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CROP AREA SURVEY REPORT FOR ORMVA-DOUKKALA'S
IRRIGATED PERIMETERS: APRIL 2013



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MOROCCO ECONOMIC COMPETITIVENESS

CROP AREA SURVEY REPORT FOR ORMVA-

DOUKKALA'S IRRIGATED PERIMETERS: APRIL 2013

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By DAI

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SUMMARY

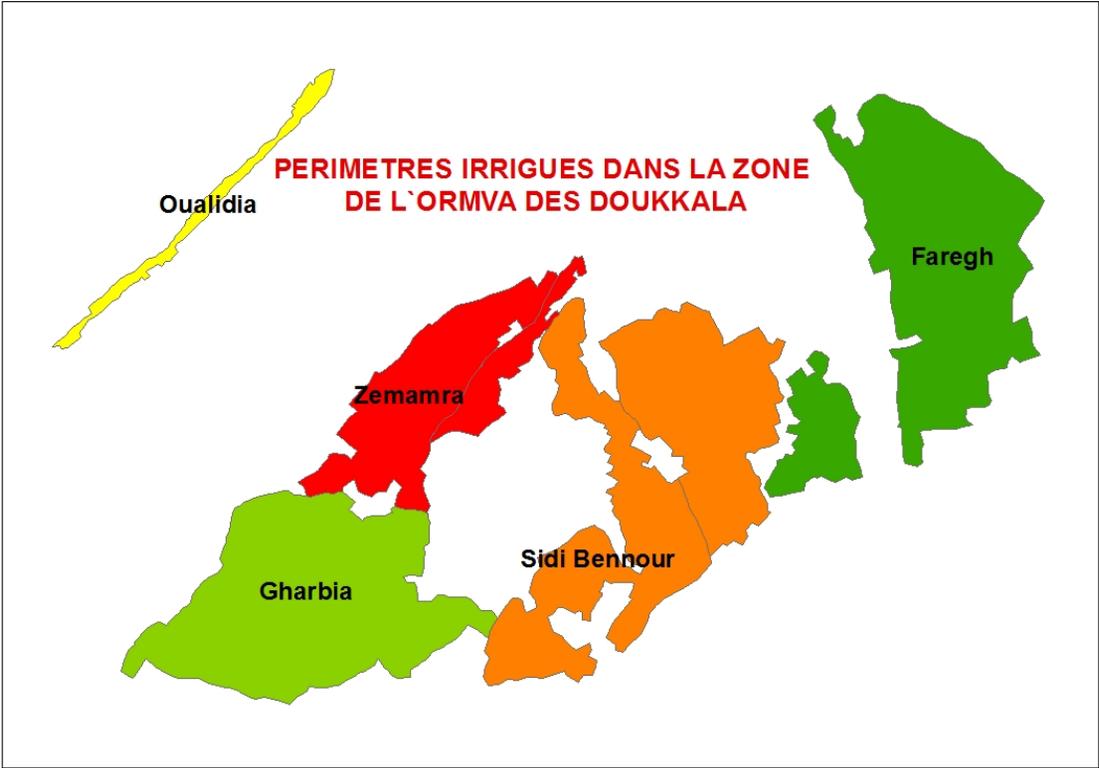
- The 2013 Crop Area Survey of irrigated perimeters in the ORMVA-Doukkala area of operations is a joint effort of the Office Regional de Mise en Valeur Agricole des Doukkalas (ORMVA-D) in cooperation with the USAID Morocco Economic Competitiveness (MEC) Program.
- The first Crop Area Survey was carried out in April 2010. It was followed by annual surveys in April 2011, April 2012. This is the fourth Crop Area Survey and we hope that annual surveys will continue in future years to compare and detect changes in cropping patterns over time as farmers adjust to changing conditions.
- April is the preferred month to conduct crop area surveys because many spring and summer crops like potatoes, tomatoes, maize and melons have already been planted while winter crops like cereals and sugar beets are still on the ground before harvest. Nevertheless, short cycle crops that are planted after April are missed in the survey.
- The crop area survey follows the Area Frame Spot Sampling procedures previously developed by DAI in other projects elsewhere. This is an adaptation of the Area Frame Spot Sampling methodology used by the National Agricultural Statistics Service (NASS) of the USDA to generate US agricultural statistics. The main innovation is that the units of observation are circular areas 100 meters around randomly selected sample points. Each parcel within the circular area is mapped using standard handheld GPS receivers. Appendix A gives a more detailed description of the Area Frame Spot Sampling methodology.
- In this survey the ORMVA-D irrigated area comprises five distinct perimeters: Oualidia, Gharbia, Zemamra, Sidi Bennour, and Faregh. Oualidia is a small coastal strip with ready access to underground water. The other four perimeters get water from ORMVA-D through a network of distribution canals. Zemamra and Gharbia perimeters are south of Sidi Ismail along the national road to Safi. Sidi Bennour perimeter surrounds the city of Sidi Bennour, and Faregh lies south of the town Had Oulad Farej. Two main canals bring water from El Masira dam reservoir on the Oum E-Rabia river to the area: the “lower service” canal runs north of the “Upper service” canal. Most of the ORMVA-D irrigated perimeters are in the Sidi Bennour province, with small areas in El Jadida and Safi provinces.
- The survey collected observations from 505 sample points selected randomly throughout the irrigated area. To prevent excessive clustering a minimum distance of one kilometer between sample points was enforced. One-third of the points were kept from the 2011 survey, another third were from the 2012 survey and the remainder third were randomly generated anew for this survey. Geographic coordinates (longitude and latitude) for each sample point were entered in GPS memory to help locating the points and mapping the parcels within a 100 meter radius. Each parcel is therefore geo-referenced and can be later on identified for verification, even years later.
- The survey area encompasses a total of 146,769 hectares. About 100,000 of those are irrigated and some additional 20,000 were rain-fed cultivated at the time of the survey. Non-agricultural uses occupy 17,223 hectares, and 9,042 additional hectares are fallow (*jachere*). Significant patches of rain-fed (bour) agriculture scattered throughout the irrigated perimeters, especially around Faregh. Sidi Bennour is the largest perimeter with 44,408 ha, followed by Faregh (41,373 ha), Gharbia (36,985 ha) and Zemamra (20,587 ha). Oualidia is the smallest (3,416 ha) and stands separate from the others.
- Wheat is by far the most important crop in the ORMVA-D irrigated areas, in terms of area planted. An estimated 48,652 hectares are planted to wheat, or 33.1 % of the survey area. The precision of this wheat area estimate is rather high, with a margin of error plus or minus 3.4% (coefficient of variation). Wheat is viewed as a priority crop by water authorities and together with sugar beets gets priority in years when irrigation water is in short supply. Wheat production is rather evenly distributed throughout the Doukkala irrigated perimeters.

- Sugar beets crop area in 2013 reached 11,842 hectares; this is nearly double the acreage of 6,599 ha in 2012 but still far from 25,240 ha in 2010. This remarkable drop follows a similar trend in the Oriental region, attributed to reduced competitiveness of sugar beets and difficulties of sugar companies reaching agreement with farmers on suitable terms. Sugar beets are concentrated in Zemamra (33.7 %) and Sidi Bennour (32.1%). After nearly disappearing from Gharbia in 2012, sugar beets reappeared with 2,717 ha (22.9%) in 2013.
- Forage crops occupy 25,997 hectares, the second largest planted area after wheat, and equivalent to 17.7% of the survey area. Alfalfa (*Luzerne*) and clover (*bersim*) are the two principal forage crops and are grown in small patches throughout all irrigated perimeters. Alfalfa is a perennial that needs irrigation throughout the year, while *bersim* is only grown as green forage in winter months. The margin of error for forage crop area is 4.9%. Half of the forage crop area is found in Sidi Bennour (46.1%) irrigated perimeter, with Faregh contributing an additional 31.4%.
- Barley and maize are also grown mainly for animal feed. Barley area is estimated at 11,415 ha (7.8% of total) while maize at 7,823 ha (5.3%). Barley is often grazed as green forage in winter while still able to produce a grain harvest in June. Barley is a hardy crop tolerant of water stress conditions, and is more often found in rain-fed fields. Maize is grown mainly for grain but increasingly farmers also plant “maïs fourrager” as green forage to be cut at early flowering stage and chopped for making silage for milking cows. Over half (52.5%) of the maize is grown in Gharbia, and 30.6% additional in Faregh.
- Vegetable crops are gradually gaining ground and importance in Doukkala irrigated perimeters. In 2013 an estimated 3,076 ha were planted, mainly in the Faregh (50.4%) and Oualidia (30.7%) irrigated perimeters. Potatoes and onions are among the most popular vegetables. In terms of value per cubic meter of water, vegetable crops rank higher than cereals, and sugar beets, mainly because vegetable crops are short cycle crops harvested before the hot summer months when the need for irrigation water is highest. However, priority in water allocation is given to sugar beets and wheat at the expense of vegetables.
- Maraichage can comprise other crops besides vegetables. In previous years the “maraichage” category included maize as well as legume crops such as lentils and chickpeas (legumes). Both maize and legumes have also increased rapidly in the past couple of years, in part as a result of a reduction in sugar beets area, but also higher prices of maize and pulses. The overall “Maraichage” crop category covered an area in 2013 of 20,373 hectares (13.9 % of the total survey area), slightly down from 2012 (26,272 ha) but much higher than 9,927 ha in 2010. Nearly half (41.7%) of the legume crops are grown in Gharbia, and 24% additional in each of Sidi Bennour and Faregh.
- Fruit trees are practically absent from the cropping pattern in Doukkala, in contrast to the prevalence of citrus orchards and other fruit trees in Oriental province. Only 2,225 hectares planted to fruits were found in 2013 or 1.5% of the survey area. Fruit crops comprise mainly grapes and olive trees, and 66.5% of the area is in Faregh and nearly all the remainder in Sidi Bennour. The reasons for the absence of fruit tree orchards in Doukkala irrigated perimeters are not easily understood, since rainfall and irrigation water availability are more favorable in Doukkala than in Oriental region. The stated policy of giving priority for irrigation water to cereals and sugar beets in the Doukkala region might discourage farmers from planting fruit tree crops.
- Fallow land (*Jachere*) represents 9,042 hectares or 6.2% of the survey area. This fallow acreage is a significant reduction from the 14,772 hectares recorded in 2012. Fallow land is present in all irrigation perimeters, but especially in Faregh (25.4%), Sidi Bennour (27.7%) and Gharbia (23.6%). Fallow land is smaller in Zemamra (19.1%) and Oualidia (4.2%). Some fallow land might be planted to summer crops after the crop area survey was taken, but most fallow land is the result of insufficient irrigation water, especially in summer months. Gains in water economy can potentially be used to irrigate fields currently left fallow.
- Gravity irrigation is the predominant field irrigation method, used in 58,561 hectares or half (48.5%) of the cultivated area. Drip irrigation area in 2013 is estimated at 2,108 hectares, barely 1.7% of the cultivated area. About 29,390 hectares use sprinkler irrigation, 24.3% of cultivated

area. A larger area estimated at 30,760 hectares was not using any irrigation at all in the survey area; they were rain-fed agriculture (*bour*).

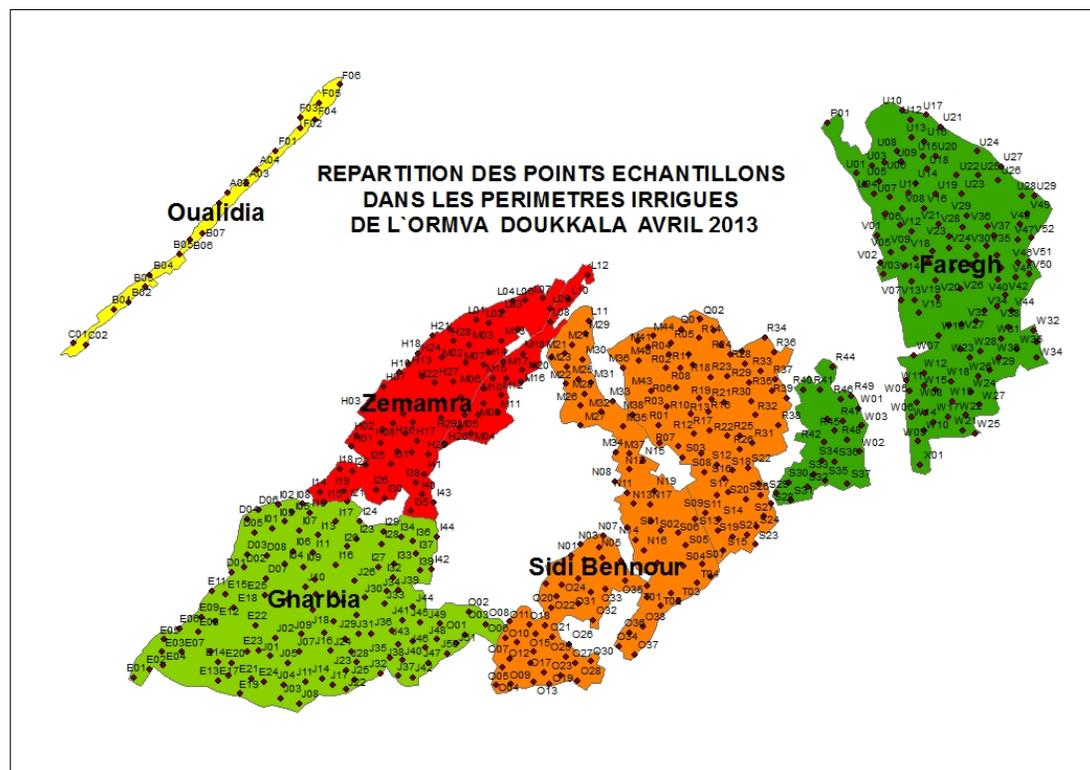
- Sprinkler irrigation is highly concentrated in Zemamra (13,188 ha) and Gharbia (12,342 ha) perimeters. About half of sugar beets are produced in zones with sprinkler irrigation and the other half under gravity (5,027 and 6,572 ha respectively). On the other hand, half of the acreage with sprinkler irrigation is used for wheat production (12,633 ha out of 29,159 ha). Water pressure is provided by a network of pumping stations and pipeline distribution network operated by ORMVA-Doukkala. Water is pumped initially to 6 to 8 bars of pressure to ensure field pressure of at least 3 bars. Pumping costs consumes about half of the budget for the water authority. The sprinkler system is viewed as too expensive and only slightly more efficient than gravity irrigation. It is not being expanded; on the contrary the most recent ORMVA-D investments is converting pressurized sprinkler to drip irrigation systems.
- A reconversion pilot project in Boulaouane has installed drip irrigation system on 1,000 hectares previously irrigated by sprinklers. The new system has been in operation for only eighteen months and farmers are already making significant adjustments in their farming systems, with increased emphasis on vegetables, legumes, forage crops, and fruit trees instead of cereals and sugar beets.
- Farmers in the Oualidia coastal strip also use drip irrigation, mainly in vegetable crops production, using underground water. Unlike Boulaouane where the ORMVA-Doukkala is responsible for the operation and costs of a single electric pumping and filtering station for 1,000 hectares, farmers in Oualidia operate their own individual pumping and filtering facilities at their own expense, often using antiquated equipment powered with diesel or natural gas.
- Under the Plan Maroc Vert the Government subsidizes the expansion of drip irrigation in farms throughout the country, but in Doukkala irrigated perimeters few farmers have taken advantage of the generous subsidies offered. Unlike in Oriental region, the ORMVA-Doukkala does not actively promote the establishment of basins and drip irrigation systems. Two large collective basins were built with international aid on a pilot basis in the past few years, but little or no effort has been made to expand the program to more farmers. A new JICA project in Gharbia is planning to introduce drip irrigation in about 200 hectares using residual water pressure from the high service canal.
- In addition to sprinkler, drip, and gravity irrigation, an estimated 30,207 cultivated hectares are not being irrigated at all, dependent solely on rainfall (*bour*). This is mainly attributed to the presence of rain-fed zones within irrigated perimeters or along the border of those perimeters. However, farmers can also decide to grow rain-fed crops in part of the farm and to use irrigation water saved in the remainder farmland.
- It is possible to make a rough estimate of irrigation water needed at each sample point, based on the crops present and the expected number of *tours d'eau* that ORMVA-D assigned to each crop. Each tour is equivalent to 648 tons of water (six hours at 30 liters per second). Eight *tours* are assigned for sugar beets, seven for forage and vegetable crops, and three for cereals. Irrigation water needs are fairly uniform throughout the irrigated perimeters.
- Similarly, the crop area survey makes it possible to compute gross revenues at each sample point, based on the crops at each spot and average revenue per hectare. The assumed revenues were 11,000 dirhams per hectare of wheat, 6,250 for barley, 23,000 for sugar beets, 100,000 for forage crops, 87,500 for *maraichage*, and 83,125 for fruits. Based on these expected revenues the gross value of agricultural production in the survey area has increased from 4,240 million dirhams in 2010 to 5,367 million dirhams in 2013, and increase of 26.6 % over the three-year duration of the USAID/MEC project.
- More detailed analyses based on the accumulated data base of sample spots could reveal significant differences in water use efficiency and lead to recommendations on better water use management.

MAP: ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013

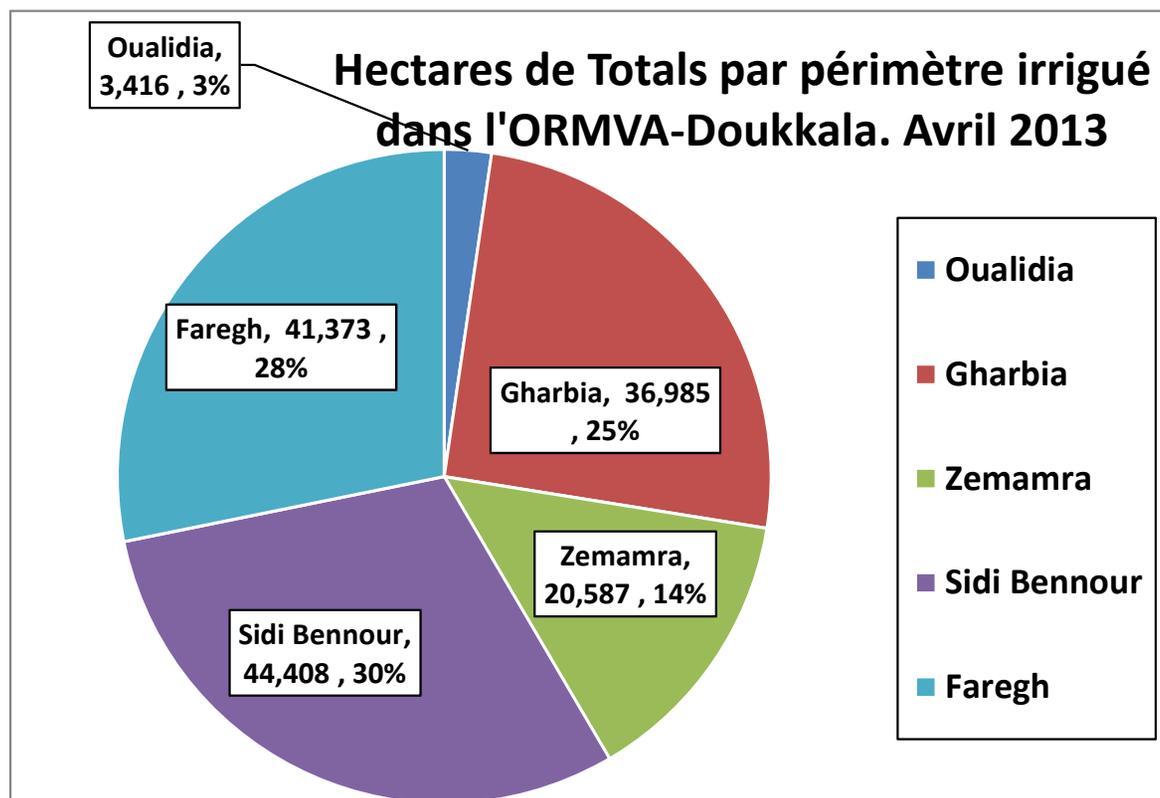


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MAP: 505 SAMPLING POINTS IN FIVE IRRIGATED PERIMETERS OF THE ORMVA-DOUKKALA, 2013



PIE CHART: AREAS OF FIVE IRRIGATED PERIMETERS OF THE ORMVA-DOUKKALA, 2013



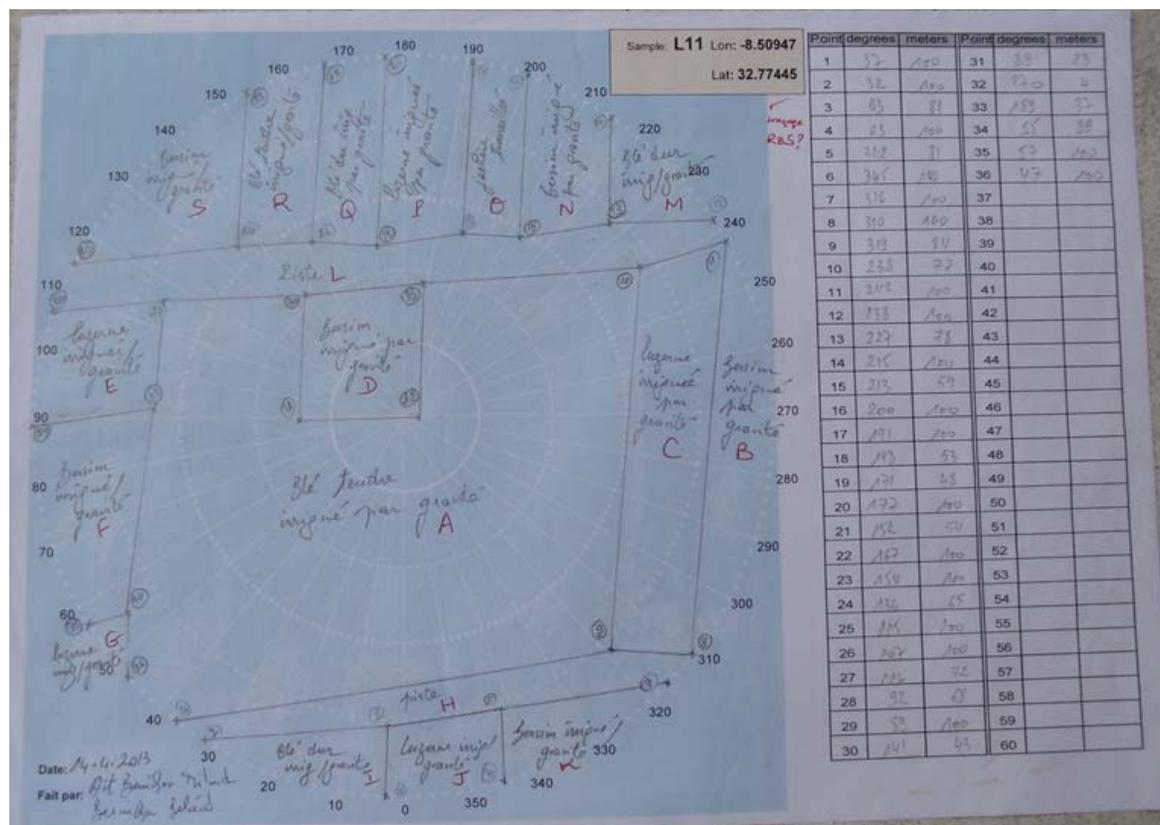
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SAMPLE BLANK FIELD FORM USED IN THE DOUKKALA CROP AREA SURVEY, 2013

Point	degrees	meters	Point	degrees	meters
1			31		
2			32		
3			33		
4			34		
5			35		
6			36		
7			37		
8			38		
9			39		
10			40		
11			41		
12			42		
13			43		
14			44		
15			45		
16			46		
17			47		
18			48		
19			49		
20			50		
21			51		
22			52		
23			53		
24			54		
25			55		
26			56		
27			57		
28			58		
29			59		
30			60		

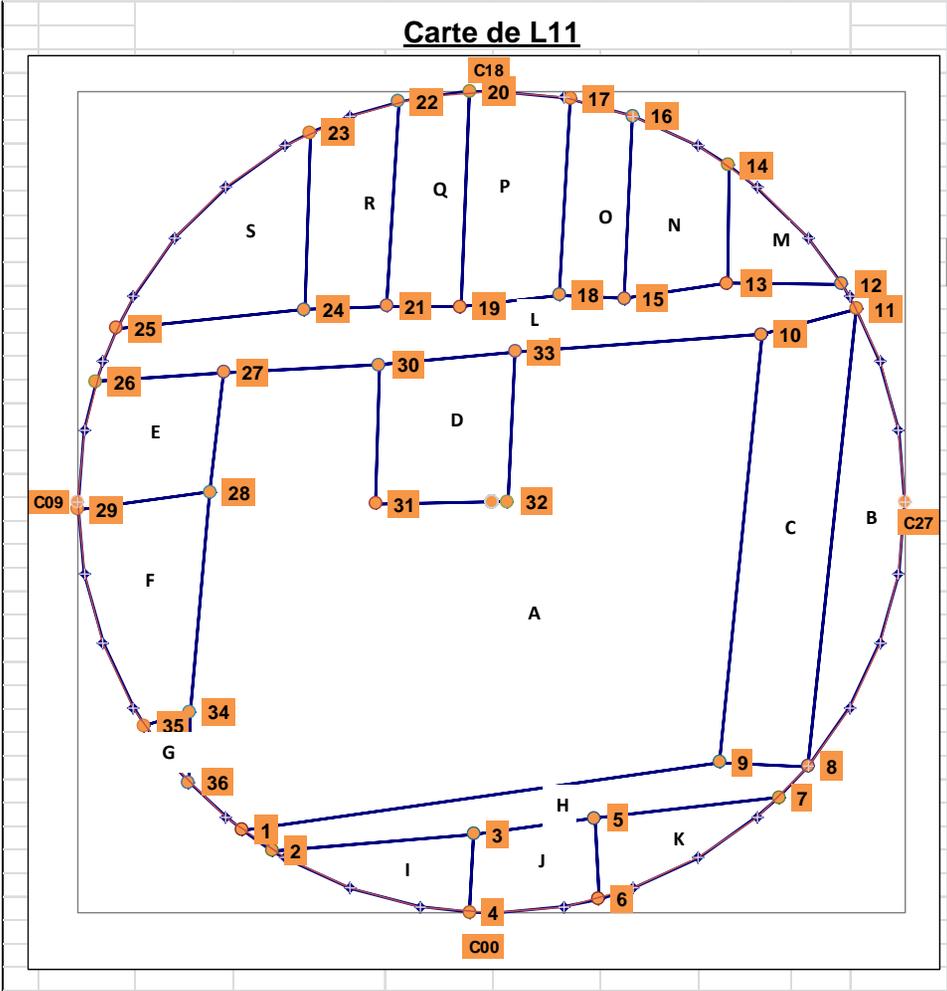
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COMPLETED FIELD FORM USED IN THE DOUKKALA CROP AREA SURVEY, 2013



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EXAMPLE OF SAMPLE CIRCLE IN THE DOUKKALA CROP AREA SURVEY, 2013



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SUMMARY PARCEL DATA FORM SAMPLE IN THE DOUKKALA CROP AREA SURVEY, 2013

	Polygon Name	Land Used (Ha)	Surveyor Description	Land Use		Irrigation Type	Hectares
				Primary	Secondary		
L11	A	1.2790	Blé tendre-gravitaire	BT	NO	GRV	1.2790
L11	B	0.1269	Bersim-gravitaire	BR	NO	GRV	0.1269
L11	C	0.2367	Luzerne-gravitaire	LU	NO	GRV	0.2367
L11	D	0.1140	Bersim-gravitaire	BR	NO	GRV	0.1140
L11	E	0.0954	Luzerne-gravitaire	LU	NO	GRV	0.0954
L11	F	0.1292	Bersim-gravitaire	BR	NO	GRV	0.1292
L11	G	0.0096	Luzerne-gravitaire	LU	NO	GRV	0.0096
L11	H	0.1108	Piste	RT	NO	NO	0.1108
L11	I	0.0557	Blé dur-gravitaire	BD	NO	GRV	0.0557
L11	J	0.0602	Luzerne-gravitaire	LU	NO	GRV	0.0602
L11	K	0.0534	Bersim-gravitaire	BR	NO	GRV	0.0534
L11	L	0.2248	Piste	RT	NO	NO	0.2248
L11	M	0.0445	Blé dur-gravitaire	BD	NO	GRV	0.0445
L11	N	0.0895	Bersim-gravitaire	BR	NO	GRV	0.0895
L11	O	0.0718	Jachère travaillée	JA	NO	NO	0.0718
L11	P	0.1214	Luzerne-gravitaire	LU	NO	GRV	0.1214
L11	Q	0.0897	Blé dur-gravitaire	BD	NO	GRV	0.0897
L11	R	0.0954	Blé tendre-gravitaire	BT	NO	GRV	0.0954
L11	S	0.1220	Bersim-gravitaire	BR	NO	GRV	0.1220
L11	T	-					-
L11	U	-					-
L11	V	-					-
L11	W	-					-
L11	X	-					-
L11	Y	-					-
L11	Z	-					-
				Total Hectares			3.1300
				Total Accounted For			100%

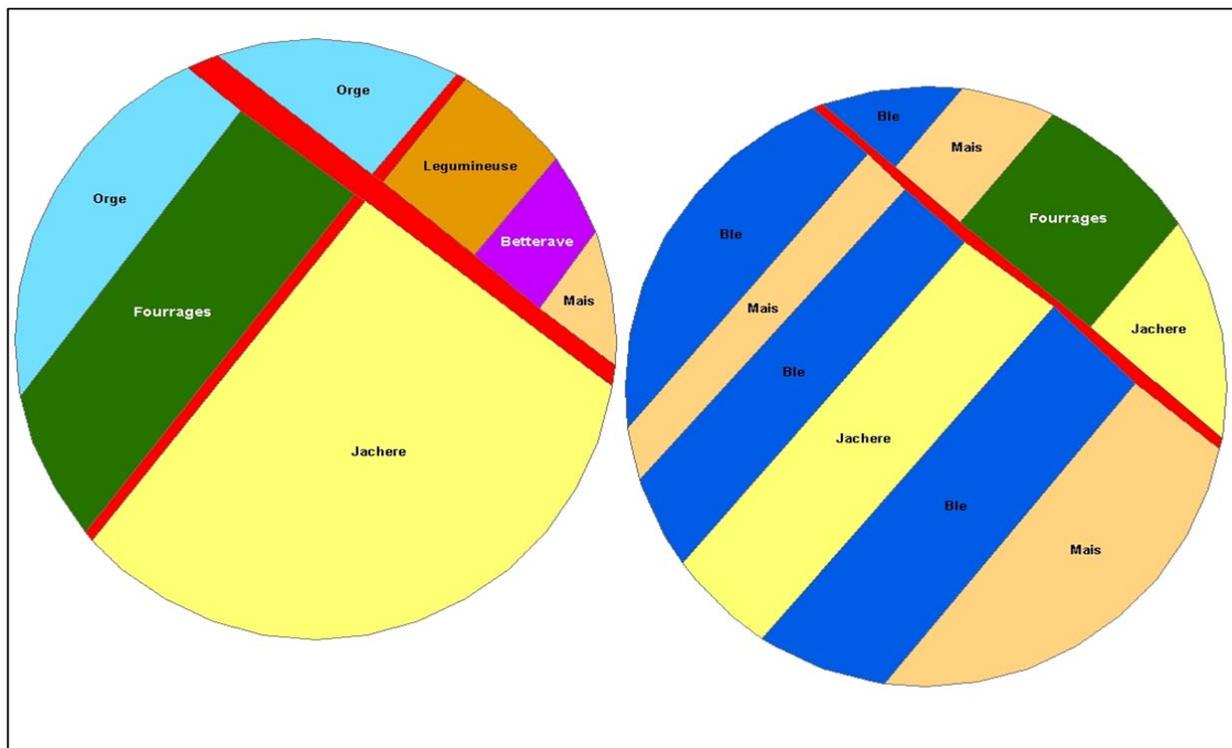
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DATABASE OF SAMPLE FIELD DATA FROM THE DOUKKALA CROP AREA SURVEY, 2013

Sample	Block	Area	Crop	Primary	Secondary	Irrigation	Hectares	Supervise
G01	A	0.009001	Pois chiche en bour	PCH	NO	BOUR	0.009001	AMAJOU
G01	B	0.254282	Fenugrec en bour	FEN	NO	BOUR	0.254282	AMAJOU
G01	C	0.132551	mais en bour	MA	NO	BOUR	0.132551	AMAJOU
G01	D	0.386768	menthe en bour	MENT	NO	BOUR	0.386768	AMAJOU
G01	E	0.673003	ble dur en bour	BD	NO	BOUR	0.673003	AMAJOU
G01	F	0.718495	Fenugrec en bour	FEN	NO	BOUR	0.718495	AMAJOU
G01	G	0.293236	mais en bour	MA	NO	BOUR	0.293236	AMAJOU
G01	H	0.659552	Ble tendre en bour	BT	NO	BOUR	0.659552	AMAJOU
H01	A	0.708686	betterave aspersion	BV	NO	ASP	0.708686	AMAJOU
H01	B	0.8081	ble tendre aspersion	BT	NO	ASP	0.8081	AMAJOU
H01	C	0.13201	Piste	RT	NO	NO	0.13201	AMAJOU
H01	D	0.063013	Colature	COL	NO	NO	0.063013	AMAJOU
H01	E	1.414918	ble tendre aspersion	BT	NO	ASP	1.414918	AMAJOU
H02	A	0.165162	ble tendre aspersion	BT	NO	ASP	0.165162	AMAJOU
H02	B	0.019554	Piste	RT	NO	NO	0.019554	AMAJOU
H02	C	0.289162	ble tendre aspersion	BT	NO	ASP	0.289162	AMAJOU
H02	D	0.082558	route	RT	NO	NO	0.082558	AMAJOU
H02	E	0.323443	Mais aspersion	MA	NO	ASP	0.323443	AMAJOU
H02	F	0.186896	ble dur aspersion	BD	NO	ASP	0.186896	AMAJOU
H02	G	0.487512	Luzerne aspersion	LU	NO	ASP	0.487512	AMAJOU
H02	H	0.086549	Piste	RT	NO	NO	0.086549	AMAJOU
H02	I	1.168361	Ble tendre aspersion	BT	NO	ASP	1.168361	AMAJOU
H02	J	0.317798	Jachere non travaille	JA	NO	NO	0.317798	AMAJOU
H03	A	0.087932	Orge en bour	OR	NO	BOUR	0.087932	AMAJOU
H03	B	0.045611	Piste	RT	NO	NO	0.045611	AMAJOU
H03	C	0.12788	Jachere non travaille	JA	NO	NO	0.12788	AMAJOU
H03	D	0.328652	Ble tendre en bour	BT	NO	BOUR	0.328652	AMAJOU

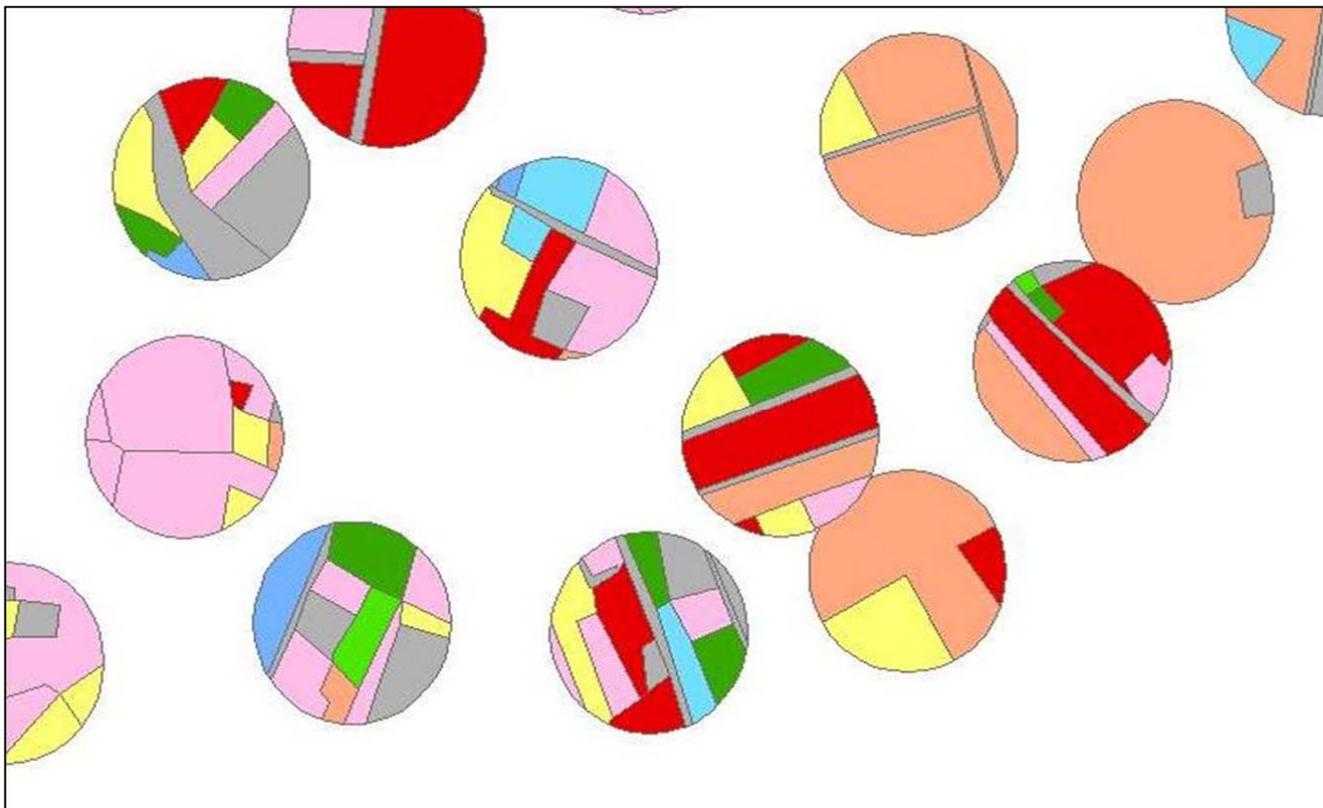


EXAMPLES OF TWO NEARBY SAMPLE CIRCLES FROM THE CROP AREA SURVEY, 2013



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EXAMPLES OF PLOTS AND CROP MAPS MADE BY DATA COLLECTORS IN A NUMBER OF SAMPLING POINTS



[TofC](#)

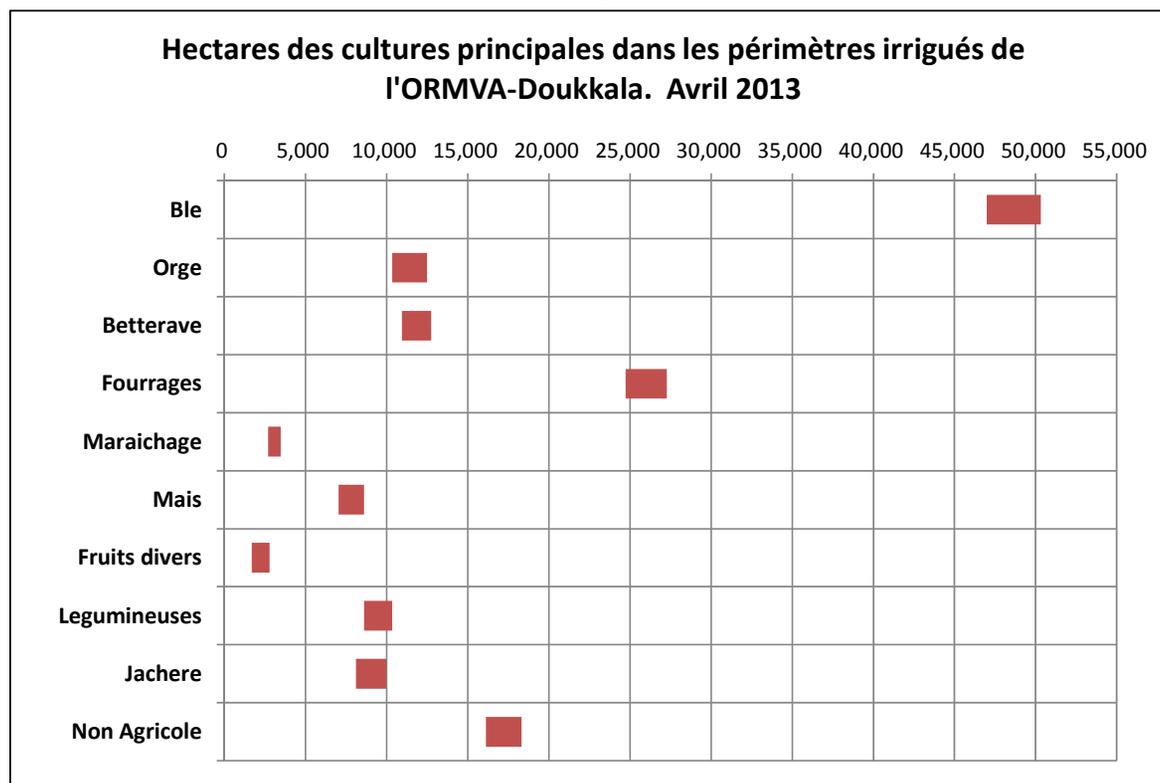
HECTARES OF MAIN CROPS IN ALL ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013

Hectares des cultures principales dans les périmètres irrigués de l'ORMVA-Doukkala. Avril 2013							
Cultures	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	48,652	33.1%	1,662	3.4%	46,990	50,314	Wheat
Orge	11,415	7.8%	1,074	9.4%	10,341	12,489	Barley
Betterave	11,842	8.1%	907	7.7%	10,935	12,749	Sugar Beets
Fourrages	25,997	17.7%	1,273	4.9%	24,724	27,270	Forage crops
Maraichage	3,076	2.1%	383	12.4%	2,694	3,459	Vegetables
Mais	7,823	5.3%	788	10.1%	7,035	8,611	Maize
Fruits divers	2,225	1.5%	554	24.9%	1,672	2,779	Other fruits
Legumineuses	9,474	6.5%	873	9.2%	8,601	10,347	Legume crops
Jachere	9,042	6.2%	942	10.4%	8,099	9,984	Fallow
Non Agricole	17,223	11.7%	1,098	6.4%	16,124	18,321	Non-Agric.
Total	146,769						Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.

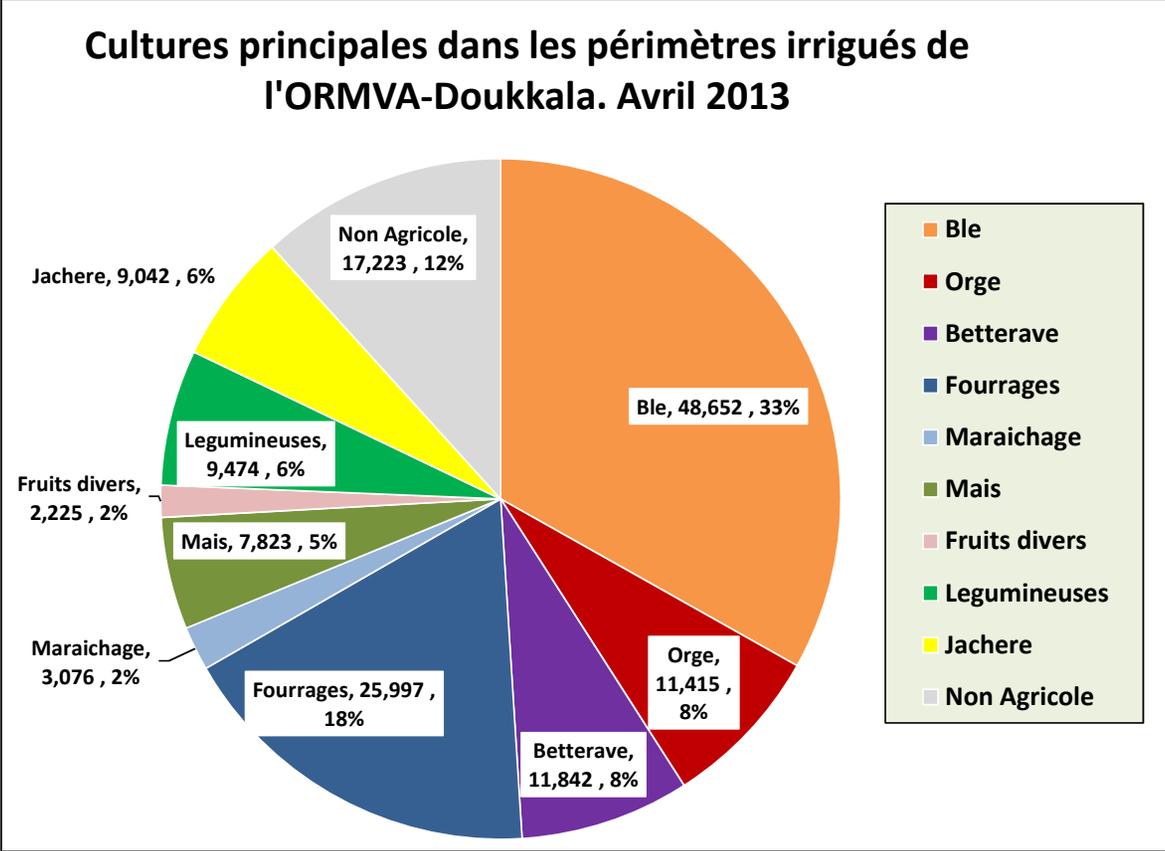
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HECTARES OF MAIN CROPS AND MARGINS OF ERRORS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



[TofC](#)

PIE CHART: MAIN CROPS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



TofC

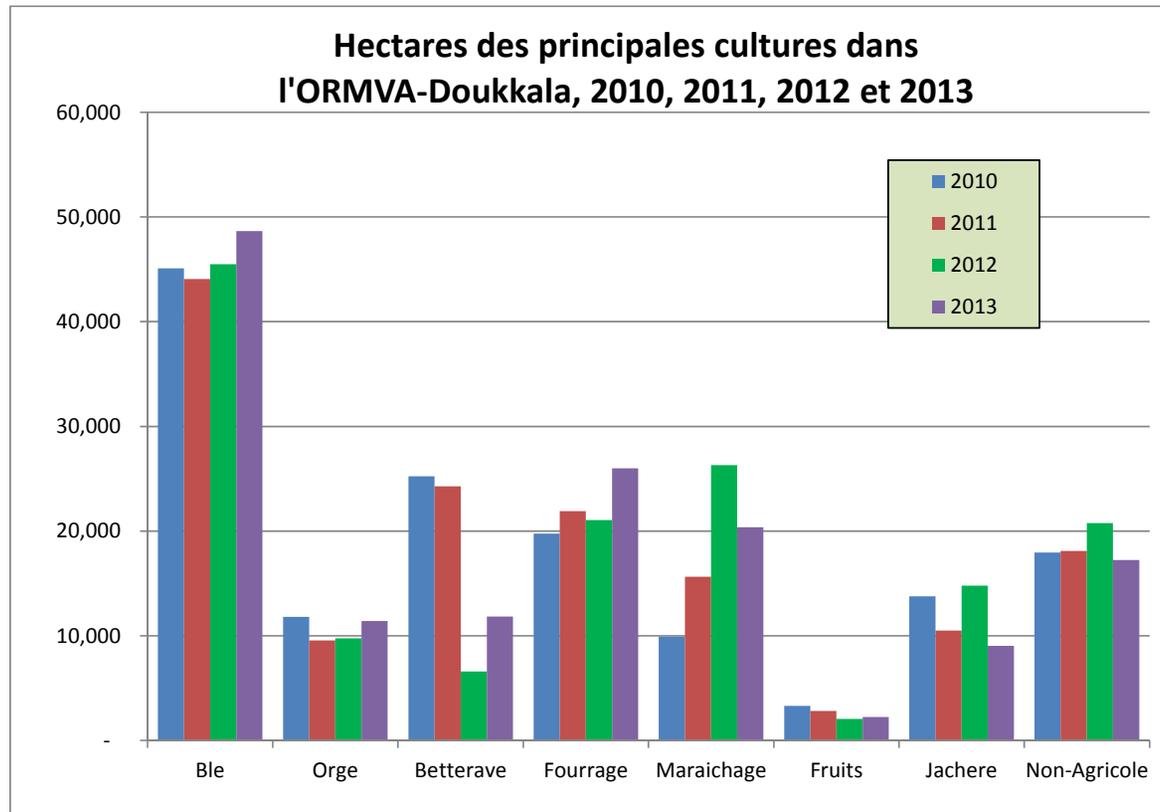
MAIN CROPS AREAS (HA) AND VALUE IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS: 2010, 2011, 2012 AND 2013

Crop areas and value in Doukkala irrigated perimeters, 2010, 2011, 2012 and 2013										
Cultures	Hectares				DH/Ha	Revenue (MDH)				Crops
	2010	2011	2012	2013		2010	2011	2012	2013	
Ble	45,093	44,066	45,480	48,652	11,000	496	485	500	535	wheat
Orge	11,800	9,558	9,760	11,415	6,250	74	60	61	71	barley
Betterave	25,240	24,276	6,599	11,842	23,000	581	558	152	272	sugarbeets
Fourrage	19,756	21,897	21,050	25,997	100,000	1,976	2,190	2,105	2,600	forage
Maraichage	9,927	15,636	26,279	20,373	83,125	825	1,300	2,184	1,694	vegetables
Fruits	3,302	2,810	2,056	2,225	87,500	289	246	180	195	fruits
Jachere	13,769	10,489	14,772	9,042	-	-	-	-	-	fallow
Non-Agricole	17,938	18,103	20,760	17,223	-	-	-	-	-	non-arable
Totals	146,825	146,835	146,755	146,769		4,240	4,838	5,182	5,367	Totals
							14%	7%	4%	% change

Source: ORMVA-D & MEC, Crop area surveys, Doukkala, 2010, 2011, 2012 et 2013

TofC

BAR CHART: HECTARES OF MAIN CROPS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, 2010, 2011, 2012 AND 2013



TofC

HECTARES OF MAIN CROPS PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013

Hectares des cultures principales dans les périmètres irrigués de l'ORMVA-Doukkala. Avril 2013							
Values	Oualidia	Gharbia	Zemamra	Sidi Bennour	Faregh	Total	Land Use
Ble	678	14,429	6,395	14,173	12,977	48,652	Wheat
Orge	87	3,522	990	2,426	4,390	11,415	Barley
Betterave	0	2,717	3,993	3,799	1,333	11,842	Sugar Beets
Fourrages	138	2,187	3,528	11,989	8,155	25,997	Forage crops
Maraichage	944	26	287	269	1,550	3,076	Vegetables
Mais	234	4,109	867	219	2,394	7,823	Maize
Fruits divers	0	-	67	679	1,479	2,225	Other fruits
Legumineuses	43	3,954	961	2,273	2,242	9,474	Legume crops
Jachere	376	2,133	1,729	2,506	2,299	9,042	Fallow
Non Agricole	917	3,907	1,770	6,074	4,555	17,223	Non-Agric.
Total	3,416	36,985	20,587	44,408	41,373	146,769	Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.

[TofC](#)

**PERCENT OF HECTARES OF MAIN CROPS BY IRRIGATED PERIMETER IN ORMVA-DOUKKALA,
APRIL 2013 (PERCENT BY CROP)**

Pourcentage de cultures principales dans chaque périmètre irrigué de l'ORMVA-Doukkala. Avril 2013							
Values	Oualidia	Gharbia	Zemamra	Sidi Bennour	Faregh	Total	Land Use
Ble	19.8%	39.0%	31.1%	31.9%	31.4%	33.1%	Wheat
Orge	2.5%	9.5%	4.8%	5.5%	10.6%	7.8%	Barley
Betterave	0.0%	7.3%	19.4%	8.6%	3.2%	8.1%	Sugar Beets
Fourrages	4.0%	5.9%	17.1%	27.0%	19.7%	17.7%	Forage crops
Maraichage	27.6%	0.1%	1.4%	0.6%	3.7%	2.1%	Vegetables
Mais	6.9%	11.1%	4.2%	0.5%	5.8%	5.3%	Maize
Fruits divers	0.0%	0.0%	0.3%	1.5%	3.6%	1.5%	Other fruits
Legumineuses	1.3%	10.7%	4.7%	5.1%	5.4%	6.5%	Legume crops
Jachere	11.0%	5.8%	8.4%	5.6%	5.6%	6.2%	Fallow
Non Agricole	26.8%	10.6%	8.6%	13.7%	11.0%	11.7%	Non-Agric.
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.

TofC

**PERCENT OF HECTARES OF MAIN CROPS BY IRRIGATED PERIMETER IN ORMVA-DOUKKALA,
APRIL 2012 (PERCENT BY PERIMETER)**

Pourcentage des cultures principales par périmètre irrigué de l'ORMVA-Doukkala. Avril 2013							
Values	Oualidia	Gharbia	Zemamra	Sidi Bennour	Faregh	Total	Land Use
Ble	1.4%	29.7%	13.1%	29.1%	26.7%	100.0%	Wheat
Orge	0.8%	30.9%	8.7%	21.3%	38.5%	100.0%	Barley
Betterave	0.0%	22.9%	33.7%	32.1%	11.3%	100.0%	Sugar Beets
Fourrages	0.5%	8.4%	13.6%	46.1%	31.4%	100.0%	Forage crops
Maraichage	30.7%	0.8%	9.3%	8.7%	50.4%	100.0%	Vegetables
Mais	3.0%	52.5%	11.1%	2.8%	30.6%	100.0%	Maize
Fruits divers	0.0%	0.0%	3.0%	30.5%	66.5%	100.0%	Other fruits
Legumineuses	0.5%	41.7%	10.1%	24.0%	23.7%	100.0%	Legume crops
Jachere	4.2%	23.6%	19.1%	27.7%	25.4%	100.0%	Fallow
Non Agricole	5.3%	22.7%	10.3%	35.3%	26.4%	100.0%	Non-Agric.
Total	2.3%	25.2%	14.0%	30.3%	28.2%	100.0%	Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.

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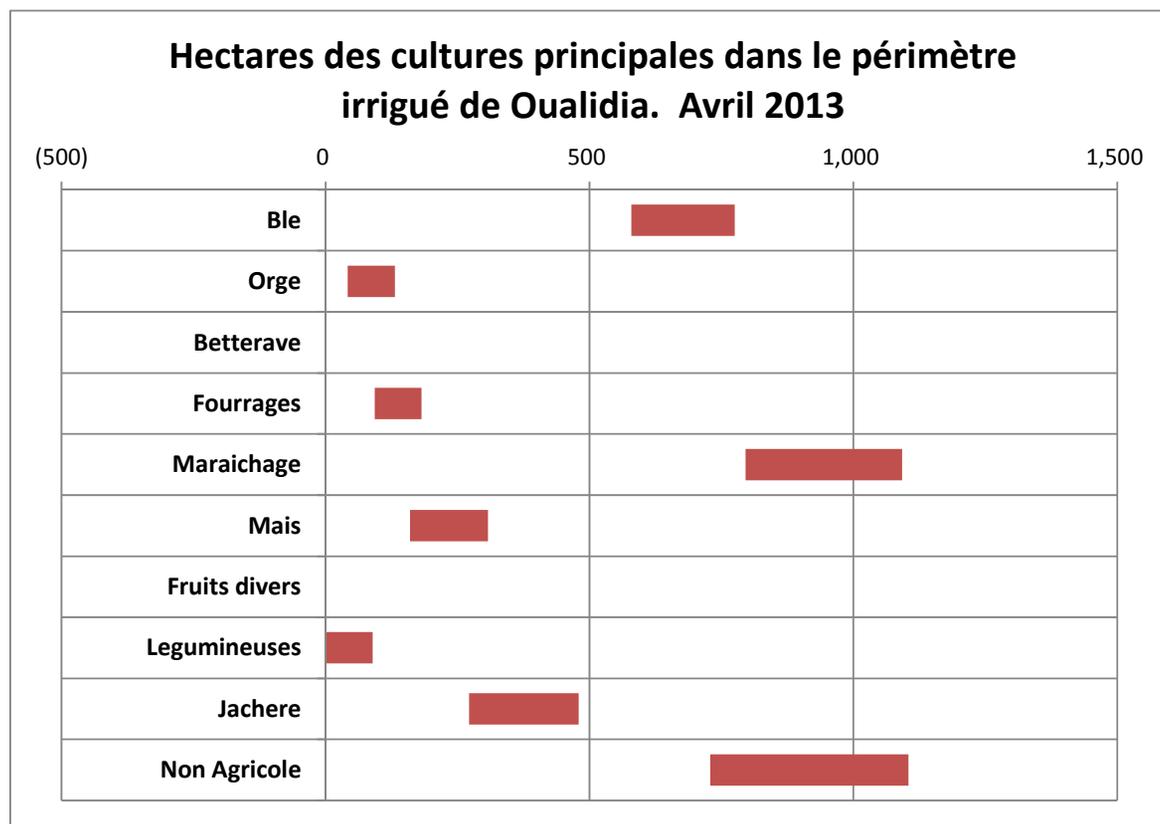
HECTARES OF MAIN CROPS IN OUALIDIA'S IRRIGATED PERIMETER, APRIL 2013

Hectares des cultures principales dans le périmètre irrigué de Oualidia. Avril 2013							
Cultures	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	678	19.8%	98	14.4%	580	775	Wheat
Orge	87	2.5%	45	51.7%	42	132	Barley
Betterave	0	0.0%	0	0.0%	0	0	Sugar Beets
Fourrages	138	4.0%	44	32.1%	94	182	Forage crops
Maraichage	944	27.6%	149	15.7%	796	1,093	Vegetables
Mais	234	6.9%	74	31.6%	160	308	Maize
Fruits divers	0	0.0%	0	0.0%	0	0	Other fruits
Legumineuses	43	1.3%	45	102.7%	(1)	88	Legume crops
Jachere	376	11.0%	104	27.7%	272	480	Fallow
Non Agricole	917	26.8%	188	20.5%	729	1,104	Non-Agric.
Total	3,416						Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.

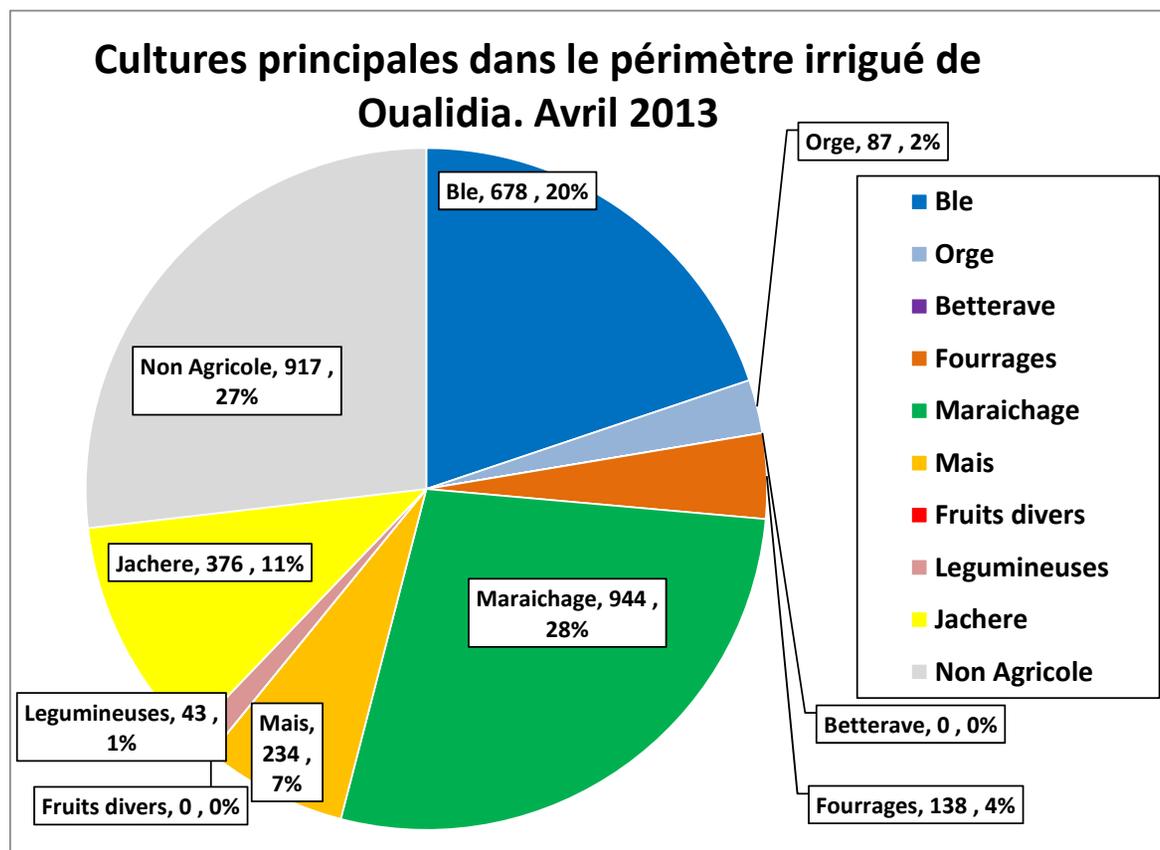
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HECTARES OF MAIN CROPS AND MARGINS OF ERROR IN OUALIDIA'S IRRIGATED PERIMETER, APRIL 2013



[TofC](#)

PIE CHART OF MAIN CROPS IN OUALIDIA IRRIGATED PERIMETER, APRIL 2012



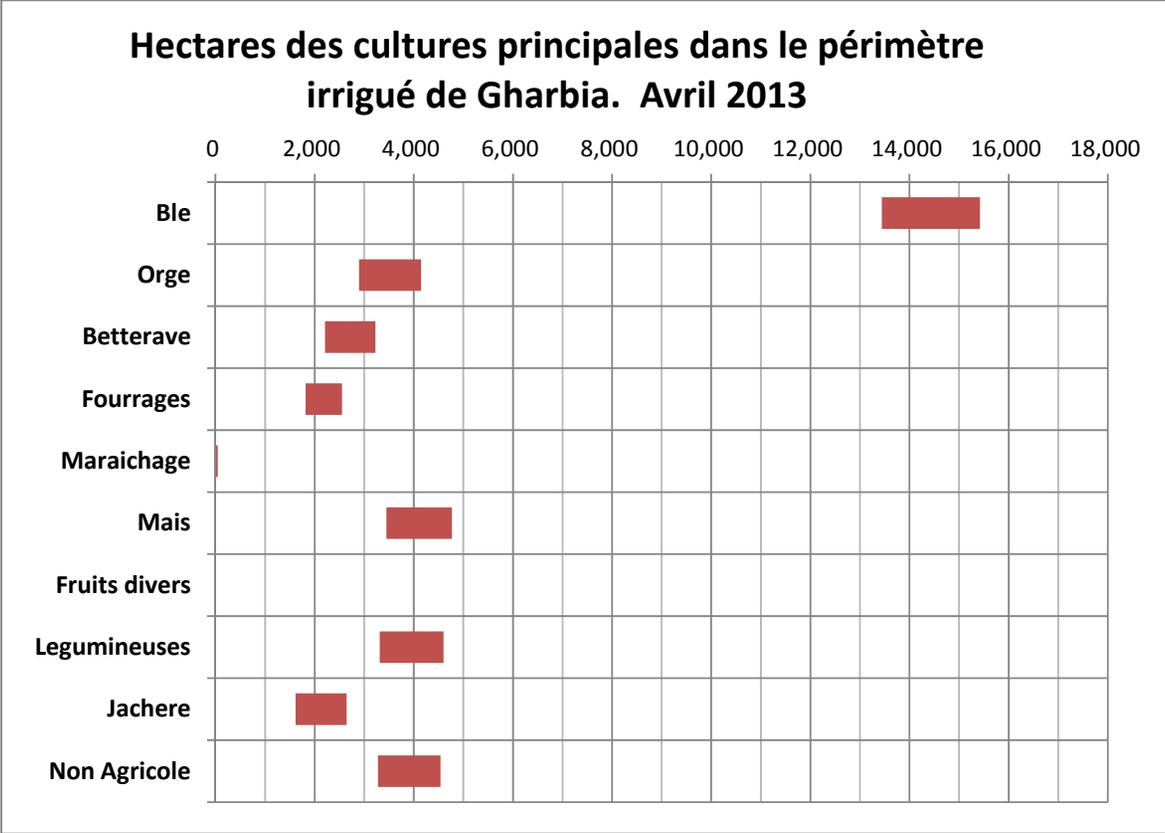
HECTARES OF MAIN CROPS IN GHARBIA IRRIGATED PERIMETER, APRIL 2013

Hectares des cultures principales dans le périmètre irrigué de Gharbia. Avril 2013							
Cultures	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	14,429	39.0%	988	6.8%	13,441	15,418	Wheat
Orge	3,522	9.5%	624	17.7%	2,899	4,146	Barley
Betterave	2,717	7.3%	510	18.8%	2,207	3,227	Sugar Beets
Fourrages	2,187	5.9%	367	16.8%	1,820	2,554	Forage crops
Maraichage	26	0.1%	19	71.6%	7	45	Vegetables
Mais	4,109	11.1%	663	16.1%	3,446	4,773	Maize
Fruits divers	0	0.0%	0	0.0%	0	0	Other fruits
Legumineuses	3,954	10.7%	643	16.3%	3,311	4,597	Legume crops
Jachere	2,133	5.8%	515	24.2%	1,617	2,648	Fallow
Non Agricole	3,907	10.6%	630	16.1%	3,276	4,537	Non-Agric.
Total	36,985	100%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.

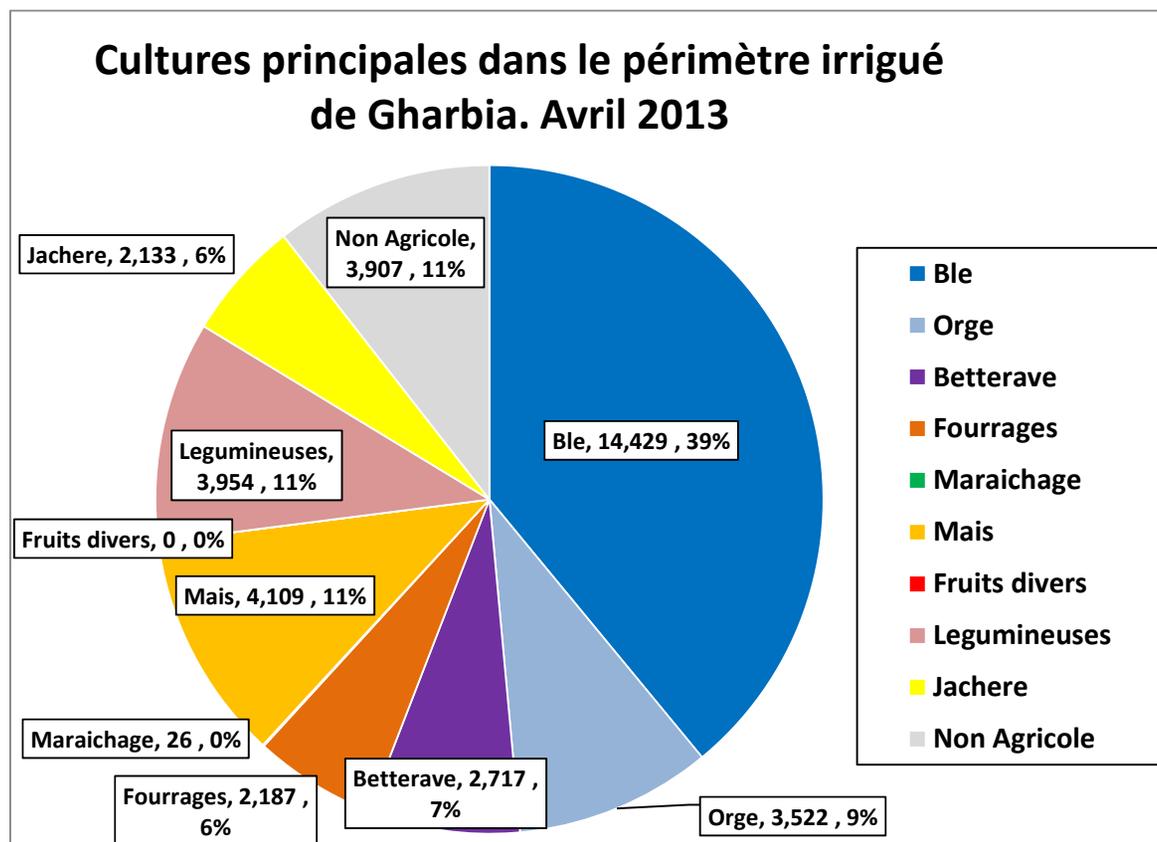
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HECTARES OF MAIN CROPS AND MARGINS OF ERROR IN GHARBIA IRRIGATED PERIMETER, APRIL 2013



TofC

PIE CHART: MAIN CROPS IN GHARBIA'S IRRIGATED PERIMETER, APRIL 2013



TofC

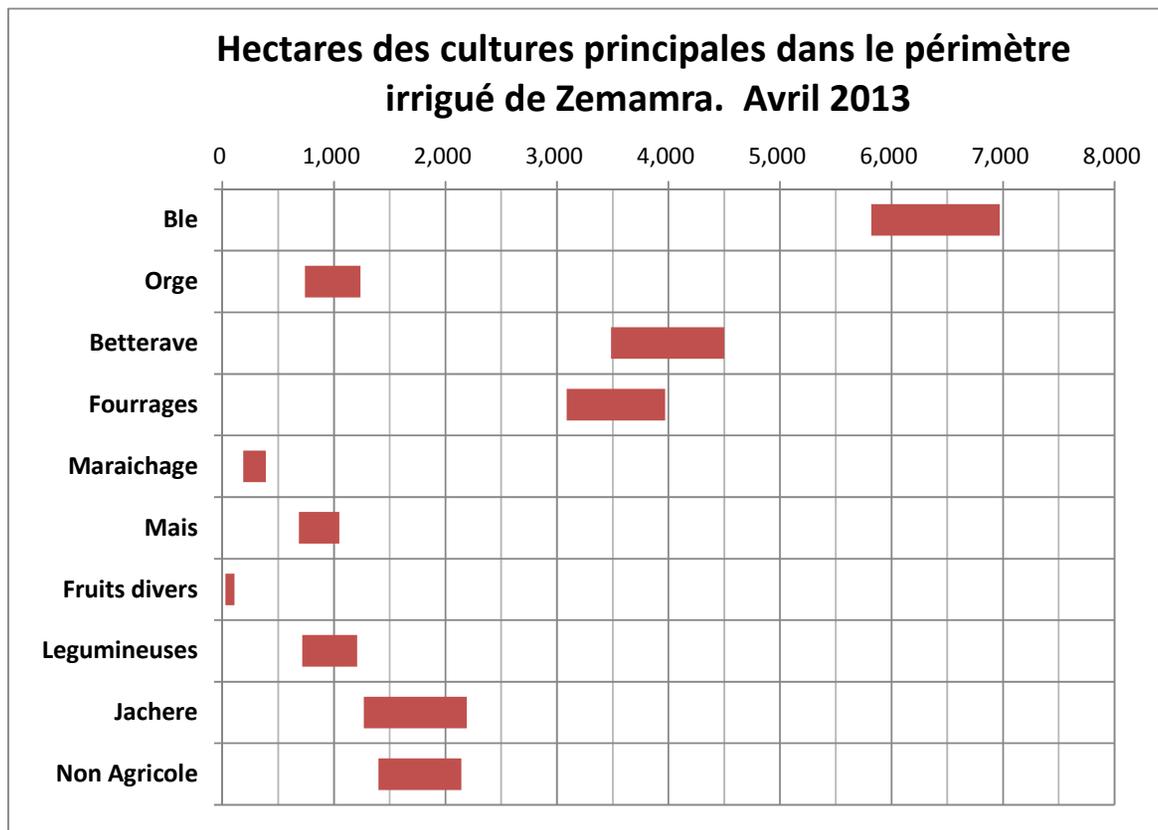
HECTARES OF MAIN CROPS IN ZEMAMRA IRRIGATED PERIMETER, APRIL 2013

Hectares des cultures principales dans le périmètre irrigué de Zemamra. Avril 2013							
Ble	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	6,395	31.1%	576	9.0%	5,819	6,971	Wheat
Orge	990	4.8%	249	25.2%	740	1,239	Barley
Betterave	3,993	19.4%	508	12.7%	3,485	4,501	Sugar Beets
Fourrages	3,528	17.1%	441	12.5%	3,087	3,969	Forage crops
Maraichage	287	1.4%	102	35.4%	186	389	Vegetables
Mais	867	4.2%	182	20.9%	685	1,048	Maize
Fruits divers	67	0.3%	42	62.2%	25	108	Other fruits
Legumineuses	961	4.7%	246	25.6%	715	1,208	Legume crops
Jachere	1,729	8.4%	462	26.7%	1,267	2,190	Fallow
Non Agricole	1,770	8.6%	371	21.0%	1,399	2,142	Non-Agric.
Total	20,587	100%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.

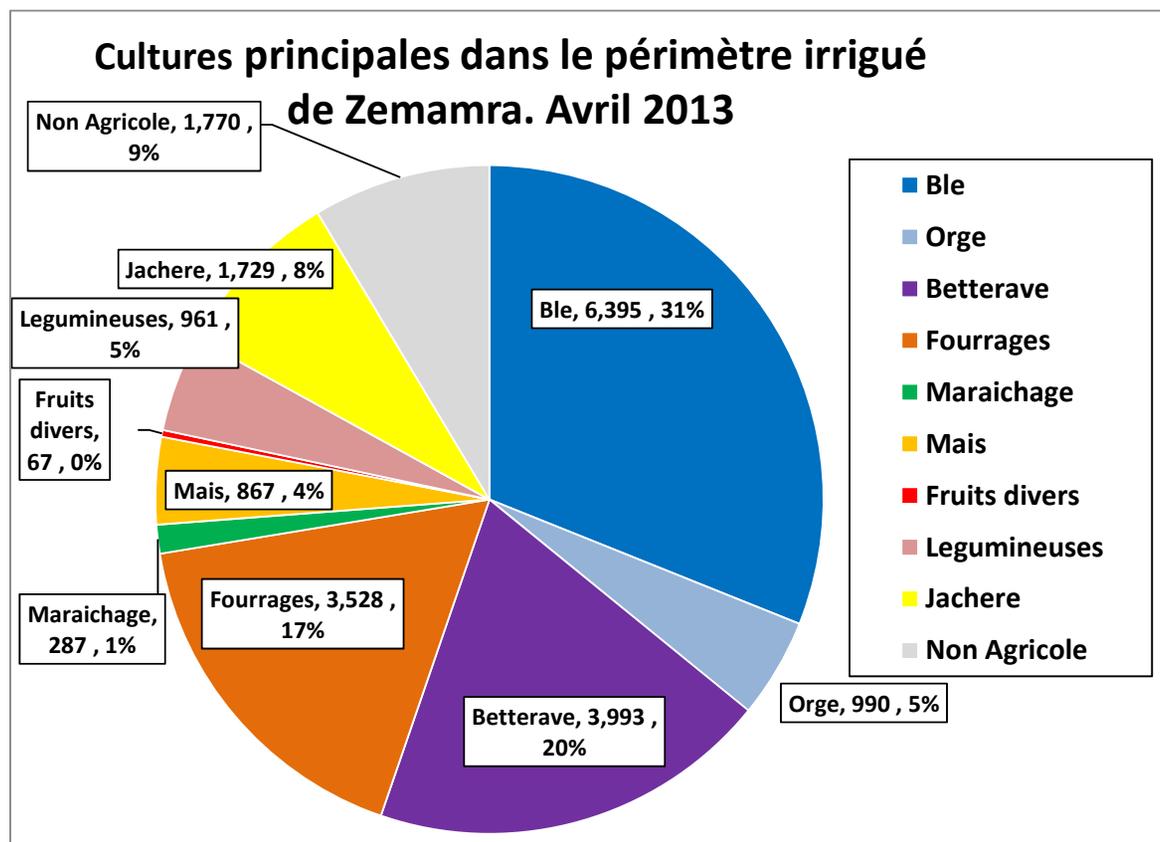
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**HECTARES OF MAIN CROPS AND MARGINS OF ERROR IN ZEMAMRA IRRIGATED PERIMETER,
APRIL 2013**



TofC

PIE CHART: MAIN CROPS IN ZEMAMRA IRRIGATED PERIMETER, APRIL 2012



TofC

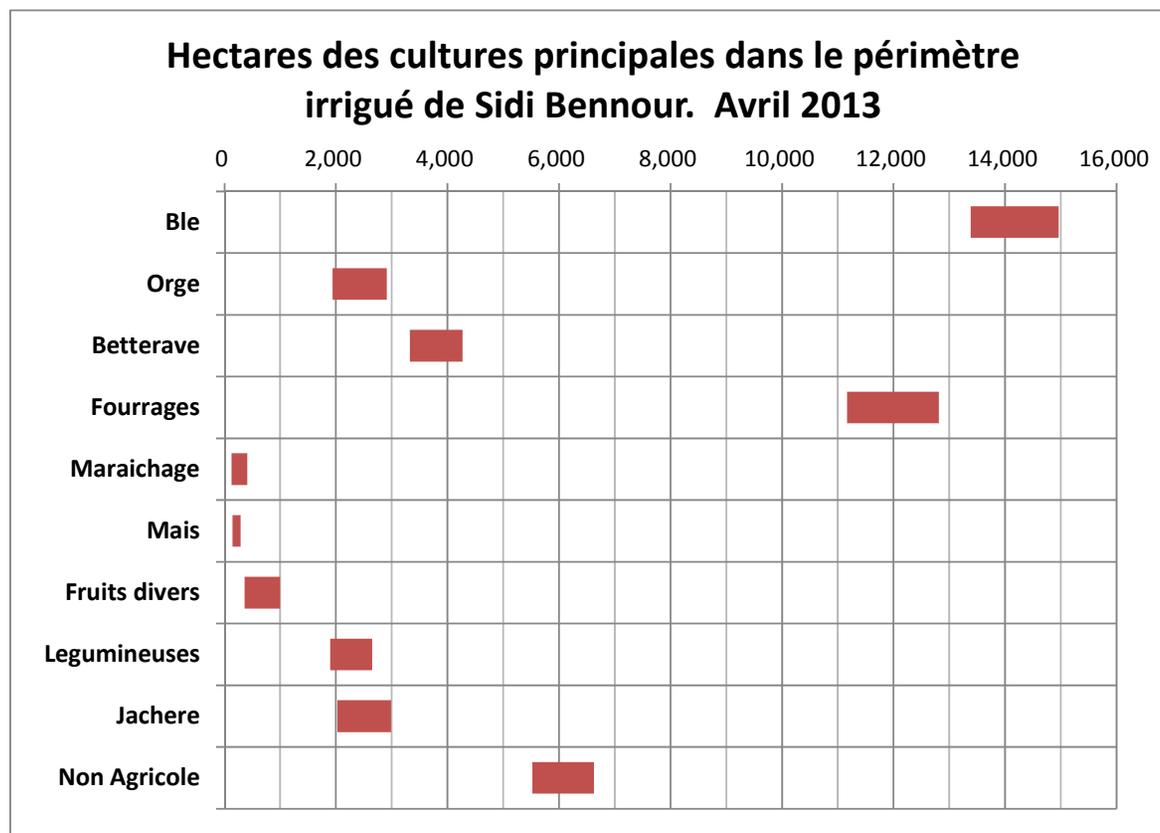
HECTARES OF MAIN CROPS IN SIDI BENNOUR IRRIGATED PERIMETER, APRIL 2012

Hectares des cultures principales dans le périmètre irrigué de Sidi Bennour. Avril 2013							
Cultures	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	14,173	31.9%	791	5.6%	13,383	14,964	Wheat
Orge	2,426	5.5%	486	20.0%	1,940	2,913	Barley
Betterave	3,799	8.6%	472	12.4%	3,327	4,271	Sugar Beets
Fourrages	11,989	27.0%	824	6.9%	11,165	12,814	Forage crops
Maraichage	269	0.6%	140	51.9%	130	409	Vegetables
Mais	219	0.5%	73	33.3%	146	292	Maize
Fruits divers	679	1.5%	317	46.8%	362	997	Other fruits
Legumineuses	2,273	5.1%	379	16.7%	1,895	2,652	Legume crops
Jachere	2,506	5.6%	481	19.2%	2,025	2,987	Fallow
Non Agricole	6,074	13.7%	550	9.1%	5,523	6,624	Non-Agric.
Total	44,408	100%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.

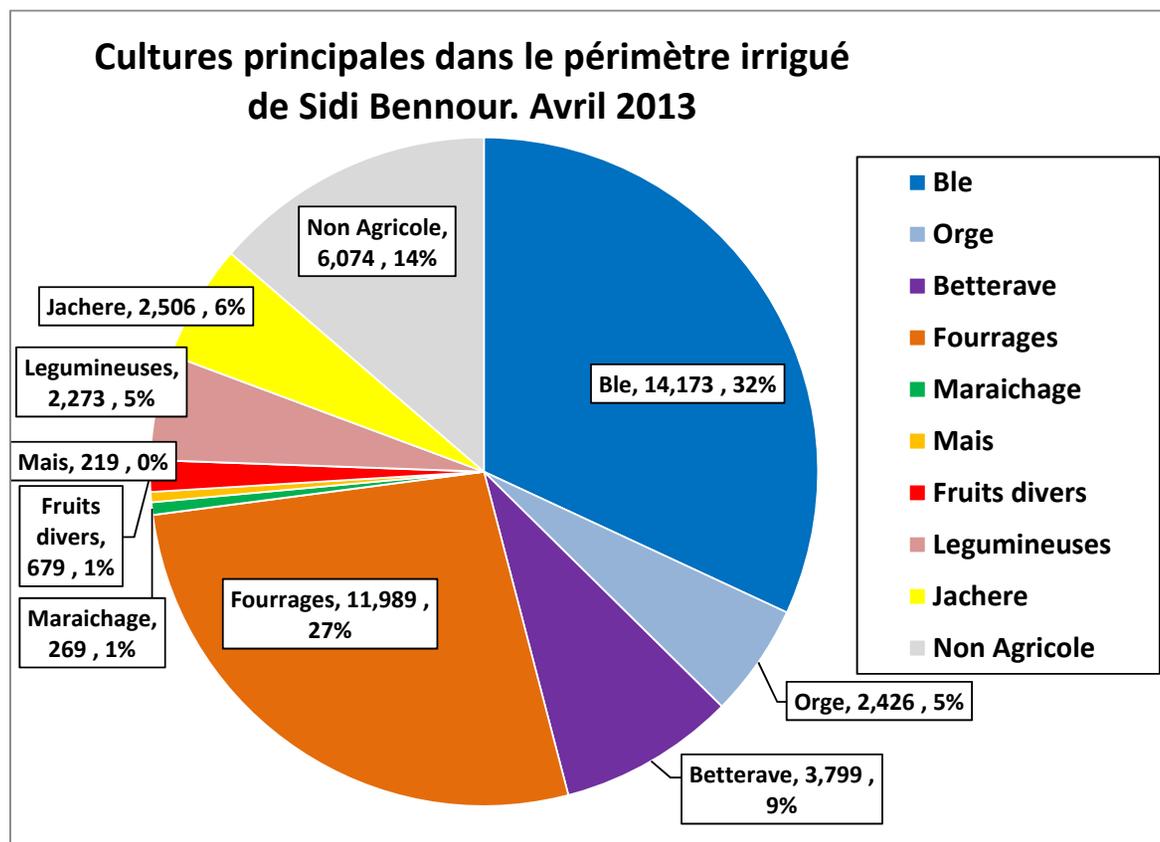
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HECTARES OF MAIN CROPS AND MARGINS OF ERROR IN SIDI BENNOUR IRRIGATED PERIMETER, APRIL 2013



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PIE CHART: MAIN CROPS IN SIDI BENNOUR IRRIGATED PERIMETER, APRIL 2013



TofC

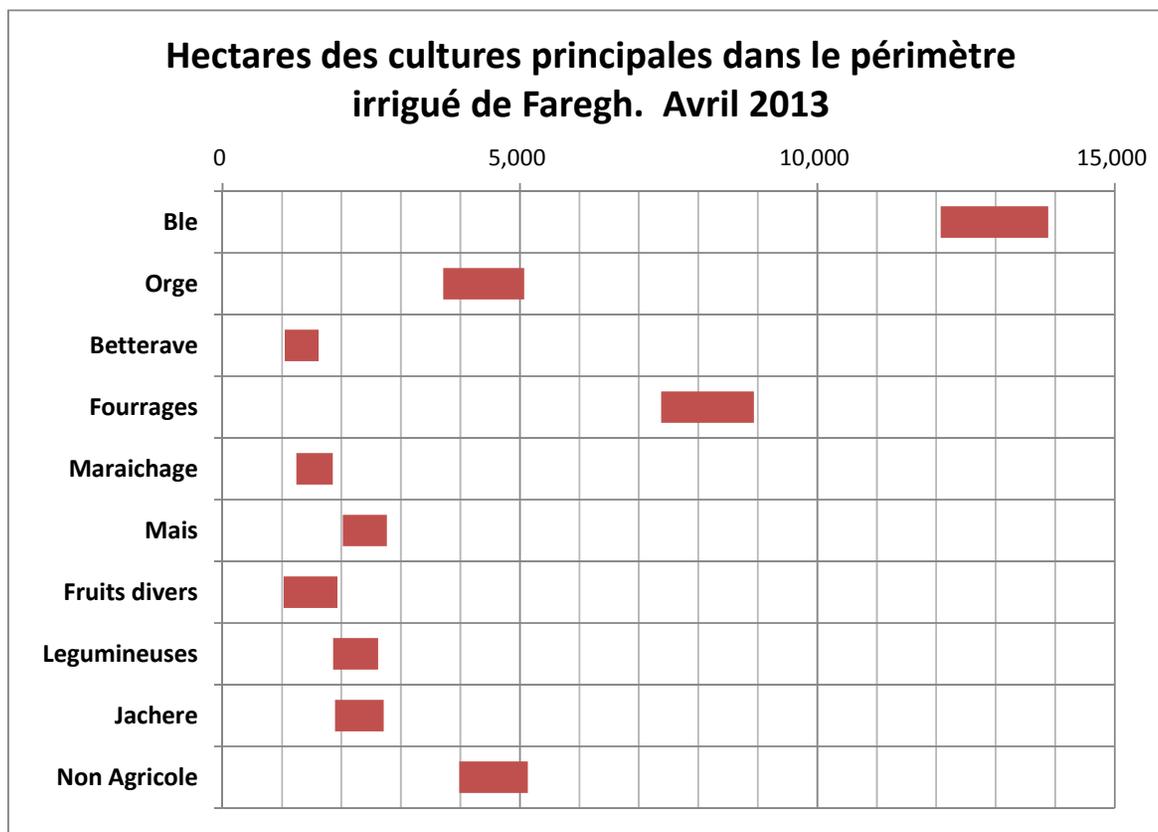
HECTARES OF MAIN CROPS IN FAREGH IRRIGATED PERIMETER, APRIL 2013

Hectares des cultures principales dans le périmètre irrigué de Faregh. Avril 2013							
Cultures	Hectares	Percent	Std Err	Cof Var	Bas / Low	Haut / High	Land Use
Ble	12,977	31.4%	905	7.0%	12,072	13,882	Wheat
Orge	4,390	10.6%	681	15.5%	3,709	5,071	Barley
Betterave	1,333	3.2%	284	21.3%	1,048	1,617	Sugar Beets
Fourrages	8,155	19.7%	781	9.6%	7,373	8,936	Forage crops
Maraichage	1,550	3.7%	307	19.8%	1,243	1,857	Vegetables
Mais	2,394	5.8%	370	15.5%	2,023	2,764	Maize
Fruits divers	1,479	3.6%	452	30.5%	1,028	1,931	Other fruits
Legumineuses	2,242	5.4%	379	16.9%	1,863	2,620	Legume crops
Jachere	2,299	5.6%	409	17.8%	1,890	2,708	Fallow
Non Agricole	4,555	11.0%	577	12.7%	3,978	5,132	Non-Agric.
Total	41,373	100%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.

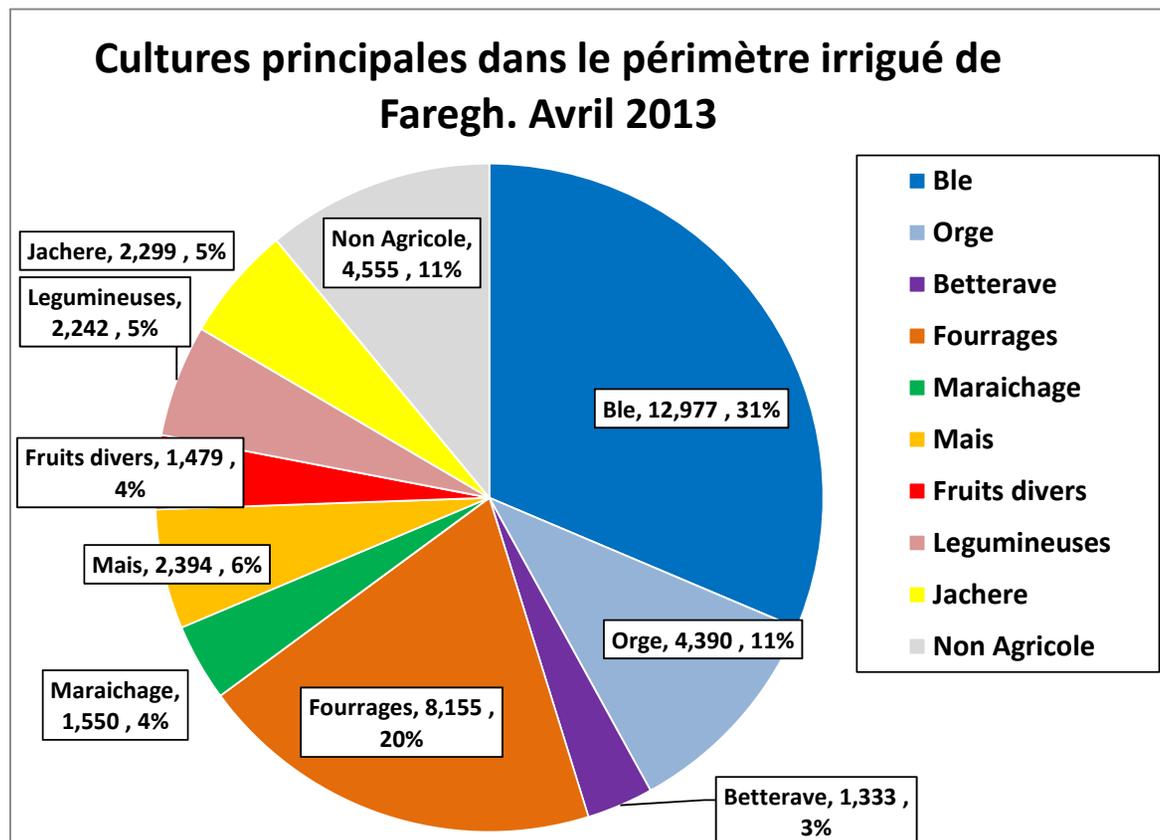
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HECTARES OF MAIN CROPS AND MARGINS OF ERROR IN FAREGH'S IRRIGATED PERIMETER, APRIL 2013



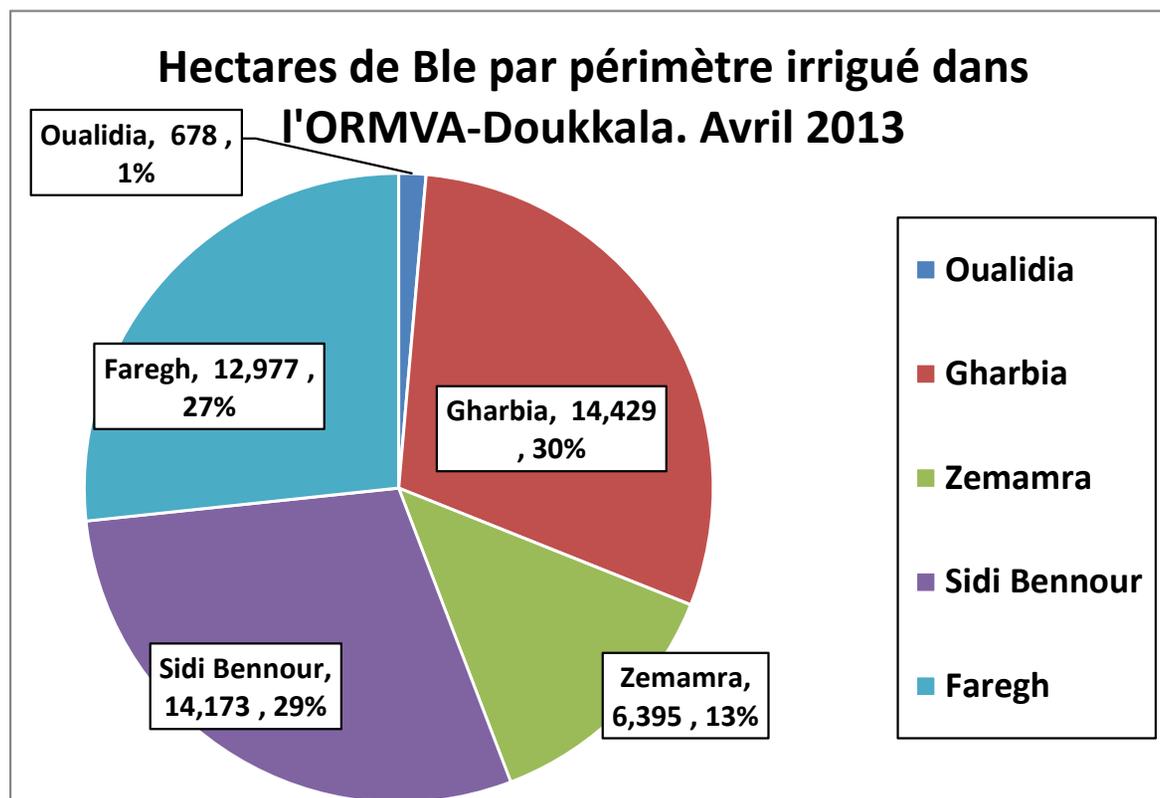
ToC

PIE CHART: MAIN CROPS IN FAREGH IRRIGATED PERIMETER, APRIL 2012



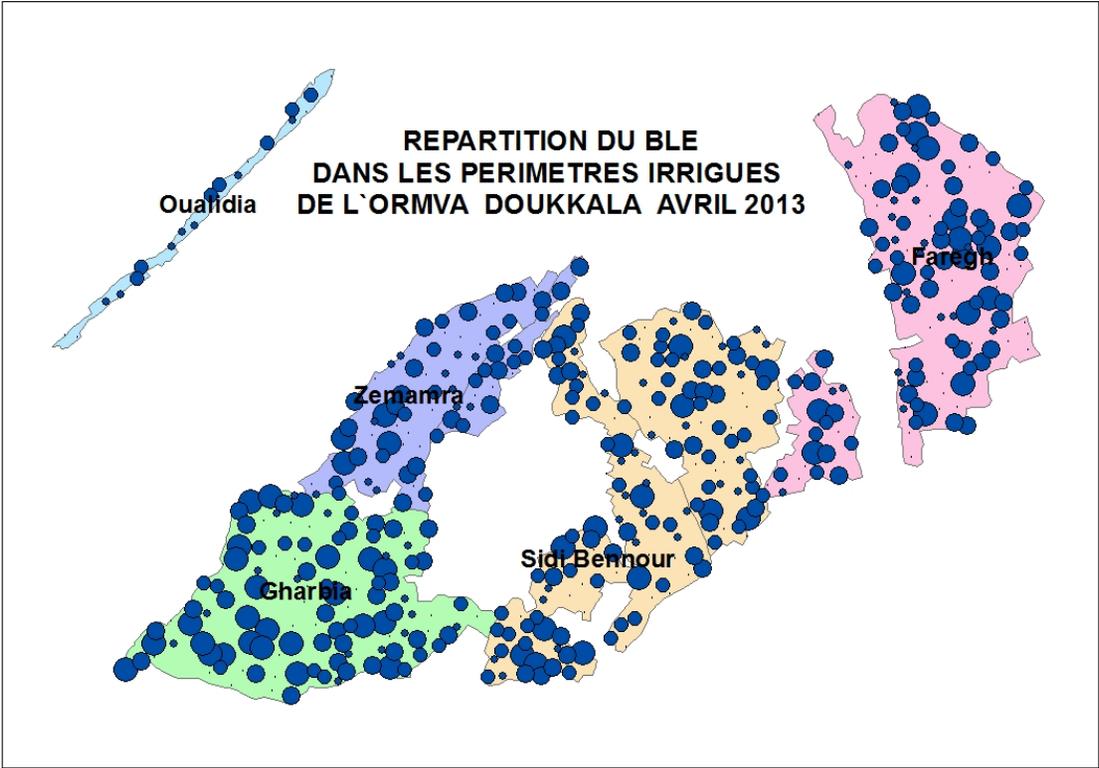
[TofC](#)

PIE CHART: HECTARES OF WHEAT PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



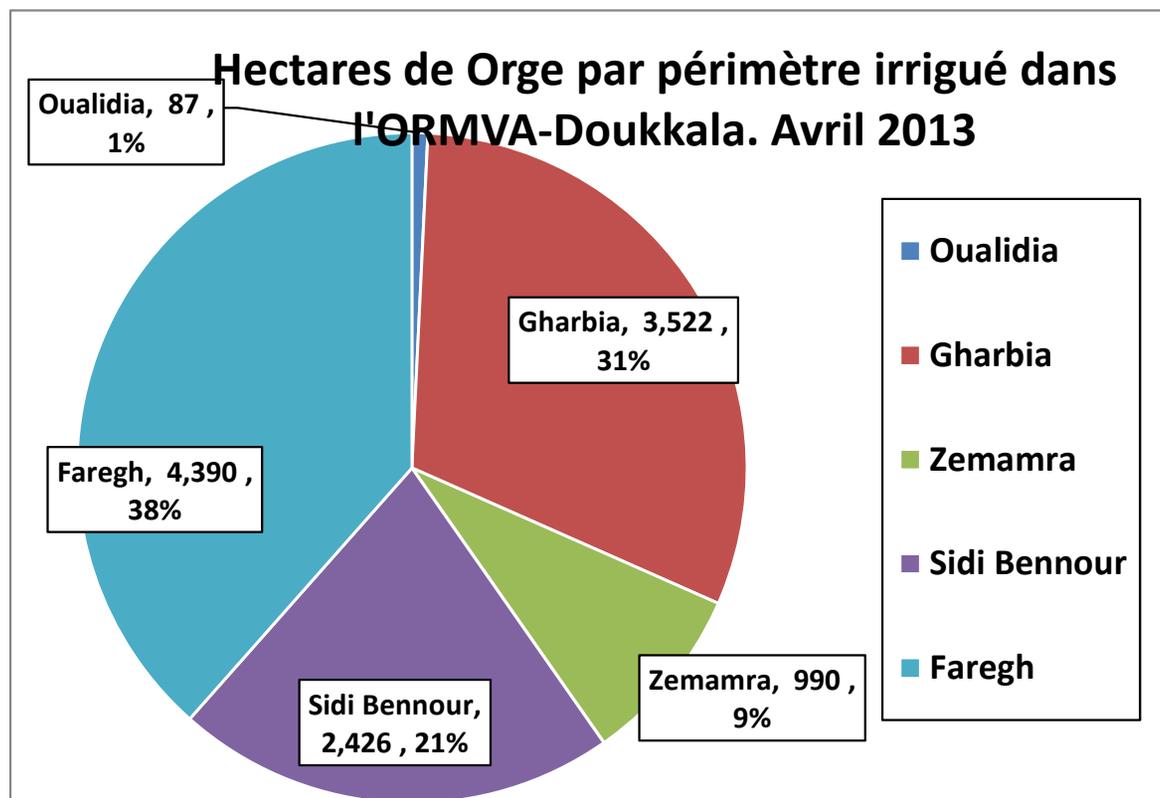
[TofC](#)

MAP - LOCATION OF WHEAT IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



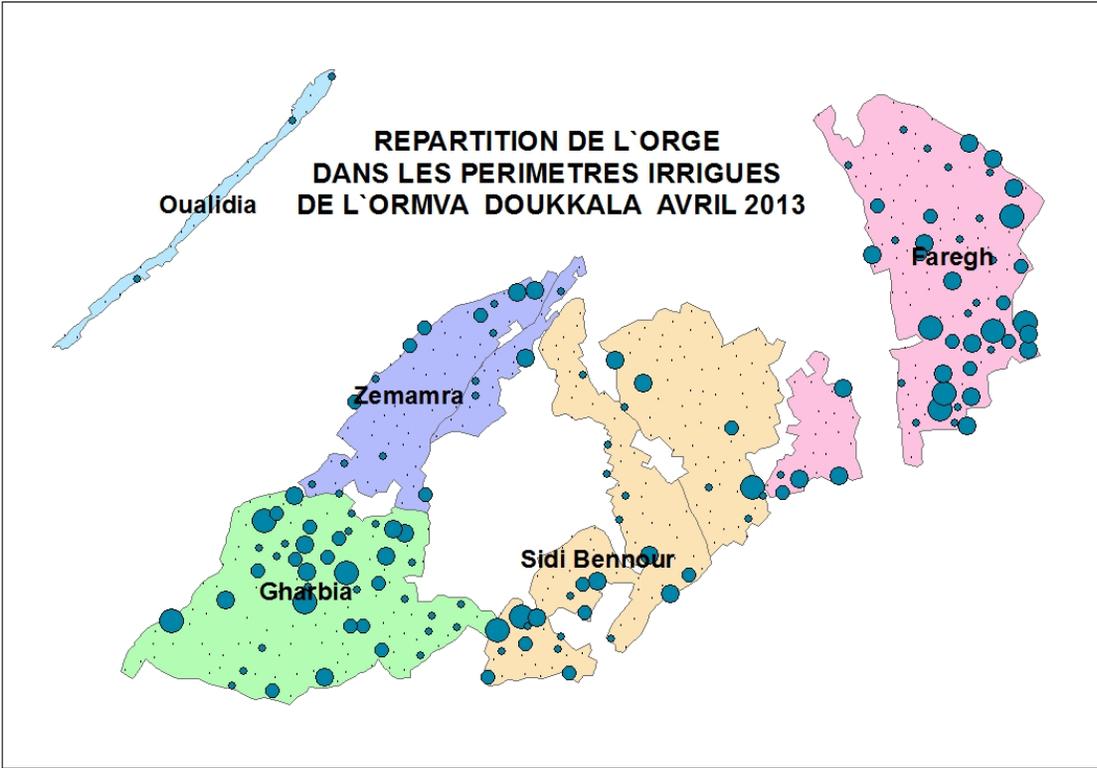
TofC

PIE CHART: HECTARES OF BARLEY PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



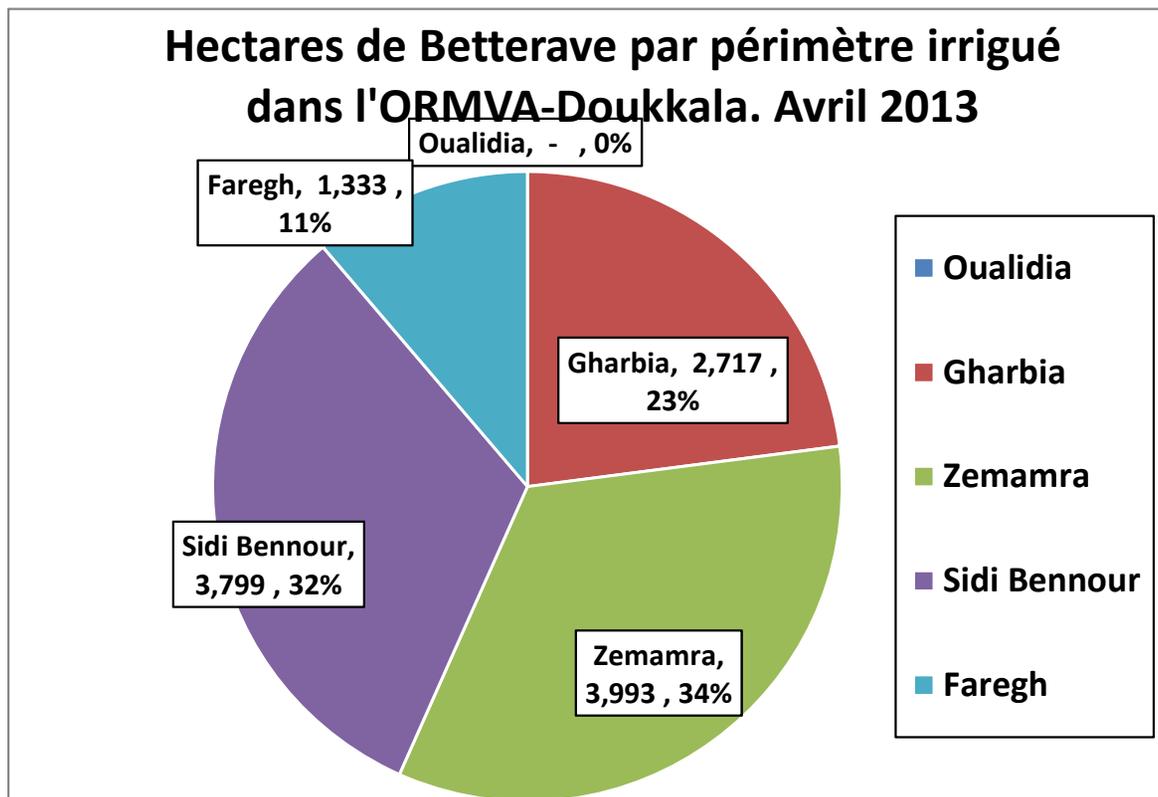
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MAP - LOCATION OF BARLEY IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



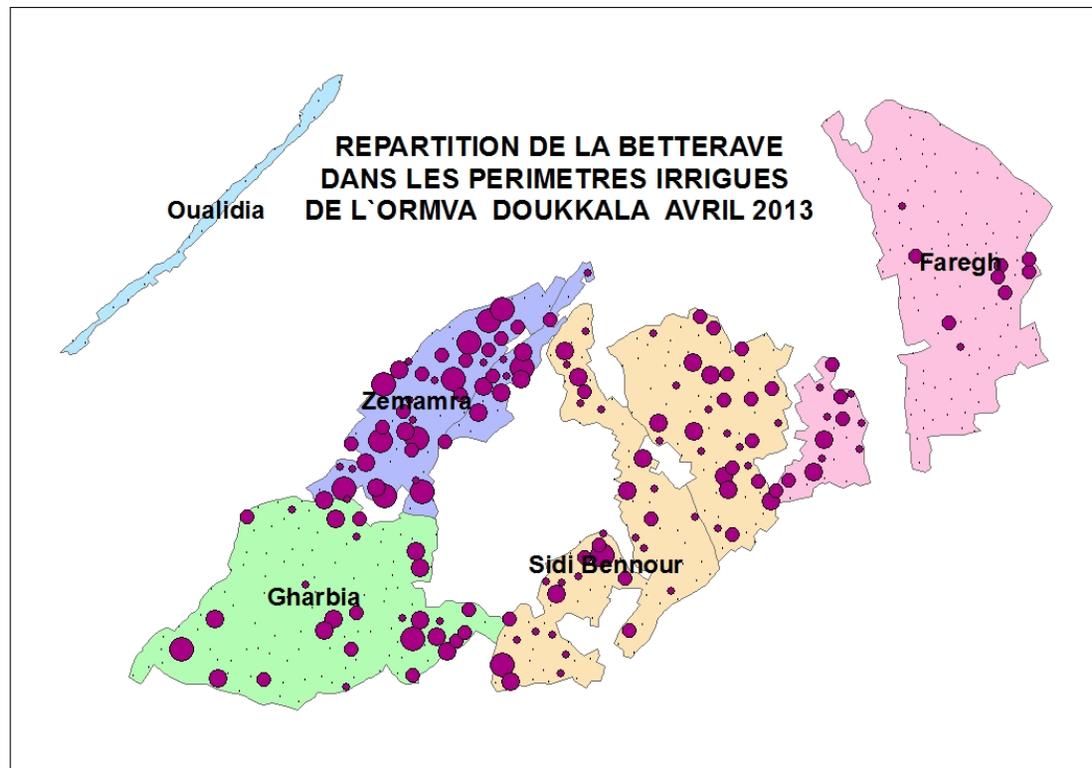
[TofC](#)

PIE CHART: HECTARES OF SUGAR BEETS PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



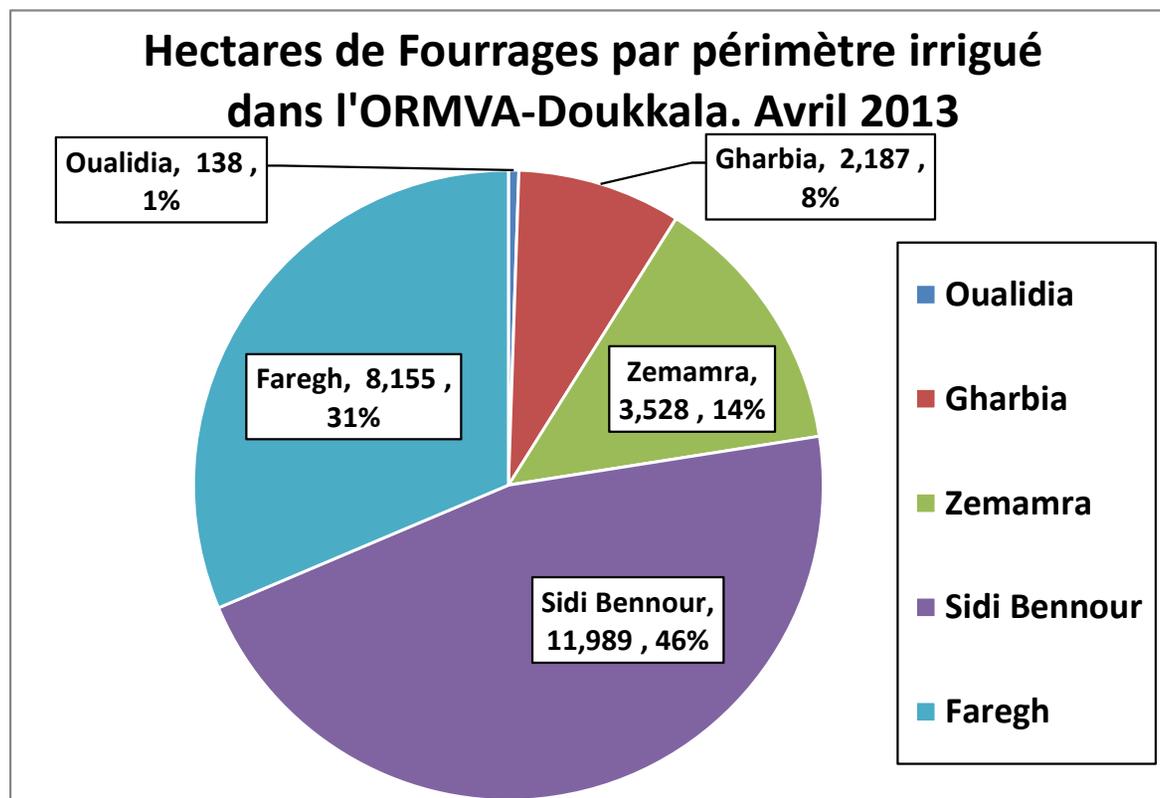
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MAP - LOCATION OF SUGAR BEETS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



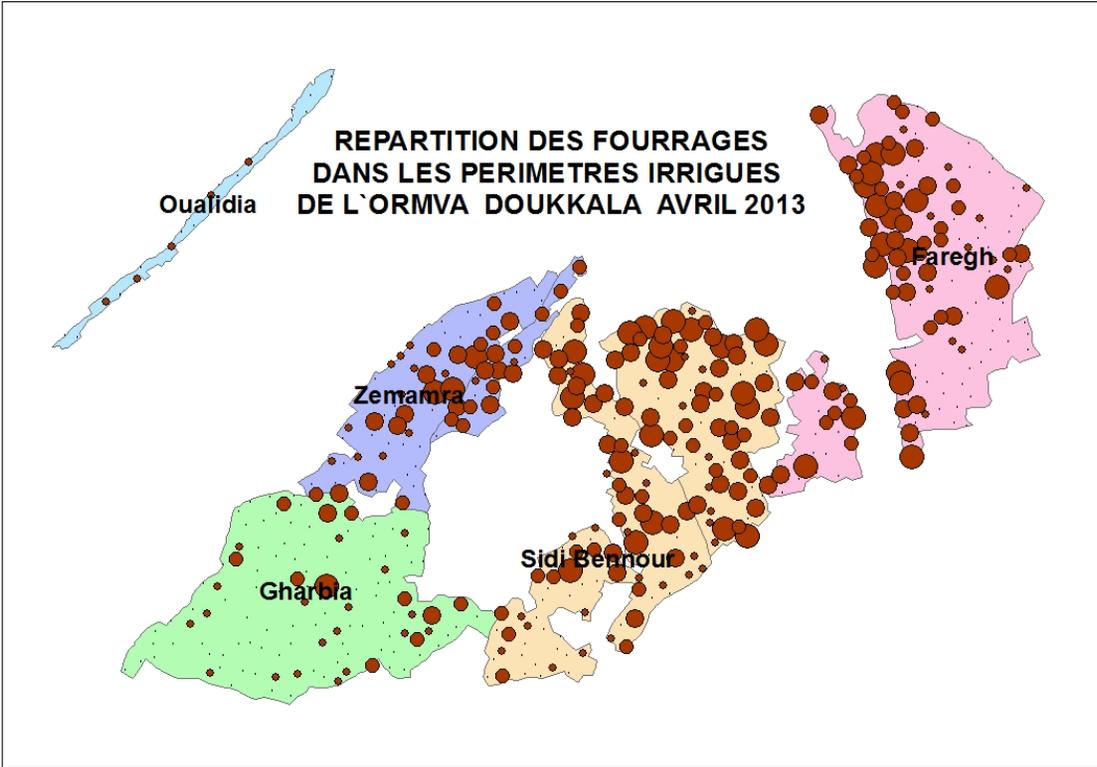
TofC

PIE CHART: HECTARES OF FORAGE CROPS PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



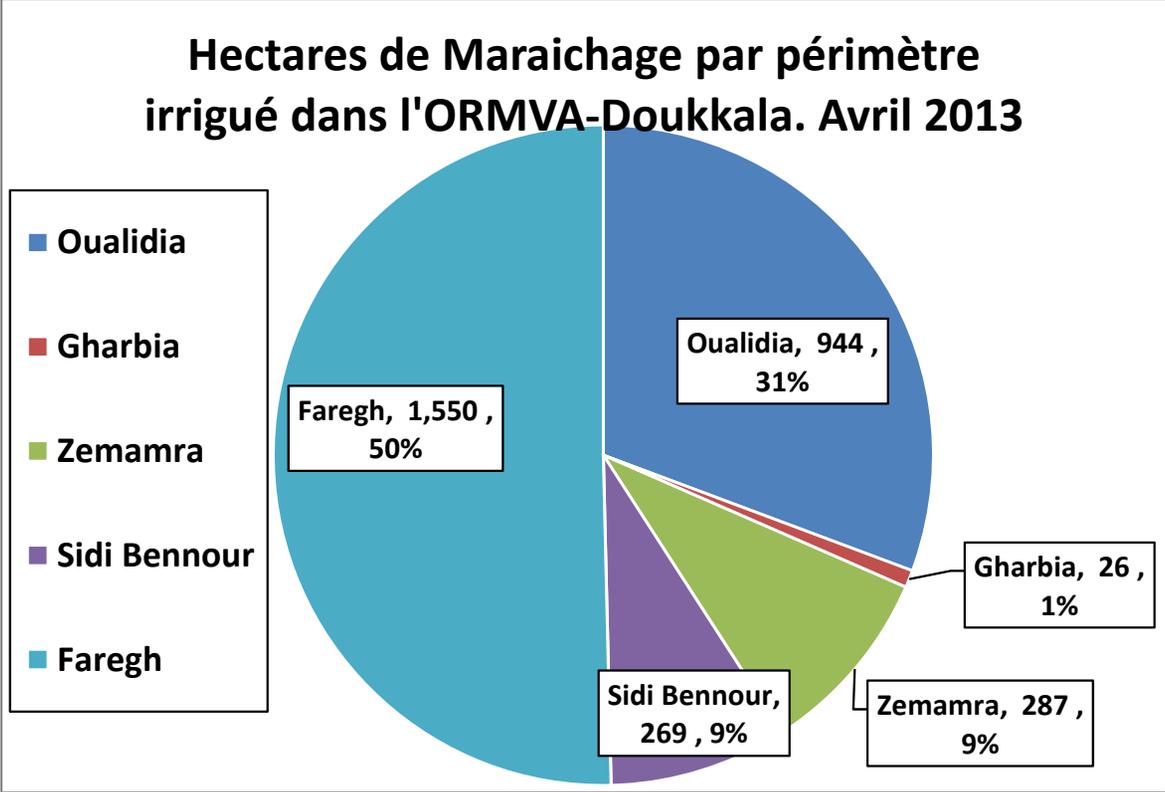
TofC

MAP - LOCATION OF FORAGE CROPS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



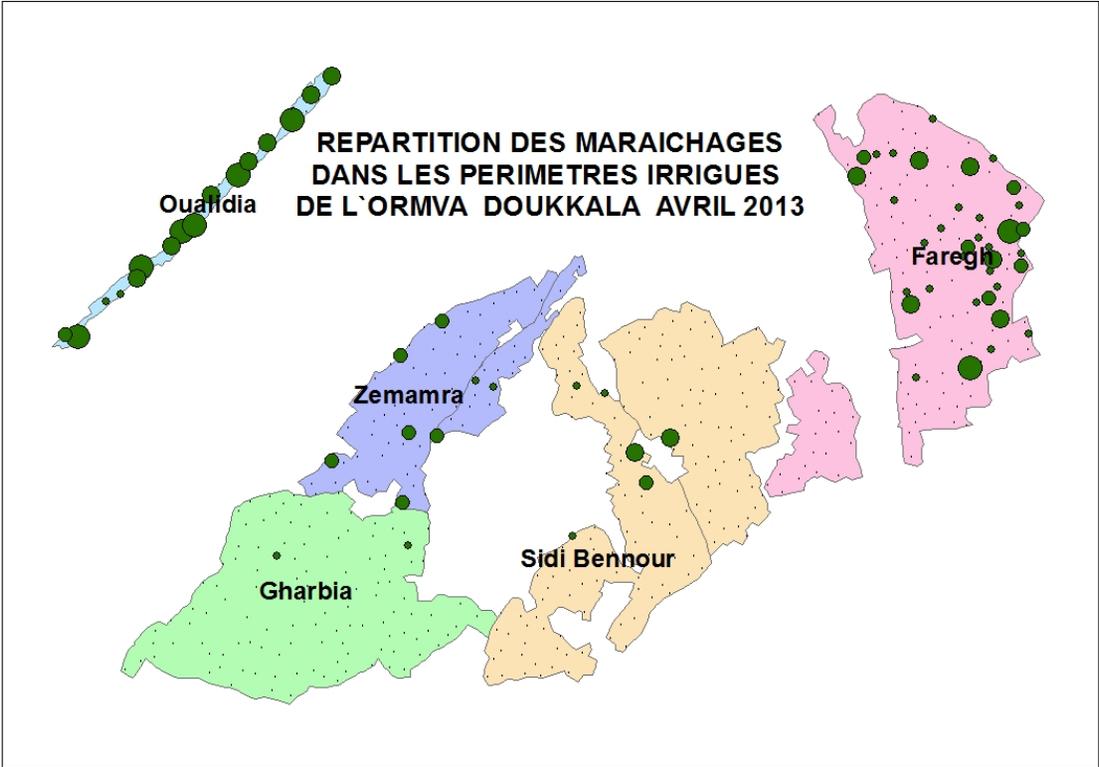
TofC

PIE CHART: HECTARES OF MARKET VEGETABLES PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



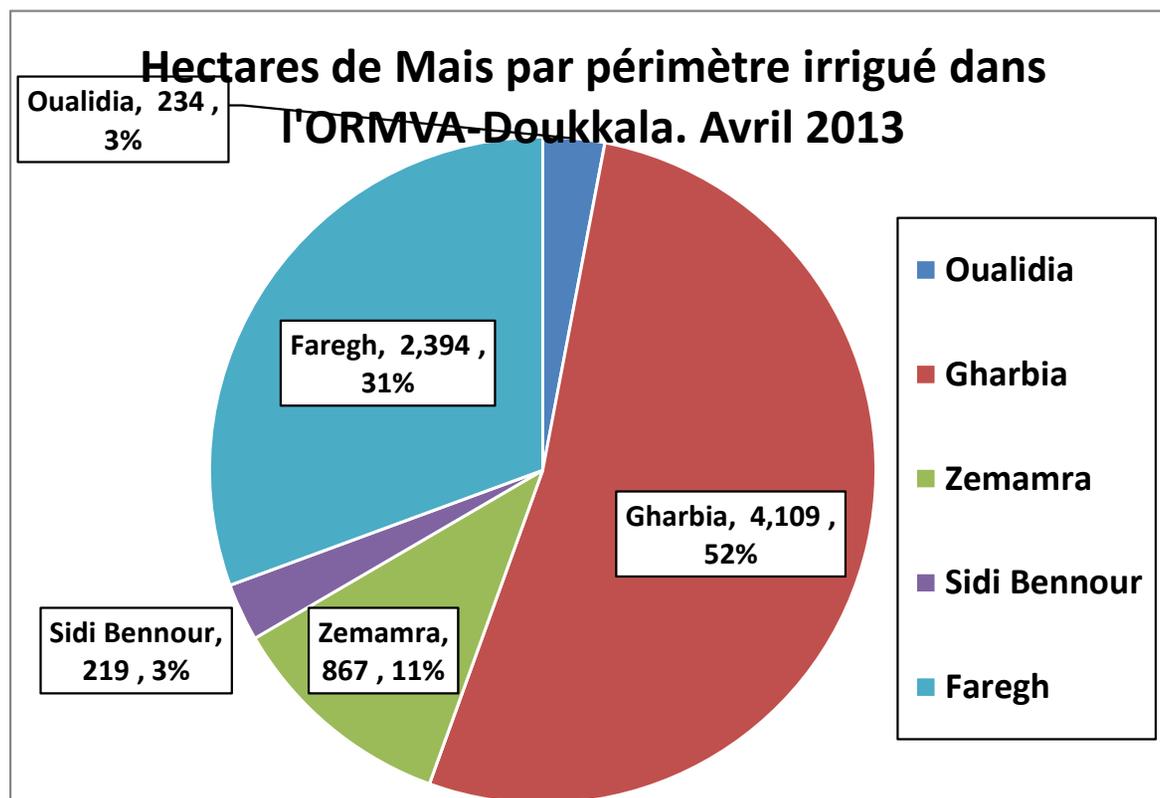
TofC

**MAP - LOCATION OF MARKET VEGETABLES IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS,
APRIL 2013**



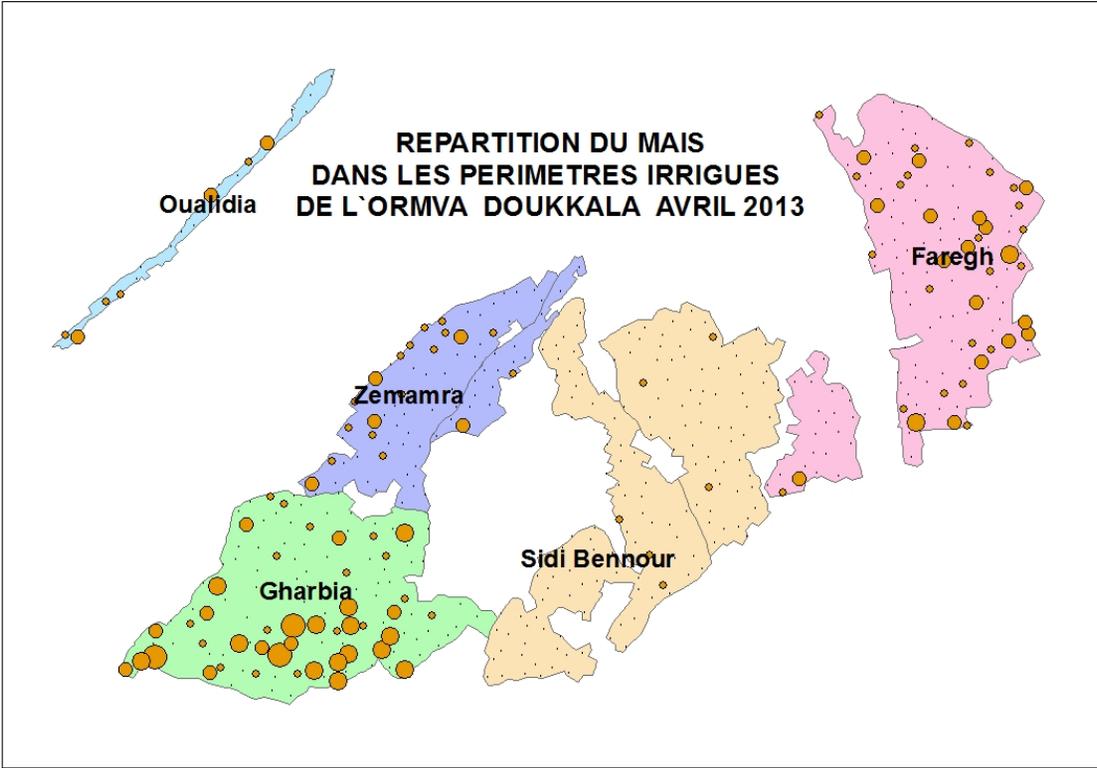
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PIE CHART: HECTARES OF MAIZE PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



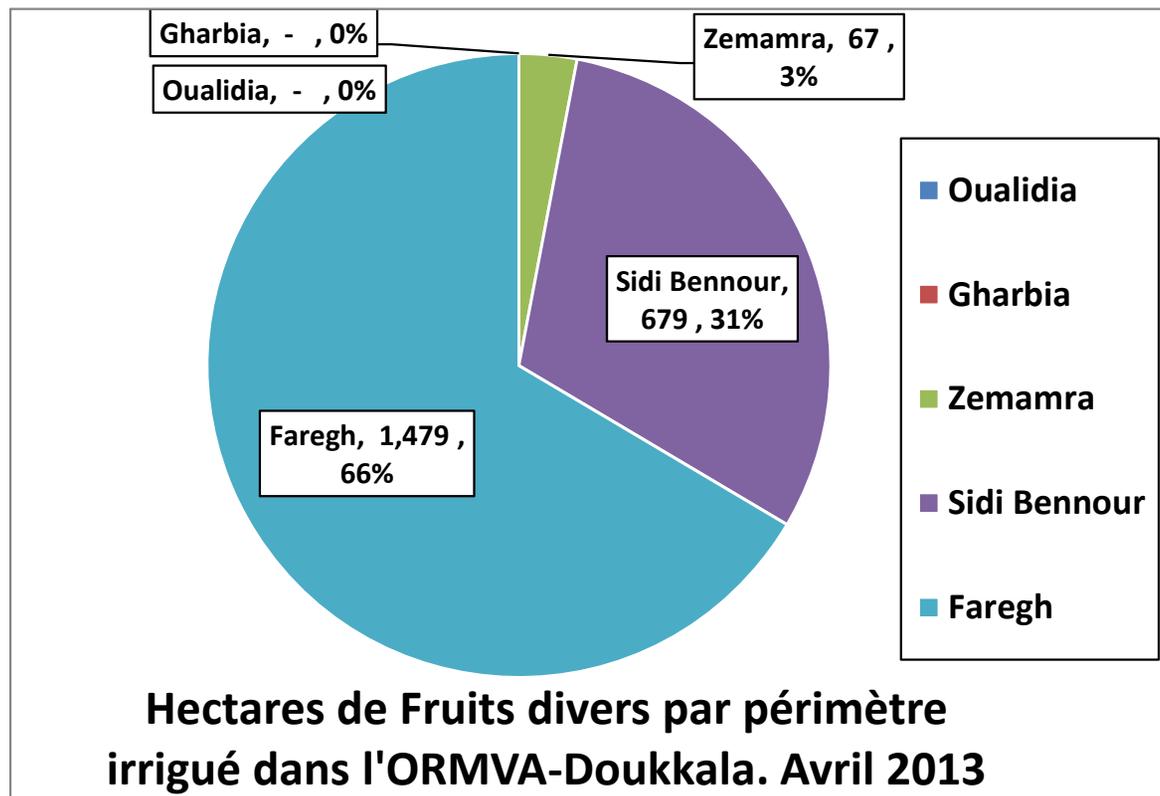
[TofC](#)

MAP - LOCATION OF MAIZE IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



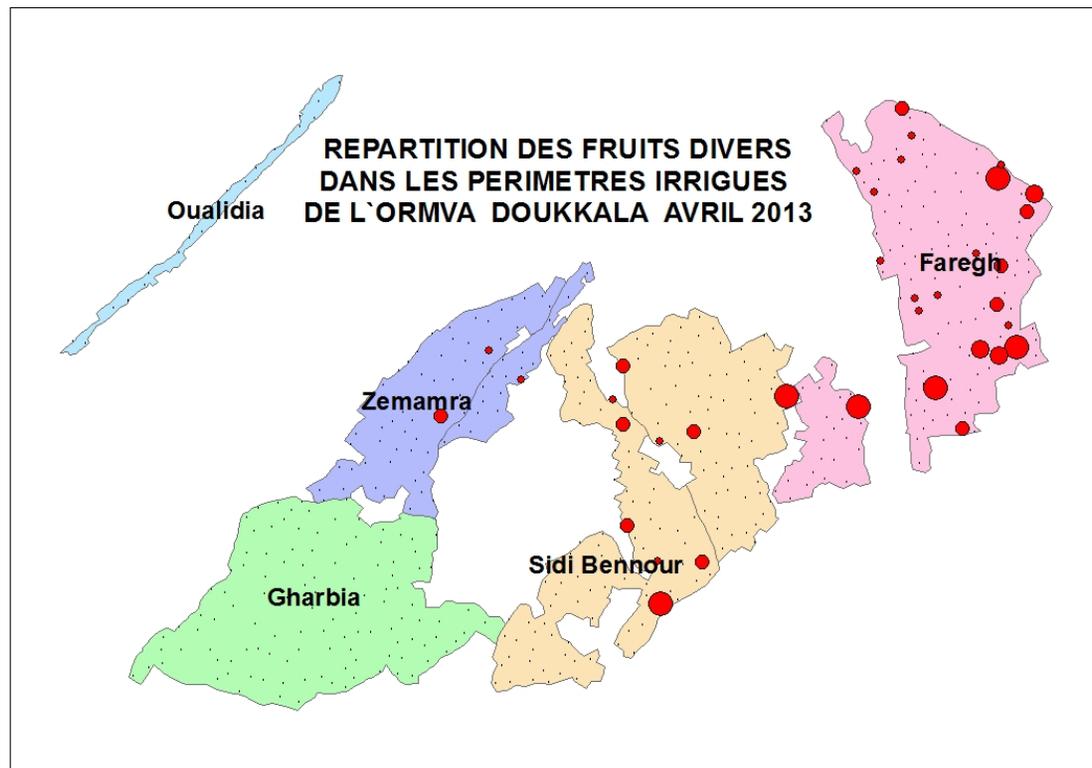
[TofC](#)

**PIE CHART: HECTARES OF ASSORTED FRUITS PER IRRIGATED PERIMETER IN ORMVA
DOUKKALA, APRIL 2013**



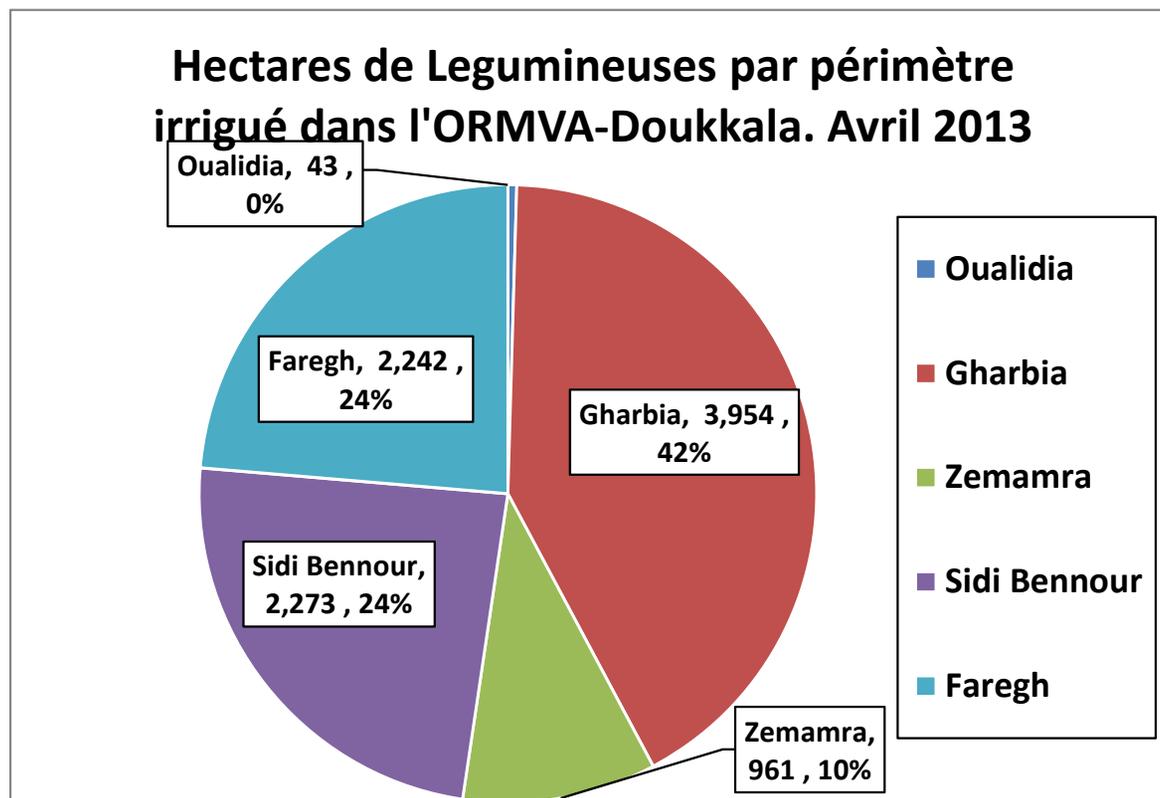
TofC

**MAP - LOCATION OF ASSORTED FRUITS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS,
APRIL 2013**



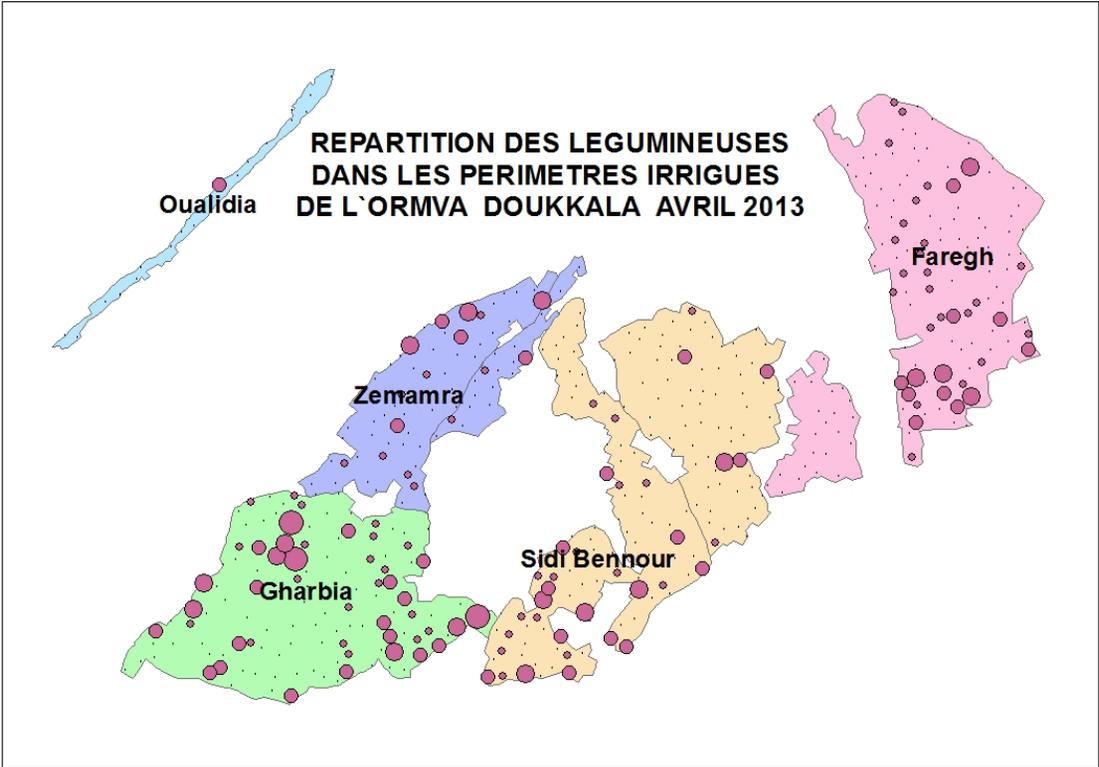
TofC

PIE CHART: HECTARES OF LEGUME CROPS PER IRRIGATED PERIMETER IN ORMVA DOUKKALA, APRIL 2013



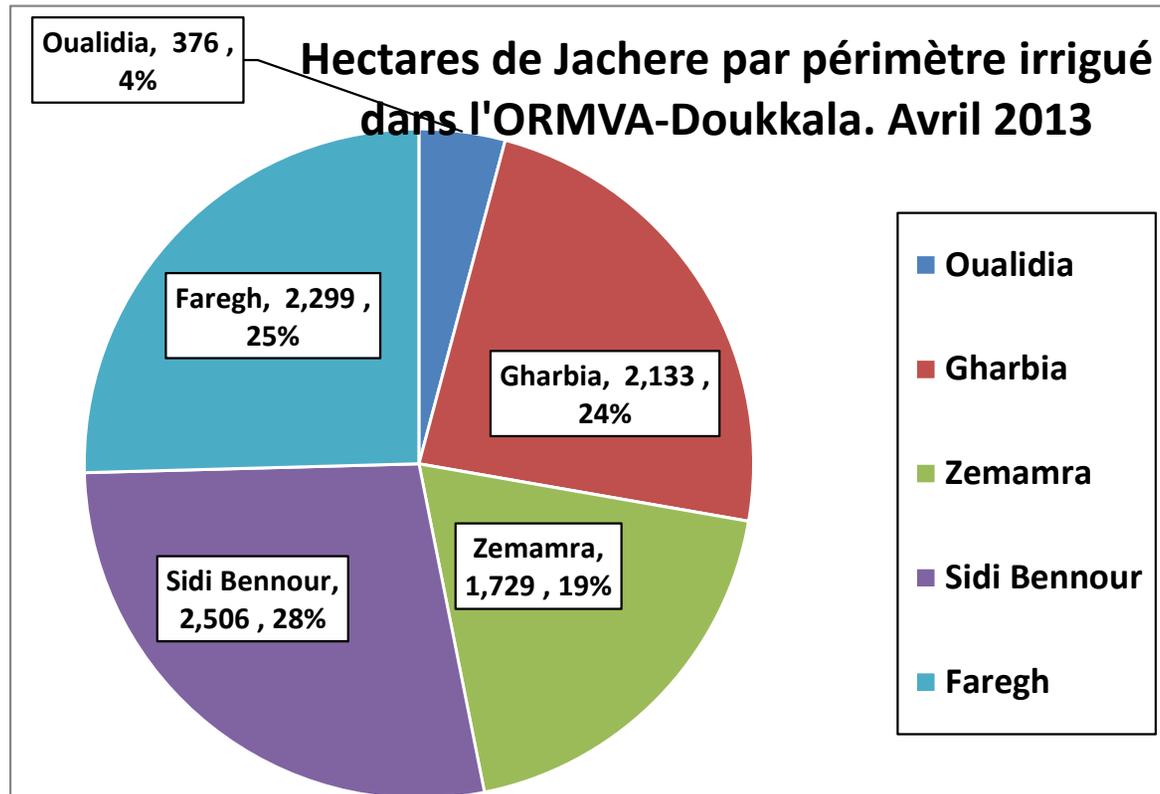
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MAP - LOCATION OF LEGUME CROPS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



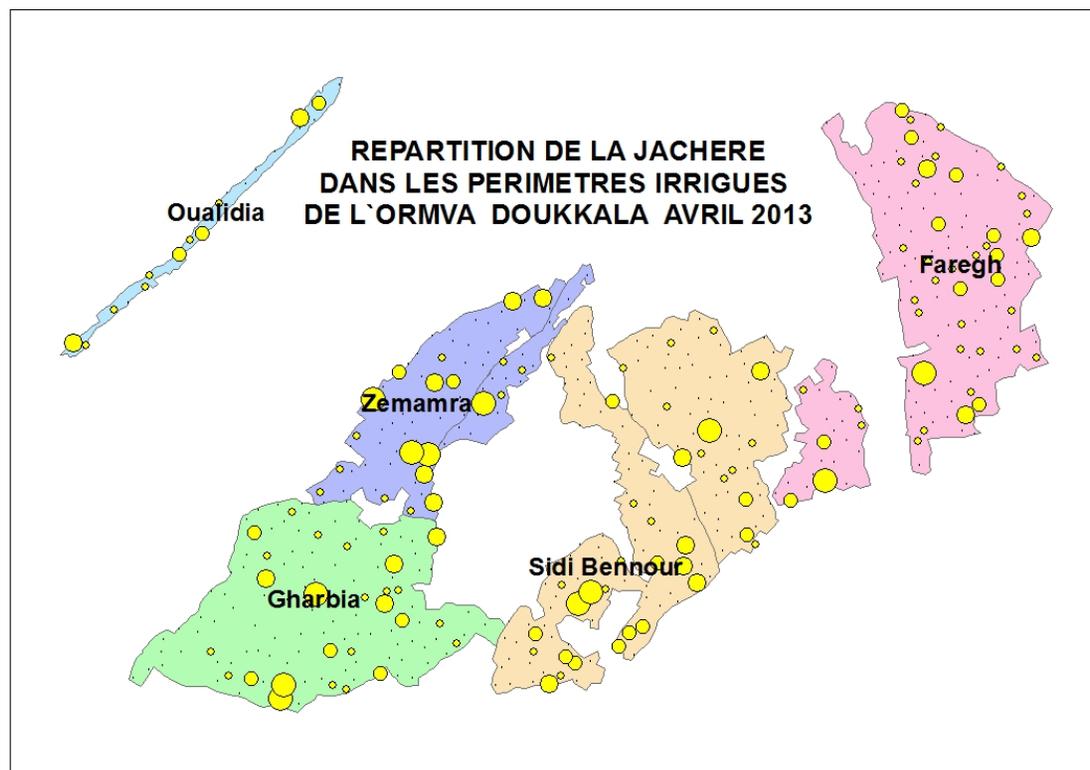
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PIE CHART: HECTARES OF FALLOW LAND PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2013



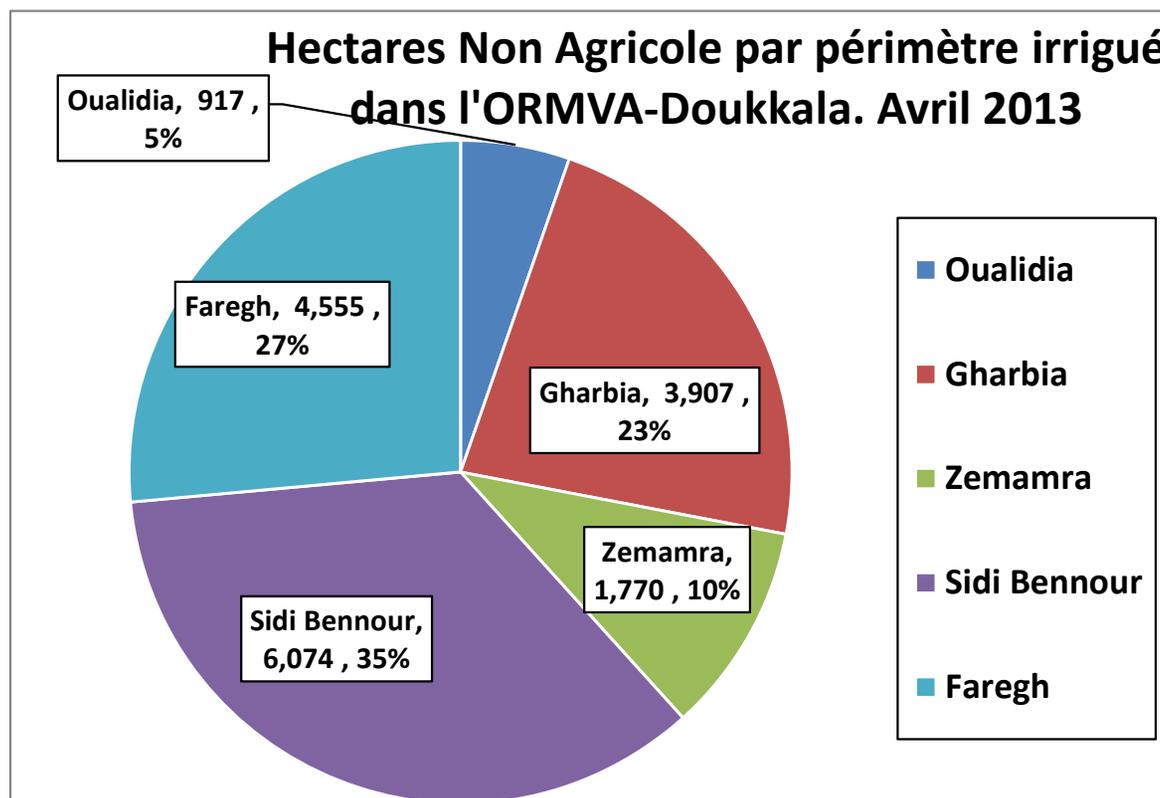
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MAP - LOCATION OF FALLOW LAND IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



TofC

PIE CHART: HECTARES OF NON AGRICULTURAL LAND PER IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2012



TofC

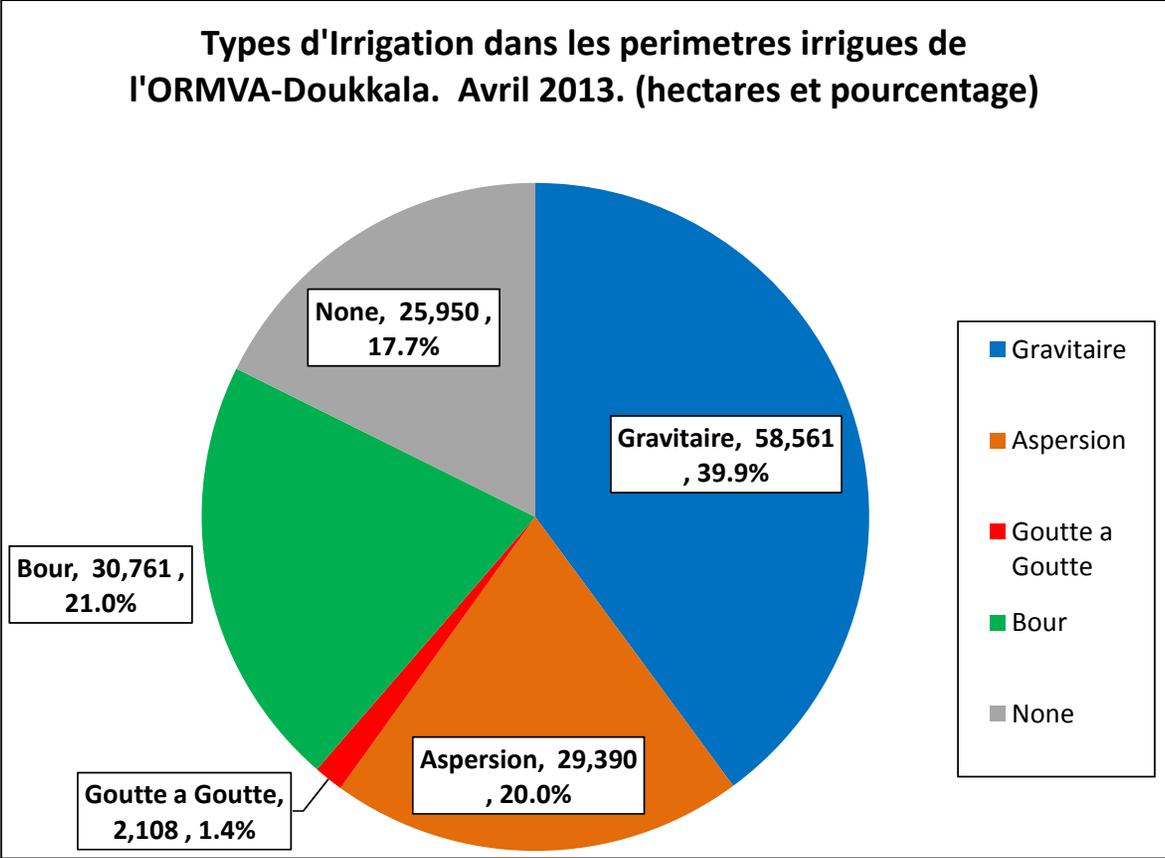
IRRIGATION METHODS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2012 (HECTARES)

Types d'Irrigation dans les périmètres irrigués de l'ORMVA-Doukkala. Avril 2013. (hectares)							
Perimetre	Gravitaire	Aspersion	Goutte a Goutte	Bour	None	Total	Perimeter
Oualidia	968	54	513	589	1,292	3,416	Oualidia
Gharbia	11,207	12,342	-	7,398	6,039	36,986	Gharbia
Zemamra	740	13,188	33	3,065	3,560	20,586	Zemamra
Sidi Bennour	30,124	1,505	609	3,702	8,467	44,407	Sidi Bennour
Faregh	15,521	2,302	953	16,008	6,591	41,374	Faregh
Total	58,561	29,390	2,108	30,761	25,950	146,769	Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.

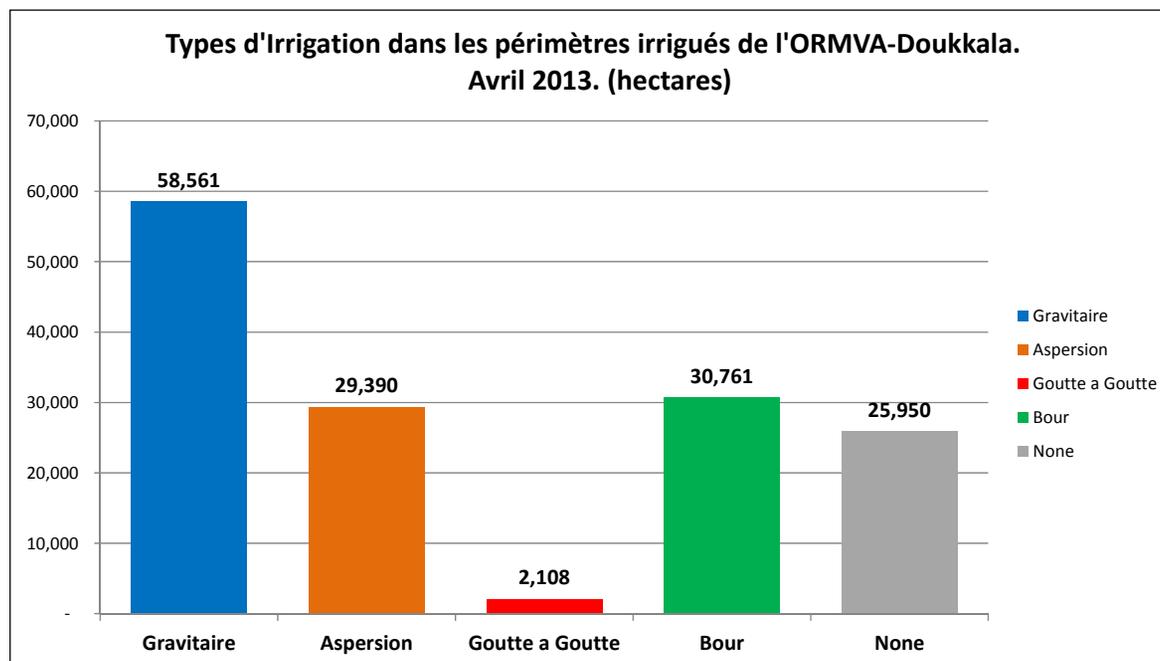
TofC

PIE CHART: IRRIGATION METHODS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013 (HECTARES)



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BAR CHART: IRRIGATION METHODS IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013 (HECTARES)

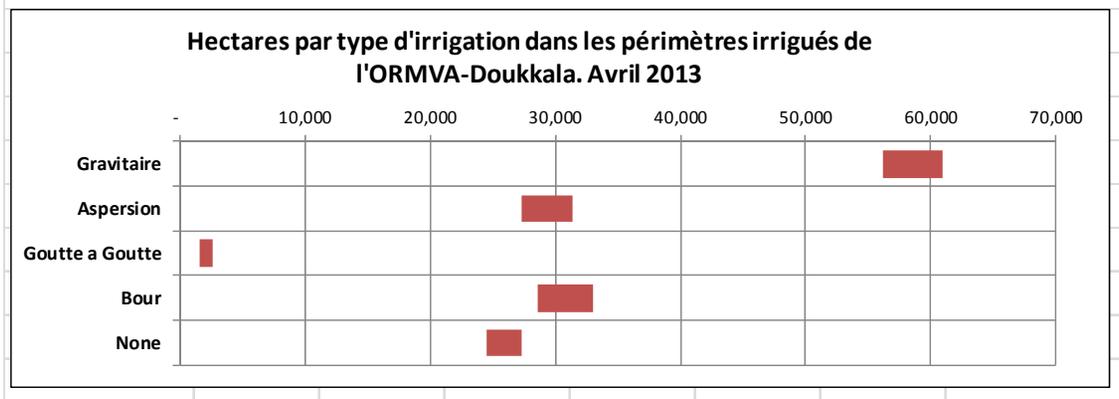


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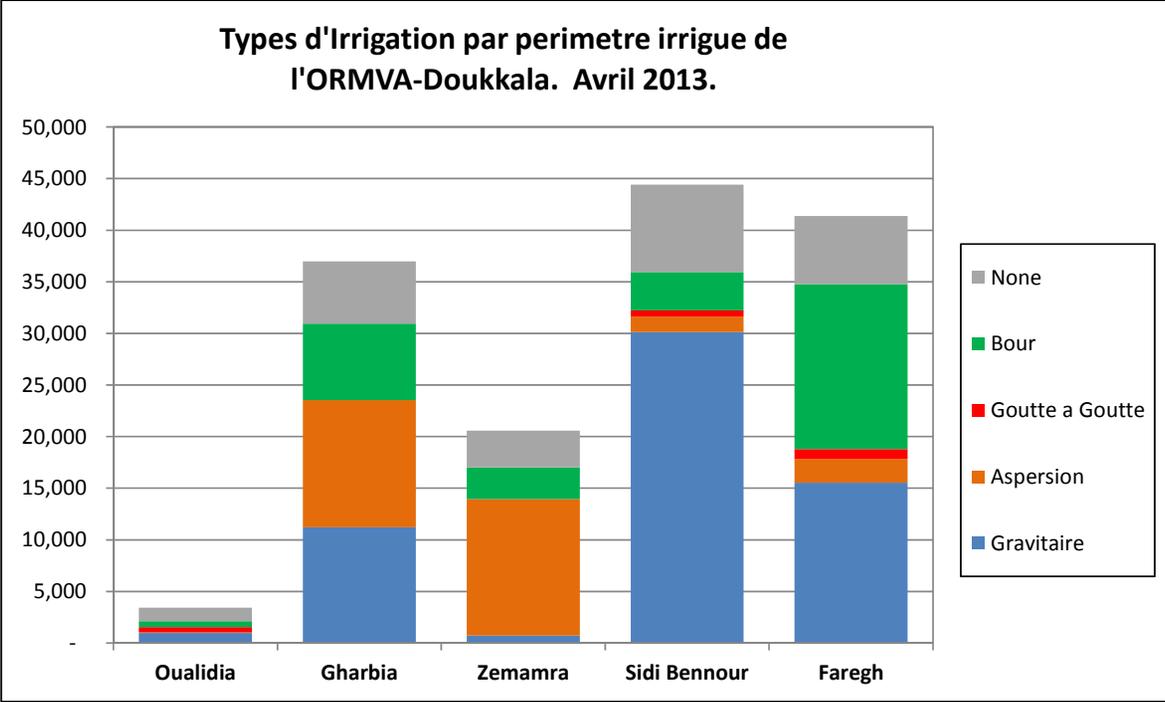
AREAS BY TYPE OF IRRIGATION IN ALL ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013 (HECTARES AND MARGINS OR ERROR)

Hectares par type d'irrigation dans les périmètres irrigués de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	58,561	39.9%	2,399	4.1%	56,162	60,959	Gravity
Aspersion	29,390	20.0%	2,025	6.9%	27,365	31,415	Sprinkler
Goutte a Goutte	2,108	1.4%	549	26.0%	1,559	2,658	Drip
Bour	30,760	21.0%	2,202	7.2%	28,559	32,962	Rain Fed
None	25,950	17.7%	1,409	5.4%	24,541	27,358	None
Total	146,769	100.0%					Total

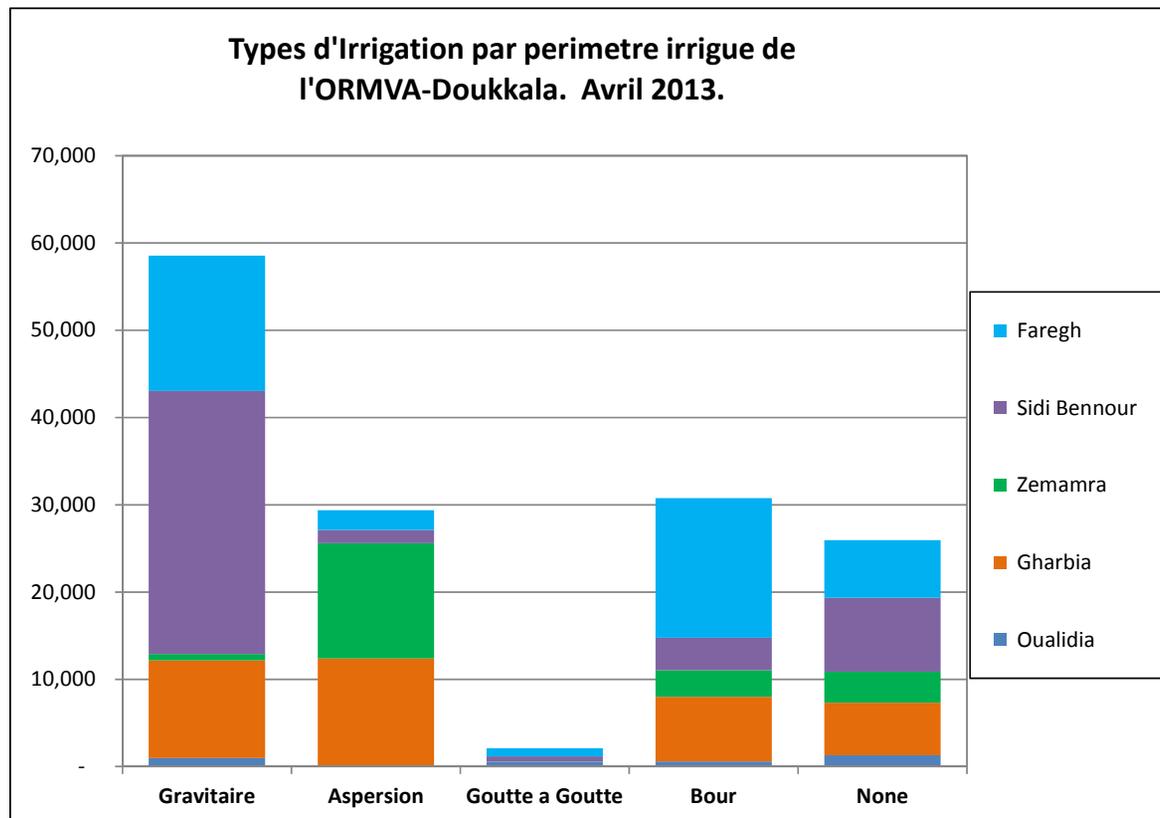
Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.



BAR CHART: IRRIGATION METHODS BY IRRIGATED PERIMETER IN ORMVA-DOUKKALA (HECTARES)



BAR CHART: IRRIGATION METHOD BY IRRIGATED PERIMETER IN ORMVA-DOUKKALA (HECTARES)

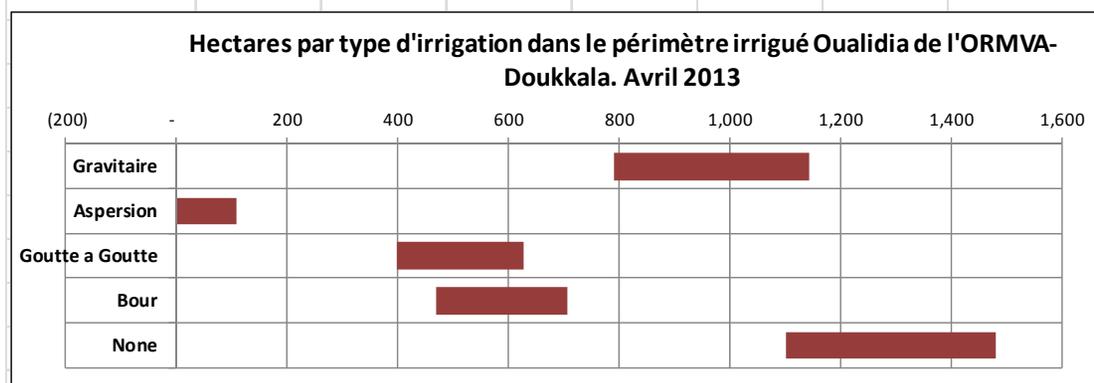


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HECTARES BY TYPE OF IRRIGATION IN OUALIDIA IRRIGATED PERIMETER IN ORMVA-DOUKKALA, APRIL 2012

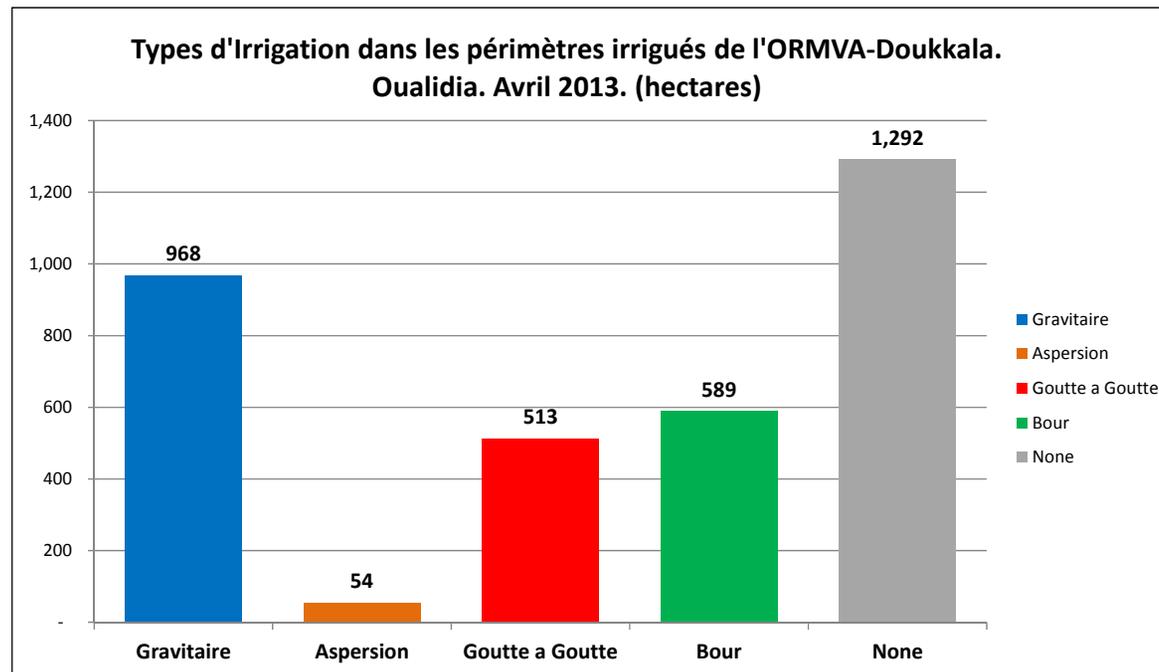
Hectares par type d'irrigation dans le périmètre irrigué Oualidia de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	968	28.3%	176	18.2%	792	1,145	Gravity
Aspersion	54	1.6%	55	102.7%	(1)	109	Sprinkler
Goutte a Goutte	513	15.0%	114	22.2%	400	627	Drip
Bour	589	17.2%	118	20.1%	471	707	Rain Fed
None	1,292	37.8%	190	14.7%	1,102	1,482	None
Total	3,416	100.0%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.



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BAR CHART: TYPES OF IRRIGATION IN OUALIDIA IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

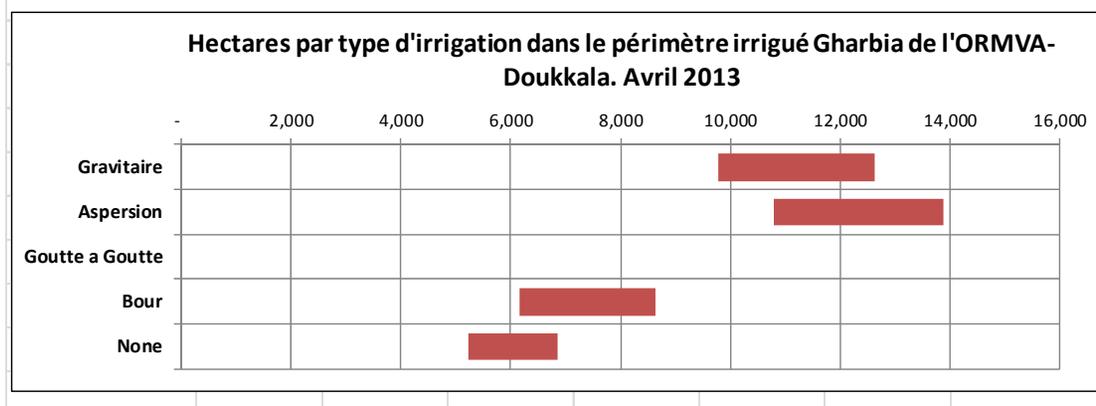


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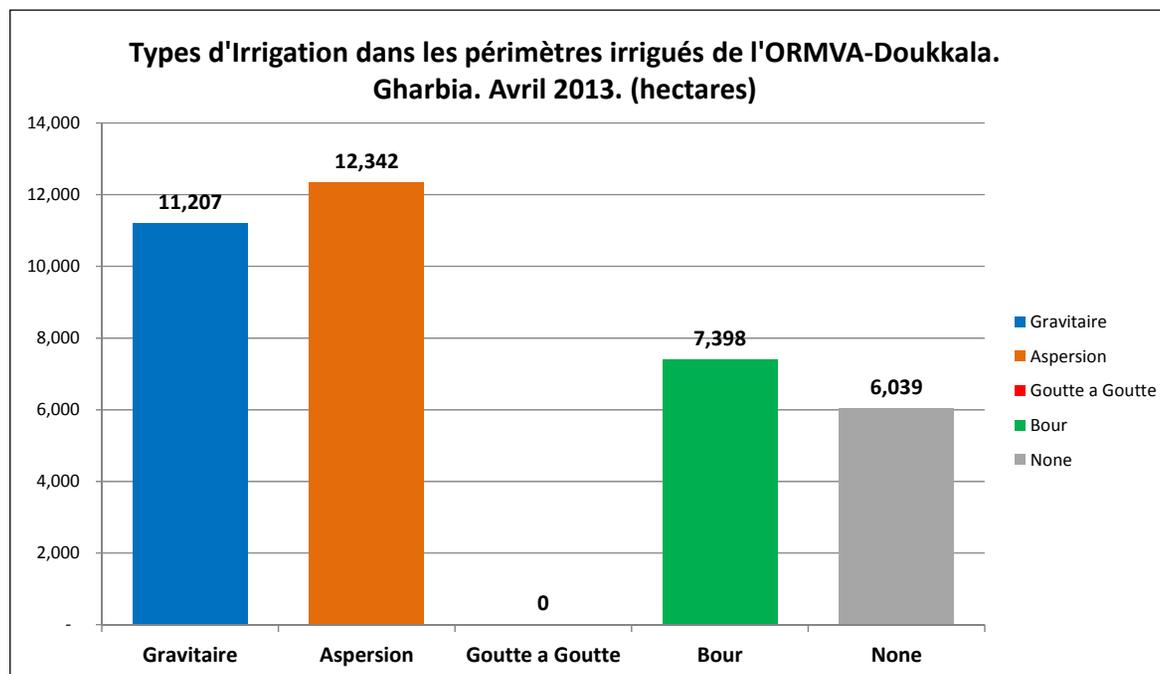
HECTARES BY TYPE OF IRRIGATION IN GHARBIA IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

Hectares par type d'irrigation dans le périmètre irrigué Gharbia de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	11,207	30.3%	1,419	12.7%	9,788	12,626	Gravity
Aspersion	12,341	33.4%	1,540	12.5%	10,801	13,882	Sprinkler
Goutte a Goutte	-	0.0%	-	0.0%	-	-	Drip
Bour	7,398	20.0%	1,227	16.6%	6,170	8,625	Rain Fed
None	6,039	16.3%	813	13.5%	5,227	6,852	None
Total	36,985	100.0%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.



BAR CHART: TYPES OF IRRIGATION IN GHARBIA IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

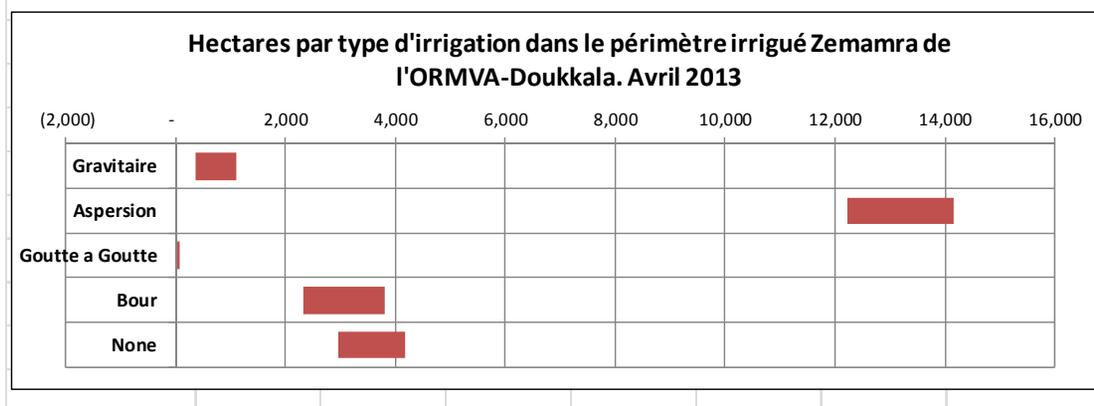


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HECTARES BY TYPE OF IRRIGATION IN ZEMAMRA IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

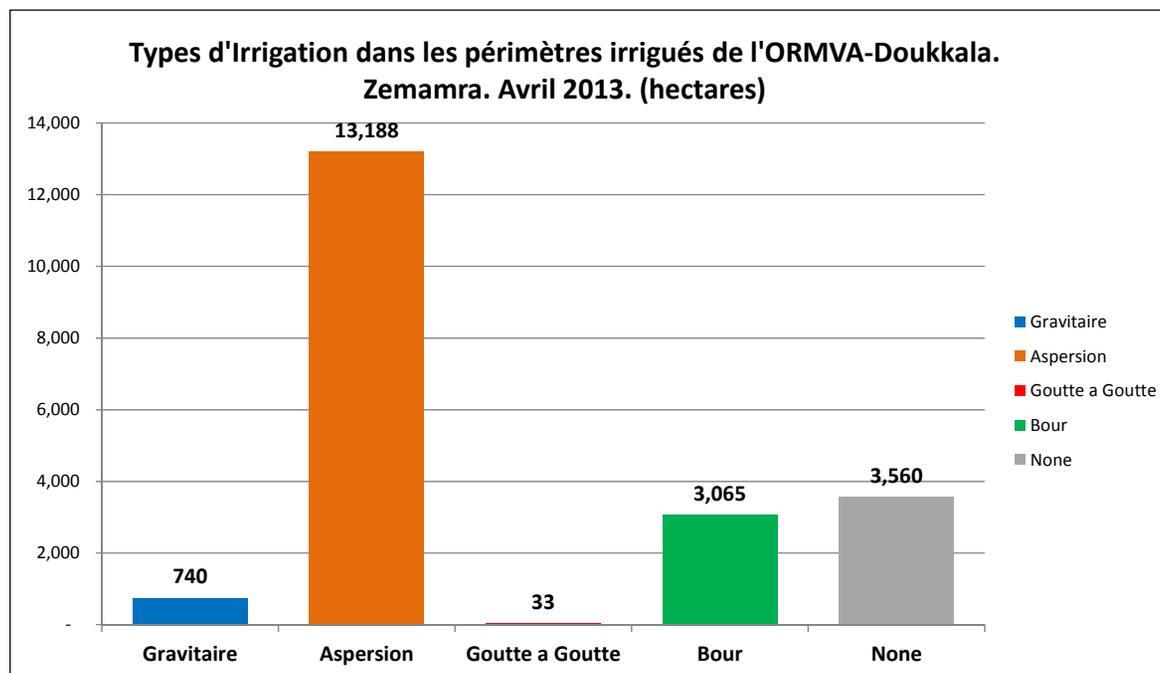
Hectares par type d'irrigation dans le périmètre irrigué Zemamra de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	740	3.6%	371	50.1%	369	1,111	Gravity
Aspersion	13,188	64.1%	967	7.3%	12,221	14,156	Sprinkler
Goutte a Goutte	33	0.2%	34	100.7%	(0)	67	Drip
Bour	3,065	14.9%	735	24.0%	2,330	3,800	Rain Fed
None	3,561	17.3%	607	17.0%	2,954	4,167	None
Total	20,587	100.0%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.



TofC

BAR CHART: HECTARES BY TYPE OF IRRIGATION IN ZEMAMRA IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

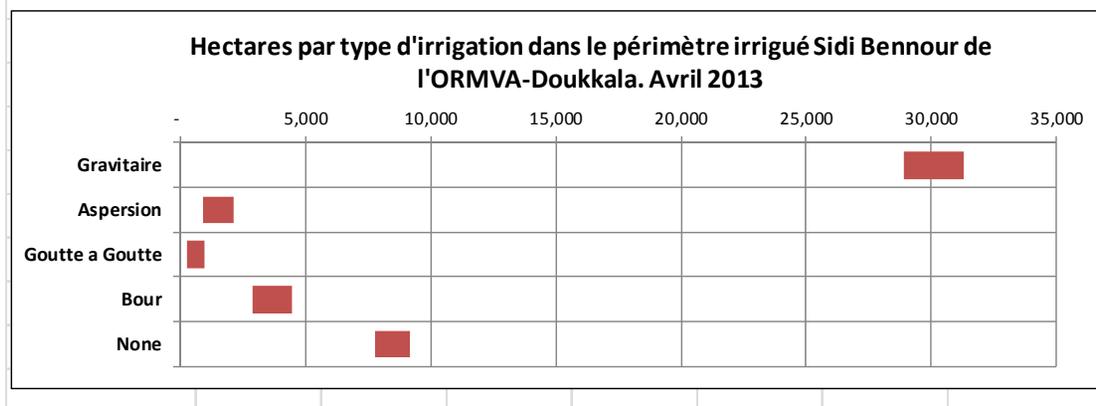


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HECTARES BY TYPE OF IRRIGATION IN SIDI BENNOUR IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

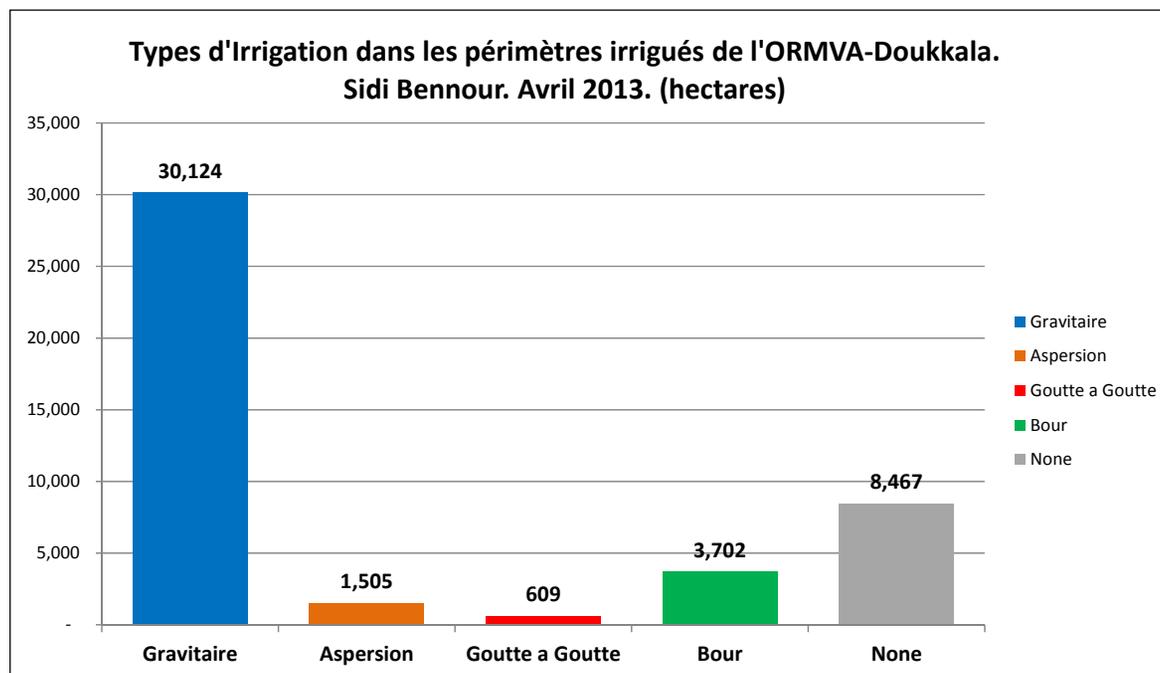
Hectares par type d'irrigation dans le périmètre irrigué Sidi Bennour de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	30,125	67.8%	1,193	4.0%	28,932	31,318	Gravity
Aspersion	1,505	3.4%	610	40.5%	895	2,115	Sprinkler
Goutte a Goutte	609	1.4%	365	59.9%	244	974	Drip
Bour	3,702	8.3%	785	21.2%	2,917	4,487	Rain Fed
None	8,467	19.1%	711	8.4%	7,756	9,179	None
Total	44,408	100.0%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala 2013.



TofC

BAR CHART: HECTARES BY TYPE OF IRRIGATION IN SIDI BENNOUR IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

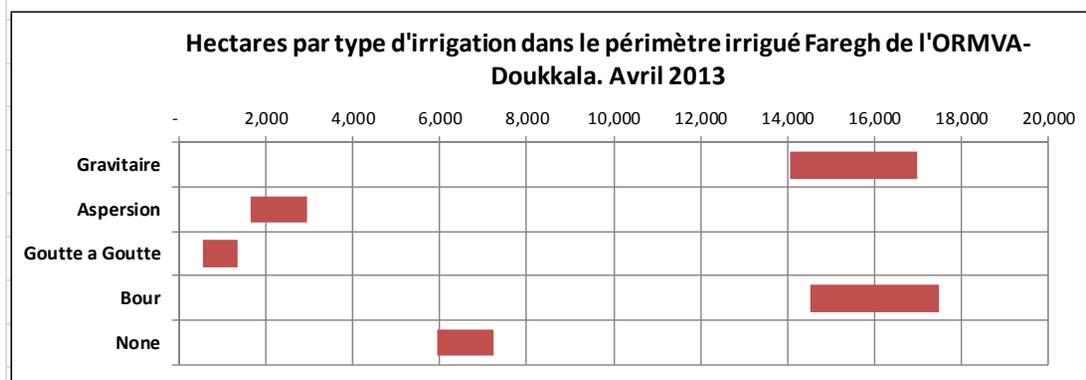


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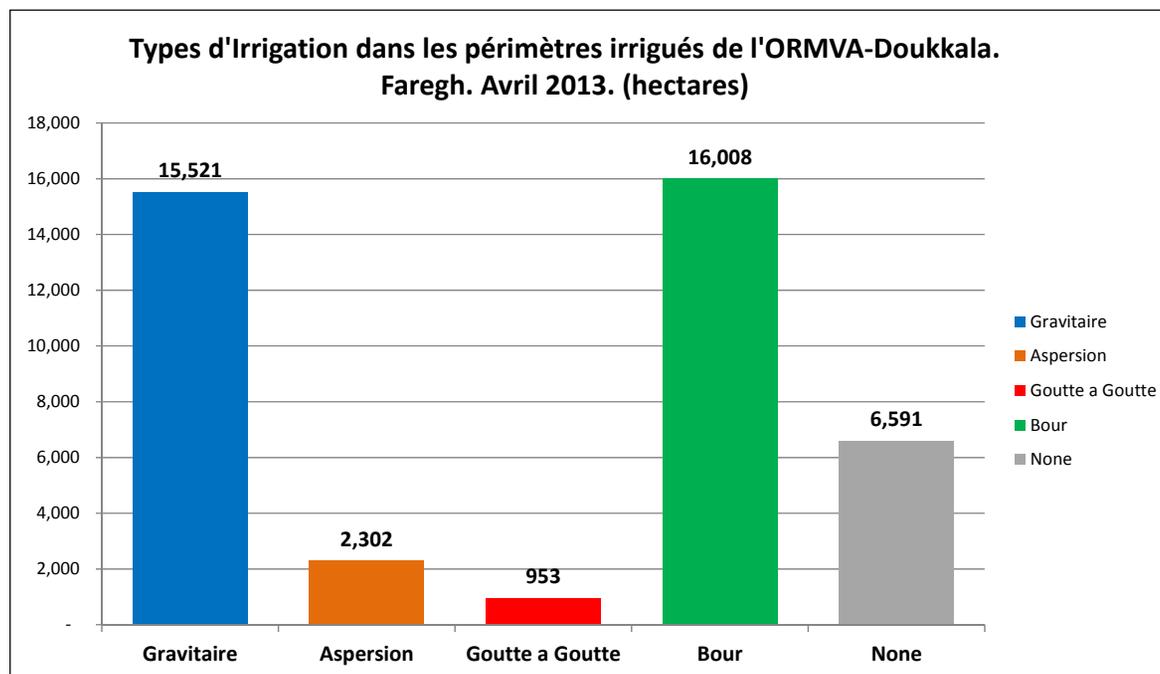
HECTARES BY TYPE OF IRRIGATION IN FAREGH IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

Hectares par type d'irrigation dans le périmètre irrigué Faregh de l'ORMVA-Doukkala. Avril 2013							
Type d'irrigation	Hectares	Percent	Std Error	Cof Var	Bas / Low	Haut / High	Type of irrigation
Gravitaire	15,521	37.5%	1,466	9.4%	14,055	16,987	Gravity
Aspersion	2,302	5.6%	644	28.0%	1,657	2,946	Sprinkler
Goutte a Goutte	953	2.3%	393	41.2%	560	1,346	Drip
Bour	16,007	38.7%	1,473	9.2%	14,534	17,480	Rain Fed
None	6,591	15.9%	643	9.8%	5,948	7,234	None
Total	41,373	100.0%					Total

Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficiés des Cultures, Doukkala 2013.

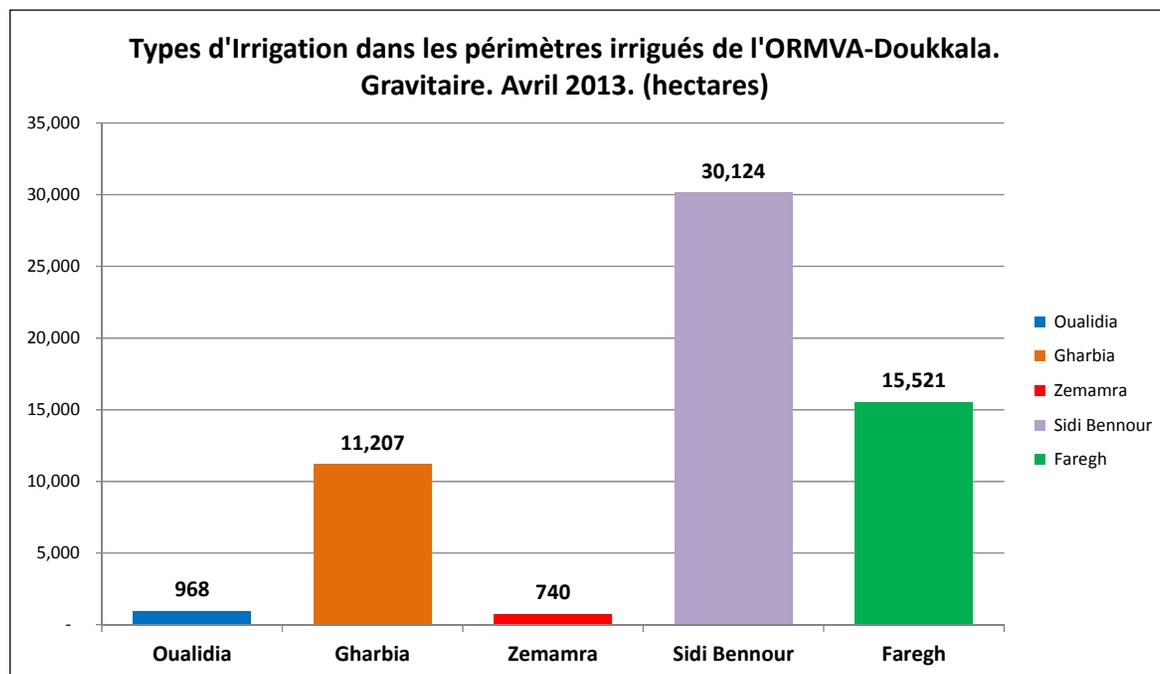


BAR CHART: HECTARES BY TYPE OF IRRIGATION IN FAREGH IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013



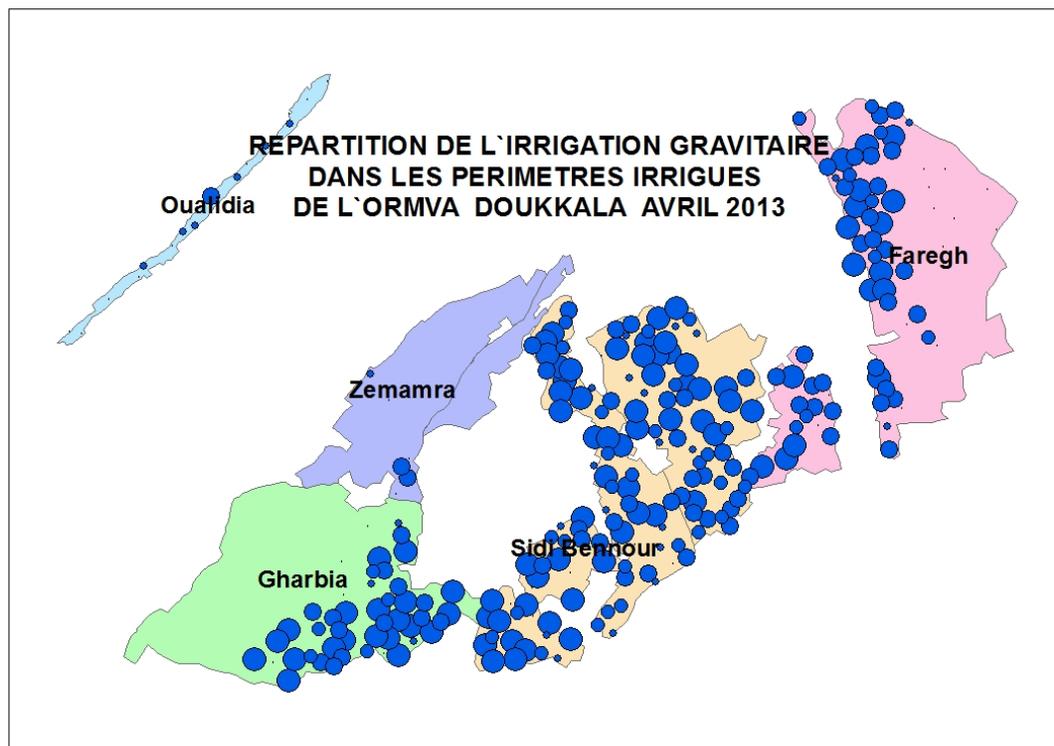
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BAR CHART: HECTARES IN GRAVITY IRRIGATION BY IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013



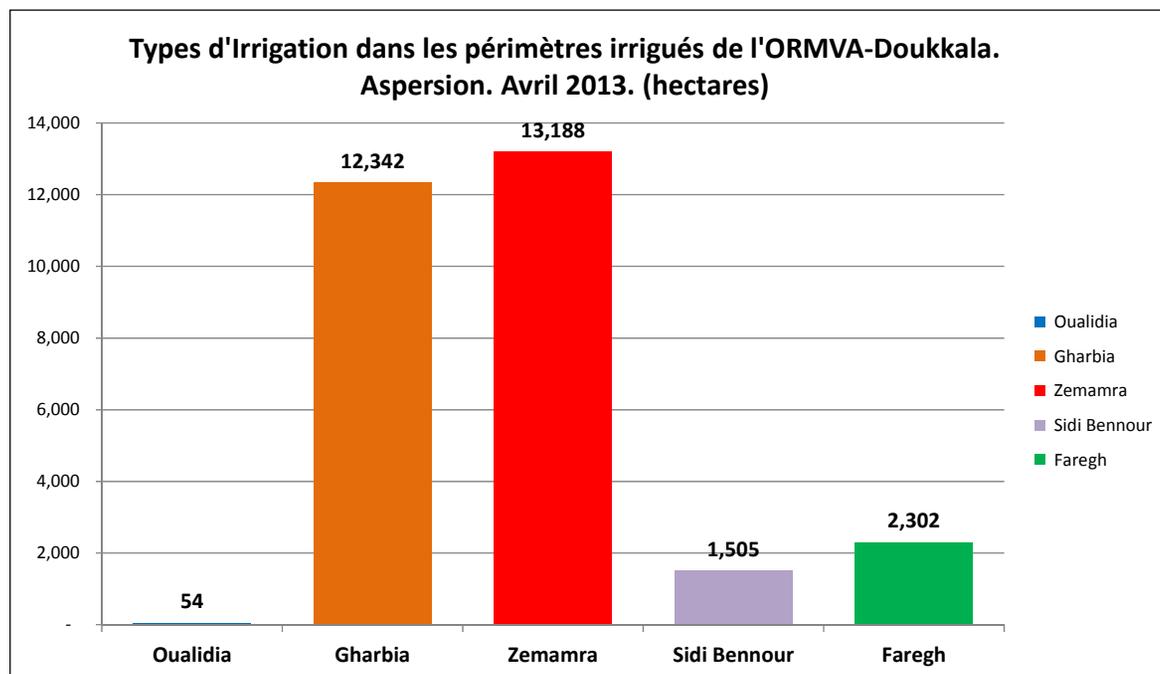
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**MAP - LOCATION OF GRAVITY IRRIGATION IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS,
APRIL 2013**

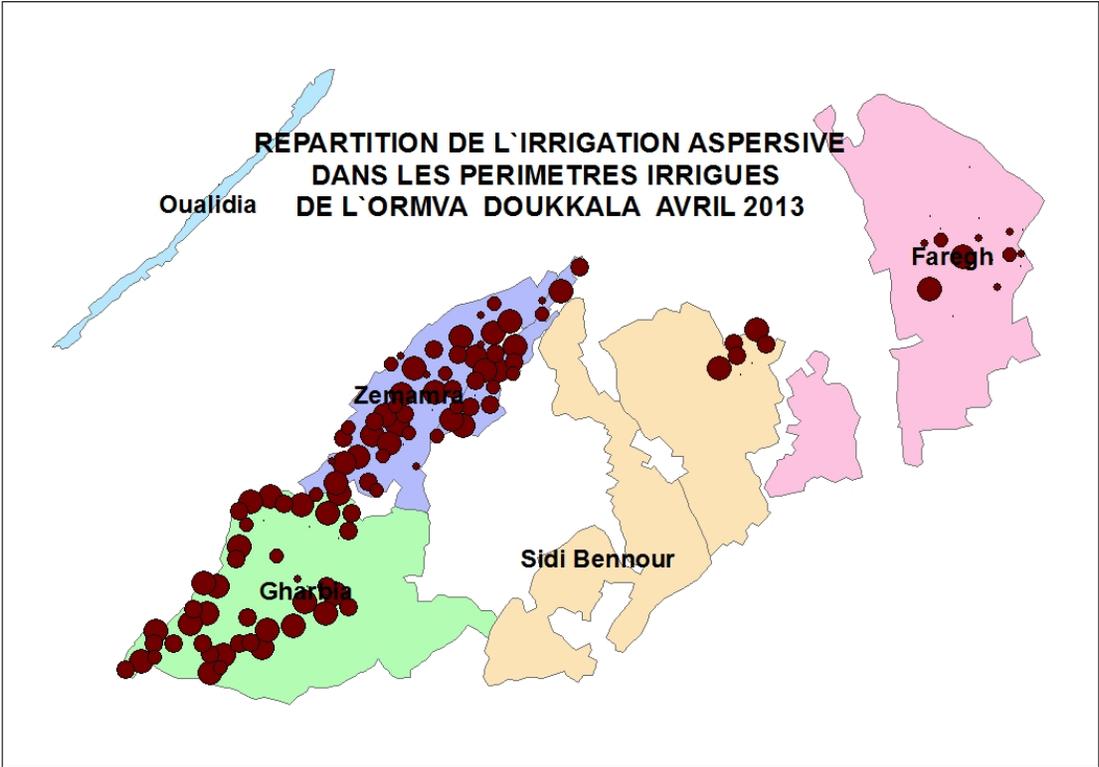


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BAR CHART: HECTARES IN SPRINKLER IRRIGATION BY IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013

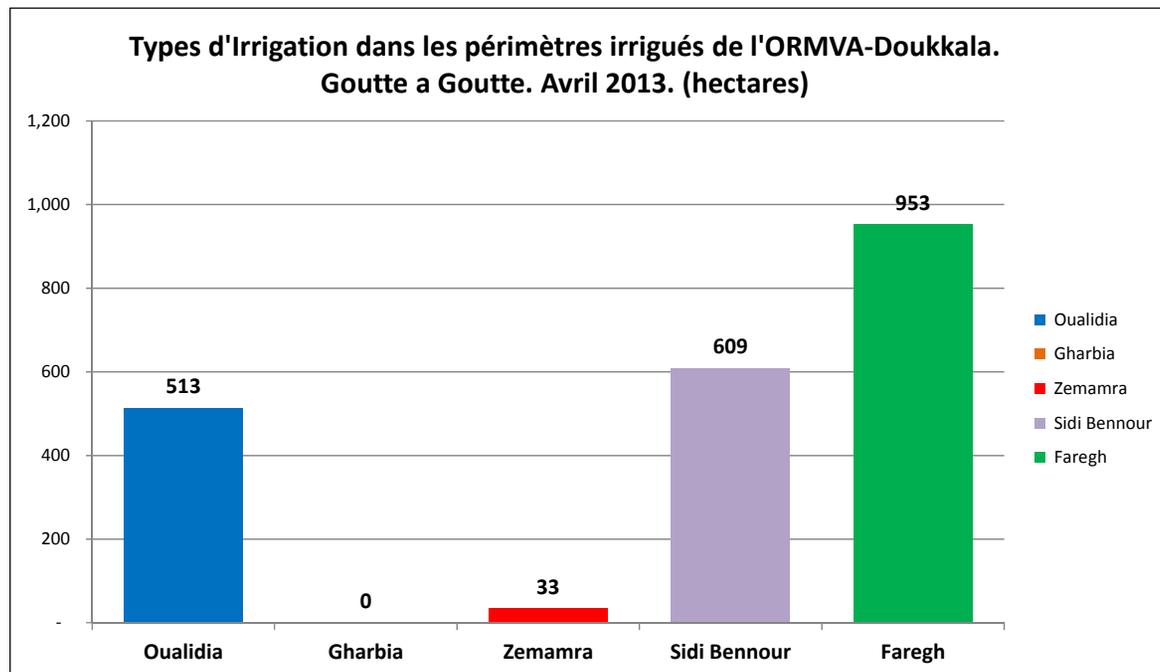


MAP - LOCATION OF SPRINKLER IRRIGATION IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



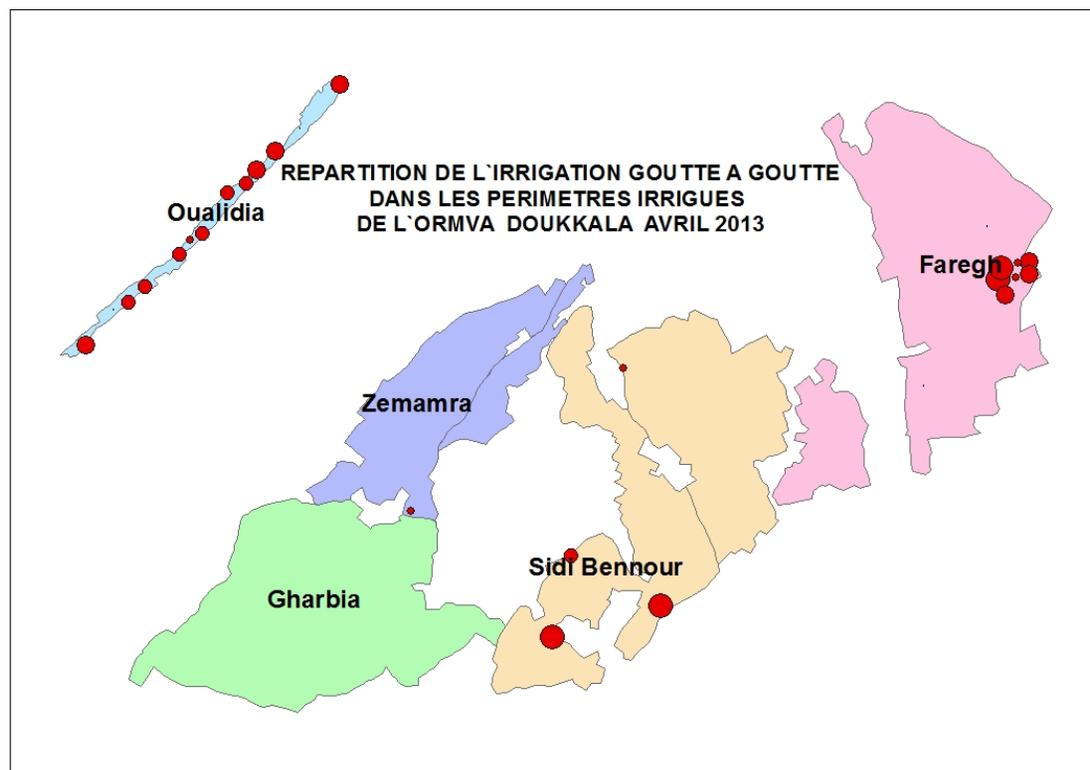
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BAR CHART: HECTARES IN DRIP IRRIGATION BY IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013



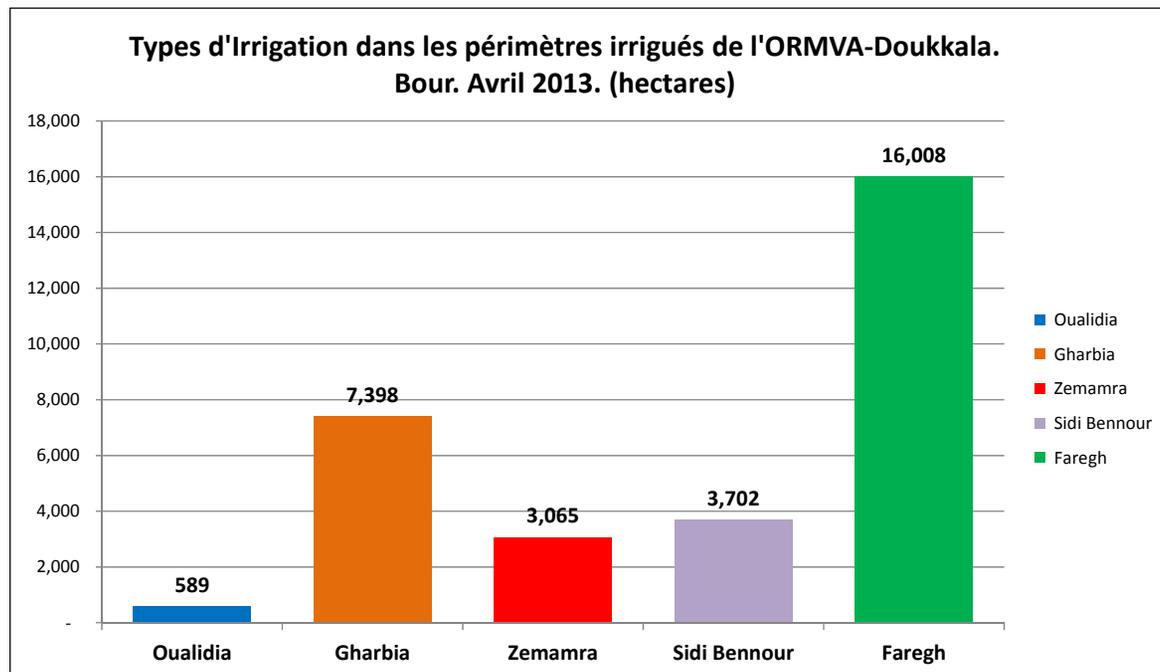
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MAP - LOCATION OF DRIP IRRIGATION IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



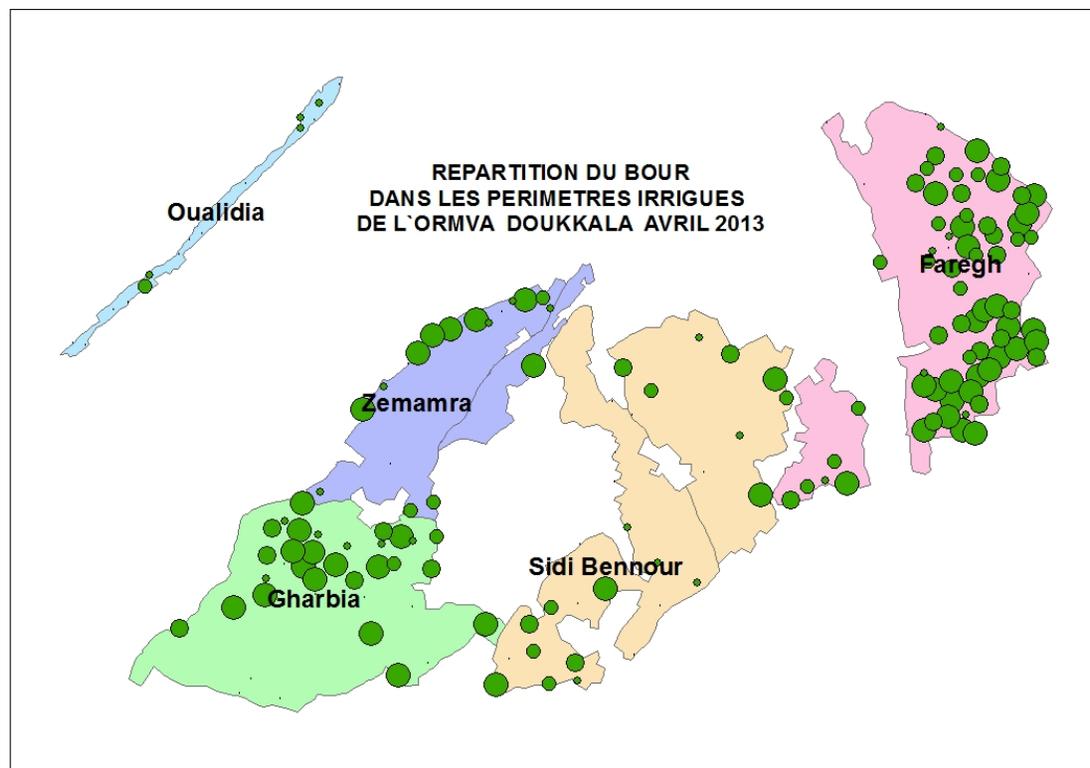
[TofC](#)

BAR CHART: HECTARES IN RAIN FED CULTIVATION BY IRRIGATED PERIMETER, ORMVA-DOUKKALA, APRIL 2013



TofC

MAP - LOCATION OF RAIN FED CULTIVATION (BOUR) IN ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013



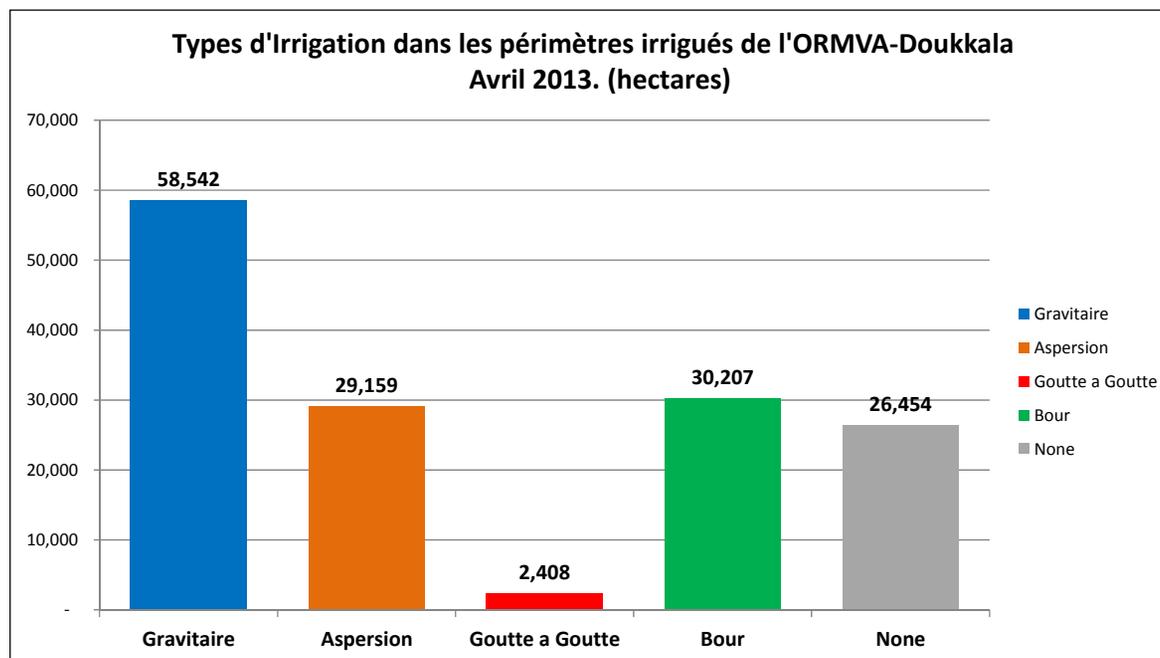
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HECTARES OF CROPS BY IRRIGATION TYPE IN ALL ORMVA-DOUKKALA'S IRRIGATED PERIMETERS, APRIL 2013

Types d'Irrigation dans les perimetres irrigues de l'ORMVA-Doukkala. April 2013. (hectares)							
Cultures	Gravitaire	Aspersion	Goutte a Goutte	Bour	None	Grand Total	Land Use
Ble	22,555	12,633	436	12,547	14	48,185	Wheat
Orge	1,916	582	-	8,647	-	11,145	Barley
Betterave	6,572	5,027	314	-	-	11,912	Sugar Beets
Fourrages	19,028	6,293	48	767	-	26,136	Forage crops
Maraichage	1,629	564	813	617	-	3,623	Vegetables
Mais	2,608	2,481	281	2,232	-	7,603	Maize
Fruits divers	343	26	341	1,410	72	2,192	Other fruits
Legumineuses	3,611	1,553	175	3,877	-	9,216	Legume crops
Jachere	-	-	-	-	9,186	9,186	Fallow
Non agricole	281	-	-	110	17,182	17,573	Non-Agric.
Grand Total	58,542	29,159	2,408	30,207	26,454	146,769	Totals
Source: ORMVA-Doukkala et USAID/MEC. Enquete de Superficies des Cultures, Doukkala, 2013.							

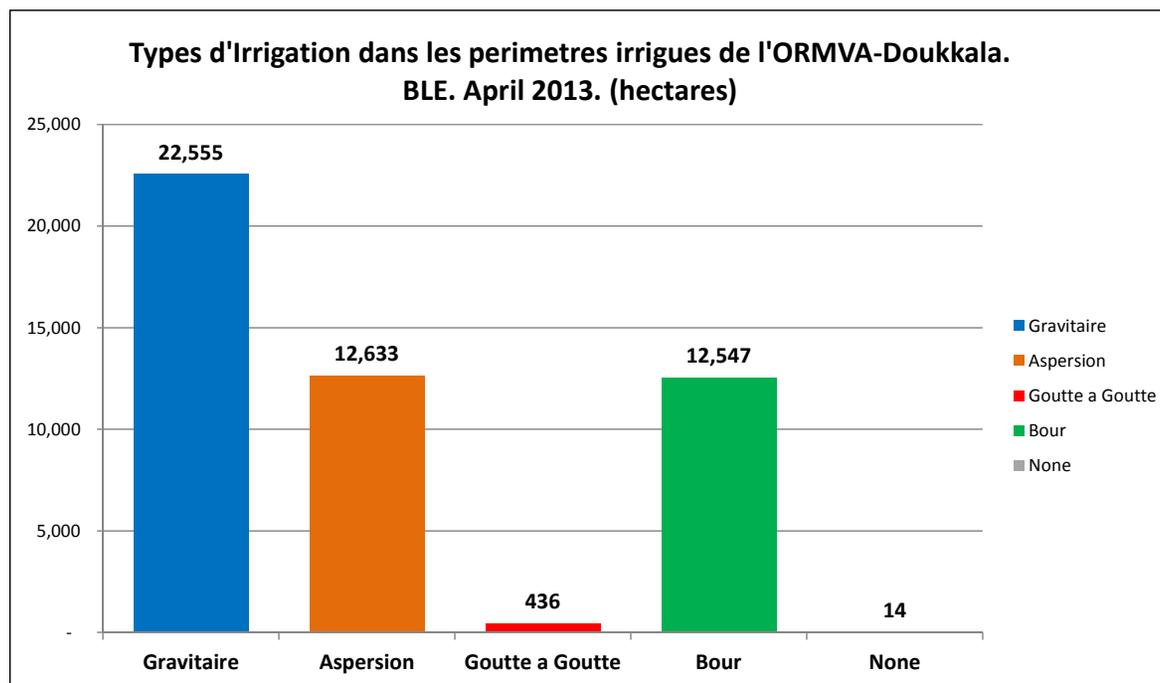
[TofC](#)

BAR CHART: HECTARES BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



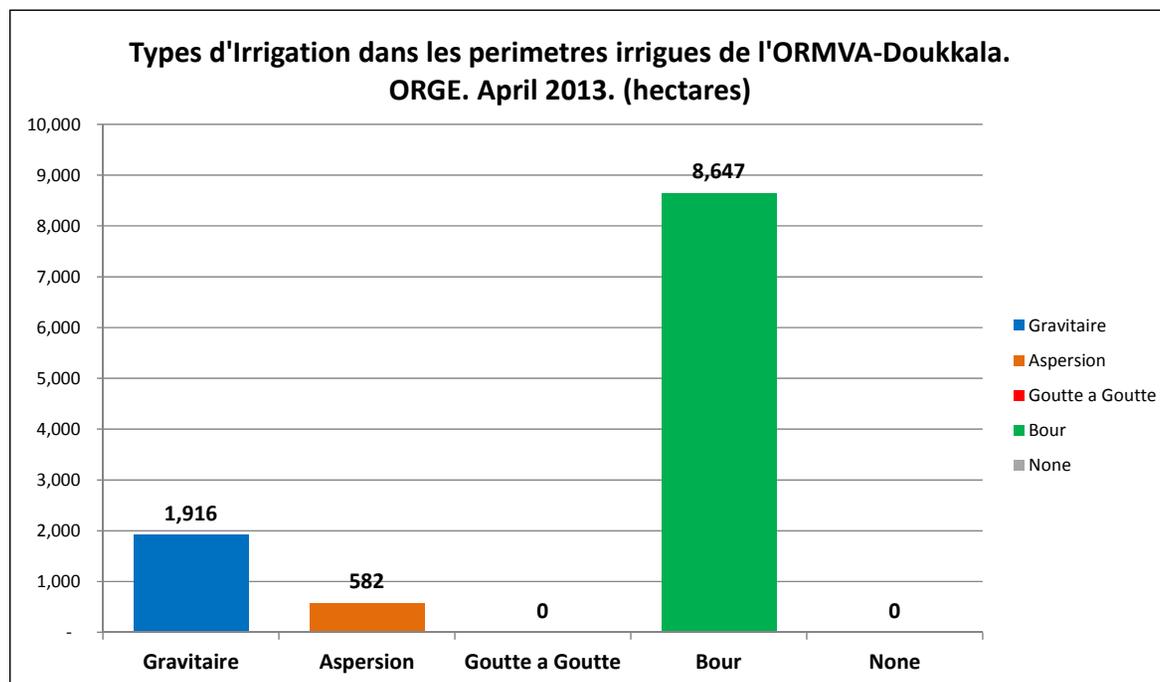
ToC

BAR CHART: HECTARES OF WHEAT BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



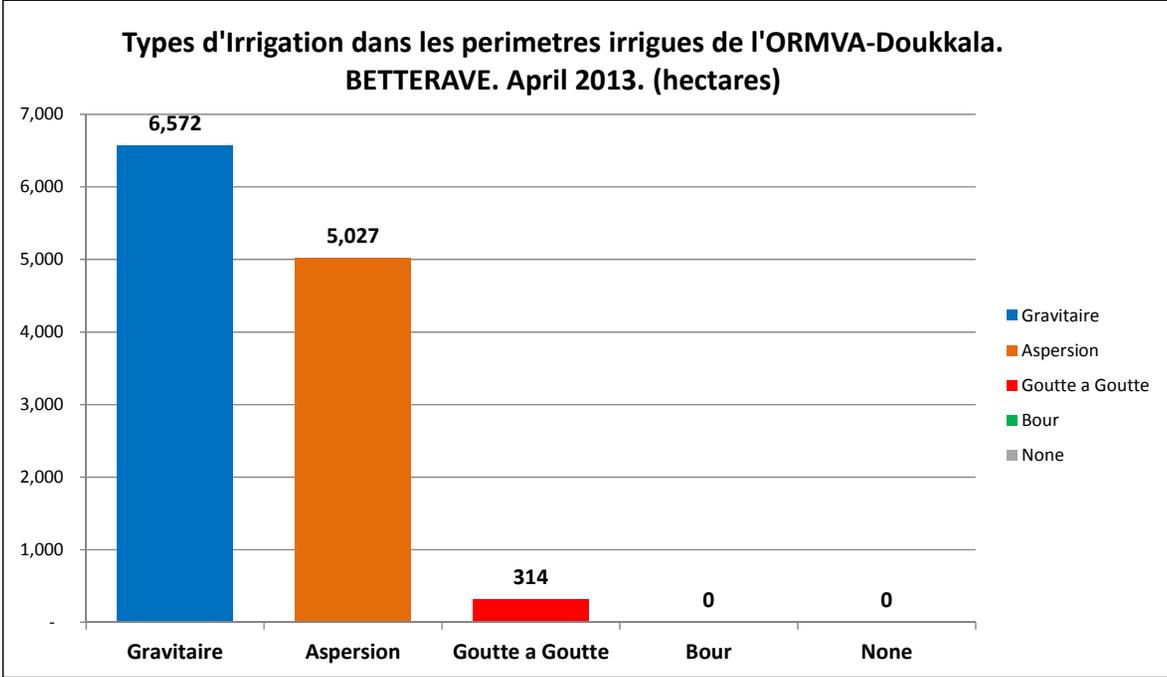
TofC

BAR CHART: HECTARES OF BARLEY BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



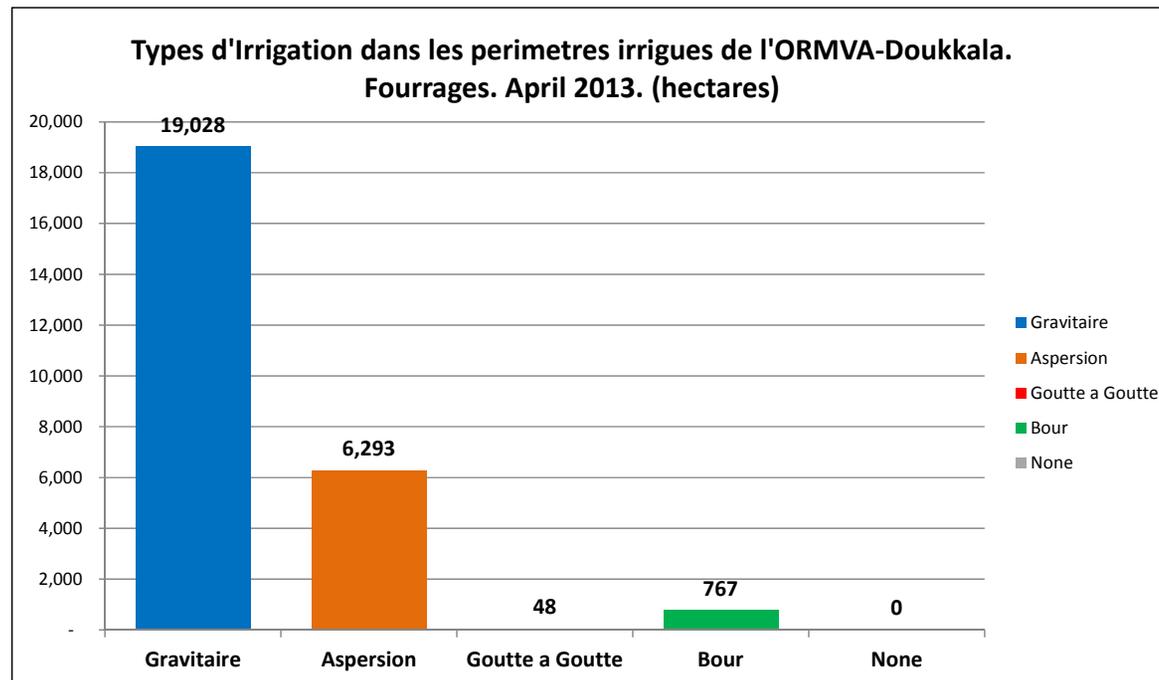
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BAR CHART: HECTARES OF SUGAR BEETS BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



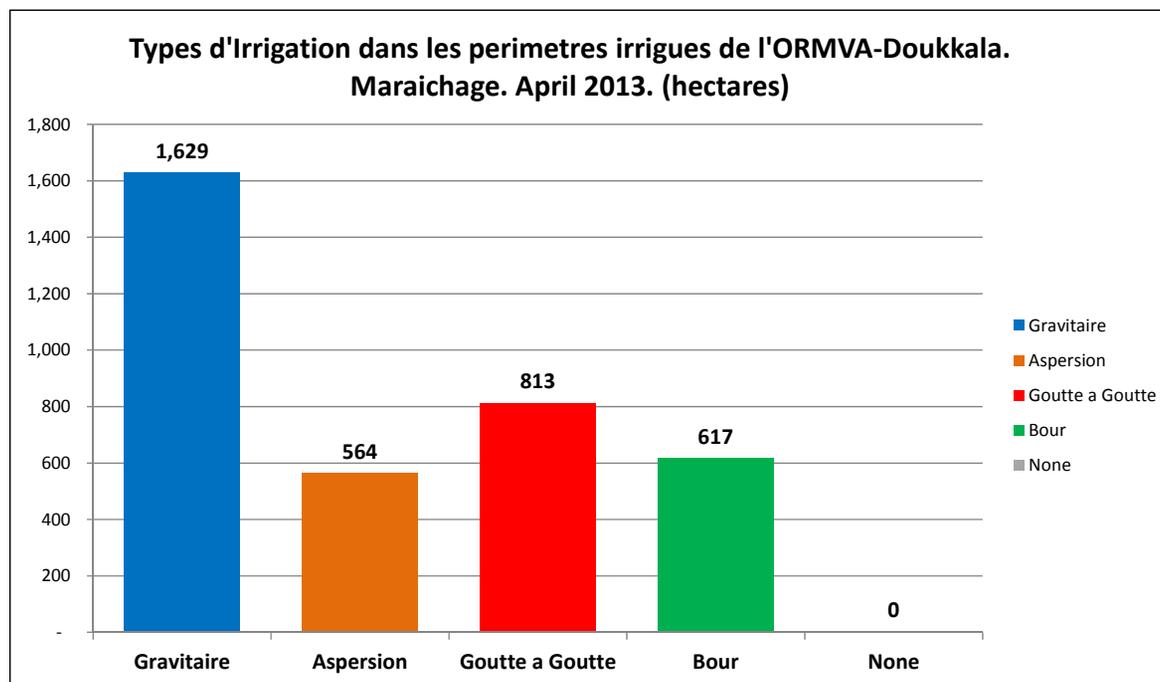
TofC

BAR CHART: HECTARES OF FORAGE CROPS BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



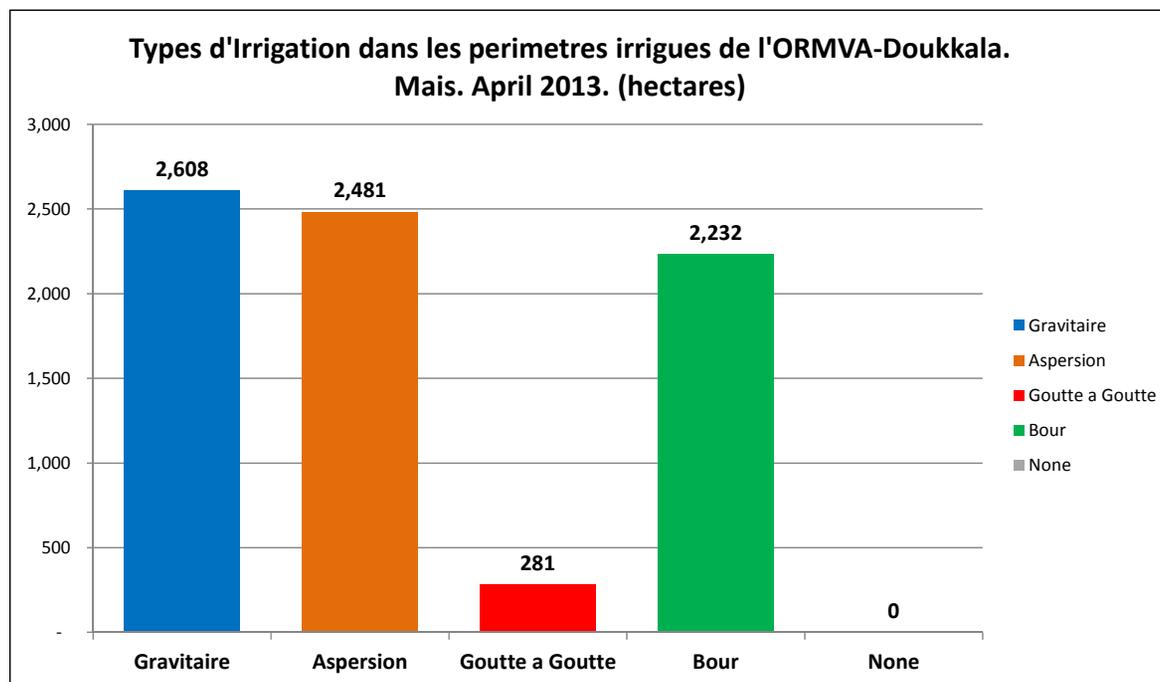
[TofC](#)

BAR CHART: HECTARES OF MARKET VEGETABLES BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



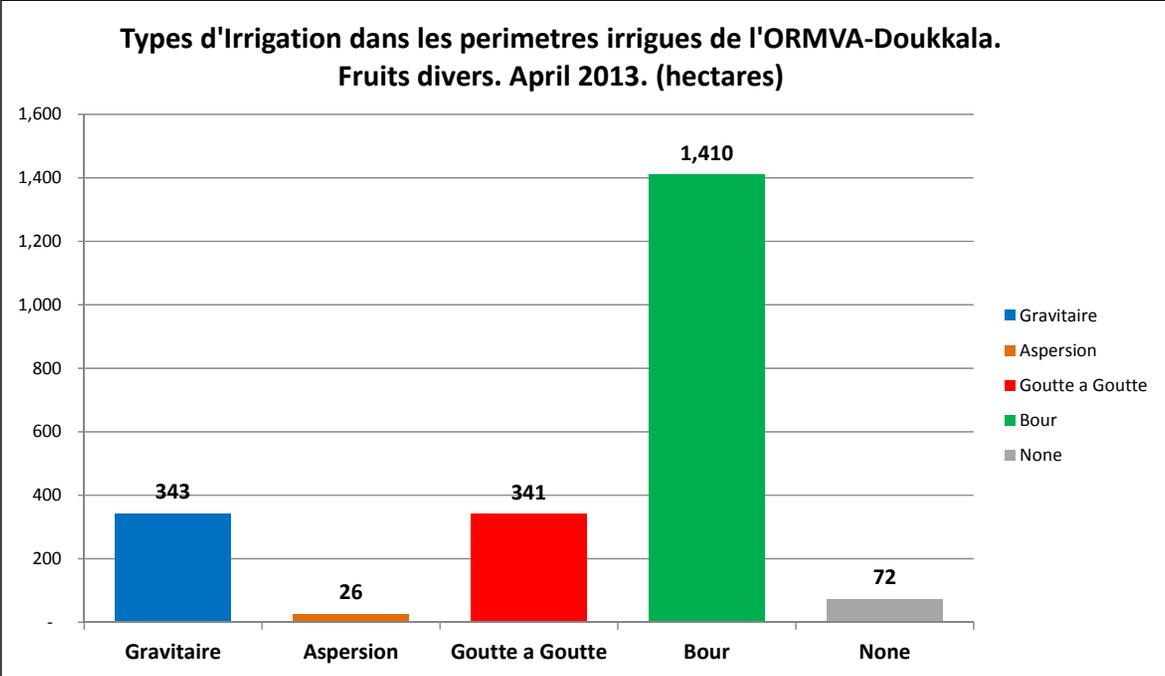
TofC

BAR CHART: HECTARES OF MAIZE BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



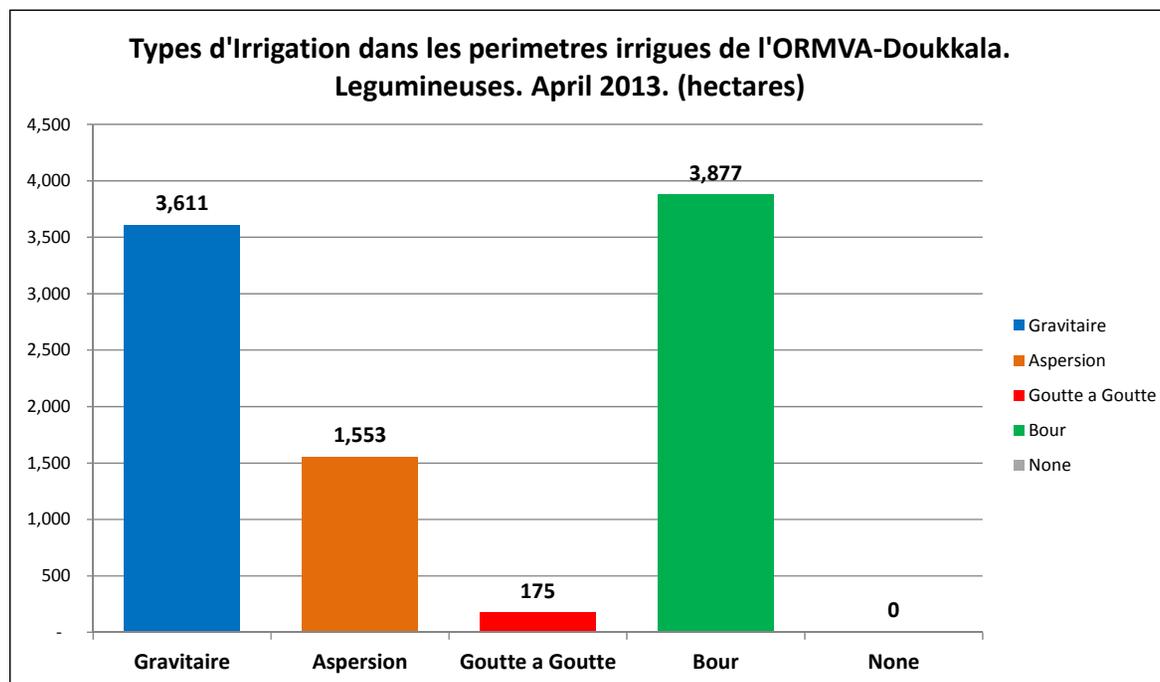
TofC

BAR CHART: HECTARES OF ASSORTED FRUITS BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



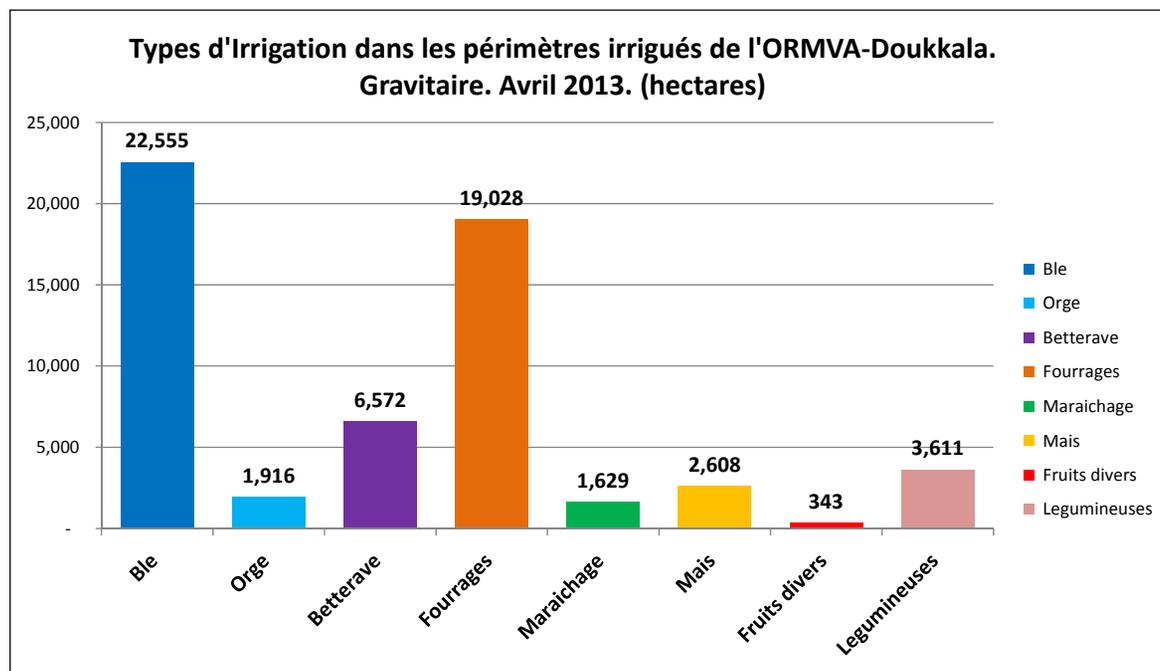
TofC

BAR CHART: HECTARES OF LEGUME CROPS BY TYPE OF IRRIGATION IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA. APRIL 2013



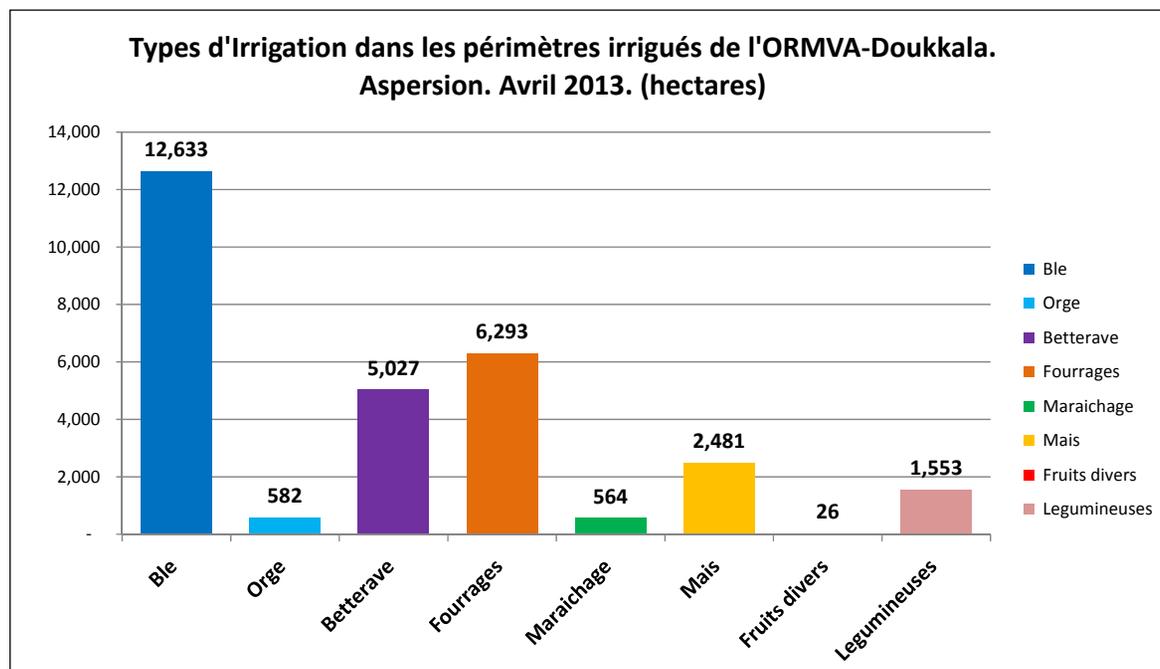
TofC

BAR CHART: HECTARES OF GRAVITY IRRIGATION BY TYPE OF CROP IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



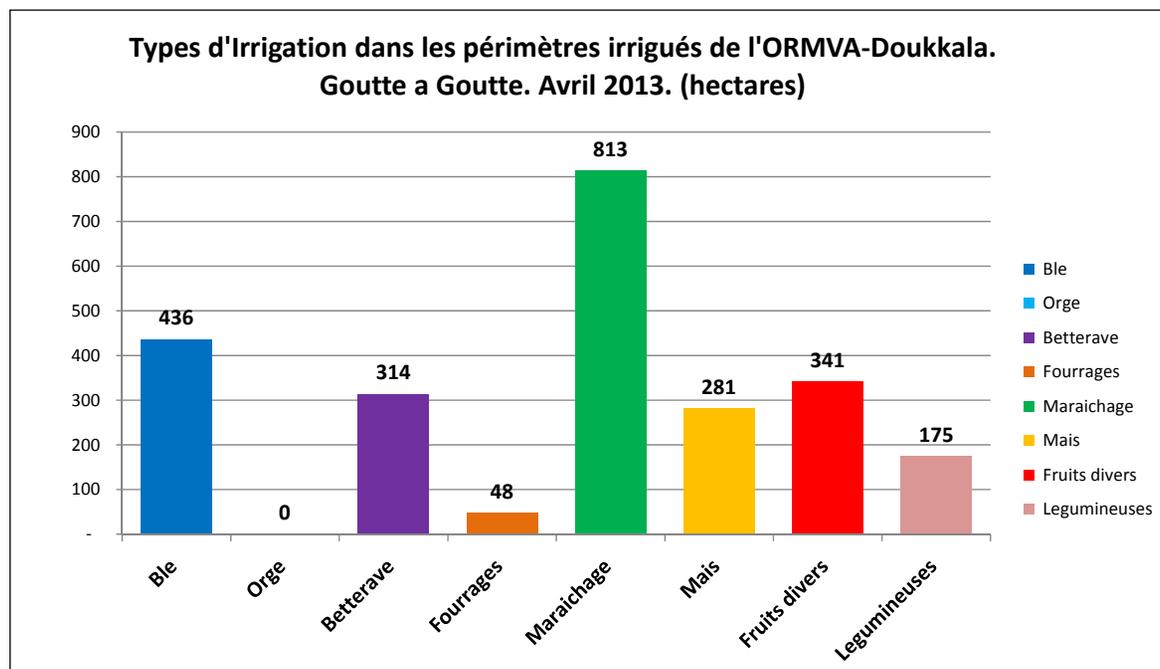
TofC

BAR CHART: HECTARES OF SPRINKLER IRRIGATION BY TYPE OF CROP IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



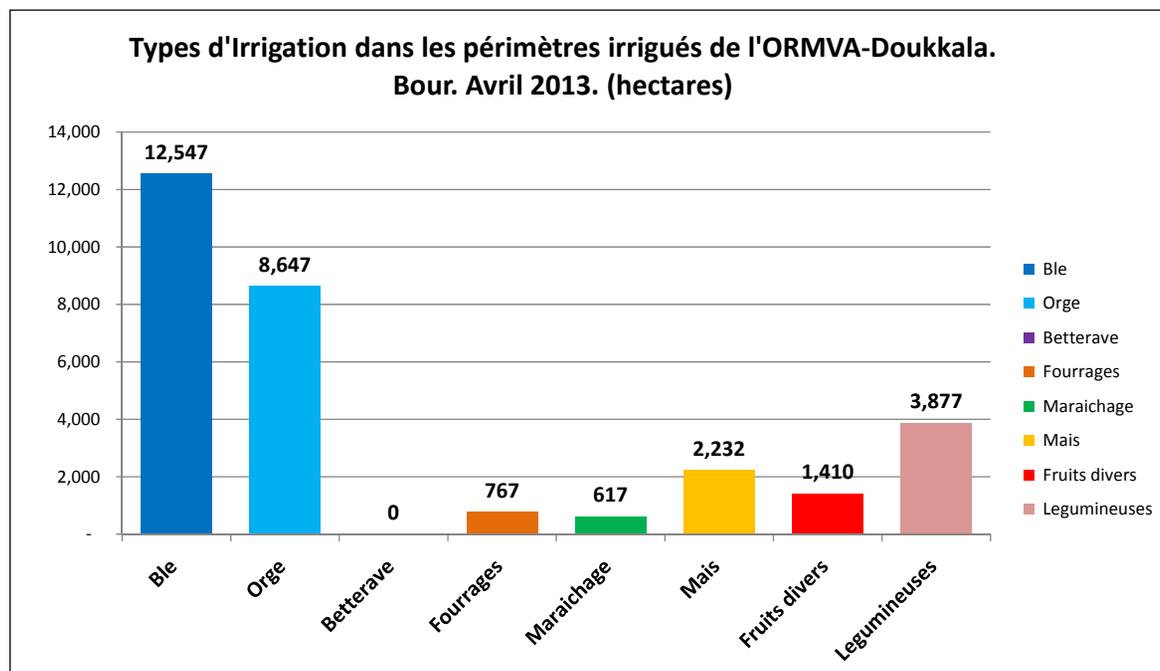
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BAR CHART: HECTARES OF DRIP IRRIGATION BY TYPE OF CROP IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



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BAR CHART: HECTARES OF RAIN FED CULTIVATION BY TYPE OF CROP IN ALL IRRIGATED PERIMETERS, ORMVA-DOUKKALA, APRIL 2013



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APPENDIX A – CROP AREA SURVEY METHODOLOGY

The 2013 Crop Area Surveys were carried out using the Area Frame Spot Sampling procedures that DAI has developed over the past few years and piloted successfully in other projects. It is a mature methodology to generate reliable agricultural statistics in a few weeks using local trained enumerators to do the field survey and a couple of agronomists with some statistics training to do the analysis.

The Crop Area Survey in the spring of 2013 selected 505 sample points in Doukkala and of 508 points in the Doukkala irrigated perimeters. There are approximately 100,000 irrigated hectares in Doukkala and 60,000 in Doukkala. The total area encompassed in the survey is much larger because it also includes villages, housing, roads, canals, and rain-fed zones within and around the irrigated areas. Thus, the 505 sample points were scattered over a total area of 146,000 hectares, while the 508 points in Doukkala were distributed over an area of 79,000 hectares. A more rigorous delimitation of irrigated perimeters in the future will improve the sampling efficiency and result in more precise crop area estimates. Each sample comprises a circular area 100 meters radius, or 3.14 hectares; the total area sampled thus represents about 1.0 percent of the global survey area in Doukkala and 1.5 percent in Oriental.

Sample points are selected using a freely available add-on sampling tool (Hawthorne's Tools) with a standard version of Esri's GIS ArcMap 10. In addition to the number of random points to be selected, one can specify the minimum distance between sample points in order to prevent excessive clustering and to ensure that the entire area is covered more or less uniformly. Longitude and latitude coordinates are provided for each sample point. These geographic coordinates are entered in the memory of handheld GPS units to help in the field work. Maps and Google Earth satellite images of the sample area are provided to facilitate locating sample points.

One-third of the points in both regions are the retained from the 2011 Crop Area Survey, another one-third are from the 2012 Survey and the other third are new points. This feature was incorporated at the suggestion of USDA's National Agricultural Statistics Service (NASS)¹ statisticians based on discussion of the results of the 2011 survey. This new feature allows distinguishing between observed changes due to farmers decisions from changes due to different random points selected in the sample, and in general dampens observed variations between one year and the next.

April is the preferred month to carry out the crop survey because all the winter crops such as wheat, barley, and sugar beets are present and ripening before harvest in May and June. It is also easier to distinguish between wheat and barley at the mature stage. At the same time, most spring and summer crops like potatoes, tomatoes, maize, and melons have already been planted.

Nonetheless, some summer crops have not yet been planted when the survey enumerators make field observations. Plots reported as fallow fields (*jachere*) in April might yet be planted later on in the season. It is important to end the field survey by the end of April to allow sufficient time to do data entry and preliminary identification of crops and parcels. Sample sites for a subsequent Crop Yield Survey of the main field crops can then be selected randomly among the plots identified with those crops. Barley harvest begins mid-May and wheat follows shortly thereafter so these two crops get priority in the yield survey, followed by sugar beets and potatoes. Crop cuttings of alfalfa, being a perennial, can be done at any time.

Five teams of two enumerators each (*binomes*) are trained in the use of handheld GPS units to locate the sample points and to map out the parcels of land planted to crops and other land uses. Google

¹ They are part of the U.S. Ministry of Agriculture.

Maps or similar Internet or mobile phone applications can help enumerators in finding sample points. Once at the site of the sample point, enumerators make a map of a circular area of 100 meters radius from the central sample point. The navigation screen in the GPS provides the distance (in meters) and bearing angle (in degrees from north) of the point where the enumerator is standing and the central sample point. These (polar) coordinates are used to make a paper field chart of the circular sample area using a customized form designed for that purpose. As enumerators walk along the border of each parcel he/she records and plots the coordinates of corner and turning points. It takes between 30 minutes to one hour to do a sample point, depending on the complexity of the site. Usually, it takes longer to reach the sample point than to actually map it out. An enumerator team can do 4 sites per day with ease, and more after experience is gained and if they know the area well. In open field crop areas enumerators can move freely with little interference from farmers, but in areas with enclosures and fruit tree orchards access to the sample sites might require prior permission from farmers. Badges and letters of accreditation provided by the ORMVA's identify the enumerators and their mission and usually suffice to gain access. Nonetheless, on occasions access to sample sites might not be possible.

Supervision of field enumerators in Doukkala is done by ORMVA-D staff posted at the district head towns for each sector. In Doukkala, supervision is done by the head person and members of the team hired by MEC to manage and supervise the survey. Supervisors are equipped with GPS units and they can visit the sample sites independently to verify their accuracy. This methodology allows to revisit the site at any time for any sample point to verify that the sketch from enumerators corresponds to what is on the ground.

In addition to direct supervision of enumerator teams by supervisors the program has developed other built-in safeguards in the survey procedure. Satellite images for each sample point were downloaded from Google Earth with sufficient detail to identify separate fields, and those images correspond very closely to the GPS measurements recorded on the ground. The GPS units track the movements of the unit and keep a record of where it has been and when. The tracking feature memory of the GPS unit can be downloaded into a computer and plotted into Google Earth or a GIS map to have a time-space record of where the enumerators have been when using the GPS. In fact, the GPS mapping memory also records the path on the ground, so it is possible to follow the movements of the enumerator team along the borderlines between plots.

Our target for data quality is to obtain coefficients of variation 10 percent or lower for the crop area estimates of the principal crops. The program has succeeded in attaining those levels of precision or better.

The statistical analysis of the field data starts a few days after the start of field work and proceeds concurrently for the next few weeks. At present MEC uses an Excel spreadsheet to estimate the plot areas in each sample point but later on the program will transfer the data to a GIS ArcView database, so that the GIS team at the ORMVA's have an opportunity to use the new GIS tools to plot the survey data and do the statistical analyses. The Excel program enters the field data recorded by enumerators in the paper plotting forms and for each plot of land it records the coordinates of its corner points, estimates the area in hectares, and records the type of irrigation and the crop present at the time. The output for each sample point consists of one line per plot of land with its sample identification, plot identifier, area in hectares, crop description, crop code, irrigation type, and whether there is a secondary crop in the same plot of land. The name of the perimeter where the sample point is located is added for each plot of land in the database. On average, each circular sample contains about 6 to 8 different plots.

Once a consolidated database is put together, the statistical analysis becomes straight forward. But the first stage is to verify the accuracy and consistency of the data: missing and duplicated records, crop codes that don't correspond to the crop descriptions, new crops and codes encountered, total area estimates below 3.125 hectares or that exceed 3.129 hectares for a sample of 100 m radius, ... are examples of typical data errors made at the time of field recording or data entry. Generally, data errors can be corrected going back to the original forms. If not, specific entries might be discarded altogether.

The principal output from the survey is a collection of tables describing the relationships between crops and irrigated perimeters, crops and types of irrigation, types of irrigation and irrigated perimeters, and comparisons between this year and the situation in previous years. Pie charts are used to present in visually attractive and understandable ways the contents of the data tables. These tabulations are done using the pivot table functions incorporated in Microsoft Excel.

A major advantage of the Area Frame Spot Sampling methodology is that the statistical analysis gives an estimate of the precision or margin of error of the resulting area estimates. The goal was to obtain coefficient of variation of 10 % or less for the main crops. Floating bar charts are used to show the confidence intervals within which we expect the true area values to fall. Standard deviations and standard errors are computed for the area estimates of each crop by perimeter and by type of irrigation. Singular estimates often have large margins of error, but when estimates are aggregated by irrigation perimeter, for example, the precision of the cumulative estimate improves, the margin of error is reduced, and the coefficient of variation is lower.

A recent innovation has been the introduction of GIS software into the analysis and interpretation of crop area survey results. It is possible to draw maps with the irrigated perimeters in the background with overlay layers depicting the location of sample points, pie charts showing the relative presence of crop types in each sample point, and individual parcels in each sample point.

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Water gained from converting gravity to drip irrigation.

Crops	Allotment (m3/ha)	# Irrig.	Cu. M	Gravity-fed	Drip	Gain, M3	% Gain
				65%	90%		
Citrus	648	8	5184	3 370	4 666	1 296	38%
Vine	540	6	3240	2 106	2 916	810	38%
Olive trees	540	6	3240	2 106	2 916	810	38%
Assorted trees	540	6	3240	2 106	2 916	810	38%
Sugar beets	648	8	5184	3 370	4 666	1 296	38%
Alfafa	648	7	4536	2 948	4 082	1 134	38%
Market gardening	648	7	4536	2 948	4 082	1 134	38%
Artichoke	648	7	4536	2 948	4 082	1 134	38%
Mint	648	7	4536	2 948	4 082	1 134	38%
Cereals (seeds)	648	4	2592	1 685	2 333	648	38%
Cereals	648	3	1944	1 264	1 750	486	38%

Source: ORMVA-Doukkala

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