FINAL TECHNICAL REPORT

PROJECT SYNTHESIS

MIND THE GAP "*Improving Dissemination Strategies to Increase Technology Adoption by Smallholders*" PROJECT LESSONS LEARNED

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List of acronyms

AVFA	Agence de Vulgarisation et de Formation Agricole
CRDA	Commissariat Régional au Développement Agricole
CTV	Cellule Territoriale de Vulgarisation Agricole
FGD	Focus Groups Discussion
Ha	Hectare
HH	Households
ICT	Information and Communication Technology
INRAT	Institut National de la Recherche Agronomique de Tunisie
OEP	Office de l'Elevage et des Pâturages
Qx	Quintals
RCT	Randomized Control Trials
SMS	Short Message Service
SMSA	Société Mutuelle de Service Agricole
T	Treatment
t	Tons
TND	Tunisian Dinar
US$	US dollar

1. Introduction

Proven agricultural technologies that can improve lives often have low adoption rates due to lack of effective service delivery systems and enabling policy environment. Agricultural extension is a common method to introduce technologies. However, little is known about which extension approaches are the most effective with farmers. Thus, the project's (***Mind the Gap-Tunisia Improving Dissemination Strategies to Increase Technology Adoption by Smallholders***) implemented in Tunisia was aiming to provide clear understanding on which extension approaches have the greatest success rate will help improve future agricultural technology dissemination efforts.

Through its life cycle, we learned lessons and discovered opportunities for improvement of the effectiveness and cost-efficiency of the suggested extension approaches and technology transfer methods. As a key part of project outcomes, documenting lessons learned helps the project team and their partners to discover both strengths and weaknesses. It provides an opportunity for team members and/or partners to discuss successes during the project, unintended outcomes, and recommendations for others involved in similar future projects. It is within this context, a synthesis on the key lessons learned from this project are outlined with special emphasis to the project context and its challenges, and the key recommendation strategies to improve dissemination strategies of two improved technologies introduced by the project such as new barely *kounouz* variety and feed blocks technology. The synthetized key lessons are to assist project teams to record the knowledge gained from the process of performing the Mind the Gap Project. The purpose is to share and use the knowledge derived from this experience to: (i) Repeat desirable outcomes in other similar contexts, and ii) Avoid undesirable outcomes.

2. Context and Challenges

Improved packages for the livestock-barley system in semi-arid Tunisia are able to save up to 40% of livestock feeding costs but are not widely adopted. Low adoption rates are typical for many proven technologies in developing countries. While developing improved technologies is important for rural livelihoods, new technologies can only affect livelihoods positively if they are adopted by farmers. A better understanding of how extension services can be modified to make them more effective in the small farm sector can help to promote rural growth and poverty reduction.

3. Objectives of the Project

It is within this context; the project goal was to increase agricultural productivity within a selected group of 700 participating farmers in the Tunisian semi-arid agro-climatic zones. In practical way, around 671 farmers have been effectively involved. This was processed through using the most effective extension approaches (trainings, access to market information, etc.) to increase the adoption of the two technologies mentioned in the above section. Moreover, the project compared different extension approaches and evaluate their impacts on technology adoption rates and farm household livelihoods. Moreover, female and male farmers participating in the experiments have received specific improvements related to the access to technical training and subsidized inputs, access to economical and organizational training, and female empowerment.

4. Methodology and Research Approach of the Project

To improve the rigor of the comparison, the project has implemented a randomized control trial (RCT) approach. RCT compares randomly selected groups that receive ("treatment") with those that do not receive ("control") the extension approaches that are being tested. Different treatment

groups receive different types of extension approaches. These groups are compared with each other and against the control group receiving no treatment.

This approach is unique in that it allows for:

- Randomization that allows impacts to be attributed to a particular treatment
- One or different treatment groups and a control group
- Comparison and evaluation of different extension approaches

These three components were combined in various ways, and the combinations implemented in different treatment groups to test and compare their individual and combined effects. By using randomized control trials (RCT) approach, the project tries to find out which agricultural extension design favors the adoption of the new barley variety *Kounouz* and the feed blocks technology the most within smallholder farmers. The table 1 shows the distribution of project households (HH) according to the treatment groups in 2018.

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

Source: Own elaboration from project data (2019).

5. Summary of Key Lessons

5.1. Effectiveness of Technology Transfer Methods

In 2017, the treatment group 3 (T3) registered a better adoption of *Kounouz* variety (61.43%) followed by the treatment group 2 (T2) (49.3%) then the treatment group 1 (T1) (47.86%) and finally the treatment group 4 (38.57%). In 2018, T4 (24.43%) takes the second position of the *Kounouz* variety adoption behind T3 (33.58%), then T1 (22.63%) and finally T2 (13.87%). These results suggest a high decrease in the adoption rate of *Kounouz* variety for the group T2 (76.8%) and T1 (53.7%) compared to T3 (46.5%) and T4 (40.7%).

With respect to the feed blocks, in 2018, empirical findings reveal that for the full sample, only 2.24 percent of the households adopted feed blocks compared to 1.53 percent for T4, 2.17 percent for T2, 2.92 percent for T3 and 4.38 percent for T1. This finding indicates that the adoption of feed blocks is very low for all treatment groups.

Lesson Learned 1:

The highest adoption rate for Kounouz obtained under T3. This is because the whole package of extension was provided to this treatment group (technical training, SMS + economic and organizational training +female empowerment + access to input). These findings are mainly related to the type of trainings received by the HH involved in the project and the participation rates of the project farmers to these trainings. The impact of the RCT method should be evaluated in 2020 after two years of experimentation of *Kounouz* variety and the implementation of the trainings.

Lesson Learned 2:

The treatment groups 3 and 4, which received the female empowerment training, have the highest *Kounouz* variety adoption rates in 2018. The implication of women in the project has a positive

influence on the adoption of innovative technologies especially in areas where men are generally absent (work outside the area). The gender dimension should be considered as a vector of adoption of new technologies especially in Tunisian agriculture as evidenced by this project.

Lesson Learned 3:
The participation rate of project farmers to different trainings has a direct impact on the adoption rate of *Kounouz* variety in the studied areas. So far, this rate reflects the involvement degree of the beneficiaries in the project. Treatment group 3 for the head of the households and treatment group 4 for women registered the highest rates of participation to trainings (40.85% and 41.4% respectively). The current attendance of farmers to trainings in general does not exceed the 50% for the Tunisian agricultural sector (i.e. all AVFA trainings). Various reasons can explain the high level of absenteeism of farmers to trainings such as the lack of direct incentives compared to the other development projects. The majority of HH heads are working outside the farming zone and they cannot participate to all the project trainings. Some farmers have other concerns on the day of the training like the harvest of olives while other few small farmers prefer working and earning money than doing trainings, etc.

Lesson Learned 4: Concerning the extension methods, the field visit (farmer to farmer visit and visits to the Tunisian research station where *Kounouz* barely variety was grown with the full technical package), evaluated with an intermediate cost, especially done in the similar areas is more preferred than the training (with a high cost) and the text message (with a very low cost). In fact, this is the case for most of project farmers. However, these extension methods are complementary and encourage the project's farmers to adopt the project implemented innovative technologies.

Lesson Learned 5: In terms of cost (Table 2), the government can choose according to the available budgetary resources between having a high level of technology adoption with the highest cost of trainings (Adoption rate of *Kounouz* for T3 in 2018 was 35% with a total cost of trainings estimated to 918.1 TND – around 317.98 US$ per person) or having a lower technology adoption rate with a lower cost of trainings (Adoption rate of *Kounouz* for T4 in 2018 was 24.5% with a total cost of trainings estimated to 540.6 TND – around 187.22 USS$ per person, Adoption rate of *Kounouz* for T1 in 2018 was 22.6% with a total cost of trainings estimated to 229.3 TND – around 79.41 US$ per person).

Table 2: Key adoption and extension-costs indicators of *Kounouz*

Indicators	T1	T2	T3	T4
Number of *Kounouz* adopters in 2018	31	19	46	32
Adoption rate of *Kounouz* 2018 (%)	22	14	33	23
Training costs per person (TND)	224	607	918	540
Training costs per adopter (TND)	1012	4473	2794	2363

Note: 1 TND = 0.35 USD$ (average 2019).
Source: Own elaboration from "Mind the Gap" project databases (2019).

Lesson Learned 6:
The project used technical SMS for both technologies and other information related to small livestock feeding and breeding. They were sent by the territorially extension cell (TEC called CTV) to

T1, T2, T3 and T4 HH on a weekly basis. 87% of farmer HH appreciated this type of inexpensive information transfer. 82% of HH used the recommendations. SMS are therefore highly appreciated by farmers for simple transfer of technical information, information about trainings and access to inputs. They cannot replace proper trainings but can be supplementary; their contribution to adoption is limited

Lesson Learned 7:
For the feed blocks technology, the effect of trainings on the adoption rates was very weak (1.45% for T4 to 4.37% for T1). According to the focus groups discussion (FGD's), the major reasons of non-adoption of this technology are the farmer's preference sticking to their traditional livestock feeding based on bran and local barley, the low palatability for animals, the unavailability of feed blocks for some farmers, the high selling price and the fact that the project's farmers graze their herds in the fields after the rainfall periods.

5.2. Understanding Farm Level Technology Adoption – Case of barely improved variety "*Kounouz*" and feed blocks technologies

Lessons learned 8:
Adoption of technologies depends more on the innovation itself than on the dissemination method. Barely *Kounouz* variety was much more requested by smallholder farmers than feed blocks and many farmers become more willing to adopt it with the passage of time.

Lesson Learned 9:
In terms of advantages on using the two improved technologies, project's findings suggest that HH express their willingness to adopt improved barely *Kounouz* variety because of its higher yields (66.7%) and its resistance to drought (49.3%). Only 14.7% of HH consider that *Kounouz* variety has no benefits. However, more than half of HH (56.3%) find that there are no benefits for the use of feed blocks. The major benefits of the use of feed blocks are related to the good growth for animals (13.2% of HH), the appetence for animals (9.2% of HH) and it contains more nutrients (7.0% of HH). Compared to *Kounouz* variety, feed blocks are not well perceived by households in terms of financial benefits

Lesson Learned 10:
For the feed blocks, the access to this technology is difficult and very difficult for about of 43.3% and 25.5% of HH involved in the project, respectively. However, around 48.8% of HH judged "easy" the access to *Kounouz* variety while 29.3% of HH stated "difficult" the access to this technology. Such findings suggest the need to improve the access of technologies for the project farmers (and beyond) in terms of availability and prices, especially for the feed blocks technology with the aim to enhance the adoption of these technologies.

Lesson Learned 11:
For the feed blocks, 47.7% of HH do not know its adoption cost while 26.3% and 18.1% of HH declared "high" and "very high", respectively the adoption cost of this technology. With respect to the barely *Kounouz* variety, 45.8% and 26.7% of HH judged respectively "high" and "very high" its adoption cost in both governorates. Among the main constraints of the adoption of *Kounouz* and feed blocks is their high adoption costs according to the perception of the farmers involved in the project. Thus, the poor farmers did not accept the increase of price of *Kounouz* variety during the cropping season 2018-2019 due to the fact on removing the subsidies by the project.

Lesson Learned 12:

More than half (50%) of HH have a low capacity of payment of inputs and resources needed to adapt the feed blocks for the following cropping season. While, around 51.3% of HH have a middle capacity to purchase *Kounouz* variety. Thus, it is imperative to improve the adaptation capacity in terms of payment of inputs and resources needed for *Kounouz* variety and especially for feed blocks by enhancing the access of small farmers to micro-credit. Moreover, additional efforts should be done especially in terms of the diffusion of information about the availability of inputs and on how to improve the mobility of the small farmers (association, transport means, etc.).

Lesson Learned 13:

Looking at the distance to the social facility, the agricultural extension office is the farthest with an average of 15.89 km for both governorates. Then comes the main agricultural products market with an average distance of 14.82 km and the main agricultural inputs market with, an average, of around 13.88 km. The village market is also far with an average distance for both governorates of 13.03 km and the secondary school is far with an average distance of 18.84 km for Kairouan and 9.7 km for Zaghouan. The minibus or public transport is the most used mean of transport for the village market (58.6%), the main agricultural inputs market (46.9%), the main agricultural products market (42.6%) and the agricultural extension office (70.6%). The role of extension and training is crucial in the development of knowledge, perceptions and attitudes about agricultural innovations. In the case of *Kounouz* variety, the distance of the extension office affects negatively the adoption of this technology. The challenge for the increase of the technology adoption is how to bring closer the social facility to the small and poor farmers. This could be done through using SMS messages which contributes to inform farmers and consequently reduce costs.

Lesson Learned 14:

Households in Kairouan and Zaghouan governorates are facing different shocks. Three major shocks were observed during the last two years. For both governorates, drought is the largest shock observed with 98.5%. Then comes the large increase in food prices with 93.3 % and finally the large increase in agricultural input prices with 91.2% in both locations. For half of the sample (56%), nothing can be done against this situation. In Kairouan, 62.8% declare that they are helpless in the face of such a situation. In Zaghouan governorate, 19.4% sold their animals as a coping strategy to deal with these shocks, while only 14.3% declare selling their animals in Kairouan to have some cash. Around 18% of the HH involved in the project region - Zaghouan prefer opting for non-agricultural employment, while it is only 5.1% of the sample are following this strategy in Kairouan. Small and poor farmers are vulnerable to shocks especially drought. In the case of the Mind the Gap project, the drought has a negative influence on the adoption of *Kounouz* variety between the cropping seasons 2017-2018 and 2018-2019. However, the farmers who own an irrigated area have increased the adoption of this variety. The effect of the external environment is crucial on the adoption of the project innovative technologies (i.e. improved barely *kounouz* variety).

Lesson Learned 15:

The socio-demographic and economic factors such as the age, education level and house size are found to influence positively the adoption of *Kounouz* variety in both regions. The average age of the households' heads was quite high (56 years) and empirical findings show that old farmers are more likely to adopt the *Kounouz* variety rather than the youngest farmers. In addition, the farmers with the high education level and large Household size are more willingness to adopt *Kounouz* variety. The characteristics of innovation represented by the factors "Have innovation benefits" and

"High adapt capacity in terms of payment of inputs" have the major influence on the adoption of *Kounouz* variety. In this sense, the project farmers (mostly small and poor) who have a high capacity of payment of inputs and resources registered the highest rate of adoption of *Kounouz* variety. In addition, the large number of farmers adopting *Kounouz* variety are convinced of the advantages on adopting this variety. Empirical findings reveal also the high influence of external environment factors on the adoption process. The drought intensity factor influences negatively the adoption of the improved barely *Kounouz* variety while the factors "intensity of increase of food prices" and "intensity of increase of inputs prices" have a positive influence. In case of drought and lack of rainfall, the project farmers have adapted the use the local barely varieties instead of improved variety (*Kounouz*) as a mitigating coping strategy to sustain productivity during this event. This finding is confirmed by the decrease on the adoption rate of *Kounouz* variety between 2017 and 2018. On the other hand, the increase of prices of foods and inputs stimulates project beneficiaries to adopt the improved variety as a mechanism to enhance the crop yield and, consequently improve financial benefits.

Lesson Learned 16:

The findings on the assessment of the potential external factors expect to influence adoption of the two technologies show that "own motorbike", "high innovation benefits", "high dependence to external environment", and "distance to main market (both for inputs and final products)" are found to affect positively the adoption of feed blocks. The distance to main market positive impact is explained by the fact that the adopters of feed blocks located far of the main market have generally a transport mean and then have a good access to this technology. However, the factors "Off farm income", "soil fertility", "high level of knowledge needed", and "sex" of the HH head are influencing negatively the adoption of feed blocks technology. The key conclusion that female HH were found to be more motivated to adopt this technology than male HH.

6. Recommendations: Focus on the effectiveness of technology transfer approaches

One of the biggest challenges facing smallholder farmers in dryland areas is not how to increase production overall but how to enable them to produce more within their limited resources both financially and naturally. The project Mind the Gap in Tunisia tend to address this gap through the introduction of two potential technologies: Improved barely *Kounouz* variety and feed blocks and testing of various agricultural technology transfer methods to enhance adoption of these technologies. However, while new introduced technologies and information transfer strategies have been motivated to improve smallholder adoption, and despite the widespread evidence of economic and environmental benefits associated with these technologies and the cost-effectiveness of the technologies transfer methods introduced by the project. The adoption rate of varies between the two technologies. It remains fluctuate and slow for the feed block. For Kounouz, it could be considered acceptable during the raining years (almost 40%), and consequently influences farm economic sustainability and performance.

Furthermore, knowledge may be an important variable, but how farmers receive information from different sources has a more significant effect on adoption than just mere knowledge acquisition. Agricultural Extension (through different channels and methods) is the basis of the transfer of agricultural technologies to farmers and, consequently to persuade farmers to adopt those agricultural techniques. Therefore, combining the impact of different dissemination methods on

adoption may sometimes be misleading since the actual impact and magnitude of each method may not be assessed clearly.

With the purpose to satisfactorily meet the demands and expectations of the different stakeholders and partners in the project "Mind the Gap", the study recommends the following:

- Improving the participation of project farmers in training (Choosing the right training period and strengthening the material and human resources of extension agents to facilitate farmer invitations).
- Define the needs of the target farmers in training before proposing the technology and then choose the best method of extension according to the adoption rate / cost ratio. A pre-project survey should be conducted for the selection of appropriate technologies.
- Redirect priorities to a gender-sensitive extension policy, especially rural women, especially for projects that are particularly targeted small-scale farming.
- It is also better to choose farmers (and women farmers) who have land titles on their land.
- Involve financial institutions (banks, ENDA, etc.) in the project phase related to the adoption of technologies by small farmers.
- Invest more in new technologies (SMS) with low costs and wide dissemination of information.
- Strengthen outreach and partial privatization of agricultural extension by including other types of service providers in the technology transfer process.

7. Strategic Actions: Considerations for policy makers

To improve the adoption of *Kounouz* variety and the feed blocks in the study area, and in similar agro-ecological contexts, we outlined the following strategic actions:

- Government should understand what knowledge and attitudes farmers have in relation to these technologies and how these are brought to them. Then, the agricultural policy can redesign these technologies (i.e. feed blocks and substitute with pellets) to the preferences and the specific conditions of farmers for a better adoption and sustainability.

- It was clear that the effectiveness of a training program depends not only on the number of farmers that receive information but also on how successful that approach and or methods influences farmers' decision to adopt a given technology. This highlighted the need of an empowerment of the Tunisian extension system to train farmers through both conventional (i.e. demonstration fields, economic training, organizational training), and technology-led approaches using ICT and mass media such as video, radio and mobile phones, since these methods have been found to be cost effective with significant impact on agricultural technology adoption decisions of farmers. Thus, to enhance the attendance of project farmers to trainings, some recommendations may be proposed:

    - (1) choosing the right training period (avoid harvest period),
    - (2) Strengthening the material and human resources of extension agents to facilitate the farmer invitation methods.

- Partly privatization of agricultural extension. Include other types of service providers than national extension agents for transferring technologies. Private enterprises or large-scale cooperatives who have a financial interest in the adoption of their technology (like new seed varieties) by farmers will work more efficient and effective.

- Support large scale SMSA through co-financing the salary of a well-qualified coordinator in a regressive way. Coordinator should have the task to train the members and bring innovations to the SMSA. He should be paid on performance.
- Improve collaboration between research (INRAT) and development (OEP, AVFA and CRDA/CTV) organizations. The project facilitated the close collaboration between these public actors with the effect that new barley variety has been shown and production method taught to farmers. This intense collaboration was new to these structures.
- To make the new barley variety "Kounouz" sustainably available on the market, multiplication of the basic and certified seeds by seed cooperatives must be assured.
- Select the most relevant extension method in terms of the type of training offered and its cost.
- Adopt the most relevant invitation method in terms of adaptability to the environment (geographical, cultural and institutional) and its cost.
- Accompany the target farmers in the realization of their projects (Microcredit, SMSA, small projects, etc.).
- Added the gender dimension in the extension strategy.
- Involve different actors in the process of transferring innovation (service providers, industries, etc.).
- Understand farmers' knowledge, perceptions and attitudes about new technology before it is released.
- Accelerate the process to change social attitudes to promote gender equality through awareness raising activities (men and women).
- Studying the socio-demographic and economic characteristics of the beneficiaries, the characteristics of the innovation and the characteristics of the external environment before the transfer of technologies.
- Include the most cost-effective new approaches in the technology transfer strategy, including SMS that have been well appreciated by the different project participants.
- Involvement of farmers in upstream innovation development processes.

Annexes

Annex 1

Characteristics of *Kounouz* Variety

Kounouz, is a spring barley six-rowed variety, developed by the National Agricultural Research Institute of Tunisia (INRAT) and was officially registered in 2010 in the Tunisian catalog of plant varieties for commercial use by farmers. 'Kounouz' was selected by INRAT in collaboration with ICARDA following the decentralization strategy for germplasm development for the region. It was initially selected from the barley segregating populations for North-Africa (BSP-NA) grown in Béja and subsequently evaluated in a series of on-station and on-farm trials over the years at different locations before the variety was released for general cultivation across semi-dry and dry areas of Tunisia. Kounouz is a cross of Alanda/5/Aths/4/Pro/Toll//Cer*2/Toll/3/5106/6/24569 (Pedigree: ICB95-0508-0AP-1BJ-2BJ-0BJ). Kounouz is semi-compact with bent ears at maturity, yellowish-white kernels and greyish albumen, hollow straw, medium early (103 days) with medium height (95 cm) adapted to semi dry location and lodging resistant. Kounouz is moderately resistant to net blotch and powdery mildew compared to Manel and has good resistance to scald under natural inoculation compared to Rihane, a commonly grown barley variety in Tunisia. Kounouz gave during three consecutive crop-seasons (2004-2007) in Kef (semiarid), an average grain yield of 51.89 qx/ha, compared to Rihane (47.52 qx/ha) and Manel (51.64 qx/ha). At Beja (sub-humid), Kounouz gave during six consecutive cropping seasons (2001-2007) an average grain yield of 40.39 qx/ha, compared to Rihane (37.77 qx/ha) and Manel (42.20 qx/ha). The specific weight is 0.6 to 0.7 (t/hl) in high-input environment (Béja) and 0.63 in low input environment (Kef). Total protein content is 9 to12% (Béja) and 11.5 to 14.9 (Kef). It is advisable to grow Kounouz in semi-arid areas (250-350 mm of rain annually).

Reference: Ben Ghanem H. et El Felah M., 2011. Inscription d'une variété d'orge ''Kounouz'' dans le Catalogue Officiel Tunisien des Obtentions Végétales. Annonces: Inscriptions variétales. Ann. de l'INRAT, Volume 84, 2011; p. 168.

Annex 2

Characteristics of Feed Blocks

Feed blocks are a solid mixture consisting mainly of local agricultural and agro-industrial by-products, used as a feed supplement for poor fodder such as straw, stubble and pasture.

The main benefits on using the feed blocks are displayed below as follows:

- Feed storage for a long time (2-3 years).
- Easy to handle and transport.
- A balanced feed that stimulates microbial activity in the rumen, provides the animal with minerals, vitamins, energy and nitrogen.
- "Catalytic" supplementation allowing the optimization of ruminal fermentations and consequently; an improvement in the digestibility of roughage.
- Reduced use of concentrate.
- Remarkable reduction in the cost of the feed ration; An improvement of the income of the farmers.

The general formula of feed blocks distributed to the project participants includes rapeseed cake, wheat bran, crushed barley, lime, urea, a mixture of ingredients that contain the desired nutrients (nitrogen, minerals, vitamins) and one of many energy rich agro-industrial by-products, such as olive cake (Table 3).

Table 3: The composition of feed blocks used in the Mind the Gap project

Ingredients	Percentage (%)
Olive cake	24
Rapeseed cake	10
Wheat bran	30
Crushed barley	20
Lime	10
Urea	2
CMV (minerals)	2
Salt	2
Total	**100**

Source: OEP elaboration for the project "Mind the Gap".