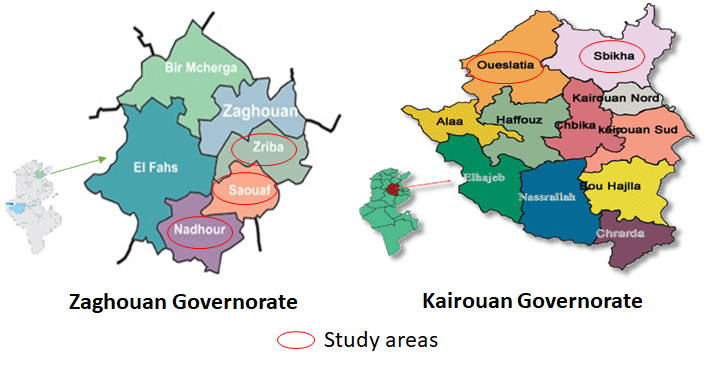
**Suppl.Material**

****

**Fig.S1.** Research study sites in Tunisia. Source: Own elaboration based on Google map (2021).

**Appendix S1**

[Baseline Characterization](#_Toc7564449)

[Module A: Household demographic data](#_Toc7564451)

[Module B: Characteristics of the main house](#_Toc7564452)

[Module C: Household assets](#_Toc7564453)

[Module D: Land owned per hectare](#_Toc7564454)

[Module E: Crop management and input use](#_Toc7564455)

[Module F: Livestock possession and marketing](#_Toc7564456)

[Module G: Livestock technology](#_Toc7564457)

[Module H: Livestock alimentation](#_Toc7564458)

[Module I: Technology awareness and uptake](#_Toc7564459)

[Module J: Technology perception](#_Toc7564460)

[Module K: Social networks](#_Toc7564461)

[Module L: Other sources of income and transfer](#_Toc7564462)

[Module M: Non-food expenditure](#_Toc7564463)

[Module N: Access to socioeconomic infrastructure](#_Toc7564464)

[Module O: Shocks](#_Toc7564465)

[Module P: Day food recall](#_Toc7564466)

**Table S1.** Treatment characterisation\*

|  |  |  |
| --- | --- | --- |
|  | **Training components** | |
|
| **Technical training** | 1.1 | 1-day training: |
| -     Presentation on feed blocks by OEP and ICARDA |
| -     Presentation on *Kounouz* by INRAT and OEP |
| -     Theoretical and practical training on Melovine by OEP |
| -     Field visit to see *Kounouz* at ripening stage at INRAT field station |
| 1.2 | 1-day follow-up training: |
| -     Demonstration of feeding with feed blocks |
| -     Verbal refreshing of all three technologies (feed blocks, *Kounouz*, Melovine) |
| 1.3 | 1-day field visit to farmer who has planted *Kounouz* during last season |
| 1.4 | 1-day field visit to INRAT demonstration farm for *Kounouz* |
| 1.5 | Regular text messages: |
| -     On technical issues in livestock management and barley |
| -     On when, where and for what price farmer can purchase the promoted technologies |
| **Economic and organisational training** | 2.1 | 1-day organisational training: |
| -     General Directorate of Financing and Professional Organizations (DGFIOP), AVFA and ICARDA |
| -     Focus on benefits of farmer organisations (better input and output prices), examples from other countries given, supported technologies were presented as examples (e.g., cheaper access to seeds and marketing) |
| 2.2 | 1-day organisational training follow-up |
| -     Creation process of farmer organisations SMSA and GDA and the administrative procedures |
| 2.3 | 1-day visit to cooperative/farmer group |
| 2.4 | 1-day economic/financial training |
| -     General theoretical lesson (with training sheet to determine cost of production) |
| 2.5 | 1 day economic/financial training follow-up/coaching |
| 2.6 | 5-day farmer business school |
| **Female empowerment** | 3.1 | 3-day BUS 1 |
| -     Implemented/supervised by AVFA |
| -     Self-esteem and personal development |
| 3.2 | 3-day BUS 2 |
| -     Develop specific business ideas for each participant |
| -     In some cases, OEP staff mentioned how barley and feed blocks could be used to develop businesses (<30 minutes) |
| 3.3 | 1-day sensibilisation on credit |
| -     Presentation by AVFA |
| -     Presentation of certified technical training options (provided by AVFA) which are required by the financial service providers to obtain credit |
| -     Obtaining credit and subsidies through Agency for the Promotion of Agricultural Investments (APIA), National Agriculture Bank (BNA), and NGOs |
| -     Identification of women’s technical training interests |
| 3.4 | 1-day visit of female cooperative/farmer group |

*\*In 2017, technical training activities for Kounouz were organised in classrooms, where technicians and scientists explained the use and advantage of these innovations. In 2018, the transfer strategy focused on field visits, where all farmers of treatments T1–T4 were invited to visit the Kounouz fields of fellow farmers who were growing this variety for the first time. The “farmer to farmer” extension approach has proven to be successful concerning the adoption of new technologies in many cases (Dhehibi et al, 2020).*

*In addition to field visits to fellow farmers, to support technical training, farmers were taken to the INRAT (NARS) research station to show them the full potential of the new barley variety. At the station, they could observe Kounouz produced under rainfed conditions with best agronomic practices. In 2017, five one-day training activities were organised to explain the economic benefits of this variety to farmers. In 2018, 280 farmer households (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 Promotion of Sustainable Agriculture and Rural Development in Tunisia (PAD) programme of GIZ in Tunisia, which uses the farmer business school (FBS) approach to enable farmers to become farm entrepreneurs in a participatory way. The FBS module was adapted to the project needs for the barley/livestock production system. A well-developed 50-page learning document was produced and used during the FBS training activities totalling seven courses. Each training lasted 5 days and included 12 modules (e.g. decision making, diversification of agricultural production, how to know if you make a profit, budget planning and management over the year, benefit of being member of a farmer association and entrepreneurship).*

*About 280 farmer households (T2 and T3) were invited to participate in organisational training activities. These trainings were split into two parts, each lasting one day. The first day was on farmer organisations in general and on SMSAs (farmer associations) and GDAs (water user associations) in particular. Examples of other countries (like Germany) where farmer cooperatives are well established were given to showcase their importance. Links to the promoted Kounouz variety were made by explaining the cost benefits of purchasing seeds in large quantities or bulking the harvest for members of a cooperative.*

*The second part of the training focused on the creation process of farmer organisations (SMSA and GDA) and the administrative procedures. This follow-up training was a request by participants. The number of farmers being organised in SMSA was below 5% (Mind the Gap project donor report, 2020). In 2018, visits were organised to existing and functioning farmer cooperatives. The visits gave project farmers the opportunity to hear from other farmers about how they had created their cooperatives and about the corresponding constraints and obstacles when managing them. The cooperatives visited were engaged in running farm supply shops and providing inputs such as seeds, fertilisers, pesticides and irrigation equipment for members and non-members. The creation of farm cooperatives is a general challenge in Tunisia, strongly supported by the government. A total of five visits were organised.*

*Finally, a group of 280 female farmers (T3 and T4) were invited to participate in entrepreneurial training. These women were either the head of households themselves (minority), the wife of the household head or any other female living in a considered household. The training called BUS (Farmer Entrepreneurial Training developed by the Andreas Hermes Academy) had two parts: BUS 1 took three days and focused on self-esteem and personal development and BUS 2 also required three days and developed specific business concept ideas for each participant. An interval of 10–14 days between BUS 1 and BUS 2 is preferable. At the end of the training, participants should have a clear concept of where they want to be in the coming five years, which business they want to undertake and how it will be developed.*

**Table S2**. Mean differences between treatment and control groups at baseline

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variables | Mean  (full sample) | Control  -  T1 | Control  -  T2 | Control  -  T3 | Control  -  T4 | Control  -  Full sample |
| Age of household head (years) | 55.920  (14.980) | -1.635  (1.738) | -2.444  (1.719) | -1.988  (1.720) | -0.230  (2.115) | -1.603  (1.491) |
| Male household head (dummy) | 0.935  (0.245) | -0.005  (0.032) | -0.034  (0.029) | -0.005  (0.032) | -0.029  (0.025) | -0.017  (0.024) |
| Education of household head (years) | (4.281)  (4.125) | 0.460  (0.531) | 1.775\*\*\*  (0.478) | 0.242  (0.524) | 0.533  (0.531) | 0.755\*  (0.403) |
| Off farm (dummy) | 0.498  (0.500) | 0.037  (0.062) | -0.044  (0.062) | -0.003  (0.062) | 0.030  (0.062) | 0.007  (0.049) |
| Household size (count) | 5.208  (2.609) | 0.393\*  (0.225) | 0.195  (0.251) | 0.312  (0.248) | -0.186  (0.265) | 0.184  (0.203) |
| Distance to main market (km) | 12.359  (13.040) | 2.319  (1.725) | 2.732\*  (1.501) | 1.241  (1.718) | -0.119  (1.790) | 1.561  (1.277) |
| Distance to extension  office (km) | 15.570  (11.618) | -3.054\*  (1.413) | 1.616  (1.217) | -0.528  (1.284) | -1.390  (1.327) | -0.833  (1.139) |
| Farm size (ha) | 5.668  6.870 | -0.581  (0.977) | 0.257  (0.872) | 0.140  (0.849) | -0.895  (0.932) | -0.263  (0.673) |
| Farm productive assets (Tunisian Dinars) | 4227.880  (8399.890) | -1204.554\*  (689.950) | -1748.773\*\*  (749.148) | -2050.102\*\*  (820.207) | -4833.662\*\*\*  (1262.453) | -2432.988\*\*  (818.112) |
| House assets (Tunisian Dinars) | 1196.300  (896.078) | -261.978\*\*  (115.762) | 86.467  (94.841) | -127.437  (96.428) | -58.824  (96.870) | -133.135  (84.457) |
| Own bike  (dummy) | 0.228  (0.434) | -0.108\*\*  (0.050) | -0.109\*\*  (0.051) | -0.116\*\*  (0.51) | -0.105\*\*  (0.50) | -0.110\*\*  (0.042) |
| Risk drought  (scale 0 to 10) | 4.736  (0.553) | -0.016  (0.059) | 0.062\*\*  (0.070) | 0.101  (0.072) | 0.097  (0.066) | 0.086  (0.055) |
| Soil fertility (dummy) | 0.762  (0.426) | 0.002  (0.055) | 0.095  (0.058) | -0.027  (0.053) | -0.014  (0.054) | 0.015  (0.045) |
| Knows *Kounouz* variety (dummy) | 0.589  (0.493) | -0.139  (0.128) | -0.045  (0.130) | -0.177  (0.125) | -0.242\*  (0.123) | -0.151  (0.119) |
| Observations | 671 | 266 | 266 | 266 | 260 | 671 |

*Note: Treatment T1, technical training; Treatment T2, technical training plus economic and organisational training; Treatment T3, technical training plus economic and organisational training plus female empowerment; Treatment T4, technical training plus female empowerment. \*, \*\* and \*\*\* denote significance at 0.1, 0.05 and 0.01 levels, respectively. Source: own elaboration from project field data, 2020.*

**Table S3.** Attendance rates in training sessions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Number | | % | | Total observations | |
| Attending any of the sessions offered in T1 (dummy) | 99 | | 72.2 | | 137 | |
| Attending any of the sessions offered in T2 (dummy) | 118 | | 86.1 | | 137 | |
| Attending any of the sessions offered in T3 (dummy) | 130 | | 94.9 | | 137 | |
| Attending any of the sessions offered in T4 (dummy) | 119 | | 90.8 | | 131 | |
| Attending at least one agricultural session offered in T1 (dummy) | 99 | | 72.2 | | 137 | |
| Attending at least one technical and one economic and organisational session offered in T2 (dummy) | 92 | | 78.6 | | 137 | |
| Attending at least one technical and one economic and organisational session, and one female empowerment session offered in T3 (dummy) | 68 | | 49.6 | | 137 | |
| Attending at least one technical and one female empowerment session offered in T4 (dummy) | 69 | | 52.7 | | 131 | |
|  |  | No of trainings | | % | | No of households |
| Share (%) of households attending all trainings offered in T1 |  | 4 | | 5.84 | | 8 |
| Share (%) of households attending all trainings offered in T2 |  | 10 | | 2.92 | | 4 |
| Share (%) of households attending all trainings offered in T3 |  | 14 | | 0.37 | | 1 |
| Share (%) of households attending all trainings offered in T4 |  | 2 | | 1.53 | | 1 |

*Source: own elaboration from project field data, 2020.*

**Table S4**. Socioeconomic characteristics of the considered treatments and control group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variables | | Min | Max | Mean | SD |
| AGE (years) | T1 (N=137) | 28.00 | 95.00 | 56.08 | 14.11 |
| T2 (N=137) | 24.00 | 98.00 | 57.25 | 13.47 |
| T3 (N=137) | 21.00 | 95.00 | 56.64 | 13.51 |
| T4 (N=131) | 29.00 | 85.00 | 56.01 | 13.31 |
| Control (N=129) | 22.00 | 90.00 | 54.62 | 13.86 |
| Education (year number) | T1 (N=137) | 0.00 | 17.00 | 4.43 | 4.29 |
| T2 (N=137) | 0.00 | 13.00 | 3.21 | 3.36 |
| T3 (N=137) | 0.00 | 16.00 | 4.72 | 4.19 |
| T4 (N=131) | 0.00 | 17.00 | 4.37 | 4.26 |
| Control (N=129) | 0.00 | 17.00 | 4.89 | 4.37 |
| Gender of Household Head  (1 male, 0 female) | T1 (N=137) | 0.00 | 1.00 | 0.93 | 0.26 |
| T2 (N=137) | 0.00 | 1.00 | 0.96 | 0.20 |
| T3 (N=137) | 0.00 | 1.00 | 0.93 | 0.26 |
| T4 (N=131) | 0.00 | 1.00 | 0.94 | 0.25 |
| Control (N=129) | 0.00 | 1.00 | 0.92 | 0.27 |
| Household size (number) | T1 (N=137) | 2.00 | 10.00 | 4.96 | 1.77 |
| T2 (N=137) | 2.00 | 15.00 | 5.30 | 2.38 |
| T3 (N=137) | 2.00 | 15.00 | 5.01 | 2.10 |
| T4 (N=131) | 2.00 | 13.00 | 5.43 | 2.10 |
| Control (N=129) | 2.00 | 10.00 | 5.36 | 1.90 |
| Farm productive assets  (Tunisian Dinars) | T1 (N=137) | 0.00 | 48550.00 | 3467.19 | 5814.86 |
| T2 (N=137) | 0.00 | 38450.00 | 3953.00 | 6570.39 |
| T3 (N=137) | 0.00 | 44200.00 | 4316.51 | 7756.00 |
| T4 (N=131) | 0.00 | 78060.00 | 7305.16 | 13635.85 |
| Control (N=129) | 0.00 | 43010.00 | 2262.64 | 5360.93 |
| Farm size (Hectare) | T1 (N=137) | 0.00 | 40.00 | 6.09 | 7.76 |
| T2 (N=137) | 0.00 | 30.00 | 5.09 | 5.68 |
| T3 (N=137) | 0.00 | 40.00 | 5.30 | 5.46 |
| T4 (N=131) | 0.00 | 50.00 | 6.56 | 6.97 |
| Control (N=129) | 0.00 | 60.00 | 5.46 | 8.19 |

*Source: own elaboration from project field data, 2020.*