

TECHNICAL REPORT



Improving Dissemination Strategies to Increase Technology Adoption by Smallholders in the Tunisian Arid Land Areas: An assessment from follow up survey

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Table of contents

List of Acronyms	3
1. Introduction.....	3
2. Objectives.....	4
3. Study Areas.....	4
The Tunisian satellite site includes Zaghouan and Kairouan governorates.....	4
3.1. Zaghouan Governorate	4
3.2. Kairouan governorate	5
4. Methodological framework	6
5. Baseline Characterization.....	7
5.1. Module O: Identification of the household.....	7
5.2. Module A: Household demographic data.....	10
5.3. Module B: Characteristics of the main house	27
5.4. Module C. Household assets	31
5.5. Module D. Land owned per hectare	38
5.6. Module E: Crop management and input use.....	46
5.7. Module F: Livestock possession and marketing	75
5.8. Module G: Livestock technology	87
5.9. Module H : Livestock alimentation	101
5.10. Module I. Technology awareness and uptake	118
5.11. Module J: technology perception.....	132
5.12. Module K: Social networks	144
5.13. Module L : Other sources of income and transfer.....	156
5.14. Module M : Non food expenditure.....	161
5.15. Module N: Access to socioeconomic infrastructure.....	167
5.16. Module O: Shocks.....	172
5.17. Module P: Day food recall	176
6. Concluding remarks and policy implications	187

List of Acronyms

CRDA	Regional Department for Agricultural Development
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
Ha	Hectare
HH	Household Head
ICARDA	International Center for Agricultural Research in the Dry Areas
INRAT	National Agronomic Research Institute of Tunisia
Kg	Kilograms
L	Liter
M ³	Cubic meter
OEP	Office of Livestock and Pasture
RCT	Randomized Controlled Trials
SPSS	Statistical Package for Social Sciences

List of Tables

Table 1. Repartition of sample / Governorate & Delegation	6
Table 2. Number of months the household member is away from home.....	12
Table 3. Number of new member in the household by governorate, %	17
Table 4. Ages of new HH members by governorate.....	20
Table 5. Years of formal education by governorate (number)	20
Table 6. Number of months the new household member is away from home	23
Table 7. New member years' experience in agriculture by governorate	25
Table 8. Amount of Household assets in both governorates, %	35
Table 9 . Land area by governorate (hectare).....	38
Table 10. Households without own land by governorate, %	39
Table 11. Land use by governorate, hectare	40
Table 12. Area of the renting plots by governorate (Hectare)	42
Table 13. Cost of the renting plots by governorate (TND)	44
Table 14. Communal pasture area in hectare by governorate	45
Table 15. Communal pasture days by governorate	45
Table 16. Size of the plots	47
Table 17. Quantity of sowing (total kg used on the plot1)	55
Table 18. Seed price (TND/Kg)	56
Table 19. Sowing date, %	57
Table 20. Total cost of seed treatment (TND).....	58
Table 21. Manure unit, %	58
Table 22. Quantity of manure (Ton).....	59
Table 23. Purchase price of manure (TND/Ton).....	59
Table 24. Quantities of basal fertilizer (Kg).....	61
Table 25. Cost of basal fertilizer (TND/kg)	61
Table 26. Quantities of Cover fertilizer (Kg)	63
Table 27. Cost of cover fertilizer (TND/kg)	63
Table 28. Herbicides applications in the last 12 months	64
Table 29. Hiring the workforce by activity in the last 12 months, %	65
Table 30. Number of working days	66
Table 31. Labor cost per day (man).....	66
Table 32. Use of machines by activity in the last 12 months	67
Table 33. Access to machine in the last 12 months	68
Table 34. Cost per hour of the rented machine in the last 12 months	69
Table 35. Number of hours of rented machine in the last 12 months.....	69
Table 36. Use of animals in the last 12 months.....	70
Table 37. Total production in the last 12 months	71
Table 38. Utilization of grain (Kg) in the last 12 months.....	71
Table 39. Seed prices (TND/Kg)	72
Table 40. Quantities of by-products produced.....	72
Table 41. Quantities used for livestock feed.....	74
Table 42. Livestock owned by governorate.....	78
Table 43. Total value of the animals by governorate (in TND).....	80
Table 44. Number of animals consumed as meat during the last year	81
Table 45. Number of animals sold in the last year	82
Table 46. Average price per animal sold (TND)	83
Table 47. Number of animals purchased in the last year	83
Table 48. Average price per animal purchased (TND)	84

Table 49. Number of animals given as gifts during the last year	85
Table 50. Number of animals received as gifts during the last year	85
Table 51. Number of animals dead due to illness/accident during the last year	86
Table 52. Number of animals born in the last year	86
Table 53. Number of aged ewes with stunted growth by governorate	88
Table 54. Number of Communication with a veterinarian in the last 12 months	91
Table 55. Dates of vaccinations against parasites in the last 12 months. %	95
Table 56. Dates of vaccinations against Enterotoxaemia in the last 12 months. %	98
Table 57. Use of feed livestock in the last 12 months, %	101
Table 58. Number of days for the use of common pastures	102
Table 59. Number of days for the use of private rangeland	102
Table 60. Number of days for the use of pasture barley	103
Table 61. Percentage of HH using the feed livestock by season in the last 12 months, %	103
Table 62. Average of the total quantity of feed livestock used in Kairouan	104
Table 63. Average of the total quantity of feed livestock used in Zaghouan	105
Table 64. Average of the total quantity purchased of feed livestock used in Kairouan	105
Table 65. Average of the total purchased quantity of feed livestock used in Zaghouan	106
Table 66. Average price per unit purchased in Kairouan	106
Table 67. Average price per unit purchased in Zaghouan	107
Table 68. Number of uses per day, %	108
Table 69. Water cost (June to August 2018) by governorate	111
Table 70. Watering livestock frequency by governorate	111
Table 71. Cattle cost feeding by governorate in TND	117
Table 72. Number of years of technology use (for variety # seasons planted) / Governorate	124
Table 73. Main source of vaccinations used this year by governorate	127
Table 74. Distance between household farm and neighbor's farm (minutes)	146
Table 75. Number of contacts with the neighbors during the last month	147
Table 76. HH Spending (Item/service) last year (TND)	162
Table 77. HH Spending (Item/service) last three months (TND)	163
Table 78. HH Spending (Item/service) last month (TND)	165
Table 79. HH Spending (Item/service) last week (TND)	166
Table 80. Distance to the nearest social facilities by governorate	169
Table 81. Intensity of the last shock to the HH	173
Table 82. Food Consumption in the previous 24 hours by governorate. %	177
Table 83. Amount of food products spent in the previous 7 days (TND)	179
Table 84. Total production value consumed during the last 7 days (TND)	182
Table 85. Total value received as a gift, payment or loan, consumed during the last 7 days (TND)	184
Table 86. Total value of hunting / fishing consumed during the last 7 days (TND)	185

List of Figures

Figure 1. Zaghouan governorate	5
Figure 2. Kairouan governorate	6
Figure 3. Sex of the Household head by location, %	8
Figure 4. Marital Status distribution by Governorate	8
Figure 5. Land property by governorate, %	9
Figure 6. Household agricultural diploma by Governorate, %	9
Figure 7. Household size by governorate (without new member), %	10
Figure 8. Age ranges of Household members by governorate in %	11
Figure 9. Household members living and eating at home by governorate, %	13
Figure 10. Reasons for leaving the family home by governorate, %	14
Figure 11. Main occupation by governorate, %	15
Figure 12. Off farm income/work for HH members by governorate, %	16
Figure 13. New members in the household by governorate, %	17
Figure 14. Sex of the new household member by governorate, %	18
Figure 15. Relationship with the Head of Household by governorate, %	19
Figure 16. Highest level of education reached, %	21
Figure 17. Registration of new member at school by governorate, %	22
Figure 18. Marital status of new member by governorate, %	23
Figure 19. Main occupation of new HH members by governorate, %	24
Figure 20. Household farm labor contribution's of new HH members	25
Figure 21. Off farm income/work for new members by governorate, %	26
Figure 22. Ownership mode by governorate, %	27
Figure 23. Other modes of ownership by governorate, %	28
Figure 24. Payment of renting house by governorate, %	28
Figure 25. Main sources of water by governorate, %	29
Figure 26. Distance between the water source and the house by governorate, %	29
Figure 27. Number of rooms in the house by governorate, %	30
Figure 28. Number of Household assets in Kairouan, N= 454, %	32
Figure 29. Number of Household assets in Zaghouan. N= 217, %	33
Figure 30. Number of Household assets in both governorates, N= 671, %	34
Figure 31. Owned land area by governorate. %	38
Figure 32. Land title possession by governorate, %	39
Figure 33. Total land used by governorate. %	41
Figure 34. Rented land by governorate. %	41
Figure 35. Number of the renting plots by governorate. %	42
Figure 36. Use of the renting plots by governorate. %	43
Figure 37. Irrigation of the renting plots by governorate. %	44
Figure 38. Access to communal pasture by governorate. %	45
Figure 39. Number of plots grown in the last 12 months	46
Figure 40. Soils fertility by governorate, %	48
Figure 41. Plots irrigation by governorate, %	49
Figure 42. Number of crops planted by governorate, %	49
Figure 43. Main crops / Main trees planted by governorate, %	50
Figure 44. Secondary crops / trees planted by governorate, %	51
Figure 45. Previous crops by governorate, %	51
Figure 46. Main previous crops by governorate, %	52
Figure 47. Ownership of the plots by governorate, %	52
Figure 48. Decision-maker of the plot production by governorate, %	53

Figure 49. Person doing the most of the work, %	54
Figure 50. Number of tillages, %	54
Figure 51. Types of tillage, %	54
Figure 52. Varieties of barley seed used, %	55
Figure 53. Purchase of seed, %	56
Figure 54. Date of the last sowing, %	57
Figure 55. Seed treatment, %	57
Figure 56. Manure application for the previous 12 months, %	58
Figure 57. Sources of Manure	59
Figure 58. Fertilization: basal application in the last 12 months, %	60
Figure 59. Sources of basal fertilizers, %	60
Figure 60. Fertilizer use in the last 12 months	61
Figure 61. Application of cover fertilizers in the last 12 months, %	62
Figure 62. Sources of cover fertilizers, %	62
Figure 63. Cover fertilizers used in the last 12 months	63
Figure 64. Number of applications of cover fertilizers in the last 12 months	64
Figure 65. Hiring the workforce in the last 12 months, %	65
Figure 66. Use of machines in the last 12 months, %	67
Figure 67. Most frequent sales method, %	72
Figure 68. Livestock possession by governorate, %	76
Figure 69. Livestock possession in the last 12 months by governorate, %	77
Figure 70. Cattle breeds by governorate, %	79
Figure 71. Number of aged ewes with stunted growth by governorate. %	87
Figure 72. Sheep first sold by governorate. %	88
Figure 73. Rams over 6 years old by governorate. %	89
Figure 74. Rams replaced in the previous 12 months by governorate. %	89
Figure 75. Reasons for replacing rams by governorate. %	90
Figure 76. Source of rams by governorate	90
Figure 77. Record of sheep mating date by governorate. %	90
Figure 78. Mating date. %	91
Figure 79. Number of Communication with a veterinarian in the previous 12 months	92
Figure 80. National vaccination campaign by governorate. %	92
Figure 81. Dates of free vaccinations provided by the government	93
Figure 82. Free vaccinations for the whole flock by governorates. %	93
Figure 83. Personal vaccinations by governorate. %	94
Figure 84. Reasons of non-reception of free vaccinations by governorates. %	94
Figure 85. Vaccinations against parasites in the last 12 months by governorates. %	95
Figure 86. Vaccinations against parasites received in the previous 12 months. %	96
Figure 87. Personal vaccinations against parasites by governorates. %	96
Figure 88. Reasons of non-reception of free vaccinations against parasites by governorates. %	97
Figure 89. Vaccinations against Enterotoxaemia in the last 12 months by governorate %	97
Figure 90. Vaccinations against Enterotoxaemia received in the last 12 months. %	98
Figure 91. Personal vaccinations against Enterotoxaemia by governorates. %	99
Figure 92. Reasons of non-reception of free vaccinations against Enterotoxaemia parasites by governorates. %	99
Figure 93. Feeding of lambs and adult sheep in concentrate and food blocks by governorate, %	109
Figure 94. Main reasons of no use of the green barley by governorate, %	110
Figure 95. Main reasons of no use of the cactus pear by governorate, %	110
Figure 96. Main reasons of no use of the products from pruning of olive trees by governorate, %	111
Figure 97. Cactus chopper used to feed animals by governorate, %	112

Figure 98. Main reasons of no use of the cactus chopper by governorate, %	112
Figure 99.Grinding barley before sheep feeding by governorate, %	113
Figure 100.Change in your sheep's diet in the last 2 years by governorate, %	113
Figure 101. Reasons for changing feeding practices by governorate, %	114
Figure 102. Types of forage that decreased compared to 2 years ago	114
Figure 103. Types of forages that increased compared to 2 years ago	115
Figure 104. Food and forage preservation in a storage by governorate, %	115
Figure 105. Main constraints to forage storage by governorate, %	116
Figure 106. Buying extra fodder by governorate, %	116
Figure 107.Households that heard about the variety/technology by governorate. %	118
Figure 108.Percentage of use of the variety-technology by governorate. %	119
Figure 109. Main reasons of no use of the Kounouz variety by governorate, %	120
Figure 110. Main reasons of no use of the Amonitrate by governorate, %	121
Figure 111 .Main reasons of no use of the mechanical seeder by governorate, %	121
Figure 112 .Main reasons of no use of the feed blocks by governorate, %	122
Figure 113 .Main reasons of no use of the Enterotoxaemia and Anthelminthic parasites vaccinations by governorate, %	123
Figure 114 .Main sources of information about variety-technology used this year / Governorate	124
Figure 115.Decision makers for the adoption of the variety-technology by governorate	126
Figure 116.Main source of variety-technology used this year by governorate	127
Figure 117.Consideration on using the variety-technology in the future by governorate, %	128
Figure 118.Main reasons for non considering the use of the Kounouz variety in the future by governorate,%	129
Figure 119.Main reasons of no use of the Amonitrate in the future by governorate, %	129
Figure 120.Main reasons of no use of the mechanical seeder in the future by governorate, %	130
Figure 121.Main reasons of no use of the Feed blocks in the future by governorate, %	130
Figure 122. Main reasons of no use of the Enterotoxaemia vaccination and the Anthelminthic parasites vaccination in the future by governorate, %	131
Figure 123.Benefits of Kounouz variety by governorate, %	132
Figure 124.Benefits of Amonitrate application by governorate, %	132
Figure 125.Benefits of Mechanical seeder by governorate, %	133
Figure 126.Benefits of the use of feed blocks by governorate, %	133
Figure 127.Benefits of Enterotoxaemia and Anthelminthic parasites vaccinations by governorate, %	134
Figure 128.HH perception of the Knowledge needed for the variety-technology by governorate, %	135
Figure 129.HH perception of the Access to variety-technology by governorate, %	136
Figure 130.HH perception of the adoption cost of the variety-technology by governorate, %	137
Figure 131.HH perception of the labor intensity of adoption of the variety-technology, %	138
Figure 132.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of skills and personal knowledge by governorate, %	139
Figure 133.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of payment of inputs and resources needed by governorate, %	139
Figure 134.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of availability of inputs and resources by governorate, %	140
Figure 135.HH perception of their dependence degree to the environment/others to adopt variety/technology, %	141
Figure 136.HH perception of the Kounouz variety performance in comparison with the local variety, %	141
Figure 137.HH perception of the performance of the Amonitrate application in comparison with their preferred management method, %	142
Figure 138.HH perception of the mechanical seeder performance in comparison with their preferred management method, %	142

Figure 139.HH perception of the feed blocks performance in comparison with their preferred method of livestock feeding, %	143
Figure 140.HH perception of the performance of the Anthelminthic parasites and Enterotoxaemia vaccinations compared to the no use, %	143
Figure 141.Knowledge of the neighbor's household	144
Figure 142. Change in the frequency of communication during the last 2 years	149
Figure 143. Exchanging information about the culture/agriculture with neighbors during the last month	150
Figure 144.Barley planting by the neighbors during the last growing season, %	151
Figure 145.Use of Kounouz seeds by the neighbors during the last season, %	152
Figure 146.Family neighbor's relationship, %	153
Figure 147.Requesting advice for a technical problem regarding crops, %	154
Figure 148.Requesting advice for a technical problem regarding livestock, %	155
Figure 149. Amount /value received in the last 12 months by location. %	156
Figure 150.Persons who received the payment by governorate. %	157
Figure 151.Main beneficiaries of the payment by governorate. %	158
Figure 152.Most important sources of income by governorate. %	160
Figure 153.HH Spending (Item/service) last year by governorate. %	161
Figure 154.HH Spending (Item/service) last three months by governorate, %	163
Figure 155.HH Spending (Item/service) last month by governorate, %	164
Figure 156.HH Spending (Item/service) last week by governorate. %	165
Figure 157. Distance to the Nearest Social Facilities by governorate	168
Figure 158.Closest distance to the farm by taking the paved road (Km) by governorate	169
Figure 159.Most frequently used means of transportation to the Social Facilities by Governorate	170
Figure 160.Constraints Importance / Perceptions to Access to Market by Governorate	171
Figure 161.Shocks observed in the previous 2 years	172
Figure 162.Worst shock observed in previous 3 years	174
Figure 163.Coping strategies to shocks by location	175
Figure 164.Food Consumption in the previous 7 days by governorates. %	176
Figure 165.Food sources by governorates. %	179
Figure 166. Food outside the household by governorate. %	186
Figure 167.Barley consumption by governorate. %	186

Executive summary

This present study comes as a second step of the research project “Mind the Gap: Improving Dissemination Strategies to Increase Technology Adoption by Smallholders” and presents the results of the follow-up survey conducted on December 2018. The project is implemented in two governorates with similar agro-ecological conditions: Zaghouan and Kairouan. 671 questionnaires of the baseline survey were divided into 217 questionnaires in Zaghouan and 454 questionnaires in Kairouan. This report has a particular aim to find the mechanisms through which farmers can effectively adopt agricultural technologies that may improve their economic status and wellbeing. The findings from the survey are presented using descriptive statistics based on frequencies and percentages.

The factors influencing HH adoption of innovative agricultural production technologies are various and related to socio-demographic, economic, institutional and ecological aspects.

The HH of the sample were mostly men (93.6%), married (91.3%), owners of their land (92%) and only 6% have agricultural diploma in both governorates. The household size was composed by 3 members for 68.7% of the sample and young persons (25 years of less) represent more than 50% of the total household members.

The turnover of asset sales is very important for 100% of the HH in Zaghouan then comes the rental income for 75% and the trade with agricultural products produced by others (75%). For Kairouan, the most important sources of income are the turnover of asset sales (60%) and the permanent non-agricultural employment for 57.1%.

For both governorates, the households lack mostly the agricultural equipment (strawpress, combine harvester, grain storage, a tractor, a chempump, a waterpump, a tank, a shredder, a plough, a wagon, an irrigation water management and a milking machine). For the house equipment, despite the fact that they possess for 95,1% their houses, these households require some assets such like a drinking water installation, solar panels for energy, means of transport; internet devices and air conditioner. In both governorates, most of the households own less than 5 ha (67.6%), only 3.9% have large lands with more than 21 ha. In Kairouan, 45.6% households have no title whereas they are only 35% in Zaghouan. The most common animals are the male lambs with 63.7% in Kairouan and 85.4% in Zaghouan and also the female lambs with 49.6% in Kairouan and 82.9% in Zaghouan. Then comes the rams with 35.6% in Zaghouan and 28% in Kairouan and the ewes with 25% in Zaghouan and 21.9% in Kairouan.

The drought, the large increase in food prices and the large increase in agricultural input prices were the major shocks observed in the last two years. To respond to the shocks, more than half of HH said that nothing can be done against this situation in both governorates. In Zaghouan governorate, 19.4% declare selling their animals while they are only 14.3% in Kairouan to copy with the shock. At least 52% of HH heard about all technologies in both governorates. The proportions of HH to use the variety/technology are high for Enterotoxaemia and Anthelmintic parasites vaccinations, low for mechanical seeder (9.6%) and Kounouz variety (16.7%) and very low for feed blocks (1.8%).

The main reasons of no use of variety/technology are the unavailability of seed and the preference for the other varieties of barley for Kounouz variety, the preference for other technologies for Amonitrate and Mechanical seeder, the preference for other foods for animals (bran and local

barley seed) for feed blocks and the highness of the price for Enterotoxaemia and Anthelminthic parasites vaccinations.

For all the technologies, the household head is the main decision-maker for its adoption in both governorates with a percentage of HH that oscillates between 74.8% and 82.5%. In both governorates, the highest proportion of HH indicate that the extension agents are the main source of information of kounouz variety and feed blocks used this year, the “other farmers” (relative/neighbors) for Amonitrate and mechanical seeder and the Market for the Enterotoxaemia and Anthelminthic parasites vaccinations.

The knowledge needed for all technologies is perceived “high” by a major proportion of the HH. Also, a considerable proportion of HH indicate “good” the access for all technologies except the feed blocks where the access is judged mainly “bad”. The adoption cost of all technologies is judged “high” and “very high” in both governorates by the highest proportion of the HH. A high proportion of HH indicated that the adoption decision depends on them for feed blocks (55.4%), mechanical seeder (49.6%) and Kounouz variety (40.7%) in both governorates. For the Amonitrate, 42.9% of HH declared that the adoption decision depends to a great extent to the environment/others in Kairouan while for the Enterotoxaemia and the Anthelminthic parasites vaccinations, the HH depends to a small extent to the environment/others to adopt these technologies in Zaghouan.

A high proportion of HH consider “higher yield” and “drought resistance” the main benefits for Kounouz variety, “higher yield” for Amonitrate, “save labor” for mechanical seeder, “good growth of animals for feed blocks” and “good animal health” for Enterotoxaemia and Anthelminthic parasites vaccinations.

Key-words: Variety/technology adoption, smallholder farmers, livelihoods, farming system, vulnerability, Tunisia.

Highlights:

- Smallholder farmer’s skills and personal knowledge is high to adapt some technologies for the next cropping season (Enterotoxaemia and Anthelminthic parasites vaccinations, Amonitrate and Kounouz variety).
- Smallholder farmer’s capacity of payment of inputs and resources needed is low to adapt some technologies for the next cropping season (feed blocks, mechanical seeder and Amonitrate application).
- The average distance to the nearest social facility is more than 13 km especially for the agricultural extension office (15.89 km), the main agricultural products market (14.82 km) and the main agricultural inputs market (13.88 km) in both governorates.
- Smallholder farmer’s consideration on using the variety/technology in the future is important for some technologies (Enterotoxaemia and Anthelminthic parasites vaccinations, Kounouz variety and Amonitrate) and less important for other ones (mechanical seeder and feed blocks).

1. Introduction

Tunisia has been successful developing sustainable intensification and cost-effective farming options that are able to save up to 40% of livestock feeding costs (Haddad et al. 2007). However, the adoption of these innovative farming techniques remains low. This ‘adoption gap’ is not only observed in the case of the Tunisian innovation adoption, but it 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 remains unclear in research how this ‘adoption gap’ could be bridged by appropriate technology transfer packages and extension approaches. Research on improving agricultural extension approaches has hardly been a major research priority so far; neither within the CGIAR system nor outside. While individual extension approaches are sometimes evaluated in terms of their effectiveness (Davis et al. 2012; Gildemacher and Mur 2012), a comparative assessment of different approaches, which would help to gain a broader understanding of what works under various conditions, has never been carried out.

The objective of this project is 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 will be rigorously evaluated in terms of their effects on innovation adoption, agricultural productivity performance, and household livelihoods through randomized controlled trials (RCTs). New technologies and technology transfer models will be 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 proposed research can also generate knowledge on how to improve agricultural extension far beyond the concrete case of Tunisia. Thus, ‘Mind the Gap’ research project represents an innovative step towards more outcome-oriented research on agricultural extension worldwide.

“Mind the Gap” is a project implemented by ICARDA in central Tunisia with the financial support of the Federal Ministry for Economic Cooperation and Development in Germany. It includes activities in both Zaghouan and Kairouan governorates, where a production system based on barley and livestock is predominant.

By using Randomized Control Trials, the project tries finding out which agricultural extension design favors the adoption of the new barley variety Kounouz and the feed blocks technology within smallholder farmers. These technologies were made available to 560 household farmers. The technology transfer models tested comprise four model components: access to inputs, access to technical information, access to organizational and economical training and female empowerment. These four model components are combined in various ways, and the combinations are implemented in different treatment groups to test and compare their individual and combined effects. In total, we compared four different treatments with and without certain components included, and one control without any treatment. Each treatment is implemented with 140 randomly selected farmers. Together with the control group, which also consists of 140 randomly selected farmers, the total sample size is 700 farm households.

2. Objectives

After a baseline survey conducted on December 2016, a follow up survey was realized on December 2018 to provide more understanding about farmers' production and marketing decisions. This study presents the second step of the research project and presents the results of the follow up survey. The research project is particularly interested in finding the mechanisms through which farmers can effectively adopt agricultural technologies that may improve their economic status and wellbeing.

In the framework of the project mentioned above, this report describes and analyzes the current farming systems in the site with a production system characterization and system vulnerability. This site is embodied with two governorates: Zaghouan and Kairouan.

The data and information included in this report can be used to judge on the quality and development results achieved by the project. The specific objectives of the report are:

- Socio-demographic characteristics of the household
- Financial physical, natural and social capitals
- Livestock production and management
- Technology adoption and perception
- Socials networks
- Identify constraints of the production system
- Determine the causes of vulnerable households and resilient livelihoods

3. Study Areas

The Tunisian satellite site includes Zaghouan and Kairouan governorates.

3.1. Zaghouan Governorate

Zaghouan governorate is located in North East of Tunisia. It is bordered by the governorates of Ben Arous, Ariana and Manouba to the north, Sousse and Kairouan to the south, Siliana and Beja to the east. It covers an area of 2820 km² and it is characterized by a semi-arid climate with an average annual rainfall of 450 mm. The Governorate of Zaghouan is shared in 6 delegations and 8 municipalities (Figure 1).

The number of inhabitants in Zaghouan governorate is around 158 thousand, among which 45% are located in urban area. The agricultural sector contributes significantly to the economic growth of the region. It accounts for about 13.1 % of total employed labor force. The useful agricultural area covers two thirds of the territory of the governorate (282,000 ha, among which 185,000 ha of arable land and 87,000 ha of rangeland and forests). The water resources are represented by 2 large dams, 19 hillside dams, ground water of 19 million m³ and a deep layer of 35 million m³. The agricultural activities are based mainly on cereals (68400ha), olive trees (55546ha), arboriculture (5964ha) and sheep extensive farming (193000 female units) as well as a recent expansion of organic crops (CGDR, 2017).

Regarding the main agricultural productions in 2017, Zaghouan counts 114496 tons of cereals, 831 tons of legumes, 26255 tons of forage, 21800 tons of olives, 180566 tons of vegetables, 18040 tons of arboriculture, 23630 tons of milk, 5620 tons of red meat, 3971 tons of poultry, 289 tons of wool, 72.5millions of eggs and 84 tons of honey (CGDR, 2017).



Figure 1. Zaghouan governorate

3.2. Kairouan governorate

Kairouan governorate is located in Central West of Tunisia. It has a privileged geographical position since it represents a crossroads between the north, the south, the east and the west of the country. It is bordered by the governorates of Zaghouan, Siliana, Kasserine, Sidi Bouzid, Sfax, Sousse and Mahdia. It covers an area of 6712 km², and it is characterized by an arid climate in the south and semi-arid climate in the north. Average rainfall ranges from 200 mm in the south to 350 mm in the north. The Governorate of Kairouan is shared in 13 delegations and 12 municipalities (Figure 2).

The number of inhabitants in Kairouan governorate is around 584 thousand, among which 64.7% are located in urban area. The agricultural sector contributes significantly to the economic growth of the region. It accounts for about 24 % of the total employed labor force. Kairouan counts 347929 ha of arable land, 207119 ha of rangeland and 37627 ha of forests. The agricultural activities are based mainly on cereals (116480ha), arboriculture (218632ha), vegetables (20858 ha), and sheep extensive farming (719000 female units) (OCDO, 2017). The irrigated area is estimated at 58646 ha among which 25.6% belongs to the public area. The intensification rate is about 115%.

Regarding the main agricultural productions in 2017, Kairouan counts 1205054 tons for cereals, 50680 tons for olives, 435270 tons for vegetables and 52600 tons for arboriculture (OCDO, 2017).

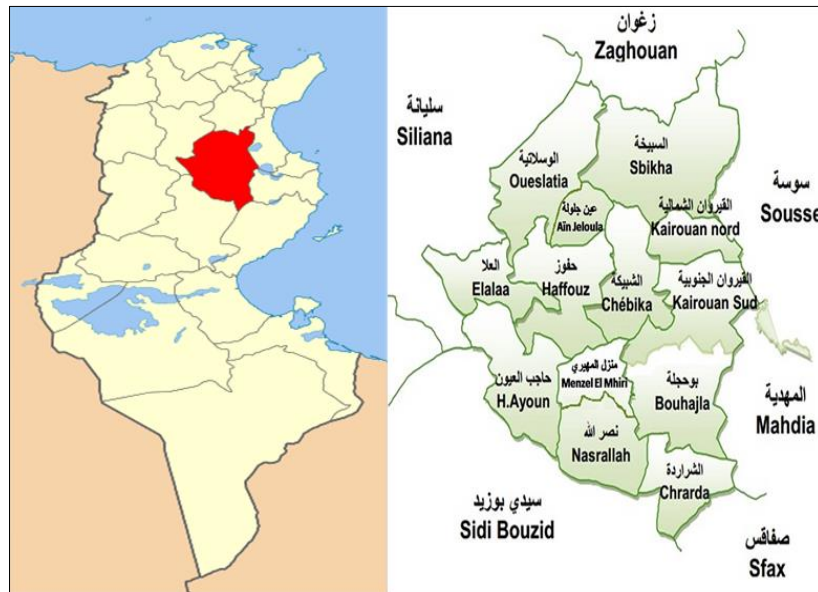


Figure 2. Kairouan governorate

4. Methodological framework

The project is implemented in two governorates with similar agro-ecological conditions: Zaghouan and Kairouan. The selection of the individual farmers was based on a random sample predefined in the frame of the baseline survey conducted on December 2016.

The distribution of the sample between both governorates is based on the number of households. Zaghouan represents almost 32 % of the total and Kairouan 67% (Table 1). Then, 671 questionnaires of the baseline survey were divided into 217 questionnaires in Zaghouan governorate and 454 questionnaires in Kairouan governorate. By delegation, Nadhour, Saouaf and Zriba represent 10.13%, 14.90% and 7.30% respectively of the total sample for the governorate of Zaghouan while Oueslatia and Sbikha represent respectively 32.04% and 35.62% of the total sample for the governorate of Kairouan.

Table 1. Repartition of sample / Governorate & Delegation

Governorate	Frequency	Percent
Zaghouan		
Nadhour	68	10.13
Saouaf	100	14.90
Zriba	49	7.30
Total Zaghouan	217	32.34
Kairouan		
Oueslatia	215	32.04
Sbikha	239	35.62

Total Kairouan	454	67.66
Total	700	100

The questionnaire was divided into different modules presented as follow:

- Module O: Identification of the household
- Module A : Household demographic data
- Module B : Characteristics of the main house
- Module C: Household assets
- Module D: Land owned per hectare
- Module E: Crop management and input use
- Module F: Livestock production and marketing
- Module G: Livestock technology
- Module H : Livestock alimentation
- Module I: Technology awareness and uptake
- Module J: Technology perception
- Module K: Social networks
- Module L: Other sources of income and transfer
- Module M: Non food expenditure
- Module N: Access to socioeconomic infrastructure
- Module O: Shocks
- Module P: Day food recall

The questionnaire was used to collect the data through face-to-face interviews. Data was coded, entered and edited in the computer. Microsoft Excel and Statistical Package for Social Sciences (SPSS 21) were used for the analysis.

5. Baseline Characterization

5.1. Module O: Identification of the household

This section provides an overview of the socio-economic characteristics of the households who participated in this survey. A total of 671 households participated in two locations: Zaghouan and Kairouan. 623 persons of the household head were men (93.6%) and only 43 were women (widowed in most of the cases).

Percentages of men and women household head are approximately equal in the two governorates with 92.1% of men in Zaghouan and 94.2% in Kairouan (Figure 3) and 7.9% of women household head in Zaghouan and 5.8% in Kairouan.

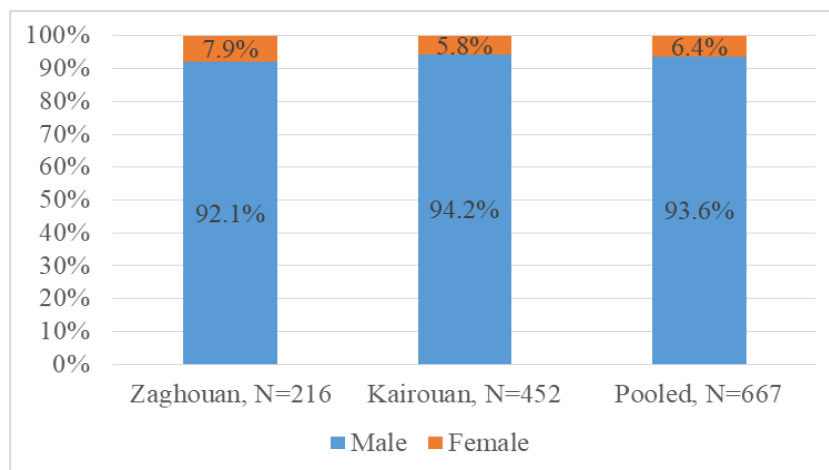


Figure 3. Sex of the Household head by location, %

Concerning the marital status, Figure 4 shows that most of the interviewed farmers are married (91.3%). By location, Zaghouan has the highest proportion of married persons, 92.6% against 90.7% for Kairouan.

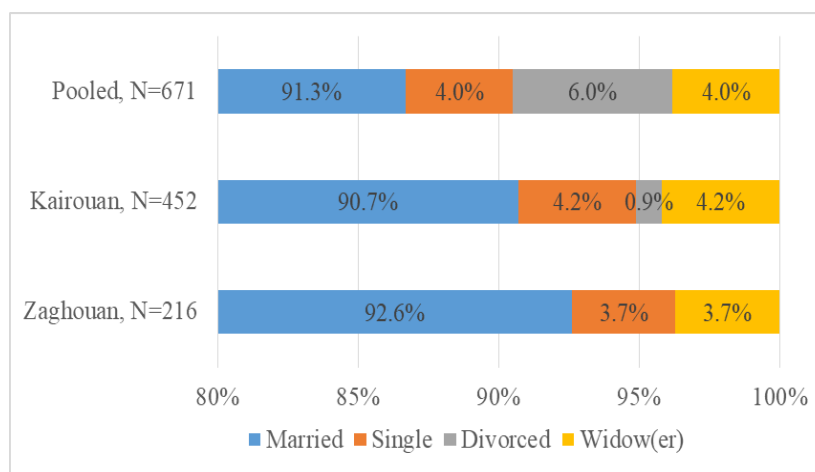


Figure 4. Marital Status distribution by Governorate

Nearly 92% of the households own lands with almost the same percentage for both governorates (93% for Kairouan and 91.7% for Zaghouan) (Figure 5).

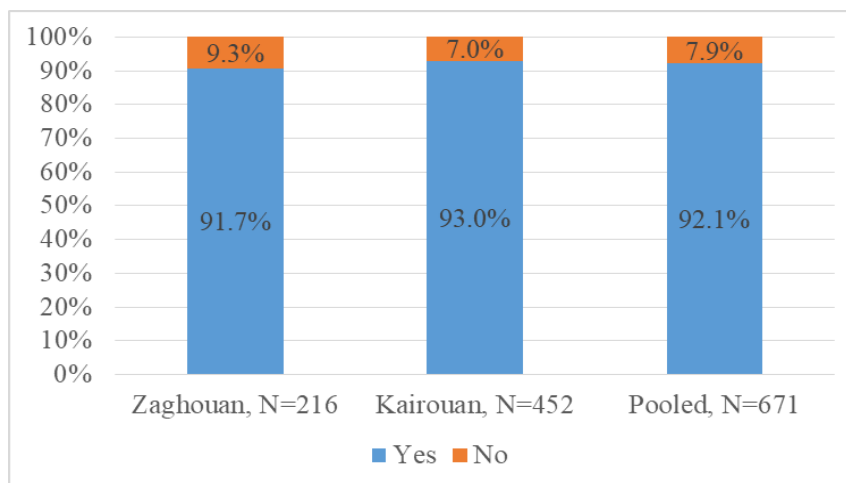


Figure 5. Land property by governorate, %

Concerning education, Figure 6 shows that few persons in both governorates have agricultural diploma. The rate is higher in Zaghuan with 96.8%. In Kairouan, 92.7% of the sample has no agricultural diploma.

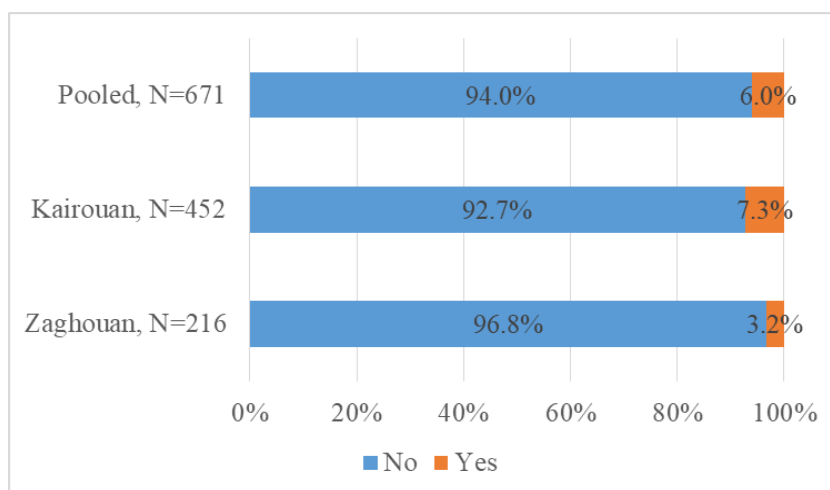


Figure 6. Household agricultural diploma by Governorate, %

5.2. Module A: Household demographic data

In this section, an analysis of the household will be made. First, there is an analysis of the household size. Then the age ranges of the household members, the number of months the household is away from home, the percentage of households members living and eating at home, the main reasons for leaving the family home, the main occupation by governorate, the off farm income for household members.

Then the existence of new members in the household with their sex, relationship with the household head, their age, their education (in years), the highest level of education achieved, the registration of the member at school, the marital status, their main occupation, their contribution to the farm labor, their experience in the agriculture (years) and finally their off farm work.

Figure 7 shows the household size by governorate. It appears that it is almost the same percentage for the two governorates: 68% of the households are composed by 3 to 7 persons.

Zaghouan governorate has the highest rate of small households with 22.3%, for a total of 215 persons and the smallest rate for large households (more than 7 persons) with 9.3%.

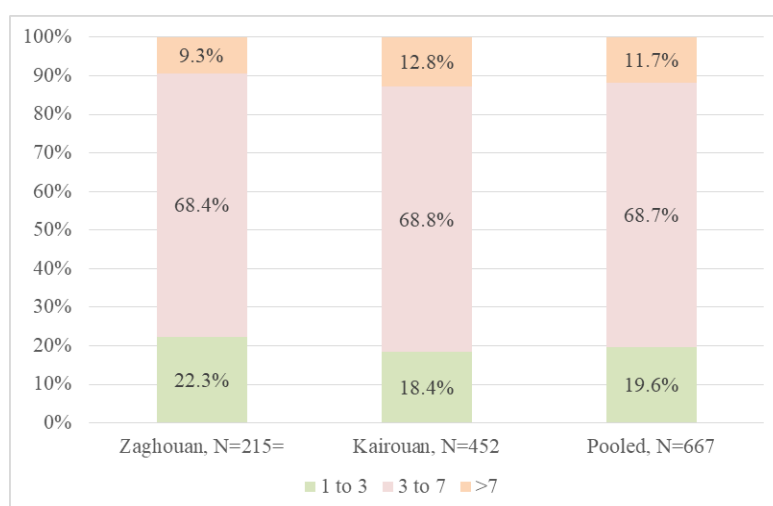


Figure 7. Household size by governorate (without new member), %

Figure 8 shows the age range of the household members by governorate. It shows that a large part of the sample is composed by members aged less than 25 years. For member 1, 2, 3, 4 and 5 the sample is composed by 55.8%, 67.1%, 76.3%, 75.2% and 73.2% respectively of people aged less than 25 years for both governorates. The second age ranges from 26 to 35 years old it concerns 24.2% of the sample in Kairouan and 32.6% in Zaghouan for member 1.

Concerning member2, this category is 24.7% in Kairouan and 22.5% in Zaghouan.

For the people aged from 66 years and above, the largest rates are found in Kairouan for member 7 with 12.9% and in Zaghouan with 7% for member 5.

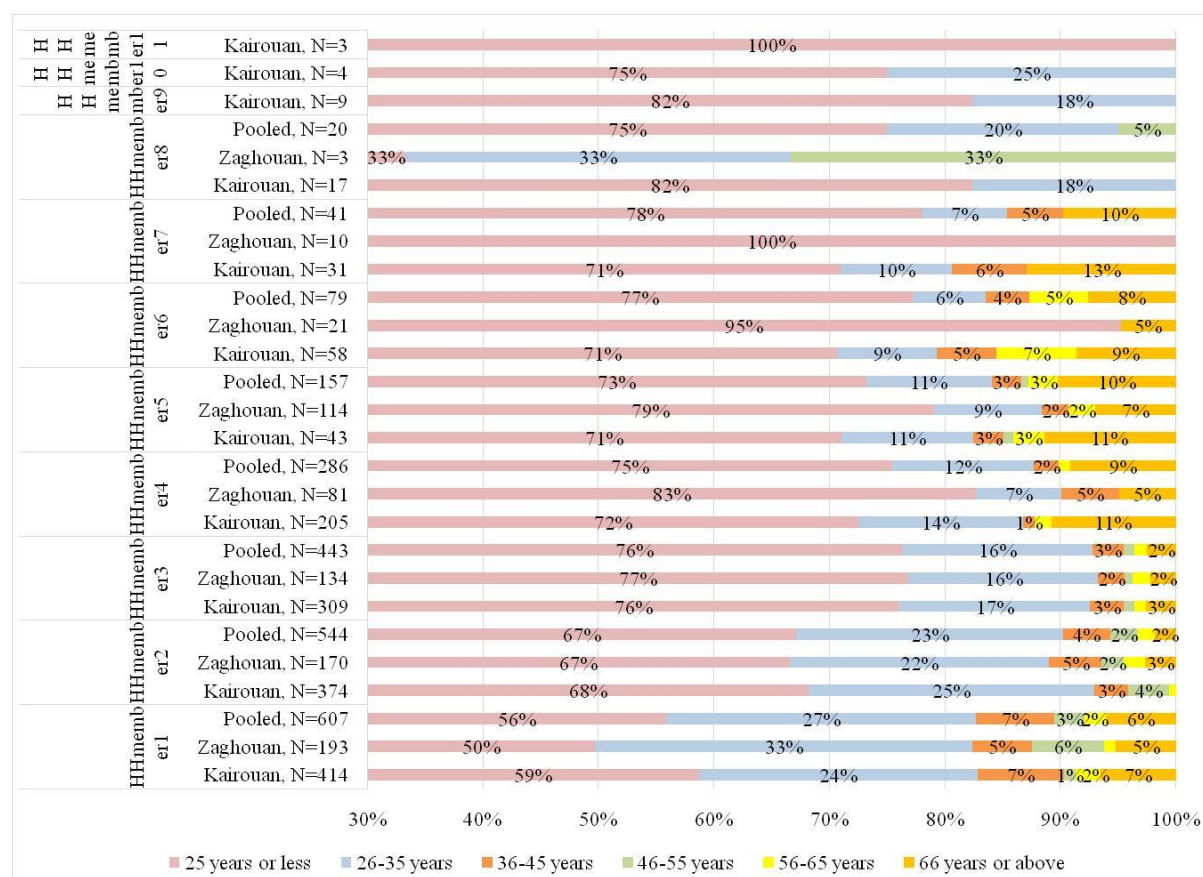


Figure 8. Age ranges of Household members by governorate in %

As shown in table 2, the number of months the household member is away from home varies from a governorate to the other. For both governorates, the minimum is 0.5 month for member 1, 2, 3 and 4. Then it is 1 month for member 5, 6 and 7 except for member 8 when the number of months is 8. Twelve months is the longest period of absence in Kairouan for all the members of the household except for member 8 where it is 11 months, while for Zaghouan governorate it varies from 6 months for member 1 to 12 months for member 3, 4 and 6.

Figure 9 shows the households members living and eating at home. When the household exceeds 11 members, 100% of the family lives and eats at home for both governorates. Few members live and eat outside the household, the highest rate is found in Kairouan for member 8 with 22.4%. Concerning member 1 and 2; less than 2% are eating outside home.

Figure 9 shows the households members living and eating at home. When the household exceeds 11 members, 100% of the family lives and eats at home for both governorates. Few members live and eat outside the household, the highest rate is found in Kairouan for member 8 with 22.4%. Concerning member 1 and 2; less than 2% are eating outside home.

Table 2. Number of months the household member is away from home

		Min	Max	Mean	S.Deviation
HHmember1	Kairouan, N=39	0.5	12.0	4.897	3.7049
	Zaghouan, N=5	1.0	6.0	3.800	1.9235
	Pooled, N=44	0.5	12.0	4.773	3.5494
HHmember2	Kairouan, N=42	0.5	12.0	3.214	3.6344
	Zaghouan, N=10	0.5	8.0	1.500	2.2973
	Pooled, N=52	0.5	12.0	2.885	3.4664
HHmember3	Kairouan, N=51	1.0	12.0	7.461	3.5900
	Zaghouan, N=18	0.5	12.0	8.972	2.4998
	Pooled, N=69	0.5	12.0	7.855	3.3891
HHmember4	Kairouan, N=40	0.5	12.0	7.913	3.9401
	Zaghouan, N=16	2.0	12.0	9.375	2.6300
	Pooled, N=56	0.5	12.0	8.330	3.6522
HHmember5	Kairouan, N=33	1.0	12.0	8.576	3.1428
	Zaghouan, N=14	3.0	11.0	7.857	2.7695
	Pooled, N=47	1.0	12.0	8.362	3.0247
HHmember6	Kairouan, N=14	1.0	12.0	9.143	3.5051
	Zaghouan, N=9	4.0	12.0	8.778	2.5874
	Pooled, N=23	1.0	12.0	9.000	3.1189
HHmember7	Kairouan, N=114	1.0	12.0	7.385	4.2336
	Zaghouan, N=3	5.0	10.0	8.000	2.6458
	Pooled, N=16	1.0	12.0	7.500	3.9158
HHmember8	Kairouan, N=3	8.0	11.0	9.667	1.5275
	Zaghouan, N=2	10.0	11.0	10.500	0.7071
	Pooled, N=5	8.0	11.0	10.000	1.2247

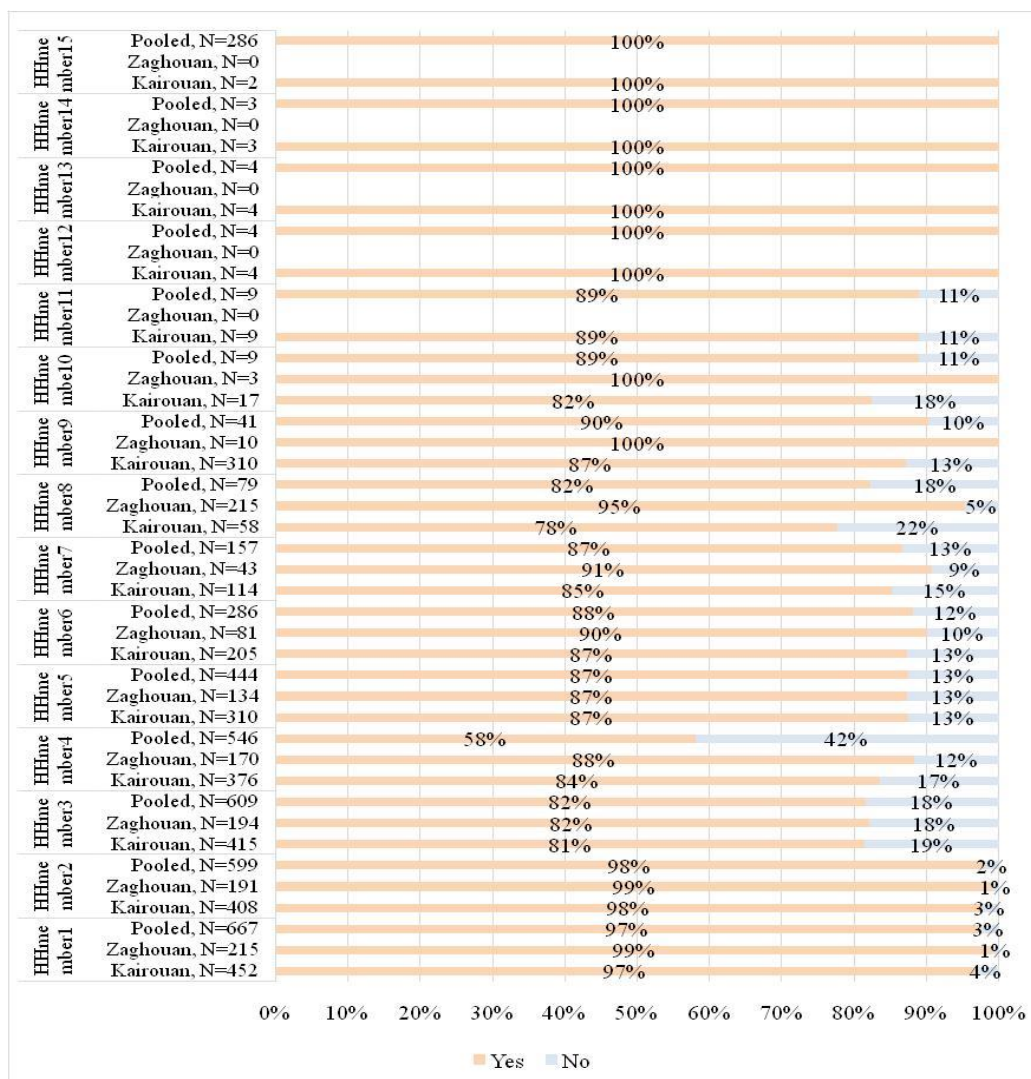


Figure 9. Household members living and eating at home by governorate, %

Figure 10 shows the main reasons for leaving the family home by Governorate. For member 1 and member 2, 100% in Zaghouan declare leaving the household because the person is dead. The second reason to leave the house would be that the person moved to an off-farm employment, it concerns 56.3% of the sample in Kairouan for member 1 and 10% for member 2. Leaving the house because the person got married and moved to another household concerns 6.3% for member 1 and 10% for member 2 in Kairouan.

The highest rate for persons moving to study with 17.6% of the sample is found in Zaghouan for member 5 and in Kairouan for member 7. In Kairouan, 100% of the sample moved because the person is dead for member 11.

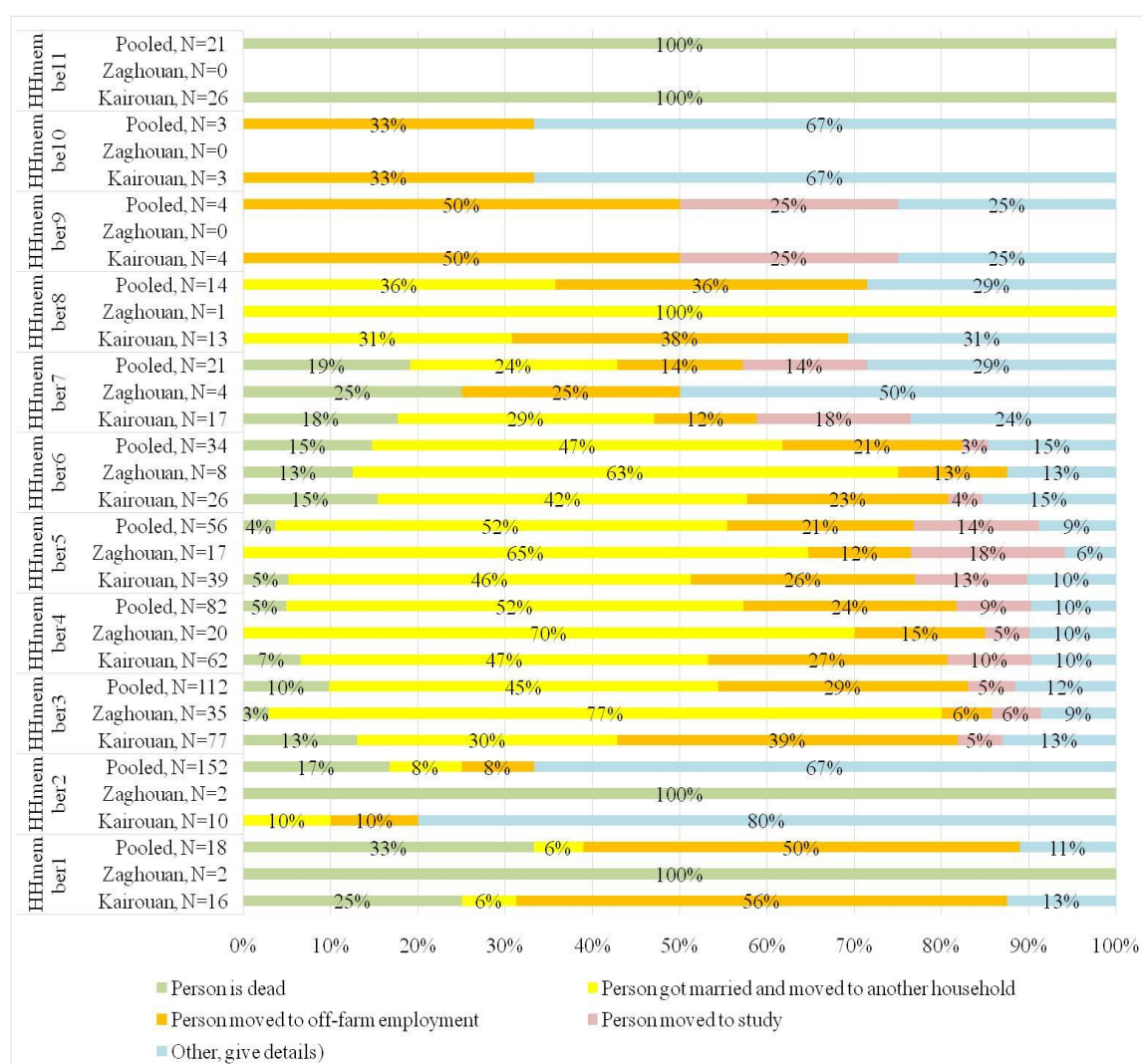


Figure 10. Reasons for leaving the family home by governorate, %

Figure 11 shows the main occupation by governorate. For member 1 and 2, it appears that agriculture (breeding) on the own farm is the main occupation for 37.3% of the sample in both governorates. The agriculture through crops in the own farm represents 30% for member 1 and 13% for member 2 for both governorates. Only 5% of the sample for both locations has no occupation while this rate goes up to 18% for member 2 and 41% for member 9.

Concerning member 3, the sample is more diversified for both locations with 22% that have no occupation, 8% doing agriculture (crops) and 9% doing breeding on the own farm, 16% having occasional off farm labor, 15% are employees and 28% being students or pupils.

The main occupations are also much diversified for the other members with high rates of students or pupils from member 3 to member 8 for both governorates.

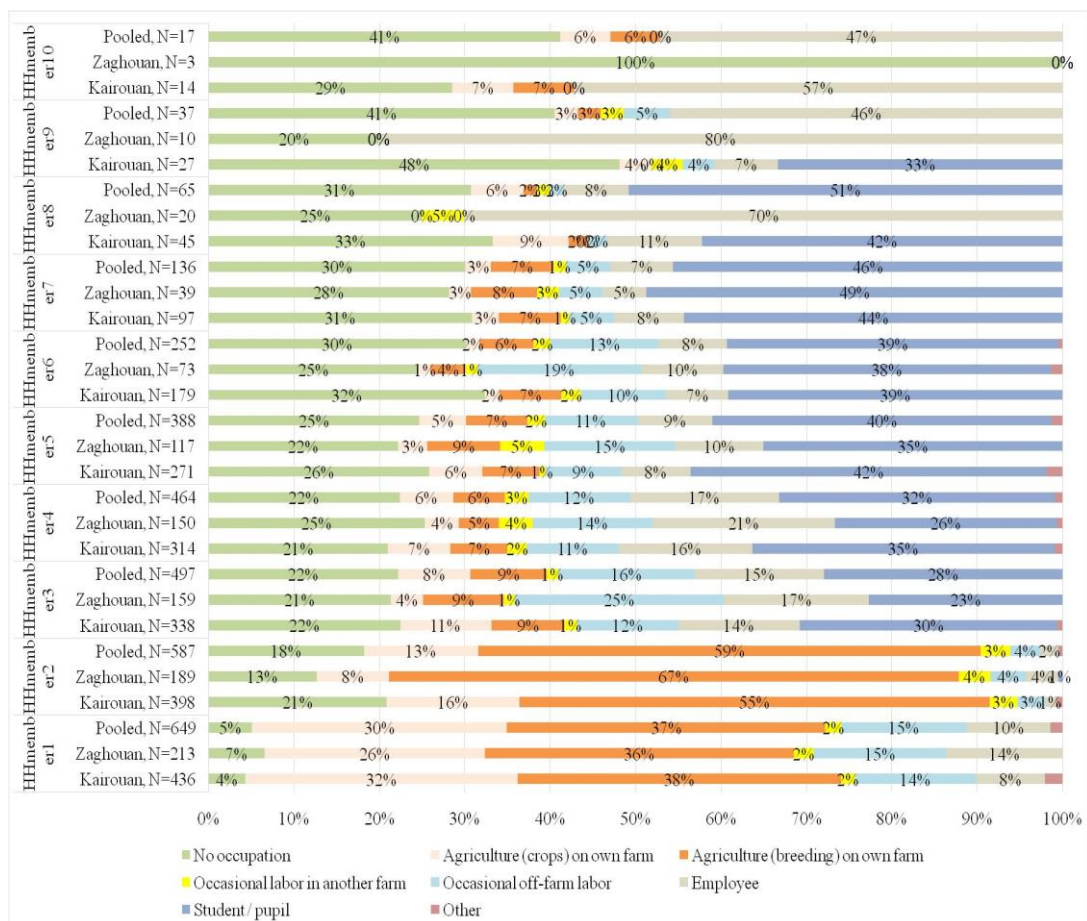


Figure 11. Main occupation by governorate, %

The off farm work is represented in Figure 12. It shows that for almost the whole sample there are only few persons that have an off farm work. Concerning member 1, percentages are almost equal between the two governorates with 38.9% of the sample having an off farm job and 37.1% in Zaghouan. For member 2, rates go down with only 10.1% of the sample having an off farm income in Zaghouan and 9.3% in Kairouan. From member 3 to member 6, rates are between 60 and 70% of the sample for both locations to not have an off farm work.

For Zaghouan, member 9 and 10 are 100% without any off farm income. While they are also 100% in Kairouan for member 10, they are 18.8% of the sample to have an extra job.

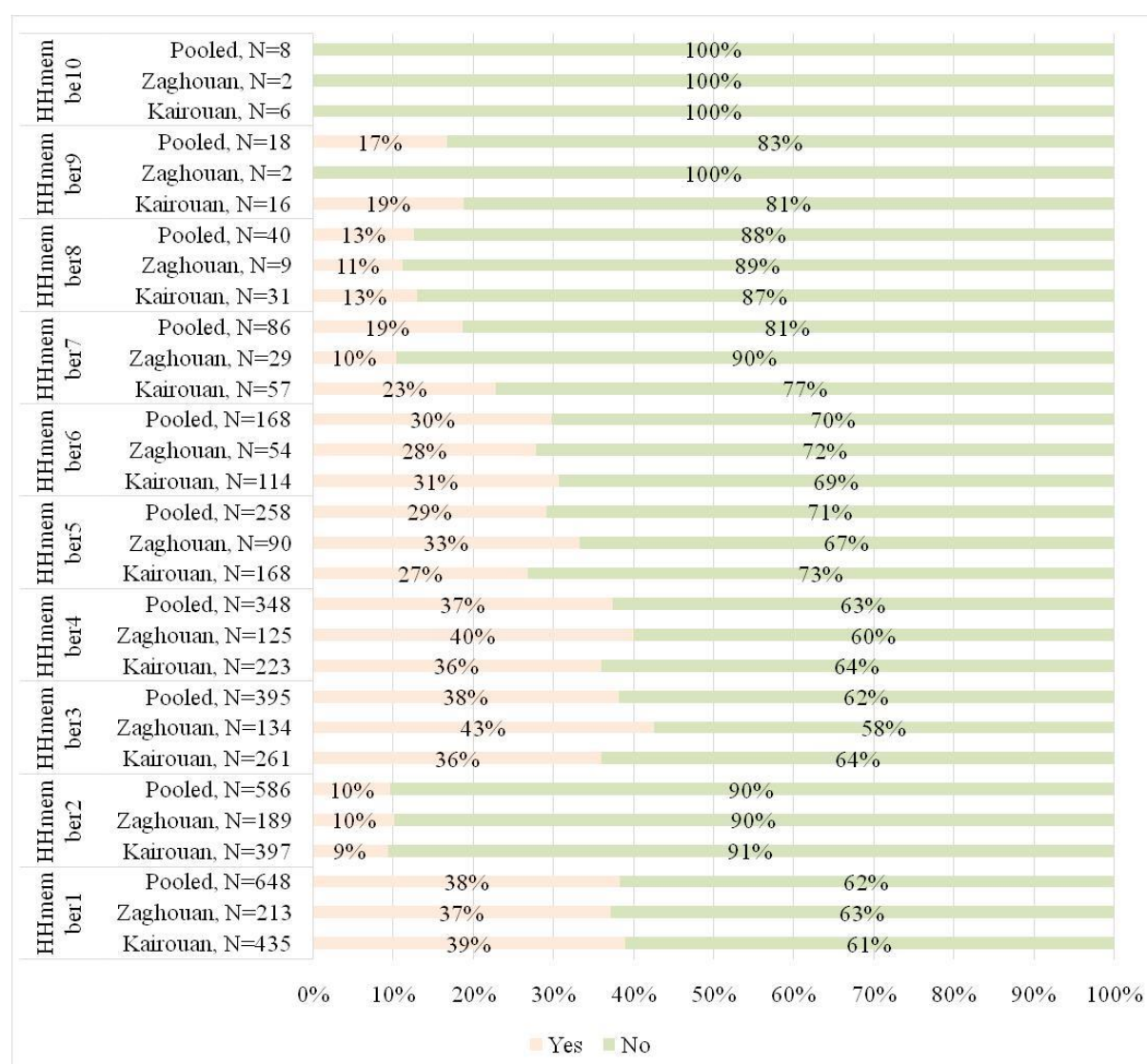


Figure 12. Off farm income/work for HH members by governorate, %

Percentages of new members in the households are approximately equal in the two locations with 14.3% of new members in Kairouan and 11.1% in Zaghuan. For both governorates, 86.7% declare that they did not register any new member in the household (Figure 13).

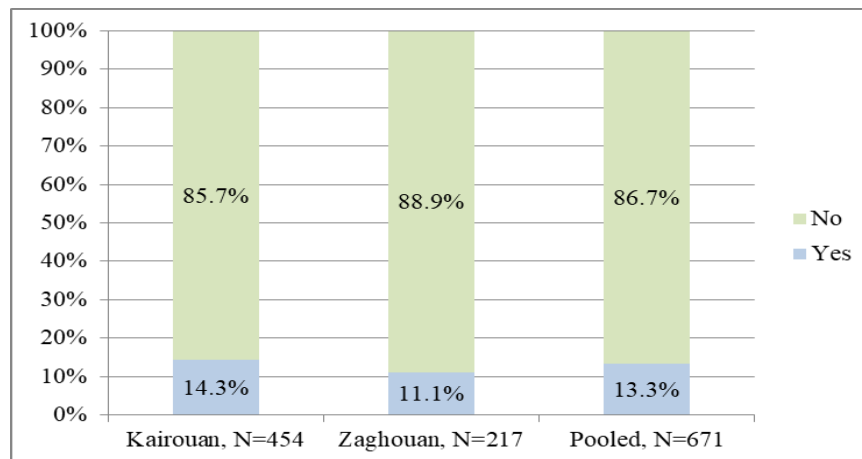


Figure 13. New members in the household by governorate, %

Table 3 shows that for both governorates, the minimum number of new member is 1 and the maximum is 6, with a mean for Kairouan of 1.20 and a mean for Zaghouan of 1.65.

Table 3. Number of new member in the household by governorate, %

	Min	Max	Mean	S.Deviation
Kairouan, N=64	1	6	1.20	0.739
Zaghouan, N=23	1	6	1.65	1.301
Pooled, N=87	1	6	1.32	0.934

Figure 14 shows the sex of the new household member by governorate. It shows that for member 1, the sample is almost equal in Kairouan with 56.3% of male and 43.7% of female. The rate is lower in Zaghouan for the men with only 34.8% of the sample.

Concerning new member 2, 42.9% of the sample in Kairouan are male while 71.4% in Zaghouan are male. For new member 3, rates are different from a governorate to another, they are 66.7% female in Kairouan and only 33.3% in Zaghouan. For the other new members (4,5 and 6), they are composed by 100% of men in Kairouan. For the governorate of Zaghouan they are 66.7% women for new member 4 and then no females for new member 5 and new member 6.

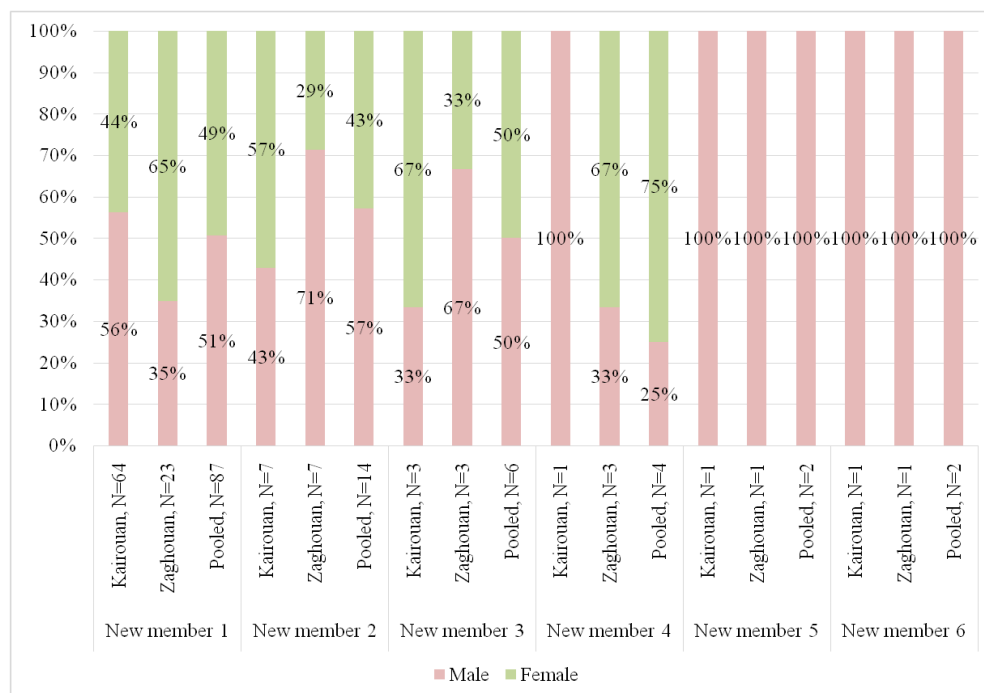


Figure 14. Sex of the new household member by governorate, %

The relationship with the head of the household by governorate is represented in Figure 15. For almost the whole sample, the new member is in general a son or a daughter. This is the case for 100% of the sample for both governorates for new member 3,4,5 and 6.

Concerning new member 1, for both governorates 65.5% are a son or a daughter of the head of the household. For 13% of the sample in Zaghouan, the new member is a spouse, for 17.4% a grandchild, for 4.3% a house girl and for 4.3% they are other relatives.

For new member 2, the sample is equally composed by sons or daughters for both governorates (57.1%). In Kairouan 14.3% of the sample is composed by spouses as new members while there is no new spouse in Zaghouan. Then in Kairouan, the sample is composed equally by 14.3% of fathers or mothers of the household head and 14.3% of grandchildren as new members.

In Zaghouan, the sample is equally composed by 14.3% of grandchildren, 14.3% of sister or brother in law and 14.3% by other relatives for new member 2.

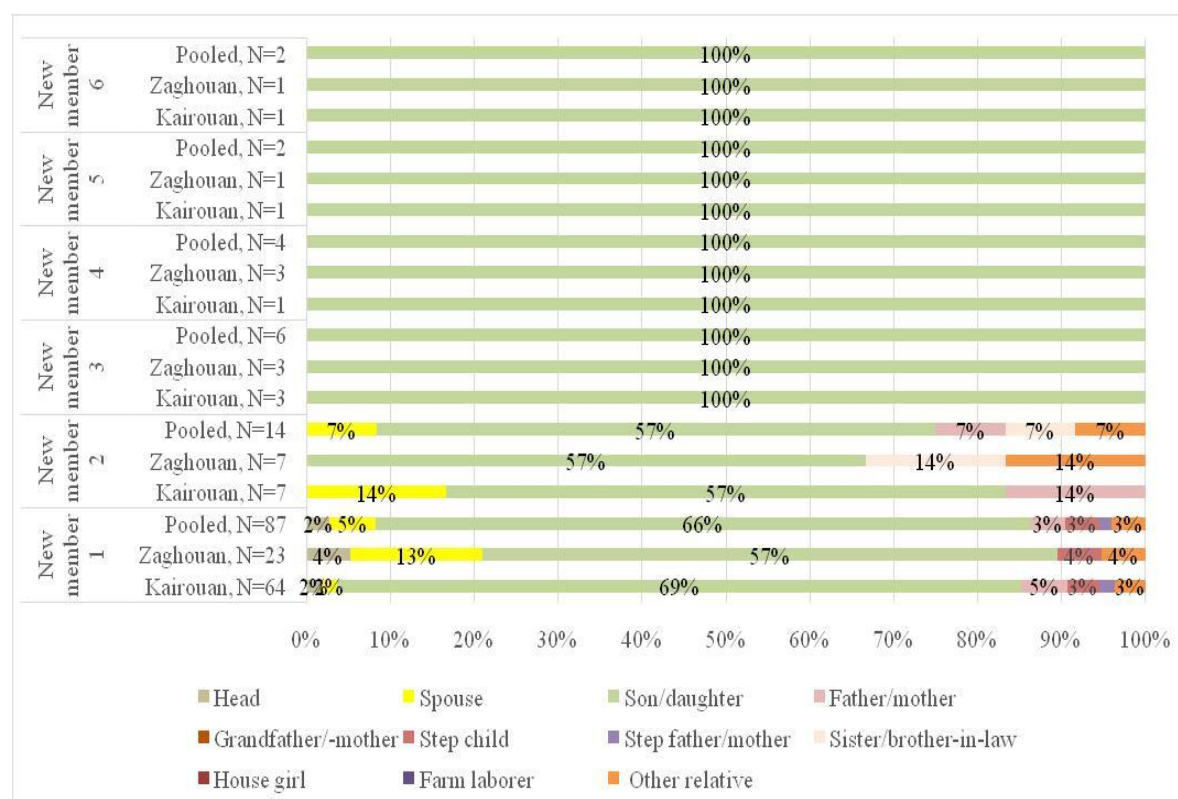


Figure 15. Relationship with the Head of Household by governorate, %

Table 4 below shows the age of the new members in the household by governorate. The oldest person is found in Kairouan for new member 1 with 90 years old while the youngest is 1 year. The mean for new member 1 is 17.42 years.

The oldest person in Zaghouan is 50 years for new member 1 while the youngest is 1 year. The mean in Zaghouan for new member 1 is 25 years.

For new member 2, in Kairouan the maximum is 80 years and the minimum is 5 years. In Zaghouan, the minimum is 14 years and the maximum 30.

Then new member 3, 4, 5 and 6 are composed by younger persons for both governorates. For new member 3, in Kairouan the maximum is 35 years while in Zaghouan the maximum is only 14 years. For new member 4, there is only one person in Kairouan with 18 years old while in Zaghouan there are 3 new members, the oldest person is 9 years.

There are few new members for both locations as member 5 and 6. Only one member in Zaghouan aged 2 years and one member in Kairouan aged 21 years. It is the same situation for new member 6 with one new person in Kairouan aged 16 years and one new person in Zaghouan aged 2 years.

Table 4. Ages of new HH members by governorate

		Min	Max	Mean	S.Deviation
New member 1	Kairouan, N=50	1	90	17.42	23.202
	Zaghouan, N=19	1	50	25.00	17.966
	Pooled, N=69	1	90	19.51	22.022
New member 2	Kairouan, N=5	5	80	36.60	34.341
	Zaghouan, N=4	14	30	21.50	7.724
	Pooled, N=9	5	80	29.89	25.988
New member 3	Kairouan, N=3	24	35	29.50	7.778
	Zaghouan, N=2	2	14	9.67	6.658
	Pooled, N=5	2	35	17.60	12.462
New member 4	Kairouan, N=1	18	18	18.00	
	Zaghouan, N=3	1	9	5.67	4.163
	Pooled, N=4	1	18	8.75	7.042
New member 5	Kairouan, N=1	21	21	21.00	
	Zaghouan, N=1	2	2	2.00	
	Pooled, N=2	2	21	11.50	13.435
New member 6	Kairouan, N=1	16	16	16.00	
	Zaghouan, N=1	2	2	2.00	
	Pooled, N=2	2	16	9.00	9.899

Table 5 shows the number of years of formal education by governorate. The table shows that the maximum is for new member 1 for both governorates with 18 years in Kairouan and 16 years in Zaghouan. For both governorates, the mean is 6.11 years.

The number of years in formal education is also high in Zaghouan with new member 2. It goes up to 15 years while it is only 4 years maximum in Kairouan.

For the other new members, the number of years in formal education is low, for new member 3 it is 5.75 years for both governorates. Concerning new member 4, it is 12 years in Kairouan and a maximum of 3 years in Zaghouan. For new member 5 and 6, there is no one in Zaghouan while there is only one person in Kairouan for member 5 with 7 years in education and one person for new member 6 with 9 years.

Table 5. Years of formal education by governorate (number)

		Min	Max	Mean	S.Deviation
New member 1	Kairouan, N=24	0	18	5.83	5.010
	Zaghouan, N=14	0	16	6.57	5.598
	Pooled, N=38	0	18	6.11	5.172
New member 2	Kairouan, N=4	0	4	1.25	1.893
	Zaghouan, N=4	0	15	7.75	6.344
	Pooled, N=8	0	5	4.50	5.555
New member 3	Kairouan, N=2	3	6	4.50	2.121
	Zaghouan, N=2	7	7	7.00	0.000

	Pooled, N=4	3	7	5.75	1.893
	Kairouan, N=1	12	12	12.00	
New member 4	Zaghouan, N=2	1	3	2.00	1.414
	Pooled, N=3	1	2	5.33	5.859
	Kairouan, N=1	7	7	7.00	
New member 5	Zaghouan, N=0				
	Pooled, N=1	7	7	7.00	
	Kairouan, N=1	9	9	9.00	
New member 6	Zaghouan, N=0				
	Pooled, N=1	9	9	9.00	

Figure 16 below indicates the highest level of education reached by governorate. It shows that a small proportion of the sample has at least one member with a university degree with 7.9% for both governorates having one member who went to the university. Besides, 21.1% of both governorates went to high school for member 1 and 22% for member 2. The highest level achieved by the other members of the households is the college level.

On the other side, there is a little part of the two governorates that are illiterate; the figure shows that 18% for member 1 are illiterate for both governorates and 44% for member 2.

New member 5 and new member 6 composed each one by only one member in Kairouan and zero member in Zaghouan went to college.

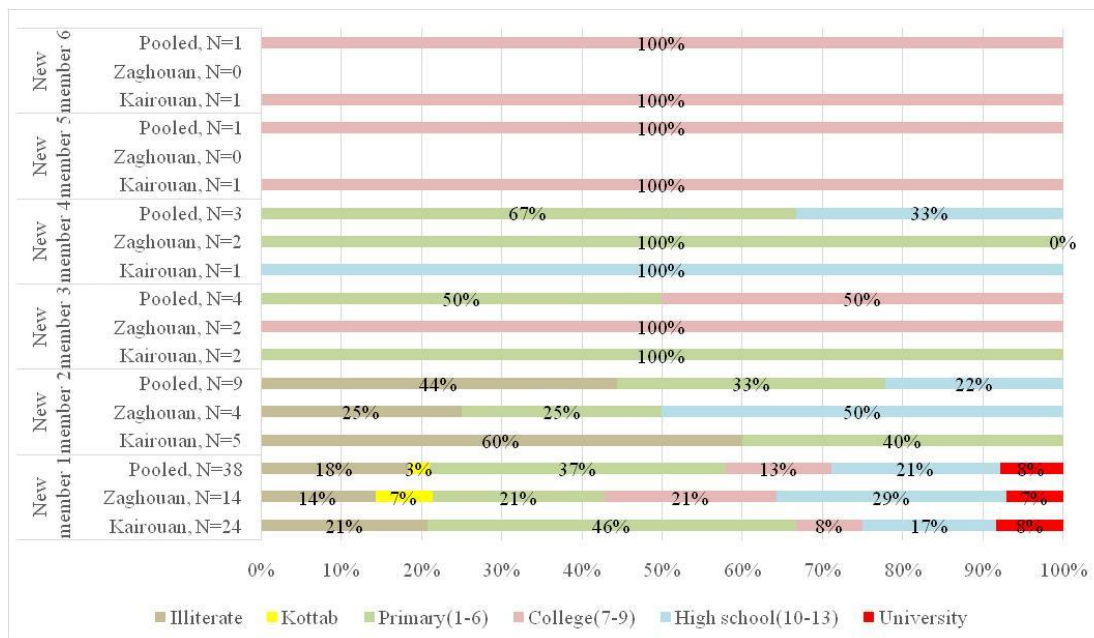


Figure 16. Highest level of education reached, %

The registration of a new member at school is described in Figure 17. We notice that there is always a new registration of a new member. For member 1, 83% of the sample registered a new member, while they were 50% in Zaghouan. Concerning member 2, they

were 50% in Zaghouan and 100% in Kairouan. Only half of the two new members were registered in Zaghouan for new member 3 while they were 100% for new member 4 for both locations.

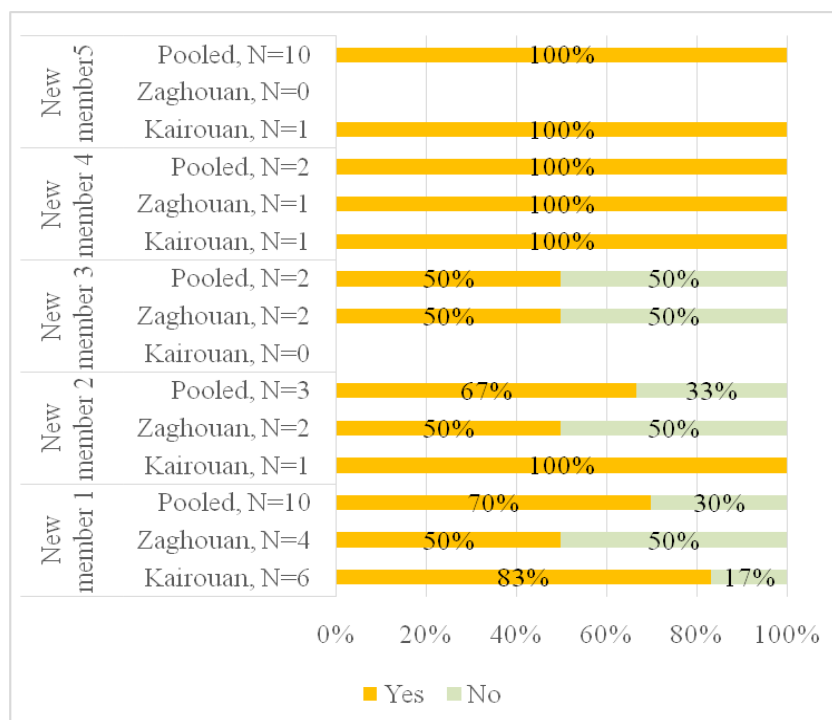


Figure 17. Registration of new member at school by governorate, %

Figure 18 shows the marital status of the new member by governorate. Almost the whole sample is composed by single persons for both governorates from new member 3 to new member 6. Concerning new member 1, 64% are single in Kairouan while they are 57% in Zaghouan. Then 29% are married in Kairouan while they are 36% in Zaghouan for new member 1. 14% are widowed in Kairouan.

Concerning new member 2, 100% of the sample in Zaghouan are single, while the sample is equally divided in Kairouan with 33% of married, 33% of single and 33% of widowed.

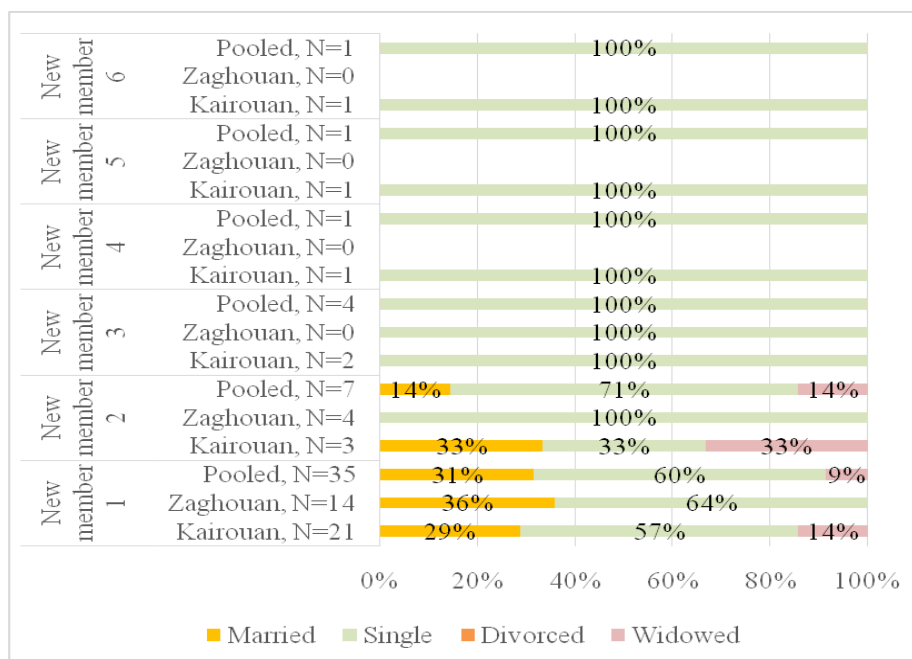


Figure 18. Marital status of new member by governorate, %

Table 6 shows the number of months the new household member is away from home. The maximum is for the governorate of Kairouan with 11 months and 1 month minimum. In Zaghouan the maximum is 9 months. This concerns the new member 1 only.

Table 6. Number of months the new household member is away from home

		Min	Max	Mean	S.Deviation
New member1	Kairouan, N=6	1	11	5.83	4.665
	Zaghouan, N=1	9	9	9.00	1.9235
	Pooled, N=7	1	11	6.29	4.424

Figure 19 shows the main occupation of new household member by governorate. It appears that there are different occupations in the sample. For new member 1, 38% of the sample in Kairouan has no occupation while they are 29% in Zaghouan. Then 21% are employed in Zaghouan and they are 15% in Kairouan. Around 15% of the sample is composed by students or pupils for both governorates. 13% are occasional off-farm workers. 5% work on breeding for the own farm and 10% work on crops for both locations.

The situation is different for new member 2 with 44% of the sample having no occupation for both locations. Then 22% are students or pupils for Zaghouan and Kairouan. Finally, the sample is divided into 3 groups of 11% with 11% of workers in crops, 11% of workers in breeding and 11% employed.

Concerning new member 3, half of the sample works on crops for both governorates, a quarter works have no occupation while the last quarter is composed by students or pupils.

The other new members are mainly composed by students or pupils in Kairouan, 100% for new member 4 and 6.

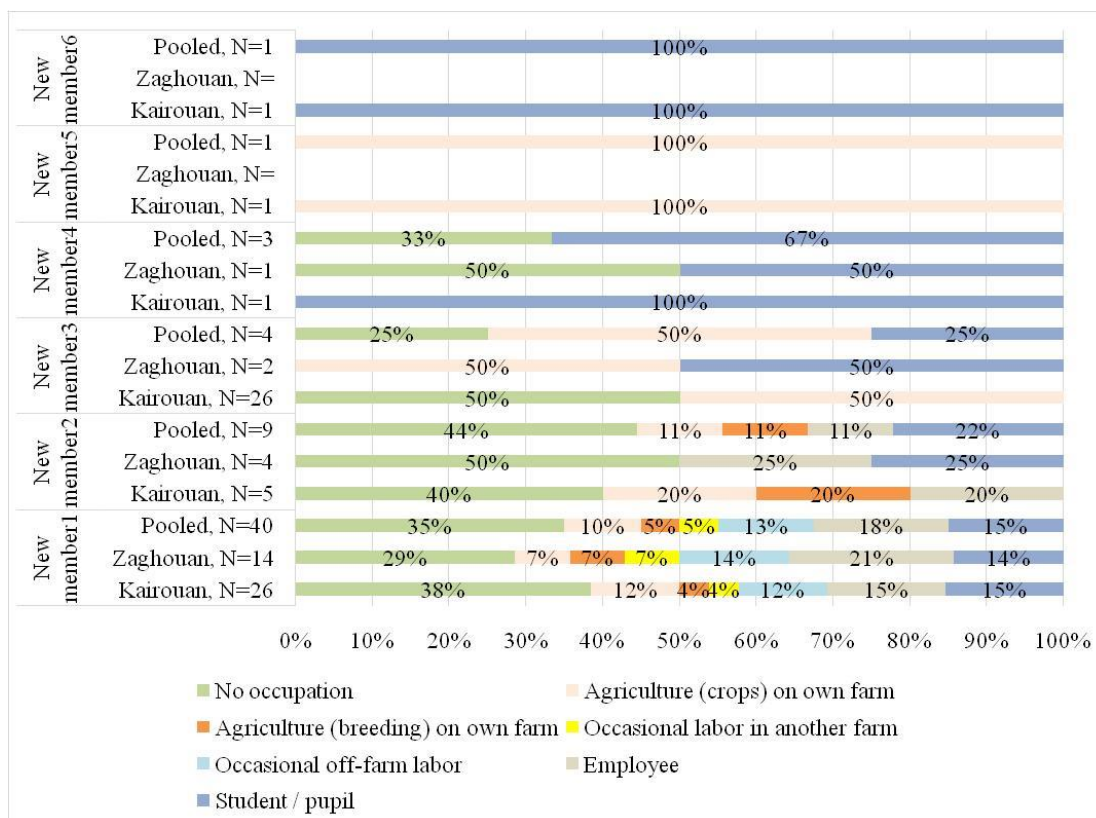


Figure 19. Main occupation of new HH members by governorate, %

Figure 20 shows the household farm labor contribution's of the new household members. Concerning new member 1, more than half of the sample (55%) in Kairouan do not work on the farm, 25% have a full time work on the farm and 20% have a part time.

In Zaghuan, half of the sample has a part time, 28.6% have a full time and 21.4% do not work on the farm.

Concerning the new member 2, the sample is equally divided in Kairouan with 33.3% having a part time, 33.3% having a full time and 33.3% who do not work on the farm. In Zaghuan they are 75% to have a part time and 25% to not work on the farm.

For the new member 3, 100% of the sample for both governorates has a part time work in the farm. For new member 4 and 6, they are 100% in Kairouan to not work on the farm.

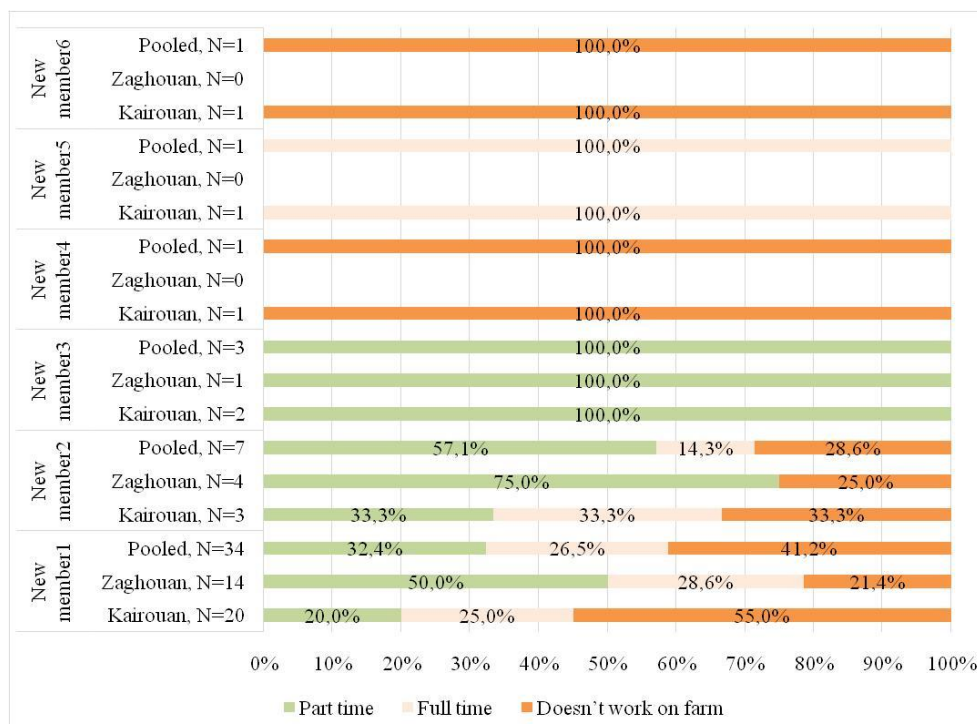


Figure 20. Household farm labor contribution's of new HH members

Table 7 below shows the new members years of experience in agriculture. It shows that the most experienced new members are new member 1 and new member 2 for both governorates.

Table 7. New member years' experience in agriculture by governorate

		Min	Max	Mean	S.Deviation
New member 1	Kairouan, N=3	0	40	18.33	20.207
	Zaghouan, N=4	0	15	7.25	6.602
	Pooled, N=7	0	40	12.00	13.892
New member 2	Kairouan, N=20	0	50	8.30	15.752
	Zaghouan, N=12	0	30	10.25	10.181
	Pooled, N=32	0	50	9.03	13.776
New member 3	Kairouan, N=2	12	15	13.50	2.121
	Zaghouan, N=12	3	3	3.00	
	Pooled, N=3	3	15	10.00	6.245
New member 4	Kairouan, N=1	3	3	3.00	
	Zaghouan, N=0				
	Pooled, N=3	3	3	3.00	
New member 5	Kairouan, N=1	6	6	6.00	
	Zaghouan, N=0				
	Pooled, N=1	6	6	6.00	
New member 6	Kairouan, N=1	2	2	2.00	
	Zaghouan, N=0				
	Pooled, N=1	2	2	2.00	

In Kairouan, the maximum is 40 years while it is 15 in Zaghouan for new member 1.
In Zaghouan, the maximum is 30 years for new member 2 while it is up to 50 years in Kairouan.

Concerning new member 3, they are more experienced with 12 years minimum and 15 years maximum in Kairouan while in Zaghouan the maximum is 3 years.

For the other new members, there is no new member in Zaghouan while for Kairouan there is only one member with 3 years experience for new member 4, 6 years for new member 5 and 2 years for new member 6.

Figure 21 below shows the off farm work for new members by governorate. It shows that only new member 1 and 2 have off farm income. In Kairouan, for member 1, 35% of the sample has an off farm work, this rate goes up to 42.9% in Zaghouan. Concerning member 2, they are 25% of the sample in Zaghouan to have an off farm work. In Kairouan, no one has a job outside the farm. It is also the case for the other new members in both governorates.

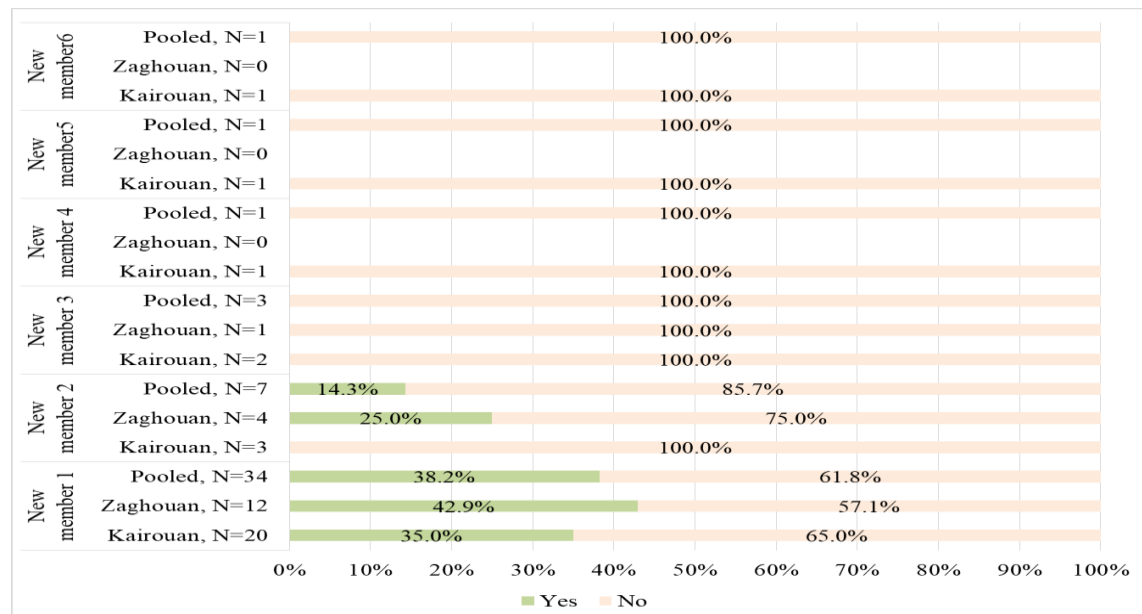


Figure 21. Off farm income/work for new members by governorate, %

5.3. Module B: Characteristics of the main house

In this section, an analysis of the characteristics of the main house is made. It concerns first the ownership mode by governorate, the other modes of ownership, the payment of renting house, the main sources of water, the distance between the water source and the house and the number of rooms in the house by governorate.

Figure 22 shows that almost the whole sample owns his house. The rate is higher in Zaghouan with 98.6% while it is 93.4% in Kairouan. Less than 1% rent the house in both governorates. For 4.6% of the households in Kairouan the house is the property of a family member while they are only 0.5% in this case for Zaghouan governorate.

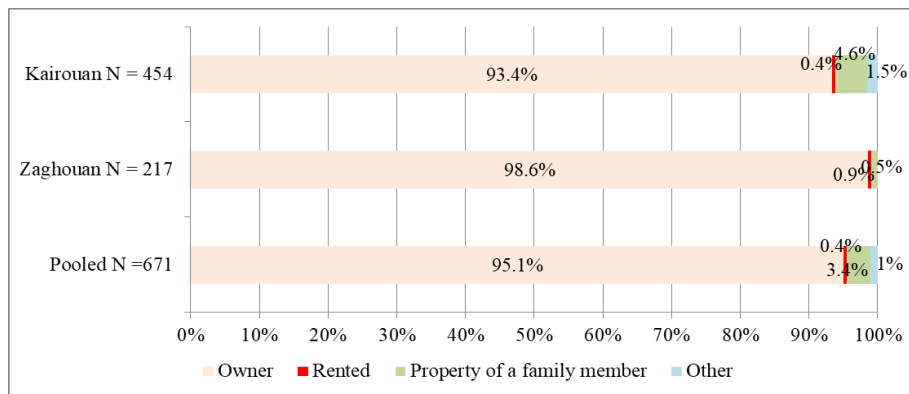


Figure 22. Ownership mode by governorate, %

The other modes of ownership by governorate are represented in figure 23. The largest part is the state land for 28.57% of the sample (Figure 23). The other modes are equal with 14.29% of the sample built on a state land, 14.29% owned by inheritance, 14.29% is a state owner land, 14.29% is a property dude father and 14.29% is the property of the mother in law.

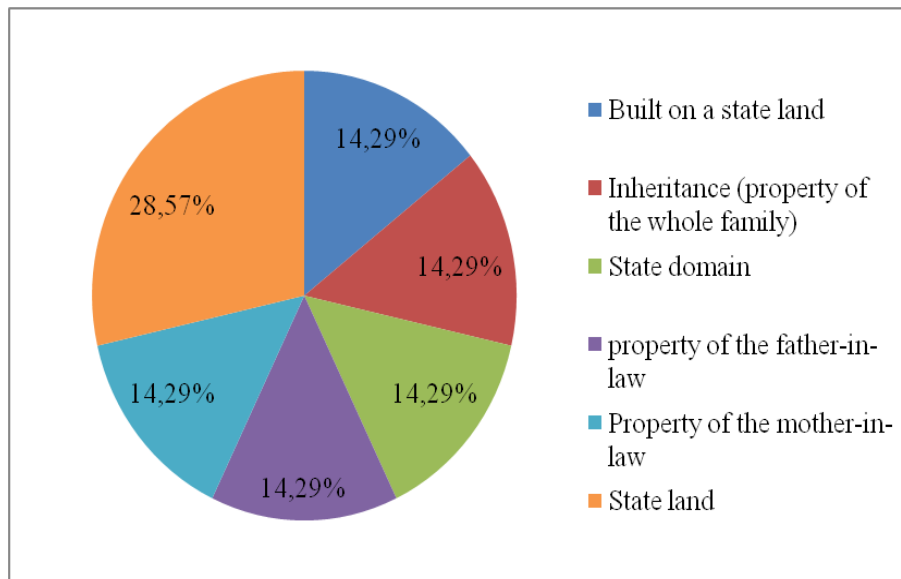


Figure 23. Other modes of ownership by governorate, %

Figure 24 shows the payment of the renting house by governorate. Prices are higher in Kairouan with 12.5% of the sample paying more than 250 TND/ month; they are 45.2% paying between 100 and 250 TND/month while they are 35.4% paying this price in Zaghuan. The lowest prices are in Zaghuan where more than half of the sample (54.4%) pays less than 100 TND/month. 35.4% pay between 100 and 250 Tnd while 10.3% pay more than 250 TND.

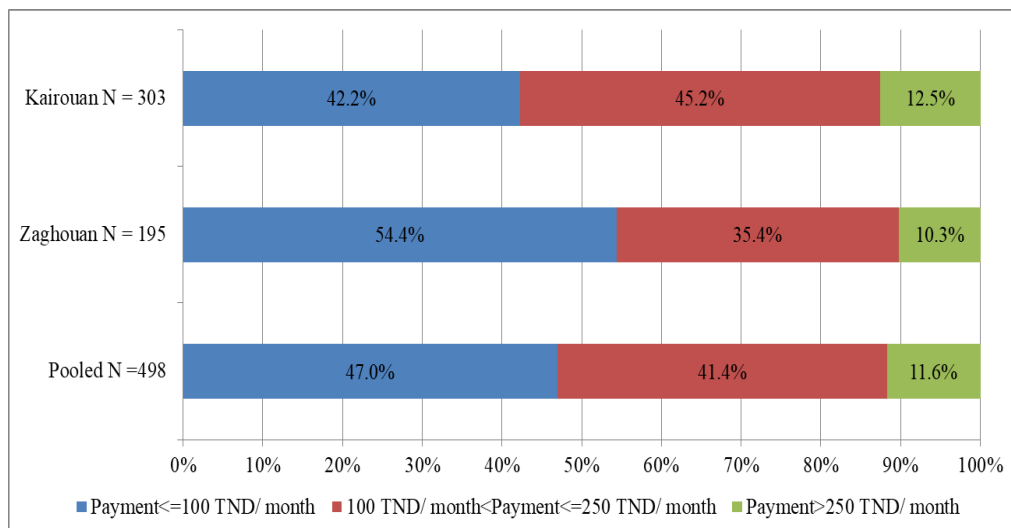


Figure 24. Payment of renting house by governorate, %

The main sources of water are represented in figure 25. Zaghuan is better equipped with 74.7% of the sample having the tap water (Figure 25). This governorate is also equipped with protected wells (sharing mode) with 8.3% of the sample and 1.4% having private protected wells.

The water routed through ducts in the neighborhood is almost equal on both governorates with 6.4% in Kairouan and 6% in Zaghuan.

Kairouan is better equipped with protected wells in a sharing mode with 16.1% of the sample and 5.3% having private protected wells. 62.6% of the sample has tap water in the house. Besides, 6.4% are routed through ducts in the neighborhood.

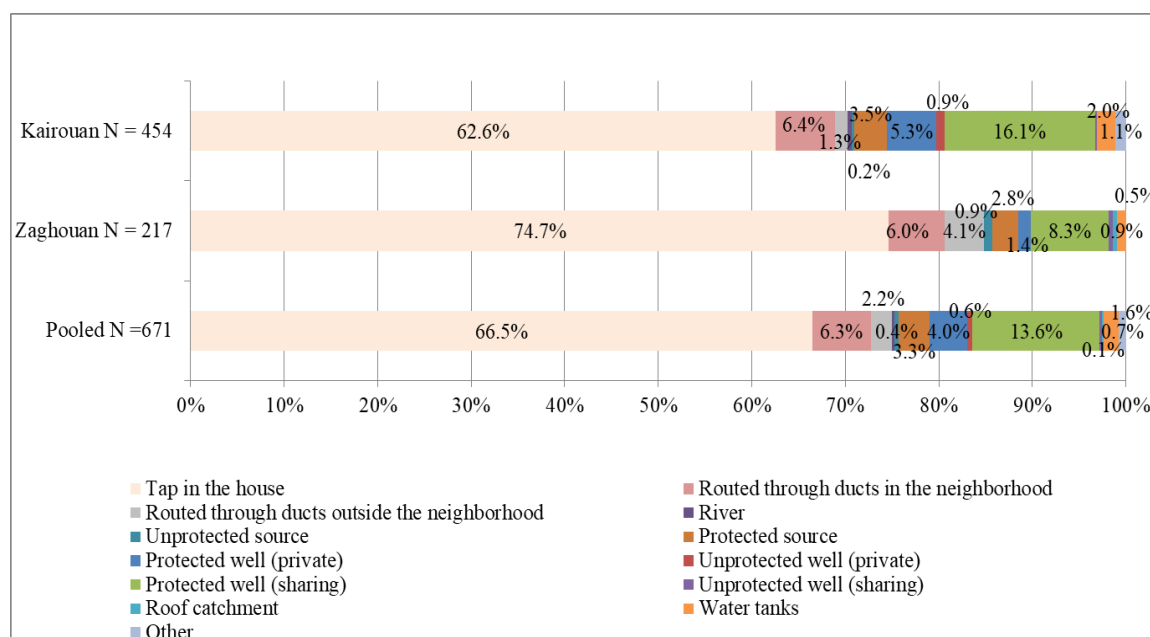


Figure 25. Main sources of water by governorate, %

Figure 26 shows the distance between the water source and the house by governorate. Percentages are almost equal with 80.2% for Zaghouan and 82.7% for Kairouan having the water source on site. For both governorates, it takes less than 15 minutes to reach the water source for 9.4% of the sample. Kairouan has the highest rate for the farthest point of water source with 2.7% of the sample. For 9.2% in Zaghouan it takes between 16 to 45 minutes to reach the source of water. The same time is needed for 4.6% in Kairouan.

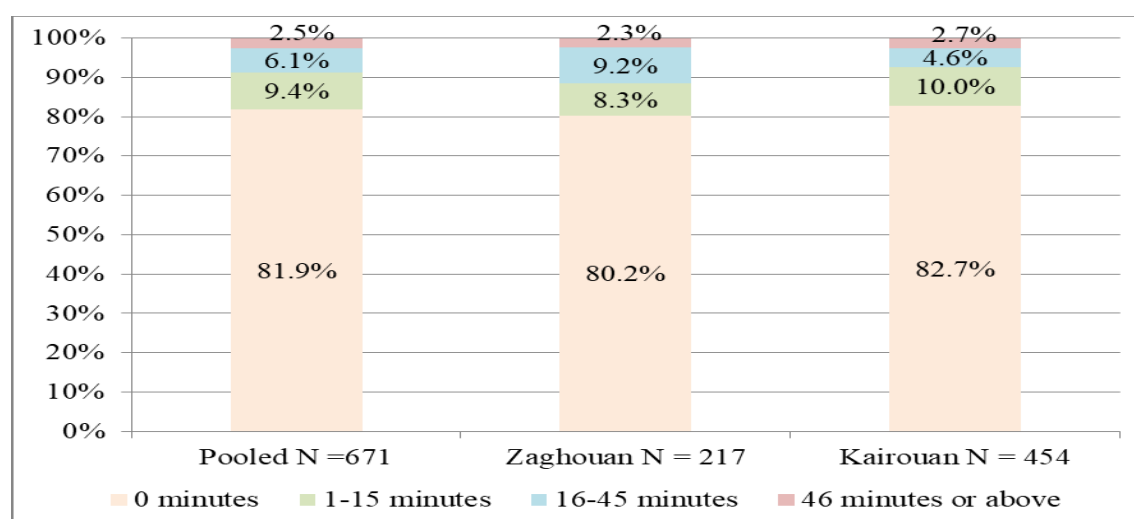


Figure 26. Distance between the water source and the house by governorate, %

Figure 27 shows the number of rooms in the house by governorate. For both governorates, 39.2% of the sample has 3 rooms. In Kairouan, houses are bigger with more than 4 rooms for 11.4% of the sample while they are only 4.1% in Zaghouan.

Percentages are almost equal for 28% of the sample having 2 rooms in the house. The highest rate of small houses is found in Kairouan with 2.9% of the sample while they are only 1.4% in Zaghouan having a 1 room house.

The large part of the sample is composed by 3 rooms. It concerns 41% in Zaghouan and 38.4% in Kairouan.

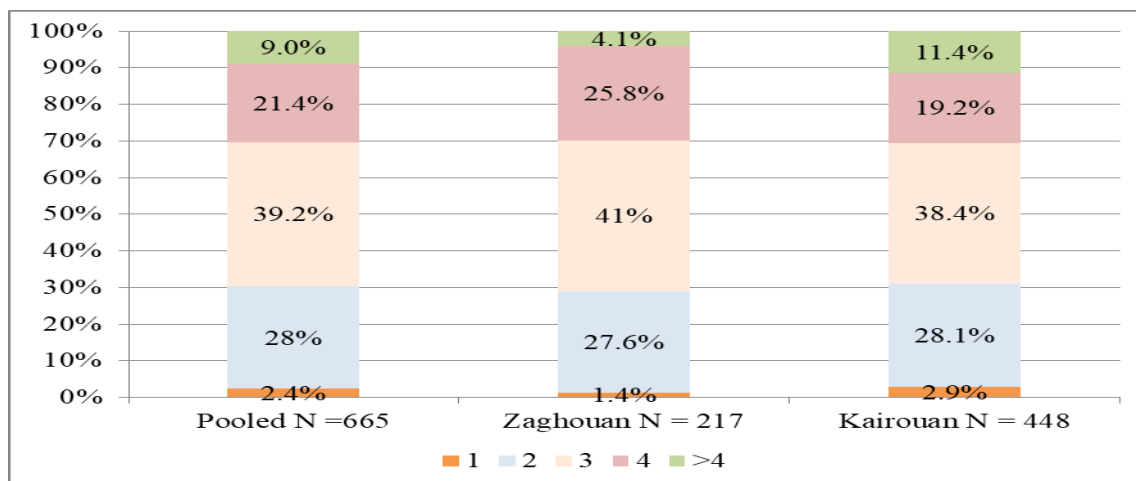


Figure 27. Number of rooms in the house by governorate, %

5.4. Module C. Household assets

In this section a description of the household assets will be made. It concerns the entire equipment present in the household in both governorates with a detailed table including the minimum and maximum number or amount of each asset.

Concerning the households assets (Figure 28), for the governorate of Kairouan, most of the sample (>90%) do not possess these agricultural equipments: tractor (93.8%), chempump (90.3%), a waterpump (94.7%), a shredder (98.5%), a plough (94.1%), a milking machine (98.5%), a grain storage (92.3%), a combine harvester (99.8%) and a straw press (100%). More than half of the households (55.9%) have a stable. For the irrigation water management, only 19.6% possess it while only 27.3% have a drinking water installation. Other assets are also lacking in this governorate, it concerns the solar panels (96.9%) and a generator (95.2%).

For transportation, the households suffer also from the lack of means of transport, 91.9% do not possess a car, neither a pickup for 81.7% nor a motorbike for 78.6% or a bike for 95.6%. Most of the households in this sample possess a house (94.9%) and a fridge (96.7%), but not all of them own an oven (only 51.5% do), a radio (47.8% do), a phone (41.4%).

For the house equipment, 97.4% do not own an air conditioner in 2016, this percentage slightly dropped to 95.8% in 2018. Also for the washing machines, 96.7% do not have an auto washing and 62.6% do not possess a semi washing machine.

These households are not connected to the internet, they were 99.6% in 2016 to not have an internet device and they become 99.3% in 2018, only 15.2% declare having a Smartphone. 96.3% do not have a computer at home. On the other hand, they are 78.9% to possess a TvTube.

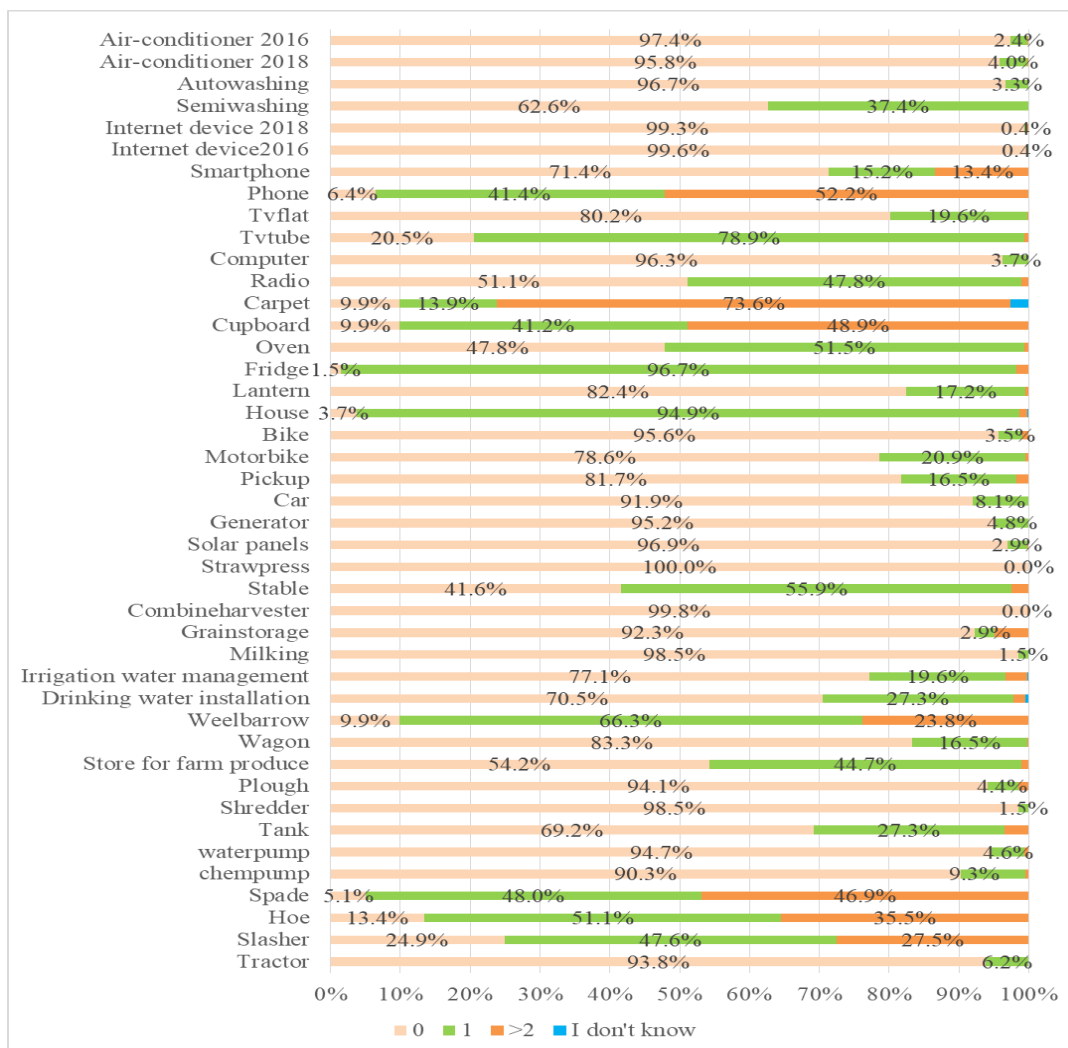


Figure 28. Number of Household assets in Kairouan, N= 454, %

For Zaghouan governorate and based on a sample of 217 households, most of them (>90%) do not possess these agricultural equipments: tractor (96.8%), chempump (96.8%), a water pump (98.6%), a shredder (99.1%), a plough (97.7%), a milking machine (98.2%), a grain storage (94.9%), a combine harvester and a straw press for 100%. For the irrigation water management, only 9.7% possess it while only 27.6% have a drinking water installation. These households do not have solar panels for 98.6% and a generator for 97.7% (Figure 29).

For the transport, the households in Zaghouan own a motorbike for 23% of them, a pickup for 10.1%, a car for 5.5% and a bike for only 0.9%.

Concerning the house equipment, the households in this sample possess a house for 95.4% and a fridge for 97.2%, half of them do not own an oven (51.2%) or a radio (52.5%).

For the air conditioner, from 2016 to 2018, percentages of the households having this asset increased from 0.9% to 1.8%. The percentages are also very low for the washing machines, 0.5% own an auto washing and 30.4% do have a semi washing machine.

Very few persons are connected to the internet, they were 99.5% in 2016 and now all of them (100%) do not have an internet device. However, 21.2% have a Smartphone. 96.8% do not have a computer but 87.6% possess a Tvtube.

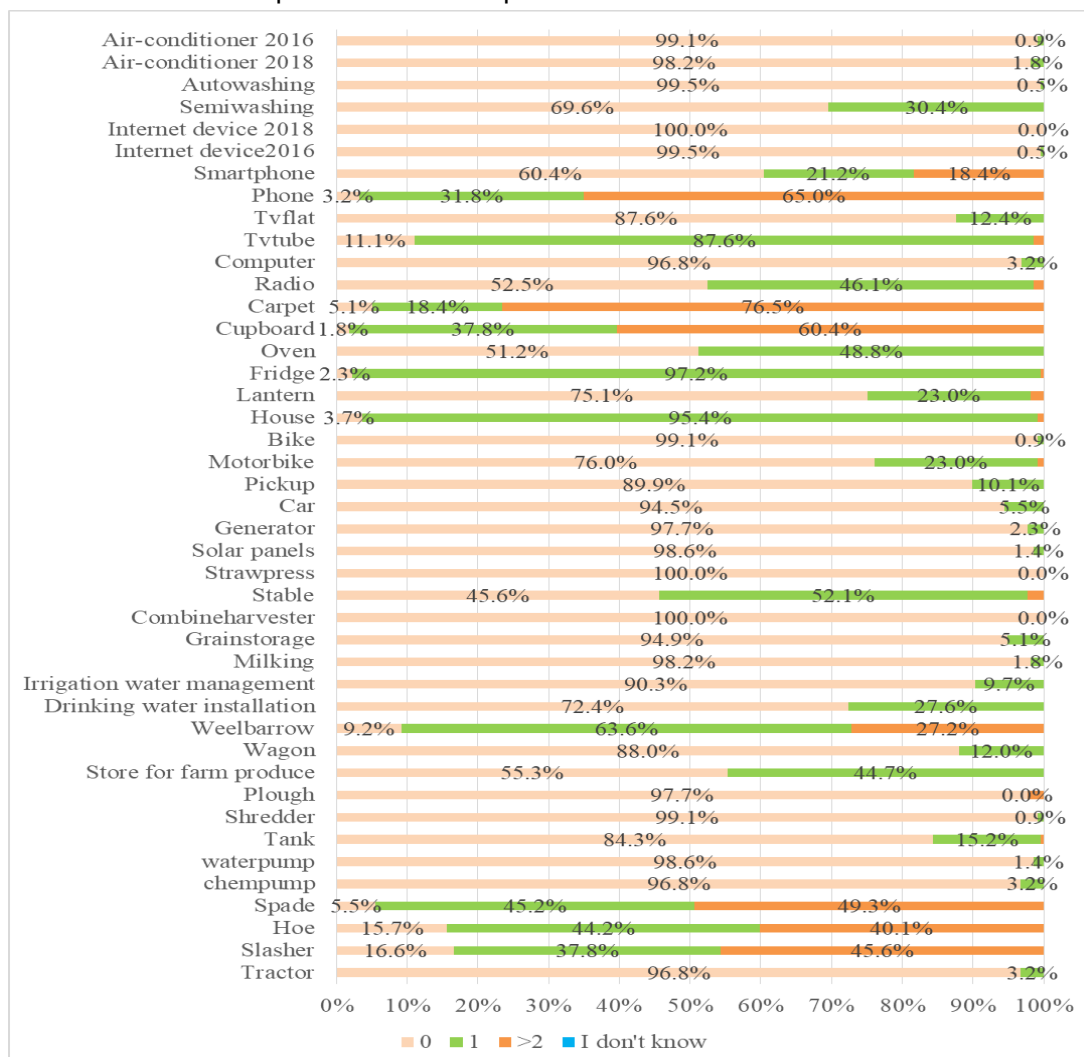


Figure 29. Number of Household assets in Zaghouan. N= 217, %

For both governorates, the households lack mostly the agricultural equipment (straw press, combine harvester, grain storage, a tractor, a chempump, a water pump, a tank, a shredder, a plough, a wagon, an irrigation water management and a milking machine). For the house equipment, despite the fact that they possess for 95.1% their houses, these households require some assets such like a drinking water installation, solar panels for energy, means of transport; internet devices and air conditioner (Figure 30).



Figure 30. Number of Household assets in both governorates, N= 671, %

Table 8 shows the amount of Household assets in both governorates. Concerning the agricultural equipment, we notice that the governorate of Kairouan is much better equipped with 27 tractors versus only 7 for Zaghouan; 18 chempumps versus only 3; 22 water pumps versus only 3; 133 tanks versus 34 for Zaghouan; 24 ploughs for tractor versus 4; 92 irrigation water management versus 20 for Zaghouan; 199 stables in Kairouan versus 107 in Zaghouan and 7 milking machines versus 4 for Zaghouan. Grain storage is the same for both governorates with 10 for Kairouan and 11 for Zaghouan.

For the energy, Kairouan is better equipped with 14 solar panels and 22 generators while Zaghouan has only 3 solar panels and 5 generators.

Concerning the means of transport, Kairouan is still more equipped with 36 cars, 81 pickups, 92 motorbikes and 20 bikes while the governorate of Zaghouan count only 12 cars, 22 pickups, 51 motorbikes and 2 bikes.

For the house equipment, there are 359 houses in Kairouan and 207 houses in Zaghouan, all equipped with fridges and carpets. 342 houses in Kairouan have TvTubes while there are 191 Tvtubes in Zaghouan. We count only 15 computers in Kairouan and 7 in Zaghouan, only 2 have internet devices in Kairouan and 1 in Zaghouan.

There are 14 auto washing in Kairouan and only 1 in Zaghouan, also for the air-conditionner we count 19 in Kairouan and only 4 in Zaghouan.

Table 8. Amount of Household assets in both governorates, %

		Minimum	Maximum	Mean	Std. Deviation
Tractor	Pooled N = 34	2000	50000	23397.06	10843.08
	Kairouan N = 27	2000	50000	22870.37	11825.33
	Zaghouan N = 7	20000	35000	25428.57	5883.80
Chempump	Pooled N = 21	40	2000	362.38	493.73
	Kairouan N = 18	40	2000	371.67	530.94
	Zaghouan N = 3	120	500	306.67	190.09
Water pump	Pooled N = 25	40	3500	682.80	670.39
	Kairouan N = 22	50	3500	726.36	699.32
	Zaghouan N = 3	40	600	363.33	289.89
Tank	Pooled N = 167	40	2000	308.98	249.55
	Kairouan N = 133	40	2000	317.22	274
	Zaghouan N = 34	100	500	276.76	107.72
Shredder	Pooled N = 3	100	5000	1750	2814.69
	Kairouan N = 2	100	150	125	35.36
	Zaghouan N = 1	5000	5000	5000	
Ploughs for tractor	Pooled N = 28	150	5000	1416.79	1450.94
	Kairouan N = 24	150	3000	986.25	982.46
	Zaghouan N = 4	2500	5000	4000	1080.12
Store for farm produce	Pooled N = 268	100	45000	3954.58	5138.89
	Kairouan N = 175	100	45000	4292.05	5791.80
	Zaghouan N = 93	100	15000	3319.57	3545.87
Wagon	Pooled N = 82	80	4000	337.93	564.63
	Kairouan N = 57	80	4000	355.96	566.93
	Zaghouan N = 25	100	3000	296.80	568.77
Drinking water installation	Pooled N = 154	100	40000	1540.16	5168.28
	Kairouan N = 95	100	40000	2166.16	6496.51
	Zaghouan N = 59	100	5000	532.20	621.44
Irrigation water management	Pooled N = 112	150	40000	4704.91	8161.32
	Kairouan N = 92	150	40000	5050.54	8671.73
	Zaghouan N = 20	400	20000	3115	5071.83
Milking	Pooled N = 11	100	2000	736.36	558.61
	Kairouan N = 7	100	2000	907.14	632.74
	Zaghouan N = 4	200	700	437.50	228.67
Grain storage	Pooled N = 21	120	20000	1951.90	4358.48
	Kairouan N = 10	120	6000	1529	1900.52
	Zaghouan N = 11	200	20000	2336.36	5865.20
Combine harvester	Pooled N = 1	14000	14000	14000	
	Kairouan N = 1	14000	14000	14000	

		Minimum	Maximum	Mean	Std. Deviation
	Zaghouan N = 0				
Stable	Pooled N = 306	100	35000	2416.90	4208.19
	Kairouan N = 199	100	35000	2206.63	3905.35
	Zaghouan N = 107	100	35000	2807.94	4714.69
Solar panels	Pooled N = 17	300	20000	2050	4642.67
	Kairouan N = 14	300	20000	2217.86	5133.51
	Zaghouan N = 3	1100	1400	1266.67	152.75
Generator	Pooled N = 27	100	3000	691.11	577.48
	Kairouan N = 22	100	1500	523.18	316.41
	Zaghouan N = 5	750	3000	1430	896.94
Car	Pooled N = 48	5000	35000	15781.25	8221.60
	Kairouan N = 36	5000	35000	16986.11	8472.21
	Zaghouan N = 12	5000	25000	12166.67	6436.17
Pickup	Pooled N = 103	1500	130000	22907.77	19983.79
	Kairouan N = 81	1500	130000	23697.53	21935.51
	Zaghouan N = 22	2000	35000	20000	9768.75
Motorbike	Pooled N = 143	120	15000	903.43	1373.54
	Kairouan N = 92	120	4500	779.67	689.79
	Zaghouan N = 51	250	15000	1126.67	2100.71
Bike	Pooled N = 22	50	600	145.91	125.19
	Kairouan N = 20	50	600	149.50	131.01
	Zaghouan N = 2	100	120	110	14.14
House	Pooled N = 566	2000	150000	27040.65	21927.49
	Kairouan N = 359	2000	150000	26579.41	22764.76
	Zaghouan N = 207	3000	120000	27840.58	20423.16
Fridge	Pooled N = 640	40	1500	394.34	192.49
	Kairouan N = 428	40	1500	389.21	207.62
	Zaghouan N = 212	100	1070	404.72	157.53
Oven	Pooled N = 327	10	600	155.89	94.67
	Kairouan N = 222	10	500	152.75	93.34
	Zaghouan N = 105	50	600	162.52	97.54
Carpet	Pooled N = 579	10	2000	187.64	217.61
	Kairouan N = 375	10	2000	204.81	256.15
	Zaghouan N = 204	20	600	156.07	111.39
Computer	Pooled N = 22	200	1500	629.55	303.81
	Kairouan N = 15	400	1500	663.33	343.03
	Zaghouan N = 7	200	800	557.14	198.81
Tvtube	Pooled N = 533	40	1000	205.82	111.98
	Kairouan N = 342	40	1000	188.04	112.61
	Zaghouan N = 191	50	600	237.64	103.75
Tvflat	Pooled N = 116	150	1700	608.71	231.06
	Kairouan N = 89	150	1700	619.21	245.20

		Minimum	Maximum	Mean	Std. Deviation
Phone	Zaghouan N = 27	300	850	574.07	176.16
	Pooled N = 620	10	280	74.62	48.82
	Kairouan N = 414	10	280	72.46	51.08
Smartphone	Zaghouan N = 206	20	220	78.94	43.74
	Pooled N = 211	45	1200	308.15	222.71
	Kairouan N = 125	45	1000	276.72	197.65
Internet	Zaghouan N = 86	100	1200	353.84	248.97
	Pooled N = 3	35	120	91.67	49.07
	Kairouan N = 2	120	120	120	0.00
Semiwashing	Zaghouan N = 1	35	35	35	
	Pooled N = 231	50	500	243.80	90.18
	Kairouan N = 165	50	500	238.17	90.77
Autowashing	Zaghouan N = 66	100	450	257.88	87.77
	Pooled N = 15	100	1030	572	252.93
	Kairouan N = 14	100	1030	562.86	259.89
Air-conditioner	Zaghouan N = 1	700	700	700	
	Pooled N = 23	200	1800	739.13	420.76
	Kairouan N = 19	200	1800	731.58	448.52
	Zaghouan N = 4	500	1200	775	298.61

5.5. Module D. Land owned per hectare

In this section, the objective is to describe the land owned per hectare for the governorate of Kairouan and the governorate of Zaghouan. It concerns the land title possession, the total land used by governorate, the rented land by location, the number of the renting plots and how do the households use them, the irrigation of the renting plots with their costs and finally the access to communal pasture.

According to figure 31, in both governorates, most of the households own less than 5 ha (67.6%), only 3.9% have large lands with more than 21 ha. In Zaghouan the percentage of small land owners is higher with 77.4% of the sample owning less than 5 ha. 14.7% have between 6 and 10 ha while only 2.8% have more than 21 ha. In Kairouan governorate there is the highest rate of large lands with 4.4% of the sample owning more than 21 ha, this governorate has also the lowest rate of small lands with 62.9% of the sample.

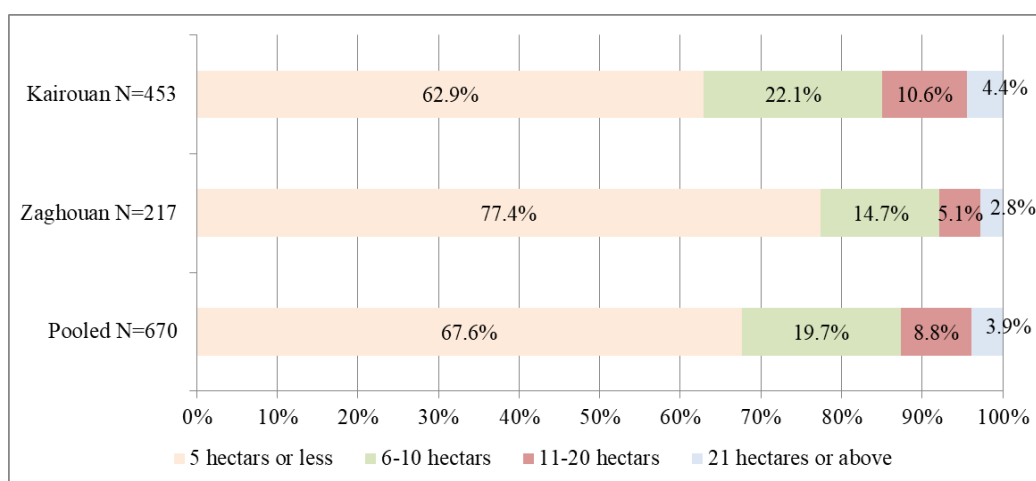


Figure 31.Owned land area by governorate. %

Table 9 shows that the minimum land area is nearly the same between the two governorates with 0.20 ha for Kairouan and 0.25 ha for Zaghouan. The largest area is located in Kairouan with 60 ha while it is only 40 ha for Zaghouan. The mean is nearly the same, it is 5.07 in Zaghouan and it goes up to 6.9 Ha in Kairouan.

Table 9 . Land area by governorate (hectare)

	Min	Max	Mean	Std. Deviation
Pooled N= 599	0.20	60	6.36	6.97
Zaghouan N=178	0.25	40	5.07	5.81
Kairouan N=421	0.20	60	6.90	7.34

Concerning the land title possession, Zaghouan has the highest rate of households having the totality of the land title with 54.4% while 10.6% have only a partial title (Figure 32). In Kairouan, 45.6% households have no title whereas they are only 35% in Zaghouan. Besides, table 10 shows that 18% of the households own the land in Zaghouan, while they are only 7% in Kairouan.

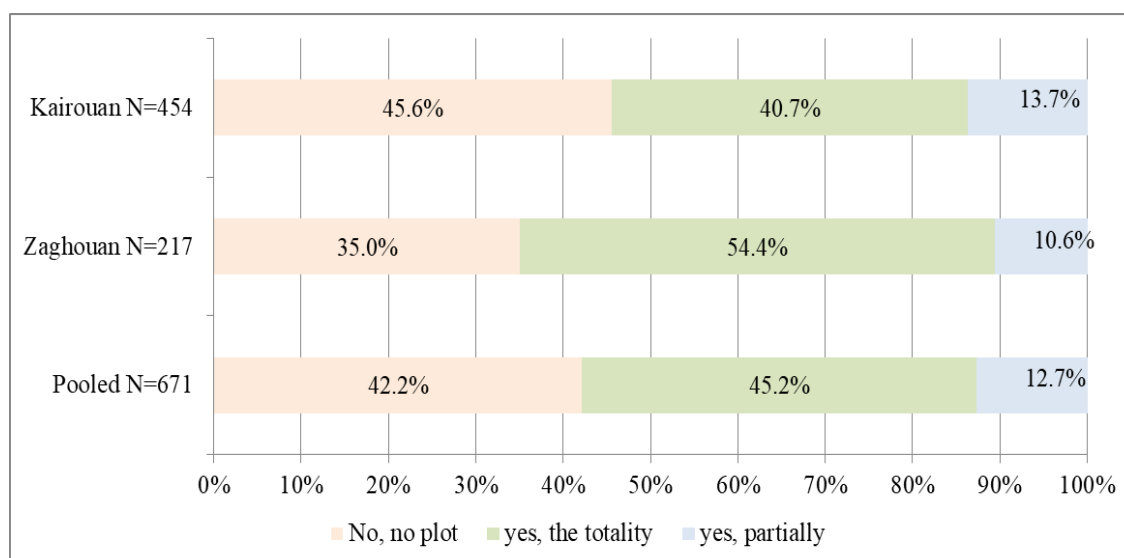


Figure 32. Land title possession by governorate, %

Table 10 shows the percentage of HH without own land. This percentage is nearly 11% in both governorates (18% in Kairouan and 7% in Zaghouan).

Table 10. Households without own land by governorate, %

	Percentage
Pooled N=671	10.6%
Zaghouan N=217	18%
Kairouan N=454	7%

Table 11 shows the land use by governorate. The maximum land is allocated to crops with 40 Ha in Zaghouan and 35.5 Ha in Kairouan. The minimum land is for the livestock and fallow with 0.1 Ha for both governorates. 40 Ha are allocated as maximum in Kairouan for the fallow, while there are only 26.5 Ha in Zaghouan.

23 Ha are rented in Kairouan for 5 households while there isn't any rented area in Zaghouan.

The maximum surface for livestock is 12 Ha in Kairouan and 15 Ha in Zaghouan.

The other uses for the land cover a surface of 0.25 Ha as a minimum in Kairouan and 27 Ha as a maximum while the minimum in Zaghouan is 1.5 Ha and the maximum is only 4.5 Ha.

Table 11.Land use by governorate, hectare

		Min	Max	Mean	Std. Deviation
Crops	Pooled N=573	0.20	40	4.56	4.88
	Kairouan N=403	0.20	35.50	4.82	4.99
	Zaghouan N=170	0.25	40	3.94	4.58
Livestock	Pooled N=164	0.10	15	2.30	2.58
	Kairouan N= 126	0.10	12	2.39	2.53
	Zaghouan N= 38	0.10	15	1.98	2.75
Rented	Pooled N= 5	1	23	12.00	9.30
	Kairouan N= 5	1	23	12.00	9.30
	Zaghouan N= 0	-	-	-	-
Fallow	Pooled N= 155	0.10	40	4.28	5.82
	Kairouan N= 119	0.10	40	4.33	5.90
	Zaghouan N= 36	0.10	26.50	4.11	5.62
Others	Pooled N= 24	0.25	27	3.95	5.96
	Kairouan N= 21	0.25	27	4.04	6.36
	Zaghouan N= 3	1.50	4.50	3.33	1.61

The total land used is represented in figure 33. The majority of the land is less than 5 hectares, it represents 72.5% in Zaghouan and 60.2% in Kairouan.

Kairouan has the highest rate of large land used with 4.7% with 21 hectares and above and 11.6% with a surface between 11 and 20 hectares. Zaghouan governorate has 18 % of the land between 6 and 10 hectares; 6.2% between 11 and 20 hectares and only 3.4% with 21 hectares and above.

The total land used is represented in figure 33. The majority of the land is less than 5 hectares, it represents 72.5% in Zaghouan and 60.2% in Kairouan.

Kairouan has the highest rate of large land used with 4.7% with 21 hectares and above and 11.6% with a surface between 11 and 20 hectares. Zaghouan governorate has 18 % of the land between 6 and 10 hectares; 6.2% between 11 and 20 hectares and only 3.4% with 21 hectares and above.

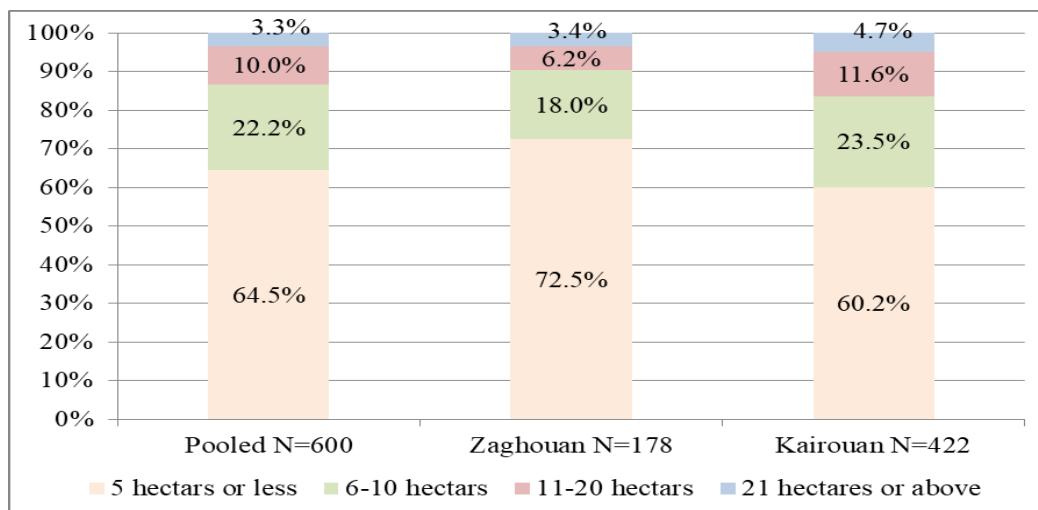


Figure 33.Total land used by governorate. %

Figure 34 shows the rented land by governorate. Percentages are exactly equal between the two governorates with 19.4% of rented land and 80.6% of non rented land for both locations.

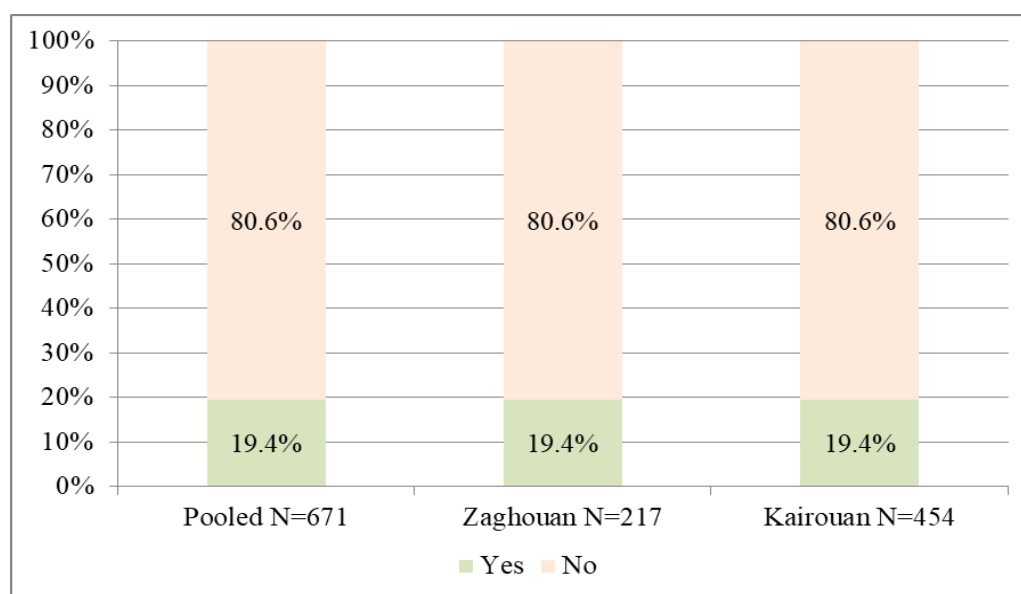


Figure 34. Rented land by governorate. %

Figure 35 shows the number of renting plots by governorate. It appears that almost the whole sample rent only one plot with 84.1% in Kairouan and 73.8% in Zaghouan. The rented land with 2 plots represents 19% in Zaghouan while it is only 10.2% in Kairouan. For both governorates 5.4% is a land composed in 3 plots. Finally, there is no rented land with 4 plots in Zaghouan while it is the case for 1.1% of the sample in Kairouan.

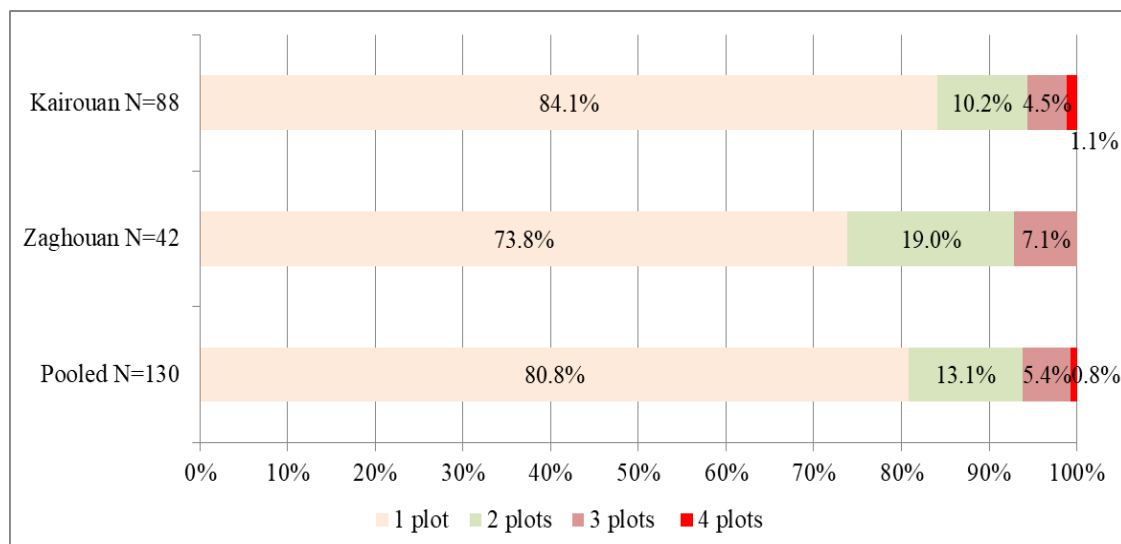


Figure 35. Number of the renting plots by governorate. %

Table 12 shows the area of the renting plots by governorate. It shows that the largest area is allocated to plot 1 for Zaghouan with 30 Ha maximum and 50 Ha for Kairouan. The second largest area is for plot 2 with a maximum of 8 Ha in Zaghouan and 25 Ha in Kairouan. The third plot has 17 Ha maximum in Zaghouan and only 6 Ha in Kairouan. The fourth plot is only present in Kairouan with a maximum of 2 Ha.

Table 12. Area of the renting plots by governorate (Hectare)

		Min	Max	Mean	Std. Deviation
Plot 1	Pooled, N=126	1	50	6.20	7,169
	Zaghouan, N=41	1	30	4.2	5.449
	Kairouan, N=85	1	50	7.2	7.703
Plot 2	Pooled, N=25	1	25	4,58	5,467
	Zaghouan, N=11	1	8	2.7	1.954
	Kairouan, N=14	1.5	25	6.0	6.860
Plot 3	Pooled, N=8	2	17	5,25	5,007
	Zaghouan, N=3	2	17	7.0	8.660
	Kairouan, N=5	2	6	4.2	1.643
Plot 4	Pooled, N=1	2	2	2,00	.
	Zaghouan, N=0				
	Kairouan, N=1	2	2	2.0	

Figure 36 shows the use of the renting plots by governorate. For plot 1, 72.3% is used for agriculture for both governorates, then 31% is used for livestock in Zaghouan while it is only 17% in Kairouan. Fallow is used only in plot 1 in Kairouan for 5.7% of the sample. For 2.3% of both governorates there are other uses in plot 1.

For plot 2, there are only two ways of use; 72% for agriculture and 28% for livestock for both governorates. The third and fourth plots are allocated at 100% for agriculture (crops/trees) in Kairouan.

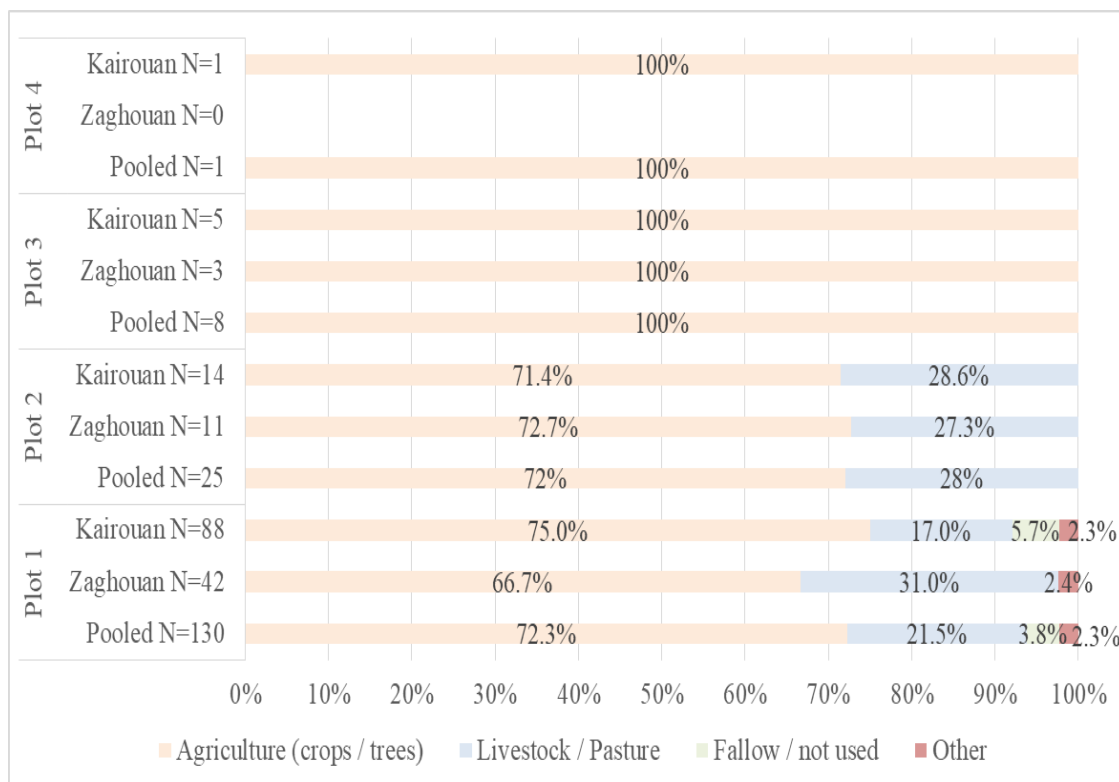


Figure 36. Use of the renting plots by governorate. %

Figure 37 shows the irrigation of the renting plots by governorate. The plots are mainly rainfed. It is the case for plot 1 for 95.2% in Zaghouan and 80.7% in Kairouan. For plot 1 there are some other irrigation methods with 17% of irrigated plots through borehole or well water, while they are only 2.4% in Zaghouan to use this method. The third method is irrigation through public water for 2.3% for both governorates in plot 1.

Plot 2 is 100% rainfed in Zaghouan while only 4% use well water in Kairouan. Plot 3 is also 100% rainfed in Zaghouan and 20% of the sample use irrigated water in Kairouan through borehole or well water. Plot 4 is 100% rainfed in Kairouan.

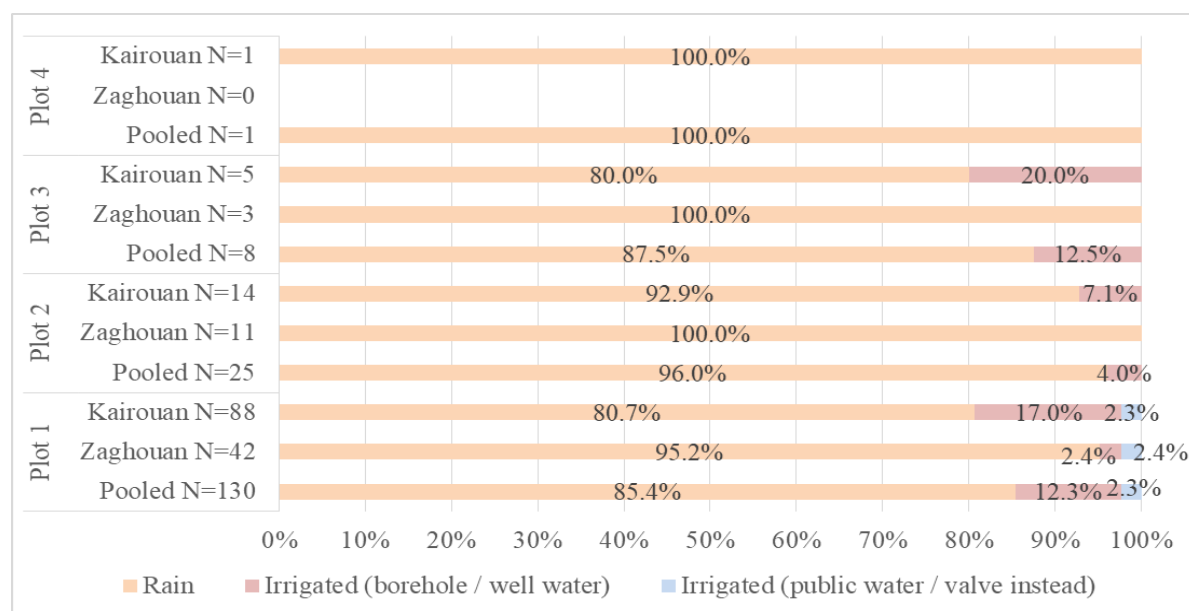


Figure 37. Irrigation of the renting plots by governorate. %

The cost of the renting plot is represented in table 13. The maximum amount is allocated to plot 3 with 13600 TND in Zaghuan, while the maximum for plot 1 is 12000 TND and 6400 TND are allocated to plot 2.

The minimum cost is allocated to plot 2 for Zaghuan with 60 TND, and for plot 1 with 80 TND for Kairouan. Plot 3 has the highest minimum cost with almost the same price: 300 TND for Zaghuan and 308 TND for Kairouan.

Table 13. Cost of the renting plots by governorate (TND)

		Min	Max	Mean	Std. Deviation
Plot 1	Pooled, N=123	80	12000	1047.5	1506.6
	Zaghuan, N=41	150	12000	933.9	1907.1
	Kairouan, N=82	80	7000	1104.3	1270.1
Plot 2	Pooled, N=24	60	6400	1044.8	1620.3
	Zaghuan, N=11	60	6400	883.6	1839.0
	Kairouan, N=13	120	5000	1181.2	1473.1
Plot 3	Pooled, N=7	300	13600	2679.7	4861.1
	Zaghuan, N=3	300	13600	4733.3	7678.8
	Kairouan, N=4	308	2000	1139.5	755.8

Concerning the access to communal pasture by governorate, Figure 38 shows that percentages are almost equal between the two governorates with 24.4% in Kairouan and 36.4% in Zaghuan having access to these lands.

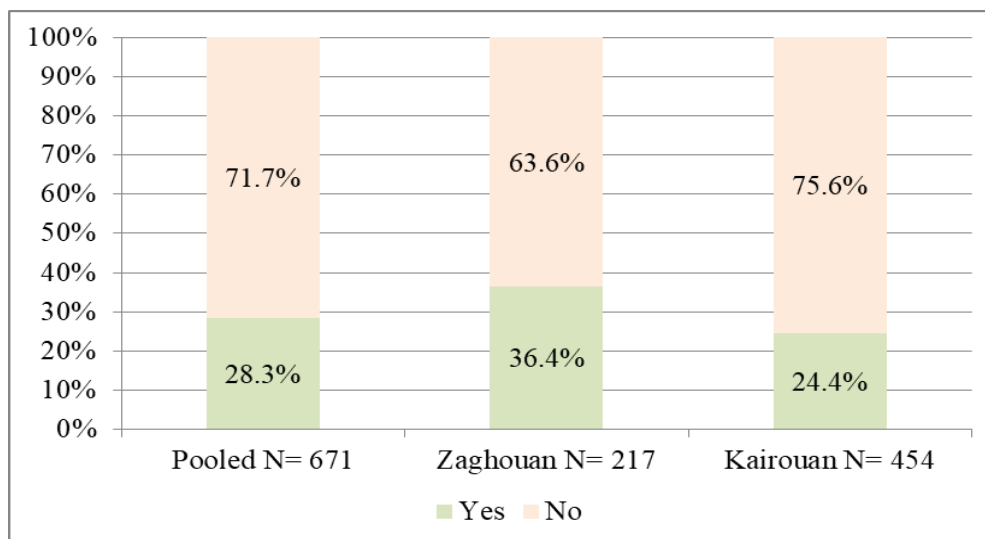


Figure 38. Access to communal pasture by governorate. %

Table 14 shows that the maximum area is 2000 Ha for both governorates and the minimum is 1 Ha for Zaghouan and 2 Ha for Kairouan.

Table 14. Communal pasture area in hectare by governorate

	Min	Max	Mean	Std. Deviation
Pooled N= 167	1	2000	645.78	723.89
Zaghouan N=100	1	2000	767.58	774.74
Kairouan N=67	2	2000	463.99	601.33

The communal pasture days represent a one year round as a maximum for both governorates (Table 15). The minimum is different between the two locations; it is one day for Zaghouan while it goes up to 30 days for Kairouan.

Table 15. Communal pasture days by governorate

	Min	Max	Mean	Std. Deviation
Pooled N= 180	1	365	244.65	128.35
Zaghouan N=104	1	365	205.13	134.21
Kairouan N=76	30	365	298.74	97.22

5.6. Module E: Crop management and input use

In this section a description of the crop management and input use will be made. It will include a description of the number of plots grown in the last 12 months, their size and irrigation, the soils fertility, the main crops and trees planted by governorate, the secondary crops, the main previous crops. It concerns also the ownership of the plots, the decision-maker of the plot production, the person doing the most of the work, the number and types of tillages, the varieties of barley seed used, the quantity of sowing, the seed price, the date of the last sowing, the total cost of seed treatment, the quantity, price and source of manure (Ton).

We also analyze the fertilization with the sources of basal fertilizers, the use, price and quantity of fertilizer in the previous 12 months, also the application, source, quantities and price of cover fertilizers.

Concerning the labor force, we analyze the workforce hired in the previous 12 months by activity, the number of working days, the labor cost per day (man), but also the use and access of machines in the previous 12 months by activity.

Concerning the number of plots grown in the last 12 months, 46.5% of HH possess 2 plots in both governorates while 26.5% have only one plot. In Zaghouan, 12.9% of HH do not have a plot and 20.3% have more than 2 plots. In Kairouan, 47.8% of HH possess 2 plots and 28.2% hold only one plot (Figure 39).

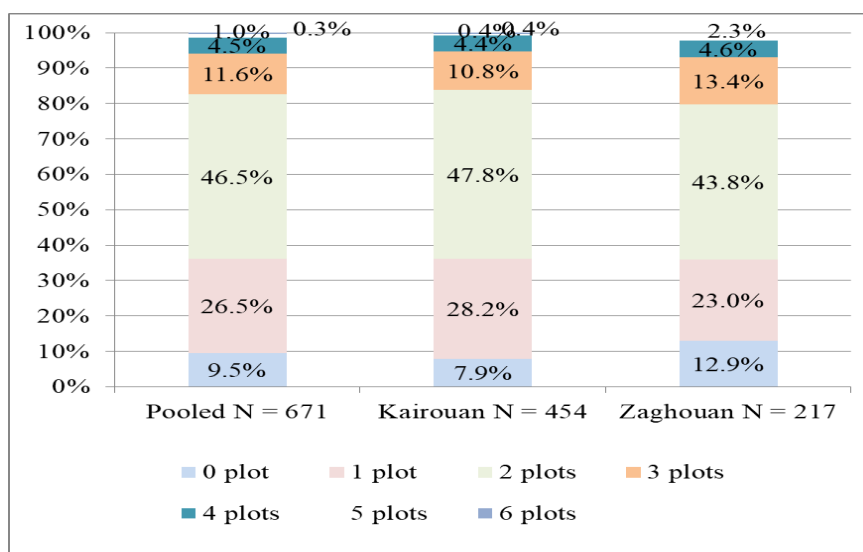


Figure 39. Number of plots grown in the last 12 months

Table 16 portrays the size of the plots by site. Farmers usually focus most of their strength and resources on Plot 1. In fact, farmers use this plot to cultivate their main crops. The average size for the total sample for the first plot is 3.1 ha. In Kairouan the average size is 3.5 ha, this size decreases to 2.21 ha in Zaghouan. The average size of Plot 2 in both governorates is 2.84 ha; it ranges from 3.22 ha in Kairouan to 2.04 ha in Zaghouan.

Plot 3 average size for the total area is 2.51 ha; it is equal to 2.96 ha in Kairouan and 1.79 ha in Zaghouan. The sum of the plot sizes drop for the other plots.

Table 16. Size of the plots

		Min	Max	Mean	Std. Deviation
Plot 1	Pooled N = 609	0.20	100	3.10	5.15
	Kairouan N = 420	0.20	100	3.50	5.97
	Zaghouan N = 189	0.25	17	2.21	2.25
Plot 2	Pooled N = 432	0.1	36	2.84	3.46
	Kairouan N = 292	0.3	36	3.22	3.83
	Zaghouan N = 140	0.1	20	2.04	2.34
Plot 3	Pooled N = 114	0.5	12	2.51	2.09
	Kairouan N = 70	0.5	12	2.96	2.31
	Zaghouan N = 44	0.5	8	1.79	1.42
Plot 4	Pooled N = 40	0.25	6	2.12	1.50
	Kairouan N = 25	0.25	6	2.25	1.41
	Zaghouan N = 15	0.50	6	1.90	1.68
Plot 5	Pooled N = 9	0.50	3	1.89	0.89
	Kairouan N = 4	2	3	2.25	0.50
	Zaghouan N = 5	0.50	3	1.60	1.08
Plot 6	Pooled N = 2	1	2	1.50	0.71
	Kairouan N = 2	1	2	1.50	0.71
	Zaghouan N = 0				

Soil fertility plays a crucial role in determining the productivity for the farmers. In the first plot and for both governorates, 76.3% of the soil has a good fertility and 21.8% is judged medium while 2% is considered poor (Figure 40). In Kairouan, 81.9% of the soil is of good fertility and 16.6% is medium while 1.4% has poor fertility. Zaghouan has only 3.2% of poor fertility soils and 63.7% of good quality and 33.2%, medium fertility. In Plot 2, the majority of the land in total area is of good fertility with 79.2% and 18.9% has good quality soils and only 1.8% is considered poor. Overall the soil quality in all the plots varies between good quality soils and medium fertility except plot 6 which is 100% of good fertility in Kairouan. Medium fertility soil increases to reach 40% of the land in Zaghouan in plot 5.

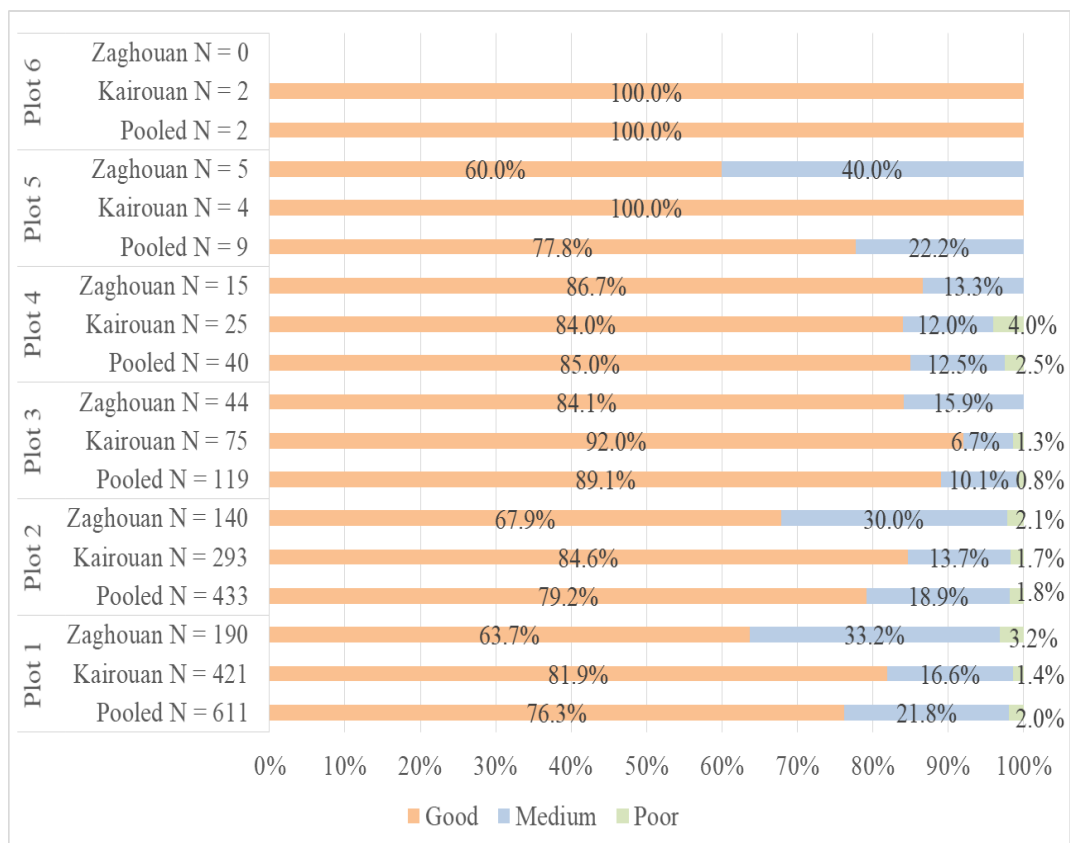


Figure 40. Soils fertility by governorate, %

The cropped area for the six plots relay mainly on rainfed except the plot 5 in Kairouan where the irrigated land (well, well water) represents 75% of the total area. Irrigated land (public water/ valve instead) ranges between 0.8% and 8.0% for the first 5 plots. Kairouan has a higher percentage of irrigated land than Zaghouan for the first 5 plots (Figure 41).

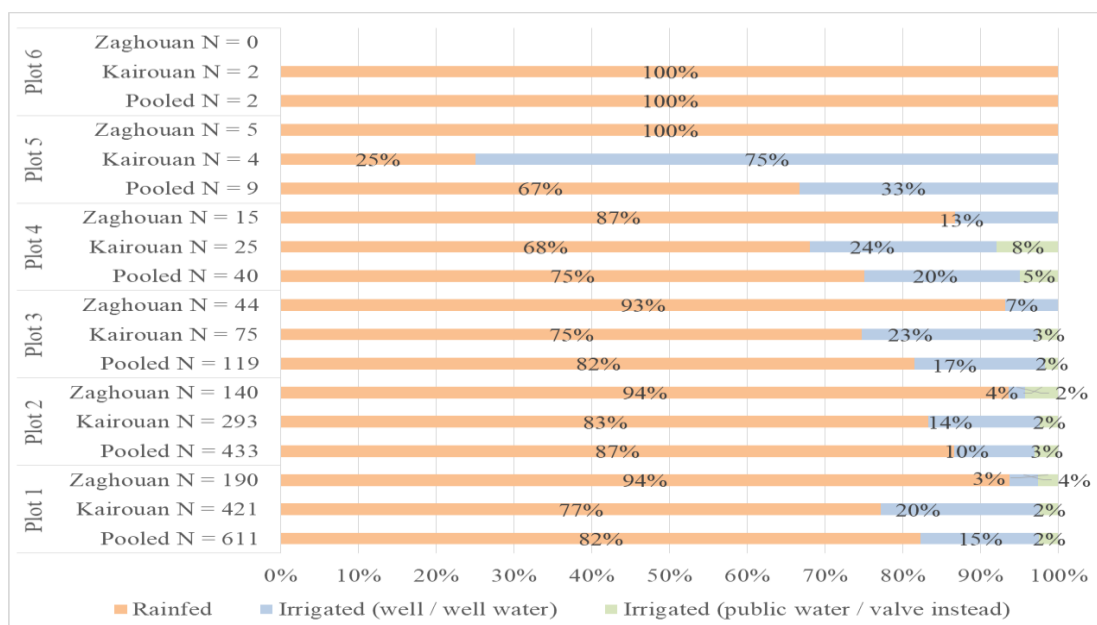


Figure 41. Plots irrigation by governorate, %

Figure 42 shows the number of crops planted by governorate. A single crop is planted for the majority of HH for the six plots (this percentage ranges between 85.7% and 100%). Nearly 11.9% of HH have 2 crops for the plot 1 in Kairouan and they are 11.1% in Zaghouan. Only 6.7% of HH have 3 crops for the plot 4 in Zaghouan.

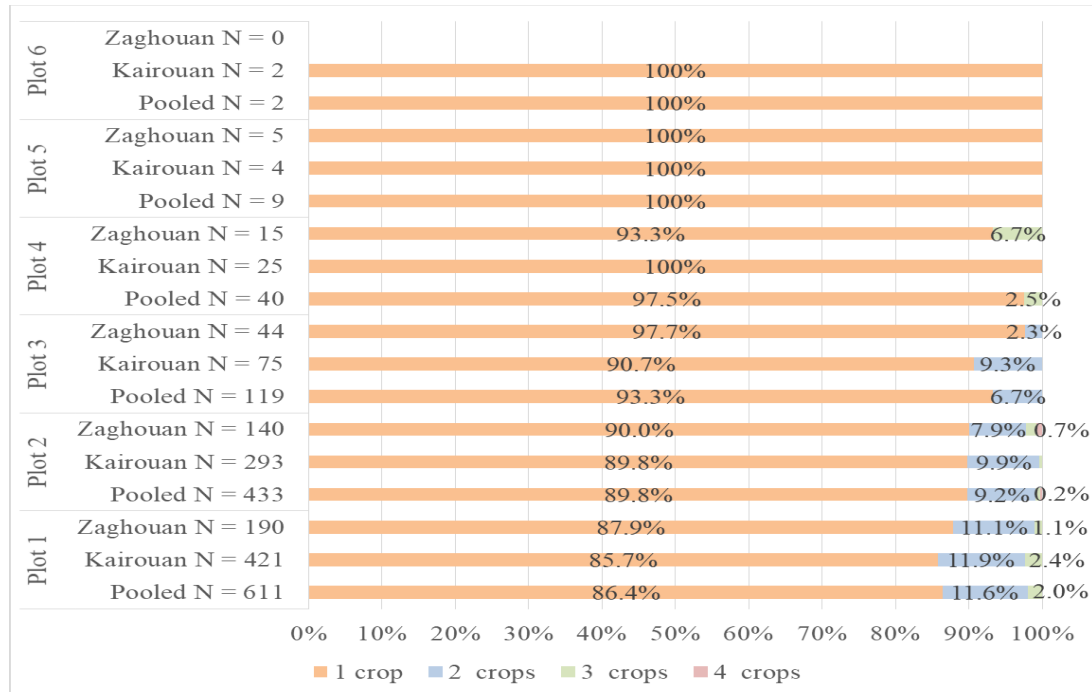


Figure 42. Number of crops planted by governorate, %

The main crops and trees planted by governorate are represented in figure 43. In the first plot, 60% of the land is cultivated in olive trees and the barley is the second most important crop for the total sample (35%). In Zaghouan 62% of the land is used to cultivate olive trees, this percentage decreases to 58% in Kairouan. The second crop in Kairouan is barley with 36% of the land use while it is 32% in Zaghouan.

In the second plot, barley holds the first place for both governorates with 62% in Kairouan and 59% in Zaghouan. Then comes the olive trees with 17% of the land use in both locations.

In plot 3, Durum wheat occupies the third position for the cultivated crops with 19% for the total sample, oat comes in the fourth place with 12%. In Kairouan, 32% of the land is used for barley, durum wheat is in the second place with 25% and 15% are used for olive trees. In Zaghouan, barley is in the first place with 39% while olive trees holds the second place with 20% of the land use.

For plot 4, barley has the first position with 23% of the land use for the whole sample, olive trees comes in second with 15%, 13% of the land is used for Faba bean and 13% is used to produce Oat. In Kairouan, 16% of the land is used for durum wheat. In Zaghouan, 33% of the total land is used to produce Fababean and 27% is used to produce oat.

For plot 5, green fodder and vegetable hold equally 25% of the total land in Kairouan while chickpea, oat, hay, durum wheat and barley hold equally 20% of the land in Zaghouan. In plot 6, 50% of the land is used to produce vegetables in Kairouan while the other 50% are used for other crops.

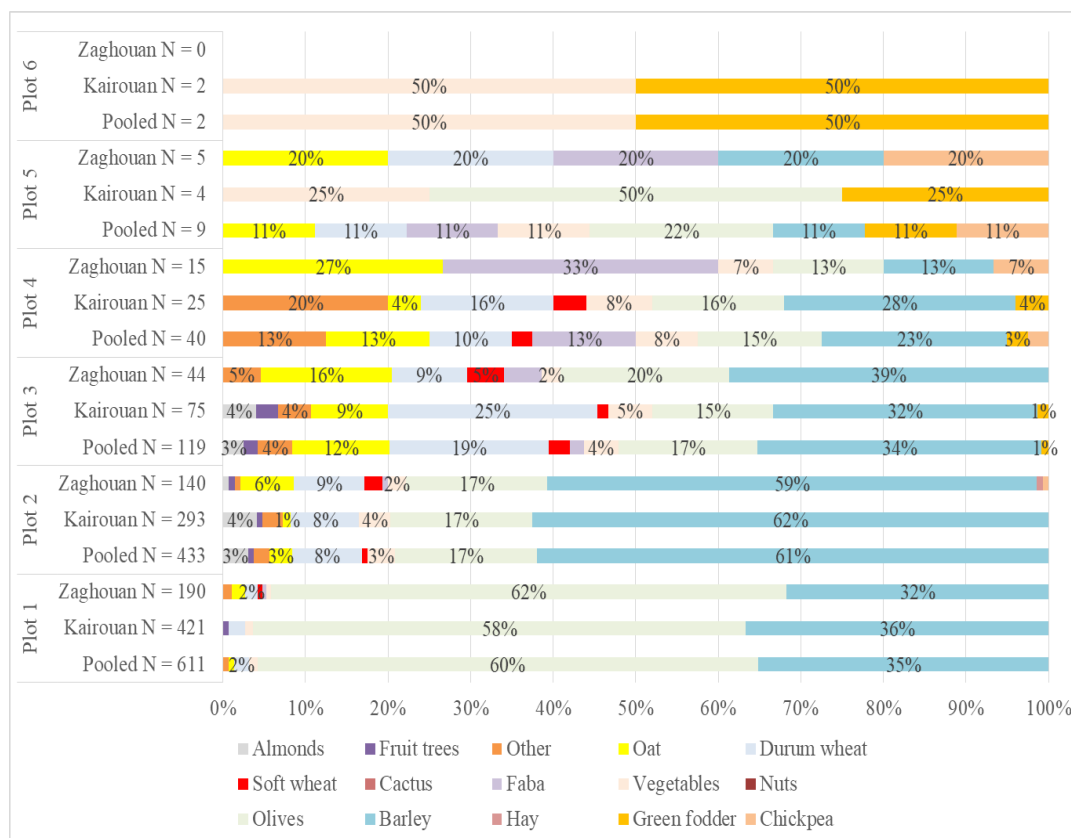


Figure 43. Main crops / Main trees planted by governorate, %

Figure 44 shows the secondary crops and trees planted by governorate. In the first plot, 46% of the land is cultivated in barley and durum wheat is the second most important secondary crop for the total sample (18%) in both governorates. In plot 2, barley occupies the first position for the cultivated secondary crops with 27% for the total sample in Kairouan while oat comes in the first place in Zaghouan with 36%. In plot 3, only barley is cultivated as secondary crops in Zaghouan while vegetables and oat hold equally 29% of the total land in Kairouan. In plot 4, only a single HH cultivates vegetable as secondary crops in Zaghouan.

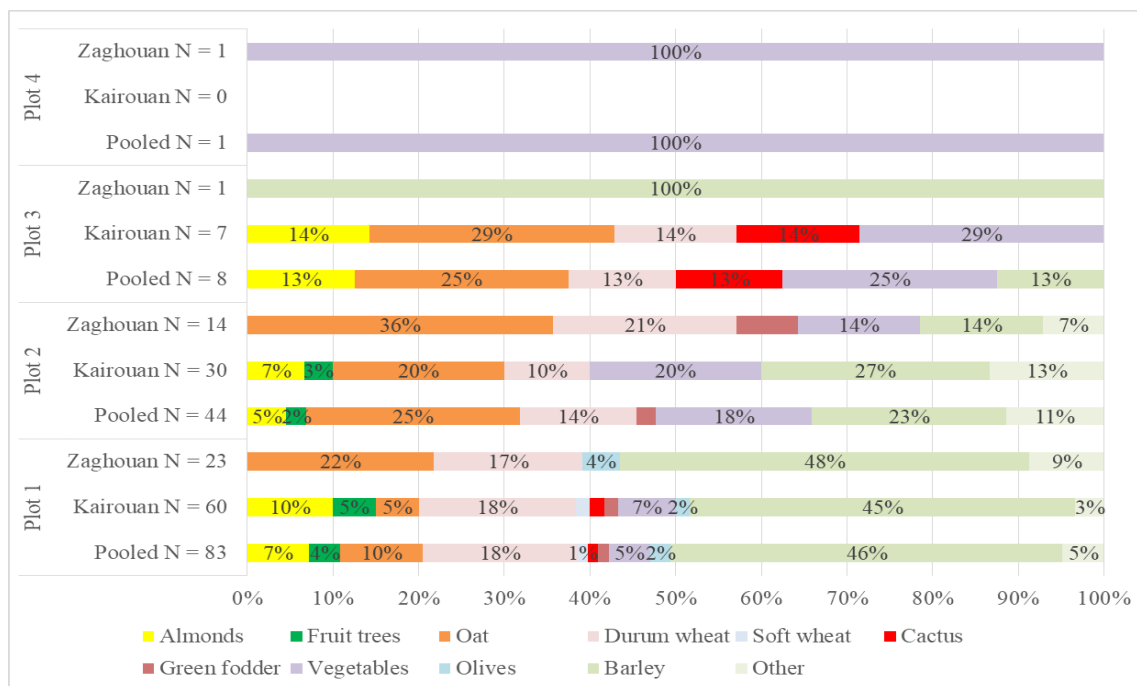


Figure 44. Secondary crops / trees planted by governorate, %

The mainstream activity in both governorates is monoculture (Figure 45). A small portion of farmers leave their land fallow for one year and uses it for grazing. The monoculture ranges between 66% and 100% of the total land while the other crops fluctuate between 1.3% and 13.3% in both governorates. The fallow/no crop during the last season ranges between 9.5% and 27.3% of the total land.

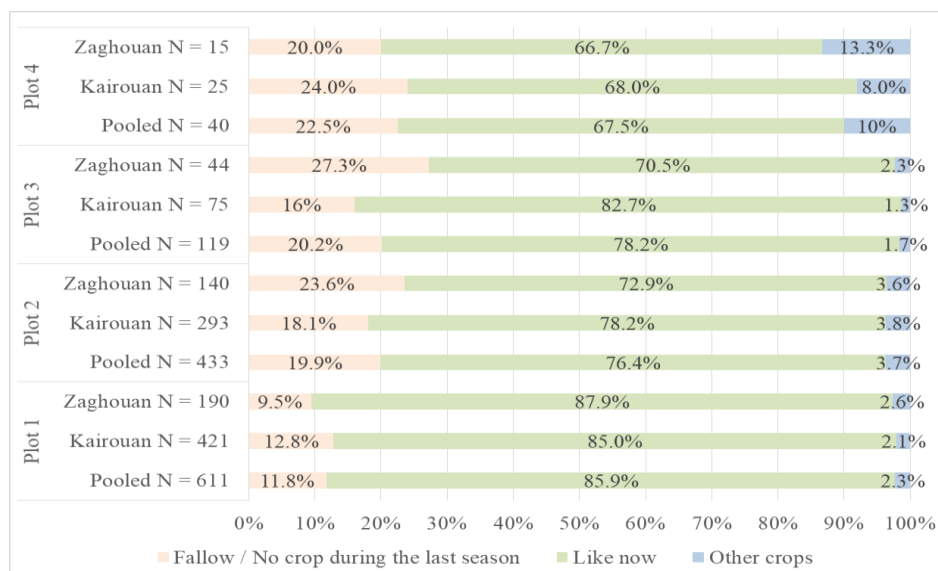


Figure 45. Previous crops by governorate, %

Figure 46 shows the main previous crops by governorate. In the first plot, barley (33.3%) and Oat (22.2%) are the main previous crops in Kairouan. In Zaghouan, olive trees is the main previous crop (40%), then come in equal percentages barley (20%), vegetables (20%) and fababean (20%).

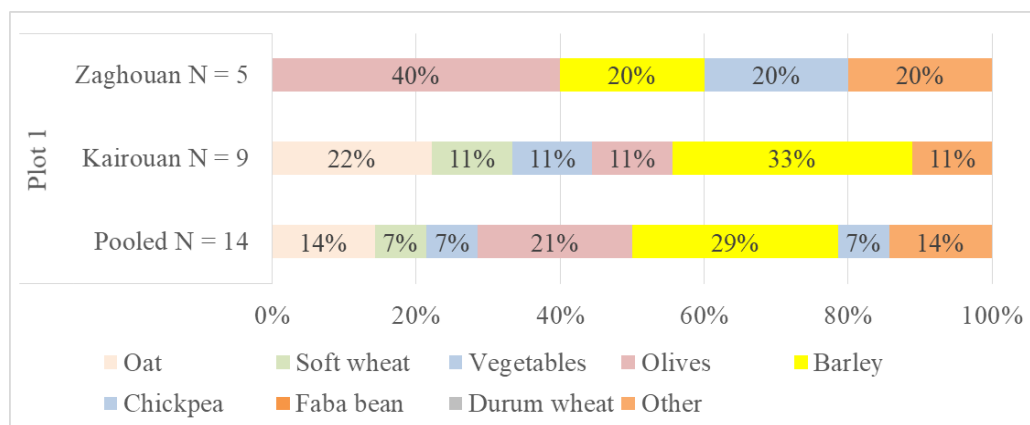


Figure 46. Main previous crops by governorate, %

Figure 47 depicts the ownership of each plot used by the farmers. It is crucial to understand the ownership of the land used in order to assess the farmers' situation. The principal owner of the land is the head of the household with a percentage higher than 75% for all the plots in both governorates. Other male household member own between 3% and 25% of the land for the 5 first plots. The spouse has a smaller percentage of land owned (between 1 and 3%). Other persons own 20% of the land for the plot 5 in Zaghouan.

100% of the plot 6 is owned by the head of the household.

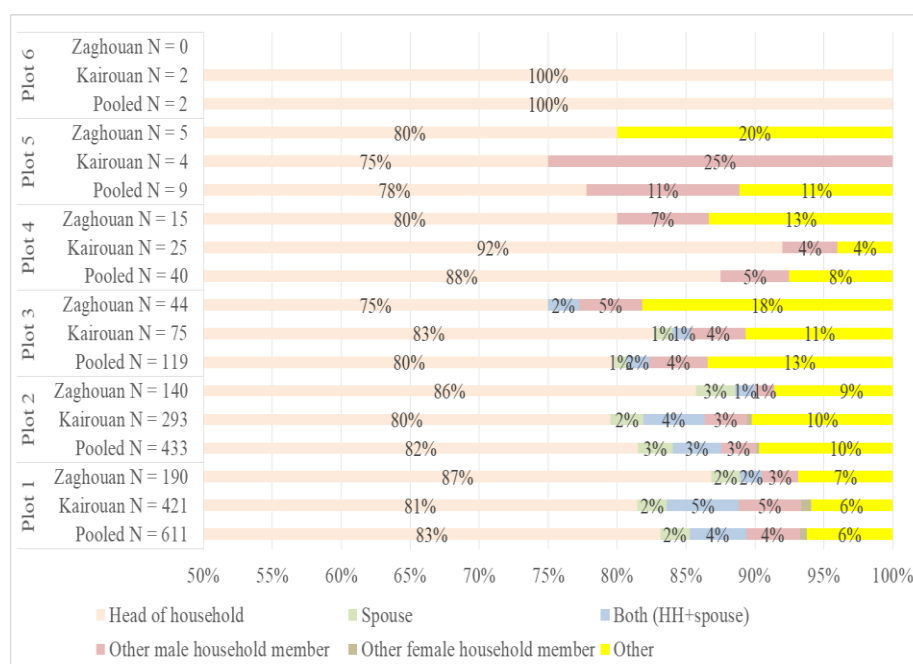


Figure 47. Ownership of the plots by governorate, %

Figure 48 describes who is the main decision-maker for the production in the plot. In all plots, the main decision maker is the head of the household with a percentage that fluctuates between 72 % and 100%. Both the HH and his spouse are the principal decision maker of the plot production for 20% of HH in plot 5 in Zaghouan while the spouse is the main decision maker for 25% of HH in plot 5 in Kairouan.

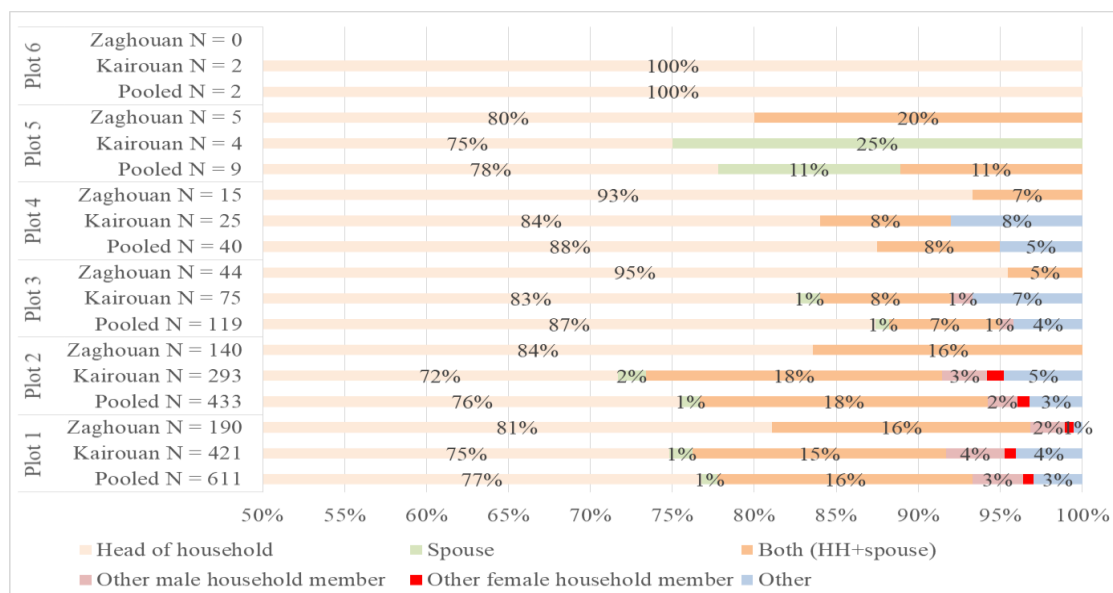


Figure 48. Decision-maker of the plot production by governorate, %

Both men and women are doing the most of the work in plot 1 (62%), plot 2 (50%), plot 4 (45%) and plot 5 (56%) while only men are doing the most of the work in plot 3 (53%) in both governorates. In plot 6, half of the work is done by men and the other half is done by both men and women. In plot 4, 16% of the work is done by women in Kairouan, while they are only 7% in Zaghouan (Figure 49).

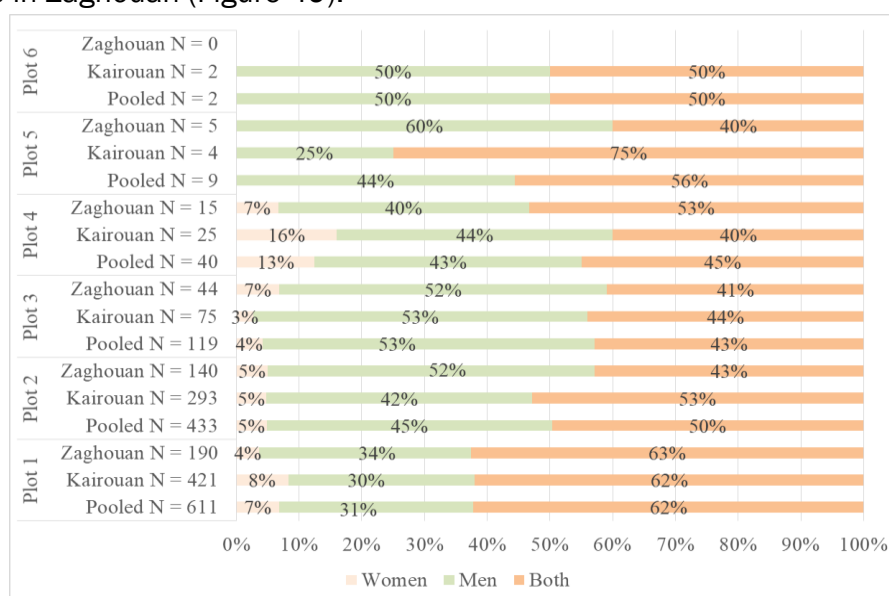


Figure 49. Person doing the most of the work, %

➤ **Barley crop**

Land preparation is a crucial step towards increasing the productivity of a crop. 76.2% of HH make two tillages in both governorates (Figure 50), 81.2% in Zaghouan and 74.3% in Kairouan. The number of tillages is 3 for 17.1% of the HH in Kairouan and 11.6% in Zaghouan. Only 8% and 5.8% of HH respectively in Kairouan and Zaghouan make a single tillage.

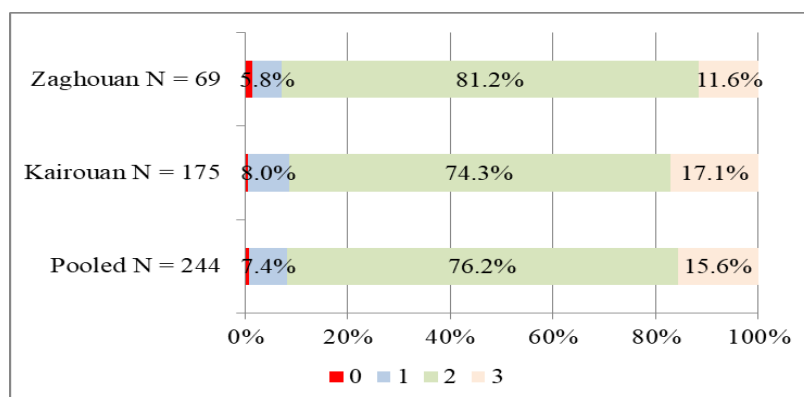


Figure 50. Number of tillages, %

42.6% of HH make a shallow tillage after the last harvest while 89.3% do a shallow tillage before sowing in both governorates (Figure 51). In addition, 85.3% of the HH in Zaghouan make a tillage directly after sowing against 67.8% in Kairouan.

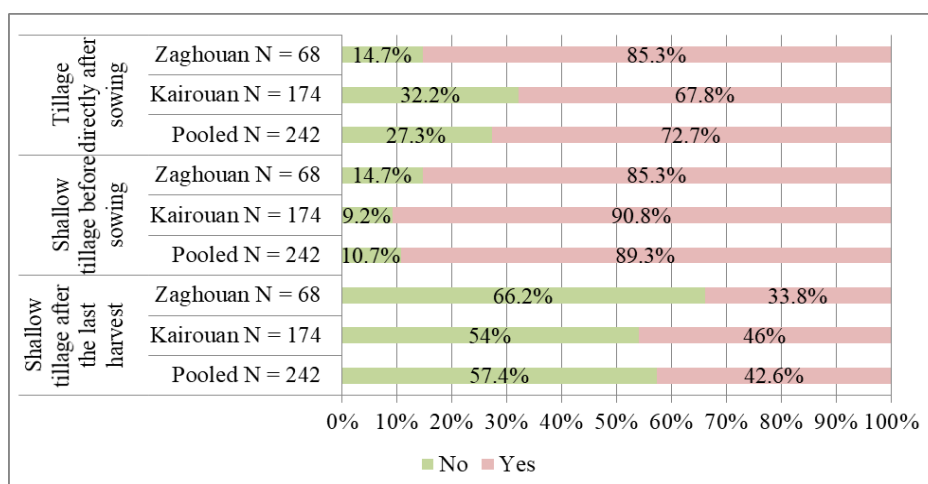


Figure 51. Types of tillage, %

Figure 52 describes the varieties of barley seed used for both governorates. The farmers of both regions generally use the local varieties (40 to 52%) known as “Arbi” or “Swihli” in the Tunisian dialect. However, Kounouz variety freshly introduced was adopted by more than 40% of the interviewed farmers. Yet, some of them tend to use other certified varieties such as “Manel” and “Rihan”, which are available on the local markets but they are not used frequently because of the high prices of the seed.

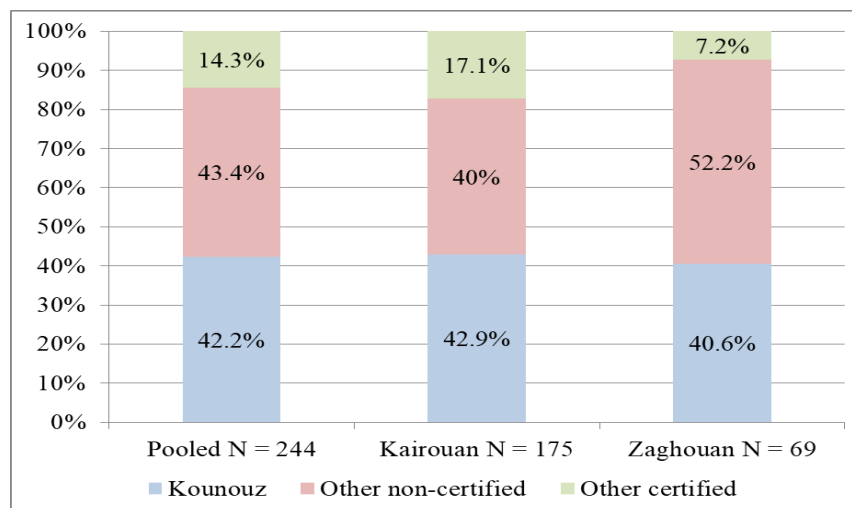


Figure 52. Varieties of barley seed used, %

In Tunisia, studies have shown that the optimum sowing rate of barley is 130 kg per hectare, but this dose may vary according to rainfalls in each area. Because of a more frequent drought, the farmers have adopted a new strategy, which consists in minimizing the sowing doses in order to maximize the germination under extreme conditions, but also to diminish the financial losses if it is another year of drought. Table 17 shows the quantity of sowing for both governorates, in Kairouan the maximum is 4300 kg while in Zaghouan this number goes down to 1700 kg.

Table 17. Quantity of sowing (total kg used on the plot1)

		Min	Max	Mean	Std. Deviation
Pooled	N = 240	1	4300	311.58	462.86
Kairouan	N = 172	1	4300	343.20	521.80
Zaghouan	N = 68	50	1700	231.62	245.44

Almost nine of ten farmers are buying their seeds from the local or regional seed markets (Figure 53). Farmers also can buy their seeds from their neighbors if the yields of these latter were better than the average for the last agricultural campaign. Other tends to produce their own seeds, in order to ensure the continuity of the local varieties, or to minimize the production costs.

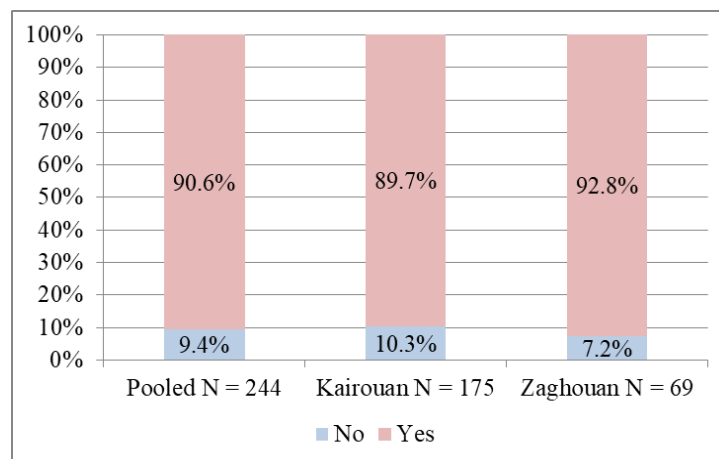


Figure 53. Purchase of seed, %

The seed prices depends essentially on its origins i.e. certified or non-certified. The average price for one kg is estimated at 73.3 TND/qx. This price is fixed by the government on the beginning of every new agricultural campaign. Some farmers choose to buy their seeds from the local or regional markets where the prices are reasonable compared to the governmental prices. But this is a risked operation since they do not know the origins of the seeds, neither its specifications; specific purity, germination rate etc.

Table 18 shows that the seed price is equal at both locations for its minimum but it is different for its maximum with 128 TND/kg in Kairouan and 60TND/kg in Zaghouan.

Table 18. Seed price (TND/Kg)

		Min	Max	Mean	Std. Deviation
Pooled	N = 218	0.40	128	7.33	18.49
Kairouan	N = 155	0.40	128	9.09	20.43
Zaghouan	N = 63	0.40	60	3.00	11.53

Generally the sowing date of barley in Tunisia begins from the second half of October until December. These dates are chosen depending on how the barely will be used: grain, greenery etc. If the farmers are aiming to use it as green fodder for their livestock they will choose an early sowing date starting from September if autumn rain is common. But if the main reason is to harvest it as grain the dates will be pushed until the second half of November.

Figure 54 shows the date of the last sowing. In Zaghouan, 89.9% of the sample did it in November while 84% in Kairouan did it in the same month. 14.3% did it in October in Kairouan while they were only 7.2% in Zaghouan.

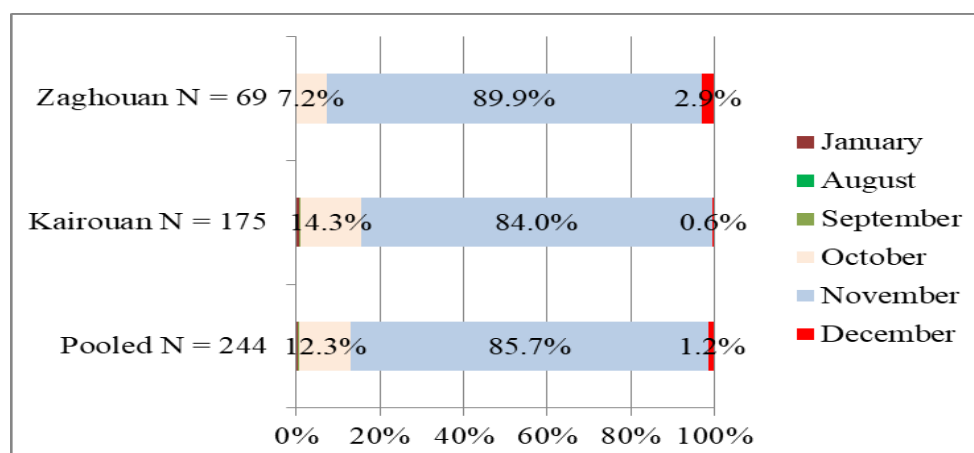


Figure 54. Date of the last sowing, %

Table 19. Sowing date, %

		First fortnight	Second fortnight
Pooled	N = 244	47.1%	52.9%
Kairouan	N = 175	53.1%	46.9%
Zaghouan	N = 69	31.9%	68.1%

Seed treatment is not well known by the small-holders in Tunisia. More than 90% of the interviewed farmers are using certified seeds which mean that they do not have to treat the seeds twice.

Figure 55 shows that 89.9% of the sample in Zaghouan has no seed treatment and this is also the same for Kairouan with 84.6%.

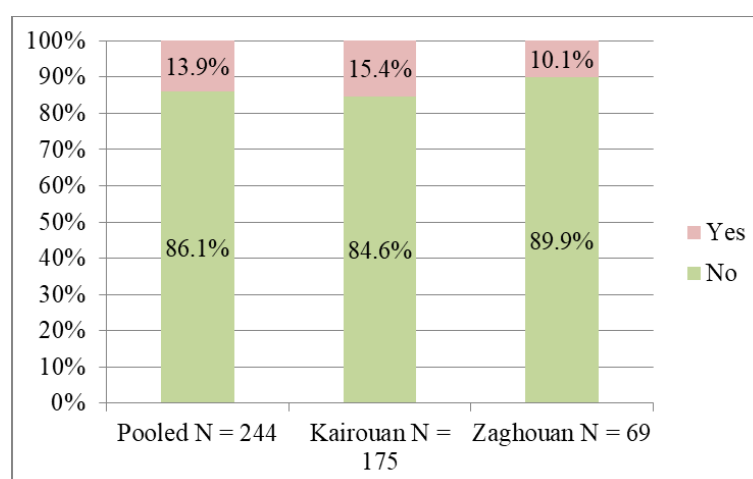


Figure 55. Seed treatment, %

The total cost of the seed treatment will be 55 TND as a maximum in Zaghouan and 50 TND in Kairouan (Table 20).

Table 20. Total cost of seed treatment (TND)

		Min	Max	Mean	Std. Deviation
Pooled	N = 3	12	55	39	23.52
Kairouan	N = 2	12	50	31	26.87
Zaghouan	N = 1	55	55	55	-

Manure application begins right before the first land preparation. Yet in some cases, farmers can apply it after the first tilling operations, especially if the autumn rains were frequent. Only one of three interviewed farmers is using this fertilization technique, the main reason is to reduce the costs of weed control operations. The second main reason is the absence of the agricultural equipment needed to perform this operation. Farmers who are using this fertilization technique are doing it manually; they bring the needed quantities then they leave it on the ground for a while under the sun's radiations. After that, they mix it to the soil during the first tilling operations.

In both governorates, they were nearly 29% to apply manure in the previous 12 months (Figure 56).

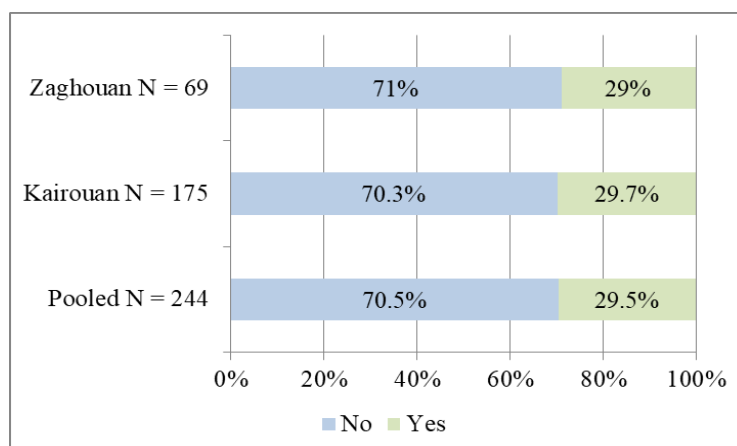


Figure 56. Manure application for the previous 12 months, %

Table 21. Manure unit, %

		Kilogram	Trailer- 1 ton	Trailer- 1.5 tons	Trailer- 2 tons	Bag - 100kg	Bag - 50kg	Ton
Pooled	N=72	1.4%	54.2%	12.5%	11.1%	13.9%	2.8%	4.2%
Kairouan	N=52	-	55.8%	13.5%	15.4%	5.8%	3.8%	5.8%
Zaghouan	N=20	5%	50%	10%		35%		

The quantity of manure used by farmers is not important, compared to the real needs of soil. They bring 5.27 Tons for a whole plot in general which is less than one ton per hectare, since the average area of plot1 was estimated to 6.2 hectares (Table 22). The used manure is usually produced on the level of the farm. Only 15.3% of farmers buy the needed quantities. The cost of one ton is estimated to 30 TND in Zaghouan and goes up to 45 TND in Kairouan, this depends on the means of transport and how far the plot is from production sites (Table 23).

The maximum for the governorate of Kairouan is 50 tons while it is only 15 tons in Zaghouan.

Table 22. Quantity of manure (Ton)

	Min	Max	Mean	Std. Deviation
Pooled N = 69	0.20	50	5.27	8.33
Kairouan N = 49	0.50	50	6.48	9.36
Zaghouan N = 20	0.20	15	2.32	3.72

Figure 57 describes the sources of manure; in Kairouan they are 82.7% to use their own production while in Zaghouan they are up to 90% to use manure from their own farms.

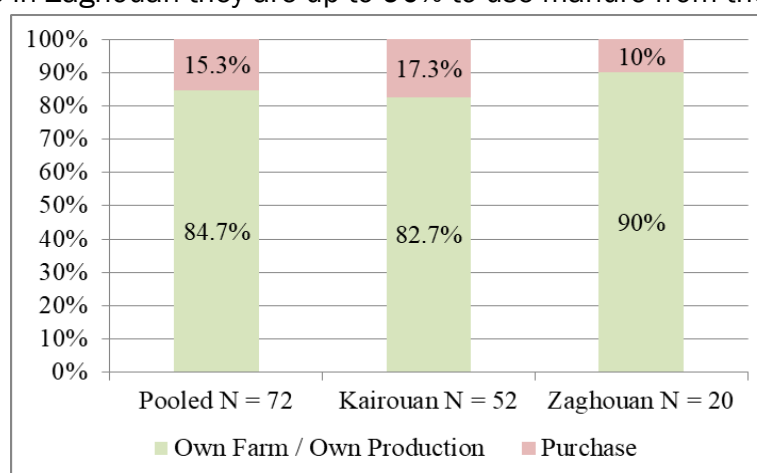


Figure 57. Sources of Manure

Table 23. Purchase price of manure (TND/Ton)

	Min	Max	Mean	Std. Deviation
Pooled N = 11	12	45	30.86	10.38
Kairouan N = 9	12	45	32.17	10.86
Zaghouan N = 2	20	30	25	7.07

Figure 58 describes the basal application of fertilizer in the last year. It is a common practice which aims to distribute uniformly the fertilizer over the entire field and mix it with the soil in order to ensure a maximum seed germination. Most farmers are not using this method; only 8.2% are practicing this technique for the whole sample. Percentages are different according to the location; they are 5.7% in Kairouan to use this technique while they are 14.5% in Zaghouan.

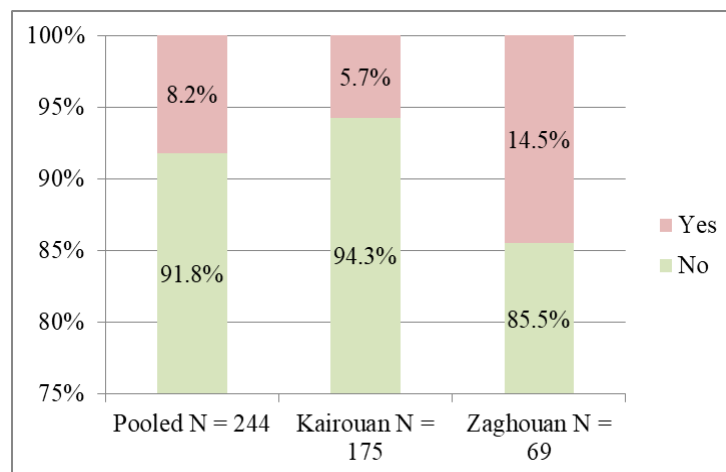


Figure 58. Fertilization: basal application in the last 12 months, %

The main sources of the basal fertilizers are various; farmers can buy them from public companies or from the private ones, near the “Douar” meaning the local markets or they could have providers outside the regional markets i.e. commercial agents.

The new trend is to buy the maximum inputs from Farmer’s cooperatives where the prices are affordable and the quality guaranteed. But the numbers of such organizations is still limited.

In Zaghouan, 70% of the household buy from a commodity trader outside the douar and 10% buy from farmers cooperatives or group (Figure 59).

In Kairouan, there are more sources with 30% from state-owned seed companies, 20% from private seed companies, 20% from shopkeepers at the souk, 20% from commodity trader outside the douar and 10% from seed producers.

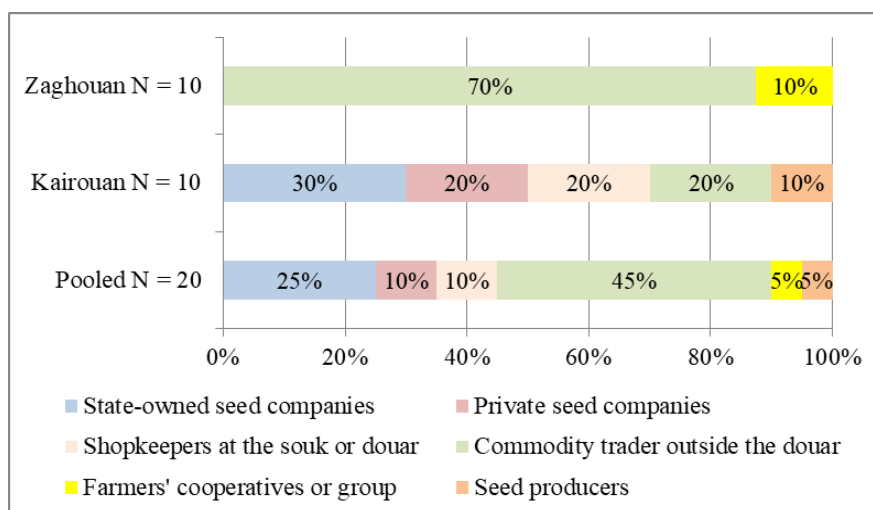


Figure 59. Sources of basal fertilizers, %

Farmers are using only two types of basal fertilizers: “DAP” and the “Super Phosphate 45” rich in phosphorus. In Zaghouan, households use 100% of DAP, while in Kairouan they are 60% to use “super phosphate” and 90% to use DAP in the last 12 months (Figure 60).

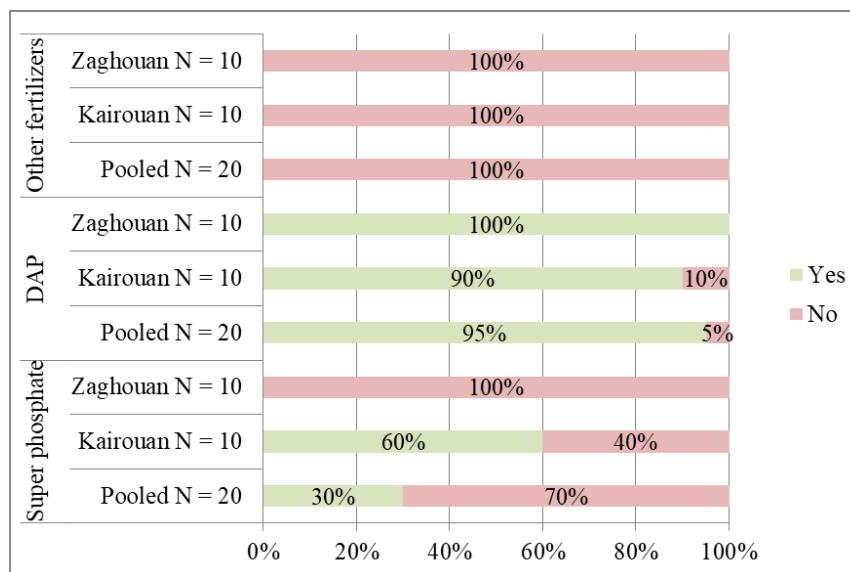


Figure 60. Fertilizer use in the last 12 months

Farmers use generally the Super phosphate before sowing, while DAP is used during sowing operations. The quantities used depend on the frequency of rainfall during the autumn.

Usually, farmers distribute 50 to 100 kg per hectare for both types of fertilizers. In the table 24, the average quantity was calculated per plot and not per hectare. The prices of these two fertilizers are fixed by the government, yet some farmers are purchasing them from the informal market.

Table 24. Quantities of basal fertilizer (Kg)

			Min	Max	Mean	Std. Deviation
Super phosphate	Pooled	N = 6	100	1000	266.67	360.09
	Kairouan	N = 6	100	1000	266.67	360.09
	Zaghouan	N = 0				
DAP	Pooled	N = 19	50	1000	234.74	245.89
	Kairouan	N = 9	50	1000	330	325.73
	Zaghouan	N = 10	50	300	149	96.78

DAP has a higher price with a maximum of 1.05 TND/kg for both locations (Table 25). Super phosphate is at minimum 0.38 TND/kg in Kairouan and a maximum of 0.68 TND/kg.

Table 25. Cost of basal fertilizer (TND/kg)

		Min	Max	Mean	Std. Deviation
Super phosphate	Pooled N = 6	0.38	0.68	0.51	0.15
	Kairouan N = 6	0.38	0.68	0.51	0.15
	Zaghouan N = 0				
DAP	Pooled N = 19	0.30	1.05	0.62	0.22
	Kairouan N = 9	0.30	1.00	0.61	0.28
	Zaghouan N = 10	0.48	1.05	0.63	0.16

The majority of farmers do not use top dressing fertilizers; only 5.3% are still using this technique for both locations. The main reason is that the farmers estimate that using the basal fertilizers is enough to guarantee a better yields.

In Kairouan, only 4.6% use this technique while they are 7.2% in Zaghouan (Figure 61).

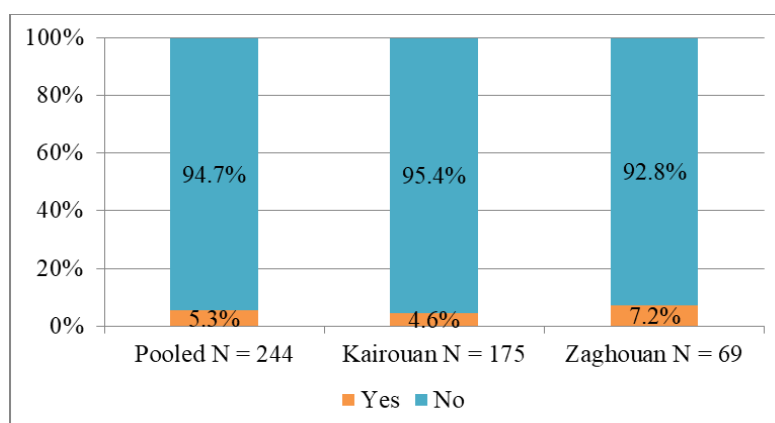


Figure 61. Application of cover fertilizers in the last 12 months, %

Input suppliers for the top dressing fertilizers are the same as for the seeds; governmental or private companies. But in this case, the farmers are buying the needed inputs from outside their communities in order to avoid the informal markets (Figure 62).

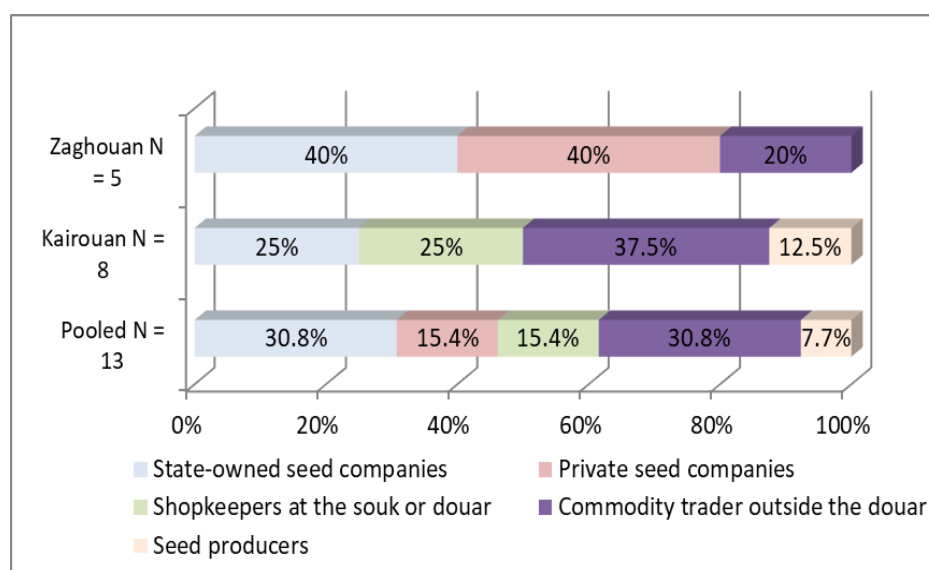


Figure 62. Sources of cover fertilizers, %

The only used top dressing fertilizer is “Ammonitrate”, which is a synthetic fertilizer rich in Nitrogen, because it is the only type available on the national market, also well known by all farmers in Tunisia (Figure 63).

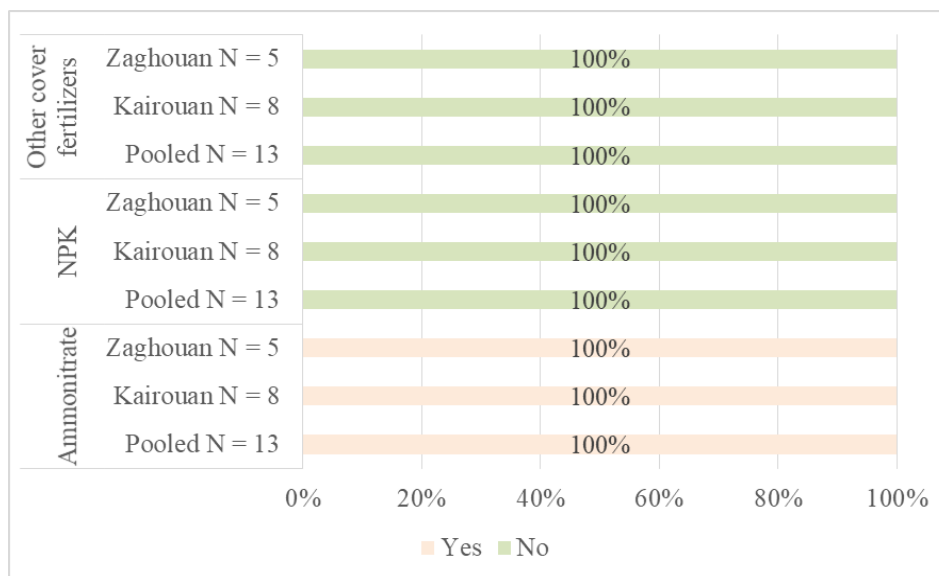


Figure 63. Cover fertilizers used in the last 12 months

“Ammonitrate” is used during winter season to intensify the vegetative activity. Farmers use this type of fertilizers to regenerate the barley uses as green fodder for the livestock during winter and spring. The quantities used per hectare vary from 50 to 100 kg.

Normally, the price of 100 kg of Ammonitrate is fixed and controlled by the government, but the informal market gets its share making 100 kg cost 90 TND instead of 38 TND.

Generally, the use of Ammonitrate is divided in two or three applications depending on the frequency of rainfall and the crop status. Almost 85% of the interviewed farmers are top dressing the barley in a unique operation, while 7.7% of them are doing it in two or more than two applications (Figure 64).

Table 26. Quantities of Cover fertilizer (Kg)

		Min	Max	Mean	Std. Deviation
Ammonitrate	Pooled N = 13	50	840	310.77	236.31
	Kairouan N = 8	100	840	348.75	247.87
	Zaghouan N = 5	50	500	250	229.13

Table 27. Cost of cover fertilizer (TND/kg)

		Min	Max	Mean	Std. Deviation
Ammonitrate	Pooled N = 13	0.20	0.90	0.52	0.22
	Kairouan N = 8	0.20	0.64	0.44	0.17
	Zaghouan N = 5	0.35	0.90	0.64	0.25

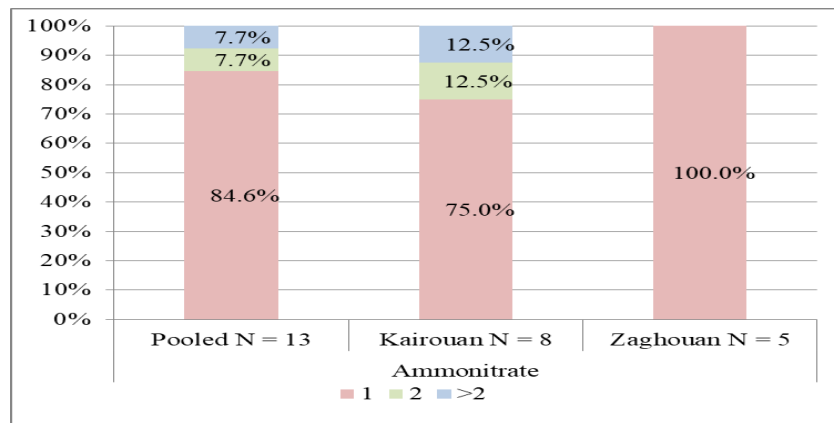


Figure 64. Number of applications of cover fertilizers in the last 12 months

Like the fertilization, small-holders of both targeted areas are not practicing chemical weed control. Only 1.2% of them are doing so (Table 28). This is mainly due to the high costs generated by such operation. The average cost of one liter of herbicide was estimated to 52 TND and 56 TND for one kg. To apply the herbicides, farmers must rent a tractor alongside all the required equipments for such operations, which will make the cost even higher.

Table 28. Herbicides applications in the last 12 months

		Pooled N = 244	Kairouan N = 175	Zaghouan N = 69
Application of herbicides	Yes	1.2%	1.1%	1.4%
	No	98.8%	98.9%	98.6%
Number of herbicide applications, %		Pooled N = 3	Kairouan N = 2	Zaghouan N = 1
	1	66.67%	100%	
	2	33.33%		100%
Herbicide unit, %		Pooled N = 3	Kairouan N = 2	Zaghouan N = 1
	Liters	33.33%		100%
	Kg	66.67%	100%	
Quantities of herbicides used (Kg)		Pooled N = 2	Kairouan N = 2	Zaghouan N = 0
	Min	3	3	
	Max	150	150	
	Mean	76.50	76.50	
	Std. Deviation	103.94	103.94	
Quantities of herbicides used (Liter)		Pooled N = 1	Kairouan N = 0	Zaghouan N = 1
	Min	2		2
	Max	2		2
Cost of herbicides used (Kg)		Pooled N = 2	Kairouan N = 2	Zaghouan N = 0
	Min	52	52	
	Max	60	60	
	Mean	56	56	
	Std. Deviation	5.66	5.66	
Cost of herbicides used (Liter)		Pooled N = 1	Kairouan N = 0	Zaghouan N = 1
	Min	52		52
	Max	52		52

Hiring workforce is a rare practice especially for small-holders. They use essentially family members as active workforce during any farming activities. Barley cropping is no exception for this, farmers tend to hire workforce only during sowing activities. All the remaining activities are generally done by the family members: the household head, the spouse and the elder son/daughter (Figure 65).

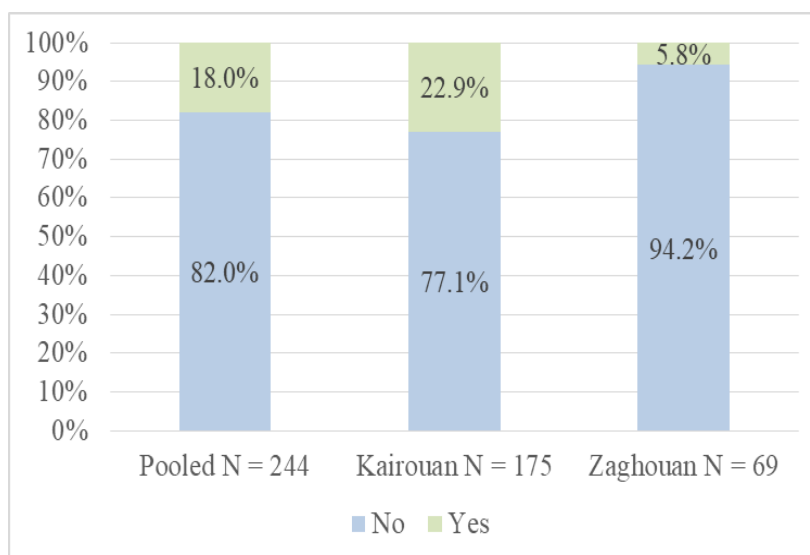


Figure 65. Hiring the workforce in the last 12 months, %

Table 29. Hiring the workforce by activity in the last 12 months, %

		No	Yes
Tillage	Pooled N = 44	65.9%	34.1%
	Kairouan N = 40	62.5%	37.5%
	Zaghouan N = 4	100%	
Sowing	Pooled N = 44	45.5%	54.5%
	Kairouan N = 40	47.5%	52.5%
	Zaghouan N = 4	25%	75%
Fertilize	Pooled N = 23	82.6%	17.4%
	Kairouan N = 20	80%	20%
	Zaghouan N = 3	100%	
Pesticides	Pooled N = 2	50%	50%
	Kairouan N = 2	50%	50%
	Zaghouan N = 0		
Harvest	Pooled N = 44	65.9%	34.1%
	Kairouan N = 40	62.5%	37.5%
	Zaghouan N = 4	100%	
Selling	Pooled N = 44	100%	
	Kairouan N = 40	100%	
	Zaghouan N = 4	100%	
Other	Pooled N = 44	95.5%	4.5%

	Kairouan N = 40	95%	5%
	Zaghouan N = 4	100%	

The number of working days by activity depends essentially on the average area of the plot, and how often the machines are used in each action. For example, to fertilize the plot, 14 working days are needed, while tillage needs 6 days because it is 100% mechanical, the same for harvesting (Table 30).

Table 30. Number of working days

		Min	Max	Mean	Std. Deviation
Tillage	Pooled N = 15	1	49	6.07	12.35
	Kairouan N = 15	1	49	6.07	12.35
	Zaghouan N = 0				
Sowing	Pooled N = 24	1	40	3.71	7.84
	Kairouan N = 21	1	40	3.86	8.38
	Zaghouan N = 3	1	4	2.67	1.53
Fertilize	Pooled N = 4	3	45	14.50	20.37
	Kairouan N = 4	3	45	14.50	20.37
	Zaghouan N = 0				
Pesticides	Pooled N = 1	1	1	1.00	
	Kairouan N = 1	1	1	1.00	
	Zaghouan N = 0				
Harvest	Pooled N = 15	1	45	6.53	11.65
	Kairouan N = 15	1	45	6.53	11.65
	Zaghouan N = 0				
Other	Pooled N = 2	6	15	10.50	6.36
	Kairouan N = 2	6	15	10.50	6.36
	Zaghouan N = 0				

Table 31. Labor cost per day (man)

		Min	Max	Mean	Std. Deviation
Tillage	Pooled N = 10	8	60	26.80	13.26
	Kairouan N = 10	8	60	26.80	13.26
	Zaghouan N = 0				
Sowing	Pooled N = 24	20	45	24.58	6.2
	Kairouan N = 21	20	45	24.76	6.6
	Zaghouan N = 3	20	25	23.33	2.9
Fertilize	Pooled N = 4	20	30	23.75	4.8
	Kairouan N = 4	20	30	23.75	4.8

Pesticides	Zaghouan N = 0				
	Pooled N = 1	40	40	40	
	Kairouan N = 1	40	40	40	
Harvest	Zaghouan N = 0				
	Pooled N = 15	15	300	53.33	80.83
	Kairouan N = 15	15	300	53.33	80.83
Other	Zaghouan N = 0				
	Pooled N = 2	25	25	25	
	Kairouan N = 2	25	25	25	
	Zaghouan N = 0				

Cereal crops in general benefit from a very high rate of mechanization in each activity, almost all the intervention are mechanized from land preparation until harvesting, and barley cropping is no exception. Only 10% of the activities are done manually, mainly sowing and top dressing activities especially for small areas (Figure 66).

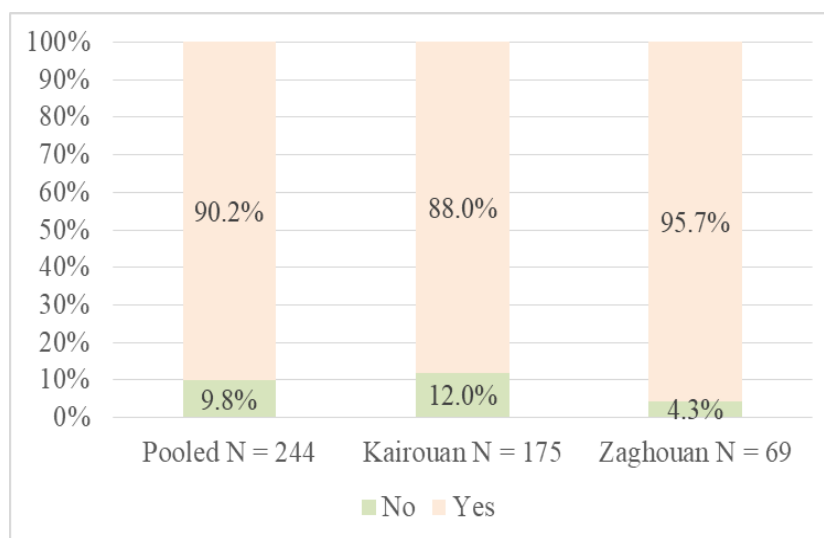


Figure 66. Use of machines in the last 12 months, %

Table 32. Use of machines by activity in the last 12 months

		No	Yes
Tillage	Pooled N = 220	0.5%	99.5%
	Kairouan N = 154	0.6%	99.4%
	Zaghouan N = 66		100%
Sowing	Pooled N = 220	82.3%	17.7%
	Kairouan N = 154	79.2%	20.8%
	Zaghouan N = 66	89.4%	10.6%
Fertilize	Pooled N = 13	100%	

	Kairouan N = 8	100%	
	Zaghouan N = 5	100%	
	Pooled N = 220	83.2%	16.8%
Harvest	Kairouan N = 154	77.9%	22.1%
	Zaghouan N = 66	95.5%	4.5%
	Pooled N = 71	87.3%	12.7%
Dung	Kairouan N = 51	84.3%	15.7%
	Zaghouan N = 20	95%	5%
	Pooled N = 220	99.5%	0.5%
Other	Kairouan N = 154	100%	
	Zaghouan N = 66	98.5%	1.5%

The availability of some machines during the crucial operation such as sowing, weed control and harvesting is a major constraint for farmers because it can diminish the yields. Almost all the interviewed farmers are renting all types of equipments during the season (Table 33).

Table 33. Access to machine in the last 12 months

		Own machine	Rented machine
	Pooled N = 219	1.4%	98.6%
Tillage	Kairouan N = 153	2%	98%
	Zaghouan N = 66		100%
	Pooled N = 39		100%
Sowing	Kairouan N = 32		100%
	Zaghouan N = 7		100%
	Pooled N = 37	2.7%	97%
Harvest	Kairouan N = 34	2.9%	97%
	Zaghouan N = 3		100%
	Pooled N = 9		100%
Manure	Kairouan N = 8		100%
	Zaghouan N = 1		100%
	Pooled N = 1		100%
Other	Kairouan N = 0		
	Zaghouan N = 1		100%

The cost per hour of the rented machines is generally fixed by the owner of these latter; it is fixed from the beginning of the agricultural campaign. But the prices could increase during the season because of the increase of fuel or the work force (machine operator i.e. drivers).

Generally, all the prices are the same in the two targeted areas, the average price of one hour of tillage is 25 TND but this price depends essentially on the type of equipment used;

for example moldboard has a higher cost than the disc (off-set). In the case of sowing, farmers can use two types of machines; the conventional sowing machine or the fertilizing machine which costs less. The combine harvester is used by almost all the farmers except those who are harvesting manually their crops. One hour costs in average 87 TND, the maximum recorded is 120 TND per hour in Kairouan (Table 34).

Table 34. Cost per hour of the rented machine in the last 12 months

		Min	Max	Mean	Std. Deviation
Tillage	Pooled N = 200	12.5	60	25.44	6.36
	Kairouan N = 134	12.5	60	25.67	7.36
	Zaghouan N = 66	20	35	24.97	3.56
Sowing	Pooled N = 34	10	60	25.49	9.65
	Kairouan N = 27	10	60	25.24	10.24
	Zaghouan N = 7	15	40	26.43	7.48
Harvest	Pooled N = 29	65	120	87.59	10.57
	Kairouan N = 26	65	120	86.73	10.76
	Zaghouan N = 3	90	100	95	5.00
Manure	Pooled N = 9	15	25	21.44	4.48
	Kairouan N = 8	15	25	21	4.57
	Zaghouan N = 1	25	25	25	
Other	Pooled N = 1	30	30	30	
	Kairouan N = 0				
	Zaghouan N = 1	30	30	30	

The number of rental hours for any type of equipments depends essentially on the planted areas. Normally, the tillage of one hectare does not need more than one hour if we are using a light plow. Two to three hours are needed in the case of a deep tillage operation. The farmers in both regions are renting plowing equipments from 5 to 10 hours respectively in Zaghouan and Kairouan.

Concerning the sowing operations, the number of rental hours depends also on the type of equipment used: a seeder or a fertilizing machine. This latter does not need more than fifteen minutes to sow a hectare, while a seeder takes 30 to 45 minutes to complete this task.

A combine harvester is rented for 18 hours in average. But to harvest one hectare this machine needs from 30 to 60 minutes depending on the yields. During the drought season, these machines are rented by hectare and not by hour because the yields are very low which makes the operation unprofitable for the machine's owner (Table 35).

Table 35. Number of hours of rented machine in the last 12 months

		Min	Max	Mean	Std. Deviation
Tillage	Pooled N = 202	1.25	175	8.52	14.47
	Kairouan N = 138	1.25	175	10	17.07
	Zaghouan N = 64	1.50	32	5.31	4.35

Sowing	Pooled N = 29	1.50	38	6.53	8.37
	Kairouan N = 23	1.50	38	6.33	8.43
	Zaghouan N = 6	2.00	25	7.33	8.85
Harvest	Pooled N = 30	1.50	160	18.65	37.65
	Kairouan N = 27	1.50	160	20.39	39.37
	Zaghouan N = 3	2	4	3	1
Manure	Pooled N = 9	1	12	3.11	3.5
	Kairouan N = 8	1	12	3.38	3.6
	Zaghouan N = 1	1	1	1	
Other	Pooled N = 1	1	1	1	
	Kairouan N = 0				
	Zaghouan N = 1	1	1	1	

The use of animals during some operations still exists in Tunisia, but it is increasingly rare. Animals are commonly used to plow the land, especially in mountainous areas difficult to access; 66.7% of the farmers are still using animal traction to plow their lands (Table 36).

Table 36. Use of animals in the last 12 months

		No	Yes
Use of animals	Pooled N = 244	96.3%	3.7%
	Kairouan N = 175	97.1%	2.9%
	Zaghouan N = 69	94.2%	5.8%
Tillage	Pooled N = 9	33.3%	66.7%
	Kairouan N = 5	20.0%	80.0%
	Zaghouan N = 4	50.0%	50.0%
Sowing	Pooled N = 9	66.7%	33.3%
	Kairouan N = 5	80.0%	20.0%
	Zaghouan N = 4	50.0%	50.0%
Fertilize	Pooled N = 1	100.0%	
	Kairouan N = 0		
	Zaghouan N = 1	100.0%	
Harvest	Pooled N = 9	88.9%	11.1%
	Kairouan N = 5	80.0%	20.0%
	Zaghouan N = 4	100.0%	
Manure	Pooled N = 4		100.0%
	Kairouan N = 1		100.0%
	Zaghouan N = 3		100.0%
Other	Pooled N = 9	77.8%	22.2%
	Kairouan N = 5	80.0%	20.0%
	Zaghouan N = 4	75.0%	25.0%

The average total production for the past agricultural campaign was estimated by the interviewed farmers. Concerning barley it is 1902 kg in Kairouan and 1881 kg in Zaghouan. Straw production was estimated at 125 bales in Kairouan and 257 in Zaghouan (Table 37).

Table 37. Total production in the last 12 months

		Min	Max	Mean	Std. Deviation
Kilogram	Pooled N = 299	100	19600	1894.72	2509.38
	Kairouan N = 193	100	14000	1902.12	2419.29
	Zaghouan N = 106	100	19600	1881.23	2677.42
Bales	Pooled N = 6	18	1000	235.5	380.97
	Kairouan N = 1	125	125	125	
	Zaghouan N = 5	18	1000	257.6	421.61

Barley is a doubly consumed cereal; it can be used for both animal and human consumption. Usually, farmers transform barley grain into other traditional production such as “Mermez”, “Bsissa”, “Kouskous” or some types of traditional bread. But the majority of the production is used for the livestock consumption. Some farmers stock a small quantity in order to be used as seeds for the next seasons. Table 38 specifies the exact utilization of barley grain during the past twelve months which means that the remaining stock of the past years is added to the production of the past campaign.

Table 38. Utilization of grain (Kg) in the last 12 months

		Min	Max	Mean	Std. Deviation
Household consumption for livestock	Pooled N = 20	100	10000	2072.40	2658.76
	Kairouan N = 17	100	10000	2344.00	2804.28
	Zaghouan N = 3	300	800	533.33	251.66
Consumption for the household	Pooled N = 274	14	3920	552.960	575.64
	Kairouan N = 178	14	2800	517.618	534.13
	Zaghouan N = 96	25.0	3920	618.490	643.44
Stored as seeds	Pooled N = 18	25	10000	1539.28	2735.92
	Kairouan N = 12	100	10000	2211.00	3173.79
	Zaghouan N = 6	25	500	195.83	201.50
Gifts, paid as wages	Pooled N = 74	20	840	250.80	214.29
	Kairouan N = 42	20	840	271.88	241.50
	Zaghouan N = 32	30	700	223.13	172.05
Quantity sold as seed	Pooled N = 12	100	7000	2644.17	2588.74
	Kairouan N = 6	100	7000	3563.33	2769.85
	Zaghouan N = 6	250	6000	1725.00	2245.83
Quantity sold as a product for consumption	Pooled N = 138	28	14000	2107.74	2599.35
	Kairouan N = 87	28	13860	2043.43	2536.41
	Zaghouan N = 51	100	14000	2217.45	2725.47

Some farmers can sell some of their production as seeds for other farmers, especially if they had better yields than their neighbors, which make their seeds better than the

average. The second criterion is the origin of the seed: certified or non-certified. The average price of one kg is 0.95 TND, the lowest recorded price for one kg is 0.5 TND (Table 39).

Table 39. Seed prices (TND/Kg)

		Min	Max	Mean	Std. Deviation
Price received as seed (TND/Kg)	Pooled N = 11	0.50	1.50	0.95	0.43
	Kairouan N = 5	0.52	1.30	0.87	0.36
	Zaghouan N = 6	0.50	1.50	1.01	0.50

The most used selling method by farmers is selling their production at the farm's gate; almost 67% of the interviewed farmers adopted this marketing strategy (Figure 67). While 11.1% are selling their products (barley grain in this case) in the village market. Some others are selling their production directly to the cereal collection centers near their villages; those centers could be owned by the government or private investors. Almost 12% are selling the barley grains to retailers so they do not have to go directly to the collection centers, especially if they are too far from them.

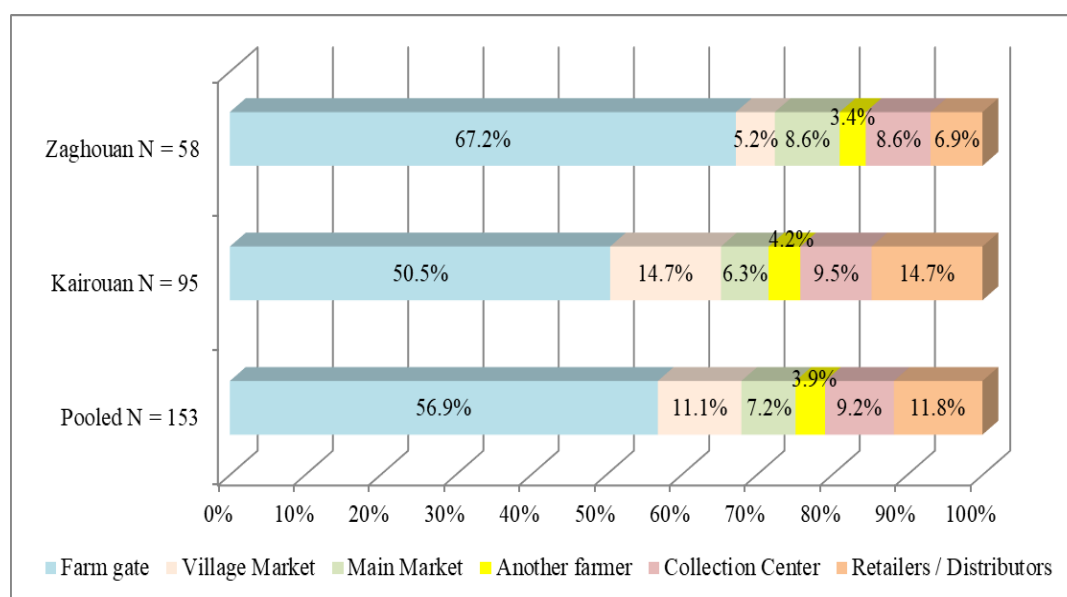


Figure 67. Most frequent sales method, %

Crop and livestock by-products are generally used by farmers in order to minimize the production costs. The straw and the pruning by-products are fed to the livestock during autumn and winter season, while manure is used to fertilize the soils.

The straw is fed to the livestock, farmers use in average 145 bales from 207 produced. Also the pruning by-products are used by farmers to feed their livestock. In average four tons of by-products are fed to the animals, especially pruning by-products from olive trees (Table 40).

Table 40. Quantities of by-products produced

		Min	Max	Mean	Std. Deviation
Straw (Balls)	Pooled N = 63	3	3300	207.95	425
	Kairouan N = 44	20	3300	265.30	497.18
	Zaghouan N = 19	3	300	75.16	70.60
Manure (Ton)	Pooled N = 259	0.25	60	5.38	8.25
	Kairouan N = 193	0.25	60	6.24	9.30
	Zaghouan N = 76	0.50	20	3.21	3.87
Pruning by-products (Ton)	Pooled N = 211	0.25	60	5.09	7.71
	Kairouan N = 128	0.50	50	5.25	7.12
	Zaghouan N = 83	0.25	60	4.86	8.58
Others (Balls)	Pooled N = 2	80	100	90	14.14
	Kairouan N = 2	80	100	90	14.14
	Zaghouan N = 0				

Table 41. Quantities used for livestock feed

		Min	Max	Mean	Std. Deviation
Straw (Bales)	Pooled N = 53	3	800	144.87	145.27
	Kairouan N = 34	20	800	183.82	161.78
	Zaghouan N = 19	3	300	75.16	70.60
Pruning by-products (Ton)	Pooled N = 203	0.02	50	4.01	6.56
	Kairouan N = 121	0.02	50	4.23	6.89
	Zaghouan N = 82	0.20	30	3.69	6.07
Others (Balls)	Pooled N = 2	80	100	90	14.14
	Kairouan N = 2	80	100	90	14.14
	Zaghouan N = 0				

5.7. Module F: Livestock possession and marketing

In this section, a description of the livestock and its marketing will be done by governorate. It concerns the livestock, the livestock in the last 12 months, the cattle breeds, the sheep and goat breeds, the total value of the animals (in TND), the number of animals consumed as meat during the last year, the number of animals sold in the last year, the average price per animal sold (TND), the number of animals purchased in the last year, the average price per animal purchased (TND), the number of animals given as gifts during the last year, the number of animals received as gifts during the last year, the number of animals dead due to illness/accident during the last year and finally the number of animals born in the last year.

Figure 68 shows the existing livestock by governorate. The most common animals for Zaghouan are the ewes for 94.5%, the chicken for 87.6% of the sample, the female and male lambs for 62.2% and the rams for 72.8%.

In Kairouan, we are more likely to find 85.9% of the sample having ewes, 64.5% for rams, 46.9% of goats and 81.7% of chicken.

Some animals are rarer to find, it concerns rabbits with only 1.5% in both governorates; mules with 1.8% in Zaghouan and 2.6% in Kairouan; horses with 1.8% in both locations; bee hives with 6% in Zaghouan and 5.9% in Kairouan; calves with 12% in Zaghouan and 7.9% in Kairouan and non milk cows with 1.3% in both governorates.

Milk cows are present with 21.7% in Zaghouan and 16.1% in Kairouan. The donkeys livestock is slightly more important in Kairouan with 38.1% compared to Zaghouan with 36.4%.

Concerning the non-milk cows livestock possession both governorates represent low percentages. It is only 0.9% in the governorate of Zaghouan while it is 1.5% in Kairouan governorate.

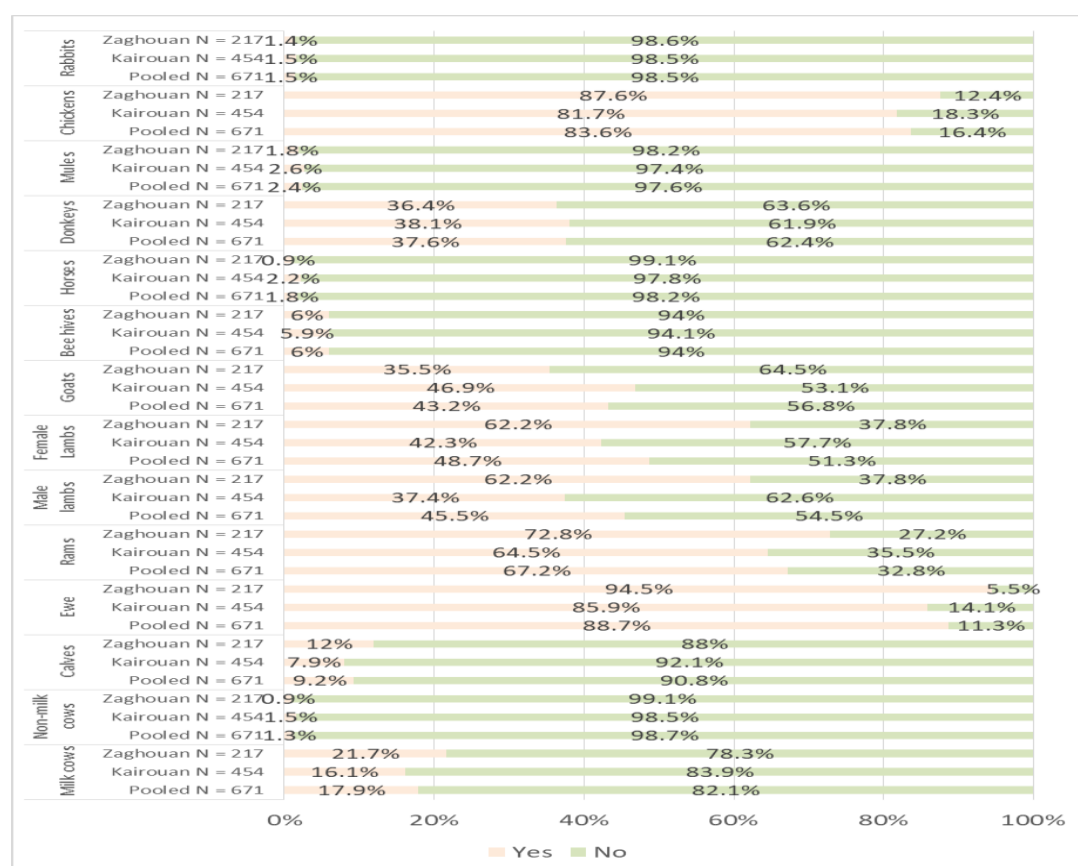


Figure 68. Livestock possession by governorate, %

Figure 69 shows the livestock existing in the last year. The most common animals for these two locations are the male lambs with 63.7% in Kairouan and 85.4% in Zaghouan and also the female lambs with 49.6% in Kairouan and 82.9% in Zaghouan. Then comes the rams with 35.6% in Zaghouan and 28% in Kairouan and the ewes with 25% in Zaghouan and 21.9% in Kairouan.

There are other animals that are not well represented; it concerns non milk cows for 100% of the sample in Zaghouan and 98.2% in Kairouan, also the milk cows where we find only 3.5% in Zaghouan and 2.6% in Kairouan. Also the calves and goats with only 3.6% and 6 % of the sample having these animals. In fact, goats livestock is more important in Kairouan with a percentage of 7.5% compared to Zaghouan with a percentage of 3.6%.

Concerning the calves livestock possession in the past 12 months by governorate, in both Zaghouan and Kairouan the percentages are almost the same with 3.7% in Zaghouan and 3.6% in Kairouan. Concerning the non-milk cows livestock in the past year, they are completely absent in Zaghouan and they represent 0.2% only in Kairouan.

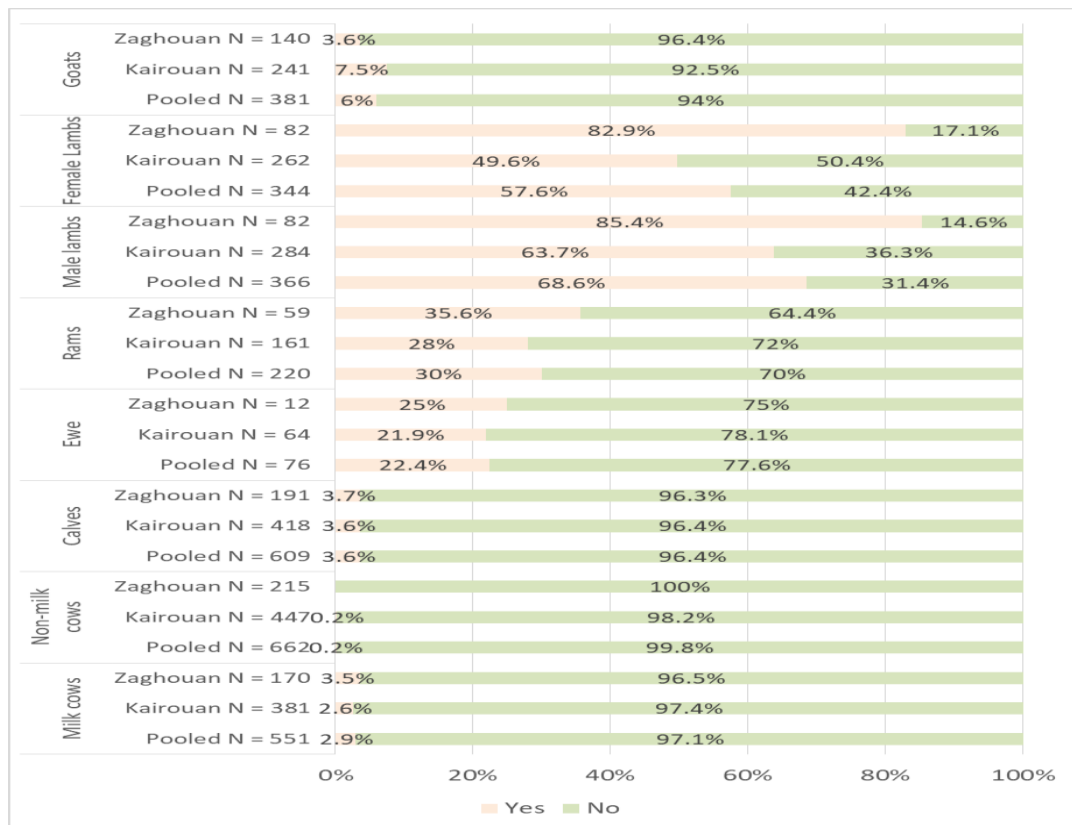


Figure 69. Livestock possession in the last 12 months by governorate, %

Table 42 presents the livestock owned by governorate. It shows that for both governorates the milk cows owned in both cities presents a mean of 0.3 with a maximum of 7 cows in Kairouan and a maximum of 4 cows in Zaghouan. Concerning the non-milk cows, the maximum is 7 cows for both governorates while the minimum is zero.

For the calves, the maximum is 5 in Kairouan with a minimum of zero and it is the same situation in Zaghouan. Concerning the ewes, the maximum is 240 in Kairouan while the maximum is only 120 with a mean of 16.6% in Zaghouan. For both governorates, rams are 40 as a maximum and zero as a minimum with a mean of 0.9. Concerning the male lambs, their number is higher in Kairouan with 150 as a maximum while they are only 45 in Zaghouan.

The female lambs are not numerous in these two regions, they were 28 as a maximum in Kairouan and 35 as maximum in Zaghouan. The minimum for both governorates was zero. For the goats, their number is higher with 70 heads in Kairouan and up to 150 in Zaghouan as a maximum.

Concerning the horses livestock owned by governorate, they are almost not present in the two locations with a maximum of 2 in Kairouan and only one in Zaghouan. The same situation is also for donkeys and mules with only 3 and 1 respectively for both governorates.

Poultry is well present in Kairouan with a maximum of 8000 heads and a mean of 42.1 while they are 3100 as a maximum in Zaghouan with a mean of 29.

Table 42. Livestock owned by governorate

		Min	Max	Mean	Std. Deviation
Milk cows	Pooled N = 671	0	7	0.3	0.761
	Kairouan N = 454	0	7	0.3	0.758
	Zaghuan N = 217	0	4	0.4	0.764
Non-milk cows	Pooled N = 671	0	7	0.0	0.428
	Kairouan N = 454	0	7	0.0	0.380
	Zaghuan N = 217	0	7	0.0	0.516
Calves	Pooled N = 671	0	5	0.2	0.595
	Kairouan N = 454	0	5	0.1	0.602
	Zaghuan N = 217	0	5	0.2	0.580
Ewe	Pooled N = 671	0	240	16.4	18.461
	Kairouan N = 454	0	240	16.3	20.282
	Zaghuan N = 217	0	120	16.6	13.940
Rams	Pooled N = 671	0	40	0.9	1.695
	Kairouan N = 454	0	40	0.9	2.006
	Zaghuan N = 217	0	6	0.8	0.683
Male lambs	Pooled N = 671	0	150	2.8	7.532
	Kairouan N = 454	0	150	2.6	8.431
	Zaghuan N = 217	0	45	3.4	5.150
Female Lambs	Pooled N = 669	0	35	2.4	3.971
	Kairouan N = 452	0	28	2.1	3.804
	Zaghuan N = 217	0	35	3.0	4.235
Goats	Pooled N = 671	0	150	2.4	7.379
	Kairouan N = 454	0	70	2.5	5.278
	Zaghuan N = 217	0	150	2.2	10.507
Bee hives	Pooled N = 671	0	200	1.4	10.254
	Kairouan N = 454	0	200	1.6	11.793
	Zaghuan N = 217	0	50	1.0	5.857
Horses	Pooled N = 671	0	2	0.0	0.176
	Kairouan N = 454	0	2	0.0	0.203
	Zaghuan N = 217	0	1	0.0	0.096
Donkeys	Pooled N = 671	0	3	0.4	0.548
	Kairouan N = 454	0	3	0.4	0.543
	Zaghuan N = 217	0	3	0.4	0.561
Mules	Pooled N = 671	0	1	0.0	0.153
	Kairouan N = 454	0	1	0.0	0.161
	Zaghuan N = 217	0	1	0.0	0.135
Chickens	Pooled N = 669	0	8000	37.9	356.600
	Kairouan N = 452	0	8000	42.1	408.951
	Zaghuan N = 217	0	3100	29.0	209.653
Rabbits	Pooled N = 671	0	30	0.1	1.754
	Kairouan N = 454	0	30	0.1	1.534

Zaghoun N = 217	0	30	0.2	2.147
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Figure 70 shows the cattle breeds by governorate. It shows that most of the cattle is improved. Concerning milk cows, 66% are improved in Zaghoun, 27.7% are local, 4.3% are cross breed and 2.1% are both races. In Kairouan, percentages are slightly the same for improved breeds with 69.9%, then 19.2% are local, 9.6% are cross breed and only 1.4% are both races.

For the non-milk cows, we observe that in Kairouan there are only 2 types of breeds with a large majority for improved breeds (85.7%) and 14.3% are local. In Zaghoun, the sample is equally divided into 2 breeds 50% improved breeds and 50% cross breeds.

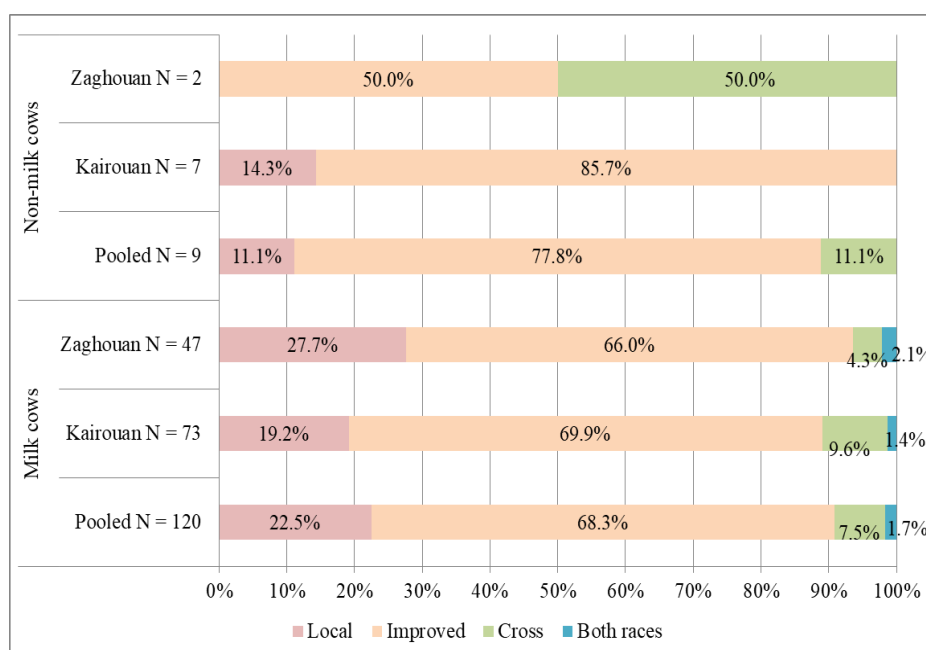


Figure 70. Cattle breeds by governorate, %

The table below shows the total value of the animals by governorate. It shows that the more valuable animals are chicken with 80000 TND in Kairouan, while they value only 7000 in Zaghoun. The most valuable animals in Zaghoun are the ewes with 66000 TND and a mean of 6277.6 while in Kairouan their value is also high with 60000 TND (Table 43).

Concerning the milk cows, their value is 27000 TND in Kairouan and 16000 TND in Zaghoun. Prices are almost the same for the non milk cows with 21000 TND in Zaghoun and 17500 in Kairouan.

Calves and rams have the same value in Kairouan with 16000 TND. In Zaghoun, the value of calves is 10000 TND and the rams is 4800 TND.

Male and female lambs have also an important value for both governorates with 12000 TND and 12500 TND respectively in Kairouan; and 16400 TND and 6000 TND respectively in Zaghoun.

Goats have a higher value in Kairouan with 21000 TND while they cost only 7500 TND in Zaghouan. Horses also have a higher price in Kairouan with 5000 TND while they cost only 950 TND in Zaghouan.

Table 43. Total value of the animals by governorate (in TND)

		Min	Max	Mean	Std. Deviation
Milk cows	Pooled N = 671	0	27000	1025.0	2698.8
	Kairouan N = 454	0	27000	928.2	2722.9
	Zaghouan N = 217	0	16000	1227.6	2642.4
Non milk cows	Pooled N = 671	0	21000	104.3	1179.6
	Kairouan N = 454	0	17500	88.1	956.0
	Zaghouan N = 217	0	21000	138.2	1548.4
Calves	Pooled N = 670	0	16000	314.3	1317.7
	Kairouan N = 453	0	16000	289.2	1363.3
	Zaghouan N = 217	0	10000	366.8	1218.1
Ewe	Pooled N = 671	0	66000	5992.1	6784.3
	Kairouan N = 454	0	60000	5855.3	7008.1
	Zaghouan N = 217	0	66000	6277.6	6297.5
Rams	Pooled N = 671	0	16000	510.4	777.4
	Kairouan N = 454	0	16000	503.2	885.0
	Zaghouan N = 217	0	4800	525.7	481.6
Male lambs	Pooled N = 666	0	16400	579.2	1400.8
	Kairouan N = 449	0	12000	488.2	1223.8
	Zaghouan N = 217	0	16400	767.4	1697.8
Female Lambs	Pooled N = 667	0	12500	470.7	1013.2
	Kairouan N = 450	0	12500	429.0	1069.2
	Zaghouan N = 217	0	6000	557.1	881.9
Goats	Pooled N = 669	0	21000	501.9	1237.0
	Kairouan N = 452	0	21000	559.5	1403.0
	Zaghouan N = 217	0	7500	382.0	775.5
Populated hives	Pooled N = 669	0	40000	198.5	1767.8
	Kairouan N = 452	0	40000	226.9	2082.1
	Zaghouan N = 217	0	7500	139.3	779.5
Horses	Pooled N = 671	0	5000	32.0	282.0
	Kairouan N = 454	0	5000	43.4	337.4
	Zaghouan N = 217	0	950	8.1	84.1
Donkeys	Pooled N = 669	0	3000	161.7	349.6
	Kairouan N = 452	0	3000	175.4	397.9
	Zaghouan N = 217	0	1000	133.0	214.8
Mules	Pooled N = 671	0	2500	23.7	175.2
	Kairouan N = 454	0	2500	26.1	190.0
	Zaghouan N = 217	0	1200	18.9	139.7
Chickens	Pooled N = 666	0	80000	322.5	3185.3
	Kairouan N = 449	0	80000	382.2	3865.1

Rabbits	Zaghouan N = 217	0	7000	198.9	479.6
	Pooled N = 671	0	900	2.9	42.5
	Kairouan N = 454	0	900	2.8	43.2
	Zaghouan N = 217	0	600	3.3	41.1

Table 44 shows the number of animals consumed as meat during the last year. It shows that the most consumed animal in Kairouan and Zaghouan is chicken with 120 and 50 heads respectively. The second most consumed animal is the rabbit with 50 heads in Kairouan while Zaghouan counts only 3 heads maximum.

In Zaghouan, more female lambs is consumed with 29 heads while Kairouan counts only 10 heads. These numbers are reversed with the male lambs with more animals for Kairouan with 20 heads and only 6 in Zaghouan.

Ewes are more consumed in Kairouan than Zaghouan with 14 and 6 heads respectively. Goats also are more consumed with 10 heads in Kairouan and only 5 heads in Zaghouan. There is no meat cow consumed in the last year in both governorates, while milk cows count for 8 heads in Kairouan and only 2 heads in Zaghouan.

Table 44. Number of animals consumed as meat during the last year

		Min	Max	Mean	Std. Deviation
Milk cows	Pooled N = 136	0	8	0.11	0.73
	Kairouan N = 83	0	8	0.13	0.89
	Zaghouan N = 53	0	2	0.08	0.33
Meat cows	Pooled N = 10	0	0	0	0
	Kairouan N = 8	0	0	0	0
	Zaghouan N = 2	0	0	0	0
Calves	Pooled N = 84	0	4	0.13	0.53
	Kairouan N = 51	0	2	0.14	0.40
	Zaghouan N = 33	0	4	0.12	0.70
Ewe	Pooled N = 612	0	14	0.35	1.19
	Kairouan N = 404	0	14	0.41	1.32
	Zaghouan N = 208	0	6	0.24	.89
Rams	Pooled N = 517	0	4	0.16	0.47
	Kairouan N = 338	0	3	0.18	0.46
	Zaghouan N = 179	0	4	0.13	0.50
Male lambs	Pooled N = 556	0	20	1.23	1.53
	Kairouan N = 351	0	20	1.24	1.77
	Zaghouan N = 205	0	6	1.21	1.02
Female Lambs	Pooled N = 525	0	29	0.24	1.52
	Kairouan N = 322	0	10	0.25	1.05
	Zaghouan N = 203	0	29	0.21	2.07
Goats	Pooled N = 313	0	10	0.42	.99
	Kairouan N = 231	0	10	0.47	1.06
	Zaghouan N = 82	0	5	0.28	0.76
Chickens	Pooled N = 545	0	120	11.21	11.55
	Kairouan N = 358	0	120	10.97	12.92

	Zaghouan N = 187	0	50	11.67	8.30
	Pooled N = 10	0	50	7.00	15.20
Rabbits	Kairouan N = 7	0	50	9.29	18.03
	Zaghouan N = 3	0	3	1.67	1.53

Table 45 shows the number of animals sold in the last year by governorate. It shows that the most important animal sold in numbers is the chicken with 100000 heads in Kairouan, while it is only 150 in Zaghouan. The second most important animal is the ram with 500 heads in Kairouan while Zaghouan sold only 5 heads. Then we have the male lambs with 100 heads in Kairouan and 40 heads in Zaghouan. Female lambs are more important in Kairouan with 75 heads and 30 heads in Zaghouan.

Ewes are also important for both governorates with almost the same number of animals sold; 60 heads in Kairouan and 64 heads in Zaghouan. Goats are also equally important for both governorates with 60 heads in Kairouan and 50 heads in Zaghouan.

Table 45. Number of animals sold in the last year

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 611	0	64	3.17	7.73
	Kairouan N = 403	0	60	3.44	7.74
	Zaghouan N = 208	0	64	2.63	7.69
Rams	Pooled N = 517	0	500	1.41	22.01
	Kairouan N = 338	0	500	2.05	27.22
	Zaghouan N = 179	0	5	0.21	0.60
Male lambs	Pooled N = 554	0	100	6.91	7.31
	Kairouan N = 349	0	100	6.78	7.98
	Zaghouan N = 205	0	40	7.14	6.02
Female Lambs	Pooled N = 524	0	75	3.42	5.44
	Kairouan N = 321	0	75	3.62	6.01
	Zaghouan N = 203	0	30	3.11	4.40
Goats	Pooled N = 313	0	60	2.21	5.68
	Kairouan N = 231	0	60	2.27	5.61
	Zaghouan N = 82	0	50	2.05	5.90
Chickens	Pooled N = 554	0	100000	201.71	4268.93
	Kairouan N = 367	0	100000	303.58	5244.42
	Zaghouan N = 187	0	150	1.77	11.30

Table 46 presents the average price per animal sold for both governorates. It shows that male lambs have the maximum average price with 18900 TND in Kairouan while it is only 3600 TND for Zaghouan. Goats have also a high average price with 15000 TND in Kairouan while it is only 2600 TND for Zaghouan.

We observe that in average for the whole sample, Kairouan has always a higher average price with 4500 TND for ewes; 2400 TND for rams and 1200 TND for female lambs while these prices are lower in Zaghouan with 680 TND for ewes; 800 TND for rams and 380 TND for female lambs.

Table 46. Average price per animal sold (TND)

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 218	80	4500	355.16	297.34
	Kairouan N = 155	80	4500	361.65	348.55
	Zaghouan N = 63	130	680	339.21	85.54
Rams	Pooled N = 126	160	2400	540.75	208.22
	Kairouan N = 98	160	2400	540.66	224.85
	Zaghouan N = 28	200	800	541.07	138.14
Male lambs	Pooled N = 495	80	18900	446.36	953.64
	Kairouan N = 306	80	18900	476.03	1196.41
	Zaghouan N = 189	140	3600	398.33	252.40
Female Lambs	Pooled N = 309	2	1200	260.73	84.63
	Kairouan N = 192	2	1200	260.65	96.10
	Zaghouan N = 117	60	380	260.85	61.72
Goats	Pooled N = 132	90	15000	372.42	1306.91
	Kairouan N = 99	90	15000	380.20	1487.00
	Zaghouan N = 33	90	2600	349.09	468.80

Table 47 shows the number of animals purchased last year by the households. In Zaghouan, ewes are the most purchased animals with a maximum of 30 heads. In Kairouan, ewes and goats are the most purchased animals with 25 heads each. 20 heads of male lambs were purchased in Kairouan while only 3 were purchased in Zaghouan. Rams are more purchased in Zaghouan with 4 animals versus only one in Kairouan. 6 Female lambs were purchased in Kairouan and 4 were purchased in Zaghouan. We count only one goat purchased in Zaghouan in the last year.

Table 47. Number of animals purchased in the last year

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 611	0	30	0.45	2.335
	Kairouan N = 403	0	25	0.48	2.146
	Zaghouan N = 208	0	30	0.38	2.668
Rams	Pooled N = 517	0	4	0.13	0.370
	Kairouan N = 338	0	1	0.13	0.340
	Zaghouan N = 179	0	4	0.11	0.422
Male lambs	Pooled N = 556	0	20	0.13	1.231
	Kairouan N = 351	0	20	0.19	1.532
	Zaghouan N = 205	0	3	0.03	0.287
Female Lambs	Pooled N = 525	0	6	0.04	0.408
	Kairouan N = 322	0	6	0.06	0.470

	Zaghouan N = 203	0	4	0.02	0.281
	Pooled N = 313	0	25	0.26	1.646
Goats	Kairouan N = 231	0	25	0.34	1.908
	Zaghouan N = 82	0	1	0.02	0.155

Table 48 indicates the average price per animal purchased by governorate. It shows that the most expensive animal is the goat in Kairouan with an average of 1000 TND while in Zaghouan the price is only 195 TND as a maximum and 130 TND as a minimum. Then the ram is also expensive in Kairouan with 800 TND as a maximum and 350 TND as a minimum, the prices are almost the same in Zaghouan with 750 TND maximum and 500 TND minimum. Ewes are also expensive with nearly the same price in both governorates; 650 TND in Kairouan and 700 TND in Zaghouan.

Male lambs have also nearly the same prices with 400 TND in Kairouan and 500 TND in Zaghouan. For both locations, the minimum is 150 TND.

Female lambs have a higher price in Kairouan with 350 TND as a maximum and 155 TND as a minimum while in Kairouan there is a unique price of 100 TND.

Table 48. Average price per animal purchased (TND)

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 49	90	700	405.00	127.969
	Kairouan N = 39	90	650	379.62	120.664
	Zaghouan N = 10	380	700	504.00	110.373
Rams	Pooled N = 60	350	800	558.83	99.747
	Kairouan N = 44	350	800	550.00	103.519
	Zaghouan N = 16	500	750	583.13	86.927
Male lambs	Pooled N = 11	150	500	274.09	106.415
	Kairouan N = 8	150	400	273.13	73.627
	Zaghouan N = 3	150	500	276.67	193.993
Female Lambs	Pooled N = 8	100	350	210.63	82.134
	Kairouan N = 7	155	350	226.43	74.426
	Zaghouan N = 1	100	100	100.00	
Goats	Pooled N = 23	70	1000	273.04	207.522
	Kairouan N = 21	70	1000	283.57	214.308
	Zaghouan N = 2	130	195	162.50	45.962

Table 49 shows the number of animals given as gifts during the last year for both governorates. Ewes are the most given animals as gifts in Kairouan with 8 heads maximum, while only 2 are given in Zaghouan.

In Zaghouan, the maximum given is 2 animals with 2 ewes, 2 male lambs or 2 female lambs.

3 rams were given in Kairouan while only one was given in Zaghouan as a gift. 4 male lambs were given in Kairouan and only one female lamb.

Table 49. Number of animals given as gifts during the last year

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 612	0	8	0.04	0.39
	Kairouan N = 404	0	8	0.05	0.47
	Zaghouan N = 208	0	2	0.02	0.17
Rams	Pooled N = 517	0	3	0.01	0.17
	Kairouan N = 338	0	3	0.02	0.20
	Zaghouan N = 179	0	1	0.01	0.07
Male lambs	Pooled N = 556	0	4	0.09	0.37
	Kairouan N = 351	0	4	0.09	0.40
	Zaghouan N = 205	0	2	0.08	0.33
Female Lambs	Pooled N = 525	0	2	0.01	0.14
	Kairouan N = 322	0	1	0.01	0.10
	Zaghouan N = 203	0	2	0.02	0.20
Goats	Pooled N = 313	0	4	0.04	0.29
	Kairouan N = 231	0	4	0.05	0.33
	Zaghouan N = 82	0	1	0.01	0.11

Table 50 shows the number of animals received as gifts during the last year. It shows that in the governorate of Zaghouan there is no animal received as a gift while this tradition exists in the governorate of Kairouan.

In fact, 10 ewes, 8 rams, 8 male and 8 female lambs and 8 goats were received during the last year as gifts in Kairouan.

Table 50. Number of animals received as gifts during the last year

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 612	0	10	0.05	0.62
	Kairouan N = 404	0	10	0.07	0.76
	Zaghouan N = 208	0	0	0	0
Rams	Pooled N = 517	0	8	0.03	0.47
	Kairouan N = 338	0	8	0.05	0.58
	Zaghouan N = 179	0	0	0.00	0.00
Male lambs	Pooled N = 556	0	8	0.02	0.35
	Kairouan N = 351	0	8	0.03	0.44
	Zaghouan N = 205	0	0	0	0
Female Lambs	Pooled N = 525	0	8	0.02	0.35
	Kairouan N = 322	0	8	0.02	0.45
	Zaghouan N = 203	0	0	0	0
Goats	Pooled N = 313	0	8	0.05	0.64
	Kairouan N = 231	0	8	0.07	0.74
	Zaghouan N = 82	0	0	0	0

Table 51 indicates the number of animals dead due to an illness or accident during the last year. It shows that ewes are the most vulnerable animals with 28 heads in Kairouan and 15 in Zaghouan. Then comes the male lambs with almost the same number for both governorates; 19 in Kairouan and 16 in Zaghouan. Female lambs are also vulnerable with 12 animals dead in Kairouan and 10 in Zaghouan. 10 goats were lost in Kairouan during the last year and 6 died in Zaghouan. Finally, the governorate of Kairouan lost a lot of rams with 8 animals while only one died in Zaghouan.

Table 51. Number of animals dead due to illness/accident during the last year

		Min	Max	Mean	Std. Deviation
Ewe	Pooled N = 612	0	28	0.98	2.21
	Kairouan N = 404	0	28	1.14	2.44
	Zaghouan N = 208	0	15	0.66	1.63
Rams	Pooled N = 517	0	8	0.08	0.44
	Kairouan N = 338	0	8	0.08	0.51
	Zaghouan N = 179	0	1	0.07	0.26
Male lambs	Pooled N = 556	0	19	0.55	1.80
	Kairouan N = 351	0	19	0.63	1.94
	Zaghouan N = 205	0	16	0.42	1.51
Female Lambs	Pooled N = 525	0	12	0.33	1.15
	Kairouan N = 322	0	12	0.38	1.27
	Zaghouan N = 203	0	10	0.25	0.93
Goats	Pooled N = 313	0	10	0.32	1.15
	Kairouan N = 231	0	10	0.37	1.25
	Zaghouan N = 82	0	6	0.20	0.81

Table 52 shows the number of animals born in the last year for both governorates. 101 male lambs were born in Zaghouan and 75 in Kairouan. Concerning female lambs, we have the same number for both governorates with 75 animals. Also for the goats, both locations have the same number with 20 animals born last year.

Table 52. Number of animals born in the last year

		Min	Max	Mean	Std. Deviation
Male lambs	Pooled N = 556	0	101	7.57	8.73
	Kairouan N = 351	0	75	6.78	7.82
	Zaghouan N = 205	0	101	8.92	9.95
Female Lambs	Pooled N = 525	0	75	6.19	7.32
	Kairouan N = 322	0	75	5.58	7.07
	Zaghouan N = 203	0	75	7.17	7.61
Goats	Pooled N = 313	0	20	2.04	3.32
	Kairouan N = 231	0	20	1.76	3.04
	Zaghouan N = 82	0	20	2.84	3.93

5.8. Module G: Livestock technology

In this section the livestock technology will be analyzed for both governorates. This concerns the number of aged ewes with stunted growth, the rams that over 6 years old, the replaced rams in the previous 12 months, their origins and the reasons for replacing them rams. Then a large part of this analysis is dedicated to the vaccination: Number of communication with a veterinarian in the previous 12 months, the national vaccination campaign by governorate, the dates of free vaccinations provided by the government, the free vaccinations for the whole flock, the personal vaccinations, the reasons of non-reception of free vaccinations, the vaccinations against parasites and their dates in the last 12 months by governorates, the personal vaccinations against parasites and the reasons of not receiving them, the vaccinations against Enterotoxaemia and their dates in the last 12 months by governorate, the personal vaccinations against Enterotoxaemia and the reasons of not receiving them.

Figure 71 shows the number of aged ewes with stunted growth by governorate. 88.6% of the sample in Zaghouan has between 1 to 5 ewes while they are 84.4% in Kairouan with this number. 12.7% of the sample in Kairouan has between 6 and 10 ewes versus 9.5% in Zaghouan. Only 1.9% in Zaghouan have more than 10 ewes while they are 3.2% in Kairouan.

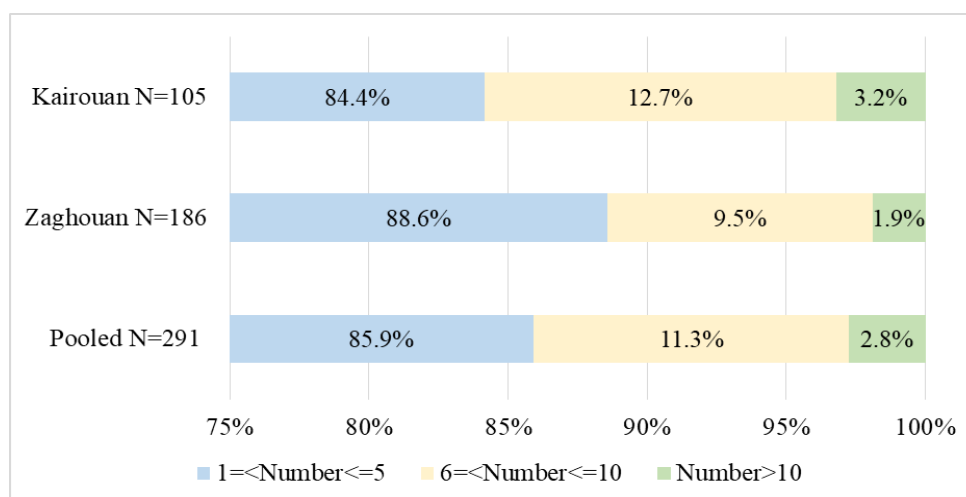


Figure 71. Number of aged ewes with stunted growth by governorate. %

The table below shows that the maximum number is 40 ewes in Kairouan, while it is only 15 in Zaghouan. For both governorates the mean is 1.75 ewe (Table 53).

Table 53. Number of aged ewes with stunted growth by governorate

	Min	Max	Mean	Std. Deviation
Pooled N=591	0	40	1.75	3.14
Zaghouan N=204	0	15	1.55	2.28
Kairouan N=387	0	40	1.86	3.50

Figure 72 shows the kind of first sheep sold by governorate. For the three quarter of the sample (75.4%) the first sheep would be young and healthy and household would get a high price for it. In Zaghouan 24.9% sell an old sheep or skeleton as a first sheep while they are 21.4% in Kairouan.

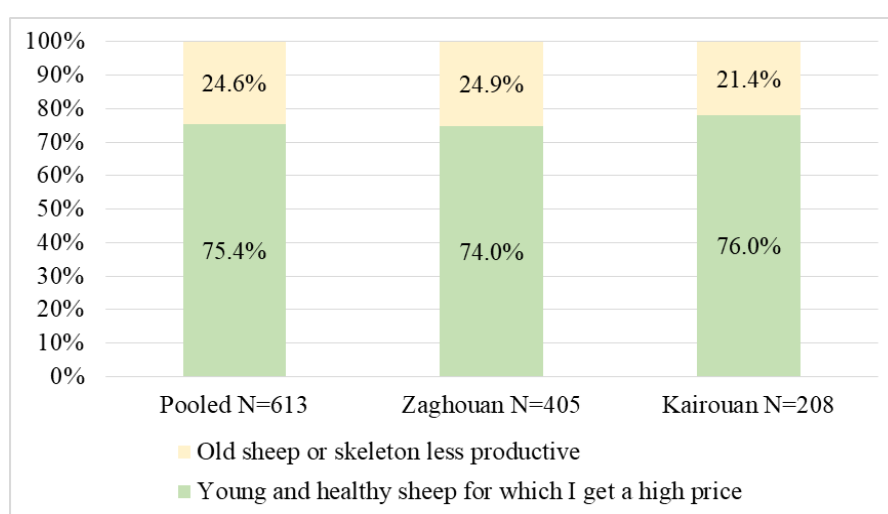


Figure 72. Sheep first sold by governorate. %

Figure 73 shows the rams that are over 6 years old. Almost the whole sample is composed by rams that are younger than 6 years. In Kairouan, we have the highest rate of old rams with 12.6% while they are only 8.2% in Zaghouan.

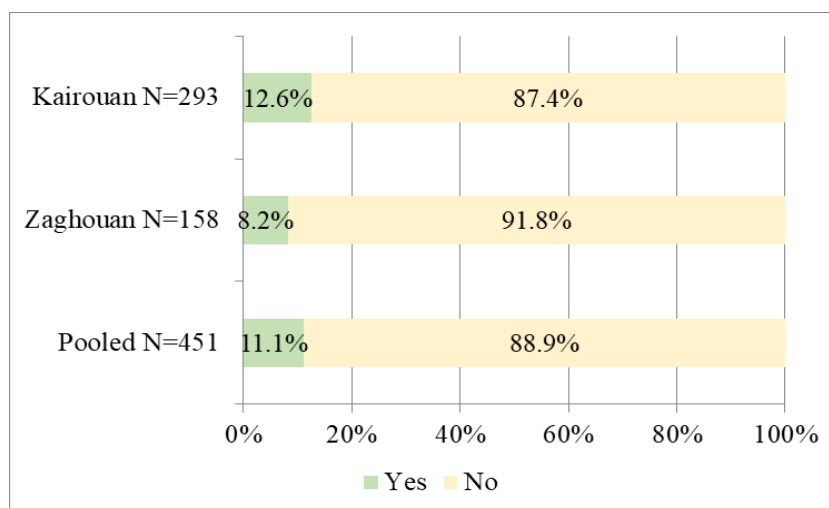


Figure 73.Rams over 6 years old by governorate. %

The number of rams replaced in the previous 12 months is represented in figure 74. In most of the sample, there is no replacement. The rate is higher in Zaghouan with 81% while it is 71% in Kairouan.

In Kairouan 26.3% replaced one ram in the last year, while they are 18.4% in Zaghouan. Household replacing more than 2 rams are only present in Kairouan with 0.3% of the sample.

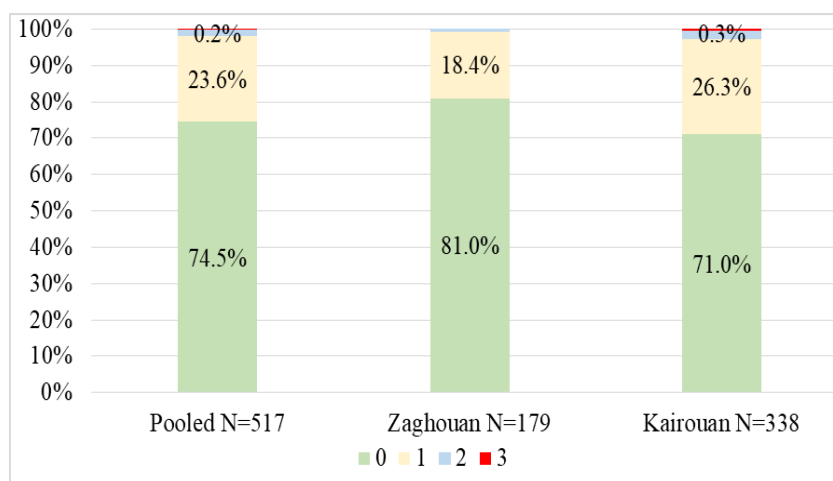


Figure 74.Rams replaced in the previous 12 months by governorate. %

The reasons for replacing the rams are represented in the figure below (Figure 75). For half of the sample in Kairouan it is because they are too old, it is also the case for Zaghouan for 31% of the sample. The second reason is to avoid consanguinity for 31% in Zaghouan and 16.5% in Kairouan. The replacement is done for no specific reason for 3.4% of the sample in Zaghouan and 2.2% in Kairouan. For both governorates, they are 27.5% of the sample that state other reasons for the replacement.

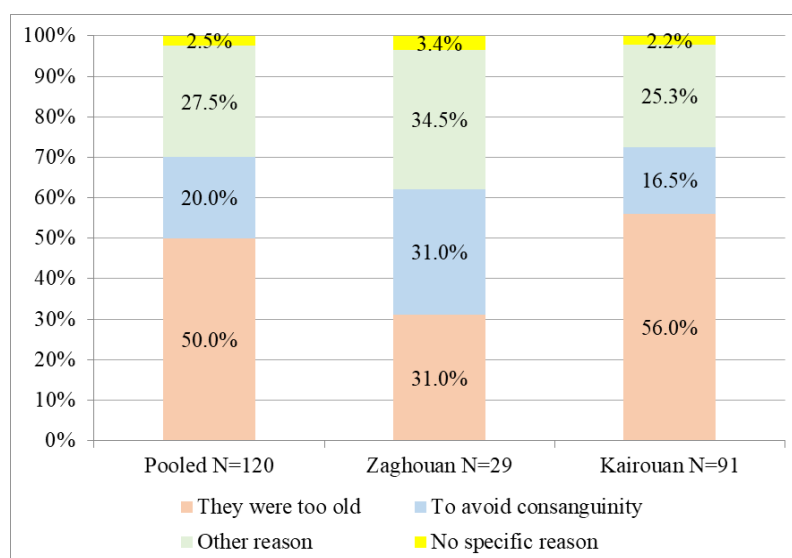


Figure 75. Reasons for replacing rams by governorate. %

Figure 76 shows from where came the rams. For nearly half of the sample, rams came from clean flocks. The second origin are rams bought from other farmers for 40.2% in Kairouan and 45.3% in Zaghouan. The third origin are rams purchased from an individual trader for 1.7% of the sample in Zaghouan and 6.2% in Kairouan.

Rams are bought from other origins only for the governorate of Kairouan for 1.5% of the sample.

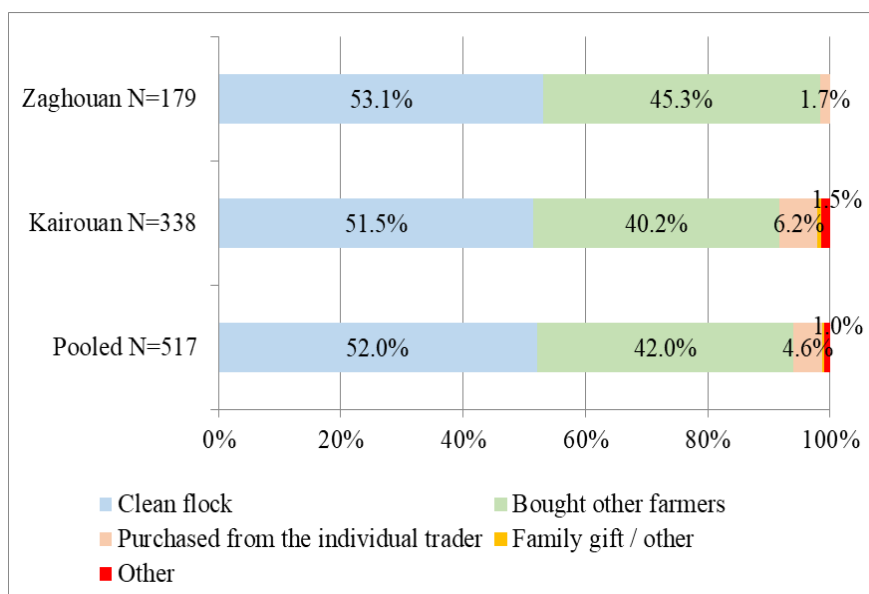


Figure 76. Source of rams by governorate

Figure 77 shows the record of sheep mating date by governorate. Only 3.4% record the mating date in Zaghouan whereas they are 13.8% in Kairouan to do so.

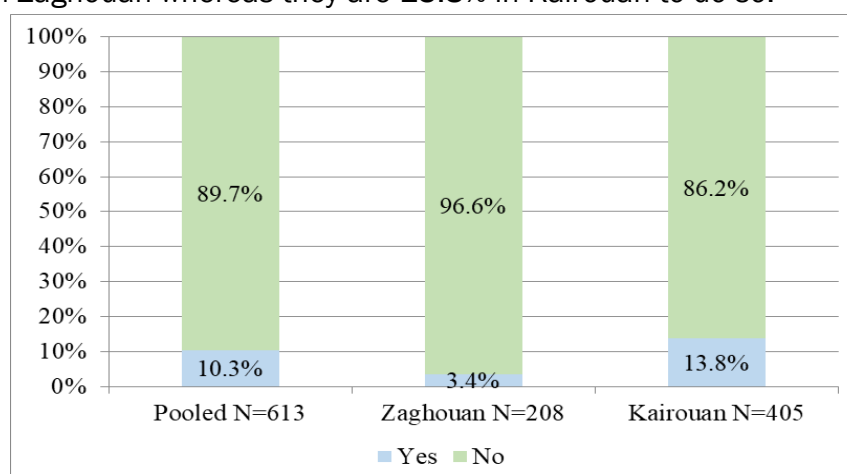


Figure 77. Record of sheep mating date by governorate. %

Figure 78 shows the year of the record for the mating date. 61.9% registered in 2018; 28.6 % in 2017; 4.8% in 2016 while they are less than 5% for the previous years.

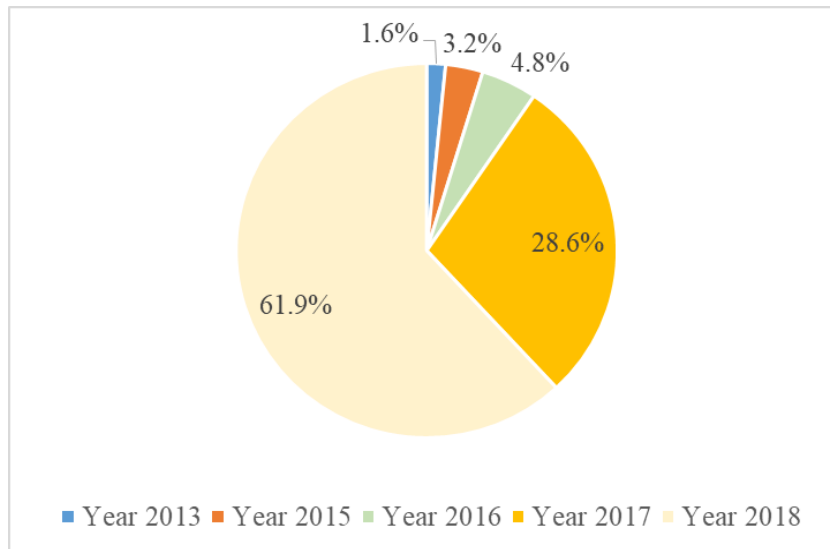


Figure 78. Mating date. %

During the last 12 months, the number of communication with a veterinarian was 20 in Zaghouan and 24 in Kairouan (Table 54).

Table 54. Number of Communication with a veterinarian in the last 12 months

	Min	Max	Mean	Std. Deviation
Pooled N=624	0	24	1.77	2.22
Zaghouan N=414	0	20	1.75	2.15
Kairouan N=210	0	24	1.81	2.36

The figure below gives more details concerning the communications. It appears that for both governorates 68.9% of the sample phoned one to 5 times to the veterinarian. The quarter of the sample did not phoned to the veterinarian at all, they were 26.2% in Zaghouan, and 27.3% in Kairouan. Less than 1% phoned more than 10 times in the previous 12 months (Figure 79).

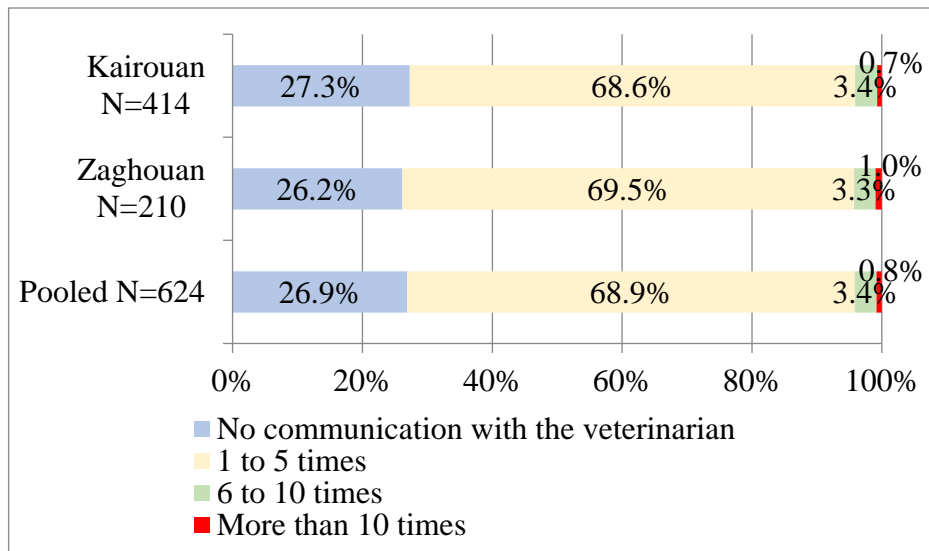


Figure 79. Number of Communication with a veterinarian in the previous 12 months

Figure 80 shows that 59.5% of the sample in Kairouan followed the national vaccination campaign while they were 78.6% in Zaghouan.

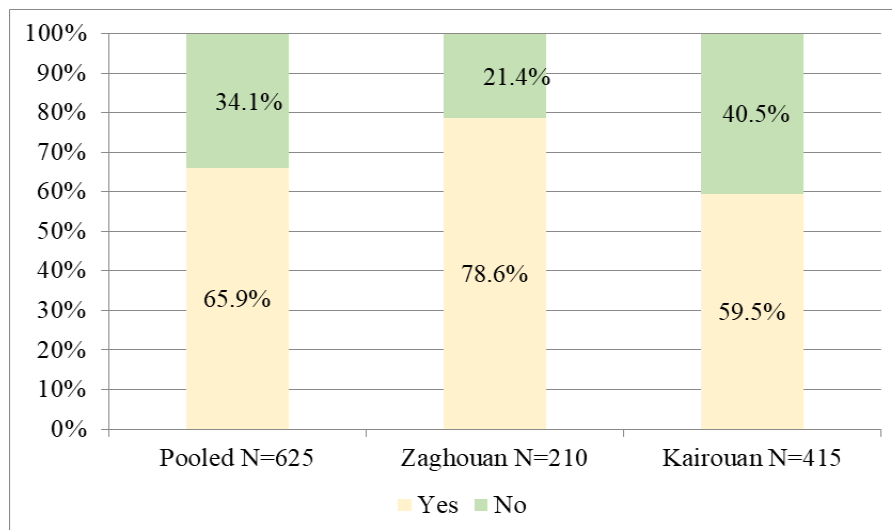


Figure 80. National vaccination campaign by governorate. %

Figure 81 shows the date of free vaccinations provided by the government. In Zaghouan, there are mainly 5 months of vaccinations. The largest number is on March for 22.4% of the sample, then there are vaccinations on April for 20.6%, on May for 14.6%, on June for 9.7% and then on October for 9.1%. There are also other free vaccinations for the month of January (1.8%); 4.9% in February, 3% in July, 3.6% in September, 5.5% in November and 3.6% in December.

In Kairouan, the situation is a little different with 17% of the sample vaccinating in November; 16.6% in March; 15.8% in October; 15.4% in May; 10.5% in April and 6.5% in February. We observe that free vaccinations are done all year around for the whole flock for both governorates (Figure 81).

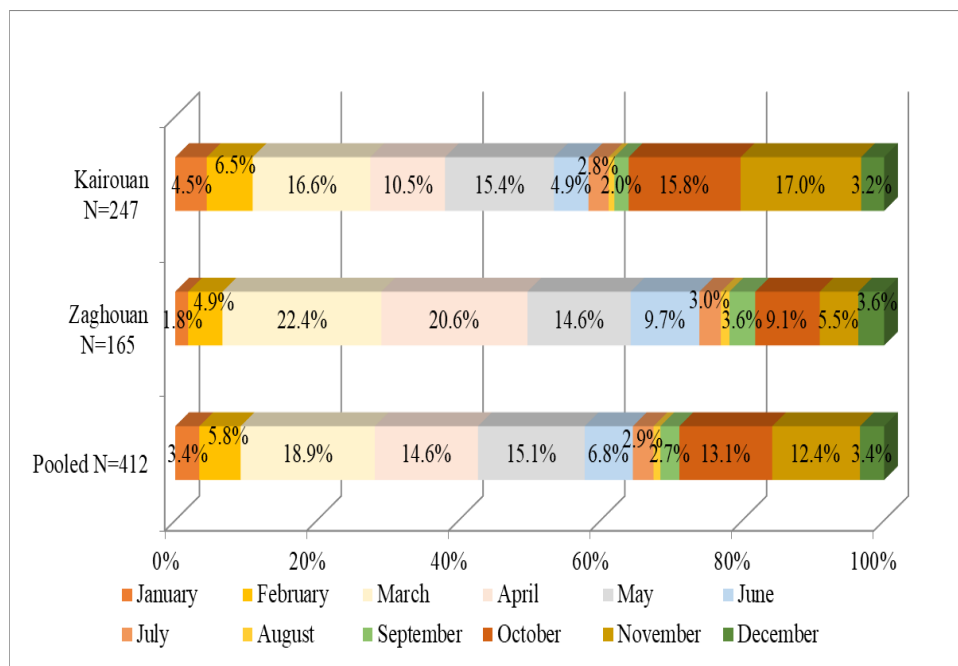


Figure 81. Dates of free vaccinations provided by the government

This figure shows the free vaccinations for the whole flock by governorate. It shows that almost all the flock is vaccinated with 98% in Kairouan and 100% in Zaghuan (Figure 82).

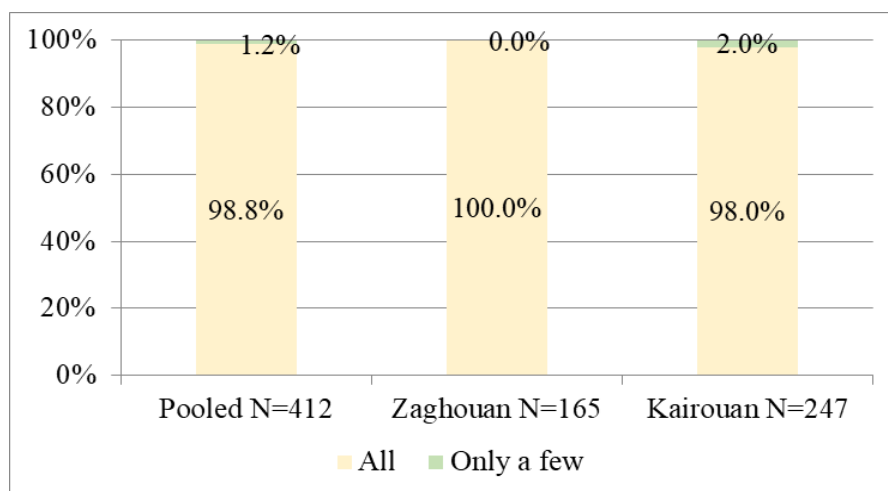


Figure 82. Free vaccinations for the whole flock by governorates. %

Figure 83 shows the personal vaccinations by governorate. In Zaghuan 82.4% of the sample is vaccinated by the government official through the OEP. This rate goes up to 88.7% in Kairouan.

Private veterinarians intervene for 4% of the sample in Kairouan and 4.2% in Zaghuan. Community animal health workers intervene for the vaccinations in 12.7% of the sample in Zaghuan and 6.9% in Kairouan. Self treatment is less than 1% for both governorates.

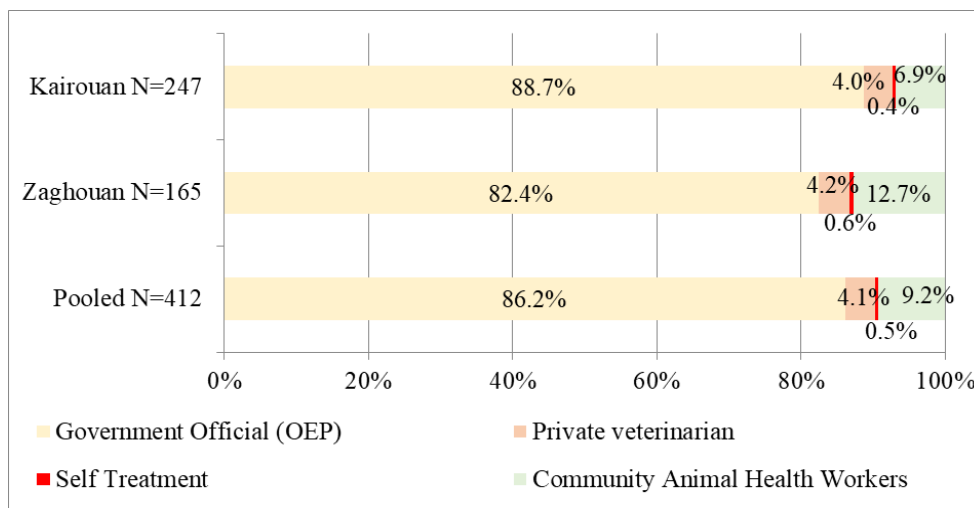


Figure 83. Personal vaccinations by governorate. %

Figure 84 shows the reasons of non-reception of free vaccinations by governorates. The most common reason is that the extension workers cannot get vaccinations, it is the case for 88.9% of the sample in Zaghouan and 72.8% in Kairouan. The second common reason is the unavailability of vaccinations, it is the case for 4.4% in Zaghouan and 4.6% in Kairouan.

Two other reasons are mentioned only for the governorate of Kairouan; it is related to the fact that the household do not trust the free vaccination for 4% of the sample and also the fact that the farmer do not see the benefit of the vaccination for 2.9% of the sample.

Households raise some other reasons of non reception of free vaccinations, it concerns 6.7% for Zaghouan and 15% for Kairouan

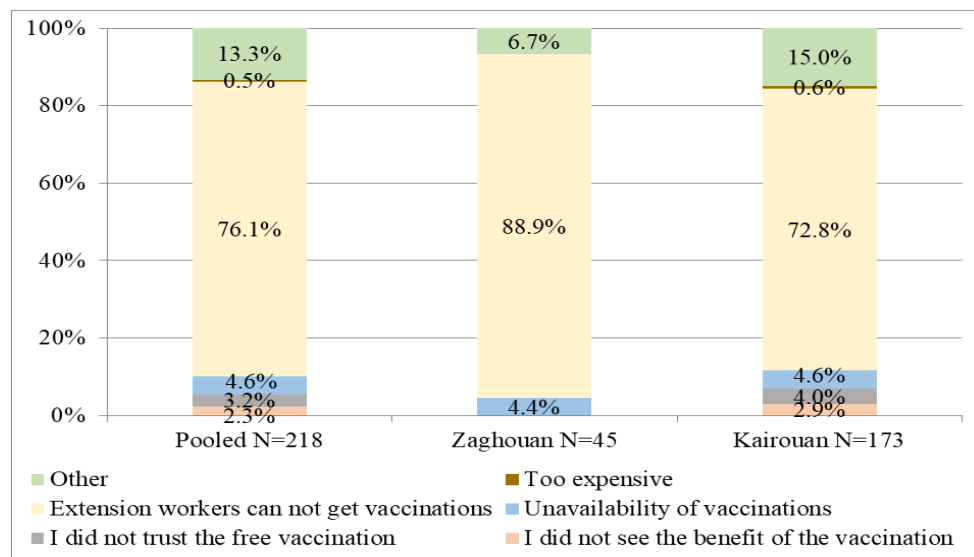


Figure 84. Reasons of non-reception of free vaccinations by governorates. %

In Zaghouan, 71% of the sample had vaccinations against parasites in the last 12 months while they were only 59.3% in Kairouan (Figure 85). The table below shows the dates of vaccinations.

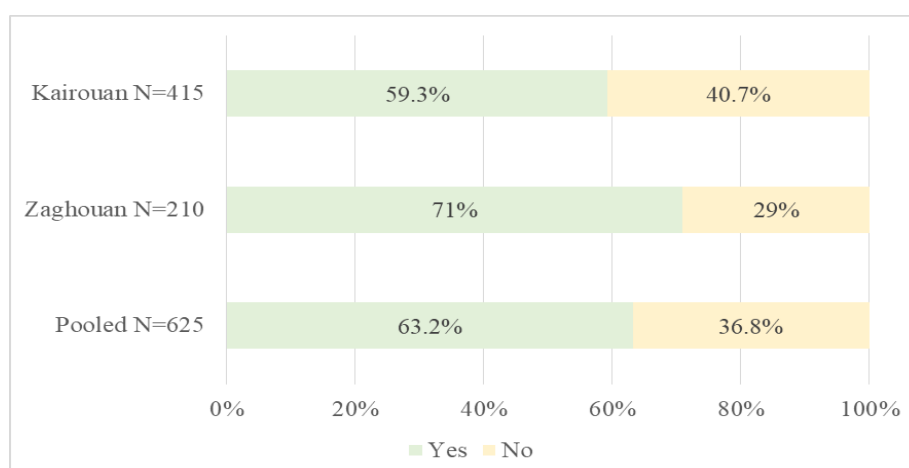


Figure 85. Vaccinations against parasites in the last 12 months by governorates. %

Table 55 shows the dates of vaccinations against parasites in the previous 12 months. Most of the vaccines are done between March and June, 65.1% for Zaghouan and 59.75% for Kairouan. The highest rate is for the month of May for 20.81% in Zaghouan and 23.17% for Kairouan. Then there is a second campaign in October and November with 20.8% in Zaghouan and 15.44% for Kairouan.

In Zaghouan there is no vaccination in the month of February and December while they are 5.28% of the sample in Kairouan to vaccine in February and 1.63% in December. In Kairouan vaccines are done all the year around.

Table 55. Dates of vaccinations against parasites in the last 12 months. %

	Zaghouan N=149	Kairouan N=246
January	1.34%	2.03%
February		5.28%
March	18.12%	16.26%
April	14.09%	8.94%
May	20.81%	23.17%
June	12.08%	11.38%
July	2.01%	8.13%
August	2.68%	3.25%
September	8.05%	4.47%
October	12.08%	10.16%
November	8.72%	5.28%
December		1.63%

Figure 86 shows the vaccinations against parasites received in the previous 12 months by the flock. It shows that almost all the flocks had vaccines, they were 99.3% in Zaghouan and 98.4% in Kairouan .

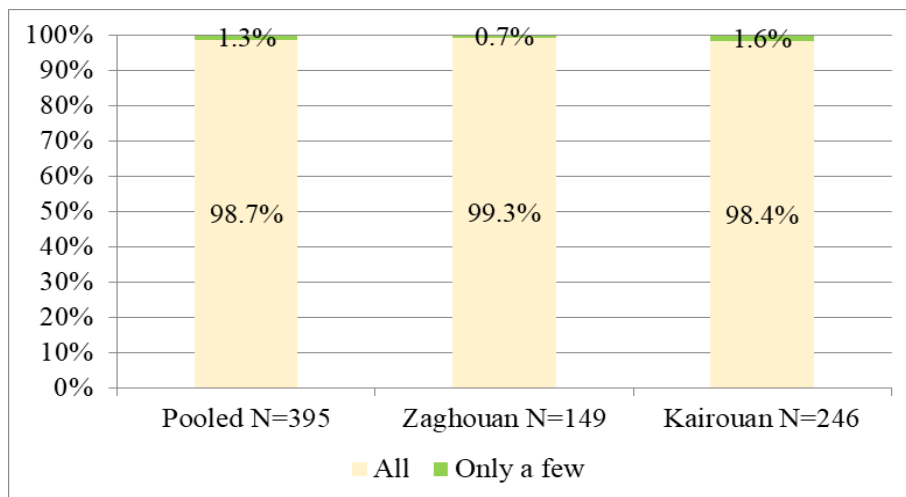


Figure 86. Vaccinations against parasites received in the previous 12 months. %

The figure below shows that more than half of the vaccines are done by private veterinarians. It is the case for 51.2% in Kairouan and it goes up to 65.1% in Zaghouan. The second method of vaccination is the self treatment with a rate of 32.9% for both locations. 35% of the sample in Kairouan vaccine by themselves and 29.5% do it in Zaghouan. Less than 2% of the vaccines are done by community animal health workers (Figure 87).

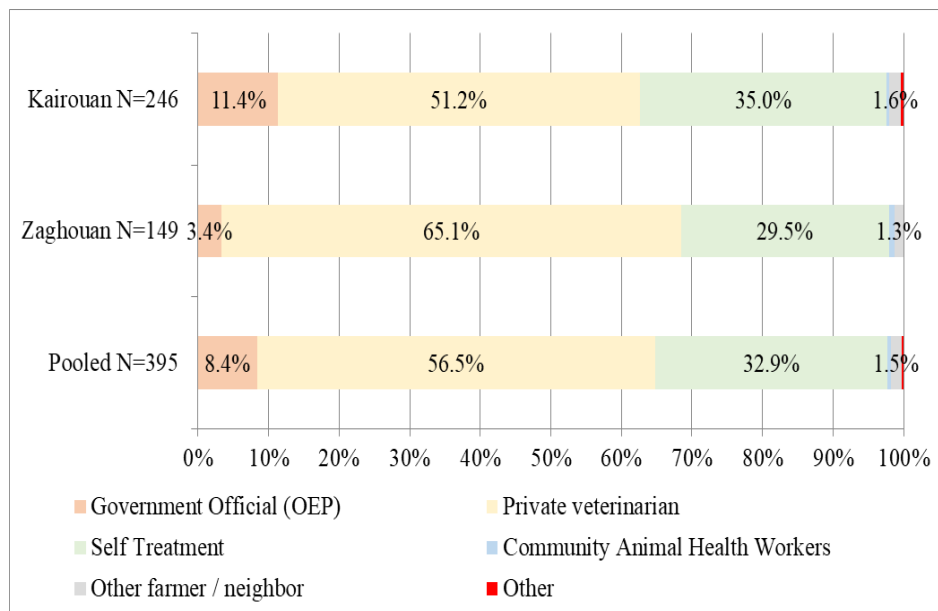


Figure 87. Personal vaccinations against parasites by governorates. %

Concerning the free vaccinations against parasites, the reasons of non reception by the households are multiple. Figure 88 shows that 54.3% did not receive the vaccine because they do not see the benefit of this vaccination, they are 35.5% of the sample to state the same argument in Zaghouan.

The second main reason is the price of the vaccine; it is too expensive for 20.2% in Kairouan and 40.3% in Zaghouan. Some households talk also about a bad experience they had with previous vaccinations; they are 13.9% in Kairouan and 11.3% in Zaghouan. Also the extension workers cannot get vaccinations and give them to the farmers for 11.3% in Zaghouan and 6.9% in Kairouan.

Another reason can be also the unavailability of the vaccine for 3.4% for both locations.

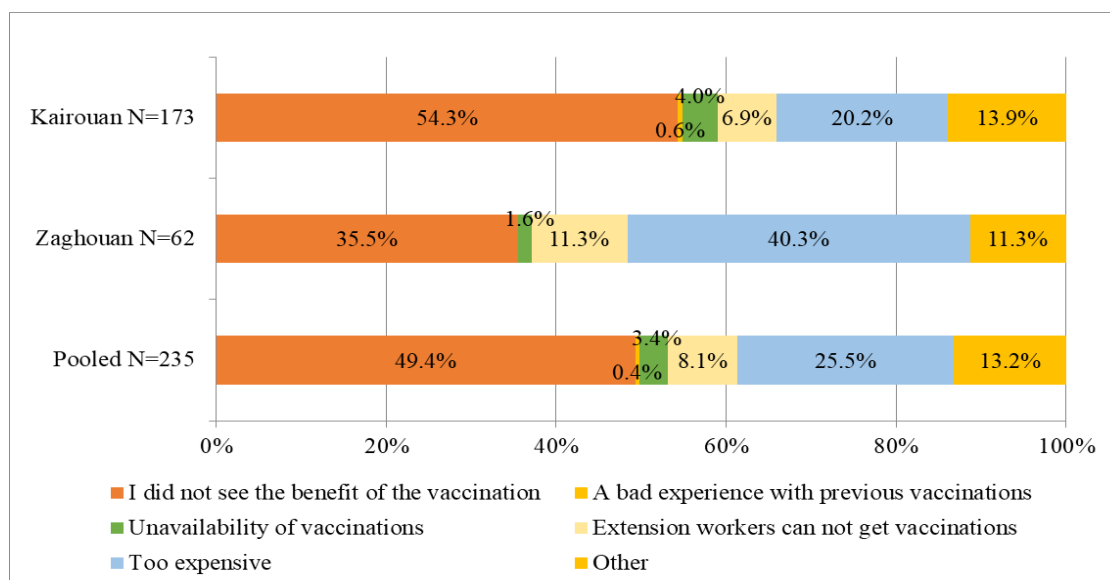


Figure 88. Reasons of non-reception of free vaccinations against parasites by governorates. %

Figure 89 shows the vaccinations against Enterotoxaemia in the last 12 months by governorate. More than three quarter of the sample had this vaccine; they were 74.5% in Kairouan and 80.5% in Zaghouan.

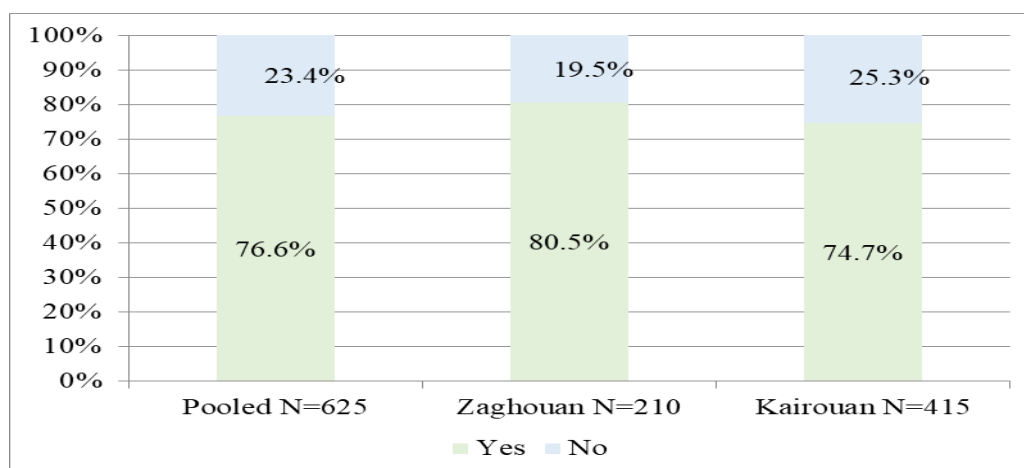


Figure 89. Vaccinations against Enterotoxaemia in the last 12 months by governorate %

The dates of the vaccinations are shown in the table below. It shows that the vaccines are done all the year long, with an emphasis on the months of March and May. In fact, in Zaghouan 29% of the sample gave the vaccine on March and 19.5% in May. In Kairouan,

they were 24.8% in March and 20.3% in May. December, January and February are the months where very few vaccinations are done against Enterotoxaemia (Table 56).

Table 56. Dates of vaccinations against Enterotoxaemia in the last 12 months. %

	Pooled N=479	Zaghouan N=169	Kairouan N=310
January	1.7%	2.4%	1.3%
February	2.5%	1.2%	3.2%
March	26.3%	29.0%	24.8%
April	10.2%	8.9%	11.0%
May	20.0%	19.5%	20.3%
June	7.9%	7.1%	8.4%
July	4.0%	1.2%	5.5%
August	2.9%	3.6%	2.6%
September	6.1%	8.3%	4.8%
October	9.4%	9.5%	9.4%
November	6.9%	8.3%	6.1%
December	2.1%	1.2%	2.6%

Almost the whole flock (99%) received vaccinations against Enterotoxaemia in the last year. They were 99.4% in Zaghouan and 98.7% in Kairouan (Figure 90).

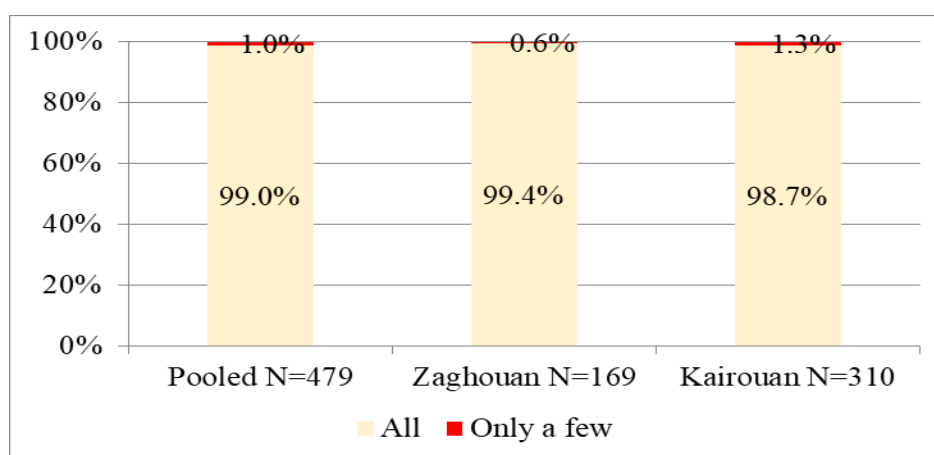


Figure 90. Vaccinations against Enterotoxaemia received in the last 12 months. %

Figure 91 shows that the personal vaccinations against Enterotoxaemia can be done by several methods. The most common is the private veterinarian with 77.5% of the sample in Zaghouan and 61.6% in Kairouan. The second method is the self treatment; it is done by 19.8% of the whole sample; 15.4% in Zaghouan and 22.3% in Kairouan. Then, the third common method is the vaccine done by the government official which is more common in Kairouan with 13.5% of the sample while they are only 4.7% in Zaghouan.

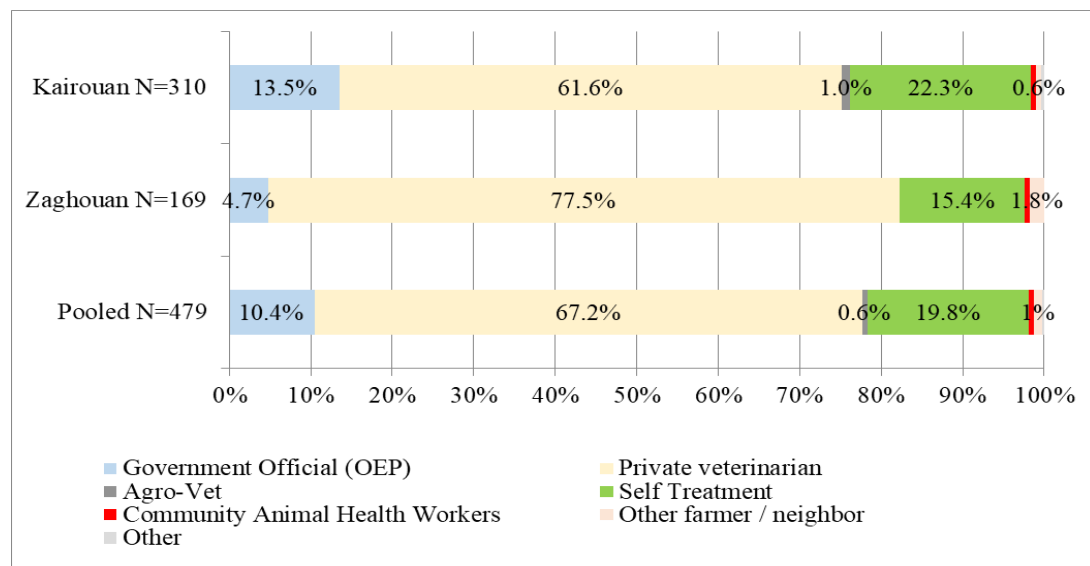


Figure 91. Personal vaccinations against Enterotoxaemia by governorates. %

Figure 92 shows the reasons of non-reception of free vaccinations against Enterotoxaemia parasites by governorate. We notice a large difference between the two locations. In Zaghouan 64.3% of the sample declare that the vaccine is too expensive, while they are only 26.6% in Kairouan to complain about the price. The second reason in Zaghouan is that the household do not see any benefit from the vaccination; this rate goes up to 39.4% in Kairouan. The third reason is almost equal between the two governorates with 11.3% for the whole sample stating that the extension workers did not get the vaccinations for them. For 18.3% of the sample there other reasons to not benefit from the vaccines while they are only 2.4% in Zaghouan.

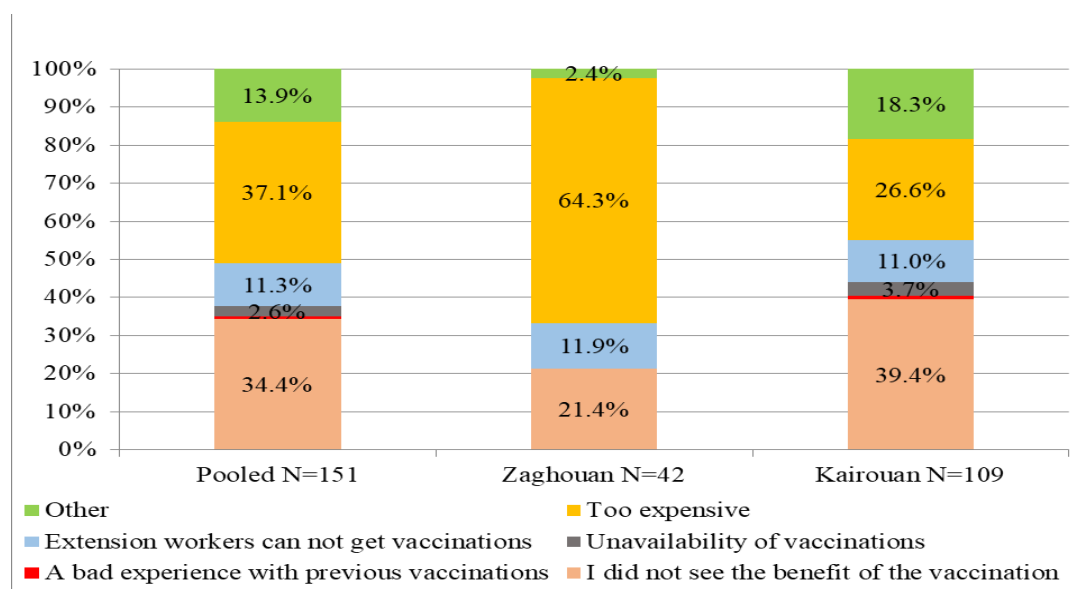


Figure 92. Reasons of non-reception of free vaccinations against Enterotoxaemia parasites by governorates. %

5.9. Module H : Livestock alimentation

Breeders from both regions are exploiting all available resources on farms. However, the basic ration remains mainly composed by barley grain, cereal bran, concentrate fodder, and dry fodder such as hay and straw. Pasture still has an important place in the forage calendar, especially for small ruminants who value this kind of resources. Cactus is one of the most used resource by the local breeders during summer season, 51% are feeding cactus to their livestock.

In a more general manner, the basic ration is composed essentially from:

Barley grain+ Cereal bran+ Straw/Hay+ Concentrate+ Cactus+ Pasture+ Agro by-products.

This composition varies according to the availability of each component during the season. During autumn and winter, the ration is composed essentially from barley grain, cereal bran, dried fodder and the pruning by-products. In the spring, pasture and greenery are the main resources. In the summer, cactus and straw are the fundamentals of this ration (Table 57).

Table 57. Use of feed livestock in the last 12 months, %

	Pooled		Kairouan		Zaghouan	
	Yes	No	Yes	No	Yes	No
Common pastures	31%	69%	27%	73%	40%	61%
Private rangeland	38%	62%	38%	62%	39%	61%
Pasture barley	13%	88%	11%	89%	11%	89%
Barley clipped	9%	91%	14%	86%	1%	100%
Straw	93%	7%	92%	8%	95%	5%
Hay	69%	31%	66%	34%	75%	25%
Dry fodder	4%	96%	3%	97%	6%	94%
Barley grain	86%	14%	81%	20%	98%	2%
Gsil	8%	92%	11%	89%	2%	98%
Green fodder	1%	99%	1%	99%	1%	99%
Cereal bran	91%	9%	88%	12%	97%	3%
Pellets (Bouchon)	29%	71%	30%	70%	28%	72%
Feed blocks	2%	98%	2%	98%	2%	98%
Cactus	51%	49%	59%	41%	34%	66%
Concentrate feed	40%	60%	42%	58%	35%	65%
Bread	23%	77%	28%	72%	13%	87%
Products from the pruning of olive trees (Kg)	65%	35%	62%	38%	71%	29%
Other by-products	3%	97%	2%	98%	3%	97%

Common pastures are used throughout the farming season. However, some farmers do not use these resources because they do not have access to it. If autumn rains are frequent, the breeders will be using the common pastures for a long time in order to minimize the production costs. In average, the common pastures are used for 50 days in winter season, 71 days during spring, 62 days in summer and 60 days during winter (Table 58). These natural rangelands are essentially composed of aromatic and medicinal plants like thyme, rosemary etc.

Table 58. Number of days for the use of common pastures

		Min	Max	Mean	Std. Deviation
Winter	Pooled N = 192	0	90	50.70	38.59
	Kairouan N = 109	0	90	45.54	38.05
	Zaghouan N = 83	0	90	57.47	38.47
Spring	Pooled N = 192	0	92	71.74	31.30
	Kairouan N = 109	0	92	65.39	34.53
	Zaghouan N = 83	0	90	80.07	24.24
Summer	Pooled N = 192	0	92	62.02	35.68
	Kairouan N = 109	0	92	54.61	37.13
	Zaghouan N = 83	0	90	71.76	31.32
Autumn	Pooled N = 192	0	91	60.18	35.82
	Kairouan N = 109	0	91	54.44	35.95
	Zaghouan N = 83	0	90	67.71	34.44

The use of private rangelands is the same as the common ones, but their access and management is much easier. However, the composition of these pastures is different from the common rangelands the present species are usually weeds. On average, breeders are using their own rangeland for 38 days in winter, 58 days during spring, 64 days in the summer, and 44 days in the autumn (Table 59).

Table 59. Number of days for the use of private rangeland

		Min	Max	Mean	Std. Deviation
Winter	Pooled N = 240	0	90	38.65	40.08
	Kairouan N = 159	0	90	43.02	41.46
	Zaghouan N = 81	0	90	30.07	35.95
Spring	Pooled N = 240	0	90	58.38	39.41
	Kairouan N = 159	0	90	61.26	38.91
	Zaghouan N = 81	0	90	52.73	40.02
Summer	Pooled N = 240	0	90	64.37	34.97
	Kairouan N = 159	0	90	64.51	35.96
	Zaghouan N = 81	0	90	64.10	33.15
Autumn	Pooled N = 240	0	90	44.39	40.37
	Kairouan N = 159	0	90	49.38	40.60
	Zaghouan N = 81	0	90	34.58	38.29

Barley green is used for a short period during the last days of autumn, winter, and spring. This depends mainly on the availability of irrigation water or the frequency of rainfall during these three seasons (Table 60).

Table 60. Number of days for the use of pasture barley

		Min	Max	Mean	Std. Deviation
Winter	Pooled N = 78	0	90	5.38	14.85
	Kairouan N = 47	0	90	4.79	16.51
	Zaghouan N = 31	0	30	6.29	12.11
Spring	Pooled N = 78	0	92	30.14	35.56
	Kairouan N = 47	0	92	24.40	34.75
	Zaghouan N = 31	0	90	38.84	35.56
Autumn	Pooled N = 78	0	90	3.65	16.07
	Kairouan N = 47	0	90	5.74	20.40
	Zaghouan N = 31	0	15	0.48	2.69

Farmers have used all the resources available on their farms; barley in its various forms, cereal bran, concentrate fodder (concentrate and bouchon), feed blocks for those who possess the fair knowledge, cactus, bread and agro by-products mainly the olive tree pruning by-products. The table below show the resources used by breeders in each season (Table 61).

Table 61. Percentage of HH using the feed livestock by season in the last 12 months, %

		Winter	Spring	Summer	Autumn
Barley clipped	Pooled, N= 57	98.2%	89.5%	91.2%	94.7%
	Kairouan, N= 56	98.2%	89.3%	91.1%	94.6%
	Zaghouan, N= 1	100.0%	100.0%	100.0%	100.0%
Dry fodder	Pooled, N= 26	42.3%	69.2%	26.9%	19.2%
	Kairouan, N= 13	30.8%	76.9%	23.1%	23.1%
	Zaghouan N= 13	53.8%	61.5%	30.8%	15.4%
Barley grain	Pooled, N= 540	96.1%	85.7%	81.5%	91.7%
	Kairouan, N= 334	94.9%	82.3%	79.3%	88.3%
	Zaghouan, N= 206	98.1%	91.3%	85.0%	97.1%
Gsil	Pooled, N= 49	57.1%	38.8%	10.2%	26.5%
	Kairouan, N= 45	55.6%	40.0%	11.1%	28.9%
	Zaghouan, N= 4	75.0%	25.0%		
Green fodder	Pooled, N= 9	55.6%	77.8%	55.6%	66.7%
	Kairouan, N= 6	50.0%	66.7%	50.0%	66.7%
	Zaghouan, N= 3	66.7%	100.0%	66.7%	66.7%
Cereal bran	Pooled, N= 571	97.2%	89.5%	84.8%	93.9%
	Kairouan, N= 367	96.5%	86.4%	82.0%	91.6%
	Zaghouan, N= 204	98.5%	95.1%	89.7%	98.0%
Bouchon	Pooled, N= 181	53.0%	31.5%	67.4%	36.5%
	Kairouan, N= 123	58.5%	39.8%	68.3%	45.5%
	Zaghouan, N= 58	41.4%	13.8%	65.5%	17.2%

Feed blocks	Pooled, N= 12	41.7%	16.7%	50.0%	16.7%
	Kairouan, N= 8	25.0%	25.0%	62.5%	25.0%
	Zaghouan, N= 4	75.0%	100.0%	25.0%	100.0%
Cactus (wheelbarrow)	Pooled, N= 228	22.8%	26.8%	68.0%	42.5%
	Kairouan, N= 158	25.9%	32.9%	65.2%	48.1%
	Zaghouan, N= 70	15.7%	12.9%	74.3%	30.0%
Cactus ha	Pooled, N= 6	33.3%	50.0%	83.6%	66.7%
	Kairouan, N= 5	40.0%	60.0%	80.0%	60.0%
	Zaghouan, N= 1	0.0%	0.0%	100.0%	100.0%
Cactus kg	Pooled, N= 80	31.3%	42.5%	68.8%	62.5%
	Kairouan, N= 80	31.3%	42.5%	68.8%	62.5%
	Zaghouan				
Concentrate feed (kg)	Pooled, N= 249	88.8%	60.2%	64.3%	62.2%
	Kairouan, N= 175	88.6%	65.7%	66.9%	65.1%
	Zaghouan, N= 74	89.2%	47.3%	58.1%	55.4%
Bread	Pooled, N= 143	86.0%	60.8%	62.2%	71.3%
	Kairouan, N= 115	86.1%	60.9%	64.3%	69.6%
	Zaghouan, N= 28	85.7%	60.7%	53.6%	78.6%
Products from the pruning of olive trees (Kg)	Pooled, N= 354	83.3%	5.6%	4.0%	18.9%
	Kairouan, N= 216	84.3%	6.5%	5.1%	19.9%
	Zaghouan, N= 138	81.9%	4.3%	2.2%	17.4%

The quantity distributed displayed in the table below is not the one distributed per head and per day, but it is the total quantity distributed for all the livestock during a season (Table 62). In winter and autumn, the ration is based on dry fodder such as hay, straw, barley grain and cereal bran. In the spring, the ration is composed mainly of greenery in these various forms: private/common rangelands, barley greenery, pruning by-products etc. In the summer, the basic ration is mainly composed from wheat and barley stubble, cactus and barley grain. The tables below show more details about the used quantities during the seasons by region (Table 62, 63).

Table 62. Average of the total quantity of feed livestock used in Kairouan

	N	Winter	N	Spring	N	Summer	N	Autumn
Barley clipped (Kg)	54	1263	50	1116	49	1054	52	1390
Cereal straw (Balls)	354	84	308	76	281	73	328	81
Hay (Balls)	234	69	178	67	117	67	191	66
Dry fodder (Balls)	1	10					1	5
Dry fodder (Kg)	2	300	3	767			2	300
Barley grain (Kg)	309	1020	270	951	251	900	285	1006
Cereal bran (Kg)	341	619	307	568	288	554	327	602
Bread (kg)	94	501	67	564	70	555	77	517
Products from the pruning of olive trees (Kg)	155	3888	14	2579	11	1691	42	1101
Products from the pruning of olive trees (Ha)	40	2	2	4			2	4
Gsil (Ha)	24	2	12	2	4	3	11	2
Other Green Fodder (Ha)	3	1	2	2	2	2	2	1

Cactus (wheelbarrow)	41	123	52	120	103	94	76	136
Cactus (Ha)	2	1	3	1	4	1	3	1
Cactus (Kg)	17	1090	27	1172	40	2296	42	1970
Concentrate Feed (Kg)	151	662	114	589	115	723	114	602
Other sub-products (Ha)			1	2				
Other sub-products (Kg)	4	4563	1	8000	1	2000		
Bouchon (Kg)	71	625	12	1041	82	604	55	648
Feed blocks (Kg)	2	325	2	150	5	244	2	675

Table 63.Average of the total quantity of feed livestock used in Zaghouan

	N	Winter	N	Spring	N	Summer	N	Autumn
Barley clipped (Kg)	1	300	1	300	1	300	1	300
Cereal straw (Balls)	188	66	169	62	143	36	187	63
Hay (Balls)	143	36	105	33	103	32	133	35
Dry fodder (Balls)	1	45	1	150	2	95		
Dry fodder (Kg)	1	200			2	95		
Barley grain (Kg)	202	702	188	650	174	637	200	696
Cereal bran (Kg)	201	389	194	369	183	358	200	387
Bread (kg)	24	315	17	300	15	295	22	355
Products from the pruning of olive trees (Kg)	112	2921	6	3458	3	1250	24	1115
Products from the pruning of olive trees (Ha)	10	2						
Gsil (Ha)	3	1	1	2				
Other Green Fodder (Ha)	2	1	2	2	2	2	1	2
Cactus (wheelbarrow)			1	45			1	45
Cactus (Ha)	11	60	9	88	52	76	21	52
Cactus (Kg)	17	1090	27	1172	40	2296	42	1970
Concentrate Feed (Kg)	151	662	114	589	115	723	114	602
Other sub-products (Ha)			1	2				
Other sub-products (Kg)	4	4563	1	8000	1	2000		
Bouchon (Kg)	71	625	12	1041	82	604	55	648
Feed blocks (Kg)	2	325	2	150	5	244	2	675

Usually, farmers are buying almost all the quantities they need for their livestock, except for some products and by-products produced by the farms such as barley, cereal straw and hay. The breeders in Kairouan are purchasing more quantities than the ones in Zaghouan because most of the basic ration components are not produced locally (Table 64, 65).

Table 64.Average of the total quantity purchased of feed livestock used in Kairouan

	N	Winter	N	Spring	N	Summer	N	Autumn
Barley clipped (Kg)	53	1261	50	1090	48	1048	52	1364
Cereal straw (Balls)	328	83	288	75	362	73	300	75

Hay (Balls)	237	63	182	59	180	61,2	193	59,5
Dry fodder (Balls)	1	10					1	5
Dry fodder (Kg)	3	100	9	22	3	583	2	150
Barley grain (Kg)	294	973	260	903	246	882	265	949
Cereal bran (Kg)	350	599	314	550	297	532	265	949
Bread (kg)	97	483	69	545	72	535	80	476
Products from the pruning of olive trees (Kg)	172	2237	14	1507	14	610	43	142
Gsil (Ha)	25	0	17	0			12	0
Cactus (wheelbarrow)	41	2	52	2	103	1	76	1
Cactus (Kg)			28	41	45	841	44	419
Concentrate Feed (Kg)	151	660	144	588	115	721	114	601
Other sub-products (Kg)	4	2694	1	8000	1	2000		
Bouchon (Kg)	71	625	12	1041	82	599	55	647
Feed blocks (Kg)	2	325	1	150	5	244	2	675

Table 65. Average of the total purchased quantity of feed livestock used in Zaghouan

	N	Winter	N	Spring	N	Summer	N	Autumn
Barley clipped (Kg)	1	300	1	300	1	300	1	300
Cereal straw (Balls)	180	66	165	61	147	62	178	62
Hay (Balls)	144	34	106	34	104	31	134	30
Dry fodder (Balls)	1	45			2	20		
Dry fodder (Kg)	3	67						
Barley grain (Kg)	196	696	183	649	171	642	191	683
Cereal bran (Kg)	201	386	194	369	183	358	191	683
Bread (kg)	24	315	17	295	15	295	22	351
Products from the pruning of olive trees (Kg)	113	1088	6	1667			24	125
Concentrate Feed (Kg)	66	371	35	421	43	721	41	415
Other sub-products (Kg)	4	1638						
Bouchon (Kg)	24	275	1	1000	38	526	9	353
Feed blocks (Kg)	1	20		1	500			

The prices of almost all the types of fodder are fixed by the markets except for the barley grain and the cereal barn subsidized and controlled by the government.

For Kairouan, the price of one ton of clipped barley varies from 493 TND in the spring to 503 TND during summer season. The price of hay is stable because it is not produced in these regions: 11 TND per bale. The prices of concentrate feed depend on the type of this latter and its quality: almost 600 TND per ton for the concentrate and 790 TND for the "Bouchon" (Table 66).

Table 66. Average price per unit purchased in Kairouan

	N	Winter	N	Spring	N	Summer	N	Autumn
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Barley clipped (TND/Kg)	52	0.499	48	0.493	47	0.503	50	0.493
Cerealstraw (TND/Balls)	323	6.4	286	6.3	256	5.9	296	6.1
Hay (TND/Balls)	217	11.5	165	11.4	162	10.5	176	11.3
Dry fodder (TND/Balls)	1	33.5					1	33.5
Dry fodder (TND/Kg)	1	0.2	1	0.2	2	0.55	1	0.2
Barley grain (TND/Kg)	284	0.48	251	0.48	240	0.47	259	0.47
Cereal bran (TND/Kg)	308	0.329	278	0.324	261	0.313	295	0.327
Bread (TND/kg)	44	0.222	29	0.22	34	0.234	31	0.237
Products from the pruning of olive trees (TND/Kg)	51	0.043	3	0.037	2	0.038	2	0.015
Gsil (TND/Ha)	1	100					2	150
Cactus (TND/wheelbarrow)	1	5	1	5	1	5	1	5
Cactus (TND/Kg)			34	0.639	2	0.56	42	0.55
ConcentrateFeed (TND/Kg)	144	0.589	109	0.572	110	0.59	107	0.589
Other sub-products (TND/Kg)	2	0.05	1	0.075	1	0.08		
Bouchon (TND/Kg)	69	0.749	9	.789	83	0.774	53	0.758
Feed blocks (Kg)	2	0.3	1	0.3	4	0.325	2	0.3

In the case of Zaghouan (Table 67), the prices are more reasonable for some fodder types such as straw and hay 5 TND in average for the cereal straw and 10 TND per bale for the hay. In the case of cereal bran, the prices are better than the ones in Kairouan because of the absence of informal market: 300 TND per ton.

Table 67. Average price per unit purchased in Zaghouan

	N	Winter	N	Spring	N	Summer	N	Autumn
Barley clipped (TND/Kg)	1	0.5	1	0.5	1	0.5	1	0.5
Cereal straw (TND/Balls)	182	5.7	167	5.7	151	5.3	178	5.5
Hay (TND/Balls)	135	10.9	100	10.8	98	10.4	121	10.6
Dry fodder (TND/Balls)	1	5			1	4		
Dry fodder (TND/Kg)	1	0.2						
Barley grain (TND/Kg)	193	0.45	181	0.45	170	0.45	188	0.45
Cereal bran (TND/Kg)	184	0.3	180	0.297	197	0.294	183	0.297
Bread (TND/kg)	4	0.163	2	0.15	4	0.213	4	0.175
Products from the pruning of olive trees (TND/Kg)	33	0.043	2	0.037				
Concentrate Feed (TND/Kg)	64	0.61	34	0.639			40	0.635
Other sub-products (TND/Kg)	5	0.0474						
Bouchon (TND/Kg)	22	0.709	4	.925	38	0.716	7	0.637
Feed blocks (Kg)	1	0.30						

Breeders in both regions are distributing the fodder at least one time per day. Hay, straw, cereal bran, barley grain and concentrate are usually distributed twice a day in every season. In the winter, 57.3% of the farmers are distributing the “Bouchon” once a day and 1% of them are doing this three times. The concentrate feed is distributed twice a day for 50.23% of the breeders. Generally, the breeders distribute all types of fodder twice a day during the four seasons (Table 68).

Table 68. Number of uses per day, %

			1 time	2 times	3 times	5 times
Winter	Bouchon	Pooled N= 96	57.30%	41.70%	1%	
		Kairouan N= 72	52.78%	45.83%	1.39%	
		Zaghoun N= 24	70.83%	29.17%		
	Feed blocks	Pooled N= 5	80%	20%		
		Kairouan N= 2	50%	50%		
		Zaghoun N= 3	100%			
	Concentrate Feed	Pooled N= 221	49.32%	50.23%	0.45%	
		Kairouan N= 155	41.29%	58.06%	0.65%	
		Zaghoun N= 66	68.18%	31.82%		
Spring	Bouchon	Pooled N= 57	57.90%	40.40%	1.80%	
		Kairouan N= 49	55.10%	42.86%	2.04%	
		Zaghoun N= 8	75%	25%		
	Feed blocks	Pooled N= 2	100%			
		Kairouan N= 2	100%			
		Zaghoun N= 0				
	Concentrate Feed	Pooled N= 150	59.33%	40%	0.67%	
		Kairouan N= 115	50.43%	48.70%	0.87%	
		Zaghoun N= 35	88.57%	11.43%		
Summer	Bouchon	Pooled N= 122	49.18%	49.18%	1.64%	
		Kairouan N= 84	51.19%	46.43%	2.38%	
		Zaghoun N= 38	44.74%	55.26%		
	Feed blocks	Pooled N= 6	50%	50%		
		Kairouan N= 5	40%	60%		
		Zaghoun N= 1	100%			
	ConcentrateFeed	Pooled N= 160	57.50%	41.88%	0.63%	
		Kairouan N= 117	47.86%	51.28%	0.85%	
		Zaghoun N= 43	83.72%	16.28%		

Autumn	Bouchon	Pooled N= 66	59.09%	39.39%	1.52%	
		Kairouan N= 56	53.57%	44.64%	1.79%	
		Zaghuan N= 10	90%	10%		
	Feed blocks	Pooled N= 2		100%		
		Kairouan N= 2		100%		
		Zaghuan N= 0				
	Concentrate Feed	Pooled N= 155	58.06%	40.65%	0.65%	0.60%
		Kairouan N= 114	50.88%	47.37%	0.88%	0.90%
		Zaghuan N= 41	78.05%	21.95%		

Figure 93 shows the feeding of lambs and adult sheep in concentrate and food blocks. 63.9% of HH (51.4% in Zaghuan and 69.1% in Kairouan) give the concentrate for both adult sheep and lambs. However, 17.6% of HH give concentrate for only lambs in Zaghuan. For the feed blocks, it is used for both adult sheep and lambs by 100% HH in Zaghuan while it is used by 75% in Kairouan.

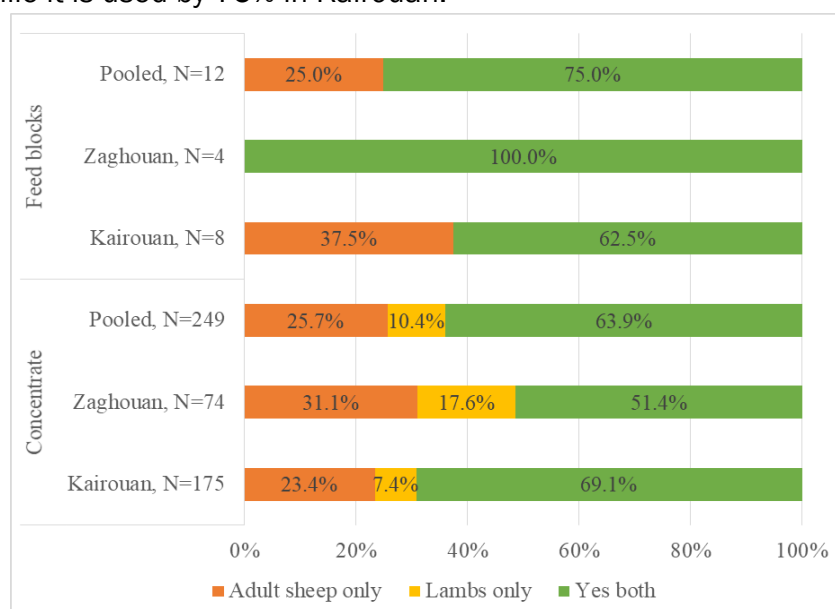


Figure 93. Feeding of lambs and adult sheep in concentrate and food blocks by governorate, %

Figure 94 shows the main reasons of no use of the green barley. The unavailability of green barley is the main reason for the no use of this feed in both governorates (97% of HH in Kairouan and 100% in Zaghuan). Only 1.9% of HH declared other reasons such as “Price is too high”, “last year was a drought year” “I sold my sheep”.

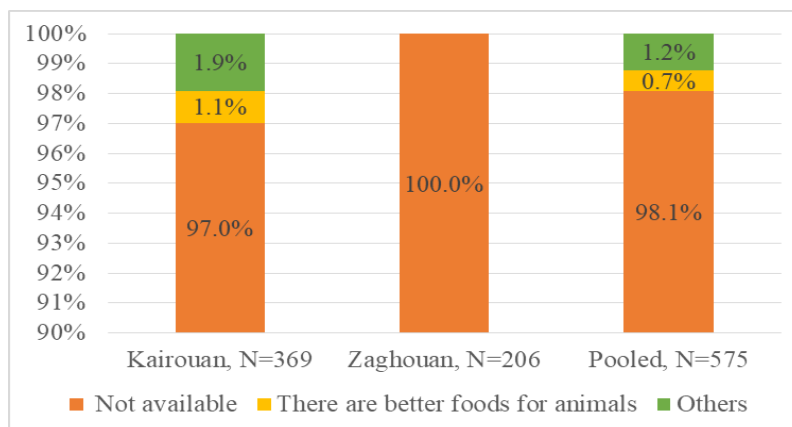


Figure 94. Main reasons of no use of the green barley by governorate, %

Figure 95 shows the main reasons of no use of the cactus pear. There are better foods for animals; it is not nutritious for animals and the unavailability of products are the major reasons of no use of the cactus pear for the option 1 and option 2 of HH responses in both governorates. By governorate, 42.3% of HH in Zaghouan think that the cactus pear is not nutritious for animals (option 2) while 50% of HH in Kairouan consider that there are a better foods for animals than the cactus pear. The other reasons stated by the HH are “Hard work to cut cactus rackets”, “Not benefit for animals” and “I sold my animals”.

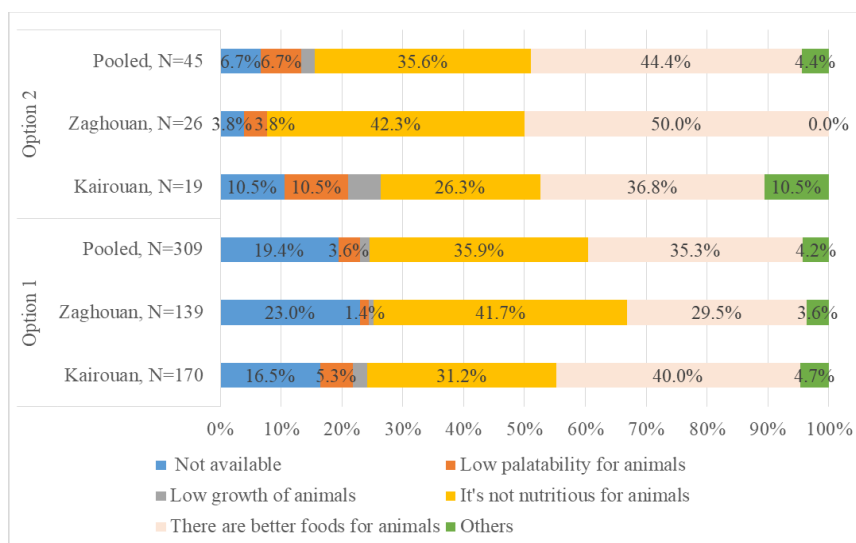


Figure 95. Main reasons of no use of the cactus pear by governorate, %

Figure 96 shows the main reasons of no use of the products from the pruning of olive trees. The unavailability of the products is the main reason for the no use of the products from the pruning of olive trees in both governorates (66.2%) for the option 1 of the HH responses. In option 2, “there are better foods for animals” (55.6%) is the main reason declared by the HH in Kairouan while 33.3% of HH in Zaghouan mentioned “it is not nutritious for animals” as the main reason of no use. The other reasons revealed by the HH

are “Doesn’t make the pruning of olive trees last year”, “Not benefit for animals” and “High transport cost”.

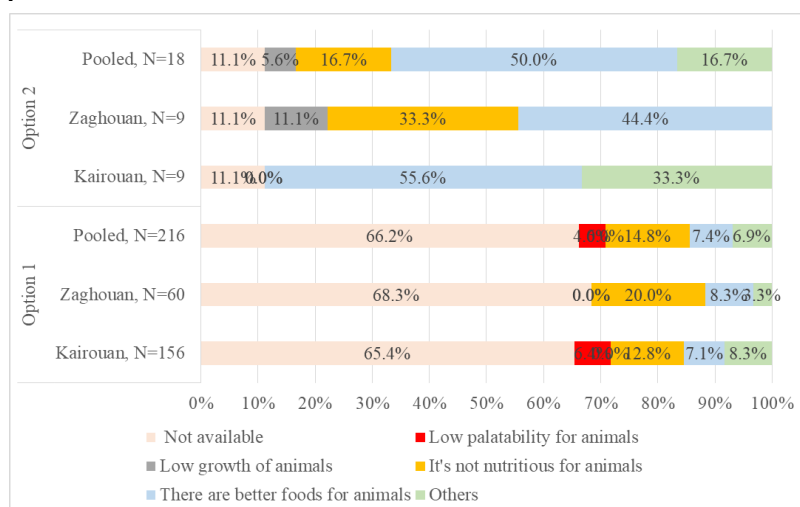


Figure 96. Main reasons of no use of the products from pruning of olive trees by governorate, %

Table 69 shows the water cost between June and August. The average water costs are high in Kairouan (79.64 TND) in comparison with Zaghoun (11.28 TND).

Table 69. Water cost (June to August 2018) by governorate

	Mean	Sd. Deviation
Pooled, N=456	53.46	633.056
Kairouan, N=282	79.64	805.254
Zaghoun, N=175	11.28	13.534

The average of watering livestock frequency is almost two for both governorates with a maximum of 5 times in Zaghoun (Table 70).

Table 70. Watering livestock frequency by governorate

	Min	Max	Mean	Sd. Deviation
Pooled, N=603	1	5	2.00	0.494
Kairouan, N=398	1	4	2.01	0.489
Zaghoun, N=205	1	5	1.96	0.503

Figure 97 shows the use of cactus chopper to feed animals. The majority of HH do not use cactus chopper to feed animals (93.1% of HH in Kairouan and 88.7% in Zaghoun).

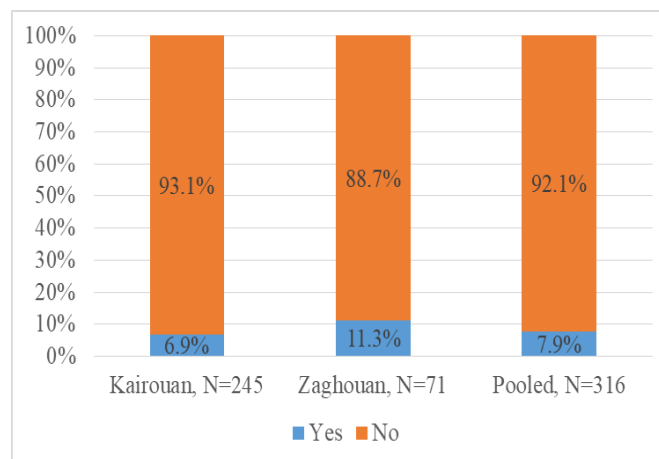


Figure 97. Cactus chopper used to feed animals by governorate, %

Figure 98 shows the main reasons of no use of the cactus chopper. 43% and 27% of HH mentioned the unavailability of the products as the main reason of no use of the cactus chopper while 22.8% and 36.5% of HH did not need the cactus chopper respectively in Kairouan and Zaghouan. However, 26.8% of HH do not know the cactus chopper in both governorates.

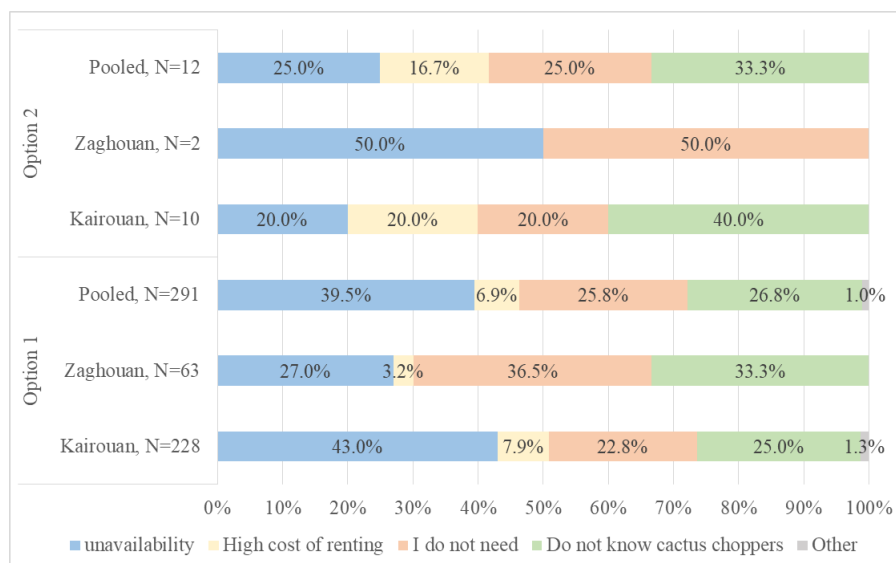


Figure 98. Main reasons of no use of the cactus chopper by governorate, %

Figure 99 shows the grinding barley method before the sheep feeding. For sheep, 47.5% of HH do coarse grinding of barley before the sheep feeding while 10.8% do a fine grinding in both governorates. For lambs, 55% of HH do coarse grinding of barley before the sheep feeding while 13% do a fine grinding in both governorates.

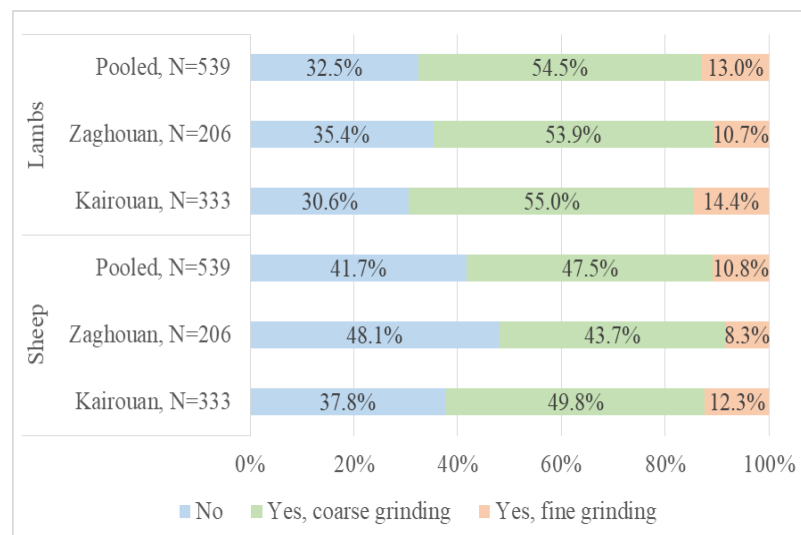


Figure 99. Grinding barley before sheep feeding by governorate, %

Figure 100 shows the change in the sheep's diet in the last 2 years. 85.3% of HH declared not have a change in the sheep's diet in the last 2 years in both governorates. However, 15.7% of HH in Kairouan and 14.2% in Zaghouan stated changing the sheep's diet in the last 2 years.

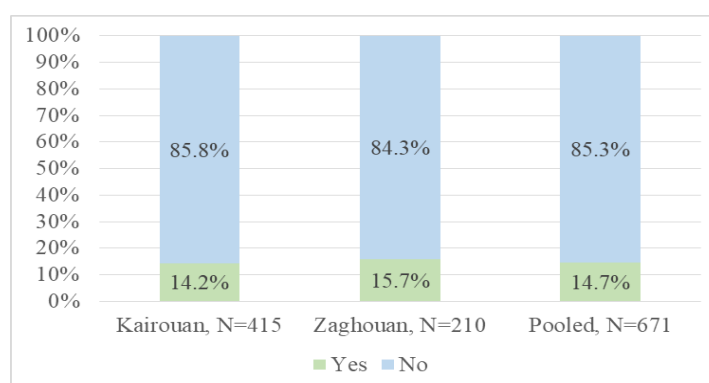


Figure 100. Change in your sheep's diet in the last 2 years by governorate, %

Figure 101 shows the reasons for changing feeding practices. 52.2% and 37% of HH declared “lower the costs” and “Availability/ access to the feed has changed” respectively as the main reasons for changing feeding practices in both governorates.

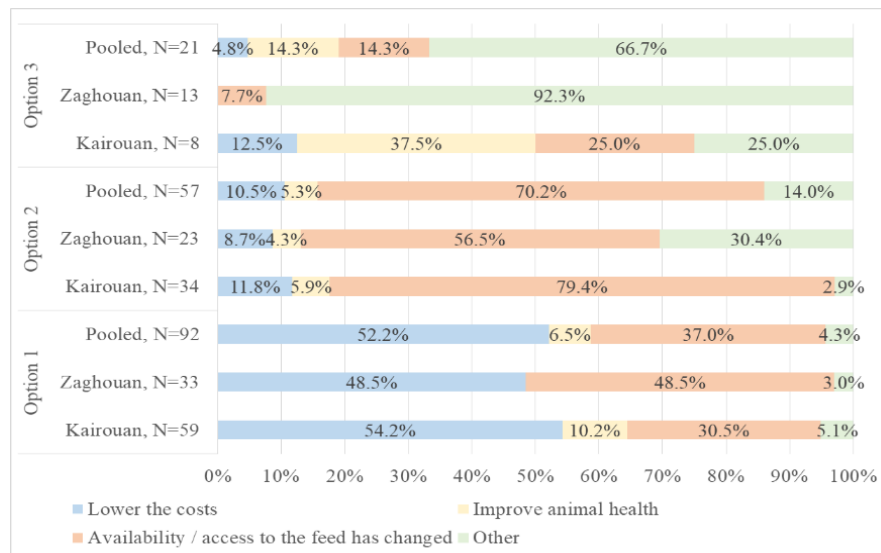


Figure 101. Reasons for changing feeding practices by governorate, %

Figure 102 shows the types of forages that decreased compared to 2 years ago. The common pastures, the concentrate feed and the private rangeland are the main forages that decreased compared to 2 years ago respectively by 48.5%, 15.2% and 12.1% of HH in Zaghuan. In Kairouan, 28.8%, 10.2% and 8.5% of HH declared respectively the common pastures, the cereal bran and the pellets as the main forages that decreased compared to 2 years ago in Kairouan.

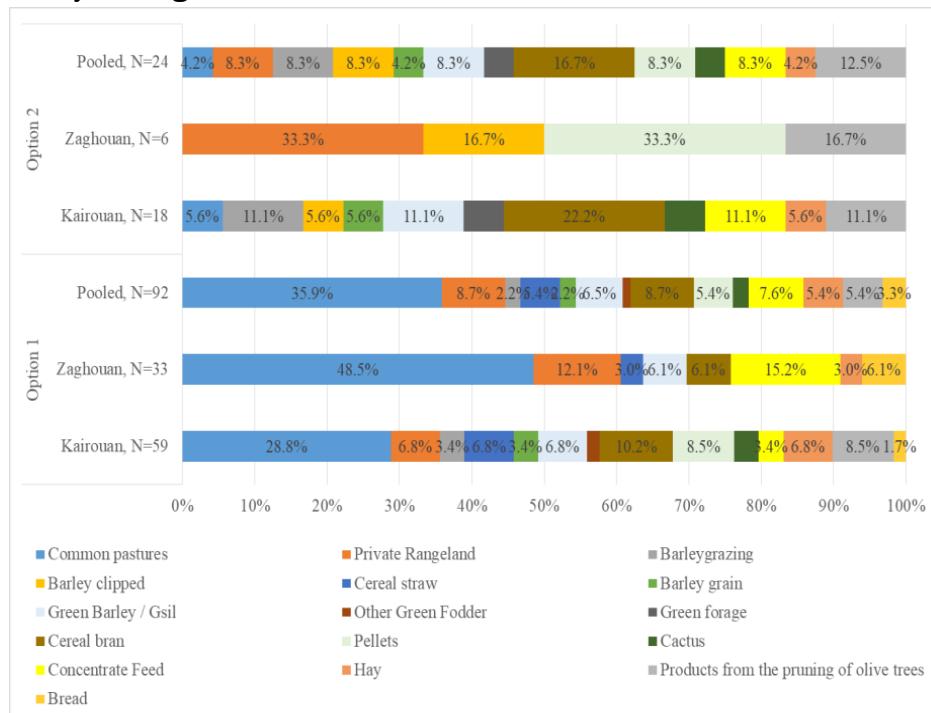


Figure 102. Types of forage that decreased compared to 2 years ago

Figure 103 shows the types of forages that increased compared to 2 years ago. The barley grain, the cereal straw and the bread are the main forages that increased compared to 2 years ago respectively by 51.5%, 15.2% and 12.1% of HH in Zaghouan. In Kairouan, 45.8%, 11.9% and 8.5% of HH declared respectively barley grain, cereal brand and the products from pruning of olive trees as the main forages that increased compared to 2 years ago in Kairouan.

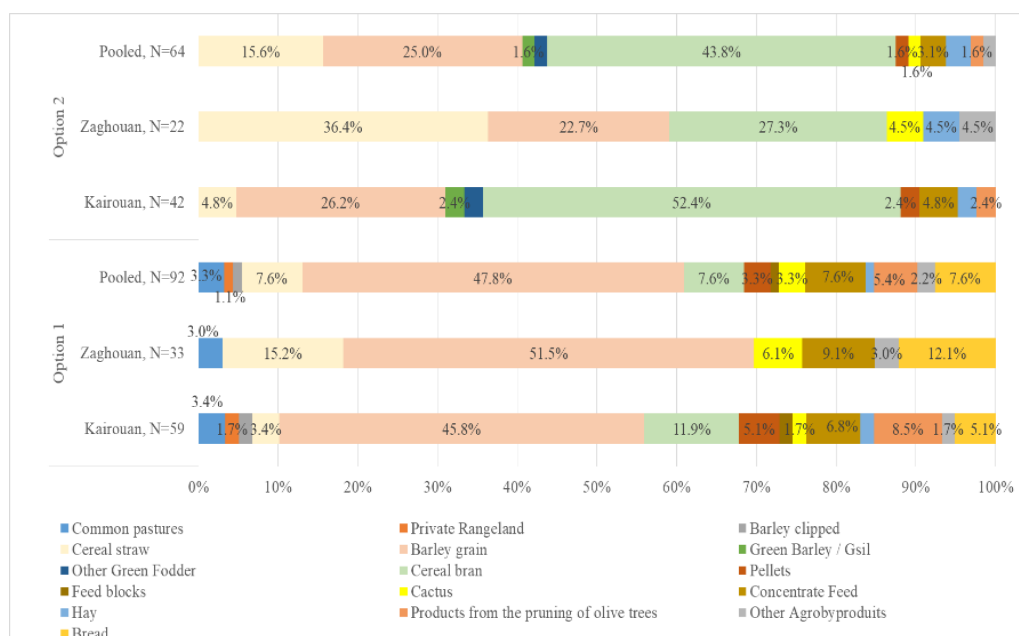


Figure 103. Types of forages that increased compared to 2 years ago

Figure 104 shows the food and forage preservation in storage. 74.8% of the HH (82.5% in Zaghouan and 70% in Kairouan) preserve their food and forage in a storage on the farm. However, only 3.6% and 1.9% of HH preserve their food and forage in a storage outside the farm respectively in Kairouan and Zaghouan.

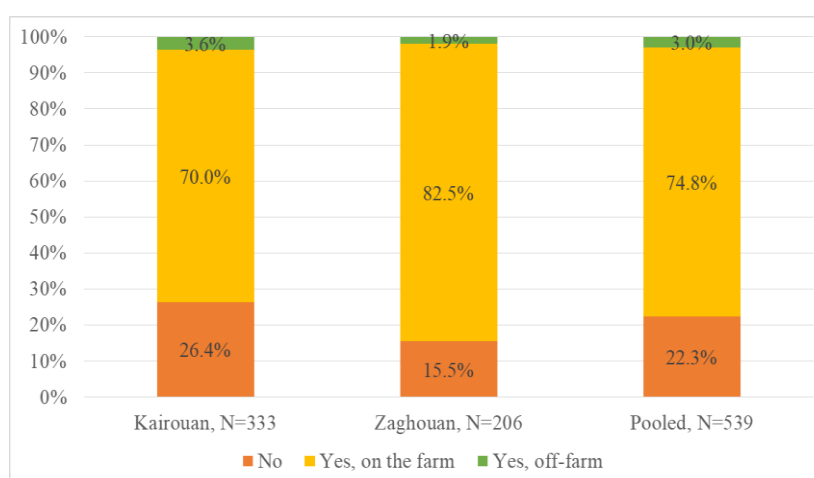


Figure 104. Food and forage preservation in a storage by governorate, %

Figure 105 shows the main constraints to forage storage. The lack of storage space and the cost of material are the major constraints to storage space respectively for 35.7% and 22.5% of HH in Kairouan. In Zaghouan, the cost of material (30.6%), the lack of storage (20.9%), the lack of transport means (19.4%) and insects' pest (17.5%) are the main constraints to forage storage. Other reasons revealed by the HH are "Low quantity of forage", "Lack of financial support" and "Not benefit for small breeders".

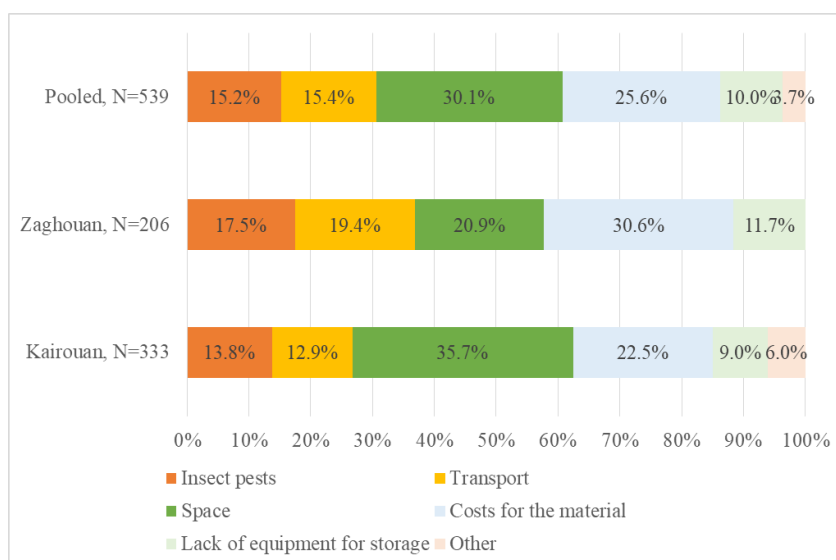


Figure 105. Main constraints to forage storage by governorate, %

Figure 106 shows the percentage of HH buying extra fodder. In Zaghouan, 47.1% of HH buy extra fodder whenever they need it while 43.8% of HH buy extra fodder when the price is lower. In Kairouan, almost half of HH buy extra fodder when the price is lower and 26.7% of HH buy whenever they need it.

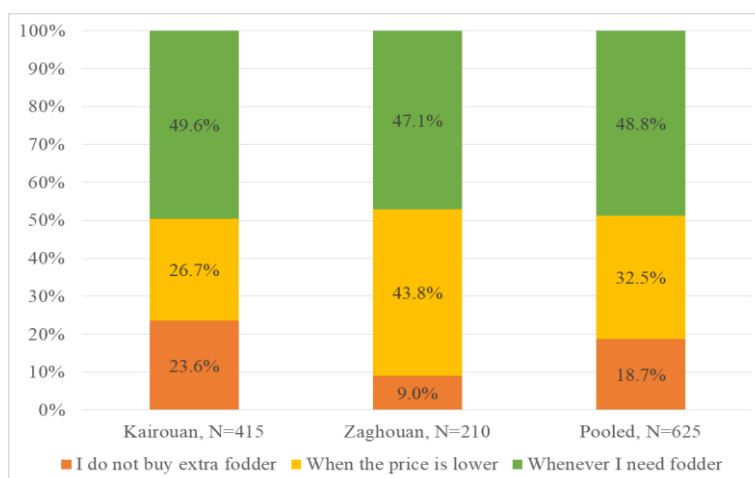


Figure 106. Buying extra fodder by governorate, %

Table 71 shows the cattle cost feeding in TND. The average cattle cost feeding in both governorates is 2629 TND with a minimum of 300 TND and a maximum of 15000 TND. The average cattle cost feeding in Zaghouan is relatively higher than Kairouan (2737 TND against 2548 TND respectively).

Table 71. Cattle cost feeding by governorate in TND

	Min	Max	Mean	S. Deviation
Kairouan, N=59	300	10000	2548.05	2307.509
Zaghouan, N=44	350	15000	2737.05	2763.803
Pooled, N=625	300	15000	2628.79	2501.347

5.10. Module I. Technology awareness and uptake

Figure 107 shows the percentage of HH who have heard about Kounouz variety and technologies. Half of HH (52.8%) have heard about feed blocks in both governorates. In Zaghouan, the proportion of HH is higher than Kairouan (59.4% against 49.6% respectively). For Kounouz variety, around 70% of HH stated having heard about it in both governorates with a higher rate for Zaghouan (73.3%). Regarding Enterotoxaemia and Anthelmintic parasites vaccinations, the percentage of HH that heard about them is high in both governorates (87.3% and 77.6% respectively). In Zaghouan, the percentage of HH who have heard about the two vaccinations is higher than Kairouan (85.7% against 17.1% for Anthelmintic parasites vaccination and 94.9% against 83.7% for Enterotoxaemia vaccination respectively).

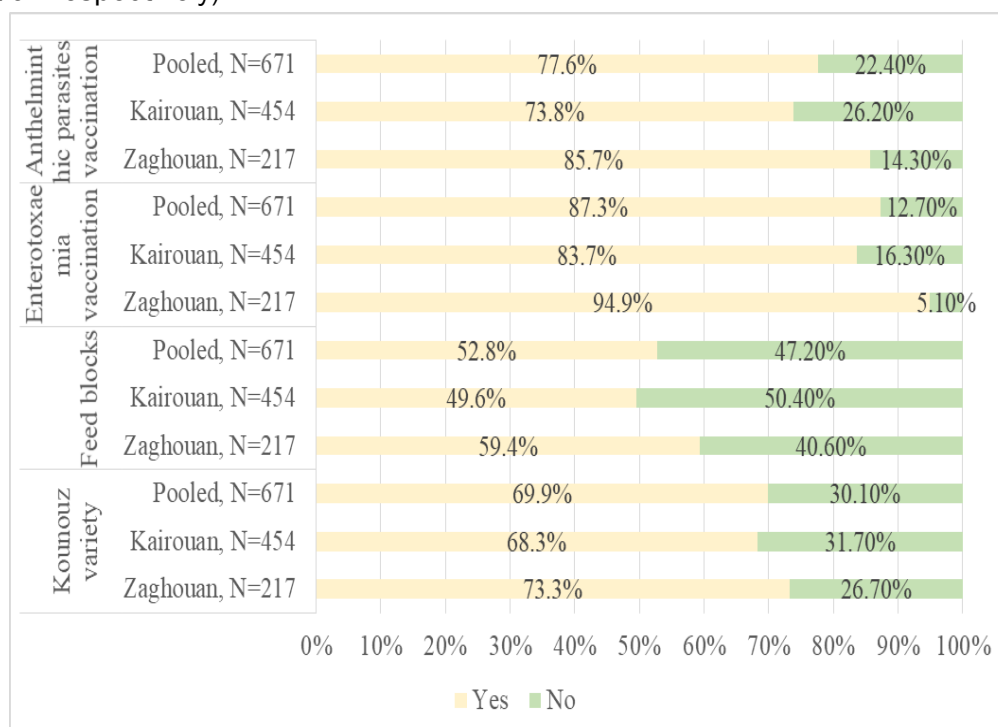


Figure 107. Households that heard about the variety/technology by governorate. %

Figure 108 shows the percentage of use of the variety kounouz and technologies. This percentage is very low for feed blocks (1.8% of HH in both governorates) and low for the use of mechanical seeder (9.6% of HH in both governorates) and for Kounouz variety (16.7% of HH in both governorates). The percentage of use of Kounouz variety by HH in Kairouan is higher than Zaghouan (20.3% against 9.2%). Nearly 45.2% of HH use Amonitrate in both governorates. The use of Enterotoxaemia and Anthelmintic parasites vaccinations by HH is high in both governorates (65.4% and 86.8% respectively) especially in Zaghouan (75.7% and 91.9% respectively).

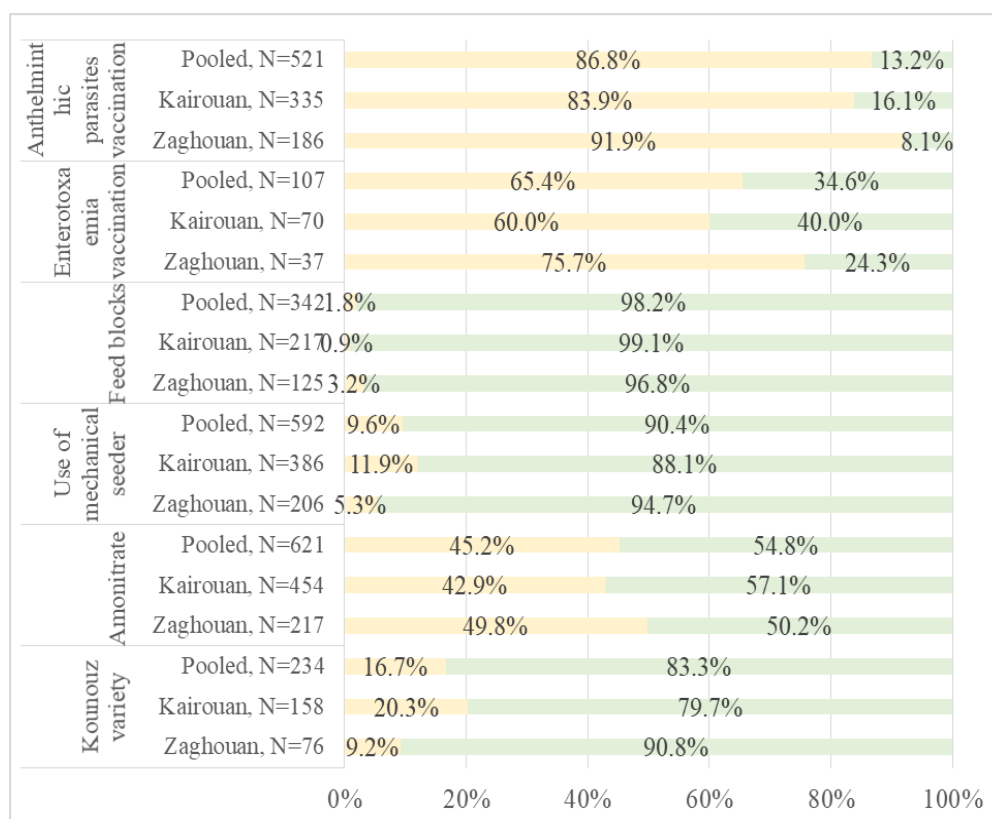


Figure 108. Percentage of use of the variety-technology by governorate. %

Figure 109 shows the main reasons of no use of the Kounouz variety. In Zaghouan, the unavailability of seed (33%), the fact that HH do not plant barley (29%) and the preference for the others varieties of barley (local variety with low purchase price) are the main reasons of no use of Kounouz variety. In Kairouan, the preference for the other varieties (29.4%), the unavailability of seed (23.8%) and the lack of cash to buy seed (9.5%) are the main reasons of no use of Kounouz variety. However, 20% of HH in both governorates declared to no use the Kounouz variety for other reasons. These reasons are:

- the unfavorable agricultural season in the year 2017-2018,
- the majority of farmers are small and poor,
- the increase in the price of the seeds from 40 to 60 TND (100kg),
- the farmers attachment to their traditional agricultural practices
- Some farmers re-used Kounouz seeds harvested during the 2017-2018 (moderate importance).

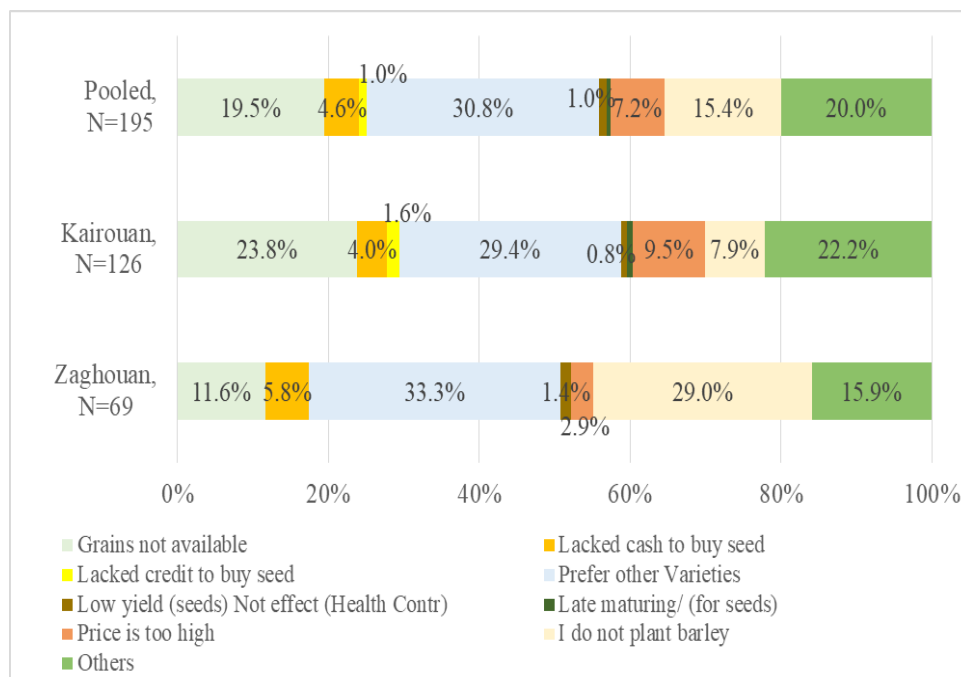


Figure 109. Main reasons of no use of the Kounouz variety by governorate, %

Figure 110 shows the main reasons of no use of the Amonitrate. In Zaghouan, the fact that HH do not have crops to which this technology applies (27.5%), the price is too high (11.9%), the preference for other technologies (11%) and unavailability of technology are the main reasons of no use of Amonitrate. In Kairouan, the preference for other technologies (22%), the fact that HH do not have crops to which this technology applies (18.1%), the price is too high (13.5%) and the lack of cash to buy technology are the main reasons of no use of Amonitrate. However, 27.2% of HH in both governorates stated no use Amonitrate for other reasons. These reasons are related mainly to the characteristics of small and poor farmers who prefer spend less money on their crops.

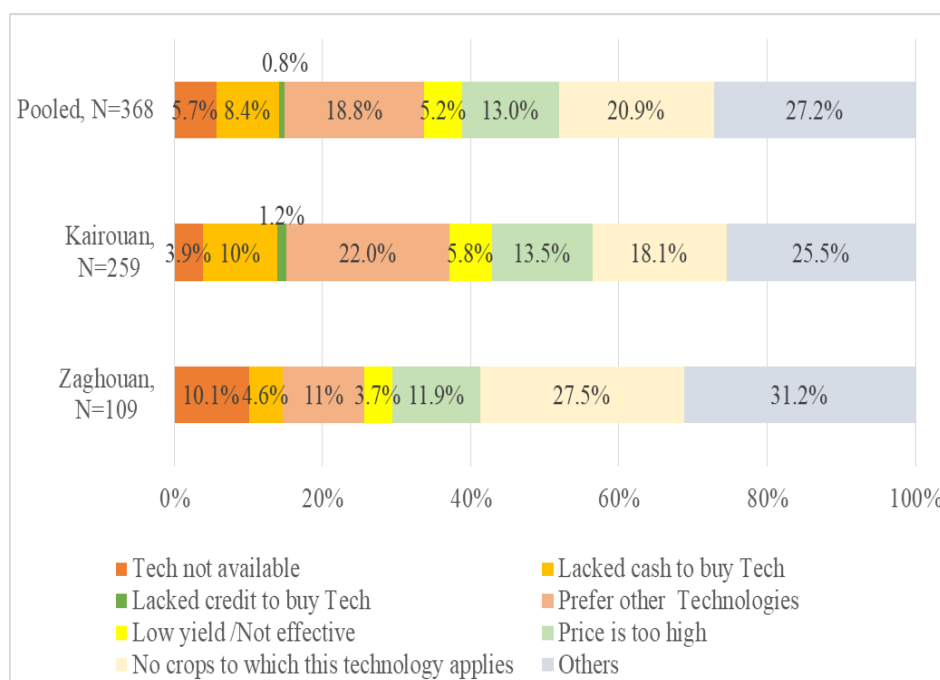


Figure 110. Main reasons of no use of the Amonitrate by governorate, %

Figure 111 shows the main reasons of no use of the mechanical seeder. In both governorates, the preference of other technologies with a low cost (31.2%), the unavailability of technology (20.4%), the fact that HH do not have crops to which this technology applies (11.6%), the inefficiency of the technology and the price is too high (11.2%) are the main reasons of no use of Amonitrate. By governorate, the percentage of HH declaring that the technology is not effective and that they do not have crops to which this technology applies is higher in Zaghouan than Kairouan.

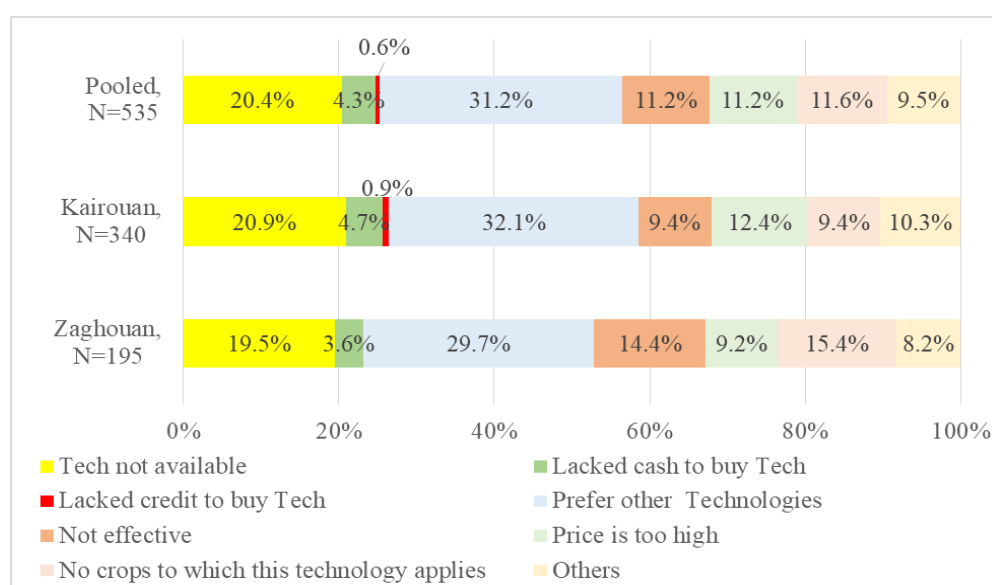


Figure 111 .Main reasons of no use of the mechanical seeder by governorate, %

Figure 112 shows the main reasons of no use of the feed blocks. In both governorates, the preference for other foods for animals (bran and local barley seed) is high (38.4%), the unavailability of technology (18.5%), The inefficiency of the technology (11.6%) and the fact that HH do not consider the technology nutritious for animals (8%) are the main reasons of no use of the feed blocks by the HH. By governorate, the percentage of HH stating the feed blocks are not nutritious for animals is higher in Zaghouan than Kairouan (13.2% against 5.1% respectively). Among the other reasons, the HH graze their herds in the fields after the rainfall periods.

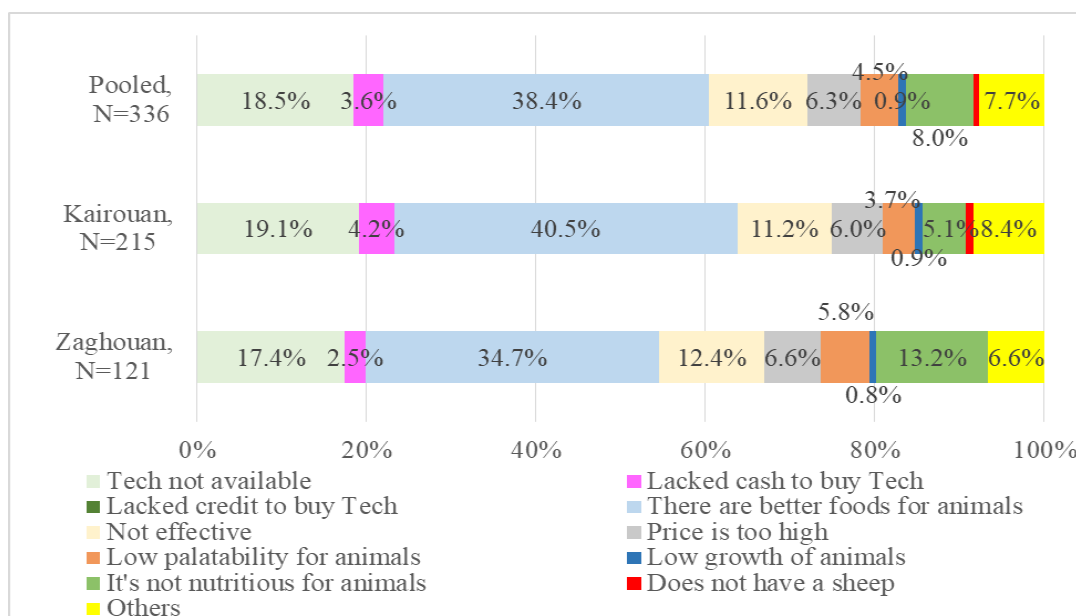


Figure 112 .Main reasons of no use of the feed blocks by governorate, %

Figure 113 shows the main reasons of no use of Enterotoxaemia and Anthelminthic parasites vaccinations. In Zaghouan, the major reasons of no use of the vaccination are the highness of the price (100% of HH for the Enterotoxaemia and 66.7% of HH for the Anthelminthic parasites). In Kairouan, the price is too high (32.1%) and the lack of cash to buy technology are the main reasons on no use of Enterotoxaemia vaccination while the highness of the price (20.4%) and the preference for other technologies (16.7%) are the major reasons of no use of Anthelminthic parasites vaccination. We notice that 30.4% and 21.6% of HH in both governorates stated other reasons for the no use of Enterotoxaemia and Anthelminthic parasites vaccinations. These reasons are related mainly to the characteristics of the zone (large area, rugged operational areas, etc.)

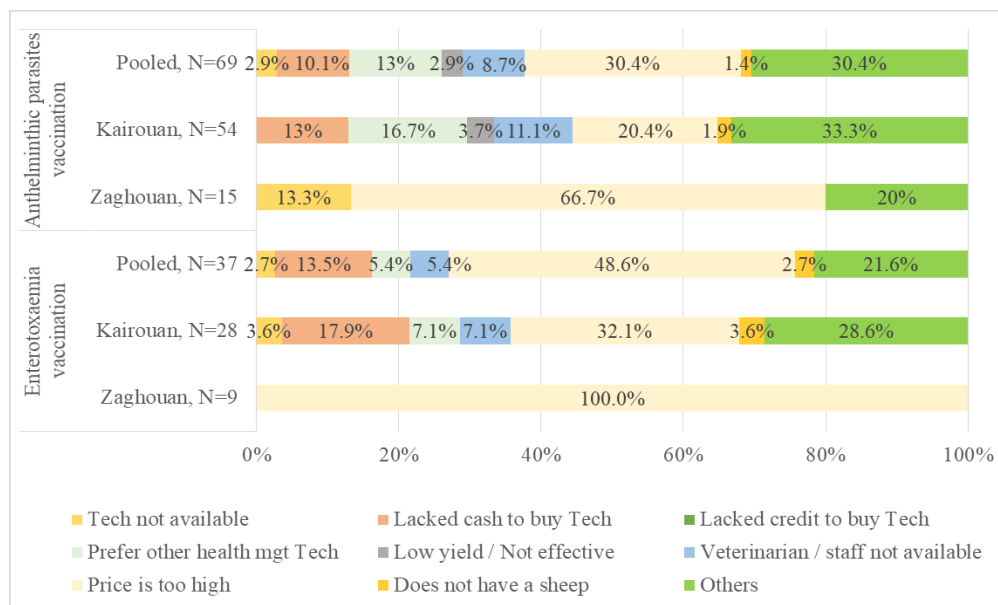


Figure 113 .Main reasons of no use of the Enterotoxaemia and Anthelmintic parasites vaccinations by governorate, %

Figure 114 shows the main sources of information about variety-technology used this year. Nearly 74.4% and 65.5% of HH stated that the extension agents are the main source of information of kounouz variety and feed blocks used respectively in both governorates. However, the other farmers (relative/neighbors) are the major source of information of Amonitrate and mechanical seeder in both governorates (65.3% and 71.1% of HH respectively). For the Enterotoxaemia and Anthelmintic parasites vaccinations, the main sources of information is the market (50.9% and 44.3% respectively) and the other farmers (29.2% and 37% respectively) in both governorates.

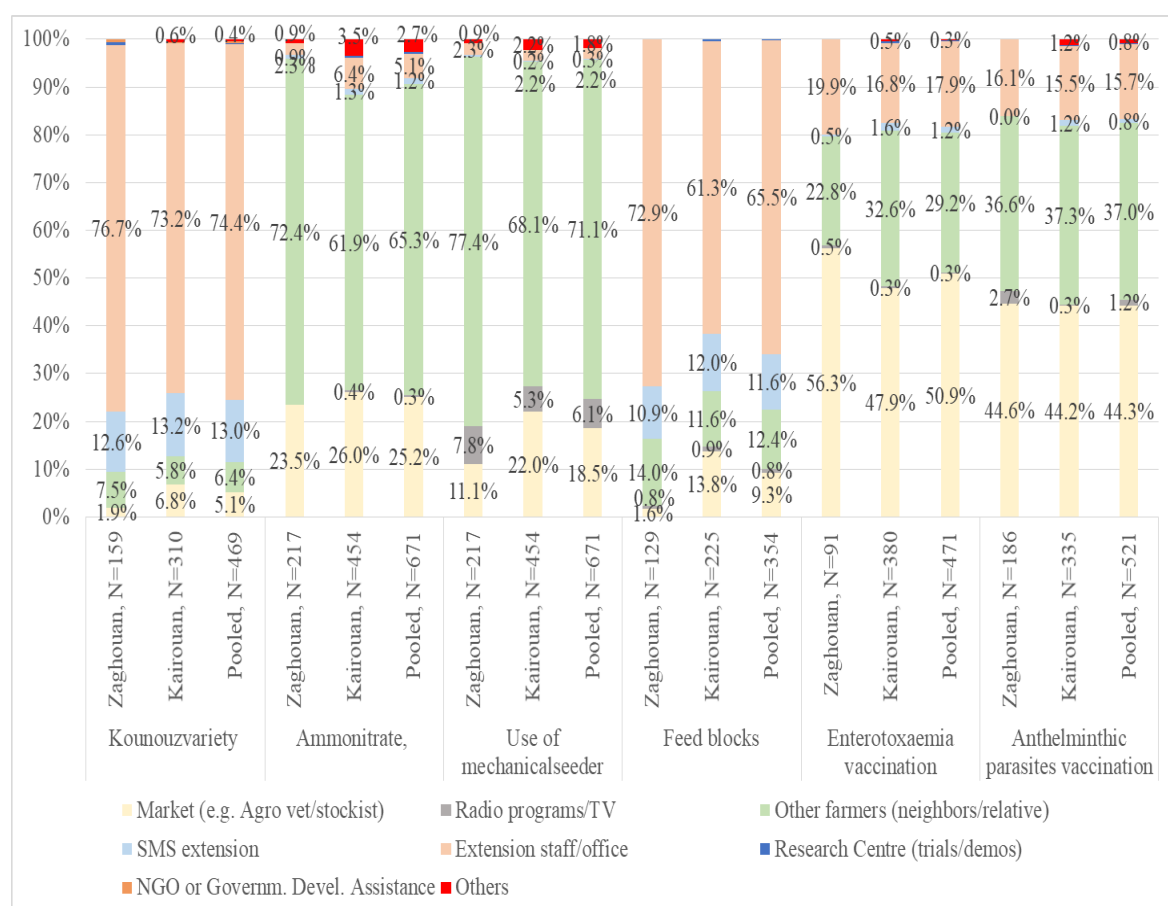


Figure 114 .Main sources of information about variety-technology used this year / Governorate

Table 72 shows the number of years of technology use. For the Kounouz variety and feed blocks, 99.6% and 94.4% of HH respectively declared using these technologies during 5 years or less in both governorates. Concerning Amonitrate, this technology has been used with almost equal proportion of HH in different periods in both governorates (27.1% in period 1, 26.7% in period 2, 29.04% in period 3 and 17.2% in period 4). The mechanical seeder has been used by HH mostly in period 1 (70.6%) and period 2 (23.5%) in both governorates. For the Enterotoxaemia and Anthelmintic parasites vaccinations, it has been used by HH for a long time especially in period 3 (12-20 years) (36.8% and 34.5% respectively).

Table 72.Number of years of technology use (for variety # seasons planted) / Governorate

	Period I		Period II		Period III		Period IV		Total	
	5 Years or less		6 – 11 Years		12 – 20 Years		21 Years or above			
	N	%	N	%	N	%	N	%	N	%
Zaghouan										
Kounouz variety	90	100%							90	100%
Ammonitrate	24	22.2%	24	22.2%	38	35.2%	22	20.37%	108	100%
Use of mechanical seeder	13	59.1%	9	40.9%				0.00%	22	100%
Feed blocks	7	87.5%		0.0%			1	12.50%	8	100%

Enterotoxaemia vaccination	15	7.6%	66	33.5%	76	38.6%	40	20.30%	197	100%
Anthelmintic parasites vaccination	34	19.9%	34	19.9%	65	38.0%	38	22.22%	171	100%
Kairouan										
Kounouz variety	183	99.5%	1	0.5%					184	100%
Ammonitrate	58	29.7%	57	29.2%	50	25.6%	30	15.38%	195	100%
Use of mechanical seeder	83	72.8%	23	20.2%	6	5.3%	2	1.75%	114	100%
Feed blocks	10	100%		0.0%					10	100%
Enterotoxaemia vaccination	62	17.6%	116	33.0%	126	35.8%	48	13.64%	352	100%
Anthelmintic parasites vaccination	71	25.3%	76	27.0%	91	32.4%	43	15.30%	281	100%
Pooled										
Kounouz variety	273	99.6%	1	0.4%					274	100%
Ammonitrate	82	27.1%	81	26.7%	88	29.04%	52	17.2%	303	100%
Use of mechanical seeder	96	70.6%	32	23.5%	6	4.41%	2	1.5%	136	100%
Feed blocks	17	94.4%		0.0%		0.00%	1	5.6%	18	100%
Enterotoxaemia vaccination	77	14.0%	182	33.2%	202	36.79%	88	16.0%	549	100%
Anthelmintic parasites vaccination	105	23.2%	110	24.3%	156	34.51%	81	17.9%	452	100%

Figure 115 shows the decision makers for the adoption of the variety-technology. For Kounouz variety and all the technologies, the household head is the main decision-maker for adoption of the variety/technologies in both governorates with a percentage of HH that oscillates between 74.8% and 82.5%. In second rank, the decision to adopt variety/technologies is made by the household head and the spouse (percentage of HH that oscillates between 13.7% and 19.8%) in both governorates.

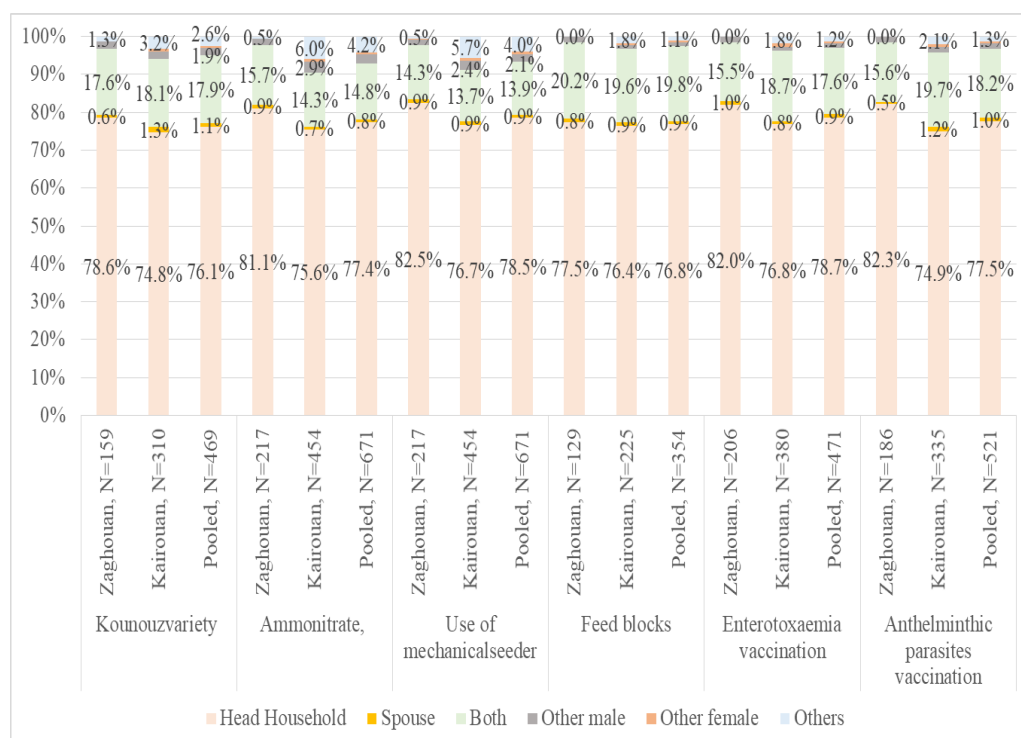


Figure 115. Decision makers for the adoption of the variety-technology by governorate

Figure 116 shows the main sources of variety-technology used this year. Nearly 94.4% and 66.7% of HH stated that the extension agents are the main source of kounouz variety and feed blocks used respectively in both governorates. However, the other farmers (relative/neighbors) and the market are the major sources of mechanical seeder in both governorates (58.31% and 30.2% of HH respectively). For the Amonitrate, the market and the governmental seed producers are the major sources in both governorates (55.8% and 26.7% of HH respectively).

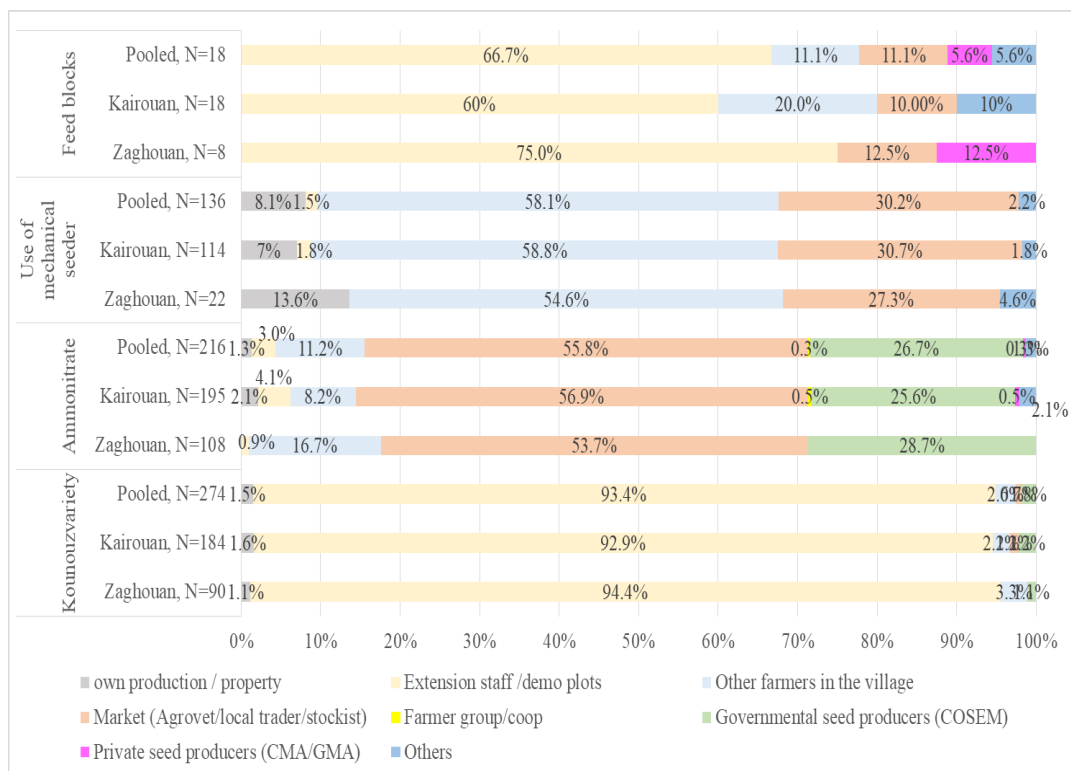


Figure 116. Main source of variety-technology used this year by governorate

Table 73 shows the main sources of vaccinations used this year. For the Enterotoxaemia and Anthelmintic parasites vaccinations, the main source is the private veterinarian in both governorates (78.5% and 73.89% respectively). In second position, the extension staff is the main source of vaccinations especially in Kairouan (15.6% and 13.5% of HH for the Enterotoxaemia and Anthelmintic parasites vaccinations respectively).

Table 73. Main source of vaccinations used this year by governorate

	Private veterinarian		Extension staff		Other farmers in the village		Farmer group/ coop		own production / property		Others		Total	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Zaghouan														
Enterotoxaemia vaccination	169	85.79	21	10.66	3	1.52					4	2.03	197	100
Anthelmintic parasites vaccination	139	81.29	15	8.77	1	0.58			7	4.09	9	5.26	171	100
Kairouan														
Enterotoxaemia vaccination	262	74.43	55	15.63	17	4.83			5	1.42	13	3.69	352	100
Anthelmintic parasites vaccination	195	69.48	38	13.52	17	6.05			19	6.76	12	4.27	281	100
Pooled														
Enterotoxaemia vaccination	431	78.51	76	13.84	20	3.64	5	0.91			17	3.1	549	100

Anthelmintic parasites vaccination	334	73.8 9	5 3	11.7 3	1 8	3.98	26	5.7 5		2 1	4.6 5	452	100
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Figure 117 shows the HH consideration on using the variety/technology in the future. The majority of HH in both governorates stated continuing to use Enterotoxaemia vaccination (97.6%) and Anthelmintic parasites vaccination (94.6%) in the future. To a lesser extent, 75.9% and 66.3% of HH declared to remain using the Kounouz variety and the Amonitrate respectively in the future. For the mechanical seeder and the feed blocks, only 40.8% and 29.4% of HH respectively in both governorates stated continuing the use of these technologies. By governorate, the percentage of HH declaring continuing the use of feed blocks is higher in Zaghuan (32.9%) against 23.3% in Kairouan.

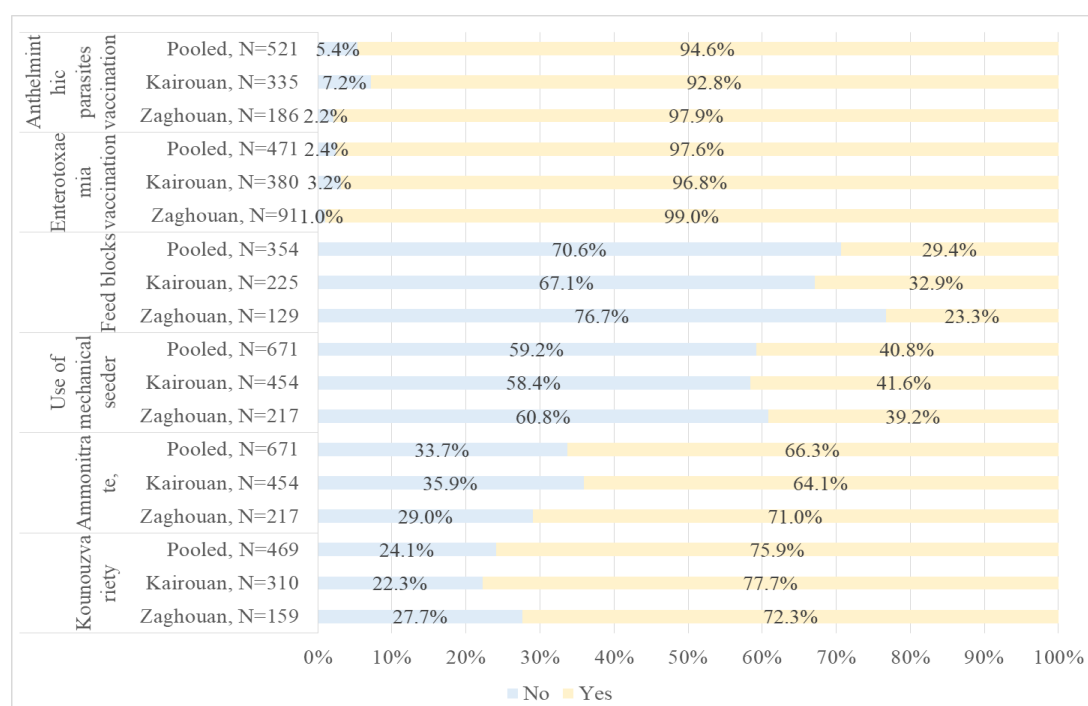


Figure 117. Consideration on using the variety-technology in the future by governorate, %

Figure 118 shows the main reasons of no use of the Kounouz variety in the future. In Zaghuan, the main reasons are that the price is too high (42.9%) and yield is low (42.9%). In Kairouan, 46.2% and 23.1% of HH consider the price too high; the yield is low and the preference for the others varieties are respectively the main reasons of no use of Kounouz variety in the future.

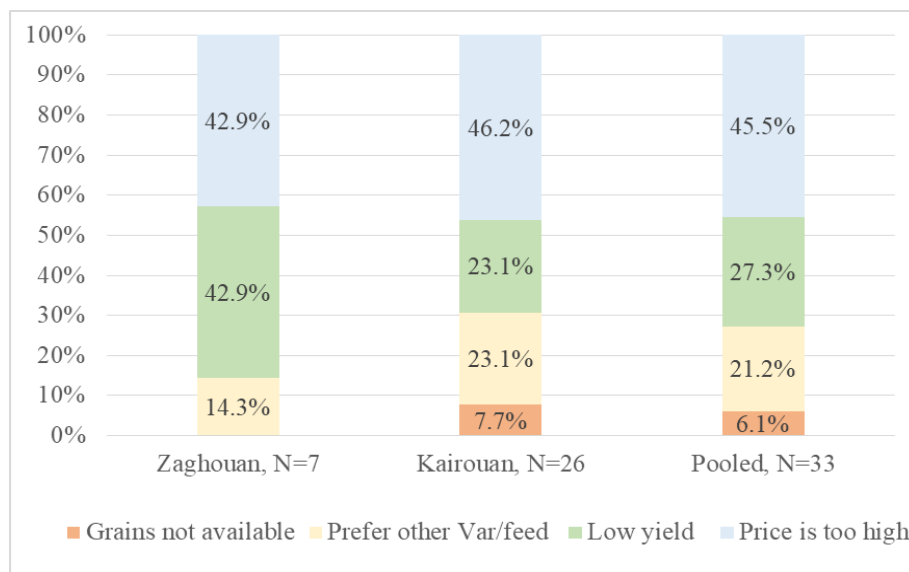


Figure 118. Main reasons for non considering the use of the Kounouz variety in the future by governorate, %

Figure 119 shows the main reasons of no use of the Amonitrate in the future. In Zaghouan, half of HH consider the lack of cash is the main constraint for not buying the Amonitrate in the future. However, in Kairouan the preference for the other technologies (20% of HH), the price is too high (10%) and the fact that HH have not crops for which this technology applies are the major reasons of no use of the Amonitrate in the future. Nearly 58.3% of HH stated other reasons of no use of the Amonitrate in the future. These reasons are related to the characteristics of small and poor farmers.

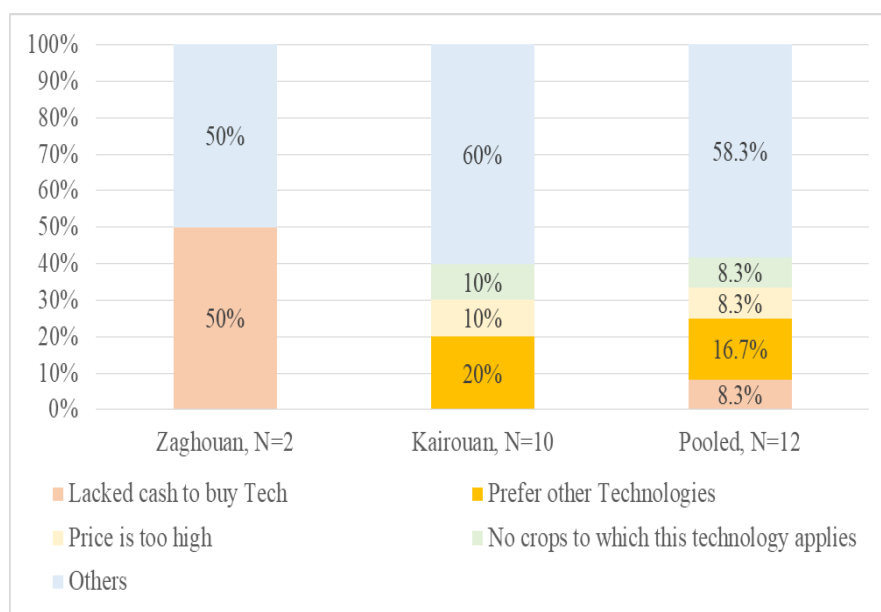


Figure 119. Main reasons of no use of the Amonitrate in the future by governorate, %

Figure 120 shows the main reasons of no use of the mechanical seeder in future. The only respondent in Zaghouan affirmed that the preference for other technology is the main reason of no use of the mechanical seeder in the future. However, two HH stated the preference for other technology and one HH declared the inefficiency of this technology as the main reasons of no use of the mechanical seeder in the future in Kairouan.

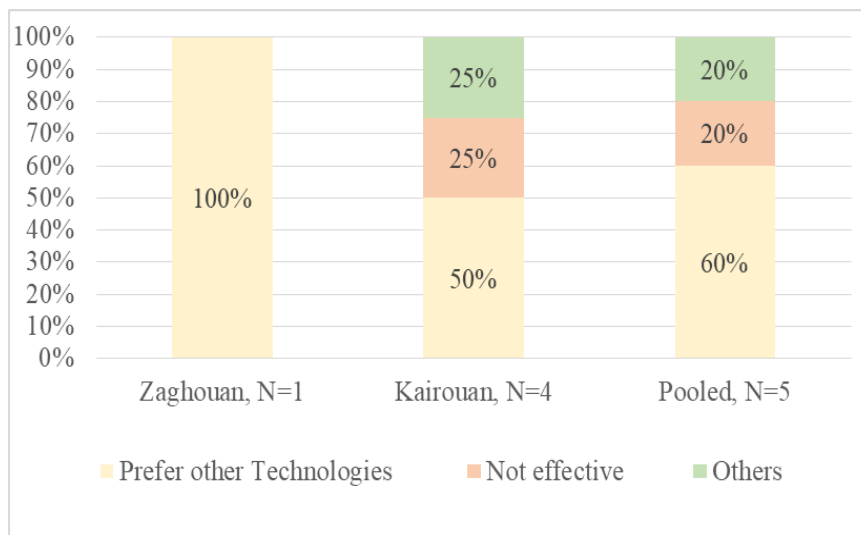


Figure 120.Main reasons of no use of the mechanical seeder in the future by governorate, %

Figure 121 shows the main reasons of no use of the feed blocks in the future. Two respondents in Zaghouan stated that there are better foods for animals as the main reason of no use of the feed blocks in future. However, Three respondents in Kairouan declared the price is too high, the inefficiency of the technology and the low palatability for animals as the main reasons of no use of the feed blocks in the future.

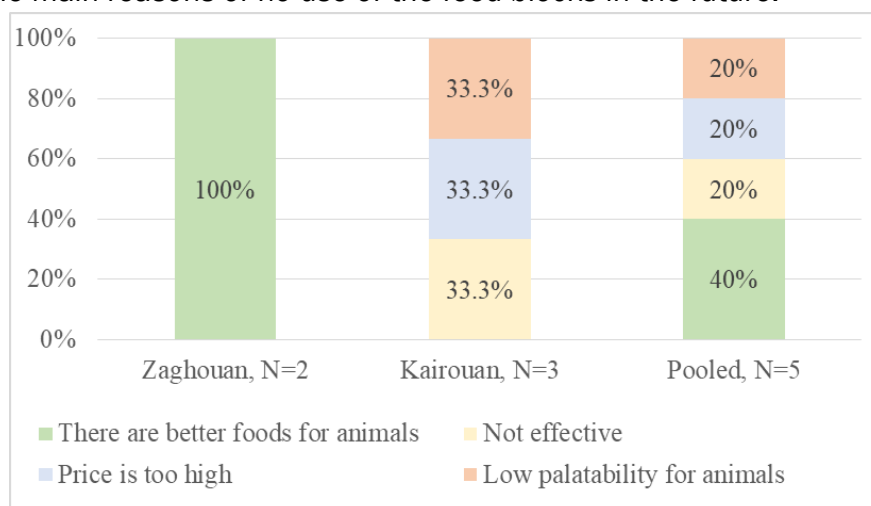


Figure 121.Main reasons of no use of the Feed blocks in the future by governorate, %

Figure 122 shows the main reasons of no use of Enterotoxaemia and Anthelmintic parasites vaccinations in the future. In Zaghouan, the major reasons are the unavailability of technology (one HH for the Enterotoxaemia vaccination) and the fact that the HH do not

have sheep (one HH for the Enterotoxaemia vaccination and one for the Anthelminthic parasites vaccination).

The unavailability of veterinarian (3 HH for the Anthelminthic parasites vaccination), the lack of cash to buy (one HH for Enterotoxaemia vaccination) and the fact that the HH do not have sheep (one HH for Enterotoxaemia vaccination) are the main reasons of no use of Enterotoxaemia and Anthelminthic parasites vaccinations in the future in Kairouan.

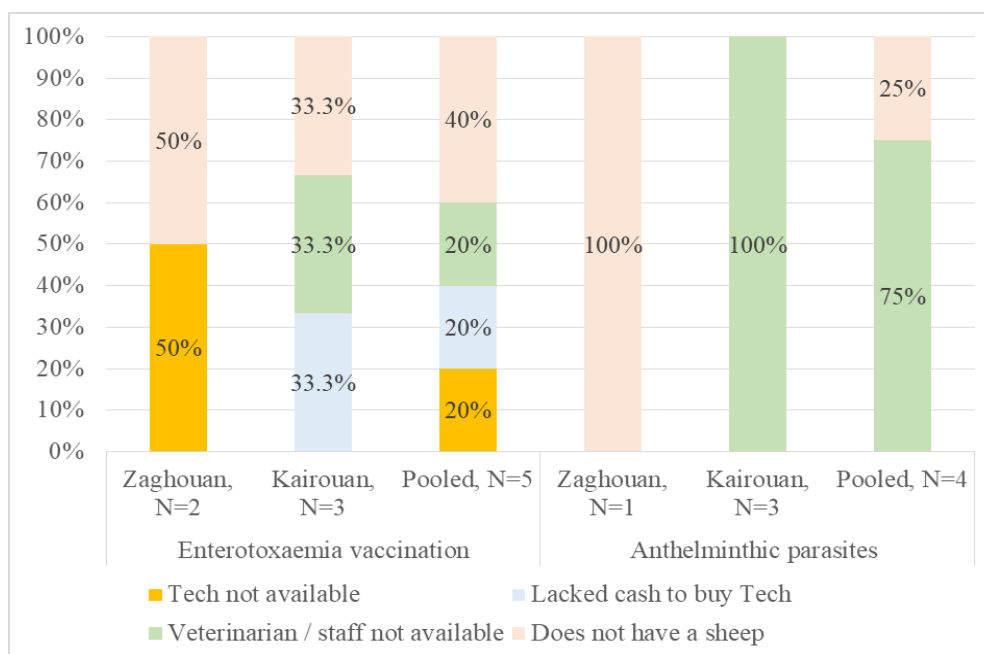


Figure 122. Main reasons of no use of the Enterotoxaemia vaccination and the Anthelminthic parasites vaccination in the future by governorate, %

5.11. Module J: technology perception

Figure 123 shows the benefits of Kounouz variety. The main benefits of Kounouz variety are higher yields (72.9% and 63.2% of HH in Zaghouan and in Kairouan respectively) and drought resistance (54.9% and 46.3% of HH in Zaghouan and in Kairouan respectively). Nearly 6.9% of HH stated the appetite for animals and 5.1% declared the good growth of animals as the benefits of Kounouz variety in both governorates. Only 14.7% of HH consider that Kounouz variety has no benefits in both governorates.

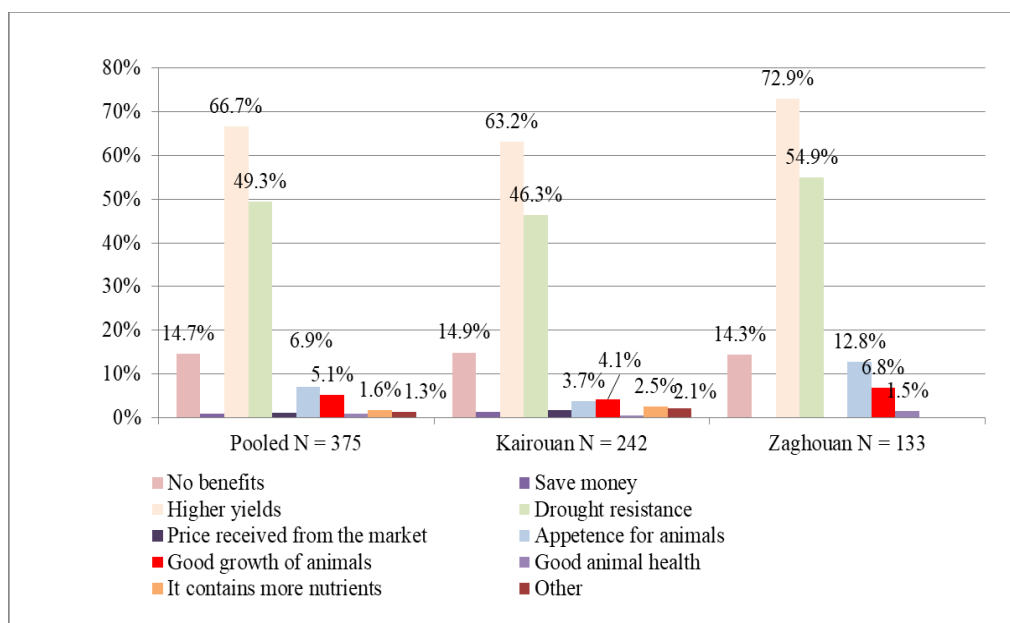


Figure 123. Benefits of Kounouz variety by governorate, %

Figure 124 shows the benefits of Amonitrate application. The major benefit of Amonitrate application is the high yield (93.3% and 84% of HH in Zaghouan and Kairouan respectively). Only 3.5% of HH stated the drought resistance as a benefit of Amonitrate application in Kairouan.

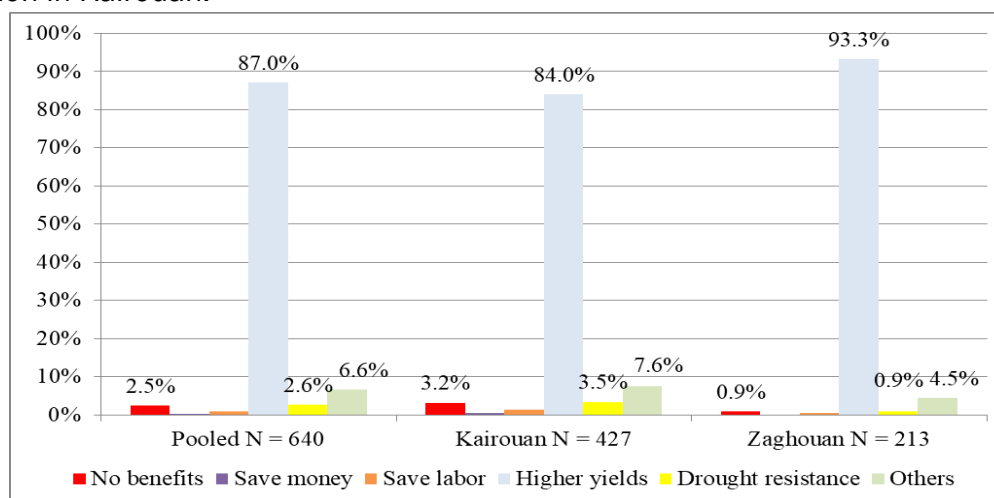


Figure 124. Benefits of Amonitrate application by governorate, %

Figure 125 shows the benefits of the use of the mechanical seeder. The major benefits are to save labor (68.6% and 60.8% of HH in Zaghouan and in Kairouan respectively). Nearly 11% and 7.1% of HH stated that higher yields and saving money are the benefits of the use of mechanical seeder in both governorates. By governorate, the percentage of HH declaring the soil improvement as a benefit of the use of mechanical seeder is higher in Kairouan than Zaghouan (7.5% against 2% respectively).

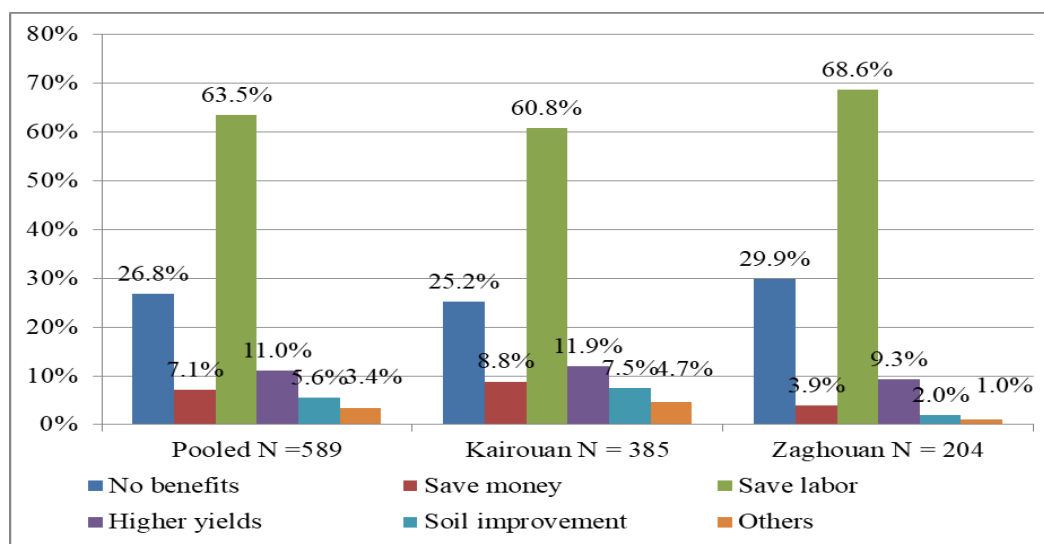


Figure 125. Benefits of Mechanical seeder by governorate, %

Figure 126 shows the benefits of the use of feed blocks. In Zaghouan, the majority of HH (79.8%) find that there are no benefits for the use of feed blocks. However, the good growth of animals and the nutrients are declared by 6.5% of HH as a benefit of the use of feed blocks. In Kairouan, the major benefits of the use of feed blocks are the good growth of animals (19.6% of HH), the appetite for animals (10.6% of HH), it contains more nutrients (7.3% of HH), save money (5.6% of HH) and save labor (5% of HH).

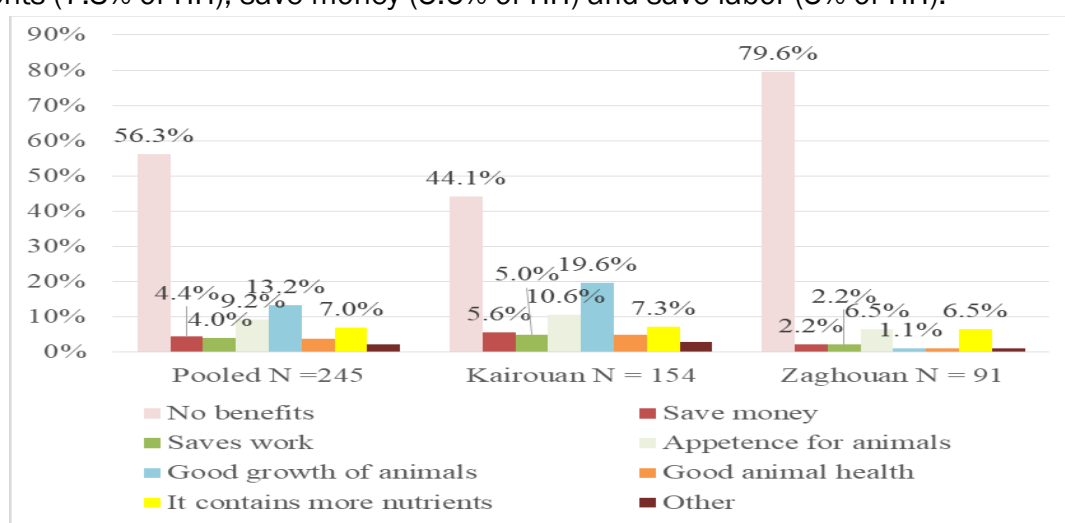


Figure 126. Benefits of the use of feed blocks by governorate, %

Figure 127 shows the benefits of the use of Enterotoxaemia and Anthelminthic parasites vaccinations. The good animal health is the major benefit of the use of Enterotoxaemia and Anthelminthic parasites vaccinations in both governorates (97.3% and 94.6% respectively). In second position, the good growth of animals is declared by 33.8% and 36.4% of HH for respectively the Enterotoxaemia vaccination and the Anthelminthic parasites vaccination in both governorates. By governorate, Zaghouan has the higher percentage of HH stating the high market price for vaccinated animals as a benefit of the use of Enterotoxaemia and Anthelminthic parasites vaccinations.

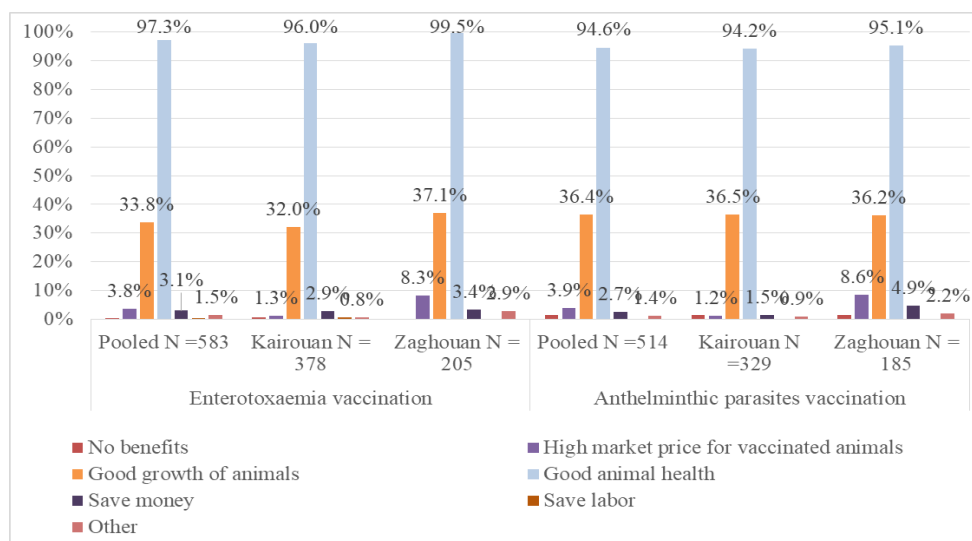


Figure 127. Benefits of Enterotoxaemia and Anthelminthic parasites vaccinations by governorate, %

Figure 128 shows the HH perception of the knowledge needed of the variety-technology. The knowledge needed of Enterotoxaemia vaccination and Anthelminthic parasites vaccination is judged “high” by 35.5% and 36.1% of HH respectively in both governorates. By governorate, 40.8% and 37.1% of HH in Zaghouan declared “low” the knowledge needed of respectively Enterotoxaemia vaccination and Anthelminthic parasites vaccination.

44.2% of HH judged “low” the knowledge needed for feed blocks in Zaghouan while 23.6% of HH stated “high” the knowledge needed for this technology in Kairouan.

Concerning the mechanical seeder, 38% and 23.9% of HH stated “high” and “low” respectively the knowledge needed of this technology in both governorates. By governorate, 35% of HH in Zaghouan judged “low” the knowledge needed for the mechanical seeder.

Regarding Amonitrate application, 40.2% and 20.6% of HH stated “high” and “very high” respectively the knowledge needed for this technology. By governorate, Zaghouan has the higher percentage of HH judging “high” and “very high” the knowledge needed for the Amonitrate application.

For the Kounouz variety, 38.2% and 25.6% of HH stated “high” and “very high” respectively the knowledge needed for this variety. By governorate, Kairouan has the

higher percentage of HH judging “high” and “very high” the knowledge needed for the Amonitrate application.

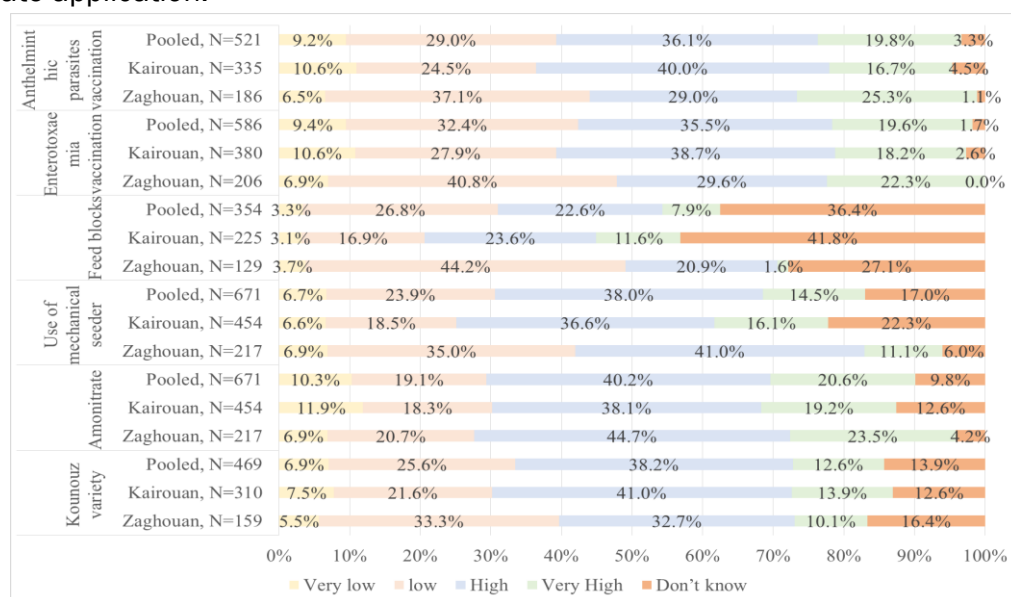


Figure 128.HH perception of the Knowledge needed for the variety-technology by governorate, %

Figure 129 shows the HH perception of the access to variety/ technology. The access for Enterotoxaemia and Anthelmintic parasites vaccinations is judged “very good” for 42.2% and 42.6% of HH in Kairouan. However, the access to the two vaccinations is judged “good” for 61.6% (Enterotoxaemia vaccination) and 58.3% of HH (Anthelmintic parasites vaccination) in Zaghouan. For the feed blocks, the access to this technology is bad for 55.6% of HH in Zaghouan and 36% in Kairouan. Nearly 25.5% of HH in both governorates judged “very bad” the access to feed blocks. Concerning the mechanical seeder, the access to this technology is mainly good (44.9% of HH in Kairouan and 41.5% of HH in Zaghouan). For the Amonitrate, 40.9% of HH stated “good” the access to this technology in Kairouan while 37.9 and 31.6% of HH declared “bad” and “very bad” respectively the access to this technology in Zaghouan. Regarding Kounouz variety, 56.6% and 45.1% of HH judged “good” the access to this variety respectively in Zaghouan and in Kairouan. However, this access to Kounouz variety is judged “bad” by 27.1% and 30.3% of HH respectively in Zaghouan and in Kairouan.

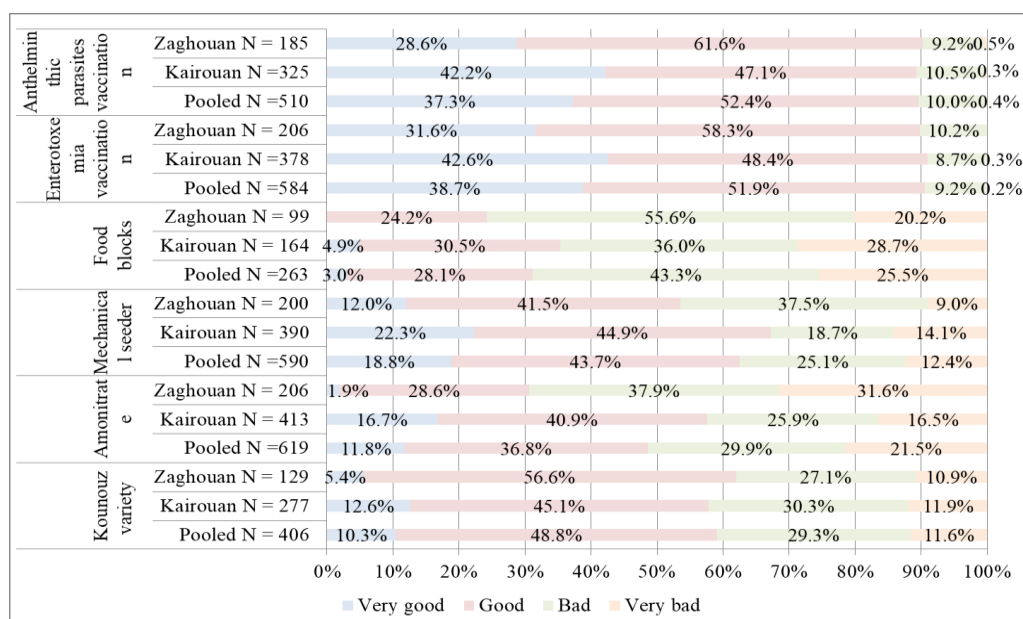


Figure 129.HH perception of the Access to variety-technology by governorate, %

Figure 130 shows the HH perception of the adoption cost to variety/ technology. The adoption cost of the Enterotoxaemia vaccination and the Anthelmintic parasites vaccination is judged “high” by 51% and 47.8% of HH respectively in both governorates. By governorate, Kairouan has the higher pourcentage of HH judging “low” the adoption cost of Enterotoxaemia vaccination and Anthelmintic parasites vaccination. For the feed blocks, 47.7% of HH do not know its adopt cost while 26.3% and 18.1% of HH declared “high” and “very high” respectively the adoption cost of this technology. Concerning the mechanical seeder, Zaghuan has the higher percentage of HH declaring “high” its adoption cost. However, Kairouan has the higher percentage of HH declaring “very high” the adoption cost of mechanical seeder. For the Amonitrate application, 41.9% and 39.5% of HH stated respectively “high” and “very high” its adopt cost in both governorates. As regards to Kounouz variety, 45.8% and 26.7% of HH judged respectively “high” and “very high” its adoption cost in both governorates. However, 11.9% of HH in Kairouan stated “low” the adoption cost of Kounouz variety.

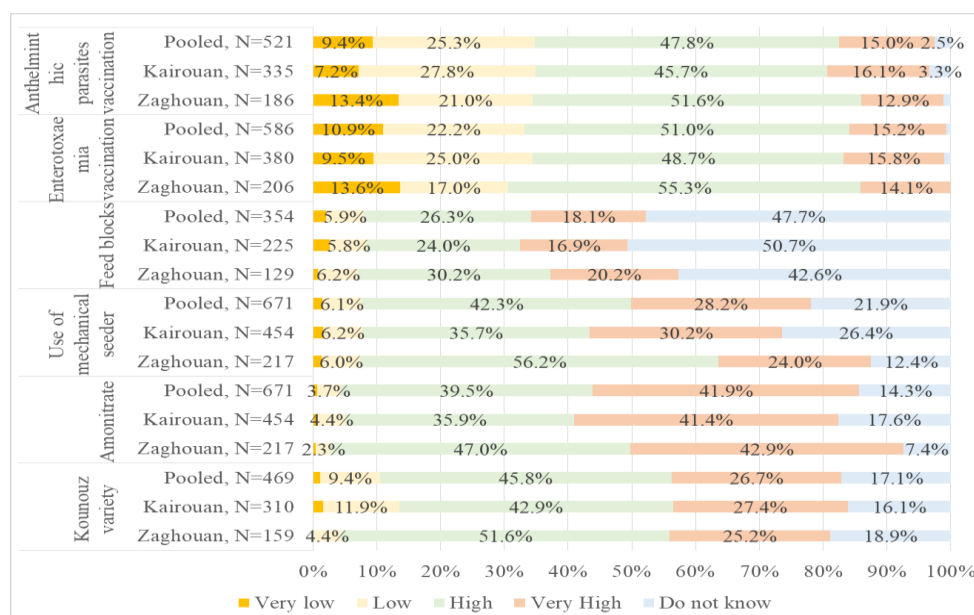


Figure 130.HH perception of the adoption cost of the variety-technology by governorate, %

Figure 131 shows the HH perception of the labor intensity of variety-technology adoption. The labor intensity of the Enterotoxaemia vaccination adoption and the Anthelmintic parasites vaccination adoption is judged “high” by 39.8% and 37.4% of HH respectively in both governorates. However, the labor intensity is considered “low” for the Enterotoxaemia vaccination adoption (36% of HH) and the Anthelmintic parasites vaccination adoption (33% of HH) in Zaghoul. For the feed blocks, 45.2% of HH do not have an appreciation for the labor intensity of the adoption of this technology. However, 17.2% and 14.7% of HH declared “low” and “high” the labor intensity off feed blocks adoption in both governorates. Concerning the mechanical seeder, 30.9% and 21.6% of HH consider “high” and “low” the labor intensity of its adoption in both governorates. However, 11.1% of HH judged “very high” the labor intensity of the mechanical seeder adoption in Kairouan than 7.3% in Zaghoul. For the Amonitrate application, 43.8% and 39.4% of HH declared “High” the labor intensity of its adoption respectively in Zaghoul and in Kairouan. As regards to Kounouz variety, 33.3% and 7.3% of HH judged “high” and “very high” respectively the labor intensity of its adoption in both governorates. However, 23.9% and 20.8% of HH declared “low” and “very low” the labor intensity of Kounouz variety adoption in Kairouan.

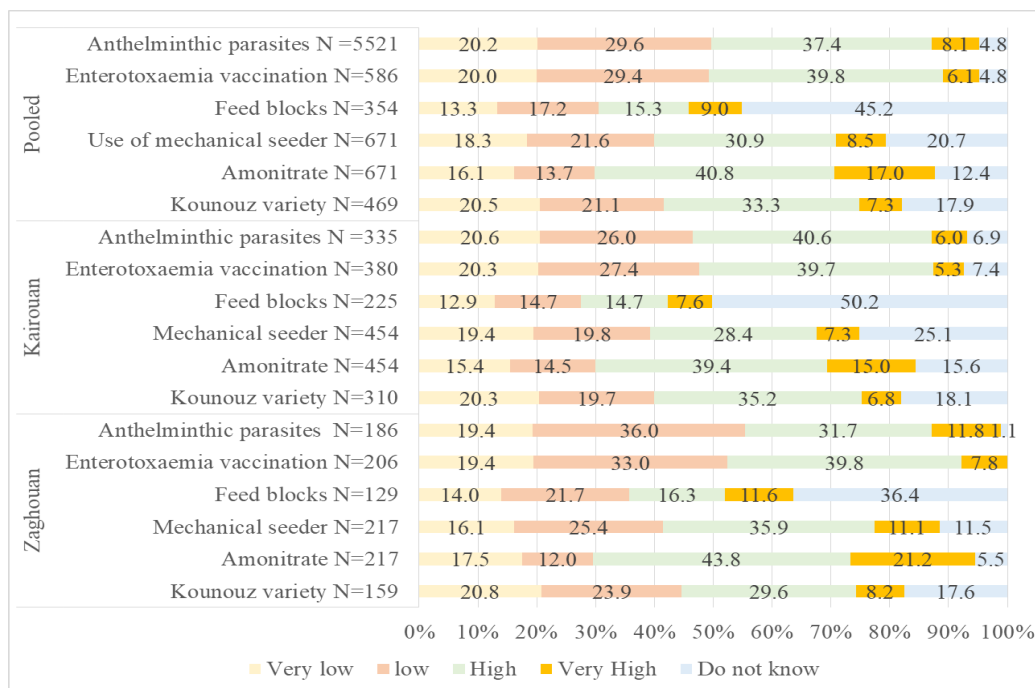


Figure 131.HH perception of the labor intensity of adoption of the variety-technology, %

Figure 132 shows the HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of skills and personal knowledge. More than half of HH have a high capacity of skills and personal knowledge to adapt the Enterotoxaemia and the Anthelminthic parasites vaccinations (57.3% and 64.1% respectively in both governorates), the Amonitrate (53.4%) and the Kounouz Variety (52%) for the next cropping season in both governorates. However, for the feed blocks and the mechanical seeder, 48.3% and 38.7% of HH respectively stated a low capacity of skills and personal knowledge to adopt these technologies for the next cropping season in both governorates.

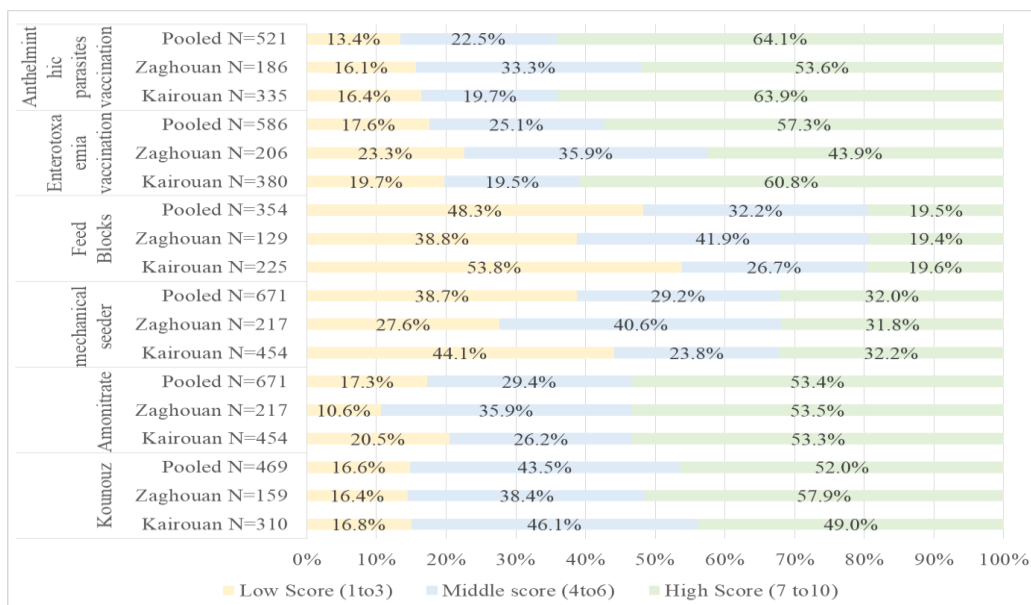


Figure 132.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of skills and personal knowledge by governorate, %

Figure 133 shows the HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of the payment of inputs and resources needed. Nearly half of HH have a high capacity of payment of inputs and resources needed to adapt the Enterotoxaemia and the Anthelmintic parasites vaccinations (48.6% and 48.4% respectively) in both governorates. However, 51.1%, 52.3% and 41.9% of HH stated a low capacity of the payment of inputs and resources needed to adopt respectively the feed blocks, the mechanical seeder and the Amonitrate for the next cropping season in both governorates. For the Kounouz variety, 54.6% of HH declared a middle capacity of the payment of inputs and resources needed to adapt this variety for the next cropping season in both governorates.

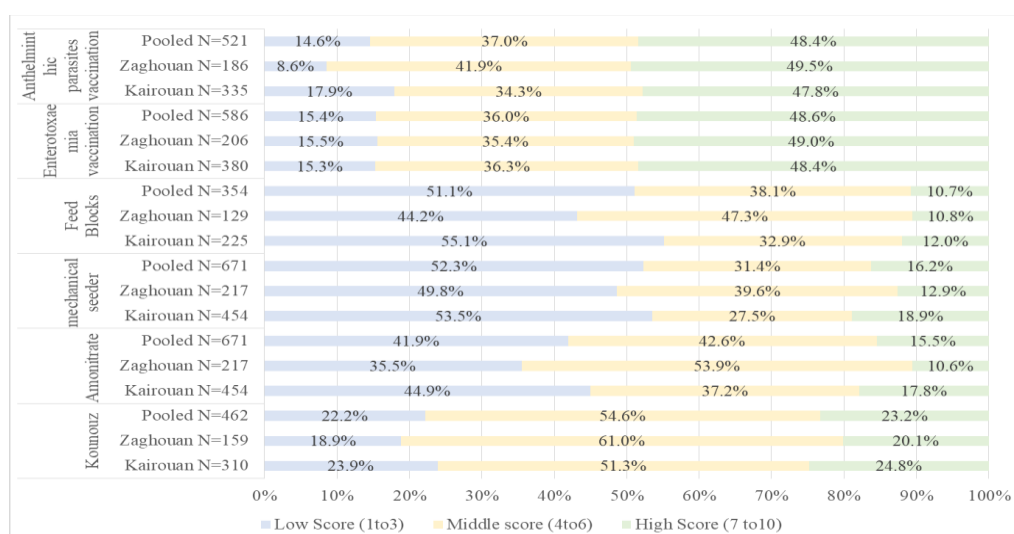


Figure 133.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of payment of inputs and resources needed by governorate, %

Figure 134 shows the HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of the availability of inputs and resources. Nearly 67% of HH have a high capacity of the availability of inputs and resources to adapt the Enterotoxaemia and the Anthelmintic parasites vaccinations (67.7% and 67.2% respectively) in both governorates. However, 62.7% of HH stated a low capacity of the availability of inputs and resources to adopt the feed blocks for the next cropping season in both governorates. For the mechanical seeder, 37% of HH have a high capacity of the availability of inputs and resources to adapt this technology in Kairouan. However, 37.3% of HH have a low capacity of the availability of inputs and resources to adapt this technology in Zaghouan. Concerning the Amonitrate, 35.9% of HH have a middle capacity of the availability of inputs and resources to adapt this technology in Kairouan. However, 49.3% of HH have a low capacity of the availability of inputs and resources to adapt the Amonitrate in Zaghouan. For the Kounouz variety, 41.4% of HH declared a middle capacity of the availability of inputs and resources to adapt this variety for the next cropping season in both governorates.

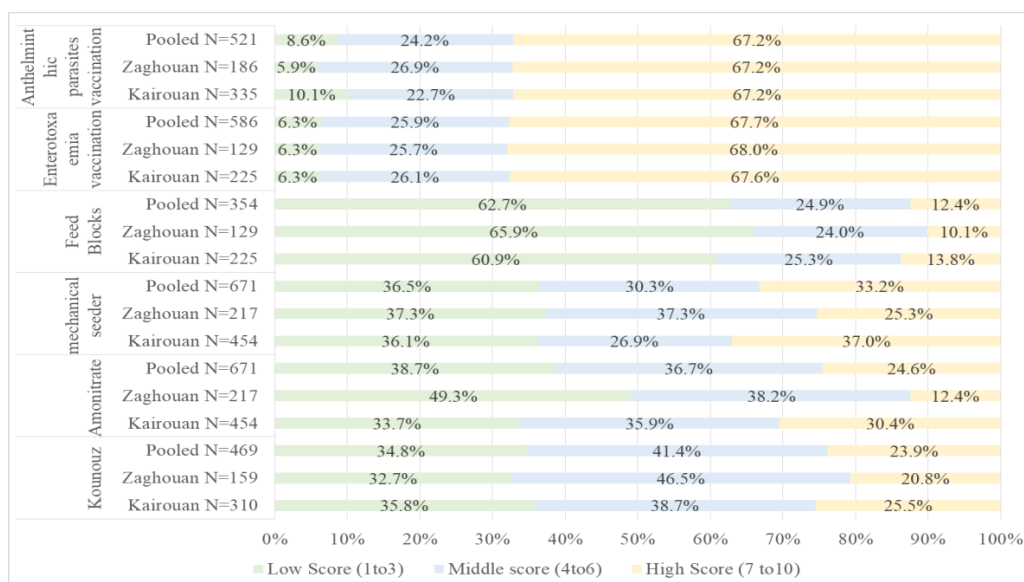


Figure 134.HH perception of the adapt capacity of the variety/technology for the next cropping season in terms of availability of inputs and resources by governorate, %

Figure 135 shows the HH perception of their dependence degree to the environment/others to adopt variety/technology. The HH stated that the adoption decision depend on them for feed blocks (55.4%), mechanical seeder (49.6%), Kounouz variety (40.7%) in both governorates. For the Amonitrate, 42.9% of HH declared that the adoption decision depends to a great extent to the environment/others in Kairouan while 40.7% of HH stated that this adoption decision depend on them in Zaghouan. Concerning the Enterotoxaemia and the Anthelmintic parasites vaccinations, the HH depend to a small extent to the environment/others to adopt these technologies in Zaghouan (42.2% and 45.2% respectively). However, nearly half of HH stated that the adoption decision depend on them to adopt the Enterotoxaemia and the Anthelmintic parasites vaccinations in Kairouan.

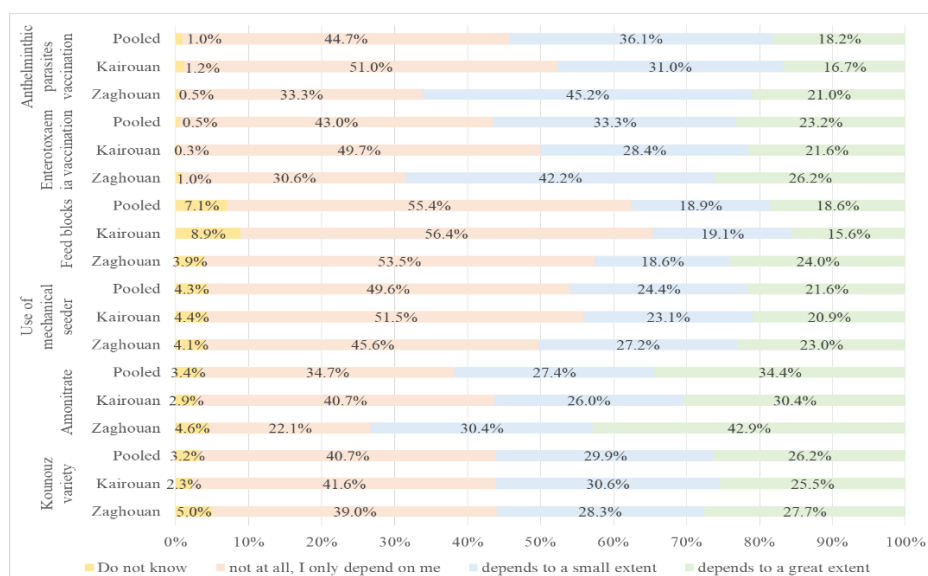


Figure 135.HH perception of their dependence degree to the environment/others to adopt variety/technology, %

Figure 136 shows the HH perception of the Kounouz variety performance in comparison with the local variety. Almost 49% and 54% of HH indicated a better performance of Kounouz variety on yield and drought resistance respectively in both governorates. However, nearly one third of HH are indifferent to the performance of Kounouz variety on the negotiability and on the price received in the market in comparison with the local variety.

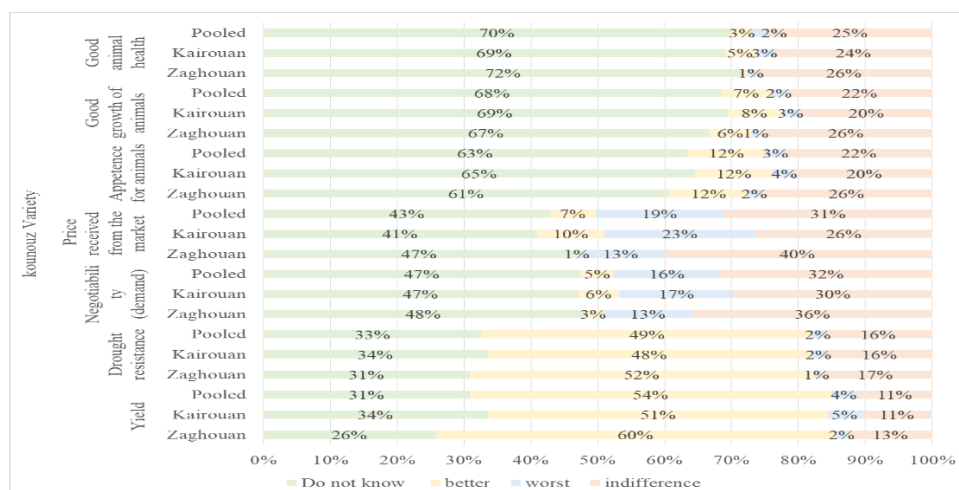


Figure 136.HH perception of the Kounouz variety performance in comparison with the local variety, %

Figure 137 shows the HH perception of the Amonitrate application performance in comparison with their preferred management method. In both governorates, nearly 96.8% of HH (91.7% in Kairouan and 89.2% in Zaghouan) stated that there is a better

performance of Amonitrate application on yield compared to their preferred management method.

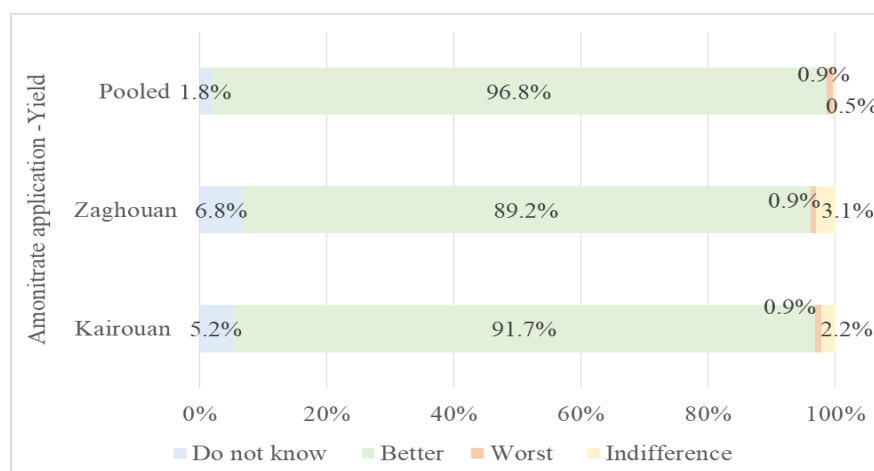


Figure 137.HH perception of the performance of the Amonitrate application in comparison with their preferred management method, %

Figure 138 shows the HH perception of the mechanical seeder performance in comparison with their preferred management method. Nearly 39.2% of HH in both governorates (36.4% in Zaghouan and 40.5% in Kairouan) declared that the mechanical seeder have a better performance on yields in comparison to their preferred management method in both governorates. However, 41.5% of HH in Zaghouan are indifferent to the performance of this technology on yield compared to their preferred management method.

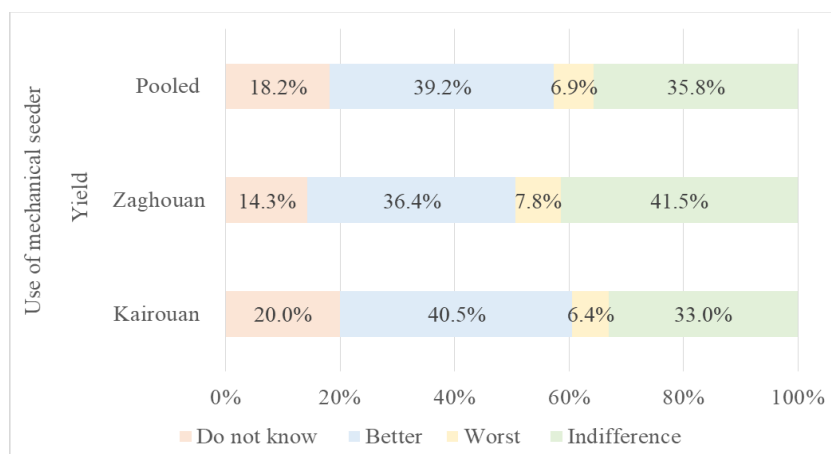


Figure 138.HH perception of the mechanical seeder performance in comparison with their preferred management method, %

Figure 139 shows the HH perception of the feed blocks performance in comparison with their preferred method of livestock feeding. More than half of HH do not know the performance of feed blocks on different attributes like appetite for animals, good growth of animals and good animal health. However, 18.4% of HH in both governorates stated that the performance of feed blocks on appetite for animals is worst in comparison with their preferred method of livestock feeding. Nearly 24% and 21.8% of HH in both

governorates are indifferent to the performance of feed blocks on the good growth of animals and the good animal health respectively in comparison with their preferred method of livestock feeding.

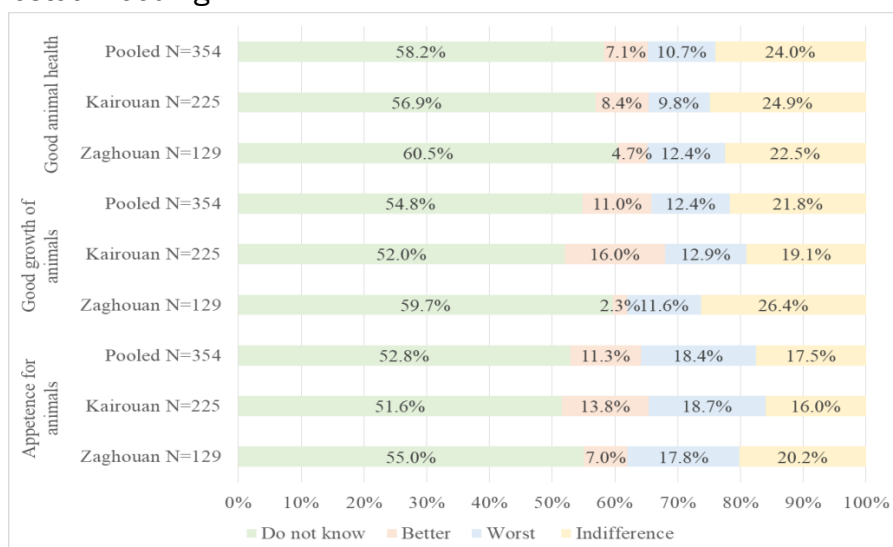


Figure 139.HH perception of the feed blocks performance in comparison with their preferred method of livestock feeding, %

Figure 140 shows the HH perception of the performance of the Anthelmintic parasites and Enterotoxaemia vaccinations compared to the no use. The majority of HH affirmed the better performance of these vaccinations on good animal health in comparison with the no use. However, 30.7% and 26.6% of HH are indifferent to the performance of the Enterotoxaemia vaccination and the Anthelmintic parasites vaccination respectively on good growth of animals in both governorates in comparison with the no use.

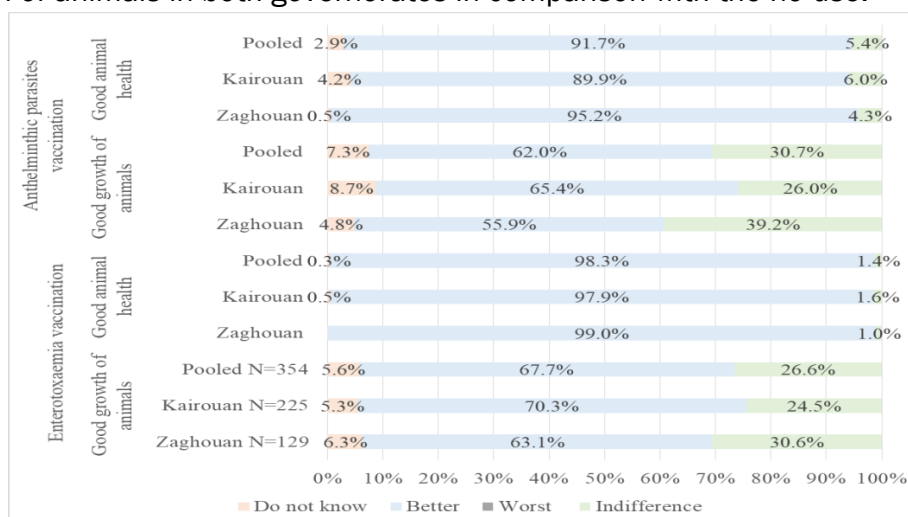


Figure 140.HH perception of the performance of the Anthelmintic parasites and Enterotoxaemia vaccinations compared to the no use, %

5.12. Module K: Social networks

Figure 141 shows the knowledge of the neighbor's household. It appears that households are more likely to know their neighbors but not their wives. For neighbor 1, 91.5% of the sample in Kairouan knows the neighbor and 93.6% do not know their spouse. It is the same case in Zaghuan where 75.9% know the neighbor and 98% do not know their spouse.

This situation is confirmed with the other neighbors for both governorates. For neighbor 2, 84.7% of the sample knows the neighbor while only 6.6% know their wives.

Concerning neighbor 3, 90.7% of the sample in Kairouan know the neighbor (3.1% for the spouse) while they are only 69.9% in Zaghuan (6.9% for the spouse).

For neighbor 5, 6, 7, 8 and 9, very few household know the neighbor's wives. They are almost 100% to not knowing them.

Concerning the sample, we notice that they are more households answering to the question concerning knowing the neighbor than those answering about knowing the neighbor's wife. For example for neighbor 1, they were 449 in Kairouan to answer for the neighbor and only 33 for the neighbor's spouse. It is the same for Zaghuan, they were 216 for the neighbor and only 50 to answer for the neighbor's wife.

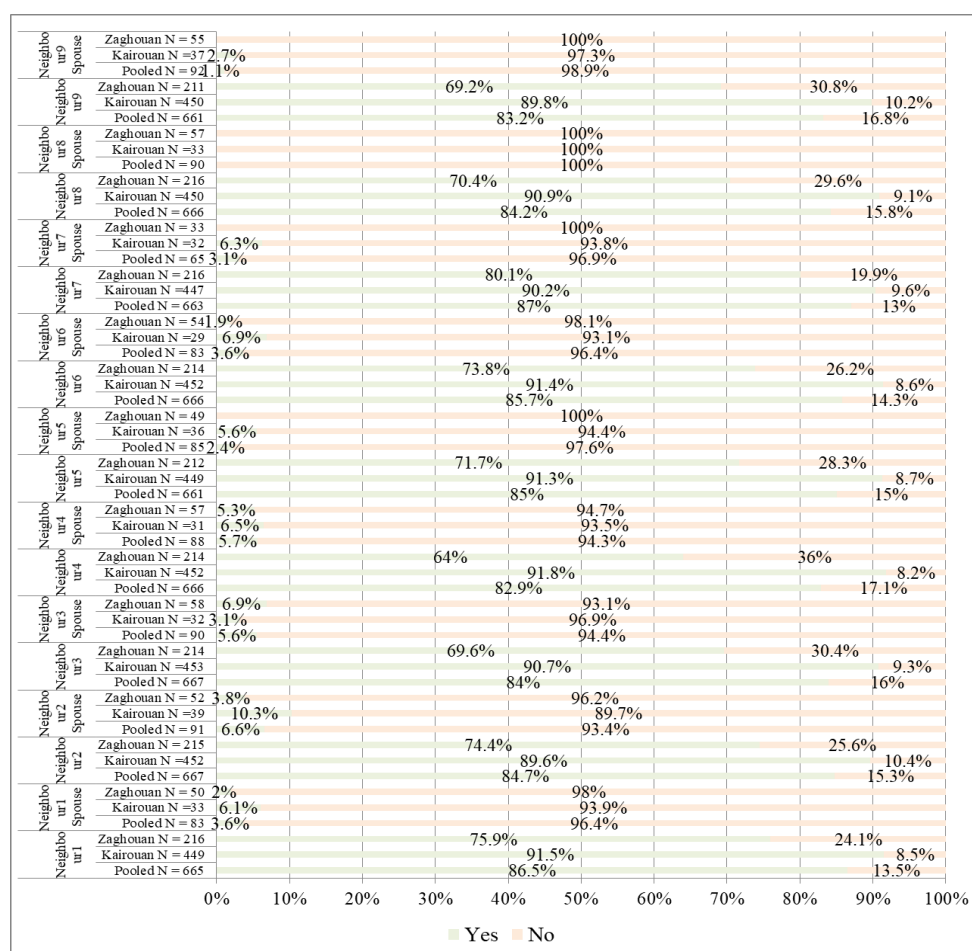


Figure 141. Knowledge of the neighbor's household

Table 74 shows the distance between the household farm and the neighbor's farm in minutes. For neighbor 1, the mean distance in minutes for both governorates is 20.22 minutes with a slightly difference between the two locations: 17.02 for Kairouan and 28.39 for Zaghouan.

The maximum distance for Zaghouan governorate is for neighbor 1, 4, 5 and 6 with 360 minutes. For Kairouan, the maximum distance is 240 minutes for neighbor 8, then 210 minutes for neighbor 5, 200 minutes for neighbor 4 and 180 minutes for neighbor 1 and 2.

The smallest distance between neighbors is 1 minute for Kairouan and Zaghouan for neighbor 9.

Table 74. Distance between household farm and neighbor's farm (minutes)

		Min	Max	Mean	Std. Deviation
Neighbor 1	Pooled N = 571	1	360	20.22	25.48
	Kairouan N = 410	1	180	17.02	18.12
	Zaghouan N = 161	1	360	28.39	37.14
Neighbor 1 Spouse	Pooled N = 3	10	60	33.33	25.17
	Kairouan N =2	10	60	35.00	35.36
	Zaghouan N = 1	30	30	30.00	
Neighbor 2	Pooled N = 558	1	180	21.72	24.05
	Kairouan N = 404	1	180	19.51	22.18
	Zaghouan N = 154	2	180	27.51	27.61
Neighbor 2 Spouse	Pooled N = 6	5	60	22.50	20.43
	Kairouan N =4	5	30	16.25	11.09
	Zaghouan N = 2	10	60	35.00	35.36
Neighbor 3	Pooled N = 556	1	360	23.87	29.94
	Kairouan N =410	1	360	21.25	31.24
	Zaghouan N = 146	1	120	31.22	24.60
Neighbor 3 Spouse	Pooled N = 5	15	120	76.00	48.66
	Kairouan N =1	35	35	35.00	
	Zaghouan N = 4	15	120	86.25	49.56
Neighbor 4	Pooled N = 550	1	360	22.08	27.17
	Kairouan N =414	1	200	18.79	21.16
	Zaghouan N = 136	2	360	32.11	38.69
Neighbor 4 Spouse	Pooled N = 5	5	60	26.00	21.04
	Kairouan N =2	20	60	40.00	28.28
	Zaghouan N = 3	5	30	16.67	12.58
Neighbor 5	Pooled N = 559	1	360	22.14	26.47
	Kairouan N =410	1	210	19.02	19.96
	Zaghouan N = 149	2	360	30.75	37.93
Neighbor 5 Spouse	Pooled N = 2	15	25	20.00	7.07
	Kairouan N =2	15	25	20.00	7.07
	Zaghouan N = 0				
Neighbor 6	Pooled N = 568	1	360	21.83	25.27
	Kairouan N =413	1	120	19.26	18.66
	Zaghouan N = 155	1	360	28.68	36.81
Neighbor 6 Spouse	Pooled N = 3	10	90	38.33	44.81
	Kairouan N =2	10	90	50.00	56.57
	Zaghouan N = 1	15	15	15.00	
Neighbor 7	Pooled N = 576	1	120	21.53	20.29

	Kairouan N =404	1	120	18.76	18.06
	Zaghouan N = 172	1	120	28.04	23.54
Neighbor 7 Spouse	Pooled N = 2	2	5	3.50	2.12
	Kairouan N =2	2	5	3.50	2.12
	Zaghouan N = 0				
Neighbor 8	Pooled N = 555	1	240	22.75	28.26
	Kairouan N =406	1	240	20.19	26.92
	Zaghouan N = 149	1	180	29.73	30.63
Neighbor 8 Spouse	Pooled N =0				
	Kairouan N =0				
	Zaghouan N =0				
Neighbor 9	Pooled N = 547	1	120	22.40	22.50
	Kairouan N =403	1	120	20.87	21.76
	Zaghouan N = 144	1	120	26.69	24.01
Neighbor 9 Spouse	Pooled N = 1	10	10	10.00	
	Kairouan N =1	10	10	10.00	
	Zaghouan N = 0				

Table 75 shows the number of contacts with the neighbors during the last month. For neighbor 1 and 2 the maximum was 30 times in both governorates, the minimum was no contact for Zaghouan and Kairouan. For the neighbor's 1 spouse there was no contact for Kairouan and only 2 contacts for Zaghouan.

Contacts are higher with neighbor 3 in Kairouan with 60 times and a mean of 9.17. In Zaghouan it is neighbor 4 who has the maximum contacts with 60.

The number of contacts with the neighbor's spouses is very limited. They go from no contact at all in Kairouan for neighbor's spouse 1 to 10 contacts minimum for neighbor's spouse 9. In Zaghouan also the contacts are limited with the neighbor's spouses, it goes from 0 contact for neighbor's 2 spouse to a maximum of 60 contacts with neighbor's 4 wife.

Table 75.Number of contacts with the neighbors during the last month

		Min	Max	Mean	Std. Deviation
Neighbor 1	Pooled N = 575	0	30	8.95	10.26
	Kairouan N = 411	0	30	9.68	10.71
	Zaghouan N = 164	0	30	7.15	8.82
Neighbor 1 Spouse	Pooled N = 3	0	2	.67	1.15
	Kairouan N =2	0	0	0	0.00
	Zaghouan N = 1	2	2	2	
Neighbor 2	Pooled N = 565	0	30	9.38	10.45
	Kairouan N = 405	0	30	10.17	10.77
	Zaghouan N = 160	0	30	7.38	9.32
Neighbor 2 Spouse	Pooled N = 6	0	5	1.50	2.35
	Kairouan N =4	0	5	1.25	2.50
	Zaghouan N = 2	0	4	2.00	2.83
Neighbor 3	Pooled N = 560	0	60	8.24	10.32
	Kairouan N =411	0	60	9.17	10.79
	Zaghouan N = 149	0	30	5.68	8.40

Neighbor 3 Spouse	Pooled N = 5	0	1	.40	0.55
	Kairouan N =1	1	1	1	
	Zaghouan N = 4	0	1	.25	0.50
Neighbor 4	Pooled N = 552	0	60	8.61	10.30
	Kairouan N =415	0	30	9.17	10.27
	Zaghouan N = 137	0	60	6.93	10.24
Neighbor 4 Spouse	Pooled N = 5	0	15	3.80	6.30
	Kairouan N =2	1	2	1.50	0.71
	Zaghouan N = 3	0	15	5.33	8.39
Neighbor 5	Pooled N = 562	0	30	8.30	9.89
	Kairouan N =410	0	30	8.71	10.05
	Zaghouan N = 152	0	30	7.17	9.40
Neighbor 5 Spouse	Pooled N = 2	0	16	8	11.31
	Kairouan N =2	0	16	8	11.31
	Zaghouan N = 0				
Neighbor 6	Pooled N = 571	0	60	8.67	10.33
	Kairouan N =413	0	60	9.29	10.79
	Zaghouan N = 158	0	30	7.06	8.86
Neighbor 6 Spouse	Pooled N = 3	0	15	5	8.66
	Kairouan N =2	0	15	7.50	10.61
	Zaghouan N = 1	0	0	0	
Neighbor 7	Pooled N = 577	0	40	8.32	9.80
	Kairouan N =404	0	40	8.91	10.15
	Zaghouan N = 173	0	35	6.95	8.80
Neighbor 7 Spouse	Pooled N = 2	0	4	2	2.83
	Kairouan N =2	0	4	2	2.83
	Zaghouan N = 0				
Neighbor 8	Pooled N = 561	0	38	8.86	10.36
	Kairouan N =409	0	30	9.59	10.64
	Zaghouan N = 152	0	38	6.89	9.33
Neighbor 8 Spouse	Pooled N				
	Kairouan N				
	Zaghouan N				
Neighbor 9	Pooled N = 550	0	60	9.37	10.70
	Kairouan N =404	0	60	10.12	11.12
	Zaghouan N = 146	0	30	7.29	9.14
Neighbor 9 Spouse	Pooled N = 1	10	10	10	
	Kairouan N =1	10	10	10	
	Zaghouan N = 0				

Figure 142 shows the change in the frequency of communication during the last 2 years. For almost the whole sample there is no change in the frequency of communication. It is the case for 100% of the neighbor's wives from neighbor 1 to neighbor 9.

For neighbor 1 in Kairouan, the frequency has decreased for 3.6% while it was 1.2% for Zaghouan. It is also the case for neighbor 2 with a decrease of 3% in Kairouan and 1.3% in Zaghouan.

The frequency of communication has increased very little with 2.2% for neighbor 1 and 2 in Kairouan while it was only 1.3% in Zaghouan. The highest change is observed for neighbor 4 with 5.1% of increase in Kairouan.

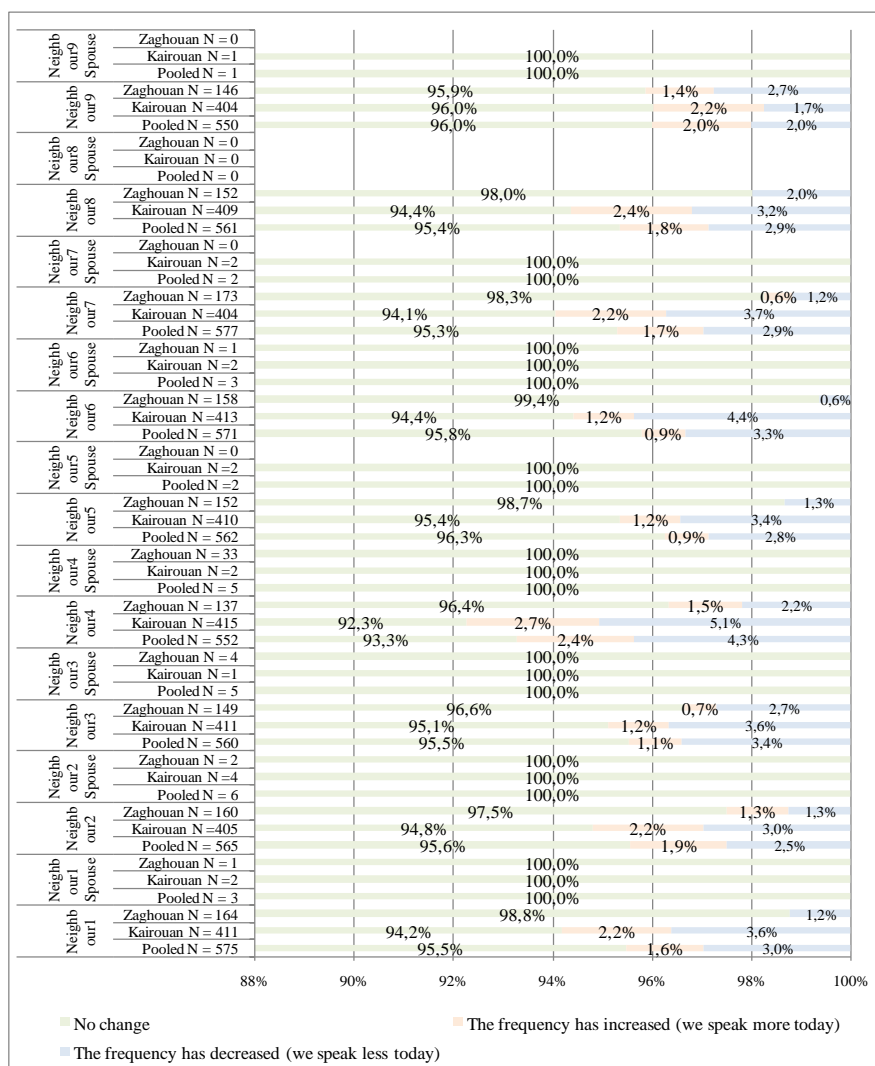


Figure 142. Change in the frequency of communication during the last 2 years

Figure 143 shows the exchanging information about the culture: agriculture with neighbors during the last month. It appears that not much information is exchanged between neighbors. Concerning the neighbor's spouses, there is absolutely no exchange (100%) with any neighbor's spouse from neighbor 1 to neighbor 9.

The maximum exchange is done by neighbor 9 in Kairouan with 57.3% of the sample saying that they exchanged with their neighbors. For Zaghouan, the maximum exchange is done with neighbor 7 with 46.6% of the sample.

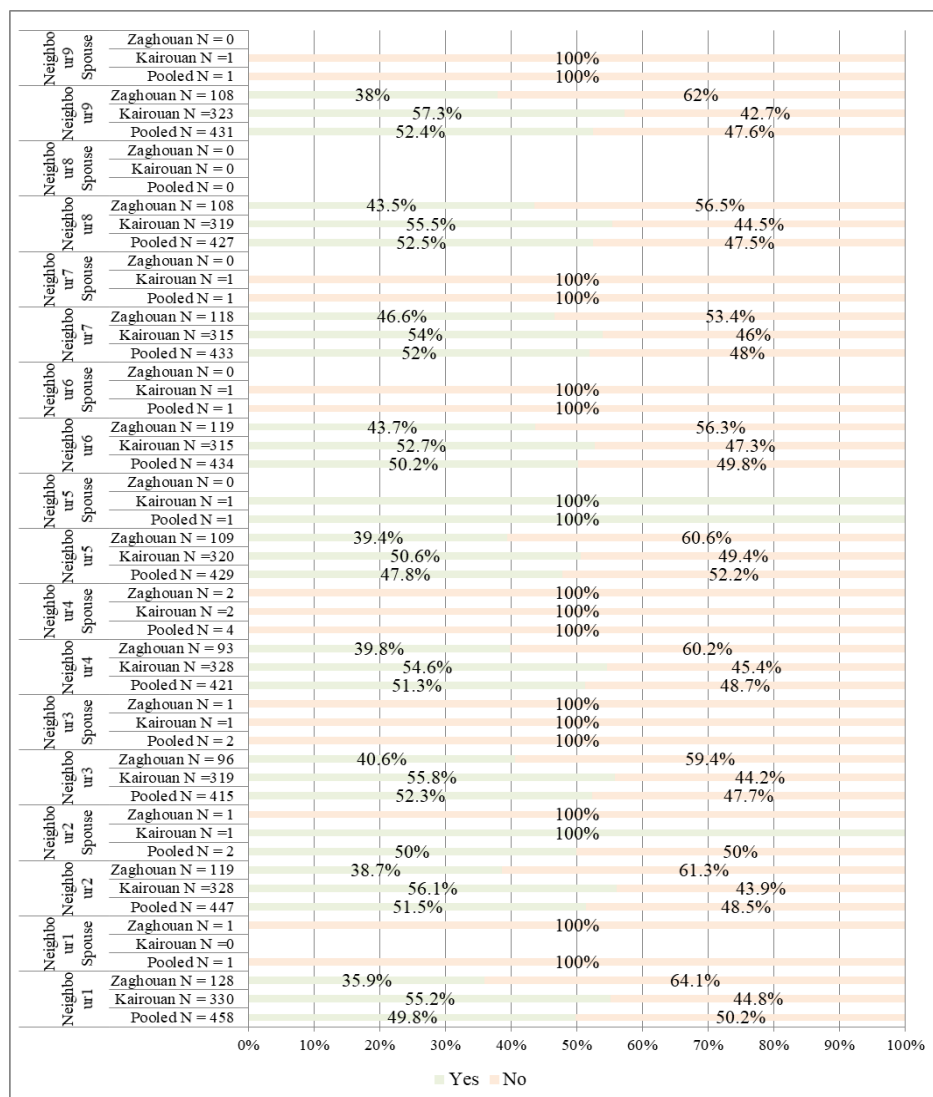


Figure 143. Exchanging information about the culture/agriculture with neighbors during the last month

Figure 144 shows the barley planting by the neighbors during the last growing season. For neighbor 1, 81.7% of the sample in Kairouan planted barley and they were 92.8% in Zaghouan. Concerning neighbor's 1 spouse; 100% in Zaghouan (1 person) planted barley while in Kairouan 100% (1 person) did not plant barley. For neighbor 2, they were 92.1% in Kairouan to plant barley and 80.4% in Zaghouan, concening the neighbor's spouse; 100% in both governorates did not plant barley. It is also the case for the neighbor's wives for neighbor 3, 5 and 9.

For both governorates, they were 81.1%; 80.4% and 79.3% for neighbor 3, 4 and 5 respectively to plant barley during the last cropping season.

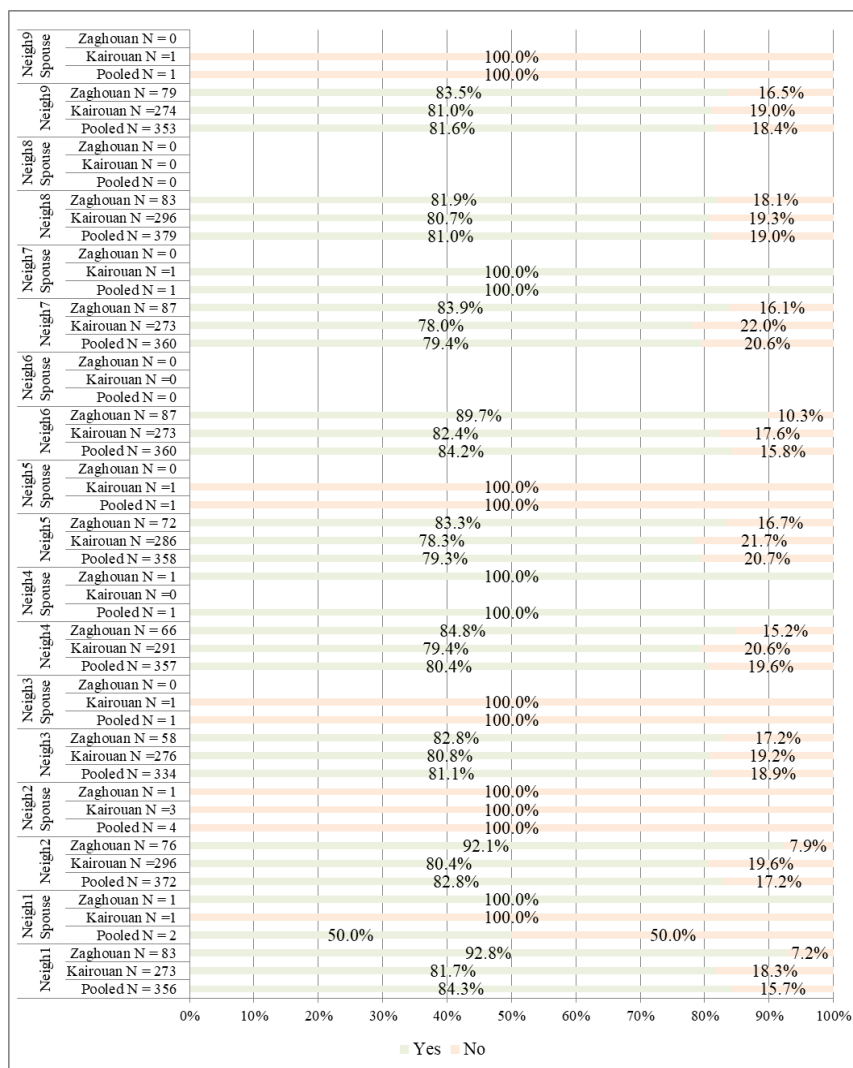


Figure 144.Barley planting by the neighbors during the last growing season, %

Figure 145 shows the use of Kounouz seeds by the neighbors during the last season. For neighbor 1, half of the sample (52.2%) used kounouz seeds last year, while they were 59.8% for neighbor 2 and 55.4% for neighbor 3. Neighbor's 1 spouse used kounouz (100%).

Mainly all the neighbor's spouses did not declare anything, this concerned neighbor's 2, 3, 5, 8 and 9 spouses.

Zaghouna governorate has the highest rates for the use of kounouz seeds with 72.1% for neighbor 1, 66.7% for neighbor 3, 82.8% for neighbor 4. Only one person declared not using Kounouz seeds for the last year, it was the neighbor's 7 spouse in Kairouan.

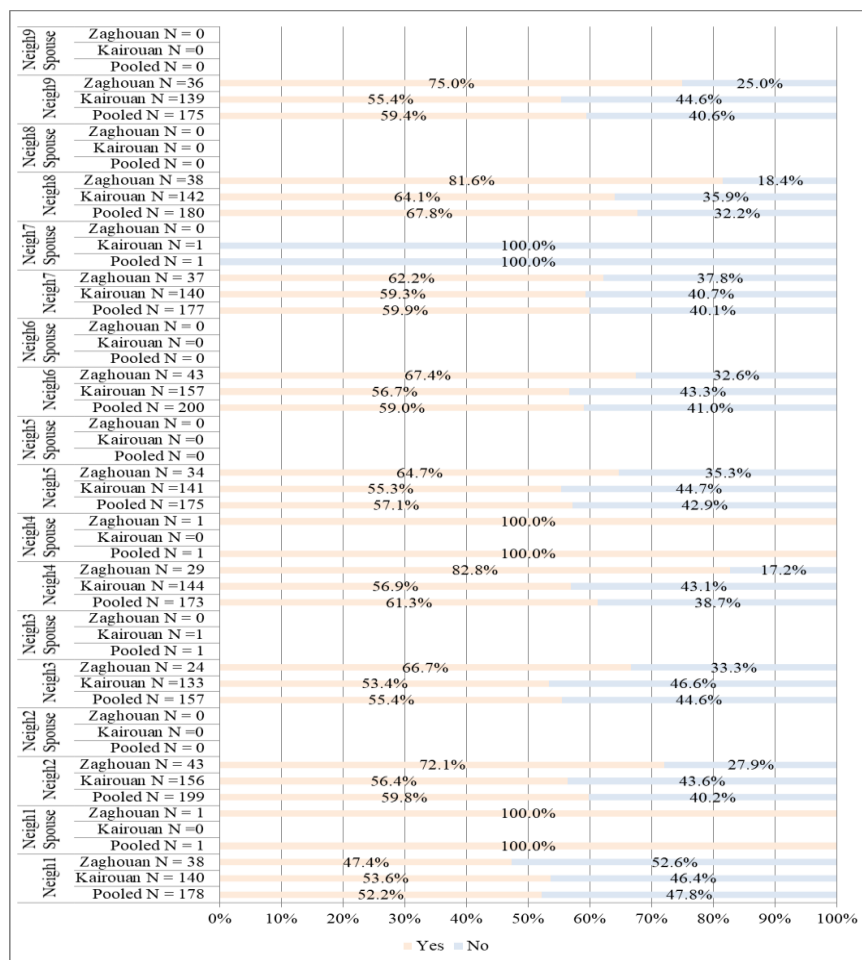


Figure 145. Use of Kounouz seeds by the neighbors during the last season, %

Figure 146 shows the family neighbor's relationship. There is not much relation in both governorates. The rates are higher in Zaghoun with 92.1% for neighbor 5 and 90% for neighbor 4.

In Kairouan, neighbor 7 has the best rate with 35.7%. The worst rate is found with neighbor 5 with 29.9%.

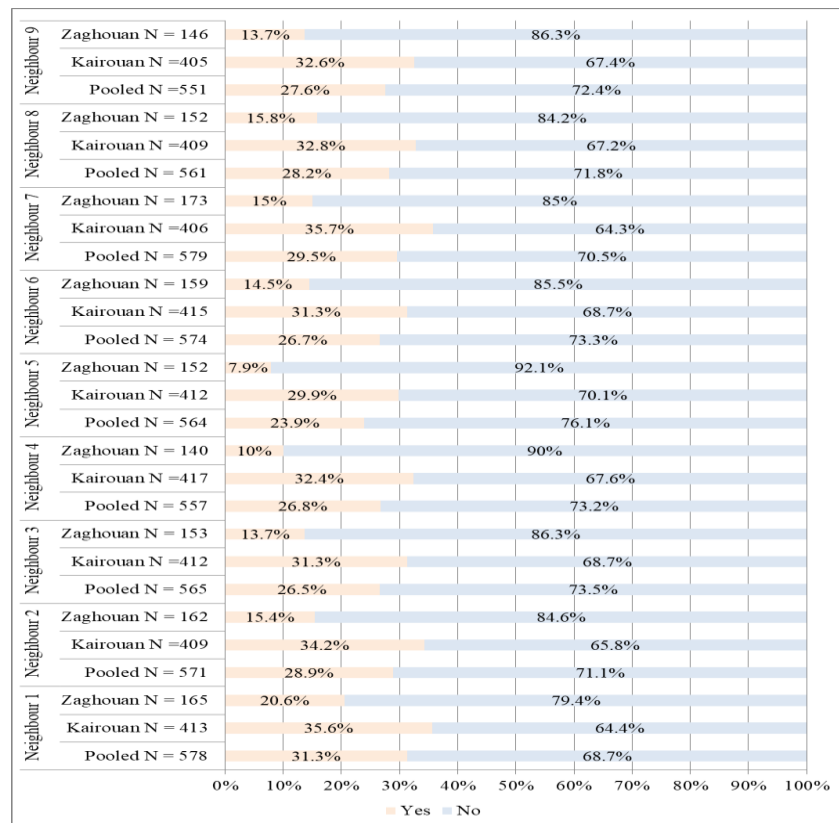


Figure 146. Family neighbor's relationship, %

Figure 147 shows the percentages of households requesting advice for a technical problem regarding crops. Mainly the whole do not ask for advice. For neighbor 1, in Zaghouan there is only 17% of the sample asking for advice and 22.3% in Kairouan. For neighbor 2, for both governorates they were only 17.7%. The highest rate is found with neighbor 1 in Kairouan with 22.3% and 17% in Zaghouan.

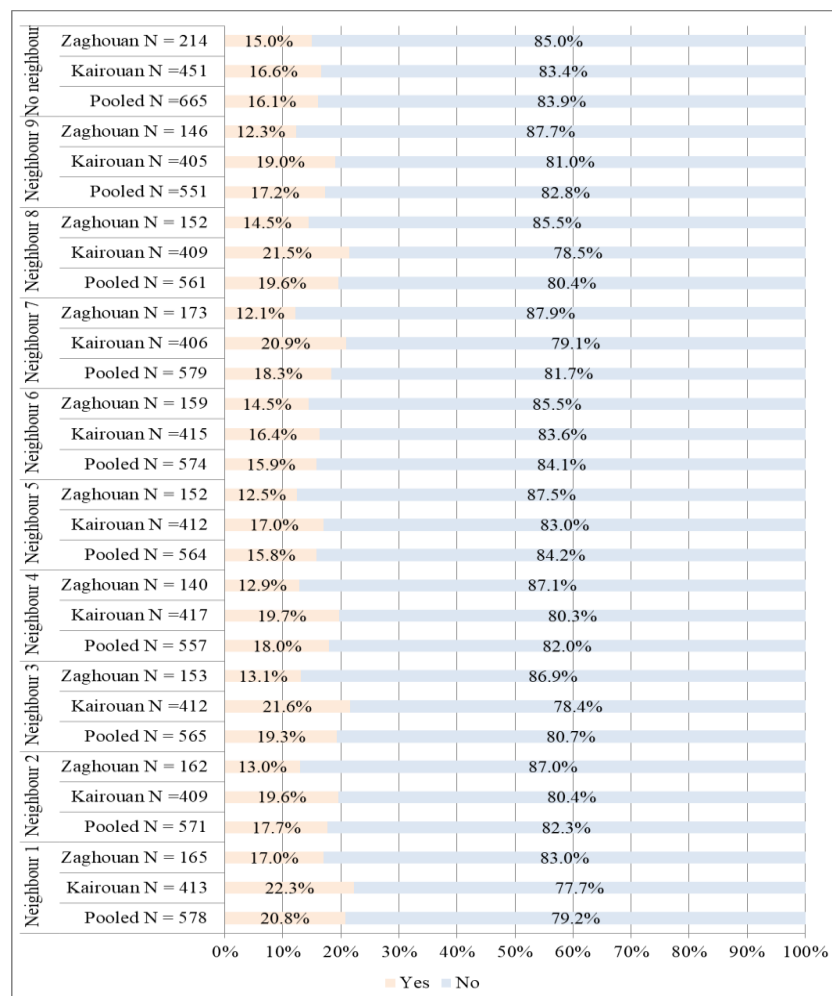


Figure 147. Requesting advice for a technical problem regarding crops, %

Figure 148 shows that the households do not request from their neighbors advice for a technical problem regarding livestock. For the whole sample, less than 20% of the household would do so.

For neighbor 1, they were only 21.1% in Kairouan to request advice and 16.4% in Zaghoul. For neighbor 2, they were 17% for both governorates to request advice. We notice that the percentages are mainly the same for the other neighbors.

In Kairouan, the highest rate is for neighbor 8 with 21.3% of the sample asking advice about livestock and in Zaghoul the highest rate was for neighbor 1 with 16.4%

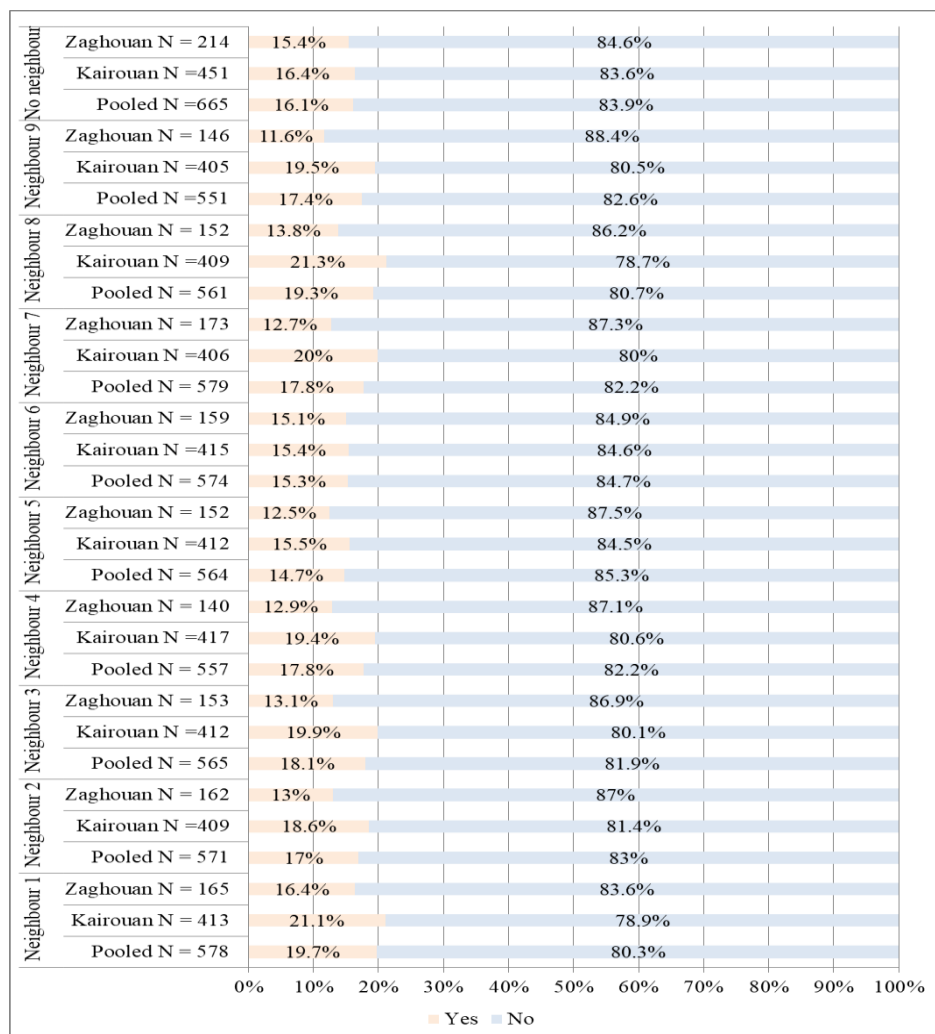


Figure 148. Requesting advice for a technical problem regarding livestock, %

5.13. Module L : Other sources of income and transfer

For the other sources of income, Figure 149 shows the percentages of households that receive additional transfers from different origins in the last 12 months. It shows that for both governorates, there is not much money received from rental income (2.7%); remittance or money order from inside or outside the country (3.3%); trade with agricultural products produced by others (5.8%); non-agricultural business or provision of other services (4%) and turnover of asset sales is also very low with 1.3% of the households for both locations.

Besides, there are some other sources that are a bit more beneficial for the households, for example the casual labor with 31.3% for Kairouan and 31.8% for Zaghouan. Permanent non-agricultural employment is more important in Zaghouan (27.6%), while the agricultural labor is more important in Kairouan with 22%. The government transfers and retirement count for 20.1% for both governorates.

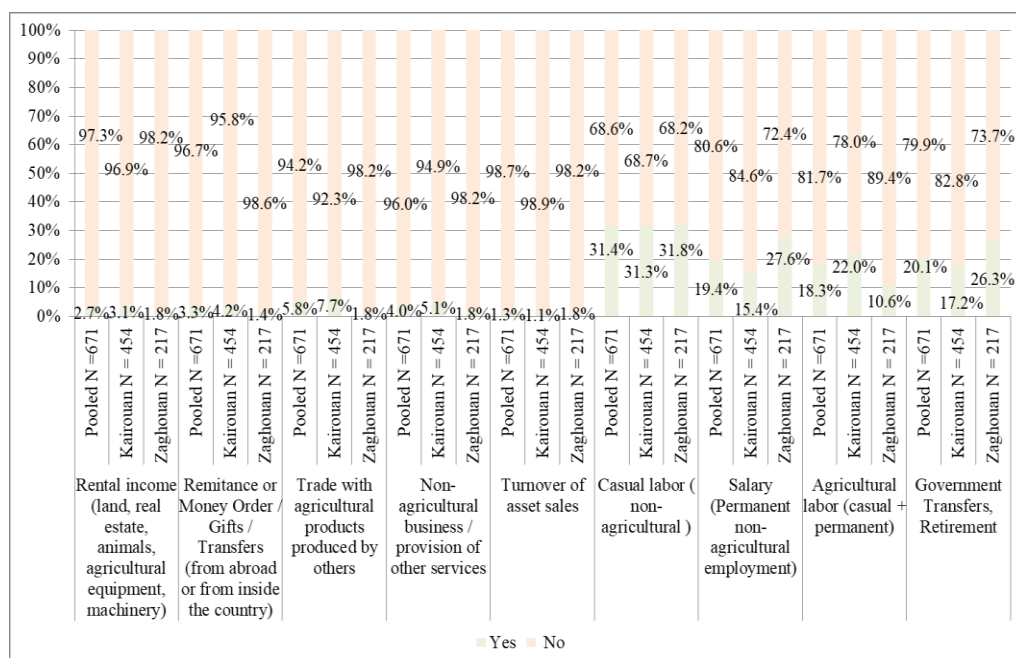


Figure 149. Amount /value received in the last 12 months by location. %

In some cases, there is only one person who benefits from the other source of income. It is the case in Zaghouan for the rental income (100%); the permanent non-agricultural employment (91.7%) and the government transfers and retirement (93%). In Zaghouan, some other sources of income are shared with the whole household for example the trade with agricultural products produced by others for 50%, the non-agricultural business also is shared with 50% and the turnover of assets sales also for 50%.

In Kairouan, salary from permanent non agricultural employment is kept by one person for 85.7% of the sample (Figure 150). Also the government transfer and retirements are for a single person for 78.2%. Otherwise, the other sources are mainly half kept by one person and the other half is for the whole household such like for the agricultural labor,

the non-agricultural business, the trade with agricultural products produced by others, the remittance or money order and the rental income.

For both governorates, there is no source of income that is totally shared with the whole family.

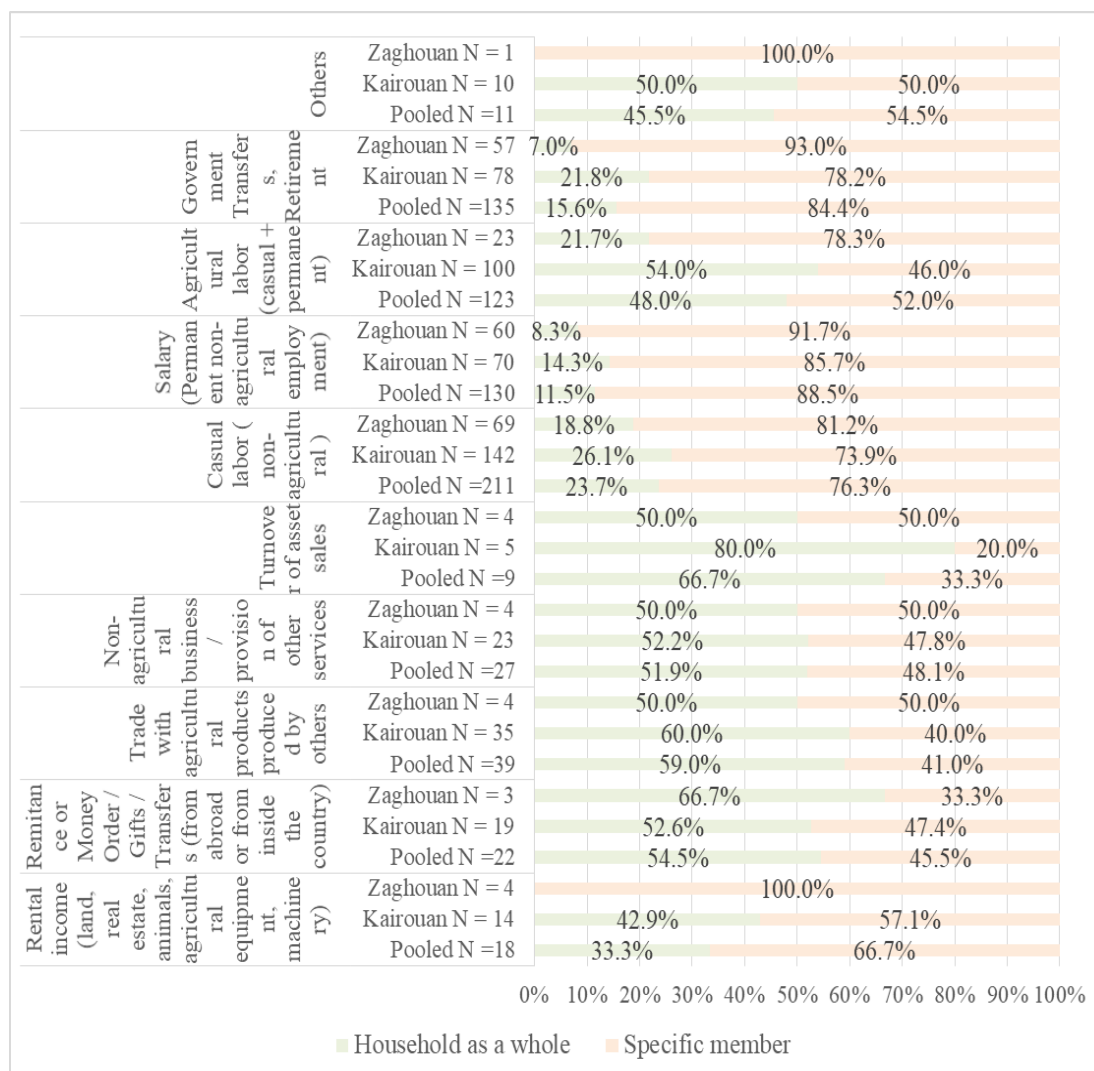


Figure 150. Persons who received the payment by governorate. %

Figure 151 shows the main beneficiaries of the payment by governorate. For most of the cases, it is the head of the household who benefits from the payment (in Zaghouan, it is the case for the rental income, the trade with agricultural products produced by others and the turnover of asset sales for 100% of the sample). In Kairouan, most of the time the payment is kept by the head of the household, it is the case for the rental income for 87.5% of the sample, the remittance or money order for 88.9%, the trade with agricultural products produced by others (85.7%) and the government transfers and retirement for 82%.

The highest rate for another person from the household benefiting from the other sources of income is the son for 100% in Zaghouan for the remittance and 39.3% also in Zaghouan for the casual labor.

The sources of incomes are jointly given to the parents in the family in Zaghouan for non-agricultural business and for the agricultural labor.

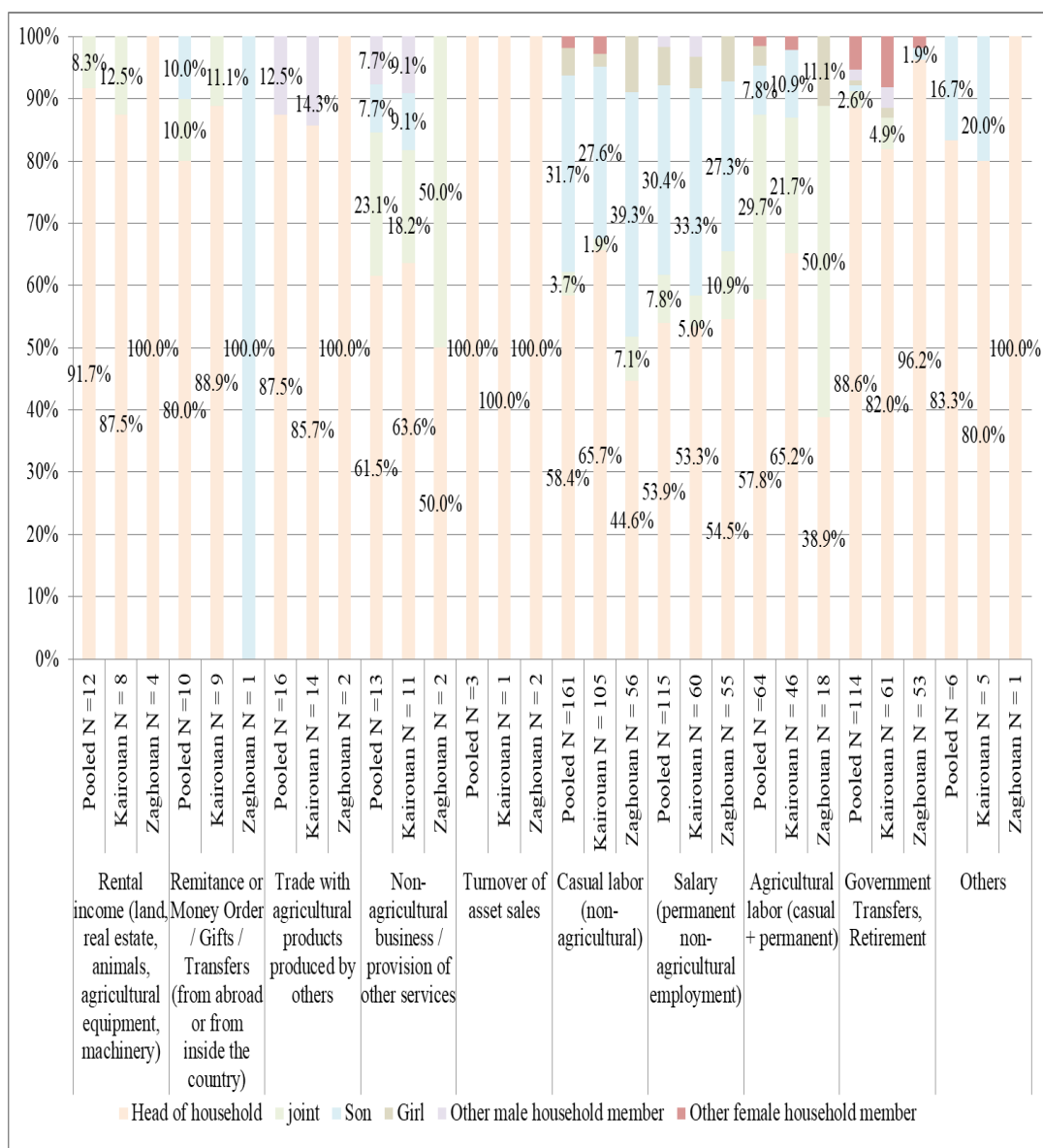


Figure 151. Main beneficiaries of the payment by governorate. %

Figure 152 shows the most important sources of income by governorate. It shows that for Zaghouan governorate the turnover of asset sales is very important for 100% of the sample, then comes the rental income for 75% and the trade with agricultural products produced by others (75%). The least important sources for Zaghouan are the remittance or money order (66.7%) and the income from agriculture crops (39.6%).

For Kairouan, the most important sources of income are the turnover of asset sales (60%) and the permanent non-agricultural employment for 57.1%. The least important sources are the remittance or money order for 36.8%; the income from agriculture crops for 28.4 % and finally the income from agricultural livestock for 16.5%.

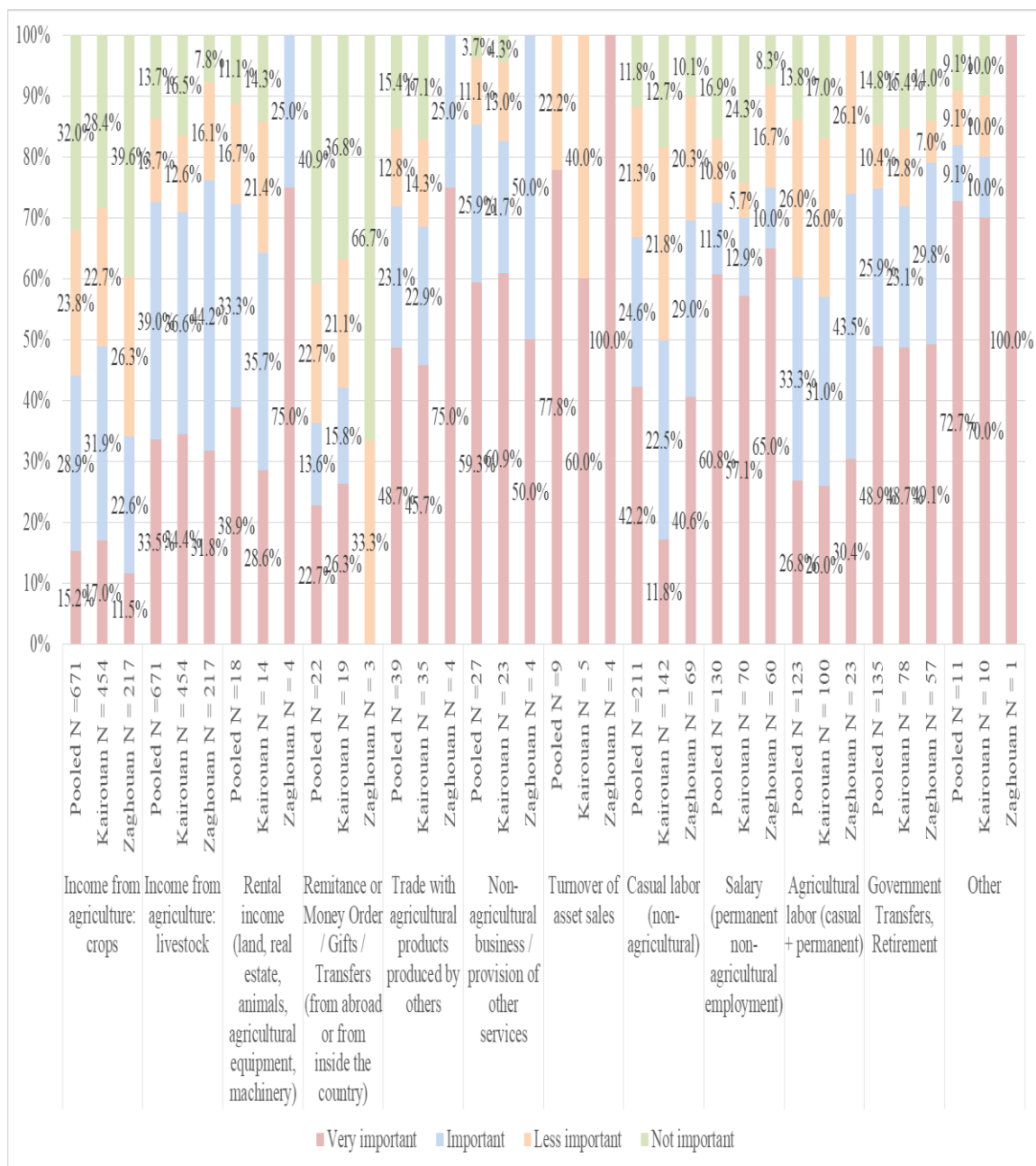


Figure 152. Most important sources of income by governorate. %

5.14. Module M : Non food expenditure

For the household expenditure, excluding the food, we can observe from figure 153 that almost the whole sample spend the minimum amount (between 0 and 500 TND) on interests on credits (98.2%); on transfer for other households (98.5%); on insurance and taxes (93.8%) and on tuition fees (90.7%). Percentages for both governorates are relatively equal for expenditures on clothing, shoes and bags accessories 74% for Zaghouan and 79.5% for Kairouan. Also money spent on celebration are equal for both locations 78.6% for Kairouan and 78.8% for Zaghouan.

The biggest amount of money (>1000 TND) is spent on celebration for both governorates: 12.7% for Kairouan and 12.9% for Zaghouan.

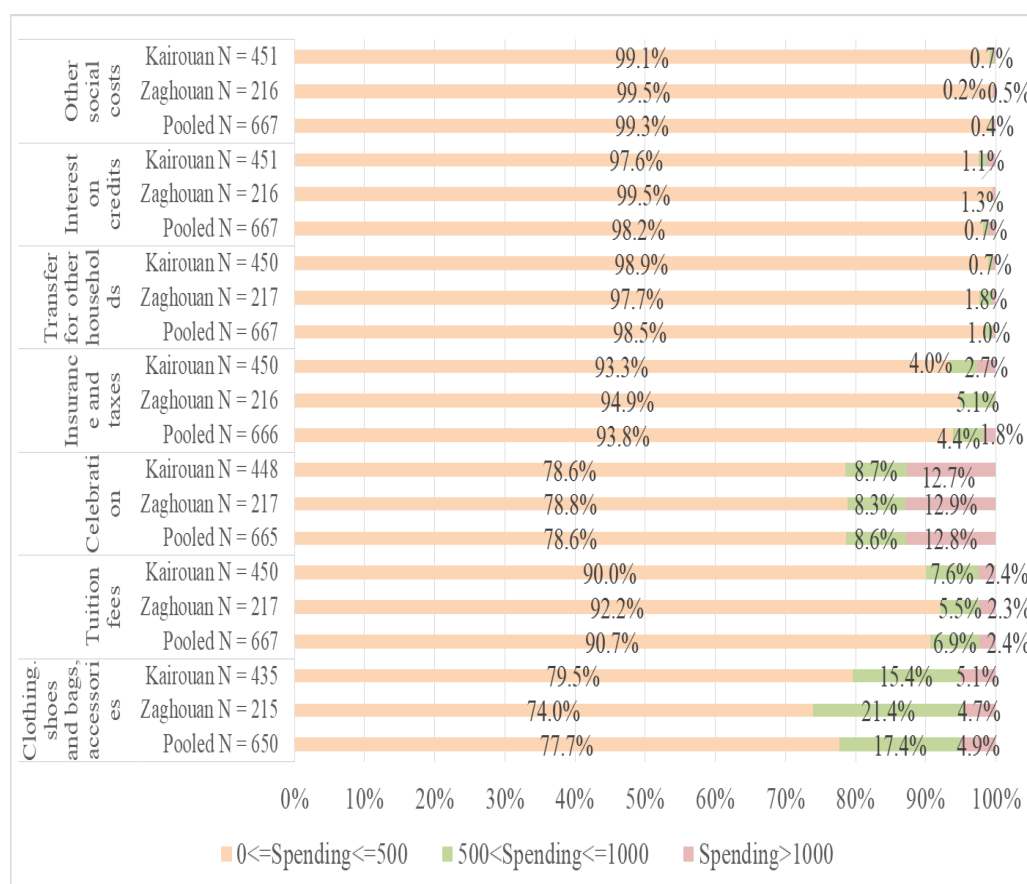


Figure 153.HH Spending (Item/service) last year by governorate. %

Table 76 shows the item/service spending for the last year for both governorates. It shows that the maximum amount is reserved for celebration for both governorates with 30000 TND. Then comes the tuition fees with a maximum of 20000 TND for Kairouan while for Zaghouan the maximum is only 2000 TND. The maximum money spent for transfer for other households is also very different between the 2 locations: it is 15000 TND for Kairouan while it is only 3000 TND for Zaghouan. The maximum money spent on Insurance and taxes for motorcycles/cars or agricultural equipment is also very different between the two locations: it is 5000 TND for Kairouan while it is only 1000 TND for Zaghouan.

Table 76.HH Spending (Item/service) last year (TND)

			Min	Max	Mean	Std. Deviation
Clothing. and accessories	Shoes bags,	Pooled N = 633	7	3000	414.32	429.36
		Kairouan N = 420	10	3000	407.12	448.24
		Zaghouan N = 213	7	2000	428.53	390.11
Celebration		Pooled N = 303	8	30000	2253.95	4585.10
		Kairouan N = 209	20	30000	2323.49	4781.03
		Zaghouan N = 94	8	30000	2099.34	4136.41
Insurance and taxes for motorcycles / cars / agricultural equipment		Pooled N = 167	60	5000	469.56	558.31
		Kairouan N = 111	60	5000	537.35	655.52
		Zaghouan N = 56	80	1000	335.18	231.75
Tuition fees		Pooled N = 314	20	20000	481.93	1178.10
		Kairouan N = 220	20	20000	505.03	1387.90
		Zaghouan N = 94	40	2000	427.87	361.79
Transfer for other households		Pooled N = 123	20	15000	316.59	1382.93
		Kairouan N = 61	20	15000	456.97	1918.96
		Zaghouan N = 62	20	3000	178.47	404.77
Interest credits	on	Pooled N = 49	50	4000	583.867	857.88
		Kairouan N = 42	50	4000	572.202	798.64
		Zaghouan N = 7	105	3450	653.857	1233.87
Other social costs		Pooled N = 54	5	2000	201.91	349.87
		Kairouan N = 34	5	1500	225.24	289.71
		Zaghouan N = 20	10	2000	162.25	439.37

Figure 154 shows the household spending per item or service for the last three months by governorate. The least amount of money (between 0 and 100 TND) is reserved for water payment for 98.2% of the sample in Zaghouan and 92.7% in Kairouan, and also for leisure and entertainment with 97.7% of the sample in Zaghouan spending less than 100 TND and 93.3% for Kairouan. The largest amount of money (more than 200 TND) is reserved for health and doctor's fees for both governorates with 19.6% of the sample for Kairouan and 11.1% for Zaghouan.

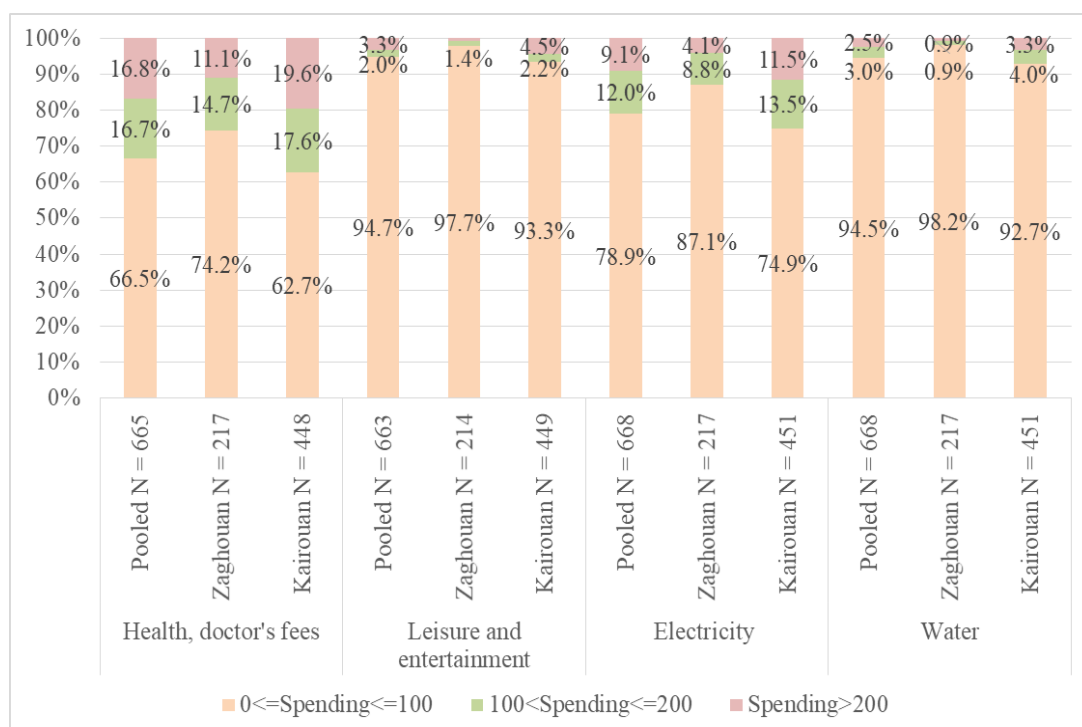


Figure 154.HH Spending (Item/service) last three months by governorate, %

Leisure and entertainment has the least amount of money with a maximum of 400 TND for Zaghoun and 1200 TND for Kairouan (Table 77). Then comes the expenditures for water with a maximum of 1200 TND for Zaghoun and 1470 for Kairouan. The maximum amount for both governorates concern the health and doctor's fees with 13000 TND.

Table 77.HH Spending (Item/service) last three months (TND)

		Min	Max	Mean	Std. Deviation
Health, doctor's fees	Pooled N = 502	2	13000	255.08	836.88
	Kairouan N = 333	2	13000	308.13	1009.24
	Zaghoun N = 169	7	2000	150.54	243.19
Leisure and entertainment	Pooled N = 126	5	1200	135.94	198.75
	Kairouan N = 86	5	1200	166.02	228.66
	Zaghoun N = 40	15	400	71.25	79.77
Electricity	Pooled N = 662	10	2450	105.293	204.21
	Kairouan N = 446	10	2450	121.493	237.80
	Zaghoun N = 216	15	1200	71.843	97.46
Water	Pooled N = 601	4	1470	50.36	106.32
	Kairouan N = 399	4	1470	57.74	104.60
	Zaghoun N = 202	4	1200	35.77	108.43

When we focus on the expenditures of the last month for both governorates, the minimum amount of money is reserved for rent (99.3%); personal care supplies (98.3%), detergent and laundry (98.8%) and school transport (95.2%). For all these expenditures the whole sample is spending between 0 and 50 TND (Figure 155).

The expenditures that cost the most are fuel and maintenance for motorcycles and cars for 18.1% for Kairouan and 12.1% for Zaghouan with an amount superior to 100 TND/month. Also for the other non-food expenses; both governorates spent more than 100 TND for 21.9% of the sample.

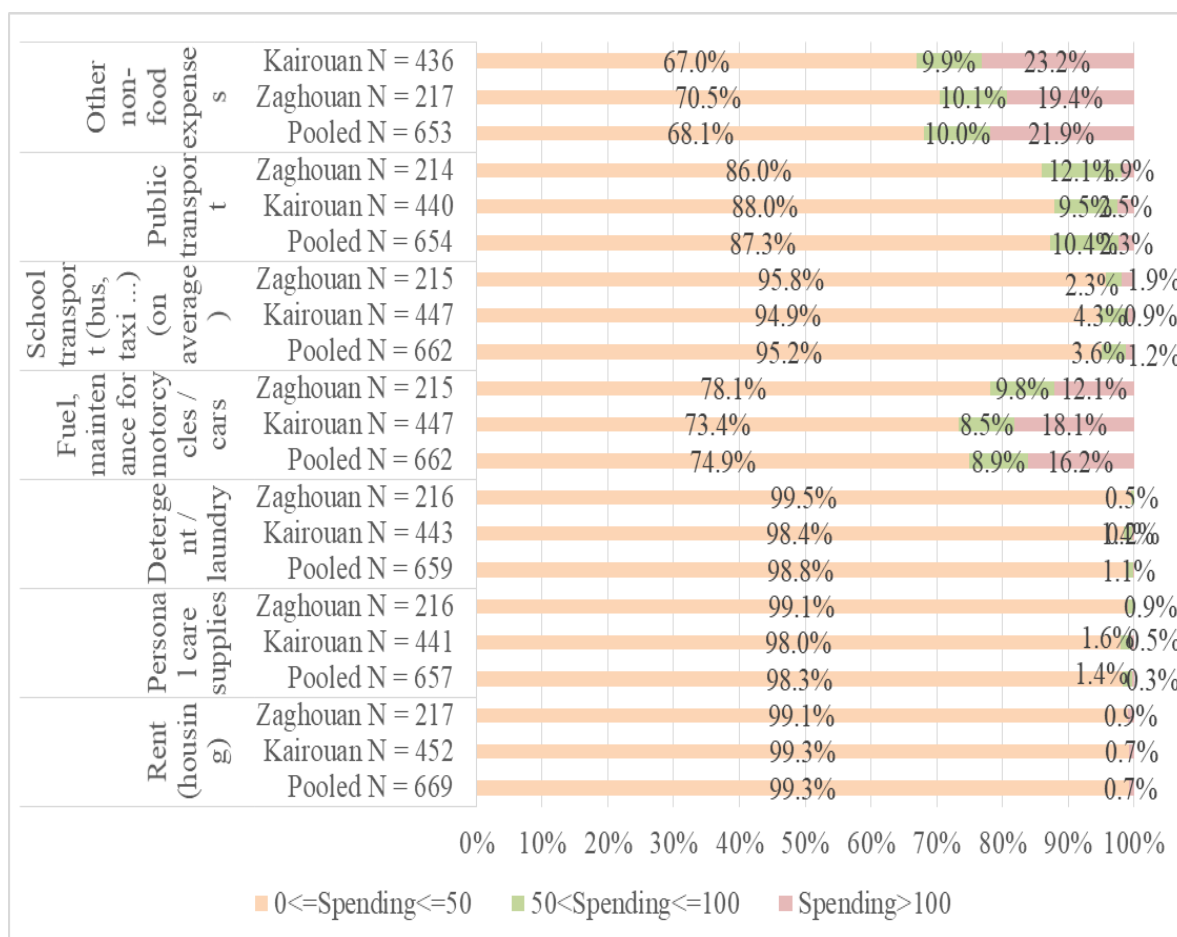


Figure 155.HH Spending (Item/service) last month by governorate, %

Table 78 shows the expenditures for the last month, the largest amount is for the other non-food expenses with a mean of 212.03 TND for both governorates and also fuel and maintenance for motorcycles or cars with a mean of 200.31 TND for both locations. The minimum mean is for detergent for both governorates with 14.899 TND.

Table 78.HH Spending (Item/service) last month (TND)

		Min	Max	Mean	Std. Deviation
Rent (housing)	Pooled N = 8	3	300	152.63	124.57
	Kairouan N = 6	3	300	143.5	145.48
	Zaghouan N = 2	160	200	180	28.28
Personal care supplies	Pooled N = 396	2	170	18.83	16.88
	Kairouan N = 233	2	170	20.98	20.13
	Zaghouan N = 163	3	60	15.75	9.9
Detergent / laundry	Pooled N = 595	1.5	120	14.899	13.19
	Kairouan N = 382	1.5	120	15.642	14.7
	Zaghouan N = 213	2	60	13.568	9.82
Fuel. maintenance for motorcycles / cars	Pooled N = 244	10	2200	200.31	304.28
	Kairouan N = 174	10	2200	228.94	345.18
	Zaghouan N = 70	20	750	129.14	141.91
School transport (bus. taxi ...) (on average)	Pooled N = 168	1	240	34.989	35.63
	Kairouan N = 110	1	150	31.765	30.56
	Zaghouan N = 58	5	240	41.105	43.3
Public transport	Pooled N = 504	0.4	200	33.565	31.98
	Kairouan N = 320	2	200	33.407	33.45
	Zaghouan N = 184	0.4	200	33.84	29.33
Other non-food expenses	Pooled N = 290	7	7000	212.03	470.17
	Kairouan N = 187	7	2000	196.19	252.25
	Zaghouan N = 103	10	7000	240.78	713.45

The expenditures for the last week show that percentages are almost equal for both governorates (Figure 156). Both locations spent less than 50 TND for 97.1% of the sample for the tobacco and 99.8% of the sample spend less than 50 TND on telephone expenses.

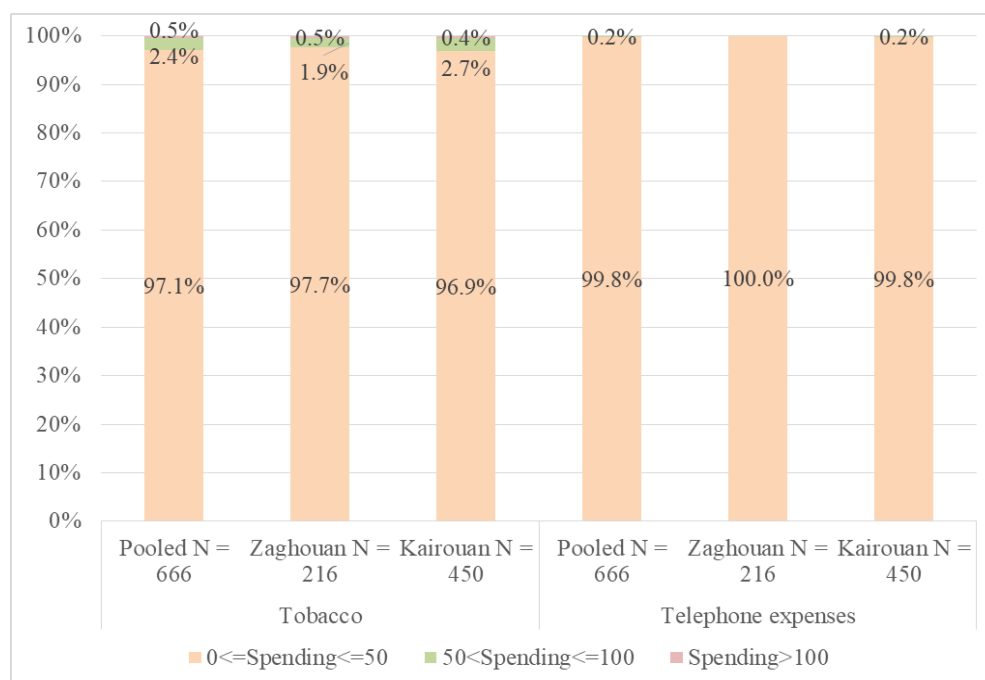


Figure 156.HH Spending (Item/service) last week by governorate. %

Table 79 shows that a little money is reserved for communication for both locations.

Table 79.HH Spending (Item/service) last week (TND)

		Mini	Max	Mean	Std. Deviation
Tobacco	Pooled N = 293	1	3000	31.49	175.14
	Kairouan N = 196	1	3000	37.91	213.60
	Zaghouan N = 97	2	144	18.50	19.11
Telephone expenses	Pooled N = 645	1	78	6.67	7.10
	Kairouan N = 432	1	78	6.51	7.03
	Zaghouan N = 213	1	50	7.00	7.26

5.15. Module N: Access to socioeconomic infrastructure

The distance to the nearest social facilities by governorate is shown in Figure 157. The nearest facility is the primary school for both governorates with 93.3% stating that the school is less than 5 km away from the house. Percentages are almost the same with the 2 governorates; 92.5% for Kairouan and 94.9% for Zaghouan. The second nearest facility for both governorates is the health care center with 70% saying that the facility is less than 5 km.

For half of the sample, the distance of the nearest social facility is between 5 to 15 km, it concerns for Zaghouan the village market (53.2%), the main agricultural inputs market (56%), the main agricultural products market (54.2%), the secondary school (50.9%) and the agricultural extension office (57%).

The farthest social facility for Zaghouan is the main agricultural products market with 19.9% of the sample declaring that this facility is far from home for more than 15km. It is also the case for 38.7% of the sample in Kairouan.

The main agricultural inputs market is also far for more than 15km for 37% of the sample in Kairouan and 17.6% in Zaghouan. It is also the same thing for the village market which is far for more than 15 km for 16.2% of the sample for both locations.

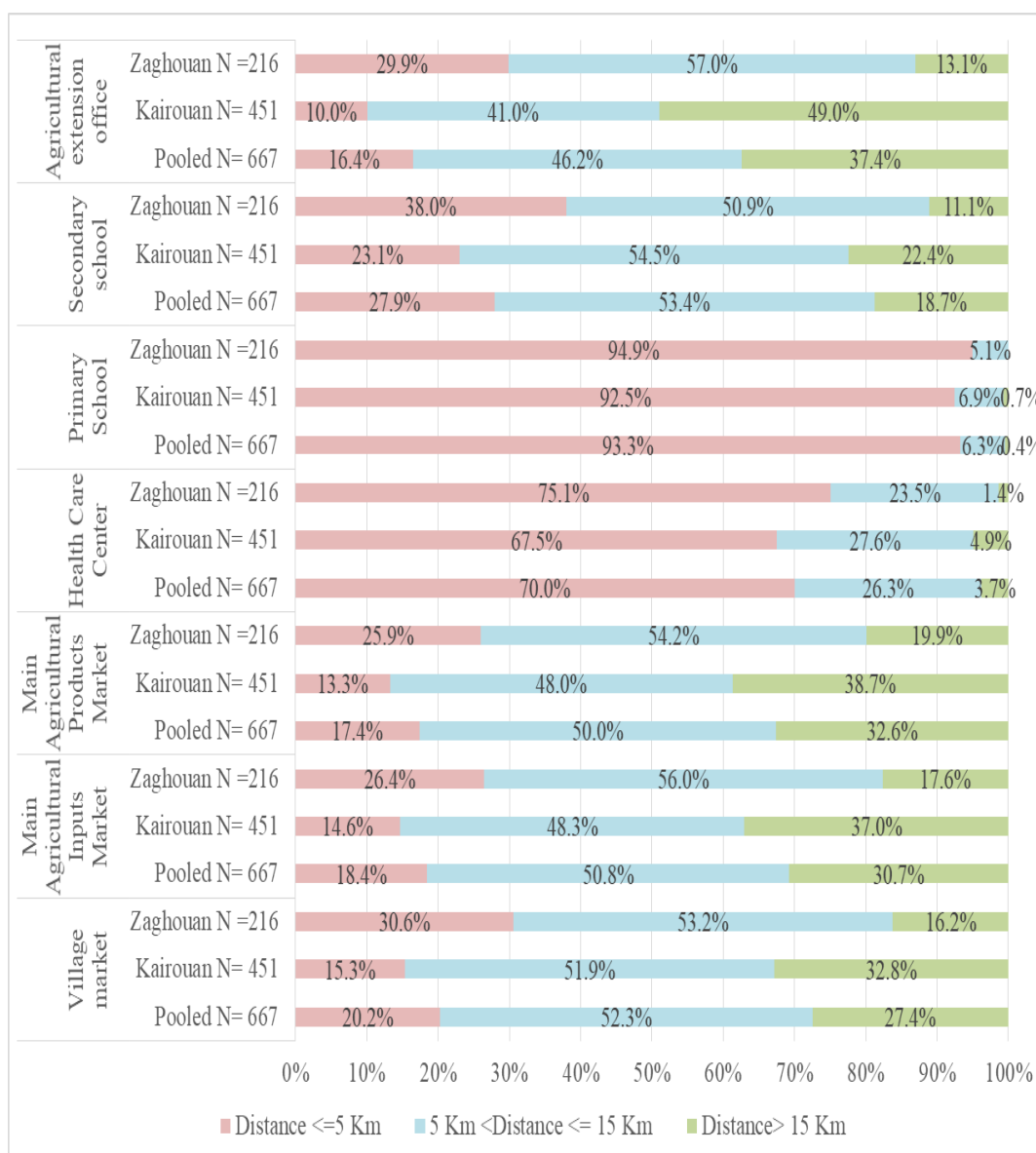


Figure 157. Distance to the Nearest Social Facilities by governorate

Looking at the distance to the nearest social facility, the agricultural extension office is the farthest with a mean of 15.89 km for both governorates. Then comes the main agricultural products market with a mean of 14.82 km and the main agricultural inputs market with a mean of 13.88 km. The village market is also far with a mean distance for both governorates of 13.03 km and also the secondary school is far with a mean of 18.84 km for Kairouan and 9.7 km for Zaghouan.

The nearest facility for both locations is the primary school with a mean of 2.38 Km distance from the household (Table 80).

Table 80.Distance to the nearest social facilities by governorate

		Min	Max	Mean	Std. Deviation
Village market	Pooled N= 667	0.1	100	13.03	9.81
	Kairouan N= 451	0.1	100	14.56	10.34
	Zaghouan N =216	0.2	50	9.82	7.68
Main Agricultural Inputs Market	Pooled N= 667	0.1	100	13.88	10.53
	Kairouan N= 451	0.1	100	15.58	11.27
	Zaghouan N =216	0.2	50	10.32	7.67
Main Agricultural Products Market	Pooled N= 663	0.1	140	14.82	12.10
	Kairouan N= 447	0.1	140	16.74	13.20
	Zaghouan N =216	0.2	50	10.85	8.13
Health Care Center	Pooled N= 667	0.1	777	7.11	36.43
	Kairouan N= 450	0.1	777	7.93	41.88
	Zaghouan N =217	0.1	300	5.40	20.99
Primary School	Pooled N= 667	0.1	30	2.38	2.58
	Kairouan N= 451	0.1	30	2.56	2.91
	Zaghouan N =216	0.1	8	2.00	1.65
Secondary school	Pooled N= 664	0.2	70	11.14	8.73
	Kairouan N= 448	0.2	70	12.35	9.33
	Zaghouan N =216	0.2	40	8.62	6.65
Agricultural extension office	Pooled N= 663	0.3	70	15.89	11.56
	Kairouan N= 449	0.5	70	18.84	12.09
	Zaghouan N =214	0.3	50	9.70	7.15

Figure 158 shows that the closest paved road to the farm is less than 5 Km for almost the whole sample (94.5%). Less than 1% of the sample has a distance of more than 15 km to the nearest paved road.

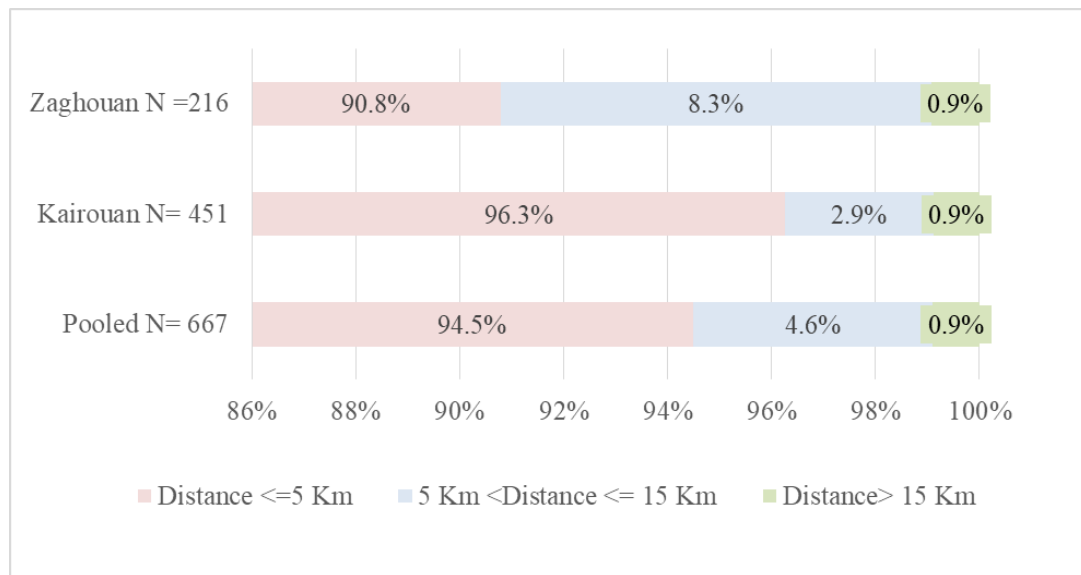


Figure 158.Closest distance to the farm by taking the paved road (Km) by governorate

Figure 159 shows the most frequently used means of transportation to the social facilities by governorate. The minibus or public transport is the most used means of transport for the village market (58.6%) of the sample, the main agricultural inputs market (46.9%), the main agricultural products market (42.6%) ,the health care center (40.8%), the secondary school (81.7%) and the agricultural extension office (70.6%).

Due to a short distance from the household, most of the sample goes to the primary school walking; it is the case for 86.6% in Zaghouan and 66.5% in Kairouan. The hired truck is also used by 29.2% of the whole sample to reach the main agricultural products market; it is mainly the same for the main agricultural inputs market with 26.1%. Finally 13.1% of the sample hire a truck to go to the village market.

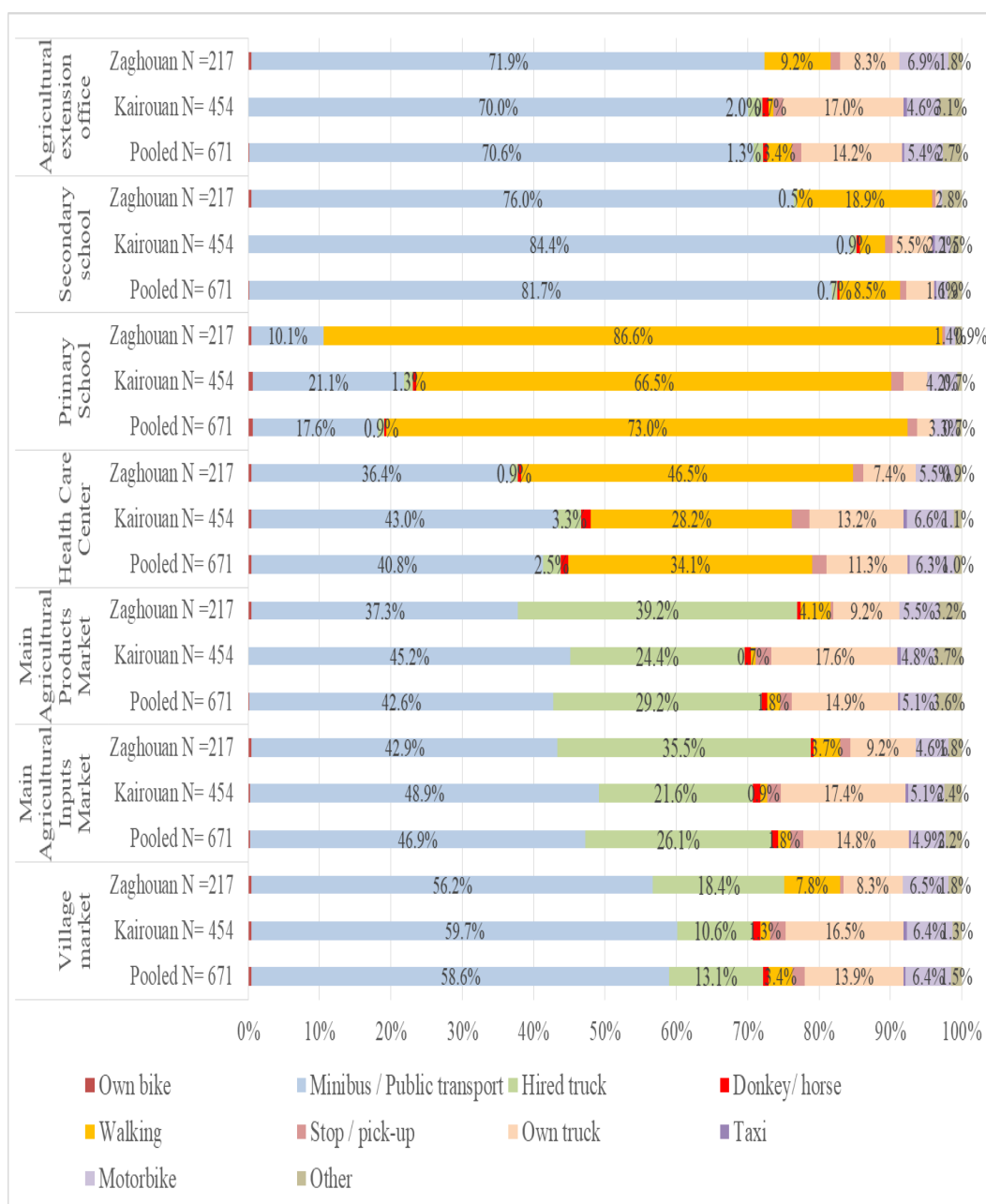


Figure 159. Most frequently used means of transportation to the Social Facilities by Governorate

Figure 160 shows the important constraints faced by the households to access the market. The first constraint is the infrastructure for both governorates (30.4%), then comes the distance to the market (27%) and also the high prices of inputs in the market (21.9%).

Household in Zaghouan suffer from the lack of information for 13.4% of the sample. The second constraint is for 9% of the sample the bad quality of inputs. In Kairouan, households suffer from the unavailability of inputs for 12.7% of the sample as constraint 2.

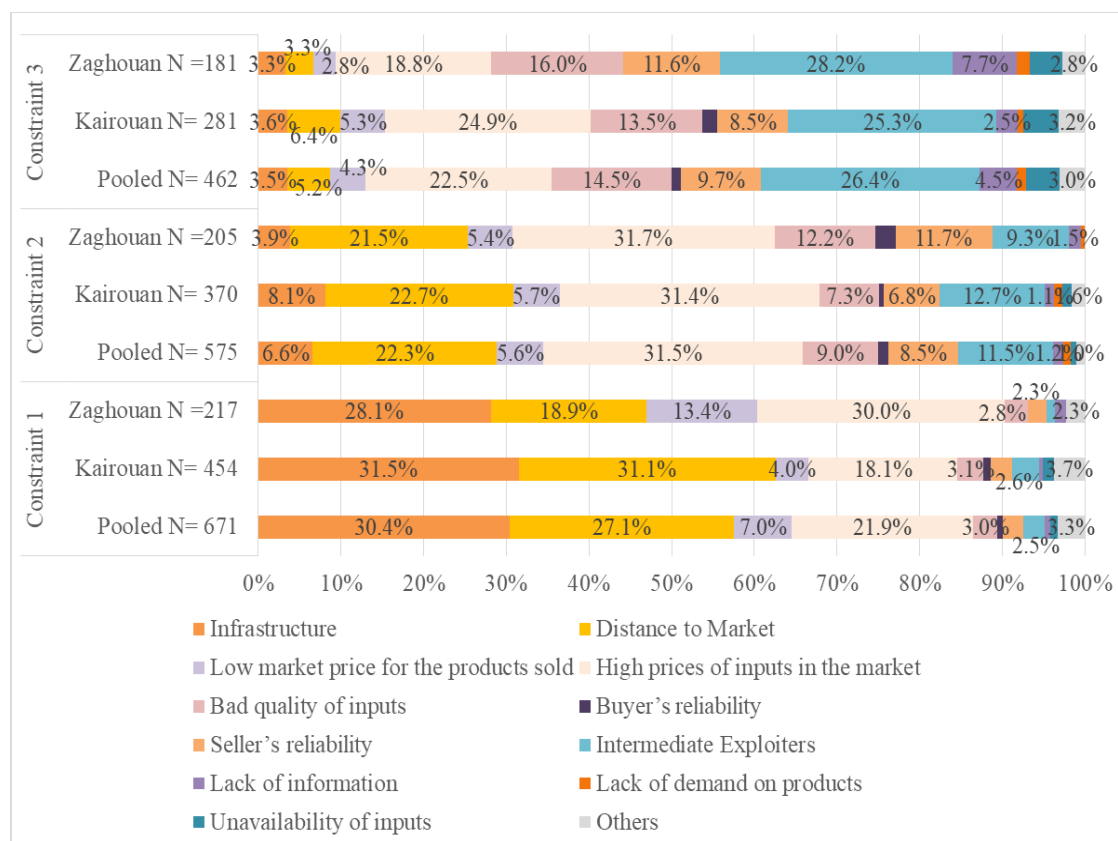


Figure 160. Constraints Importance / Perceptions to Access to Market by Governorate

5.16. Module O: Shocks

Households in Kairouan and Zaghouan governorates are facing different shocks. According to figure 153, three major shocks are observed in 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% for both locations (Figure 161).

Kairouan governorate suffers a lot from the climatic conditions with the temperature rise for 71.1% but also from the wind with 38.3%.

Fortunately, these two locations do not suffer from pests or diseases that affect crops before harvest; only 10.6% in Kairouan declare suffering from this shock and 5.1% for Zaghouan. Households declare that the loss of harvest due to pests and biological disasters only concerned 1.8% of the people surveyed in Zaghouan and 5.7% in Kairouan.

These two locations do not suffer a lot from job loss; for both governorates only 3.1% affirm that they suffer from this constraint.



Figure 161. Shocks observed in the previous 2 years

When we focus on the intensity of the last shock faced by the household, it appears again that drought is the most intensive shock with 78.4% for both governorates declaring that this constraint is very high. Also the large increase in food prices with 76.8% for both locations declaring that the intensity is very high and finally the large increase in agricultural input prices is very high in Kairouan for 66.7% and in Zaghouan for 50.2% (Table 81).

On the other side, the least intense shock is the hailstorm with more than half the persons surveyed declaring that the intensity of this shock is low to very low for Kairouan and Zaghouan.

For 57.8% an acute illness can be also very high in intensity for both governorates.

Table 81. Intensity of the last shock to theHH

		Verylow	Low	Moderate	High	Veryhigh
Drought	Pooled, N=661	0.2%	0.5%	3.3%	17.7%	78.4%
	Kairouan, N=448	0.2%	0.4%	2.9%	13.8%	82.6%
	Zaghouan, N=213	0.0%	0.5%	4.2%	25.8%	69.5%
Hailstorm	Pooled, N=81	30.9%	27.2%	16.0%	13.6%	12.3%
	Kairouan, N=63	33.3%	23.8%	14.3%	12.7%	15.9%
	Zaghouan, N=18	22.2%	38.9%	22.2%	16.7%	0.0%
Flood	Pooled, N=79	5.1%	3.8%	29.1%	35.4%	26.6%
	Kairouan, N=57	5.3%	3.5%	29.8%	38.6%	22.8%
	Zaghouan, N=22	4.5%	4.5%	27.3%	27.3%	36.4%
Loss of harvest due to pests and biological disasters	Pooled, N=30	3.3%	6.7%	20.0%	30.0%	40.0%
	Kairouan, N=26	3.8%	3.8%	19.2%	30.8%	42.3%
	Zaghouan, N=4	0.0%	25.0%	25.0%	25.0%	25.0%
Temperature rise	Pooled, N=457	0.2%	7.9%	19.0%	27.8%	45.1%
	Kairouan, N=323	0.3%	8.7%	16.4%	23.5%	51.1%
	Zaghouan, N=134	0.0%	6.0%	25.4%	38.1%	30.6%
Wind	Pooled, N=251	2.8%	8.0%	20.3%	22.3%	46.6%
	Kairouan, N=174	2.3%	6.9%	16.7%	19.5%	54.6%
	Zaghouan, N=77	3.9%	10.4%	28.6%	28.6%	28.6%
Pests or diseases that affected crops before harvest	Pooled, N=59	5.1%	13.6%	23.7%	27.1%	30.5%
	Kairouan, N=48	6.3%	12.5%	25.0%	22.9%	33.3%
	Zaghouan, N=11	0.0%	18.2%	18.2%	45.5%	18.2%
Unexpected loss of livestock (illness, theft)	Pooled, N=98	7.1%	10.2%	22.4%	29.6%	30.6%
	Kairouan, N=79	7.6%	10.1%	22.8%	30.4%	29.1%
	Zaghouan, N=19	5.3%	10.5%	21.1%	26.3%	36.8%
Large increase in agricultural input prices	Pooled, N=612	0.0%	3.4%	15.7%	19.6%	61.3%
	Kairouan, N=409	0.0%	1.7%	14.4%	17.1%	66.7%
	Zaghouan, N=203	0.0%	6.9%	18.2%	24.6%	50.2%
	Pooled, N=248	0.4%	5.6%	31.9%	25.4%	36.7%

Large decrease in agricultural output prices	Kairouan, N=159	0.6%	4.4%	28.3%	25.2%	41.5%
	Zaghuan, N=89	0.0%	7.9%	38.2%	25.8%	28.1%
Large increase in food prices	Pooled, N=626	0.0%	0.8%	5.9%	16.5%	76.8%
	Kairouan, N=418	0.0%	0.2%	4.8%	16.5%	78.5%
	Zaghuan, N=208	0.0%	1.9%	8.2%	16.3%	73.6%
Job loss	Pooled, N=21	0.0%	4.8%	4.8%	14.3%	76.2%
	Kairouan, N=20	0.0%	5.0%	5.0%	15.0%	75.0%
	Zaghuan, N=1	0.0%	0.0%	0.0%	0.0%	100.0%
Acute illness	Pooled, N=116	0.0%	2.6%	12.9%	26.7%	57.8%
	Kairouan, N=86	0.0%	3.5%	9.3%	27.9%	59.3%
	Zaghuan, N=30	0.0%	0.0%	23.3%	23.3%	53.3%
Others	Pooled, N=251	0.0%	0.0%	8.0%	16.0%	76.0%
	Kairouan, N=18	0.0%	0.0%	0.0%	11.1%	88.9%
	Zaghuan, N=77	0.0%	0.0%	28.6%	28.6%	42.9%

When asked about the worst shock observed in the previous three years, 64.9% of the sample (670 persons) declare that they suffer the most from drought (Figure 162). The percentages are nearly the same between Zaghuan with 63.1% and Kairouan with 65.8%. Then comes the large increase in food prices with 16.3% of the respondents in both governorates.

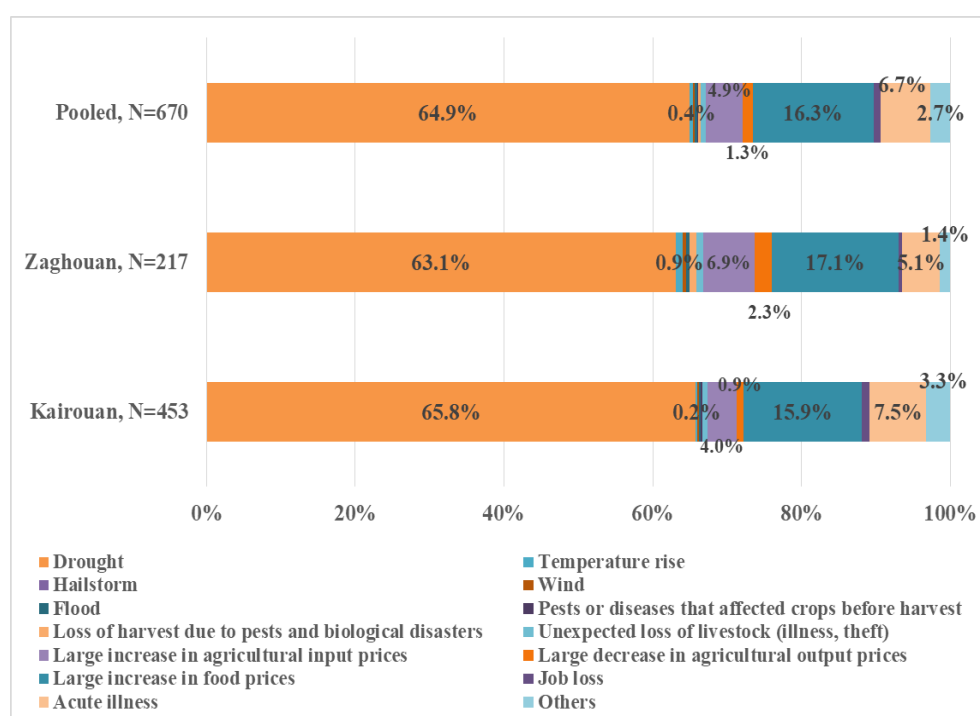


Figure 162. Worst shock observed in previous 3 years

What are the coping strategies to the shocks by location? 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% goes to the sale of animals to copy with the shock, while only 14.3% declare selling their animals in Kairouan to have some cash. 18% in Zaghouan prefer opting for non-agricultural employment, while it is only 5.1% of the sample that takes this strategy in Kairouan (Figure 163).



Figure 163. Coping strategies to shocks by location

5.17. Module P: Day food recall

Figure 164 shows the food consumption in the previous 7 days for the household. Almost the whole sample consumed vegetables and tubercular cultures (98.7%), cereals (97.6%), spices and condiments (95.1%), sweet products (97.5%), oils and fats (97.6%), milky and dairy products (92.8%) and drinks (90.6%).

There are some differences between the governorates, for example for the legumes nuts and seeds 80.2% of the sample in Zaghouan consumed it in the last week while they are only 64.9% for Kairouan. Also for the green leafy vegetables, in Zaghouan 84.8% consumed it while they are 72% in Kairouan. Meat is more consumed in Kairouan with 85.7% while they are 77.4% in Zaghouan, it is also the case for the eggs; 93.5% in Zaghouan versus 85% in Kairouan.

Fish and sea food are not much consumed in these regions, only 17.9% in Kairouan and 12.9% in Zaghouan. It is also the case for the Offal or trimming, consumed by 20.3% in Zaghouan and only 13.7% in Kairouan.



Figure 164. Food Consumption in the previous 7 days by governorates. %

For the food consumption in the last 24 hours by governorate, table X shows that percentages are almost the same for both locations. More than 95% of the sample consumed cereals (97.86%), vegetable and tubercular culture (93.8%), fruits (90.54%), meat (93.35%), eggs (94.05%), milk and dairy products (97.11%), oils and fats (97.71%), sweet products (99.54%), spices and condiments (99.53%) and drinks (95.55%).

There is a slight difference on fish and seafood between the two governorates, 46.91% of the sample for Kairouan and 67.86% for Zaghouan.

The least consumed product is the offal or trimming for both governorates with only 15.8% of the sample consuming it in the last 24 hours (Table 82).

Table 82. Food Consumption in the previous 24 hours by governorate. %

	Kairouan		Zaghouan		Pooled	
	Yes	No	Yes	No	Yes	No
Cereals	97.72%	2.28%	98.15%	1.85%	97.86%	2.14%
Vegetable and tubercular culture	91.93%	8.07%	97.67%	2.33%	93.80%	6.20%
Vegetables rich in vitamin A and tubers	85.09%	14.91%	93.10%	6.90%	87.84%	12.16%
Green leafy vegetables	83.44%	16.56%	94.02%	5.98%	87.25%	12.75%
Other vegetables	96.60%	3.40%	98.61%	1.39%	97.26%	2.74%
Other fruits	89.74%	10.26%	92.22%	7.78%	90.54%	9.46%
Offal or trimming	13.70%	86.30%	20.30%	79.70%	15.8%	84.20%
Meat	93.30%	6.70%	93.45%	6.55%	93.35%	6.65%
eggs	92.73%	7.27%	96.55%	3.45%	94.05%	5.95%
Fish and seafood	46.91%	53.09%	67.86%	32.14%	52.29%	47.71%
Legumes, nuts and seeds	79.93%	20.07%	88.51%	11.49%	83.12%	16.88%
Milk and dairy products	96.35%	3.65%	98.58%	1.42%	97.11%	2.89%
Oils and fats	97.03%	2.97%	99.07%	0.3%	97.71%	2.29%
Sweet products	99.54%	0.46%	99.53%	0.47%	99.54%	0.46%
Spices, condiments	99.30%	0.70%	100%		99.53%	0.47%
Drinks	94.81%	5.19%	97.03%	2.97%	95.55%	4.45%

When we focus on the food sources by governorate, figure 165 shows that most of the food is bought by the households. This concerns in Zaghuan 100% of the sample for the sweet products, fish and seafood and drinks. 98.1% of the sample buy vegetable and tubercular culture, 96.6% buy vegetables rich in vitamin A and tubers; 92.4% buy green leafy vegetables and 96.4% buy fruits.

In Kairouan, this tendency is almost the same, 98.7% of the vegetables and tubercular cultures are bought, also the vegetables rich in vitamin A and tubers (95.4%), the green leafy vegetables (90.2%), fruits (92.9%), fish and seafood (100%), legumes nuts and seeds (98.6%).

For some products, households in both governorates have their own production. It is the case for the eggs for 82.8% in Kairouan and 73.5% in Zaghuan. Also half of the offal or trimming is made at home in Zaghuan.

In both governorates, only 12.5% of cereals is made by the households. 32% of the sample consume its own meat for both locations.

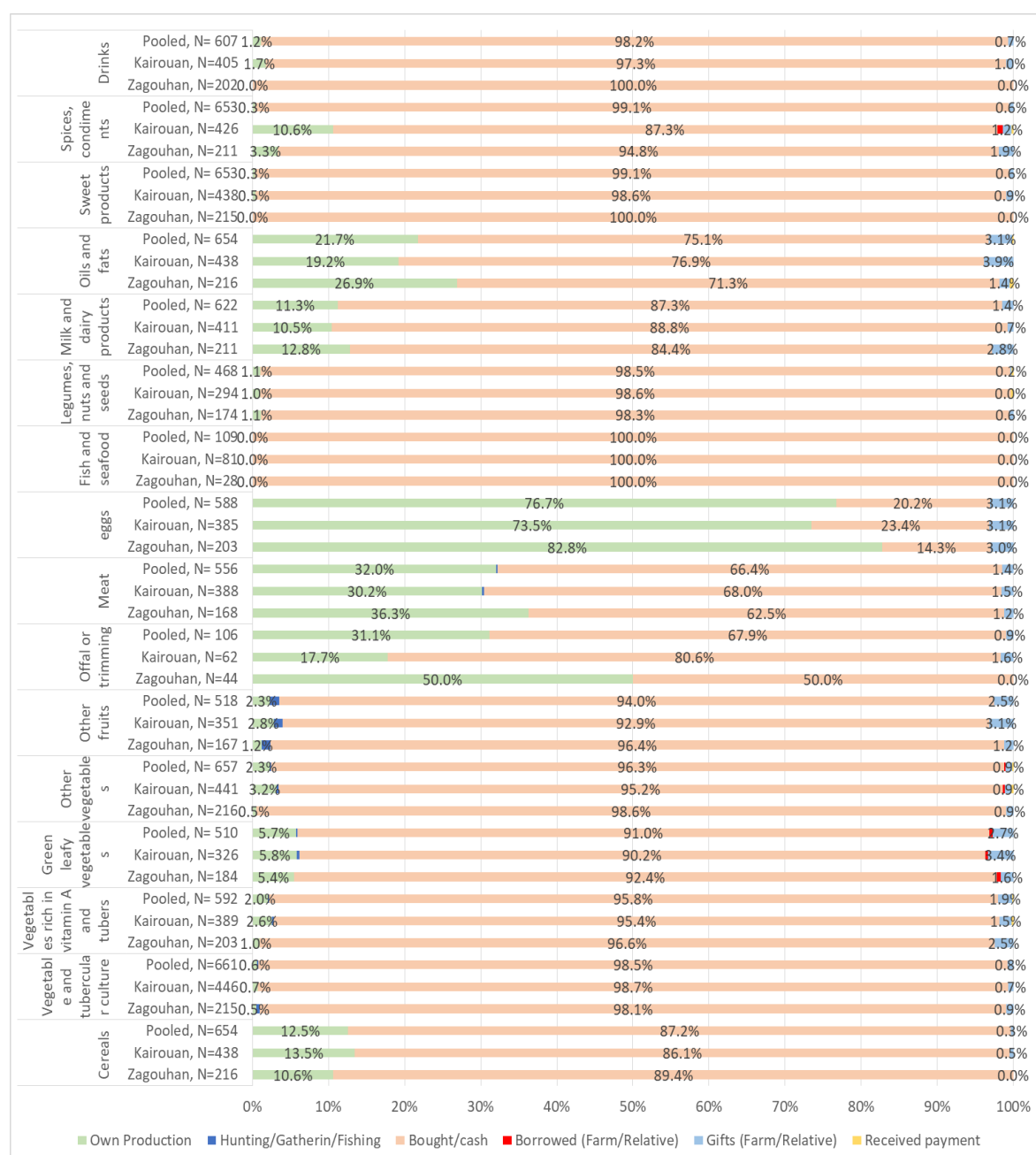


Figure 165. Food sources by governorates. %

Table 83 shows the expenditures on food products spent in the previous 7 days. The highest mean is for meat in both governorates with 18.26 TND. For some products, the mean is nearly the same for both locations: for the cereals 8.61 TND in Kairouan and 8.02 in Zaghouan, for vegetables rich in vitamin A and tubers 2.66 TND for Kairouan and 2.47 for Zaghouan, for legumes nuts and seeds 4.15 TND for Kairouan and 4.09 TND for Zaghouan.

Table 83. Amount of food products spent in the previous 7 days (TND)

	Min	Max	Mean	S.Deviation
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Cereals	Kairouan N= 402	0.4 2	300.00	8.61	18.70
	Zaghouan N= 207	0.6 0	87.60	8.02	11.12
	Pooled N= 609	0.4 2	300.00	8.41	16.51
Vegetable and tubercular culture	Kairouan N= 440	0.6 0	200.00	3.74	9.89
	Zaghouan N= 211	0.5 0	10.00	2.68	1.43
	Pooled N= 651	0.5 0	200.00	3.40	8.18
Vegetables rich in vitamin A and tubers	Kairouan N= 378	0.0 0	12.5 0	2.66	1.66
	ZaghouanN= 199	0.5 0	8.00	2.47	1.30
	Pooled N= 577	0.0 0	12.5 0	2.60	1.54
Green leafy vegetables	Kairouan N= 294	0.0 0	20.0 0	1.73	1.48
	ZaghouanN= 171	0.4 0	6.00	1.58	0.94
	Pooled N= 465	0.0 0	20.0 0	1.68	1.31
Other vegetables	Kairouan N= 429	0.6 0	25.4 0	4.79	3.18
	ZaghouanN= 213	0.8 0	87.5 0	6.24	9.79
	Pooled N= 642	0.6 0	87.5 0	5.27	6.24
Other fruits	Kairouan N= 330	1.0 0	75.6 0	6.50	6.23
	ZaghouanN= 161	1.5 0	15.7 0	5.21	2.78
	Pooled N= 491	1.0 0	75.6 0	6.08	5.38
Offal or trimming	Kairouan N= 54	2.0 0	50.0 0	10.53	9.28
	Zaghouan N= 30	3.0 0	30.0 0	9.60	7.14
	Pooled N= 84	2.0 0	50.0 0	10.20	8.55
Meat	Kairouan N= 324	0.0 0	150.00	19.88	15.80
	Zaghouan N= 141	2.3 0	63.2 0	14.53	8.13
	Pooled N= 465	0.0 0	150.00	18.26	14.13
eggs	Kairouan N= 97	0.6 0	21.0 0	4.07	3.53

	Zaghouan N= 30	0.9 0	10.0 0	3.75	2.22
	Pooled N= 127	0.6 0	21.0 0	3.99	3.26
	Kairouan N= 81	2.0 0	75.4 0	9.20	9.40
Fish and seafood	Zaghouan N= 28	3.0 0	30.0 0	7.15	5.33
	Pooled N= 109	2.0 0	75.4 0	8.68	8.57
Legumes, nuts and seeds	Kairouan N= 291	0.0 0	20.0 0	4.15	3.02
	Zaghouan N= 172	1.0 0	16.0 0	4.09	2.91
	Pooled N= 463	0.0 0	20.0 0	4.12	2.98
Milk and dairy products	Kairouan N= 378	1.0 0	95.3 0	9.4118	11.61085
	ZaghouanN= 190	1.0 0	94.2 0	7.36	10.52
	Pooled N= 568	1.0 0	95.3 0	8.7268	11.28867
Oils and fats	Kairouan N= 361	0.0 0	85.2 0	4.56	7.50
	ZaghouanN= 182	0.5 0	55.2 0	4.21	4.78
	Pooled N= 543	0.0 0	85.2 0	4.44	6.71
Sweet products	Kairouan N= 431	0.0 0	75.7 0	4.21	5.91
	ZaghouanN= 215	1.0 0	85.6 0	3.75	6.67
	Pooled N= 646	0.0 0	85.6 0	4.06	6.17
Spices, condiments	Kairouan N= 374	0.2 5	85.5 0	2.88	5.70
	ZaghouanN= 206	0.5 0	85.5 0	2.85	6.06
	Pooled N= 580	0.2 5	85.5 0	2.87	5.83
Drinks	Kairouan N= 394	0.5 0	85.5 0	5.58	7.21
	ZaghouanN= 202	1.0 0	85.2 0	4.57	6.33
	Pooled N= 596	0.5 0	85.5 0	5.24	6.93

Table 84 shows the total production value consumed during the last 7 days. The sweet products are the highest value with 13 TND mean for both governorates. Meat has also a high value with 14.59 TND mean for both locations. There is a big disparity for the fruits with 10 TND mean in Zaghouan and 4.23 TND mean in Kairouan.

The total production value consumed is nearly the same for both governorates for these products: cereals (5.49 TND mean), green leafy vegetables (1.87 TND mean), oils and fats (8.91 TND mean) and for spices and condiments (2.94 TND mean).

Table 84. Total production value consumed during the last 7 days (TND)

		Min	Max	Mean	Sd. Deviation
Cereals	Kairouan N= 90	1.0	44	5.49	5.92
	Zaghouan N= 34	1.0	20	5.01	3.92
	Pooled N= 124	1.0	44	5.36	5.43
Vegetable and tubercular culture	Kairouan N= 3	2.0	10	7.33	4.62
	Zaghouan N= 1	1.0	2	2.00	2.00
	Pooled N= 4	2.0	10	6.00	4.62
Vegetables rich in vitamin A and tubers	Kairouan N= 18	0.5	5	2.23	1.13
	Zaghouan N= 2	5.0	7	6.00	1.41
	Pooled N= 20	0.5	7	2.61	1.61
Green leafyvegetables	Kairouan N= 23	0.7	5	1.87	1.10
	Zaghouan N= 10	0.5	2	1.40	0.57
	Pooled N= 33	0.5	5	1.72	0.98
Othervegetables	Kairouan N= 24	1.2	15	3.52	3.03
	Zaghouan N= 1	1.6	2	1.60	
	Pooled N= 25	1.2	15	3.44	2.99
Other fruits	Kairouan N= 11	1.0	10	4.23	3.40
	Zaghouan N= 3	10	10	10.00	0.00
	Pooled N= 14	1.0	10	5.46	3.87
Offal or trimming	Kairouan N= 14	2.0	30	7.86	7.27
	Zaghouan N= 23	3.0	12	5.13	1.82
	Pooled N= 37	2.0	30	6.16	4.79
Meat	KairouanN= 151	5.0	60	14.45	9.53
	Zaghouan N= 83	5.0	45	14.84	9.21
	Pooled N= 234	5.0	60	14.59	9.40
eggs	KairouanN= 279	0.5	100	5.73	9.96
	ZaghouanN= 169	1.0	12	4.54	2.56
	Pooled N= 448	0.5	100	5.28	8.03
Legumes, nuts and seeds	Kairouan N= 5	2.0	8	3.90	2.36
	Zaghouan N= 2	3.0	6	4.50	2.12
	Pooled N= 7	2.0	8	4.07	2.13
Milk and dairyproducts	Kairouan N= 46	1.0	20	5.85	3.54
	Zaghouan N= 34	2.0	15	6.81	3.25

	Pooled N= 80	1.0	20	6.26	3.43
	Kairouan N= 97	1.0	33	8.91	6.58
Oils and fats	Zaghouan N= 84	2.0	40	9.46	6.37
	Pooled N= 181	1.0	40	9.17	6.48
	Kairouan N= 3	3.0	30	12.33	15.31
Sweetproducts	Zaghouan N= 1	15	15	15.00	
	Pooled N= 4	3.0	30	13.00	12.57
	Kairouan N= 44	0.5	10	2.94	2.42
Spices, condiments	Zaghouan N= 10	1.5	5	2.65	1.03
	Pooled N= 54	0.5	10	2.88	2.22
	Kairouan N= 6	0.5	4	2.25	1.33
Drinks	Zaghouan N= 0				
	Pooled N= 6	0.5	4	2.25	1.33

Table 85 shows the total value received as a gift, payment or loan during the last 7 days. We notice that households of the two locations do not receive a lot of gifts, especially for cereals, vegetable and tubercular culture, green leafy vegetables, offal or trimming, legumes nuts and seeds, spices and condiments.

The situation is different for the other products in Kairouan like vegetables rich in vitamin A and tubers with a maximum of 10 TND; for the fruits and meat with a maximum of 25 TND, for the sweet products 35 TND and 12 TND for oils and fats.

We notice the highest value for milk and dairy products in Zaghouan with 95.5 TND.

Table 85.Total value received as a gift, payment or loan, consumed during the last 7 days (TND)

		Min	Max	Mean	Standard Deviation
Cereals	Kairouan N= 2	2.0	3.0	2.50	0.71
	Zaghouan N= 0				
	Pooled N= 2	2.0	3.0	2.50	0.71
Vegetable and tubercular culture	Kairouan N= 5	1.0	2.0	1.33	0.58
	Zaghouan N= 2	2.5	3.0	2.75	0.35
	Pooled N= 3	1.0	3.0	1.90	0.89
Vegetables rich in vitamin A and tubers	Kairouan N= 24	0.5	10.0	3.49	2.07
	Zaghouan N= 8	1.4	5.0	2.74	1.15
	Pooled N= 32	0.5	10.0	3.30	1.90
Green leafyvegetables	Kairouan N= 13	0.6	3.0	1.82	0.65
	Zaghouan N= 5	1.0	2.0	1.40	0.55
	Pooled N= 18	0.6	3.0	1.70	0.63
Othervegetables	Kairouan N= 11	2.0	4.0	2.68	0.84
	Zaghouan N= 3	0.8	5.0	2.93	2.10
	Pooled N= 14	0.8	5.0	2.74	1.11
Other fruits	Kairouan N= 17	2.0	25.0	7.41	5.53
	Zaghouan N= 3	3.6	5.0	4.53	0.81
	Pooled N= 20	2.0	25.0	6.98	5.19
Offal or trimming	Kairouan N= 1	5.0	5.0	5.00	
	Zaghouan N= 0				
	Pooled N= 1	5.0	5.0	5.00	
Meat	Kairouan N= 8	3.0	25.0	11.88	7.20
	Zaghouan N= 2	10.0	10.0	10.00	.00
	Pooled N= 10	3.0	25.0	11.50	6.40
eggs	Kairouan N= 12	0.8	4.0	2.13	1.10
	Zaghouan N= 6	2.0	8.0	4.13	2.05
	Pooled N= 18	0.8	8.0	2.80	1.72
Legumes, nuts and seeds	Kairouan N= 1	4.0	4.0	4.00	
	Zaghouan N= 1	3.0	3.0	3.00	
	Pooled N= 2	3.0	4.0	3.50	0.71
Milk and dairyproducts	Kairouan N= 8	2.0	10.0	5.45	2.44
	Zaghouan N= 7	3.0	95.5	27.99	39.82
	Pooled N= 15	2.0	95.5	15.97	28.60
Oils and fats	Kairouan N= 23	2.0	12.0	8.35	3.30
	Zaghouan N=10	2.5	12.0	8.45	3.50
	Pooled N= 33	2.0	12.0	8.38	3.30
Sweetproducts	Kairouan N= 7	1.0	35.0	15.57	11.76
	Zaghouan N= 2	10.0	15.0	12.50	3.54
	Pooled N= 9	1.0	35.0	14.89	10.35
Spices, condiments	Kairouan N= 5	1.0	4.0	2.30	1.10
	Zaghouan N= 4	0.5	1.5	0.75	0.50
	Pooled N= 9	0.5	4.0	1.61	1.17

Drinks	Kairouan N= 4	0.5	12.0	6.13	4.70
	Zaghuan N= 1	8.0	8.0	8.00	
	Pooled N= 5	0.5	12.0	6.50	4.15

The total value of hunting or fishing consumed during the last 7 days is shown in table 86. Very few products are hunted or fished, we notice that vegetable and tubercular culture as well as vegetables rich in vitamin A and tubers, also the green leafy vegetables are all excluded. Only meat is represented in the table for the governorate of Kairouan for a total amount of 8 TND.

Table 86. Total value of hunting / fishing consumed during the last 7 days (TND)

		Min	Max	Mean	Standard Deviation
Vegetable and tubercular culture	Kairouan N= 0				
	Zaghuan N= 1	2	2	2.00	
	Pooled N= 1	2	2	2.00	
Vegetables rich in vitamin A and tubers	Kairouan N= 1	1	1	1.00	
	Zaghuan N= 0				
	Pooled N= 1	1	1	1.00	
Green leafy vegetables	Kairouan N= 1	2	2	2.00	
	Zaghuan N= 0				
	Pooled N= 1	2	2	2.00	
Other vegetables	Kairouan N= 1	3	3	3.00	
	Zaghuan N= 0				
	Pooled N= 1	3	3	3.00	
Other fruits	Kairouan N= 4	1	5	2.75	1.71
	Zaghuan N= 2	1	1	1.00	0.00
	Pooled N= 6	1	5	2.17	1.60
Meat	Kairouan N= 1	8	8	8.00	
	Zaghuan N= 0				
	Pooled N= 1	8	8	8.00	

In the last year, 67.8% of the sample ate outside the household in Kairouan and 65.4% in Zaghuan (Figure 166). For the last 24 hours we notice that the household had food outside with nearly the same percentages for both governorates: 85.9% in Kairouan and 87.6% in Zaghuan.

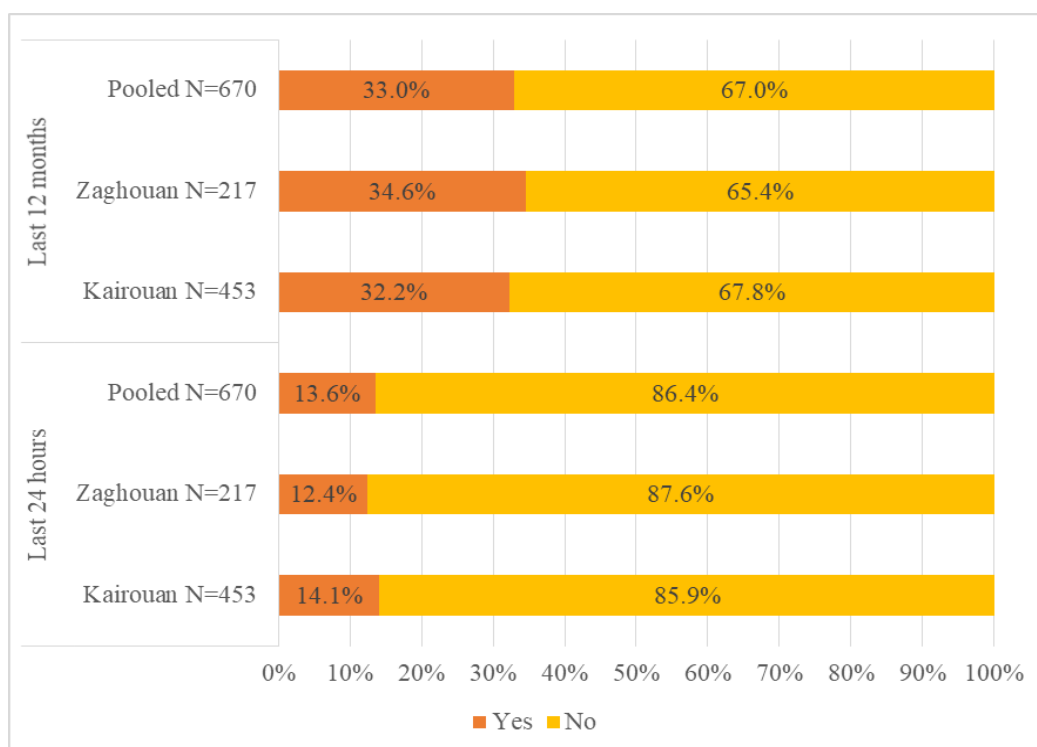


Figure 166. Food outside the household by governorate. %

Concerning the barley consumption by governorate, 48.7% consume barley in Kairouan while they are 59% in Zaghouan (Figure 167). There is no increase in barley consumption for the last two years for 75.6% in Kairouan and 77.3% of the sample in Zaghouan. We notice that only half of the sample answered to the last question.

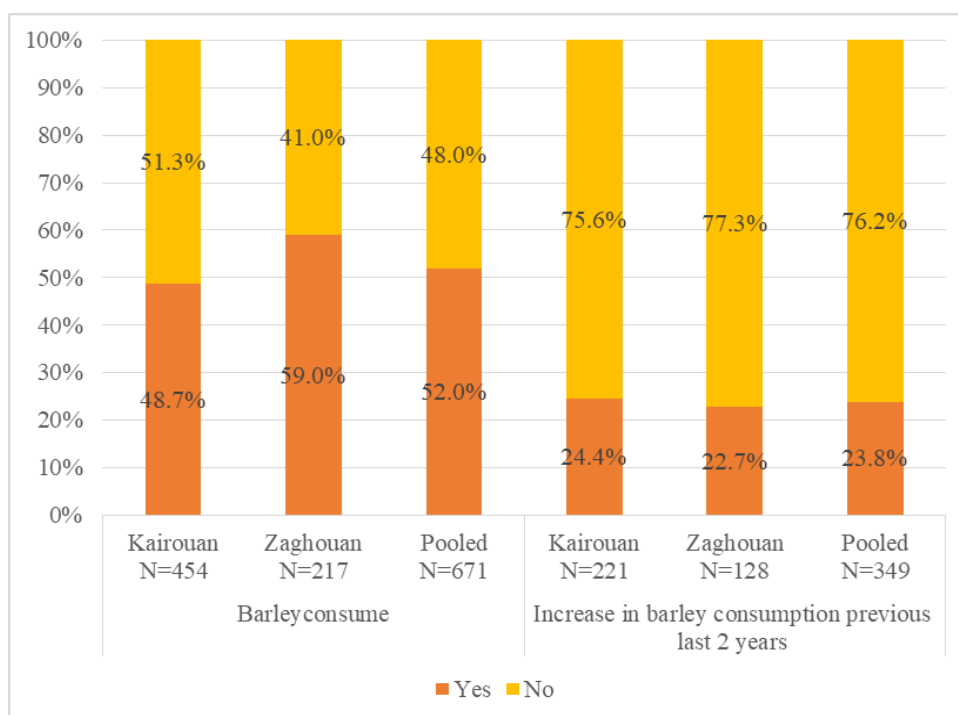


Figure 167. Barley consumption by governorate. %

6. Concluding remarks and policy implications

The factors influencing HH adoption of innovative agricultural production technologies are various and related to socio-demographic, economic, institutional and ecological aspects.

For the socio-demographic factors, the HH of the sample are mostly men (93.6%), married (91.3%), owners of their land (92%) and only 6% have agricultural diploma in both governorates. The household size is composed by 3 members for 68.7% of the sample and young persons (25 years of less) represent more than 50% of the total household members.

Regarding the economic factors, the results shows that for Zaghouan governorate the turnover of asset sales is very important for 100% of the sample, then comes the rental income for 75% and the trade with agricultural products produced by others (75%). The least important sources for Zaghouan are the remittance or money order (66.7%) and the income from agriculture crops (39.6%). For Kairouan, the most important sources of income are the turnover of asset sales (60%) and the permanent non-agricultural employment for 57.1%. The least important sources are the remittance or money order for 36.8%; the income from agriculture crops for 28.4 % and finally the income from agricultural livestock for 16.5%.

In both governorates, most of the households own less than 5 ha (67.6%), only 3.9% have large lands with more than 21 ha. In Zaghouan the percentage of small land owners is higher with 77.4% of the sample owning less than 5 ha. 14.7% have between 6 and 10 ha while only 2.8% have more than 21 ha. In Kairouan governorate there is the highest rate of large lands with 4.4% of the sample owning more than 21 ha, this governorate has also the lowest rate of small lands with 62.9% of the sample.

For both governorates, the households lack mostly the agricultural equipment (strawpress, combine harvester, grain storage, a tractor, a chempump, a waterpump, a tank, a shredder, a plough, a wagon, an irrigation water management and a milking machine). For the house equipment, despite the fact that they possess for 95,1% their houses, these households require some assets such like a drinking water installation, solar panels for energy, means of transport; internet devices and air conditioner.

Regarding the food consumption in the previous 7 days for the household, almost the whole sample consumed vegetables and tubercular cultures (98.7%), cereals (97.6%), spices and condiments (95.1%), sweet products (97.5%), oils and fats (97.6%), milky and dairy products (92.8%) and drinks (90.6%). Fish and sea food are not much consumed in these regions, only 17.9% in Kairouan and 12.9% in Zaghouan. For the household non food expenditure, we notice that almost the whole sample spend the minimum amount (between 0 and 500 TND) on interests on credits (98.2%); on transfer for other households (98.5%); on insurance and taxes (93.8%) and on tuition fees (90.7%). Percentages for both governorates are relatively equal for expenditures on clothing, shoes and bags accessories 74% for Zaghouan and 79.5% for Kairouan.

Concerning the institutional factors, the distance of the nearest social facility for half of the sample is between 5 to 15 km, it concerns for Zaghouan the village market (53.2%), the main agricultural inputs market (56%), the main agricultural products market (54.2%),

the secondary school (50.9%) and the agricultural extension office (57%).The farthest social facility for Zaghouan is the main agricultural products market with 19.9% of the sample declaring that this facility is far from home for more than 15km. It is also the case for 38.7% of the sample in Kairouan. The main agricultural inputs market is also far for more than 15km for 37% of the sample in Kairouan and 17.6% in Zaghouan. It is also the same thing for the village market which is far for more than 15 km for 16.2% of the sample for both locations.

The results show that nearly 74.4% and 65.5% of HH stated that the extension agents are the main source of information of kounouz variety and feed blocks used respectively in both governorates. However, the other farmers (relative/neighbors) are the major source of information of Amonitrate and mechanical seeder in both governorates (65.3% and 71.1% of HH respectively). For the Enterotoxaemia and Anthelminthic parasites vaccinations, the main sources of information is the market (50.9% and 44.3% respectively) and the other farmers (29.2% and 37% respectively) in both governorates.

Regarding to the technology perception, 44.2% of HH judged “low” the knowledge needed of feed blocks in Zaghouan while 23.6% of HH stated “high” in Kairouan. For the Kounouz variety, 38.2% and 25.6% of HH stated “high” and “very high” respectively the knowledge needed of this variety.

For the feed blocks, the access to this technology is bad for 55.6% of HH in Zaghouan and 36% in Kairouan. Regarding Kounouz variety, 56.6% and 45.1% of HH judged “good” the access to this variety respectively in Zaghouan and in Kairouan.

For the feed blocks, 47.7% of HH do not know its adopt cost while 26.3% and 18.1% of HH declared “high” and “very high” respectively the adoption cost of this technology. As regards to Kounouz variety, 45.8% and 26.7% of HH judged respectively “high” and “very high” its adoption cost. However, 11.9% of HH in Kairouan stated “low” the adoption cost of Kounouz variety.

More than half of HH have a high capacity of skills and personal knowledge to adapt the Kounouz Variety (52%) for the next cropping season in both governorates. However, for the feed blocks, 48.3% of HH respectively stated a low capacity of skills and personal knowledge to adopt its technologies for the next cropping season in both governorates.

51.1% of HH stated a low capacity of the payment of inputs and resources needed to adopt the feed blocks for the next cropping season in both governorates. For the Kounouz variety, 54.6% of HH declared a middle capacity of the payment of inputs and resources needed to adapt this variety for the next cropping season in both governorates.

In addition, 62.7% of HH stated a low capacity of the availability of inputs and resources to adopt the feed blocks for the next cropping season in both governorates. For the Kounouz variety, 41.4% of HH declared a middle capacity of the availability of inputs and resources to adapt this variety for the next cropping season in both governorates.

The main benefits of Kounouz variety are the high yield (72.9% and 63.2% of HH in Zaghouan and in Kairouan respectively) and drought resistance (54.9% and 46.3% of HH in Zaghouan and in Kairouan respectively). However, the majority of HH (79.8%) do not find the benefits of the use of feed blocks in both governorates.

In Zaghouan, the unavailability of seed (33%), the fact that HH do not plant barley (29%) and the preference for the others varieties of barley (local variety with low purchase price)

are the main reasons of no use of Kounouz variety. In Kairouan, the preference for the other varieties (29.4%), the unavailability of seed (23.8%) and the lack of cash to buy seed (9.5%) are the main reasons of no use of Kounouz variety. However, 20% of HH in both governorates declared to not use the Kounouz variety for other reasons. These reasons are the unfavorable agricultural season for the year 2017-2018, the majority of farmers are small and poor, the increase in the price of the seeds from 40 to 60 TND (100kg), the farmers attachment to their traditional agricultural practices and some farmers re-used Kounouz seeds harvested during the 2017-2018 campaign.

In both governorates, the preference for other foods for animals (bran and local barley seed) is high (38.4%), the unavailability of technology (18.5%), the inefficiency of the technology (11.6%) and the fact that HH do not consider the technology nutritious for animals (8%) are the main reasons of no use of the feed blocks by the HH. By governorate, the percentage of HH stating the feed blocks are not nutritious for animals is higher in Zaghouan than Kairouan (13.2% against 5.1% respectively). Among the other reasons, the HH graze their herds in the fields after the rainfall periods.

The majority of HH in both governorates stated continuing to use Enterotoxaemia vaccination (97.6%) and Anthelmintic parasites vaccination (94.6%) in the future. To a lesser extent, 75.9% and 66.3% of HH declared to remain using Kounouz variety and the Amonitrate respectively in the future. For the mechanical seeder and the feed blocks, only 40.8% and 29.4% of HH respectively in both governorates stated continuing the use of these technologies. By governorate, the percentage of HH declaring continuing the use of feed blocks in Zaghouan is higher than Kairouan (32.9% against 23.3%).

Regarding to the system vulnerability, three major shocks are observed in 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% for both locations. To respond to the shocks, nearly 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% go to the sale of animals to copy with the shock, while only 14.3% declare selling their animals in Kairouan to have some cash. 18% in Zaghouan prefer opting for non-agricultural employment, while it is only 5.1% of the sample that takes this strategy in Kairouan.

In terms of policy implications to improve the technologies adoption for HH especially who mostly depend on agriculture for their livelihoods, the political decision makers should adopt a global strategy. This global strategy must focus on different specific interventions:

- 1- The adoption of innovative technologies has been always associated with higher earnings and lower poverty; improved nutritional status; lower staple food prices and increased employment opportunities as well as earnings for small and poor farmers. In this sense, the policy interventions must improve the livelihoods of households before the adoption of modern technologies.
- 2- Improving the availability and the access to technologies. This point is crucial because in most of the cases the major constraint for the adoption of modern technologies is the lack

of financial support or the lack of credit with a low interest rate. In this sense, the small and poor farmers prefer to adopt the traditional agricultural method.

- 3- Improving the know-how of small farmers. In this direction, the efforts done by the local extension agents are inadequate and there is a real need to the implication of the private sector and non-governmental and development organizations to provide target HH with the necessary and sufficient information.
- 4- Autonomous household's adaptation was insufficient to adequately address the threats posed by climate change. Interventions could include programs (drought preparedness plans, soil erosion and water harvesting plans, etc.) that target the farmers' knowledge of how to face climate change difficulties in the best possible ways.

Otherwise, another factor of technology adoption was the perceived time available to adopt and use the new technology. In this sense, the adoption of modern technologies such as Kounouz variety and feed blocks by small HH need more time than two or three years of research project.

7. References

- COMMISSARIAT GENERAL AU DEVELOPPEMENT REGIONAL (CGDR). 2017. Gouvernorat de Zaghouan en Chiffres. 114 pages.
- Dfid, 2014: Literature Review. "What is the evidence on the impact of research on international development?". In: <http://www.ukcds.org.uk/resources/dfid-literature-review-what-is-the-evidence-on-the-impact-of-research-on-international>
- Haddad, N. ;ElMourid, M. and Nefzaoui, A. 2007: Mashreq and Maghreb Project Achievements and Lessons Learnt. ICARDA (Aleppo, Syria).
- Noltze, M., Schwarze, S. and Qaim, M. 2012: Understanding the adoption of system technologies in smallholder agriculture: the system of rice intensification (SRI) in Timor Leste. *Agricultural Systems* 108, 64-73.
- OFFICE DE DÉVELOPPEMENT DU CENTRE OUEST (ODCO). 2017. Gouvernorat de Kairouan en Chiffres. 112 pages.
- Syngenta Foundation, 2015: Scaling up smallholders' adoption of technology. Symposium. In: <http://www.syngentafoundation.org/index.cfm?pageid=364&newsid=348>.
- Davis, K., Nkonya, E., Kato, E., Mekonnen, D.A., Odendo, M., Miiro, R. and Nkuba, J. 2012: Impact of farmer field schools on agricultural productivity and poverty in East Africa. *World Development* 40, 402-413.
- Gildemacher, P. and Mur, R. 2012: Bringing new ideas into practice; experiments with agricultural innovation. *Learning from Research Into Use in Africa*, KIT Publishers, Amsterdam.

