Federal Ministry
for Economic Cooperation
and Development

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Final Report	BMZ Project Funding

General Information

Implementing Organisation and Contracting Partner	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH Friedrich-Ebert-Allee 40 53113 Bonn Tel. +49-(0) 228-44600 Internet: www.giz.de
Contact for project reports	Advisory Service on Agricultural Research for Development (BEAF) Tel. +49-(0) 228-4460-3073
Closing date	At the latest 5 months subsequent to termination of the project
Submit by e-mail to	beaf@giz.de

Notes on completing the entry form:

When completing the template, please follow the guide questions in italics, which can be overwritten.

Characters should be font size 11 in Arial. Please do not change the format nor submit a pdf.

The final report should not exceed 20 pages. Detailed research reports should be added in the form of annexes.

General directions:

The final report has to be submitted not later than 5 months after conclusion of the project. Divergent deadlines could be stated by GIZ in case of contract amendment.

If the period between the last progress report (to be submitted each end of February, reporting on the previous calendar year) and the final report would be less than 3 months, the last progress report can be omitted.

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1. Basic data

The IARC applicant	International Center for Agricultural Research in the Dry Areas (ICARDA)
Project title	Mind the Gap: Improving Dissemination Strategies to Increase Technology Adoption by Smallholders
Funding type, GIZ Project Number and Contract Number	Project Processing number: 15.7860.8-001.00 Contract Number: 81194992
Reporting Period	April 2016 – December 2019
Project Coordinator and Project Scientists	Dr. Jutta Werner (coordinator April 2016 – July 2018) Udo Rudiger (coordinator August 2018 – December 2019), ICARDA Tunis, Phone: 00216 26 329 553, email: u.rudiger@cgiar.org Dr. Mounir Louhaichi, Dr. Boubaker Dhehibi, Dr. Dina Najjar, Dr. Ramesh Verma, Dr. Quang Bao Le, Dr. Peter Moyo, Dr. Ali Nefzaoui
Project Partners	**Office de l'Elevage et des Pâturages (OEP):** Mohamed Nasri, Fethi Gouhis **Institut National de la Recherche Agronomique de Tunisie (INRAT):** Dr. Hajeur Benghanem **Georg-August-Universität Göttingen (UGOE)**: Prof. Dr. Matin Qaim **L'Agence de la Vulgarisation et de la Formation Agricoles (AVFA)**: Ahlem Ben Amor

2. Final Report

State of Project Implementation

Output 1: New and existing models of technology transfer are developed, tested and rigorously evaluated.

	Activity	State of implementation
1.1.	The procedure of the Randomized Controlled Trial (RCT) experiment is explained in detail to the Tunisian stakeholders and the local authorities	Completed in 2016
1.2.	The 700 farmers (women and men) participating in the experiment are selected using random selection procedures	Completed in 2016
1.3.	The questionnaire for the baseline survey is established, questions investigating the distribution of household tasks and decision-making power between women and men are included	Completed in 2016

1.4.	The enumerators and supervisors are selected and trained	Completed in 2016
1.5.	The baseline survey is effectuated and evaluated	Completed in 2017
1.6.	The improved technology transfer strategies for every treatment group are specified in detail and implemented by INRAT	Completed in 2017 and 2018
1.7.	The follow-up survey with the same farmers is conducted. Questions clarifying the changes in male and female household tasks and decision-making power due to technology transfer are included.	Completed in 2018
1.8.	The follow-up survey is being evaluated and the most cost-effective technology transfer strategies are being identified	Completed in 2019

Lack of adoption of innovative technologies by smallholder women and men farmers is a major constraint for agricultural development in many developing countries. The “Mind the Gap” project looks at this adoption gap between agricultural research and women and men farmers. The final objective is to determine most effective and cost-efficient technology transfer strategies and give recommendations to national extension institutes and development partners to adapt their scaling strategy.

This research project used the Randomized Control Trial (RCT) experimental approach and compared the impact of different dissemination methods (mainly trainings with gender-specific considerations) on the adoption of technologies by smallholder farmers in Tunisia. In the semi-arid regions of Kairouan and Zaghouan (two governorates in Central Tunisia), 700 households with similar crop-livestock production systems (small ruminants and barley) were selected randomly in 2016.

A very detailed baseline survey was conducted end of 2016 with the support of a PhD student from the University of Goettingen and 13 trained enumerators. Data analysis was completed in mid-2017. Exactly two years later a follow-up survey was implemented with the same 700 households and analyzed by ICARDA scientists during the first semester of 2019. Unfortunately, the PhD student of the University of Goettingen withdrew her engagement.

Beginning in 2017, the 700 households were divided randomly in four treatment groups and one control group (each 140 households). Each treatment group received a different package of trainings in 2017 and 2018, jointly organized by national partners (OEP, AVFA, INRAT and CTV). The trainings consisted of technical, organizational, economical and female empowerment trainings. The objective was to test the impact of the trainings on the adoption of the two selected technologies: i) a new drought tolerant barley variety (Kounouz) and ii) feed blocks, an innovative feed composed of locally available agro-industrial by-products. All trainings were linked to the introduced technologies. In addition, technical SMS were sent and considered as part of the technical trainings.

To facilitate the adoption of the technologies the project organized the sale of the two technologies. Feed blocks and Kounouz were sold via the regional extension offices of CTV. The number of adopters of the technology were determined based on the number of farmers who purchased the technology (seeds or feed blocks). These sale figures of the 700 households served as an indicator for technology adoption.

Table 1: Distribution of project households (HH) according to the selected treatment groups in 2018

T1 (N=140)	T2 (N=140)	T3 (N=140)	T4 (N=140)	Control (N=140)
Technical training	Technical training Economic/organizational training	Technical training Economic/organizational training Female empowerment	Technical training Female empowerment	None

Output 2: A strategy is developed on how to increase and facilitate the adoption of innovative agricultural technologies for the Tunisian government and stakeholders of development cooperation.

	Activity	State of implementation
a.	A policy brief clarifying the results, the developed technology transfer strategy and the most important points of action is created.	Completed in 2019
b.	The technology transfer strategy is discussed with the relevant ministries and authorities including the OEP (central and regional division), the CRDA (Commissariat Régional au Développement Agricole) in Zaghouan and Kairouan, GIZ agricultural development program (PAD) and GIZ agricultural innovation center and other relevant stakeholders of development cooperation.	Completed in 2019

A policy brief explaining the project approach, results and recommendations to agricultural extension services involved in technology transfer in Tunisia was prepared in collaboration with national partners. The brief is called “Innovations agricoles: options pour des approches de transfert de technologies agricoles appropriées dans les zones semi-arides en Tunisie“ and accessible under https://hdl.handle.net/20.500.11766/10501.
The project results with recommendations on technology transfer strategy were presented and discussed during the final Mind the Gap workshop which took place in November 2019 in Hammamet. 42 participants of OEP, CRDA, AVFA, INRAT, ICARDA, GIZ and farmer organizations of regional and national level exchanged for two days about the lessons learned and how to improve dissemination of technologies in the future. The director of the national agricultural extension and training institute (AVFA), Prof. Zayani, mentioned that the results will influence the new national extension strategy of AVFA; in particular, the use of technical SMS as an extension method will be used to reach more farmers at low costs.

Output 3: A policy manual and a brochure on how to appropriately design technology transfer projects under Tunisian conditions are developed and distributed.

	Activity	State of implementation
3.1	Design and content of the manual are developed	Completed in 2018
3.2	The manual is published as Internet version and as print material	Completed in 2018

3.3	A diffusion strategy for the manual is developed and implemented	Completed in 2019

A manual was prepared with the following title: "Designing and Conducting Randomized Controlled Trials (RCTs) for Impact Evaluations of Agricultural Development Research: A Case Study from ICARDA's 'Mind the Gap' Project in Tunisia", which is available online with the following links: https://hdl.handle.net/20.500.11766/8209 (English) and https://hdl.handle.net/20.500.11766/9049 (French). The document is designed to help researchers apply RCTs so that they gain a more accurate insight into the impacts of different extension strategies in different locations. It provides information on the benefits of an RCT approach in comparison to other impact evaluation models; provides a step-by-step implementation guide and a framework to avoid challenges; and it also demonstrates how an RCT approach was implemented within the context of the 'Mind the Gap' initiative. The manual was shared with the major project partners AVFA, INRAT, OEP and CRDA for wide dissemination.

Output 4: Maps for typical types of socio-cultural and environmental context over WANA region are created and published on the web identifying similar areas where the RCT experiment can be scaled up.

	Activity	**State of implementation**
4.1	A structural framework model for the socio-cultural and environmental context of the RCT results is developed to scale-up/out identified adoption approaches.	Completed in 2017
4.2	Spatially explicit cluster analysis of contextual types and their verification with regional multi-stakeholder workshops is conducted.	Completed in 2018
4.3	Web-based GIS of options-by-context database is designed and established. The "context" will be the product of the activity.	Completed in 2019
4.4	The options will be technology transfer models (with their elements) evaluated through the RCT experiments.	Completed in 2019

Efforts on promoting sustainable land management (SLM) faces a dual problem: (1) high contextual diversity of drylands vs. "uniform blanket" approach in promoting site-specific project findings on sustainable land management options over large scales, and (2) lack of tools supporting comparative analyses/assessments of successful SLM options by context, thereby supporting out-scaling efforts. An approach, so-called functional context socio-ecological type (fCSET), ws elaborated to overcome the problem. The fCSET approach groups common biophysical, economic and social drivers of land use adoption and change into distinct context types that shape SLM adoption and resulting primary productivity and efficiencies of the use of critical resources for terrestrial biological production. The process starts with a review of current knowledge on potential drivers of SLM. Based on available geospatial data we used multi-variate descriptive statistics methods (such as principal component analysis - PCA, cluster analysis - CA) to classify the region into a number of context socio-ecological types (CSET). Next, Analysis of Variance (ANOVA) with independent data was performed to test if the performance indicators are different among CSET units. Finally, the functional CSET units are mapped and recommended for supporting SLM out-scaling (see Figure 1).

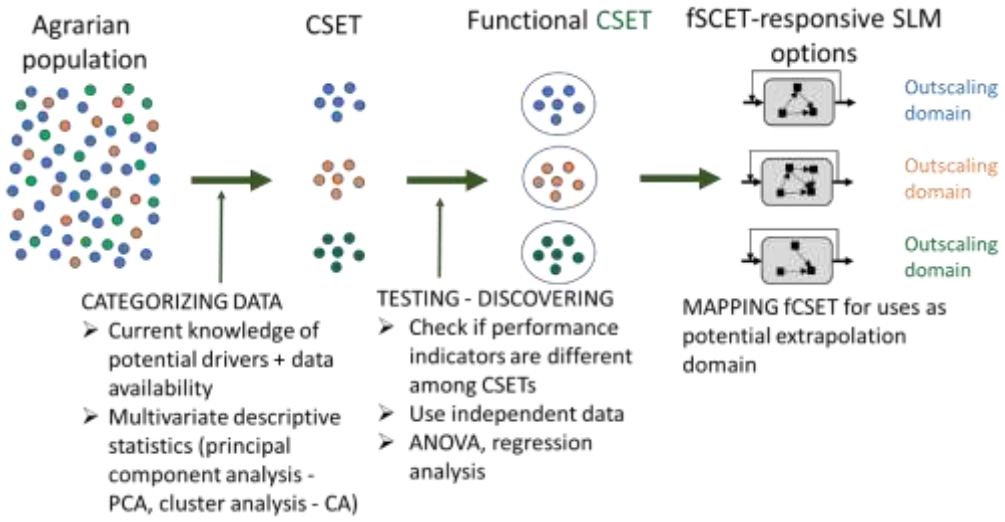

Figure 1. A structural framework model for defining functional context socio-ecological types as out-scaling domains. Notes on abbreviations: CSET: Context Socio-Ecological Type, fCSET: functional CSET, SLM: Sustainable Land Management

The study region was changed to three countries in the Maghreb region - which are Tunisia, Algeria, Morocco - rather than WANA (West Asia and North Africa). WANA was considered to be too diverse with too many sub-regions which were not relevant for inclusion in our study. An integrated, pixel-based dataset of 28 variables was constructed and is available for multi-purpose uses. The dataset is publicly accessible: https://hdl.handle.net/20.500.11766.1/FK2/AO9GYD. The dataset consists of 25 contextual variables that were used for classifying CSETs. These are variables describing biophysical conditions, accessibility, population pressure and economic development (the block on the left hand-side of Figure 2). Three performance variables as proxies for land degradation neutrality (LDN) were included for testing the functionality of CSETs, namely biomass productivity trend, biomass productivity gap and human appropriation (block on the right hand-side of Figure 2).

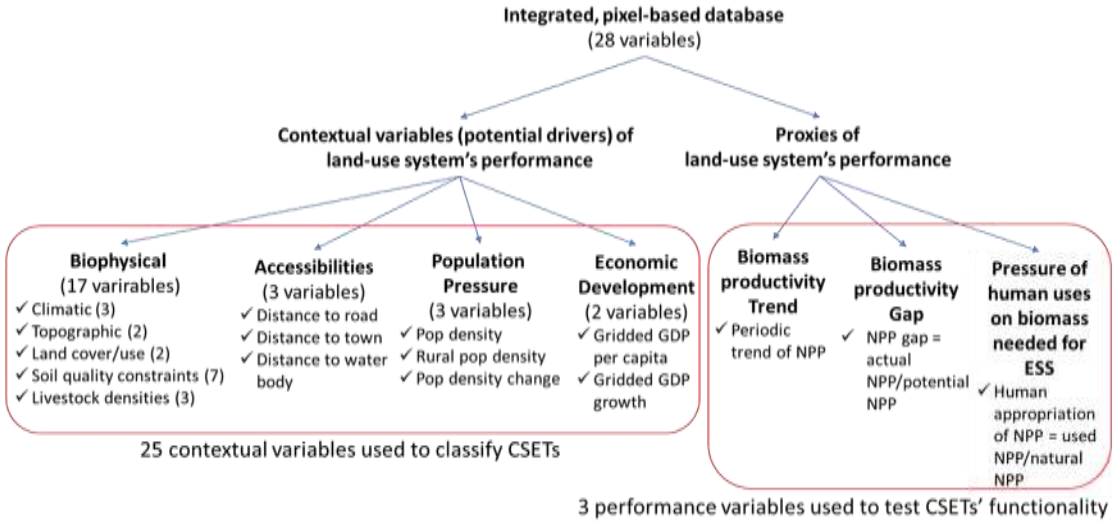

Figure 2. Categories of integrated, pixel-based database for empirical analysis of fCSET.

The analysis of fCSET was done for two major land-cover/land-use types in the region, namely: rainfed cropland, and grass-based/herbaceous vegetation land. On Tunisian rainfed cropland, four fCSETs were identified and mapped. These fCSETs are significantly different from each other regarding humidity, elevation, soil constraint in rooting condition, small ruminant and cattle densities, distance to road, and population density. On the Tunisian grass-based/herbaceous land, we found and mapped three fCSETs that differ regarding elevation, soil constraint (in rooting condition), sheep and cattle densities, distance to road, population density and population density change. Technical details of the results can be found at https://hdl.handle.net/20.500.11766/10801. The results demonstrate the potential of the fCSET approach to further our understanding of the role of socio-ecological contexts in performance of innovative agricultural practices and for managing the contextual diversity. For example, given limited resource, one can predict where efforts should be focused for introducing new practices and which drivers to cope with. The results can be used as an extrapolation domain for guiding effective out-scaling by identifying where similar intervention options have a potential of success based on contextual similarity.
The related geoinformatics data, including socio-ecological drivers, land productivity-based performance indicators and derived fCSET were also entered in the WebGIS of Geoinformatics Options by Context (GeOC) (https://mel.cgiar.org/slm/visualization) for supporting agricultural development projects/programs and scientists to improve targeting. It should be noted that although most of the data has been made visible in the online GeOC platform, the GeOC's WebGIS is sometimes offline as it is being under upgraded for components in relation to other going-on projects.

Output 5: The research results are published in peer-reviewed journals, presented at international conferences, in workshop meetings as well as in policy briefs.

	Activity	State of implementation
5.1	Publications are written and appropriate journals and conferences are chosen. Layout and content of one or several policy briefs is developed.	Completed in 2019

Two ISI papers are published; one on Gender and agricultural extension: "why a gender focus matters" in the Journal of Gender, Agriculture and Food Security (https://doi.org/10.19268/JGAFS.422019.1) and a second one on "Agricultural Technology Transfer Preferences of Smallholder Farmers in Tunisia's Arid Regions" in Sustainability (https://doi.org/10.3390/su12010421).
A working paper and a policy brief "Developing a Policy Framework for Agricultural Extension Systems in Tunisia" were developed and are available online in English (http://hdl.handle.net/20.500.11766/8389 and http://hdl.handle.net/20.500.11766/8390). The policy brief explains the need for innovative resource-saving extension methods. New extension approaches need to emerge locally, based on experimentation, learning, and adaptation to prevailing as well as evolving conditions. The discussions and interactions with key stakeholders involved in the extension information chain suggest that extension staff should receive appropriate training to carry out their duties. They also reveal that scarce resources can be used more effectively through partnerships with the private sector and use of information and communication technologies where appropriate. Finally, it is critical to note that monitoring and evaluating performance of extension service delivery based on stakeholder feedback is also crucial in ensuring that extension staff skills remain relevant to end-user's needs.
The following three papers are in the process of being published and will be submitted in 2020:

i) "Functional Context Socio-ecological Types as Potential Out-scaling Domains for supporting widespread adoption of Innovative Agricultural Practices in three Maghreb countries".

ii) “Impact of Extension Approaches on Women’s Decision-making power in Tunisia.”

iii) “Empowerment, technical, economic and organizational trainings to improving the agricultural extension system in Tunisia: Evidence from a randomized controlled trial analysis. “Paper planned to be submitted to the Journal of Rural Studies (https://www.journals.elsevier.com/journal-of-rural-studies/). (Ongoing). IF=3.30.

In addition, five blogs, three technical reports, one manual and two videos were elaborated. Details of these deliverables are listed in section 10.

The project approach and findings were shared and presented at the following events:

i) Tropentag in Kassel
During the International Conference “Tropentag” in Kassel, September 18-20, 2019 the “Mind the Gap” project was presented during a 3-hour workshop on Technology Transfer. Participants from NGOs, universities and national and international research institutes and development agencies exchanged with ICARDA, OEP and INRAT representatives about the project approach, results and recommendations. A short film was used to introduce the project activities.

ii) Knowledge Management Symposium
IFAD organized a three-day symposium on Knowledge Management, November 13-15, 2019 in Rabat, Morocco. ICARDA was invited and presented the “Mind the Gap” approach and lessons learned. Participants came from Moldovia, Sudan and Morocco and represented government institutions.

iii) Maghreb Barley Conference
ICARDA and its national partner INRAT organized a Maghreb barley conference in Tunis, December 10-12, 2019. During this workshop participants from Morocco, Algeria, Libya and Tunisia discussed challenges and opportunities regarding barley production in the Maghreb region. The successful dissemination strategies used in the Mind the Gap project to scale the new barley variety Kounouz in Tunisia were presented.

iv) Final “Mind the Gap” project workshop
Project findings were discussed during the final workshop in Hammamet, Tunisia, November 11-12, 2019. 42 participants of OEP, CRDA’s, AVFA, INRAT, ICARDA, GIZ and farmer organizations of regional and national level exchanged for two days about the lessons learned and how to improve dissemination of technologies in the future. Representatives of the partner organizations worked in groups to assess the project and formulate recommendations.

IDO Contribution

The number of beneficiaries reached between 2016 and 2018 is 560 (four treatment groups). They received multiple training activities, SMS and access to inputs. The 140 farmer households from the control group received technical information via SMS on barley and feed blocks, access to Kounouz seeds and farmer business school (FBS) trainings after the RCT-research part had been completed in 2019. The total number of 700 farmer household reached corresponds to the initial number stated in the project proposal.

Although women were always invited to the mixed training sessions, their participation with an average of 5% was weak. However, 71 women participated in female empowerment activities. In total, 138 farmers were reached through access to Kounouz barley seeds and 14 through access to subsidized feed blocks.

Besides the farmer households, employees of the national agricultural extension and research institutes benefited from trainings and study trips. In 2017 and 2018, two one-week trainings on

"result based project management" were given by CIM-ICARDA staff with a total number of 48 participants. In 2019, 12 national project partners participated in a study trip to CIHEAM in Zaragoza, Spain to learn about the innovation transfer models in Spain.

Research Outputs

Output 1: New and existing models of technology transfer are developed, tested and rigorously evaluated
Rating: 2
Reason: Everything was done according to plan; one of the technologies (feed blocks) selected was a bad choice as it did not meet the demands of farmers.

Output 2: A strategy is developed on how to increase and facilitate the adoption of innovative agricultural technologies for the Tunisian government and stakeholders of development cooperation.
Rating: **2**
Reason: The policy brief on transfer of technologies was published and discussed with major partners. Adoption of new dissemination strategies by extension services following the project results is still limited.

Output 3: A policy manual and a brochure on how to appropriately design technology transfer projects under Tunisian conditions is developed and distributed.
Rating: 2
Reason: The policy manual was developed and distributed. But partners have not yet developed any technology transfer projects using Mind the Gap results applying the most effective and efficient strategies.

Output 4: Maps for typical types of socio-cultural and environmental context over WANA region are created and published on the web identifying similar areas where the RCT experiment can be scaled up
Rating: 3
Reason: Structural framework model and cluster analysis of contextual types was developed but no regional workshops have taken place and no partner has used the tool as a decision-making support to transfer technologies yet. Partners seem to lack understanding of the tool, and further capacity development on the approach and tool is needed. Moreover, the concept and tool seem to be more relevant to needs of national policy decision-makers and planners rather than local stakeholders. In general, within the project period, the use of this output is limited in Stage 1 and 2 discovery/proof of concept projects. The approach would be very useful for piloting and scaling projects.

Output 5: The research results are published in peer-reviewed journals, presented at international conferences, in workshop meetings as well as in policy briefs**.**
Rating: 2
Reason: Results are published in journals and are publicly available. Results were presented at several national and international conferences

Achievement of the Purpose

Outcome / Purpose 1: Adoption of new agricultural technologies by smallholder farmers is increased
Rating: 2
Reason: The introduced new drought tolerant barley variety Kounouz has been adopted by a large proportion of farmer households. In 2017 42 % of the 700 HH bought seeds of the new variety and

in 2018 20%. Furthermore, the demand for the new barley variety has gone far beyond the project intervention area in 2019, which was the first year that Kounouz was available on the seed market. Two large seed cooperatives and one seed enterprise produced about 1,600 tons of Kounouz in 2019. The national demand for Kounouz seeds is estimated at 600 tons for the 2019/2020 cropping season. While the results for Kounouz have exceeded our expectations, the adoption of feed blocks was very low, with only 2 % of the 700 farmer households buying the subsidized feed blocks in 2018.

Outcome / Purpose 2: Transaction costs for farmers are reduced through improved access to input and output markets and market information
Rating: 3
Reason: The sending of SMS by local extension agents (CTV) helped the farmers to have access to input prices and information about availability of inputs like Kounouz seeds and feed blocks (when, where and what price). But the project did not manage to also provide output market information.

Outcome / Purpose 3: The results of the study have induced a process of organizational learning and continuous discussion about technology transfer models within development cooperation
Rating: 3
Reason: The sending of SMS to farmers as an innovative and inexpensive extension method is becoming part of the national extension strategy. AVFA, INGC and CTV intend or are already using it to announce trainings, provide weather information and occurring plant diseases. Field visits which have proven to be the most cost-effective dissemination method in the project are also considered but are still too costly for the national extension services (high transport costs).

Achievement of the Goal

Goal 1: Agricultural services (governmental, private services and NGOs) are impact-oriented and apply research results on how to increase the adoption of agricultural technologies and improve their livelihood impacts in a cost-effective way
Rating: 3
Reason: See reasoning outcome 3, use of SMS as a cost-effective way to reach thousands of farmers

Goal 2: The results described in the manual on how to design technology transfer projects in other countries of the North-Africa region are scaled up and tested in the North-Africa region
Rating: 3
Reason: The manual exists. The project approach and results concerning technology transfer were presented in other countries (Knowledge Management symposium in Rabat, Morocco) or to representatives of other countries of the WANA region (Algeria, Libya, Morocco) during the barley conference in Tunis. But the transfer methods have not been tested in other countries of the WANA region.

Goal 3: Access to agricultural services is improved, especially for female farmers
Rating: 2
Reason: The 700 farmer households have received a series of trainings during the project, in particular for female farmers. The farmer households in the T3 and T4 group received specific female empowerment trainings like BUS and credit training. The final survey shows that there are now more active requests for advice by male and female farmers to extension agents (CTV).

Goal 4: Agricultural productivity is sustainably increased through reduced forage costs, reduced transaction costs and increased production; this leads to more stable and higher per capita income for vulnerable households.
Rating: 3
Reason: Barley is one of the major forage crops used by the farmers. The introduction and successful scaling of the new drought tolerant Kounouz variety with more biomass and grain production under semi-arid conditions can significantly increase production in drier areas of Tunisia. The sustainability is ensured as seed multiplying cooperatives and enterprises will produce Kounouz seeds also in the future.

Gender Equity aspects

The project looked at the following specific gender questions:

- Are there gender specific differences in the transfer rate and the perception of certain innovative farming technical packages?
- What are the consequences of the new farming technology innovations for women and men? Do they strengthen their role as farm managers?

Rating: 2
Reason: Adoption rate of the new barley variety "Kounouz" was highest in treatment groups 3 and 4. Those treatment groups had specific female empowerment trainings, unlike T1 and T2. Adoption rate of Kounouz in 2018 in T3 was 33% and in T4 23%. These leads to the conclusion that adoption of feed technology is higher when special attention is given to female farmers, which is commonly not the case in Tunisian extension practices.
Our findings revealed that women were interested in attending extension training and, contrary to popular belief, their needs in training were similar to that of men, e.g. information on crop fertilization, livestock management and livestock health. There are limited sex-segregated statistics on women's roles, ownership and contributions in agriculture in Tunisia (for example the FAO factsheet on gender and agriculture in Tunisia was last updated in 1994). The project aimed at understanding the roles of men and women in agriculture, generating sex-segregated information on workload and tasks distribution, access to extension information, ownership of assets (land and livestock), and contribution to decision-making power. Our findings reveal that the T4 group which received female empowering BUS training showed an 80% higher contribution of women in the decision-making process regarding how to use farm income generated by small ruminant production. This shows that the approach tested by the project increased women decision-making power which is often reiterated as a need in applied assessment and theoretical literature on gender and agriculture.

3. Major Research Findings

The project used randomized control trials (RCT) combining different dissemination and training methods to see their impact on the adoption of two technologies:

i) A new drought tolerant barley variety called "Kounouz"
ii) "Feed blocks", a feed supplement composed of locally available agro-industrial by-products

The four treatment groups were composed of 140 households each and received the following kind of extension in different combinations:
T 1: technical training and SMS
T 2: technical training, SMS, economical and organizational training
T 3: technical training, SMS, economical and organizational training, female empowerment
T 4: technical training, SMS, female empowerment

The trainings were given in 2017 and 2018. In September/October 2017 Kounouz seeds were sold at a subsidized price (35% project subsidy) to farmers interested in Kounouz. In the same period in 2018 Kounouz seeds were sold without project subsidy (market price).
The feed blocks were sold between July and September 2018 when feed is generally scarce. The project contributed with 35% at the production costs. In 2017 there was no feed block production due to the breakdown of the feed block producing unit.

Table 2. Adoption rate of technology in 2017 and 2018

Results	T1 (N=140)		T2 (N=140)		T3 (N=140)		T4 (N=140)		C (N=140)	
	Number	%	Number	%	Number	%	Number	%	Number	%
Kounouz adopters 2017	67	47.8	69	49.3	86	61.4	54	38.6	292	41.7
Kounouz adopters 2018	31	22.1	19	13.6	46	32.9	32	22.9	138	19.7
Feed block adopters 2018	6	4.3	2	1.4	4	2.9	2	1.4	14	2

Table 2 shows that 292 farmer households from the 700 HH adopted (purchased) the new Kounouz variety in 2017. This represents 41.7% of all farmer households. The adoption rate of Kounouz diminished in 2018 to 138 HH (19.7%). This decrease of 56% was due to several reasons:

- The price increase of the seeds from 40 to 60 TND (100 kg) because the project did no longer subsidize the purchase.
- Some farmers used Kounouz seeds harvested during the 2017-2018 growing season so they did not need to purchase new Kounouz seeds for 2018-2019 season.
- The unfavorable agricultural season in the year 2017-2018 in part of the project intervention area with very limited rainfall (less than 200 mm) did not allow Kounouz to perform well, thus farmers were not convinced of Kounouz.
- The unavailability of the seeds in some regions
- Some farmers prefer growing local seeds which can be purchased on credit.

The highest adoption rate of Kounouz was in treatment group 3: 86 out of 140 farmer HH, representing 61.4% adopted the variety in 2017 which was confirmed in 2018 where T3 also showed the highest adoption rate with 46 out of 140 farmer HH (32.9%). This result leads to the conclusion that the combination of all trainings (technical, economical, organizational and female empowerment) are the most effective method to transfer technologies. The trainings are to be considered as complementary.

The control group, which did not receive any trainings but had access to both technologies had the lowest adoption rate. Through “mouth to mouth” information, farmers of this group learned about the new barley variety and 11.4% of the group members purchased the seeds.

Giving attention to female farmers had a positive impact on the adoption rate. T3 and T4 received female empowerment trainings like BUS and access to credit trainings and had the highest adoption rate of Kounouz in 2018.
The introduction of feed blocks was not successful. In 2017 the machine producing feed blocks broke down at the beginning of the production period and could not be fixed due to missing spare parts. But even in 2018, when the machine was fully functional, the adoption was very poor. Only 14 farmer household of the 700 HH purchased the blocks, which represents only 2% of all farmer HH. The reasons for the low adoption rate are as follows:

- Farmer’s preference to stick to their traditional livestock feeding based on bran and local barley grains.
- Lack of confidence: feed blocks contain Urea to improve protein content and cement as binder. Both ingredients (cement and Urea) scare farmers. They consider them as dangerous for animal health.
- Low palatability of feed blocks for animals (animals need time to adjust)

- Feed blocks are not always available
- High selling price (despite the subsidy from the project)
- Unusual rainfall in summer 2018 which allowed the project farmers to graze their herds and therefore they needed less additional feed.

To convince farmers that feed blocks are not harmful to small ruminants, visits were organized to OEP farms were goats and sheep are fed regularly with feed blocks. Video films from other countries like India and Iran where blocks are used in large quantities were shown. Animal nutrition specialists were invited during trainings to explain advantages of feed blocks for small ruminants, e.g. balanced feed, includes roughages, easy to transport and store, cheaper than concentrates, beneficial for the national economy as it uses locally available materiel (no importation costs). Nevertheless, overall adoption remained poor.

Comparing the costs of the tested extension methods, research results show that treatment 1, with only technical training, was the most cost-effective dissemination method. With a total training cost of 229 TD (84 US$) per farmer, an adoption rate of 22.6% in 2018 was achieved as compared to T3, where the highest overall adoption rate of 33% was observed with training costs reaching 918 TD (331 US$).

Most participants (80%) agreed that the field visits which were part of the technical training component contributed the most to technology adoption. Furthermore, the project farmers insisted that the field visits in similar areas were highly appreciated. The SMS method contributed less to the adoption but is a very inexpensive extension method with costs of as low as 0.01 US$ per message per farmer. SMS proved also as very useful for inviting farmers to trainings and informing them about access to inputs.
Giving special attention to female farmers in a farm household through female empowerment activities had a positive impact on the adoption rate. Female-headed households showed a significant higher adoption rate of Kounouz in 2018 than male-headed households.
Among the tested socioeconomic variables, age, education, and household size are affecting positively and significantly the adoption of Kounouz. This implies that older farmers are more likely to adopt Kounouz than younger farmers. In addition, farmers with a high education level and a large household size are also more likely to adopt Kounouz than less educated farmers and farmers with small household size, respectively. Wealth is affecting adoption positively but not significantly.
The project challenged assumptions about joint-decision making between spouses as being egalitarian and sole-decision making for women as being synonymous with empowerment and attempted to understand how decisions were made, how interventions could affect decision-making in the domains of agricultural production, selling and control over income expenditure, and the empowerment and adoption implications. Towards the end of the project, we solicited qualitative information on who made decisions in each of these domains, and why, as well as assessing changes related to Mind the Gap interventions. This information was solicited in addition to identifying examples and types of both sole and joint decision making in these domains. We also attempted to understand reasons for men's and especially women's participation or lack of participation in trainings, which trainings were the most effective and why, and related recommendations for improving the trainings. The findings contribute to a growing body of applied literature aimed at improving gender research methods related to women's involvement in decision-making with implications for training programs. A publication related to decision-making outcomes and the implications on women and men wellbeing is being prepared.

4. Assessment of Research Findings

The project included a component targeting policy makers: a policy brief outlining findings and recommendations was produced in French and English and a workshop was held to disseminate the

findings. Furthermore, Institut National de la Recherche Agronomique de Tunisie (INRAT), Agence de la Vulgarisation et de la Formation Agricoles (AVFA) and Office de l'Elevage et des Pâturages (OEP) who were actively involved in the implementation of the project gained first-hand experience in gender-sensitive extension programing. INRAT staff also led the qualitative assessment of the survey findings which improved their capacity in qualitative data analysis.
The AVFA training coordinator explained that the project led to building the capacity and experience of the organization in delivering to women and men farmers alike. He also explained that the women trainings will be used in other extension programs in rural Tunisia.
The project contributed to gender equality and women's empowerment in one of the most gender unequal regions in the world. By looking at the intra-household dynamics, the project shed light on how men could become allies in empowering women. Furthermore, the project interventions offered a clear example on how public services, namely extension, can be made more accessible and beneficial for women through targeted interventions.
In addition, the project aimed at an adequate representation of women in project management, data collection, and workshop attendance. Two women enumerators established their own consulting company focusing on gender aspects in agriculture, using the skills they have acquired through their involvement in the project.

5. Knowledge Sharing and Partnerships for Impact

5.1. Research institutes (IARC, NARS)

So far, the research findings have been shared with NARS in Tunisia during the final national workshop. Working papers, blogs and manuals related to the project results and recommendations on technology transfer and extension service in Tunisia as well as on how to improve the adoption rate through improved dissemination strategies have been developed together with partners, published and shared.
As the Mind the Gap project is mapped to the Feed and Forages flagship of CRP Livestock, results of the project will be also presented in the CRP workshops in 2020 and will contribute to scaling strategies being developed in CGIAR.

5.2. Development partners like extension and training institutions, farmers, agribusiness, policy makers.

The research findings were transferred to the DG and sub-directors of AVFA, the national agricultural extension and training institute, the Director, sub-directors and regional directors of OEP (national livestock institute), Directors of CRDA and CTV (regional extension agencies), Director and scientists of INRAT (national institute of agricultural research) and the coordinators of GIZ PAD and GIAE in Tunisia.
Outside Tunisia, the results were shared with NARS and extension services of Algeria, Libya, Morocco during the International Barley Workshop in Tunisia and of Sudan and Moldavia during the Knowledge Symposium in Rabat.
More than 35 participants at the Tropentag mainly from development organizations working in Sub-Sahara Africa benefited from presentations of the project results.
The research findings like the usefulness of the very low-cost dissemination method of sending SMS to spread information to farmers can be very beneficial for resource-poor extension services in Tunisia. It is mainly up to the involved CTV technicians who had the positive experience of this technology over the last two years, to promote and do the lobbying at regional and national level. Detailed presentation to GIZ GIAE staff and their national partner APIA can also help to improve the dissemination strategy and the adoption rate of GIZ introduced technologies.

6. Training

6.1 Trainings on the technical level provided to the end-users (beneficiaries)

Technical Training Activities

560 farmer households of four treatment groups (T1, T2, T3, T4) were selected and invited to receive technical training activities. In 2017, technical theoretical training activities for the two innovations "Kounouz" and "feed blocks" were organized in classrooms, where OEP and INRAT technicians and scientists explained the use and advantage of these innovations. In 2018, the transfer strategy focused on field visits, where all farmers of T1, T2, T3 and T4 were invited to visit the Kounouz barley fields of fellow farmers who were growing this variety for the first time. "Farmer to farmer" extension approach is known as very successful concerning adoption of new technologies. Eight farmer field days were organized between 28.03. and 12.04.2018. Due to the effects of drought in the region, biomass production levels of this variety were generally below expected levels.

To show farmers the full potential of the new barley variety, they were taken to the INRAT (NARS) research station in Mornag, on eight separate occasions. At the station, they could observe the variety produced under rainfed conditions with best agronomic practices. Fortunately, in 2017/2018 Mornag received rainfall levels similar to the long-term average amounts, which ensured higher production levels of the barley variety. The "Kounouz" variety was grown next to locally available "Rihane" barley variety and farmers observed higher biomass production for "Kounouz" than with "Rihane". In addition, a fertilizer trial showed the response of the two varieties to different doses of DAP fertilizer.

Table 3: Farmer participants in farmer field day and research station visit

	No of households (HH) in T1 – T4	No of HH participating farmer field day	% of HH participating farmer field day	No of HH visits to research station	% of HH participating at visit to INRAT
Kairouan	370	97	26	62	17
Zaghouan	190	41	22	67	35
Total/Average	560	138	25	129	23

From the total household representatives in Kairouan, 26% took part in the farmer field day and 17% took part in the visit to the research station (Table 2). In Zaghouan, 22% took part in the farmer field day and 35% visited the research station. There was a sharp decline of 50% in terms of participation in technical training events between 2017 and 2018, dropping from 48% in 2017 to 24% in 2018.

SMS

The project was using SMS as a mean of transferring technical and organizational text messages to farmer HH since August 2017. Technical messages concerning Kounouz, feed blocks and livestock feeding in general and organizational messages like when, where and for how much farmer can purchase the promoted technologies were sent to the 560 farmer HH of the project (T1-T4) on a weekly basis by five CTV (regional extension service) officers. Two workshops were held July 2017 and July 2018 with technicians of AVFA, CTV/CRDA, OEP, GIZ and INRAT to develop the messages to be sent until the end of the project (December 2019).In April 2018, the project organized a survey with 100 farmers receiving SMSes to enquire about their appreciation, use and recommendation concerning SMSes as means of extension. The results reflected positive effects of SMSes: 87% respondents stated that they find the SMSes useful and 70% responded that they had actually

applied one or more advices received through SMSes. Of the surveyed farmers, 84% continuously request additional information, in particular market price information for agricultural inputs, technical information about other crops, livestock as well as training events.The positive results of this survey motivated the project team to elaborate a specific ICT project for agriculture. A “small grant proposal” was approved by BEAF and started in April 2019. The project called “ICT2Scale” widens the spectrum of technical information to other crops and introduces a demand-driven information system using a “short number” for market price information.

Economical training

In 2017, five one-day training activities were organized to explain the economic benefits of the two innovations to farmers. In 2018, 280 farmer HH (T2 and T3) were invited to receive economic farm management training. It was observed that the capacity of trainees was often not sufficient to fully understand the economic calculations. Therefore, in 2018 the project decided to collaborate with the PAD program of GIZ in Tunisia who successfully uses the Farmer Business School (FBS) approach to enable farmers to become farm entrepreneurs in a very participatory way.

In collaboration with the GIZ FBS master trainer, the FBS module was adapted to the project needs and barley/livestock production system. A well-developed 50-page learning document was produced and used during the FBS training activities totaling seven courses. Each training lasted 5 days and included 12 modules (decision making, diversification of agricultural production, how to know if you make a benefit, budget planning and management over the year, benefit of being member of a farmer association, entrepreneurship, etc.).

Table 4: Farmer participation in FBS economic training activities

	No of households (HH) in T 2 and T 3	No of HH participating in FBS training	% of HH participating in FBS training
Kairouan	140	45	32
Zaghouan	140	65	46
Total	280	110	39

A total of 110 farmers took part in the economical training activities (FBS), representing 39% of the invited farmer households.

Organizational training

280 farmer HH (T2 and T3) were invited to participate in organizational training activities (Table 5). These trainings were split in two parts, each part lasting one day. The first day was on farmer organizations in general and on SMSA (cooperatives) and GDA (farmer association) in particular. Examples of other countries (like Germany) where farmer cooperatives are well installed were given to show the importance of farmer organizations. Links to the promoted technologies Kounouz and feed blocks were established through the possibility of bulking, e.g purchasing of seeds or feed blocks in large quantity for members of a cooperative, thereby reducing price per unit and other transaction costs like transport.

A second part of the training focused on the creation process of farmer organizations (SMSA and GDA) and the administrative procedures. This follow up training was a request of participants. The level of farmers being organized in SMSA is below 5 % (according to the baseline).

Table 5: Farmers’ participation in organizational training

	No of households	No of HH participating at	% of HH participating at	No of HH participating at	% of HH participating at

	(HH) in T 2 and T 3	organizational training part 1	organizational training, part 1	organizational training, part 2	organizational training part 2
Kairouan	140	92	66	55	39
Zaghouan	140	96	69	57	41
Total	280	188	67	112	40

In 2018, visits were organized to existing and functioning farmer cooperatives. 42% of the invited famers participated in the visits in Zaghouan (Table 6), while participation rate was very low in Kairouan (6%).
The visits gave project farmers the opportunity to receive information on how they went along to create the cooperative, constraints and obstacles in creating and running a cooperative and its general management. The cooperatives visited were engaged in running farm supply shops, providing inputs such as seeds, fertilizers, pesticides and irrigation materiel for members and non-members. Creation of farm cooperatives is a general challenge in Tunisia, strongly supported by the government. A total of five visits were organized.

Table 6: Farmers' participation in visits to farmers' cooperatives

	No of households (HH) in T 2 and T 3	No of HH participating at cooperative visits	% of HH participating at cooperative visits
Kairouan	140	8	6
Zaghouan	140	59	42
Total	280	67	24

Female empowerment and gender
The women in 280 farmer households (T3 and T4) were invited to participate in female empowerment activities. At least 28% of the women in Zaghouan participated in the visits to the farmer cooperatives, while 43% participated in Kairouan. Participating women were either the head of households themselves (minority), the spouse or were any other female relative living in the same household as the head of the HH. Similar to the above-mentioned organizational training where men were taken to farmer cooperatives; women were taken to women cooperatives. Five visits to female cooperatives producing and selling honey and essential oils were organized. The visits aimed at stimulating female farmers to join existing cooperatives or to create their own.
Women of T3 and T4 were also invited to a sensitizing event demanded by women during the 2017 BUS training activities. AVFA trainers explained to the women the different options, opportunities and requirements for women to receive subsidies by the government or credit from financial institutions. One of the lessons learned was that the Tunisian national agricultural bank BNA provides credit to women if they have a certificate of a three-month AVFA training course in their respective business domain (e.g. honey or small ruminants' production). This information motivated women to register for these courses which the project supported in 2019.

Table 7: The participation of women in visits to farmer cooperatives

	No of households (HH) in T 3 and T 4	No of HH participating women cooperative	No of HH participating credit sensitizing	% of HH participating visit to coop and credit sensitizing
Kairouan	210	43	43	20
Zaghouan	70	28	28	40
Total	280	71	71	25

Women of 280 farmer households (T3 and T4) were invited to participate at an entrepreneurial training. Those women were either the head of households themselves (minority), the spouse or any other female relative living in the same household as the head of the HH. The training called BUS (Bauern Unternehmer Schulung) has two parts. BUS 1 takes three days and focuses on self-esteem and personal development. BUS 2 also requires three days and develops specific business ideas for each participant. There should be an interval of 10-14 days between BUS 1 and BUS 2. At the end of the training, participants should have a clear concept of where they want to be in five years, which and how the business will be developed. They should be able to elaborate a simple business plan. As examples, AVFA BUS trainers and OEP staff showed the women different ways of how barley and feed blocks could be used to develop businesses (e.g. processing of barley, bulking of feed blocks). The first 140 women were invited to participate in BUS trainings from end of February till end of April 2017; a maximum of 20 women per training. A second series of trainings took place in November and December 2017. A total of 14 complete six-day BUS training sessions was organized in 2017 to reach 280 women (Table 8).

Table 8: Female farmers participating in BUS trainings

	No of HH in T 3 and T 4	No of HH participating BUS 1	No of HH participating BUS 2	Total (Bus 1 and 2)	% of HH participating BUS 1 and 2
Kairouan	210	127	97	92	44
Zaghouan	70	37	34	34	49
Total	280	164	131	126	45

After the completion of the research part of the project in December 2018, the project focused on some development activities. From February till May 2019 four parallel 3-month AVFA training courses were organized mainly for female farmers of the project. The trainings took place near the women's homes which allowed them to return to their farms after the course and fulfill their daily household and farm tasks. The four training courses covered the following areas: i) small ruminant production, ii) cattle production, iii) vegetable production in green houses and iv) bee keeping. All courses included theoretical and practical parts.

Table 9: Participation of mainly female farmers at 3-months training courses

	Small ruminant course	Cattle training course	Vegetable course	Bee keeping course	Total
Number of Participants	26	25	28	27	106

6.2 Capacity development for female researchers

Two female researchers from the project team, Dr. Hajeur Benghanem and Dr. Dina Najjar were sent to a training workshop at the University of Bocconi, Italy to attend a week-long course on Randomized Control Trials that was given by the Abdul Latif Jameel Poverty Action Lab (J-Pal). These skills were important to facilitate analysis of the data and strengthen quantitative skills of female researchers.
In addition, eight young female researchers were hired for the baseline and endline survey to ensure female farmers' perspectives are collected in a culturally sensitive way. In addition, four female assistants were trained for a qualitative assessment of gender related impacts such as women's

empowerment which can be better captured through qualitative research. The qualitative research complimented and nuanced the quantitative findings.
A one-week training course on ”innovative extension methods” was organized in collaboration with CIHEAM Zaragoza, Spain from 8-12 April, 2019. 13 participants from different extension, training and research institutes in Tunisia (5 x OEP, 5 x CTV/CRDA, 1 x AVFA, 1 x INRAT, 1 x ICARDA) learned about agricultural innovation transfer models in Spain. In addition to two days of lectures at CIHEAM campus, three days of visits to relevant institutions were organized. These included the Technology and Management Division-INTIA in Villava, the FruitCenter in Lleida, Neiker, the agricultural research and development institute in Arkaute and the cooperative Oviaragon.
The two ICARDA CIM-IF Dr. Jutta Werner and Udo Ruediger moderated two one-week training courses on result orientated project management in 2017 and 2018. Participants were representatives of national extension, training and research institutes plus APIA, the national agency for promotion of agricultural innovation (partner of GIZ green innovation center).

7. Lessons Learned

The major lessons learned of this research project included:

- The participation rate of farmers involved in the project in the various trainings has a direct impact on the adoption rate of Kounouz variety in the studied areas.
- The RCT method tested by the project allows the Government to choose according to its budgetary resources among a combination of training/extension methods with different adoption rates. In this sense, the project offers four (4) potential options for the adoption of the Kounouz barley variety:
  - An adoption rate of Kounouz for T3 in 2018 of 32.9% with a total training cost estimated at 918.1 TND[1] per person,
  - An adoption rate of Kounouz for T4 in 2018 of 22.9% with a total training cost estimated at 540.6 TND per person.
  - An adoption rate of Kounouz for T1 in 2018 of 22.1% with a total training cost estimated at 229.3 TND per person.
  - An adoption rate of Kounouz for T2 in 2018 of 13.6% with a total training cost estimated at 607.0 TND per person.
- Treatment groups that received training in empowering women showed the highest Kounouz variety adoption rates in 2017 and 2018.
- The involvement of women in the project had a positive effect on the adoption of innovative technologies, in particular in areas where men are generally absent (working outside the area).
- The project revealed that field visits, both farmer to farmers and to research stations, where Kounouz was grown under the full technological package (with an average moderate cost), conducted in similar production areas, is more preferable than training (with a considered high cost) and text message (very low cost). However, these extension methods are complementary and encourage farmers participants to adopt the innovative technologies implemented by the project.
- Farmers showed very limited interest in feed blocks despite the intensive trainings.
- The project revealed a lack of financial and human resources in the public agricultural extension system.
- The project revealed financial and administrative constraints for the creation of SMSA (agricultural cooperatives) despite the high interest demonstrated by the farmers who participated in the economic and organizational trainings.

[1] 1 Euro = 3.28 TD (average exchange rate 2018)

- The project showed that adoption of technology is a non-linear process, complex and influenced by several socio-cultural, economic, institutional, and environmental factors.
- The project proved that effectiveness of a training program depends not only on the number of farmers who received information, but also on the success of this approach and / or methods used to influence farmers' decision to adopt a specified technology.
- Women participating in T3 and T4 treatment contributes more to decisions related to the expenditure of income generated by livestock activities, potentially due to increased knowledge (more confident in their contributions).
- The project demonstrated the importance of a participatory approach involving different partners in the technology transfer strategy.

The collaboration with the national partners was very positive and exceeded our expectations. Four national partners were strongly involved:

- AVFA (national training and extension agency: provided trainers and training classrooms and helped in transport (logistics) for farmers
- CTV/CRDA (regional extension services): organized the baseline and follow-up surveys, sent SMS to farmers, invited farmers to trainings, organized sale of Kounouz and feed blocks
- OEP (national livestock agency): trained farmers on feed blocks, produced feed blocks, cleaned Kounouz seeds
- INRAT (national research): developed and multiplied Kounouz seeds, trained farmers on Kounouz production.

The collaboration with GIZ, in particular the PAD and Green Innovation Center, was also very fruitful. Adaption of the FBS module to livestock and barley was supported by GIZ master trainers. PAD trainer of trainers trained AVFA and consultants on the adapted FBS modules and BUS (female empowerment module).
Initially there were some misunderstandings with INRAT (national research), but when the right subject specialists got involved, the project advanced as intended.
Collaboration with the University of Goettingen, the German partner, was beneficial regarding the development of the project's RCT approach and the organization of the baseline and follow-up survey. Unfortunately, both PhD students, the first one, who organized the baseline as well as the second one replacing her for the follow-up survey, withdrew their engagements due to changed career plans. This had severe consequences for the workload of the ICARDA staff, who had to take over the final data analysis with no support from the university.
The process of identifying the two technologies was much more complicated as initially expected. The challenge was to find technologies which were innovative, had a proven advantage, were accessible, not too time consuming, not too expensive and not too complex.
The RCT approach involved many, many types of trainings and actors, OEP, AVFA, INRAT, private sector, and farmers' organizations. This meant that problems in the implementation processes, cross overs, and compliance were amplified. It might have been better to reduce the number of trainings into fewer batches. Furthermore, while some trainings lasted several days, others lasted a few hours. This also creates difficulty in recommending the most impactful training given the costs and intensity/duration. In particular, the FBS and women trainings were the longest and such an approach (uneven in duration and intensity of trainings albeit well meant) especially risks concluding that women trainings are impactful but very expensive.
RCTs are not a panacea for action research. In fact, there are burgeoning critiques about the approach, including in agricultural context: ethical concerns around the control not given treatments, being too rigid and risking waste of resources (if a treatment is not working you keep going because RCTs do not allow for adaptive, corrective measures, take the example of feed blocks here), last but not least RCTs tells us whether an experiment works but it does not tell us how. Luckily, in our project we have accounted very nicely for some of these critiques: 1) we have provided the control with

training and access to seeds after the endline survey was collected and 2- we have conducted qualitative analyses to understand why farmers did not show up and most importantly 3) how the treatments affected the various development outcomes of interest.

The project workplan was followed most of the time. A delay occurred with the analysis of the baseline study which took place end of 2016. The results became only available in autumn 2017. The 700 survey documents (each consists of 50 pages), were sent to University of Goettingen where only few students worked on the data entry and analysis. To avoid this delay, the final study was done using tablets which also improved quality of data (better data control) and speed up analysis.

The project organized a number of round-table meetings with all project partners to plan and discuss project activities, constraints faced and share lessons learnt. Three national two-day project workshops were organized: i) inception workshop in April 2016, ii) mid-term workshop in February 2018 and iii) final workshop November 2019. These meetings proved very useful to plan jointly, take corrective measures, discuss emerging results and ensure that results, successes/failures and lessons learnt were agreed and owned by the whole project team.

8. Outlook Future Research and Development Pathway

i) The Mind the Gap project researched the question of how different training and dissemination methods could improve the adoption of technologies by smallholders. It would be very interesting and useful for the national and sub-regional (North-Africa region) partners to look at the influence on the adoption of technologies of other aspects like access to inputs, market prices and agricultural insurance. The experience gained with the RCT approach could help setting up a new RCT project with the possible layout shown in table 9.

Table 10: Proposed RCT application for new research project

T 1	T 2	T 3	T 4	Control
Access to agricultural insurance	Access to agricultural insurance	Access to agricultural insurance	Access to agricultural insurance	No treatment
	Access to inputs	Access to inputs		
		Access to market price information	Access to market price information	

ii) The Mind the Gap project worked with the new barley variety Kounouz, as one of the technologies to be transferred. Recently INRAT registered another barley variety in Tunisia which was developed with ICARDA germplasm. The new variety called “Rima” is even more drought tolerant than Kounouz and performs well in arid regions like southern Tunisia, with only 200 mm annual rainfall. As the project has identified most effective and cost-efficient dissemination methods for new crop varieties, this knowledge can now be used to speed up adoption of the new barley variety. To assure the anchorage of the new variety on the national seed market collaboration with seed producing cooperatives and enterprises as well as the extension institutes is needed.

iii) Within the project duration, the application of fCSet and GeOC was limited for a project at discovery/proof of concept stage. These results will become more useful at piloting and scaling stages

9. Summary

Researchers have developed improved agricultural technologies for the livestock-barley system of semi-arid Tunisia over the past decades, but the adoption of these technologies has remained low. This 'adoption gap' has not only been observed in Tunisia but is typical for agricultural system innovations and natural resource management technologies in developing countries in general (Noltze et al. 2012; DFID 2014; Syngenta Foundation 2015). So far it has remained unclear how this 'adoption gap' could be bridged by appropriate technology transfer packages and extension approaches. Research on improving agricultural extension approaches has not been a research priority; neither within the CGIAR system nor outside.

The objective of this project was to address this research gap through developing and testing new and existing models of transferring sustainable technology packages to smallholder farmers. The different technology transfer models were rigorously evaluated in terms of their effects and cost-efficiency on innovation adoption, through randomized controlled trials (RCTs). The new technologies and technology transfer models were tested in the context of livestock-barley systems in Tunisia with a focus on improving sheep and forage production. However, given the innovative design, the research also generated knowledge on how to improve agricultural extension far beyond the concrete case of Tunisia. Thus, the 'Mind the Gap' research project presents an innovative step towards more outcome-oriented research on agricultural extension in the MENA region.

The project compared different models of technology transfer and documented results in terms of benefits, costs, and cost-effectiveness, which is important for possible upscaling at a later stage. The technology transfer methods comprised technical training, economical and organizational training and female empowerment activities. These training components were combined in different ways to evaluate their impact on adoption rate of two technologies: i) a new drought tolerant barley variety called Kounouz and ii) feed blocks, an innovative feed for small ruminants composed of locally available agro-industrial by-products.

The experiment showed that the combination of all training components led to the highest adoption rate. In the case of the improved barley variety, adoption rate in 2017 was 62% and in 2018 33% of smallholder households. Combining all trainings was most effective but with 918 TD training costs per farmer also the most expensive model. The most cost-effective transfer model was giving only technical trainings. With an average training cost of 229 TD per invited farmer, the adoption rate was still 22% in 2018. The technical training component was composed of theoretical classroom training, field visits to farmers, field visits to the agricultural research station and receiving technical SMS on Kounouz and feed blocks. Most participants (80%) agreed that the field visits (part of technical training component) contributed the most to the technology's adoption. Furthermore, the project's farmers insisted that the field visits in similar environments were highly appreciated. The SMS method contributed less to the adoption but was a very inexpensive extension method with costs of as low as 0.01 US$ per message per farmer. It is considered as very useful for inviting farmers to trainings and informing them about access to inputs.

Giving special attention to female farmers in a farm household through female empowerment activities had a positive impact on the adoption rate.
Among the tested socioeconomic variables, age, education, and household size are affecting positively and significantly the adoption of Kounouz. This implies that older farmers are more likely to adopt Kounouz than younger farmers. In addition, farmers with a high education level and a large household size are also more likely to adopt Kounouz than less educated farmers and farmers with small household size, respectively. Wealth is affecting adoption positively but not significantly.
To make the results accessible to the Tunisian Government and development cooperation stakeholders in order to improve their current practices of technology transfer, a policy manual for extension services is being developed. Scaling up to other regions will be facilitated with interactive similarity maps that identify similar socio-cultural and environmental contexts across the Maghreb.

10. Publications, Papers, Reports and other Media

Relevant documents, which have **already been published** or submitted for publication:

10.1 Peer-reviewed articles in periodicals (give DOI number)

1. Ileana I. Diaz, Dina Najjar 2019. Gender and agricultural extension: why a gender focus matters. AgriGender (Journal of Gender, Agriculture and Food Security), 4(2): 1-10. https://doi.org/10.19268/JGAFS.422019.1
2. Dhehibi, B., Rudiger, U., Moyo, H.P., Dhraief, M.Z. 2020. Agricultural Technology Transfer Preferences of Smallholder Farmers in Tunisia's Arid Regions. Sustainability, 12, 421. https://doi.org/10.3390/su12010421

10.2 Conference presentations and other documents

- PPT Presentation on Mind the Gap approach and results for Knowledge Management Symposium in Rabat, Morocco and Tropentag, Kassel (http://www.tropentag.de/conference/workshops/#W18.)
- Marco Kruse "Female Autonomy and Nutrition in Tunisian Farm Households" Paper presented at the ICABR (International Consortium on Applied Bioeconomy Research) conference
- Najjar, D., Oueslati, D, Benghanem, H, Werner, J, and Baruah, B. (2019). **الجنس)الجندر(والزراعة في تونس :تقرير موجز عن البلد.** ICARDA Fact Sheet [Arabic version with hyperlink]. Joint with CRP Livestock.
- Najjar, D., Oueslati, D, Benghanem, H, Werner, J, and Baruah, B. (2019). Gender and Agriculture in Tunisia: A Brief Country Report. ICARDA Fact Sheet [English version with hyperlink]. Joint with CRP Livestock.
- Najjar, D., Oueslati, D, Benghanem, H, Werner, J, and Baruah, B. (2019). Genre et agriculture en Tunisie : rapport national succinct. ICARDA Fact Sheet [French version with hyperlink]. Joint with CRP Livestock.
- Policy Brief on "Tunisian Agricultural Extension System", https://hdl.handle.net/20.500.11766/8390 (English)
- Policy Brief (In French version) on *Développer un cadre politique pour les systèmes de vulgarisation agricole en Tunisie*. https://hdl.handle.net/20.500.11766/9814
- Policy Brief (In French – Note Politique) on " *Innovations Agricoles : options pour des approches de transfert de technologies agricoles appropriées dans les zones semi-arides en Tunisie* " 10 P. https://hdl.handle.net/20.500.11766/10501 .
- Working paper on "Developing a Policy Framework for Agricultural Extension Systems in Tunisia", https://dx.doi.org/20.500.11766/8389 (English)

- Working paper on" *Improving Dissemination Strategies to Increase Technology Adoption by Smallholders in Tunisia*". https://hdl.handle.net/20.500.11766/9813
- Working paper on "*Factors Influencing Farmers' Decisions to Adopt Improved Technologies in Semi-Arid Farming Systems: A case study of the barley variety Kounouz and feed blocks technology in Tunisia***.** https://hdl.handle.net/20.500.11766/10223
- Manuals and Guidelines on the RCT Methodology, http://hdl.handle.net/20.500.11766/8209 (English) https://hdl.handle.net/20.500.11766/9049 (French)
- Blog on: Female entrepreneurs creating consultancy due to MtG experiences https://www.icarda.org/research/innovations/investments-young-women-deliver-smallholder-farmers

10.3 Thesis

- Kruse, Marco. Assessing the Role of Women Empowerment for Food Security and Nutrition: Empirical Evidence from Tunisia and India https://ediss.uni-goettingen.de/handle/21.11130/00-1735-0000-0003-C169-D

10.4 (Hand-) Books (hardcover/paperbacks) / Technical Reports

- Technical report on "Improving Dissemination Strategies to Increase Technology Adoption by Smallholders in the Tunisian Arid Land Areas (An assessment from follow up survey)" 200 p. https://hdl.handle.net/20.500.11766/10005 .
- Technical report on "Factors Influencing Farmers' Decision for Adopting Improved Kounouz Variety and Feed Blocks in Tunisia". https://hdl.handle.net/20.500.11766/10094 .
- Technical Report on "MIND THE GAP: Improving Dissemination Strategies to Increase Technology Adoption by Smallholders" Project Lessons Learned". 11 p. https://hdl.handle.net/20.500.11766/11020.

10.5 Other media (like websites, video-clips etc.)

- Short video explaining the project approach and objectives, https://hdl.handle.net/20.500.11766/9052
- Short video on CRP livestock "Feed and Forages" in Tunisia, incl Mind the Gap activities, https://hdl.handle.net/20.500.11766/10057
- Blog on "Mind the Gap – climate smart solutions" http://www.icarda.org/dryWire/mind-gap-bringing-climate-smart-solutions-field-tunisia
- Blog on: Factors Influencing Farmers' Decision for Adopting Improved Kounouz Variety and Feed Blocks in Tunisia http://www.icarda.org/dryWire/mind-gap-bringing-climate-smart-solutions-field-tunisia
- Blog on: Investments in young women deliver for smallholder farmers https://www.icarda.org/research/innovations/investments-young-women-deliver-smallholder-farmersBlog on: Addressing Tunisia's Technology Adoption Gap https://www.icarda.org/media/drywire/addressing-tunisias-technology-adoption-gap
- Blog on : Agricultural and livestock technology transfer preferences in Tunisia: https://www.icarda.org/impact/impact-stories/agricultural-and-livestock-technology-transfer-preferences-tunisia.

*Relevant documents, **planned to be published** later on:*

10.6 Articles / journals

"Impact of Extension Approaches on Women's Decision-making power in Tunisia." To be submitted by end 2020"

"Functional Context Socio-ecological Types as Potential Out-scaling Domains for supporting widespread adoption of Innovative Agricultural Practices in three Maghreb countries"> To be submitted to an ISI journal in the first half of 2020

Dhehibi, B., Dhraief, M.Z., Ruediger, U., Frija, A. 2020. Female Empowerment, technical, economic and organizational trainings to improving the agricultural extension system in

Tunisia: Evidence from a randomized controlled trial analysis. Paper to be submitted to the Journal of Rural Studies (https://www.journals.elsevier.com/journal-of-rural-studies/).

10.7 Conference presentations and other documents

Dhehibi, B., Dhraief, M.Z., Ruediger, U. 2020. Assessing coping strategies in response to drought on household food security in Central-Tunisia. Paper to be submitted as oral presentation to the International Symposium for Farming Systems Designs “Designing climate smart agricultural systems for a sustainable transition in the agri-food systems of the dry areas”, March 21-24, 2021, Tunis, Tunisia (https://fsd7.sciencesconf.org/).