especially in the surface layer (0-25 cm) and crop nutrient content. Results suggest that Sharjah effluent is suitable to be used for irrigation forages as its quality conforms to international standards for wastewater irrigation except Na and Cl. After 21 months of irrigation using recycled wastewater irrigation the soil salinity EC increased in the soil profile by 223, 418 and 299% for soils grown with Buffel, Rhodes and alfalfa crops, respectively, in comparison to soil salinity before planting date. The highest total dry weight yield from 14 cuts during the study period was recorded for Buffel grass (91.04-ton ha-1) followed by Rhodes (74.46-ton ha-1) and Alfalfa (13.63-ton ha-1). Irrigation with wastewater has shown significant increases in zinc, iron and molybdenum in soil and copper and iron in the plant tissues; however, the concentration of all elements in soil and plants were lower than toxicity thresholds except iron and Ni (source of Ni was soil and irrigation water) in the plant tissues. ICARDA recommends regular monitoring of recycled wastewater and soils and appropriate management is required to mitigate the negative impacts of sodium and salts accumulations through leaching of these salts from the soil.

Date palm production management

Extraction and storage of date palm pollen:

Study on the effect of extraction and drying methods on the viability of pollen grains and fruit characteristics and productivity were conducted to find the best extraction method, drying method and storage conditions giving the highest pollen viability and germination percentage.

Development of bio-pesticides for date palm dust mites:

Study of using of Biopestides for the control of dust mite were finding that the bio pesticide Baicao No.1 (0.36% Matrine) gave a good level of control against dust mites.

Design and of drying date polycarbonate houses

Solar drying of dates under glasshouse aims to preserve dates quality and to reduce losses of dates. The results were very positive, shortening the drying period and improving the quality of the dried fruits, proving the effectiveness of the glasshouse. The time required completing the process of drying and ripening dates halved achieve reduced from 8 to 4 day.

Figure 8 *- Glass (left) and Polycarbonate (right) drying dates houses*

The quality of dried dates was improved preventing the infestation by insects and birds which reflected on the marketing capacity of dates.

Fertigation and Mycchorizae application to increase date palm development:

The effect of date palm fertigation and Mychorrizae application on date palm young plants is under investigation in Al Hamrania research station. Insemination of plants by Mychorrizae aims to: 1-Improve vegetative growth of date palms, 2-Improve production of date palms, 3-Reduce water consumption by more than half.

Figure 9 *- Ferti-irrigation experiment and utilization of Mychorrizae to promote date palm plants development in Al Hamrranieh research stations*

TECHNOLOGY TRANSFER

The importance of technology transfer in transferring Research for Development project results has been properly recognized by national as well as international research funding organizations and by the public sectors. It has never happened before that technology-transfer enjoyed such a priority. Technology transfer has been seen as an important mechanism for stimulating the development process, reducing poverty and elevating the societies‟ standard of living”. Considering the importance of technology transfer, ICARDA's targeted technology packages is being transferred to the end users, in close collaboration with Department of Agricultural Research and Extension Services, through a set of demonstration and pilot sites using participatory approaches. Technical back stopping is being provided by ICARDA. Different participatory approaches have been utilized such as Training of the Trainers, Farmers Field Schools (FFS) and mid/end seasons workshops. Different publications, technical notes and training/field manuals will be published and provided to the end-users. The following table shows number of pilot sites established directly through ICARDA project for different technology packages in UAE 2008-2015.

Figure 10 *- Field days is a main part of ICARDA training program in UAE*

Table 1- number of pilot sites established through ICARDA projects in UAE (2008-2015)

Technology Packages	Pilot sites #
Introduction and adaption of soilless and IPPM packages to NARES and pilot growers	37
Manage indigenous forages at grower's farm including use of modern irrigation systems, sowing/planting, harvesting for maximum water use efficiency.	56
Demonstration site for Feed Block	1
Total	**94**

However, the real number of pilot sites are much greater than this which is as a result of direct support of NARS in UAE. Only number of soilless greenhouses and farms adopted Buffel grass has reported more than 1000 and 100 respectively by the Ministry officials.

Figure 11 *- some of pilot growers farms in UAE*

By December 2015 in UAE the total number of pilot farmers who adopted the Buffel grass through this project passed the records of 100 growers with an estimated total area of 10.4 ha. In the past most of these growers cultivated Rhodes grass in their fields. Based on the research results their total yield of Buffel grass is about 208-ton dry matter which consumed about 168,000 m3 of water. For producing the same amount of dry matter Rhodes grass needs about 350,000 m3. Consequently, about 52% of irrigation water, about 182,000m3 of water, per year was saved.

In 2012, ADFCA announced total water annually used for irrigation is 1.5 billion m3 from which 50% or 750 million m3 is consumed by Rhodes grass alone[1]. If all farms change Rhodes to Buffel grass, up to 50% of its irrigation water or 375 million m3 will be saved annually. As a direct impact of the project, ADFCA has stopped subsidizing Rhodes and is seriously supporting this policy to replace it with Buffel grass.

Growers Feed Back on project targeted technologies and socio-economic impact

In 2012, To study the impact of the targeted technology packages in UAE, about 114 growers randomly selected and interviewed in all UAE by local extension agents. The questionnaire was designed by ICARDA scientists. Some of the findings are presented below.

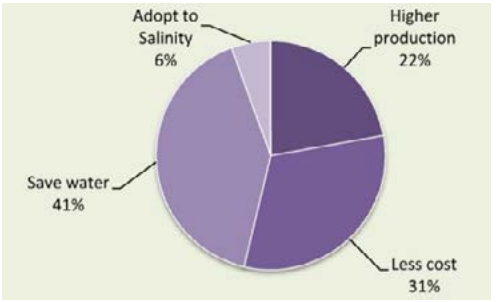

Figure 12 shows the pilot growers main reasons for adopting the Buffel grass as indigenous forage species in UAE. Data is collected during an impact assessment study. The main reason for adopting this technology for 41% of growers is saving water compared to exotic forage species. Growers' point of view on Buffel grass as a forage crops is illustrated by Figure 12. About 90% of the growers believe that Buffel grass as forage either is very good or good while only 2% of growers rejected this technology package.

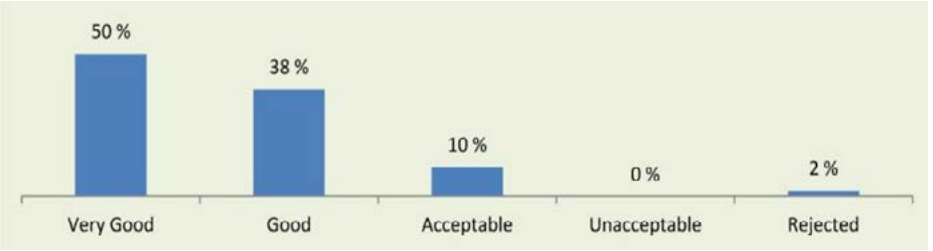

Figure 13 *- Growers' point of view on Buffel grass as a forage crop in UAE*

[1] http://gulfnews.com/news/uae/environment/farms-stop-cultivating-rhodes-grass-1.998624

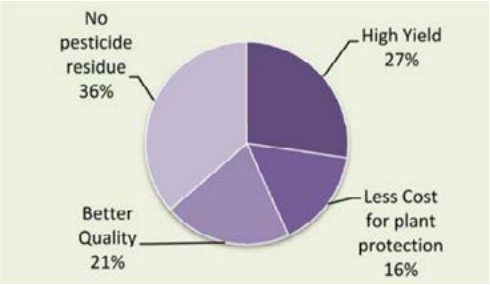

Figure 14 *- Main reasons for adopting IPPM by growers in UAE*

Figure 3 and Figure 4 show pilot growers point of view on IPPM technology in UAE. About 70% of the growers believe that the IPPM technology is very good and good. On the other hand, only about 2% of the growers in this study rejected this technology package.

Figure 16 shows growers' point of view about soilless (Hydroponics) production systems. About 76% of the growers evaluated this technology package as very good and good. However, 12% of the growers classified this technology unacceptable and rejected.

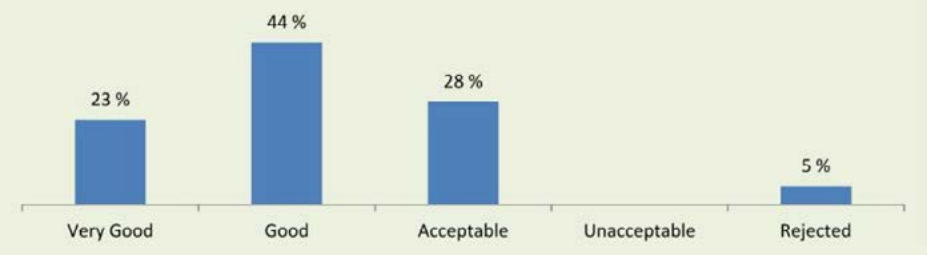

Figure 15 *- Growers point of view on IPPM technology in UAE*

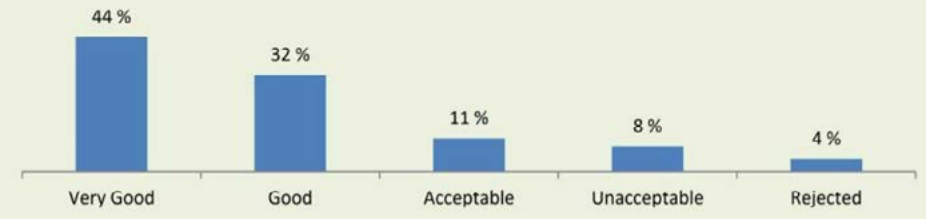

Figure 16 *- Growers' point of view on Hydroponics in UAE*

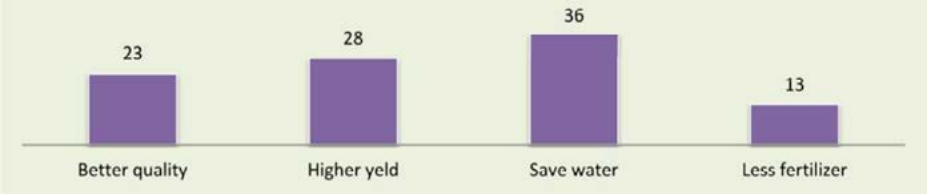

Figure 17 *- advantage of soilless culture over conventional production system from growers' point of view in UAE*

CAPACITY BUILDING

The human resources development program includes general training of members at ICARDA HQ and specialized training programs in different regions or countries. APRP specialized training program includes:

1. Regional training courses based on the participating country's needs;
2. Field days and on the job Training courses
3. Workshops, seminars and conferences

During the period between July 2008 and August 2016 APRP conducted 32 specialized training courses, 11 workshops and more than 130 field days. during this period about 167 researchers, extension agents and growers attended ICARDA-APRP specialized training courses.

Figure 18 *- some of the training courses organized in UAE*

ICARDA AND ABU DHABI FOOD CONTROL AUTHORITY

Recognizing the benefits of becoming a CGIAR member, the Government of Abu Dhabi represented by Abu Dhabi Food Control Authority (ADFCA) joined CGIAR on 14 December 2014 where the agreement signed by H.E Rashid Khalfan Al Shariqi, Director General of ADFCA in presence of Dr. Tony Kalm, Deputy Head of CGIAR Fund Office and Dr. Mahmoud Solh, ICARDA Director General.

Furth more, ADFCA and ICARDA have signed an agreement for a joint project called "Promoting Agricultural Research for Development and Smart Transfer of Technologies in Abu Dhabi Emirate" which to be financed through ADFCA contribution to CGIAR.

ICARDA and ADFCA completed the first year project. For the second year, the overall objective of the project is to enhance agricultural production systems in Abu Dhabi through initiating a comprehensive research for development program and a digital extension system addressing integrated pest management tackling major Date palm pest infestations in Abu Dhabi; as well as crop, water and production management of vegetables, date palms and irrigated forages in Abu Dhabi.

The project components include: 1) Adaptive research and technology transfer; 2) Capacity Building and 3) socio economic evaluation. The adaptive research and technology transfer focuses on:

- Integrated pest management of major Date palm pest in Abu Dhabi
- Irrigation water management at the farm level for vegetables (open and protected), date palms and irrigated forages.
- Date palm production management
- Agricultural Technology Transfer/the Smart Extension Diary

While the R&D initiatives outlined are conceptualized within the timeframe of an annual project year, the overall project is considered to be sustained for a period of three (3) to four (4) years.

***Figure 19** - Some of the training activities in collaboration with ADFCA and ADFSC*

FUTURE COLLABORATION AND TRANSFER OF TECHNOLOGY

ICARDA will continue to seek new horizons for supporting agricultural development and natural resource management in UAE, through scientifically sound research and development activities. As in our previous work, modern state-of-the-art technology will be used to achieve this important goal.

The achievements of ICARDA in the AP are demonstrated by the useful technology packages developed by APRP in rangeland rehabilitation, irrigated forages, on-farm water management, and protected agriculture. ICARDA will continue to support transfer of these technology packages to the end users in all AP countries including the UAE. The packages include:

1. Promoting an integrated production system for indigenous forage species with high water use efficiency for AP farmers.
2. Developing an integrated production system for spineless forage cactus.
3. Enhancing adoption of new forage and rangeland production systems by providing large quantities of seeds of suitable species.
4. Developing participatory technology for rangeland rehabilitation through water harvesting and re-seeding techniques.

5. Increasing adoption of IPPM for high quality cash crops, reducing pesticide residue and hazardous chemical use.
6. Increasing adoption of high intensity techniques for more water use efficient production of high quality cash crops.

Furthermore, to answer the new challenges facing the region, such as climate change and its impacts, ICARDA in collaboration with the Directorate of Agricultural Research in the MOCCE expands its focus on research and development activities. Some of these new areas includes:

1. New greenhouse design and cooling system utilizing renewable energy;
2. Strengthening the Seed Technology Unit and enhancing the production of seeds of low water consuming forage species.
3. Introducing new fodder species with high nutritive value and resistant to salinity and lack of irrigation water.
4. Safe use of Treated Waste Water for irrigation of forage crops;
5. Develop balanced animal diet based on alternative feed resources (including feed blocks) through the valorization of local agricultural byproducts mainly of date palms;
6. Elaborate the rangeland map of UAE and develop the appropriate adaptation strategy to cope with the climate change and improve the natural vegetation resilience capacity.
7. Concerning the date palm sector, the following topics constitute major concerns for UAE and have to be addressed:
   - Vulnerability of the date palm to climate change (production, management, pests,etc) and adaptation measures;
   - Determination of date palm water requirements under changing climate;
   - Develop the best tools for improving the post-harvest practices.
8. Human resources and capacity building: training courses, on the job training of the Ministry researchers and technicians and field days and practical sessions (training farmers) in the targeted prior topics for the Ministry.

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