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CROP AREA SURVEY REPORT FOR ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

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MOROCCO ECONOMIC COMPETITIVENESS

CROP AREA SURVEY REPORT FOR ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

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By DAI

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SUMMARY

- The 2012 Crop Area Survey of irrigated perimeters in the ORMVA-Moulouya area of operations is a joint effort of the Office Regional de Mise en Valeur Agricole de la Moulouya in cooperation with the USAID Morocco Economic Competitiveness (MEC) Program.
- The first Crop Area Survey was carried out in April 2010, followed by the second in April 2011. This is the third annual survey for 2012 and we expect to 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 such as cereals and sugar beets are still in the ground before harvest. Nevertheless, short cycle crops that are planted after April are missed by the survey.
- The crop area survey follows the Area Frame Spot Sampling procedures previously developed by DAI on other projects elsewhere. This is an adaptation of the Area Frame 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 crop 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-M irrigated area comprises five distinct perimeters: Bou Areg, Garret, Zebra, Aklim, and Madagh. Bou Areg is in the coastal plain near Nador, Zebra is next to Zaiou, Garret is in the interior south west. Bou Areg, Garret and Zebra are on the left of the Moulouya river in the Nador Province, while Aklim and Madagh are on the right side in Berkane province. Aklim and Madagh together are often referred to as the Triffa perimeter, but the large areas and distinct crop patterns make it preferable to treat them as two separate perimeters, Aklim to the west and Madagh to the east of the road from Berkane to Ras El Ma.
- The survey collected observations from 406 sample points selected randomly throughout the irrigated area and to avoid clustering a minimum distance of 900 meters between sample points was enforced. Half of the points were kept from the 2011 survey, and half 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 identified later on for verification, even years later.
- The survey area encompasses a total of 79,305 hectares, but only about 54,000 of those were cultivated at the time of the survey. Non-agricultural uses occupy 13,000 hectares, and 12,600 additional hectares are fallow (jachere).
- The crop area survey reveals remarkably distinct cropping patterns in the five irrigated perimeters.
    - Clementines are produced mainly in Aklim (59%) and Madagh (36%)
    - Navel oranges are concentrated in Zebra (40%), with smaller areas in Aklim (31%) and Madagh (27%)
    - Sugar beets are produced nearly exclusively in Garret (71%) and a small area in Bou Areg (22%).
    - Three quarters of vegetable crops (maraichage) are produced in Madagh (76%).
    - Garret accounts for 63% of wheat area, followed by Madagh with 22%.
    - Garret and Madagh together account for 72% of barley area.

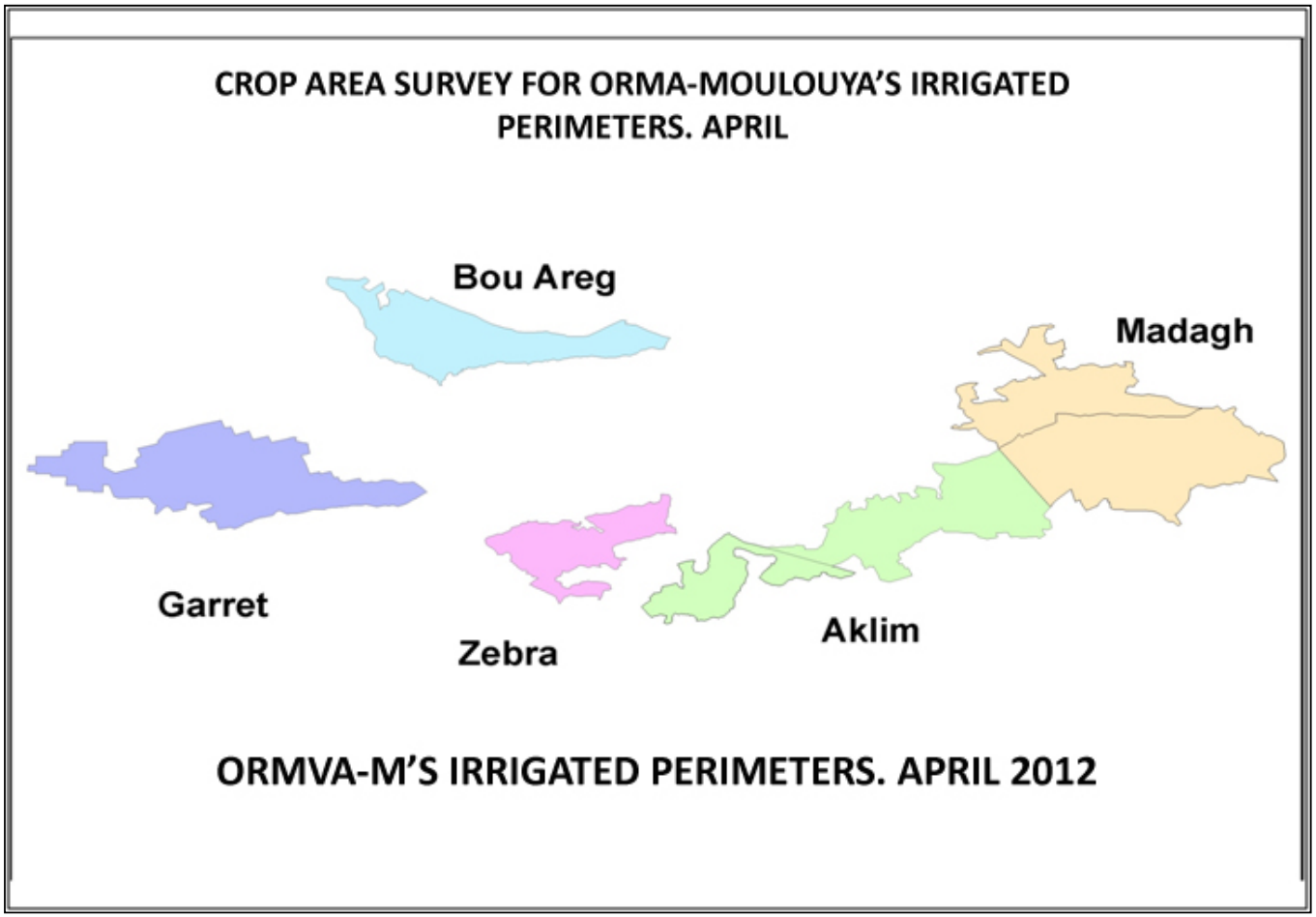
- By contrast, forage crops (mainly alfalfa and bersim) are rather evenly distributed throughout the five perimeters.
- The same is true for Other Fruits (pomegranates, apricots, grapes, olives) and Fallow Land (Jachere, land that can be irrigated but was not planted at the time of the survey)

- Clementines in by far the most important crop in the ORMVA-M irrigated areas, both in terms of area planted and in value. An estimate of 12,187 hectares is planted to clementines, or 15.4 % of the survey area. Clementines are also the main export from the region to overseas markets. Clementines are a priority crop for ORMVA-Moulouya and benefit from most Government subsidies for the establishment of water storage basins and drip irrigation systems. New acreages are planted to clementines in recent years. The reported 12,187 ha estimate for 2012 is higher than 10.419 ha in 2010 but less than 13,946 ha in 2011. We believe the 2011 value was a sample anomaly that overestimated the true value.
- Navel oranges are second in importance in terms of value and foreign exchange earnings. Navel acreage remains stable with a 2012 estimate of 4,578 hectares (5.8% of total area). Prices and export market potential for clementines are viewed more favorable than for navel oranges.
- Sugar beet crop area in 2012 shows a severe drop in acreage to merely 2,426 ha from 6,388 ha in 2010. This remarkable drop follows a parallel trend in the Doukkala region, attributed to reduced competitiveness of sugar beets and difficulties of sugar companies reaching agreement with farmers on suitable terms.
- Wheat planted area, 8,381 ha in 2012, comes second after clementines in the Moulouya perimeters, and together with barley (7,952 ha) account for 21% of the survey area and 30 % of the cultivated area (53,618 ha). Wheat is grown for grain but barley has dual purpose as forage crop (or fodder) for grazing while green and grain production. A significant area planted to cereals is for seed production, but in the survey it was not possible to distinguish those parcels. Wheat production is highly concentrated in sprinkler irrigated areas in Garret.
- Area planted to fodder in 2012 is estimated at 4,791 ha or 6% of the total survey area. Forage crops consist mainly of alfalfa (Luzerne) and clover (bersim). Alfalfa is a perennial while bersim is a winter fodder crop that takes several cuttings. Fodder crops are found in small patches scattered throughout all the irrigated lands, and consumed mainly on farm by milk producing cows. There is a significant commercial production of alfalfa hay in the area, and bales are found in Berkane at prices near 4 DH per kilogram.
- Vegetable crops (maraichage) are gradually graining ground and importance, and in 2012 an estimated 7,086 ha were planted, mainly in the Madagh irrigated perimeter. In terms of value per cubic meter of water, vegetable crops rank much higher than citrus trees, cereals, and sugar beets, mainly because vegetables 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 tree crops and sugar beets at the expense of vegetables.
- Fruits trees other than citrus are particularly popular among farmers in Aklim and Zebra, close to the Moulouya River, and they have a growing export market potential outside the region. Together they occupy a combined area of 6,216 ha or 7.8$ of the total survey area, more than the area planted to Navel oranges.
- Fallow land (Jachere) represents 12,577 ha or 15.9% of the survey area and is present in all irrigation perimeters but especially in Bou Areg and Madagh, the two farther perimeters from the water source, where uncertainty about water delivery is higher. Some fallow land might be planted to summer crops after the crop area survey is taken, but most fallow land is the result of insufficient irrigation water. Gains in water economy can potentially be used to irrigate fields currently left fallow.
- Gravity irrigation is the predominant field irrigation method, used in 28,561 ha or over half (53%) of the cultivated area. Drip irrigation in 2012 is reportedly used in 11,547 ha or 22 of the cultivated area, more than the 10,460 ha (20%) using sprinkler irrigation. Under the Plan Maroc Vert the Government subsidizes the expansion of basins and drip irrigation by about 2,000 ha per year. In addition, 3.323 cultivated hectares are reported not being irrigated at all, dependent solely on rainfall (bour). This is mainly attributed to rain-fed zones found in the borders or

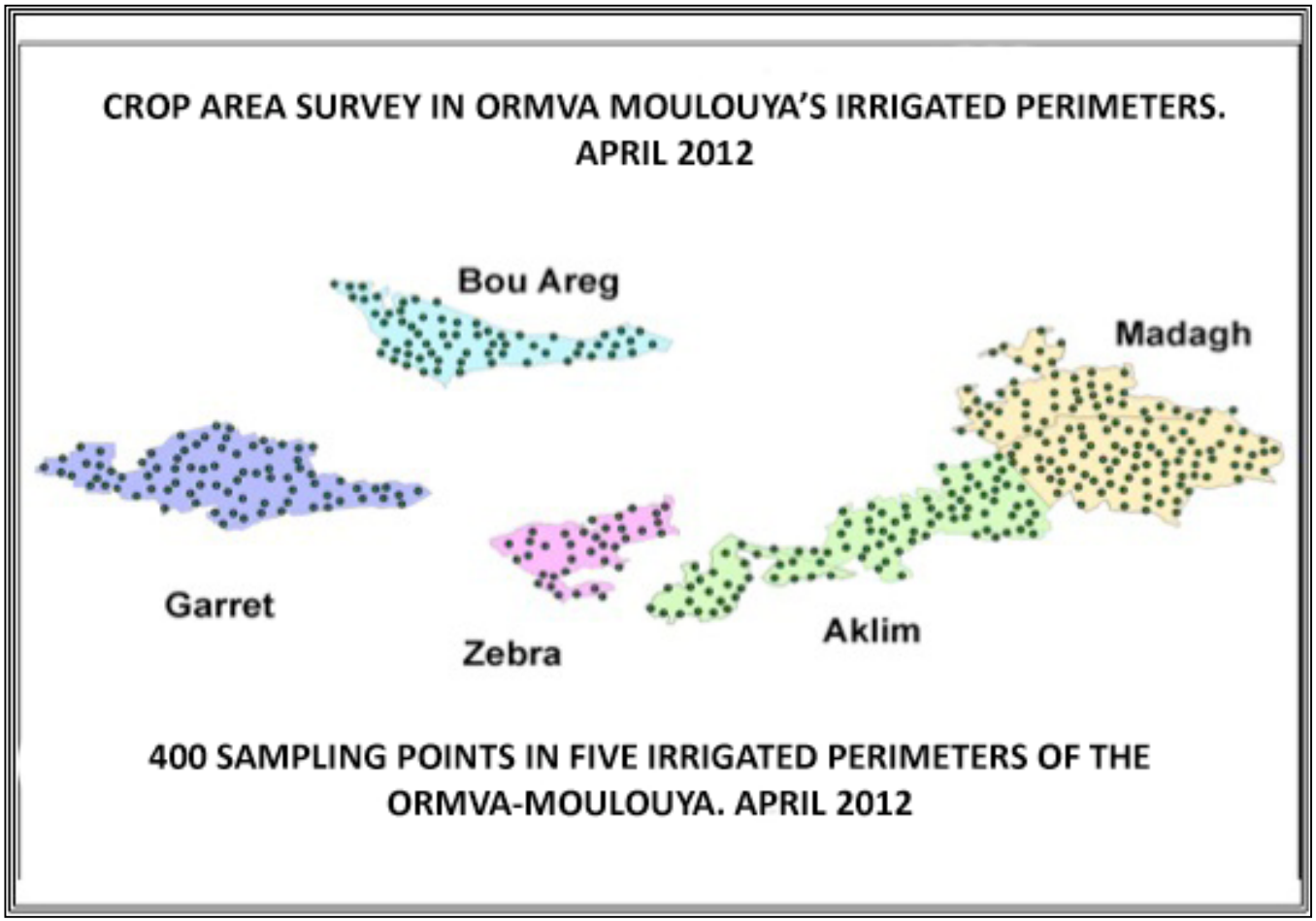
within irrigated perimeters, but also may reflect farmer decisions to use water in part of the farm and grow rain-fed crops in the remainder.

- Sprinkler irrigation is found nearly exclusively (96%) in the Garret irrigated perimeter and is used predominantly for the production of sugar beets and wheat. Pumping costs represent a major drain on the budget of the ORMVA-Moulouya as the extra fee charged to farmers does not cover most of the actual extra costs.
- Drip irrigation is now common in all irrigation perimeters, but especially so in Aklim and Madagh, where most of the citrus orchards are found. Pumping costs for drip irrigation using water stored in basins are paid entirely by farmers themselves, thus alleviating the burden on the ORMVA-M but also making farmers aware of the need to economize water. ORMVA-Moulouya has promoted building over one thousand basins to water about 12,000 ha and gradually replacing gravity irrigation. Basins allow ORMVA-M to schedule water delivery using tours-d'eau (water towers) every few weeks while empowering farmers to irrigate crops daily.
- Clementines are the only crop irrigated mainly through drip irrigation (6,751 out of 12,187 hectares or 55%). Drip irrigation is also common in Navel oranges (37%) and other fruits trees (31%), but gravity irrigation is used in most of these crops.
- Wheat and sugar beets are the only two crops irrigated mainly by sprinklers, and exclusively in the Garret irrigated perimeter. Nearly 60 percent of wheat (4,886 ha out of 8,381 ha) get sprinkler irrigation, and for sugar beets it is 69 % (1,661 ha out of 2,426 ha). Of the 9,988 hectares with sprinkler irrigation, 6,891 ha (69 %) are planted to wheat and barley.
- Two maps at the end of this pdf format report show the overall result of the Oriental 2012 Crop Area Survey. The pie-chart (camembert) map shows the shares by crop type for each sample point. The "Parcelles" map shows every plot of land in each sample spot colored according to the type of crop or land use. These two maps are geo-referenced, i.e., longitude and latitude coordinates are embedded. It is then possible to identify a particular sample point and parcel by placing the mouse cross-hair at a given point. For ease of visualization the parcel map is magnified beyond its actual size, but the central point coordinates are accurate. This geo-reference feature is available using Adobe Reader 9 or higher. Adobe Reader 9 can be downloaded free of charge from the Internet.

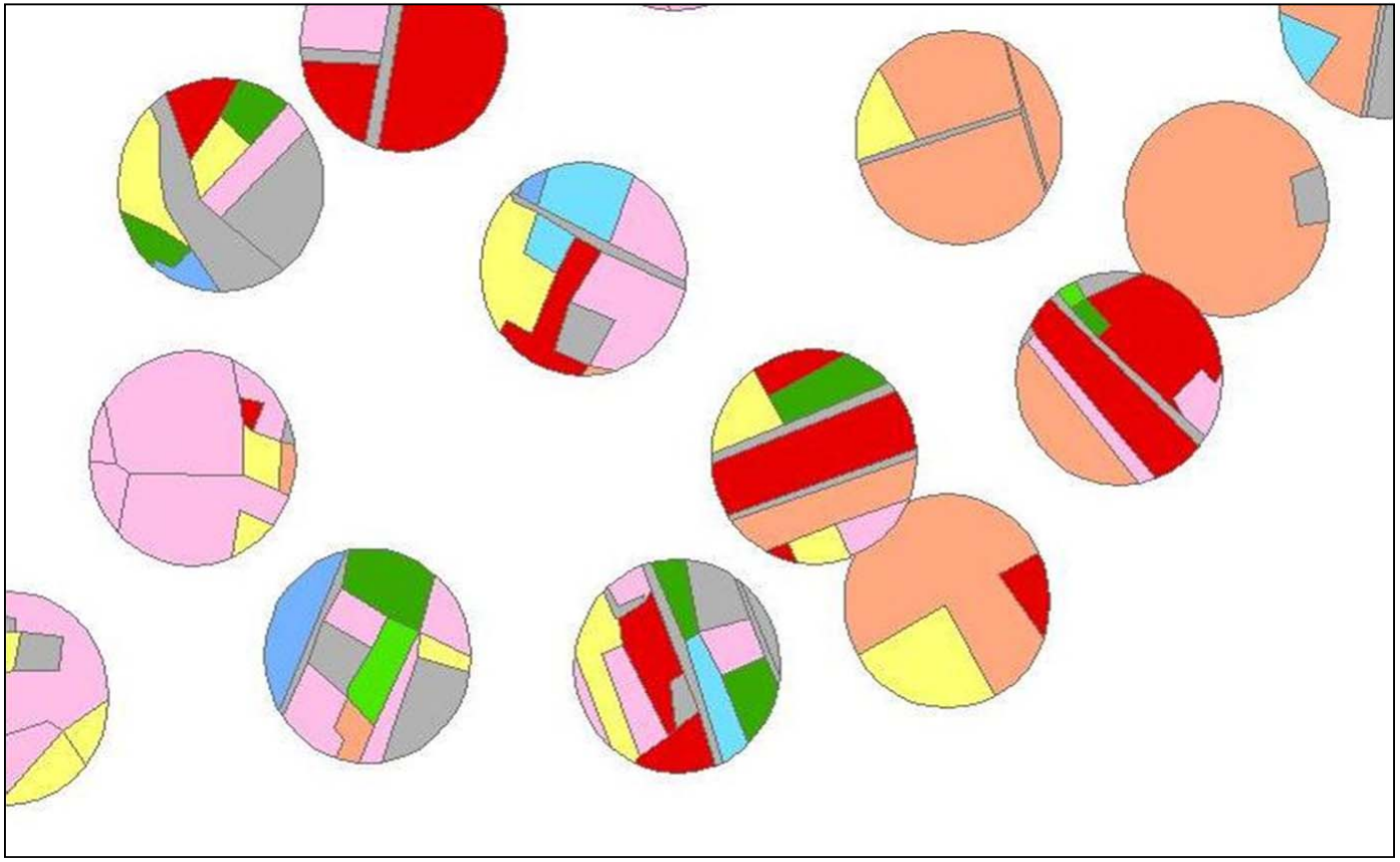
ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



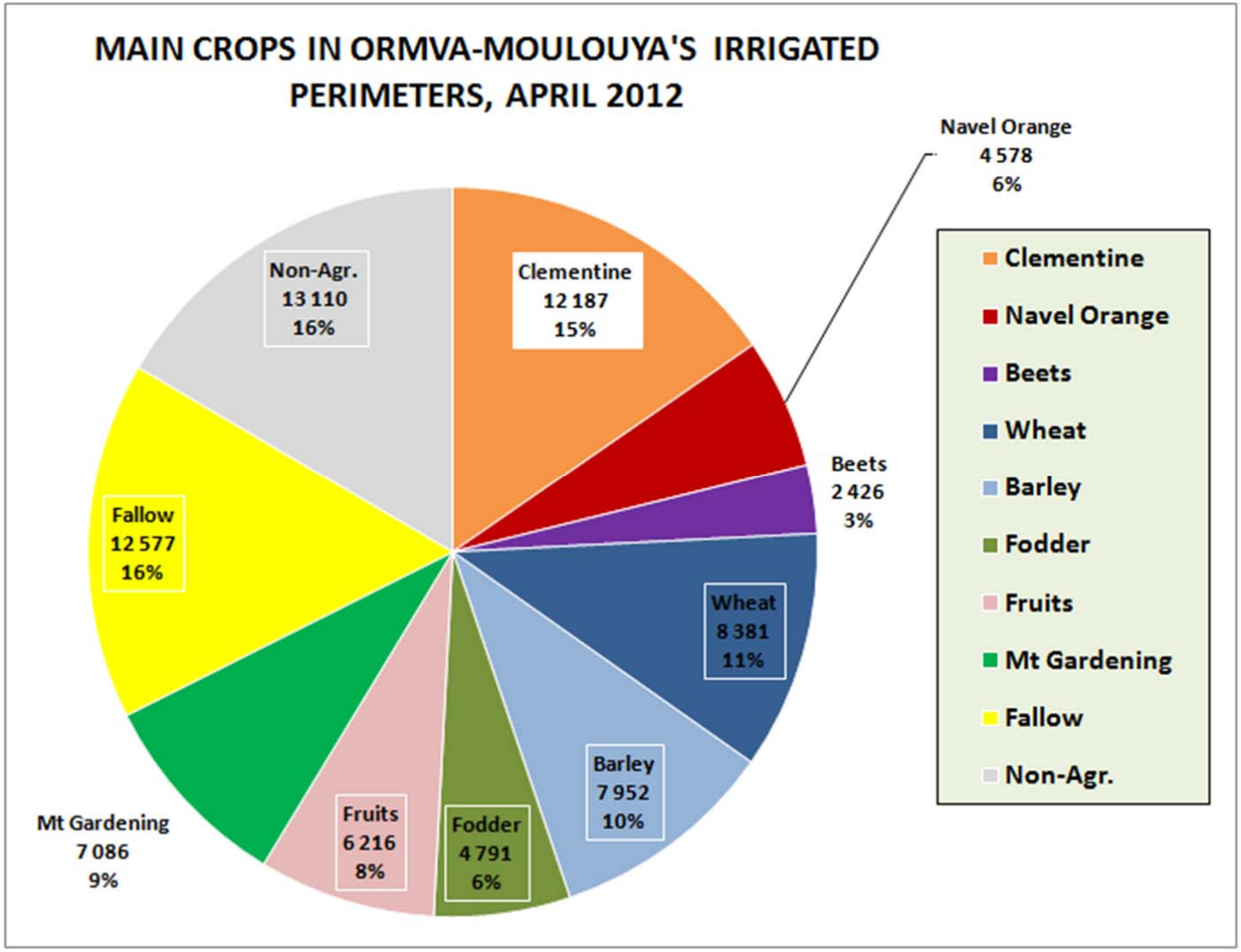
400 SAMPLING POINTS IN FIVE IRRIGATED PERIMETERS OF THE ORMVA-MOULOUYA: 2012



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



MAIN CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



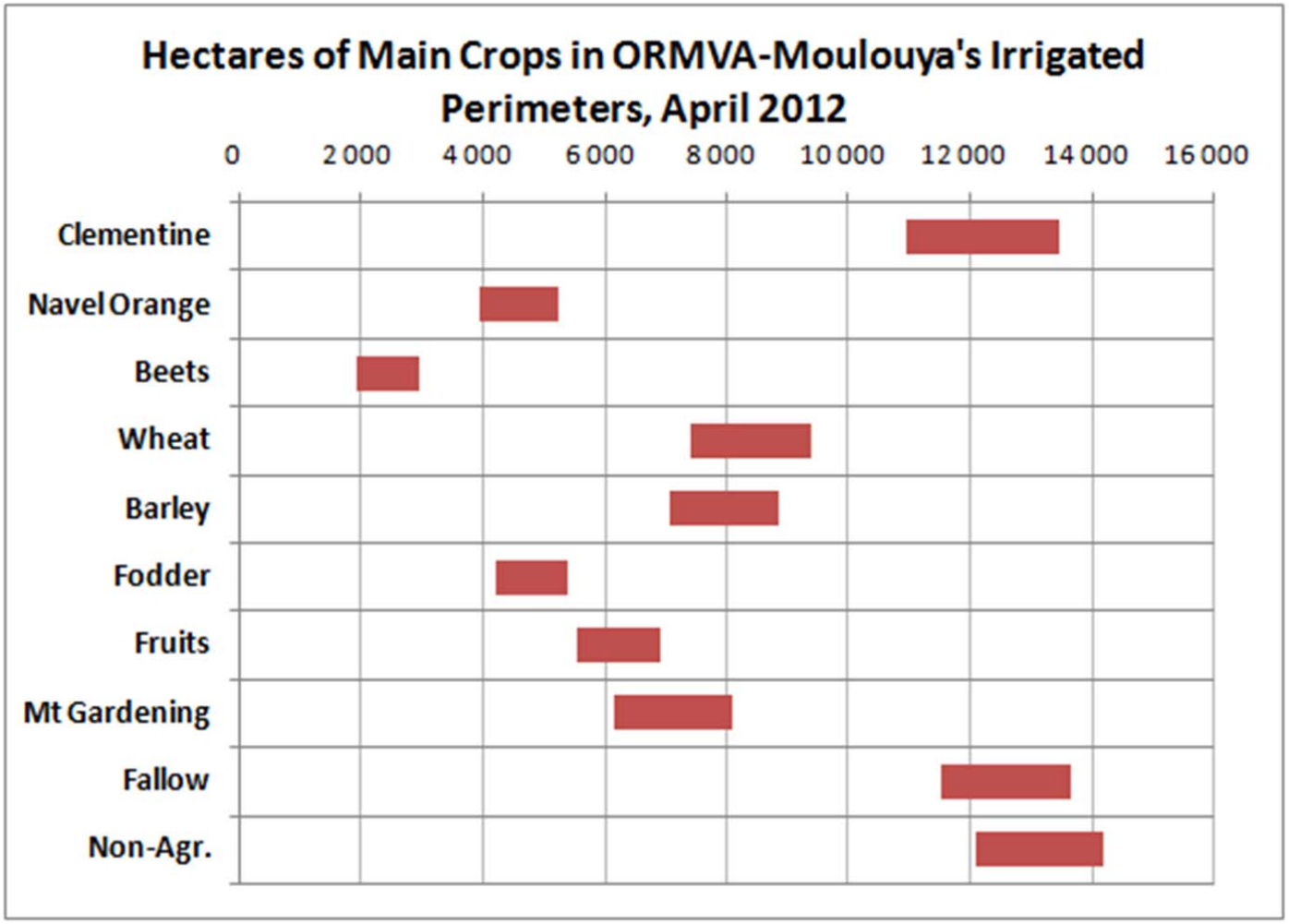
HECTARES OF MAIN CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

Hectares of Main Crops in ORMVA-Moulouya's Irrigated Perimeters, April 2012

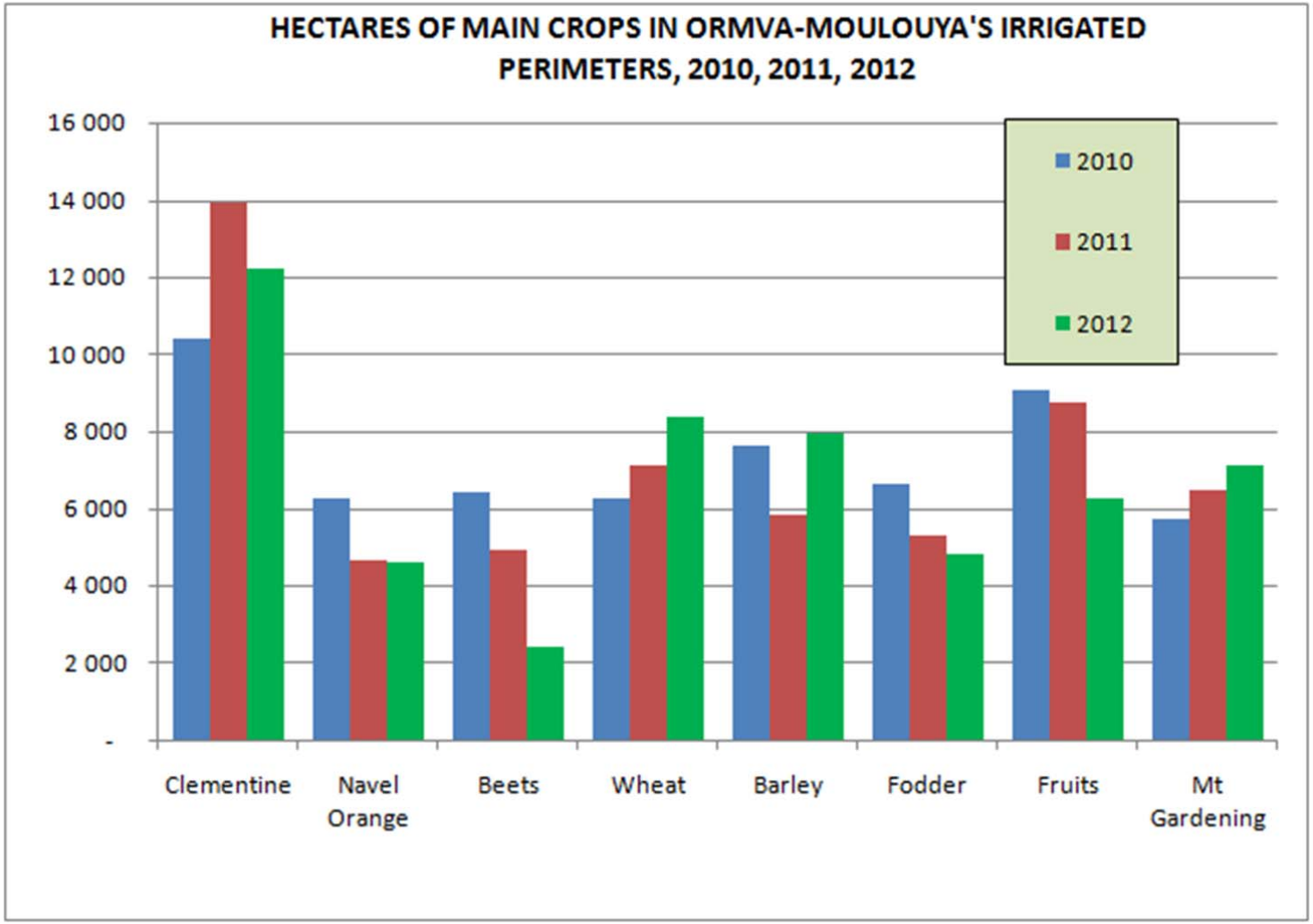
Crops	Hectares	Percent	Std Err	Cof Var	Low	High	Land Use
Clementine	12 187	15,4%	1 263	10,4%	10 924	13 451	**Clementine**
Navel Orange	4 578	5,8%	649	14,2%	3 929	5 228	**Navel Oranges**
Sugar beets	2 426	3,1%	524	21,6%	1 902	2 950	**Sugar beets**
Wheat	8 381	10,6%	994	11,9%	7 386	9 375	**Wheat**
Barley	7 952	10,0%	899	11,3%	7 054	8 851	**Barley**
Fodder	4 791	6,0%	598	12,5%	4 193	5 390	**Fodder**
Fruits	6 216	7,8%	686	11,0%	5 530	6 902	**Fruits, other**
Mkt Gardening	7 086	8,9%	972	13,7%	6 114	8 059	**Vegetables**
Fallow	12 577	15,9%	1 079	8,6%	11 498	13 655	**Fallow**
Non-Agr.	13 110	16,5%	1 044	8,0%	12 066	14 155	**Non-Agr.**
Total	**79 305**						**Total**

Source: ORMVA-Moulouya/USAID. CROP AREA SURVEY, MOULOUYA 2012.

HECTARES OF MAIN CROPS AND MARGINS OF ERRORS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



HECTARES OF MAIN CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: 2010, 2011, 2012



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

Crop areas and value in Moulouya irrigated perimeters, 2010, 2011, and 2012								
Crops	Hectares			DH/Ha	Revenue (MDH)			Crops
	2010	2011	2012		2010	2011	2012	
Clementine	10 419	13 946	12 187	122 500	1 276	1 708	1 493	**Clementine**
Navel Orange	6 217	4 639	4 578	87 500	544	406	401	**Navel Oranges**
Sugar beets	6 388	4 920	2 426	20 000	128	98	49	**Sugar beets**
Wheat	6 239	7 088	8 381	12 000	75	85	101	**Wheat**
Barley	7 607	5 788	7 952	7 500	57	43	60	**Barley**
Fodder	6 617	5 267	4 791	100 000	662	527	479	**Fodder**
Fruits	9 061	8 732	6 216	60 000	544	524	373	**Fruits, other**
Mkt Gardening	5 710	6 436	7 086	80 000	457	515	567	**Vegetables**
Fallow	9 747	13 155	12 577	0	0	0	0	**Fallow**
Other	11 294	9 327	13 110	0	0	0	0	**Non-Agr.**
Totals	**79 299**	**79 299**	**79 305**		**3 742**	**3 907**	**3 521**	**Totals**
						4%	-10%	**% change**
Source: ORMVA-Moulouya & MEC, Crop area surveys, Oriental 2010 and 2011								

HECTARES OF MAIN CROPS PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: 2010, 2011, 2012

Hectares of Main Crops in ORMVA-Moulouya's Irrigated Perimeters, April 2012							
Crops	**Hectares**	**Percent**	**Std Err**	**Cof Var**	**Low**	**High**	**Land Use**
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Total	**79 305**						**Total**
Source: ORMVA-Moulouya/USAID. CROP AREA SURVEY, MOULOUYA 2012.							

HECTARES OF MAIN CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012 (SHARE BY TYPE OF CROP)

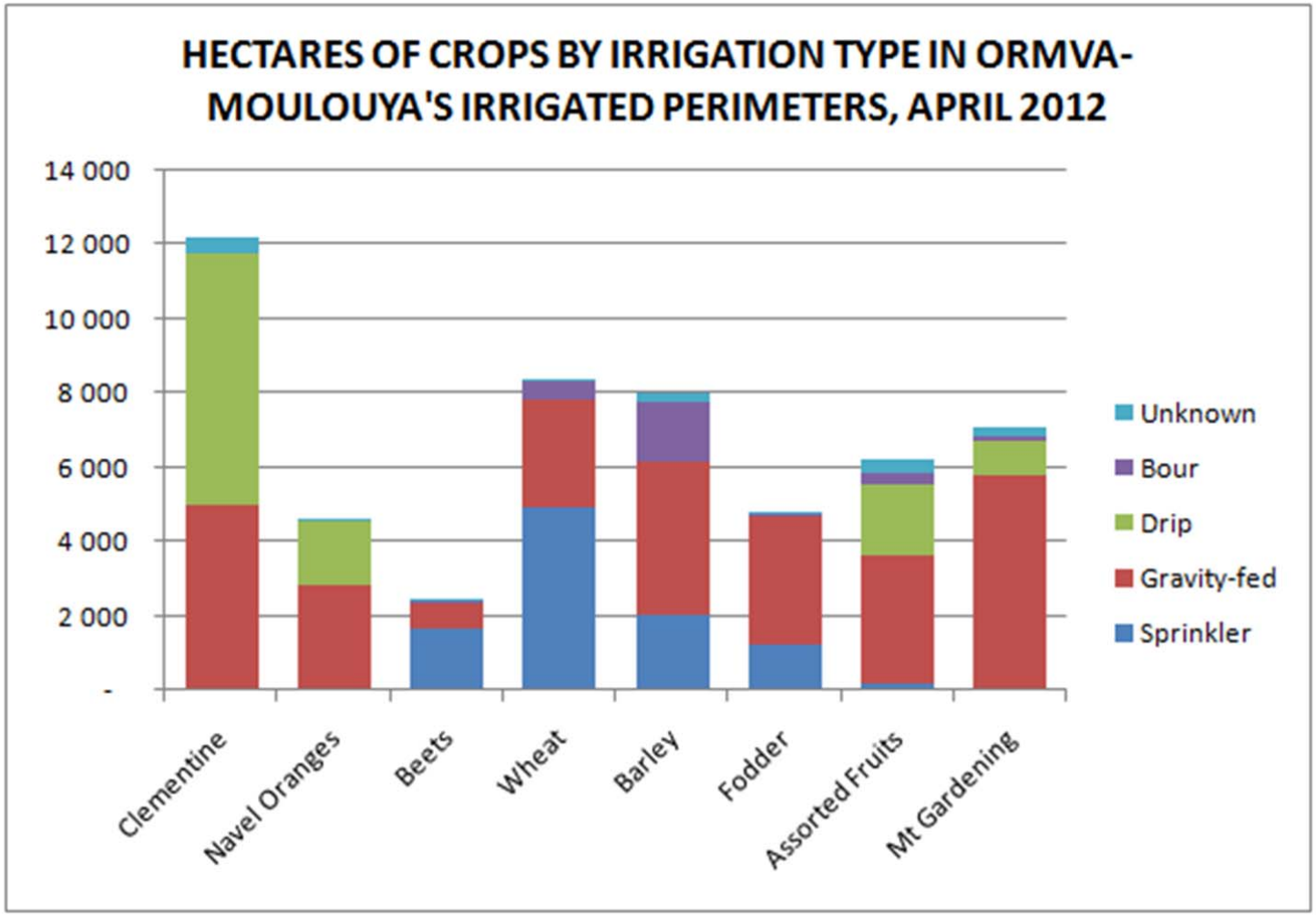
Hectares of Main Crops in ORMVA-Moulouya's Irrigated Perimeters, April 2012 (Share in %)							
Crops	**Bou Areg**	**Garret**	**Zebra**	**Aklim**	**Madagh**	**Totals**	**Land Use**
Clementine	0,0%	0,2%	7,8%	40,5%	16,6%	**15,4%**	**Clementine**
Navel Oranges	0,9%	0,0%	26,0%	8,0%	4,6%	**5,8%**	**Navel Oranges**
Sugar beets	4,7%	10,5%	0,0%	0,3%	0,5%	**3,1%**	**Sugar beets**
Wheat	8,0%	32,6%	2,3%	1,0%	7,3%	**10,6%**	**Wheat**
Barley	14,5%	16,1%	2,7%	2,4%	11,5%	**10,0%**	**Barley**
Fodder	12,2%	9,8%	9,5%	3,5%	1,5%	**6,0%**	**Fodder**
Fruits	9,9%	6,3%	20,0%	10,5%	2,5%	**7,8%**	**Fruits, other**
Mkt Gardening	5,1%	1,7%	1,5%	4,4%	20,6%	**8,9%**	**Vegetables**
Fallow	29,1%	12,1%	19,1%	10,8%	14,4%	**15,9%**	**Fallow**
Non-Agr.	15,5%	10,8%	11,2%	18,6%	20,6%	**16,5%**	**Non-Agr.**
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**Total**

Source: ORMVA-Moulouya/USAID. CROP AREA SURVEY, MOULOUYA 2012.

HECTARES OF MAIN CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012 (SHARE% BY PERIMETER)

Hectares of Main Crops in ORMVA-Moulouya's Irrigated Perimeters, April 2012 (Share in %)							
Crops	**Bou Areg**	**Garret**	**Zebra**	**Aklim**	**Madagh**	**Totals**	**Land Use**
Clementine	0,0%	0,2%	4,5%	59,1%	36,2%	**100%**	**Clementine**
Navel Oranges	2,2%	0,0%	40,3%	31,0%	26,8%	**100%**	**Navel Oranges**
Sugar beets	21,7%	71,9%	0,0%	1,9%	5,3%	**100%**	**Sugar beets**
Wheat	10,8%	64,6%	2,0%	2,2%	23,0%	**100%**	**Wheat**
Barley	20,6%	33,7%	2,4%	5,3%	38,3%	**100%**	**Barley**
Fodder	28,8%	33,9%	14,0%	13,1%	8,2%	**100%**	**Fodder**
Fruits	18,0%	16,8%	22,8%	30,0%	10,8%	**100%**	**Fruits, other**
Mkt Gardening	8,1%	4,0%	1,5%	11,0%	77,0%	**100%**	**Vegetables**
Fallow	26,1%	15,9%	10,8%	15,2%	30,3%	**100%**	**Fallow**
Non-Agr.	13,4%	13,6%	6,1%	25,2%	41,7%	**100%**	**Non-Agr.**
Total	**14,2%**	**21,0%**	**8,9%**	**22,4%**	**33,5%**	**100%**	**Total**
Source: ORMVA-Moulouya/USAID. CROP AREA SURVEY, MOULOUYA 2012.							

HECTARES OF CROPS BY IRRIGATION TYPE IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



HECTARES OF CROPS BY IRRIGATION TYPE IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

HECTARES OF CROPS BY IRRIGATION TYPE IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS, APRIL 2012						
Crops	**Sprinkler**	**Gravity-fed**	**Drip**	**Bour**	**Unknown**	**Hectares**
Clementine	-	4 977	6 751	-	458	**12 187**
Navel Oranges	-	2 830	1 707	-	41	**4 578**
Sugar beets	1 661	694	-	44	28	**2 426**
Wheat	4 886	2 895	-	595	5	**8 381**
Barley	2 005	4 155	-	1 560	232	**7 952**
Fodder	1 204	3 489	-	45	54	**4 791**
Assorted Fruits	175	3 444	1 909	291	397	**6 216**
Mkt Gardening	57	5 704	940	105	280	**7 086**
Fallow	-	55	-	659	11 862	**12 577**
Other	-	594	230	-	12 287	**13 110**
Total	**9 988**	**28 837**	**11 537**	**3 299**	**25 645**	**79 305**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

WATER SAVED BY CONVERTING FROM GRAVITY IRRIGATION TO DRIP IRRIGATION

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%
MKt 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%

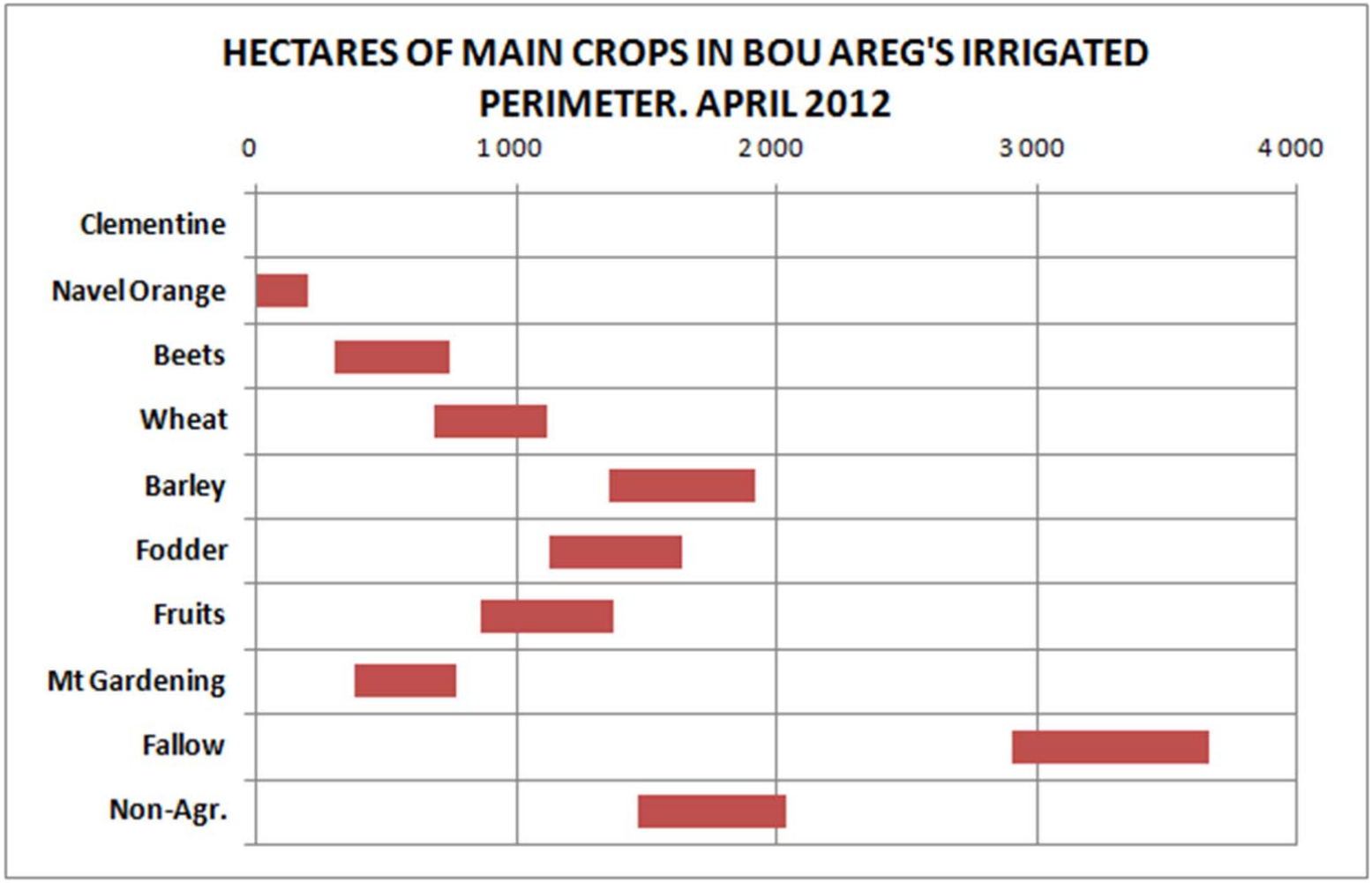
Source: ORMVA-Moulouya

HECTARES OF MAIN CROPS IN BOU AREG'S IRRIGATED PERIMETER: APRIL 2012

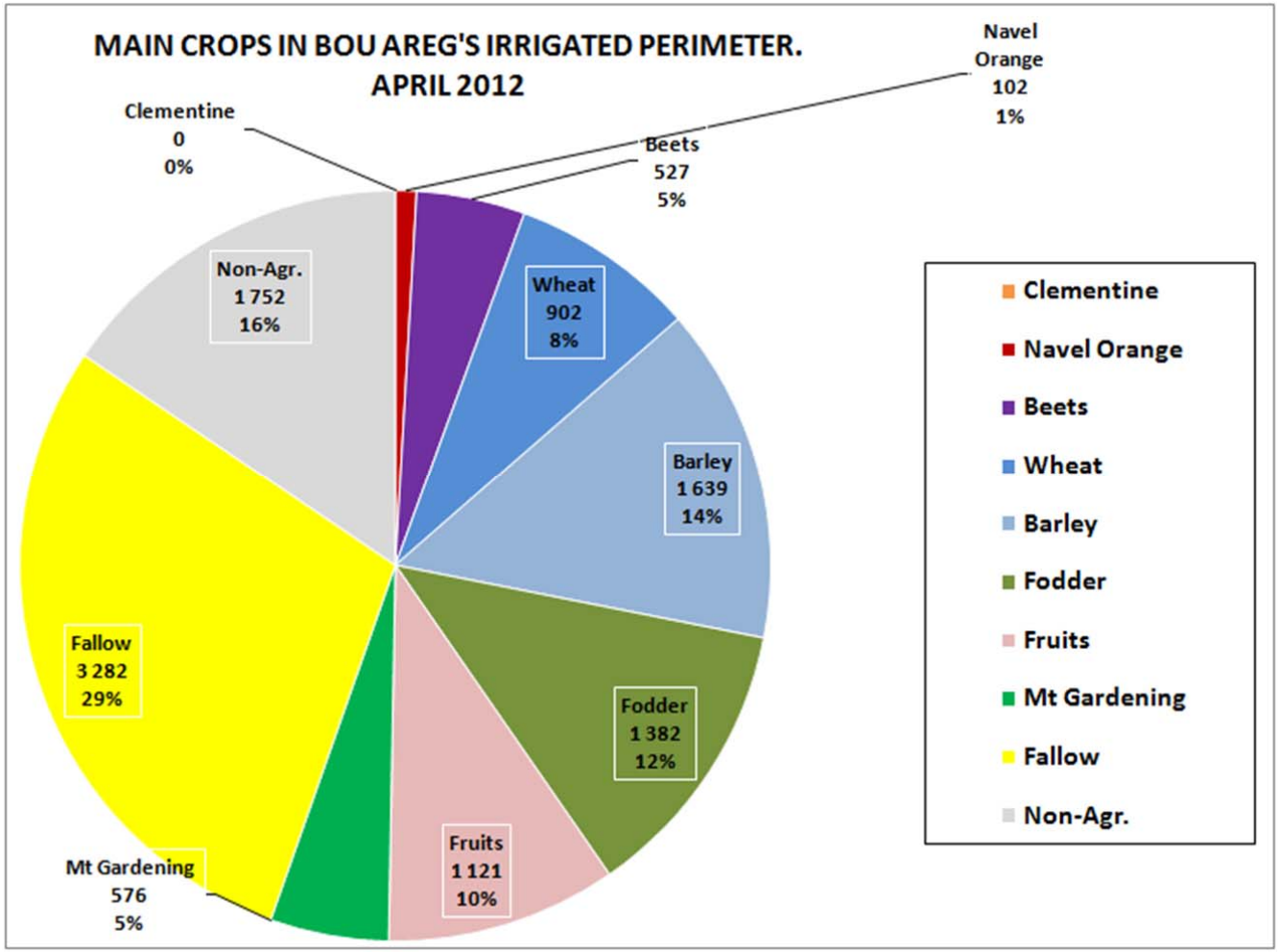
HECTARES OF MAIN CROPS IN BOU AREG'S IRRIGATED PERIMETER. APRIL 2012							
Crops	**Hectares**	**Percent**	**Std Err**	**Cof Var**	**Low**	**High**	**Land Use**
Clementine	0	0,0%	0	0,0%	0	0	**Clementine**
Navel Orange	102	0,9%	101	99,1%	1	204	**Navel Orange**
Sugar beets	527	4,7%	223	42,2%	305	750	**Sugar beets**
Wheat	902	8,0%	218	24,2%	684	1 120	**Wheat**
Barley	1 639	14,5%	282	17,2%	1 358	1 921	**Barley**
Fodder	1 382	12,2%	257	18,6%	1 126	1 639	**Fodder**
Fruits	1 121	9,9%	257	22,9%	864	1 379	**Fruits, other**
Mkt Gardening	576	5,1%	198	34,4%	378	775	**Vegetables**
Fallow	3 282	29,1%	380	11,6%	2 901	3 662	**Fallow**
Non-Agr.	1 752	15,5%	287	16,4%	1 466	2 039	**Non-Agr.**
Total	**11 285**						**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

HECTARES OF MAIN CROPS AND MARGIN OF PRECISION IN BOU AREG'S IRRIGATED PERIMETER: APRIL 2012



PIE CHART OF MAIN CROPS IN BOU AREG'S IRRIGATED PERIMETER: APRIL 2012



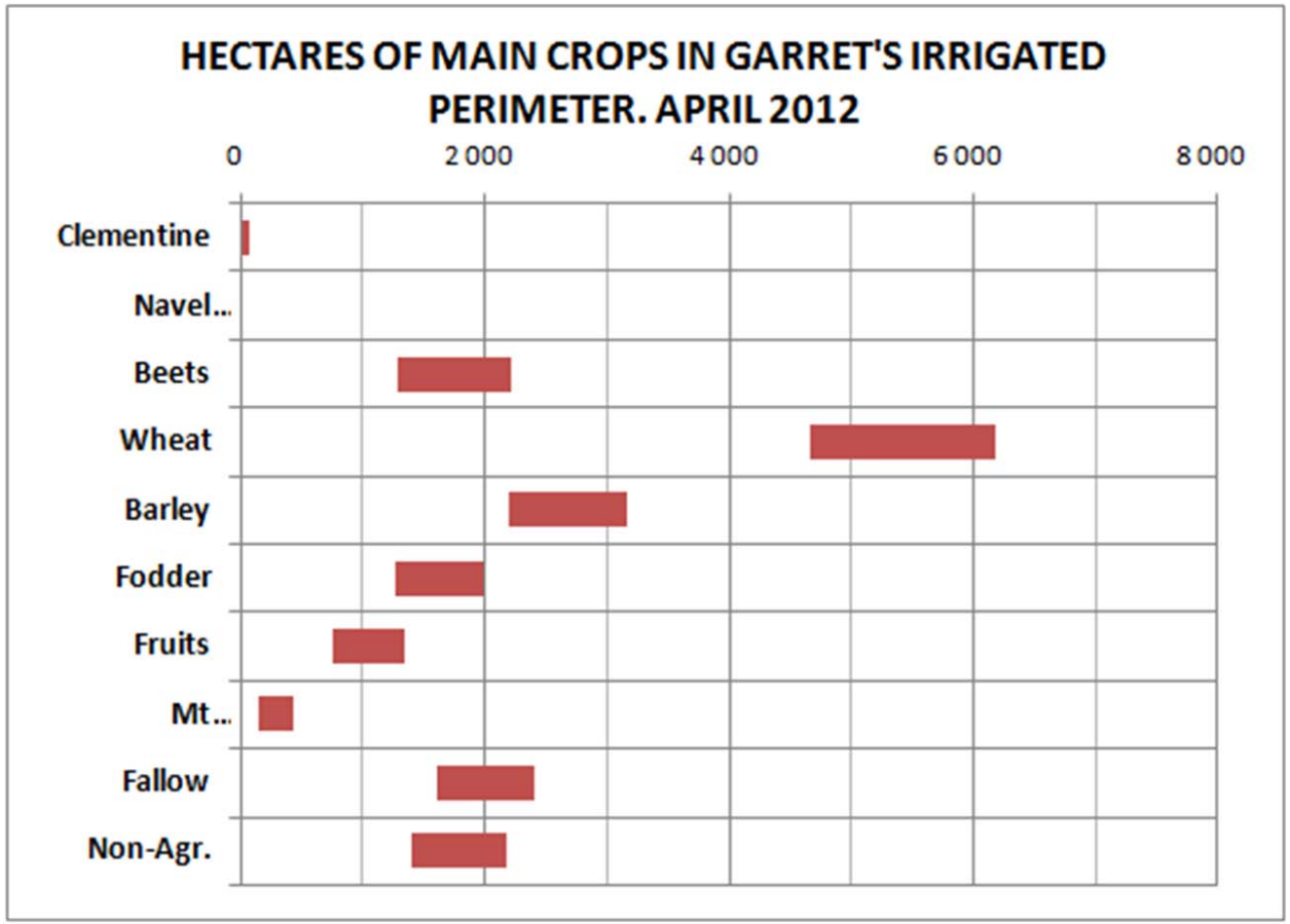
HECTARES OF MAIN CROPS IN GARRET'S IRRIGATED PERIMETER: APRIL 2012

HECTARES OF MAIN CROPS IN GARRET'S IRRIGATED PERIMETER.
APRIL 2012

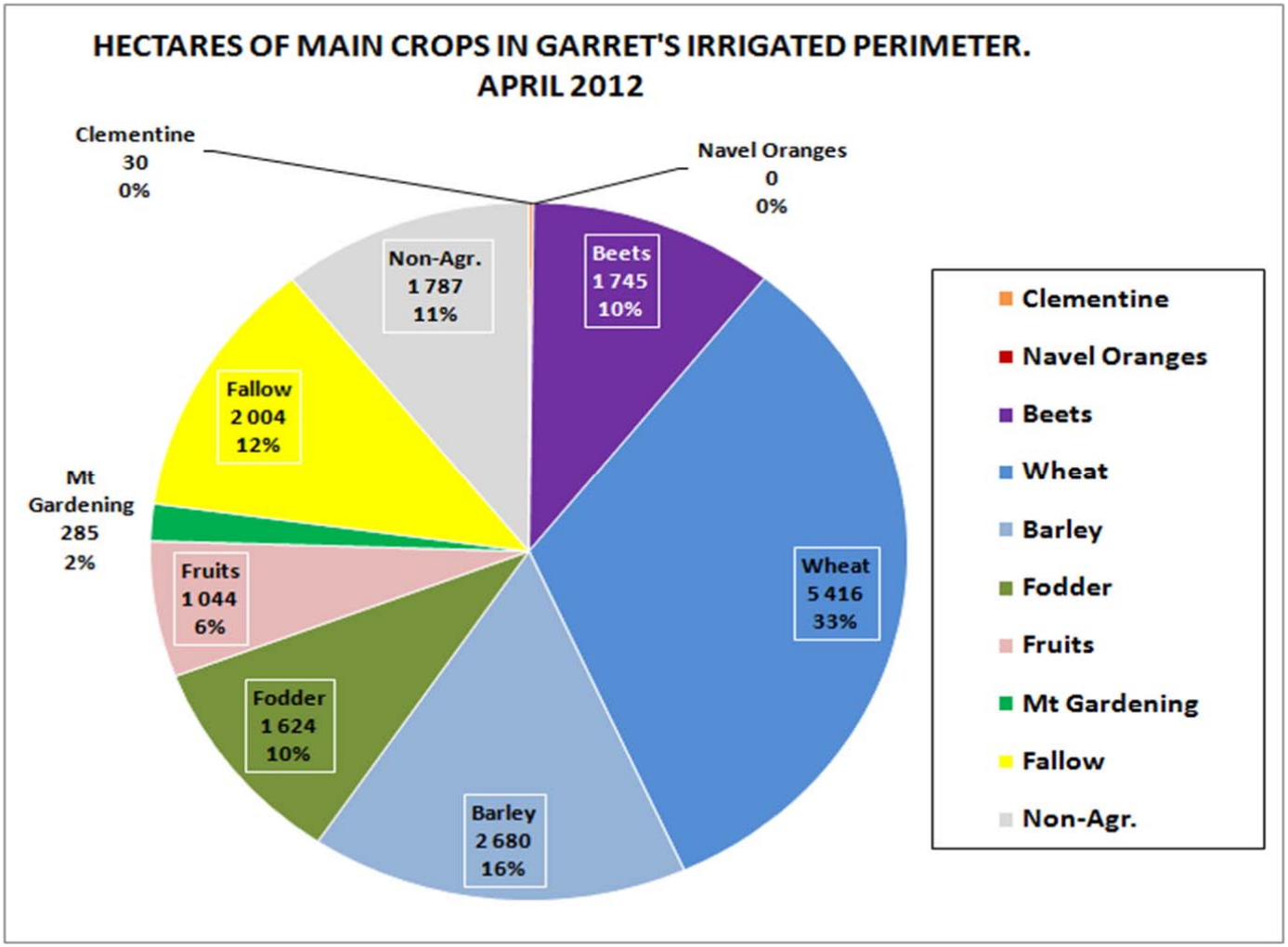
Crops	Hectares	Percent	Std Err	Cof Var	Low	High	Land Use
Clementine	30	0,2%	34	112,5%	-4	65	Clementine
Navel Oranges	0	0,0%	0	0,0%	0	0	Navel Oranges
Sugar beets	1 745	10,5%	462	26,5%	1 283	2 207	Sugar beets
Wheat	5 416	32,6%	760	14,0%	4 656	6 177	Wheat
Barley	2 680	16,1%	478	17,8%	2 202	3 158	Barley
Fodder	1 624	9,8%	358	22,0%	1 266	1 982	Fodder
Fruits	1 044	6,3%	290	27,8%	754	1 335	Fruits, other
Mkt Gardening	285	1,7%	138	48,2%	148	423	Vegetables
Fallow	2 004	12,1%	393	19,6%	1 611	2 396	Fallow
Non-Agr.	1 787	10,8%	382	21,4%	1 405	2 169	Non-Agr.
Total	**16 615**	**100%**					**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

HECTARES OF MAIN CROPS AND MARGIN OF PRECISION IN GARRET'S IRRIGATED PERIMETER: APRIL 2012



PIE CHART OF MAIN CROPS IN GARRET'S IRRIGATED PERIMETER: APRIL 2012

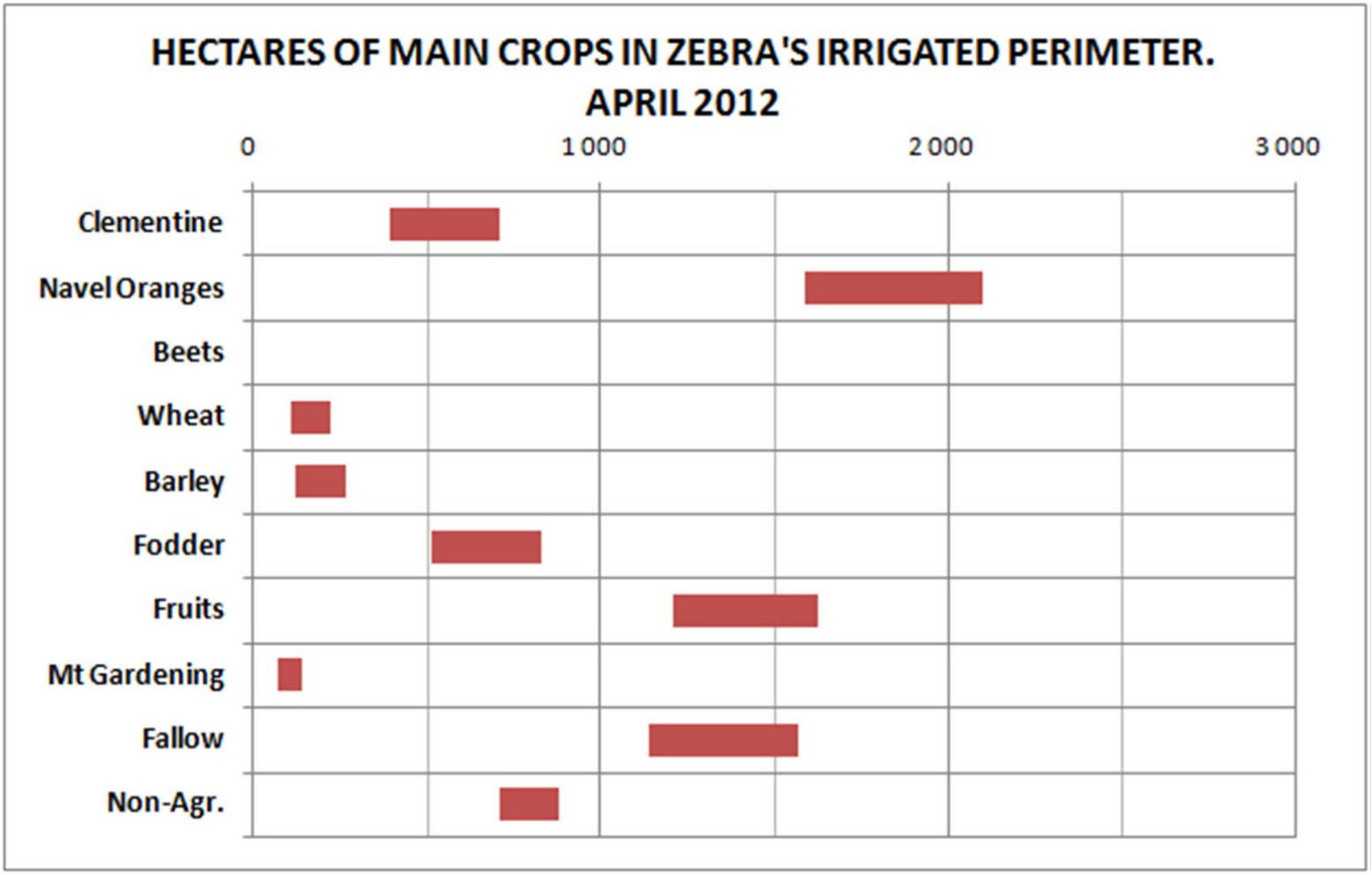


HECTARES OF MAIN CROPS IN ZEBRA'S IRRIGATED PERIMETER: APRIL 2012

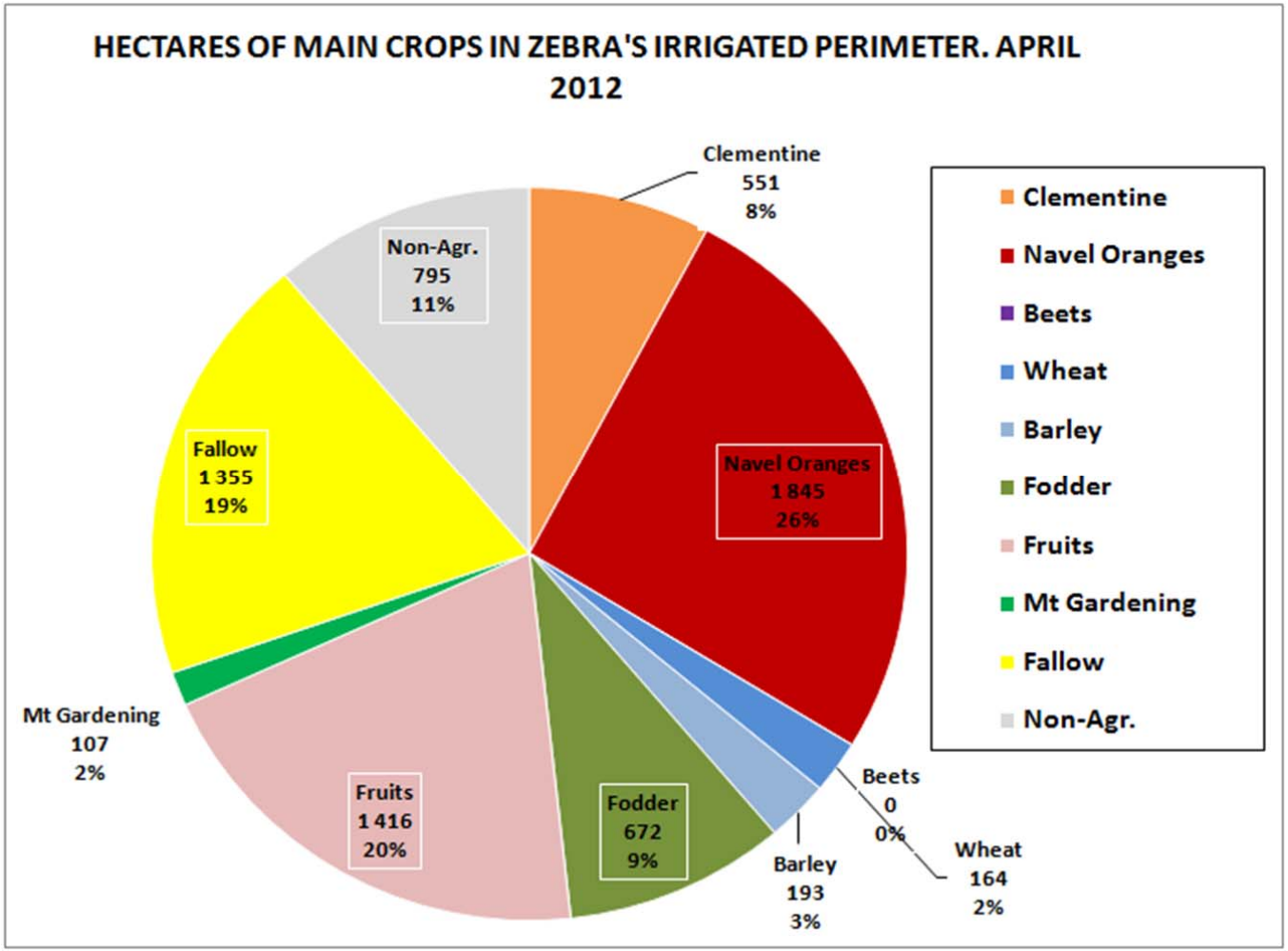
HECTARES OF MAIN CROPS IN ZEBRA'S IRRIGATED PERIMETER. APRIL 2012							
Clementine	**Hectares**	**Percent**	**Std Err**	**Cof Var**	**Low**	**High**	**Land Use**
Clementine	551	7,8%	156	28,3%	395	707	**Clementine**
Navel Oranges	1 845	26,0%	259	14,1%	1 585	2 104	**Navel Oranges**
Sugar beets	0	0,0%	0	0,0%	0	0	**Sugar beets**
Wheat	164	2,3%	59	35,6%	106	223	**Wheat**
Barley	193	2,7%	75	38,7%	118	268	**Barley**
Fodder	672	9,5%	158	23,5%	514	830	**Fodder**
Fruits	1 416	20,0%	209	14,8%	1 207	1 626	**Fruits, other**
Mkt Gardening	107	1,5%	36	33,4%	71	142	**Vegetables**
Fallow	1 355	19,1%	213	15,7%	1 142	1 568	**Fallow**
Non-Agr.	795	11,2%	88	11,0%	707	882	**Non-Agr.**
Total	**7 098**	**100%**					**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

HECTARES OF MAIN CROPS AND MARGIN OF PRECISION IN ZEBRA'S IRRIGATED PERIMETER: APRIL 2012



PIE CHART OF MAIN CROPS IN ZEBRA'S IRRIGATED PERIMETER: APRIL 2012

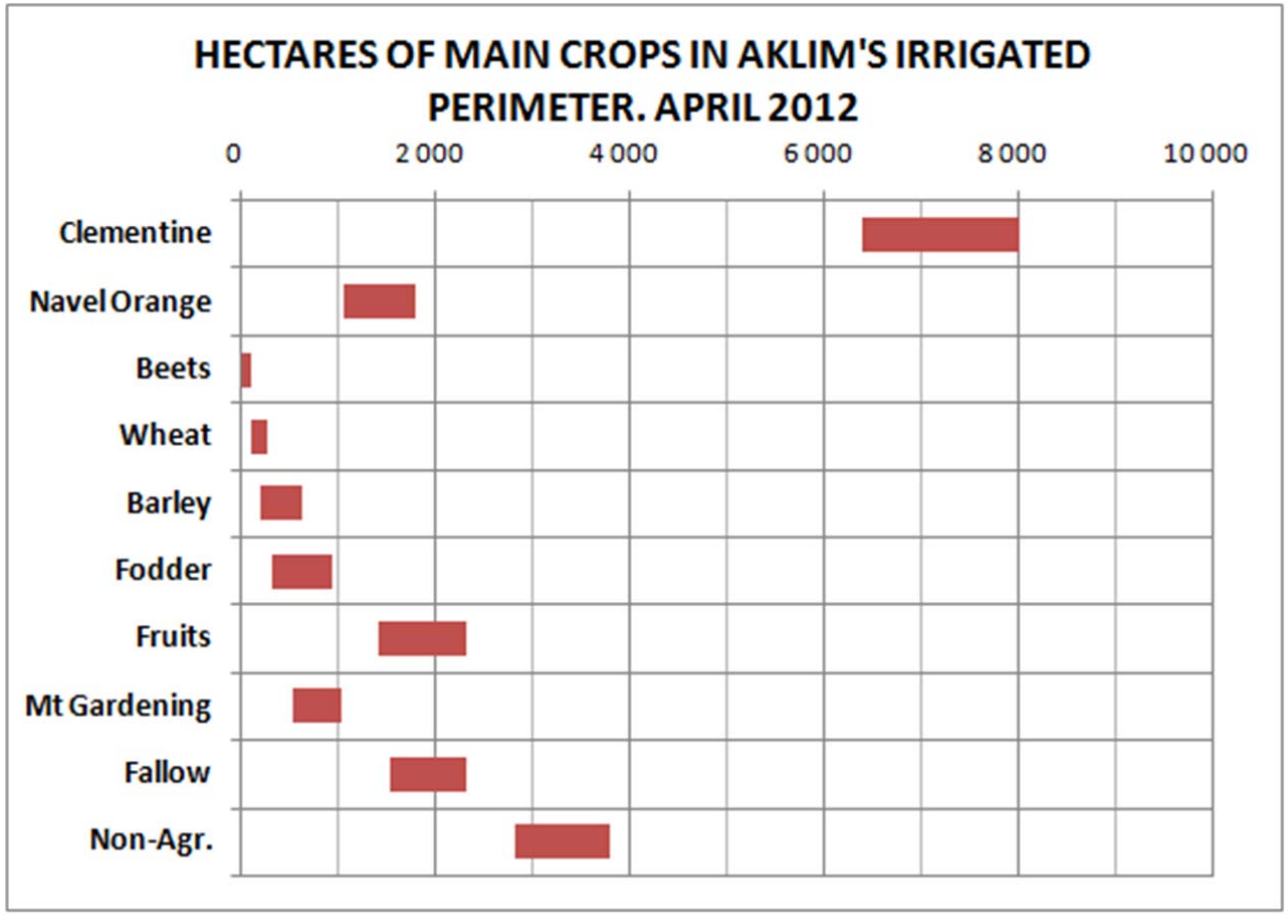


HECTARES OF MAIN CROPS IN AKLIM'S IRRIGATED PERIMETER: APRIL 2012

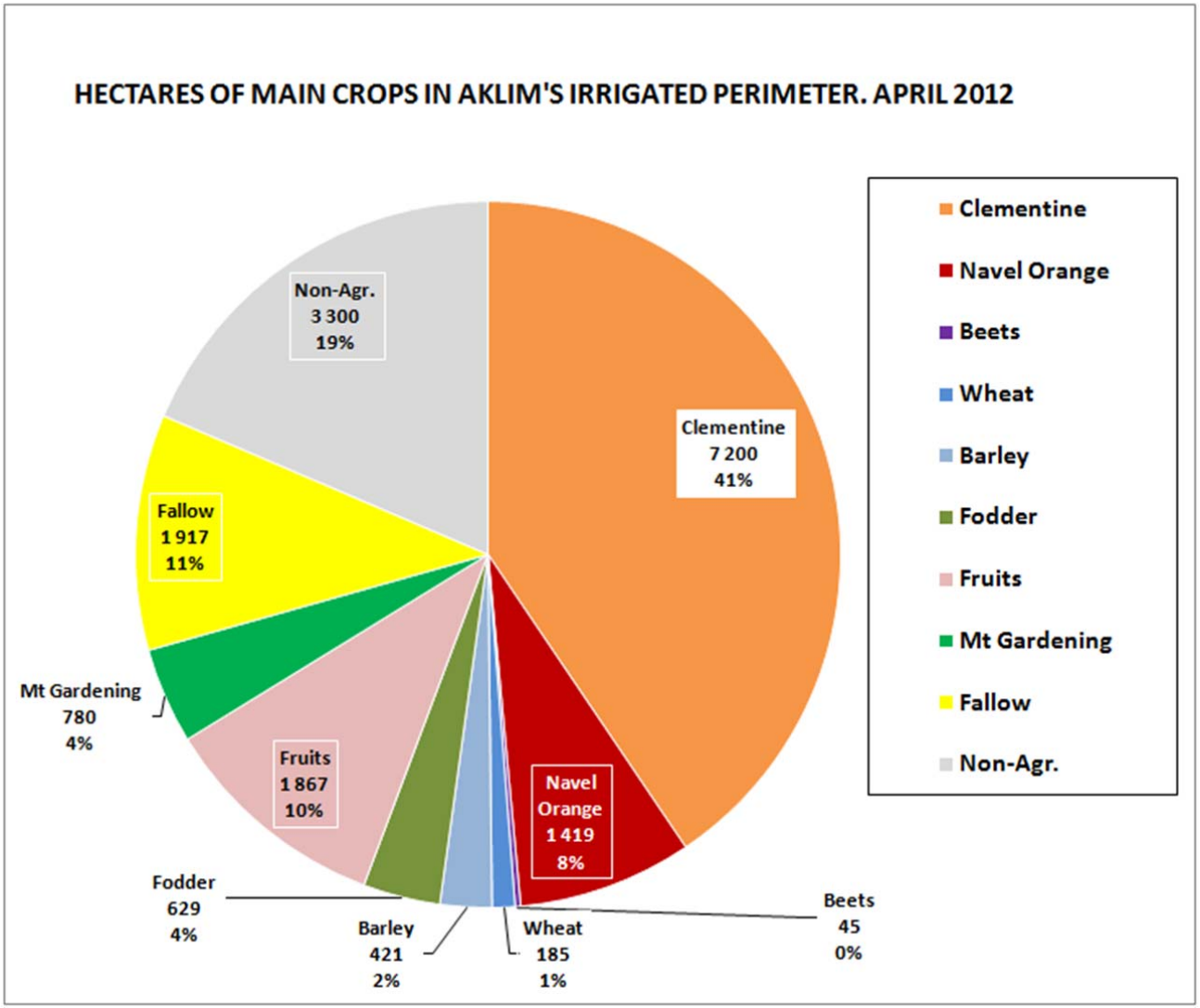
HECTARES OF MAIN CROPS IN AKLIM'S IRRIGATED PERIMETER. APRIL 2012							
Crops	**Hectares**	**Percent**	**Std Err**	**Cof Var**	**Low**	**High**	**Land Use**
Clementine	7 200	40,5%	800	11,1%	6 400	8 000	**Clementine**
Navel Orange	1 419	8,0%	364	25,7%	1 055	1 783	**Navel Orange**
Sugar beets	45	0,3%	54	119,6%	-9	100	**Sugar beets**
Wheat	185	1,0%	95	51,1%	91	280	**Wheat**
Barley	421	2,4%	216	51,4%	204	637	**Barley**
Fodder	629	3,5%	306	48,7%	323	935	**Fodder**
Fruits	1 867	10,5%	443	23,8%	1 423	2 310	**Fruits, other**
Mkt Gardening	780	4,4%	257	32,9%	524	1 037	**Vegetables**
Fallow	1 917	10,8%	391	20,4%	1 526	2 308	**Fallow**
Non-Agr.	3 300	18,6%	487	14,8%	2 813	3 787	**Non-Agr.**
Total	**17 763**	**100%**					**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

HECTARES OF MAIN CROPS AND MARGIN OF PRECISION IN AKLIM'S IRRIGATED PERIMETER: APRIL 2012



PIE CHART: MAIN CROPS IN AKLIM'S IRRIGATED PERIMETER: APRIL 2012

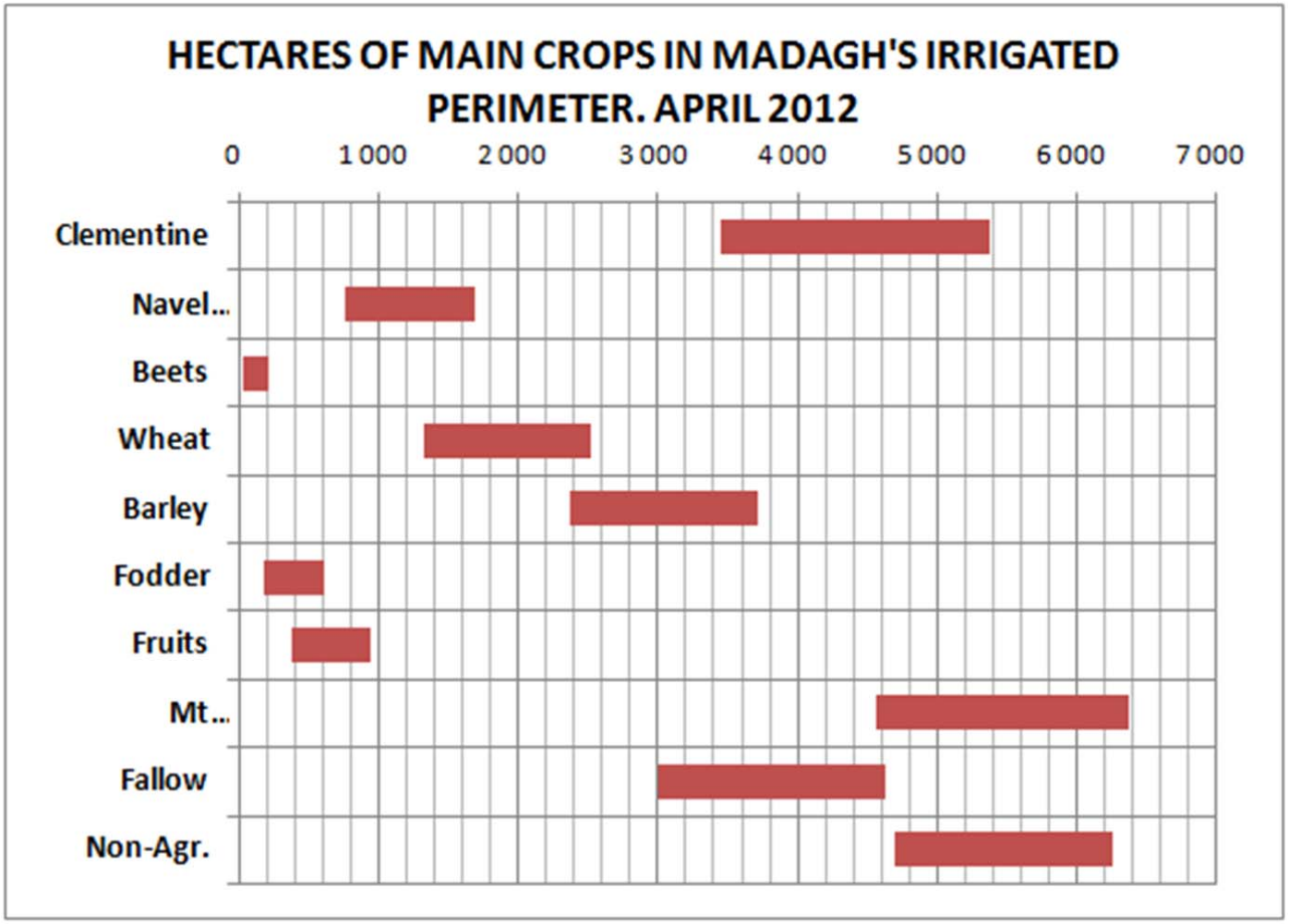


HECTARES OF MAIN CROPS IN MADAGH'S IRRIGATED PERIMETER: APRIL 2012

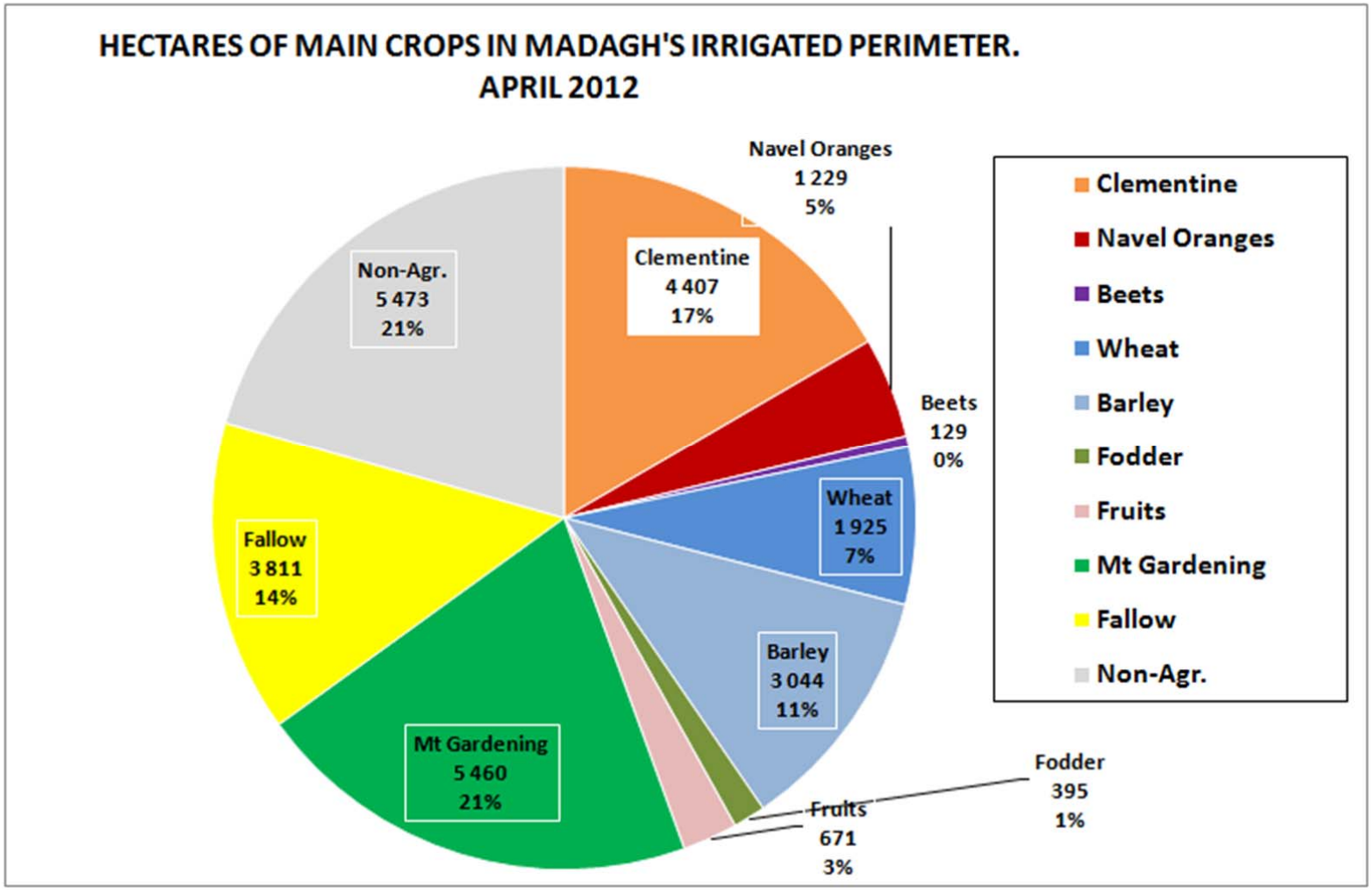
HECTARES OF MAIN CROPS IN MADAGH'S IRRIGATED PERIMETER. APRIL 2012							
Crops	**Hectares**	**Percent**	**Std Err**	**Cof Var**	**Low**	**High**	**Land Use**
Clementine	4 407	16,6%	965	21,9%	3 443	5 372	**Clementine**
Navel Oranges	1 229	4,6%	460	37,4%	769	1 689	**Navel Oranges**
Sugar beets	129	0,5%	93	71,9%	36	222	**Sugar beets**
Wheat	1 925	7,3%	592	30,8%	1 333	2 518	**Wheat**
Barley	3 044	11,5%	669	22,0%	2 376	3 713	**Barley**
Fodder	395	1,5%	214	54,2%	181	609	**Fodder**
Fruits	671	2,5%	282	42,0%	389	953	**Fruits, other**
Mkt Gardening	5 460	20,6%	905	16,6%	4 554	6 365	**Vegetables**
Fallow	3 811	14,4%	816	21,4%	2 995	4 627	**Fallow**
Non-Agr.	5 473	20,6%	786	14,4%	4 687	6 259	**Non-Agr.**
Total	**26 545**	**100%**					**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

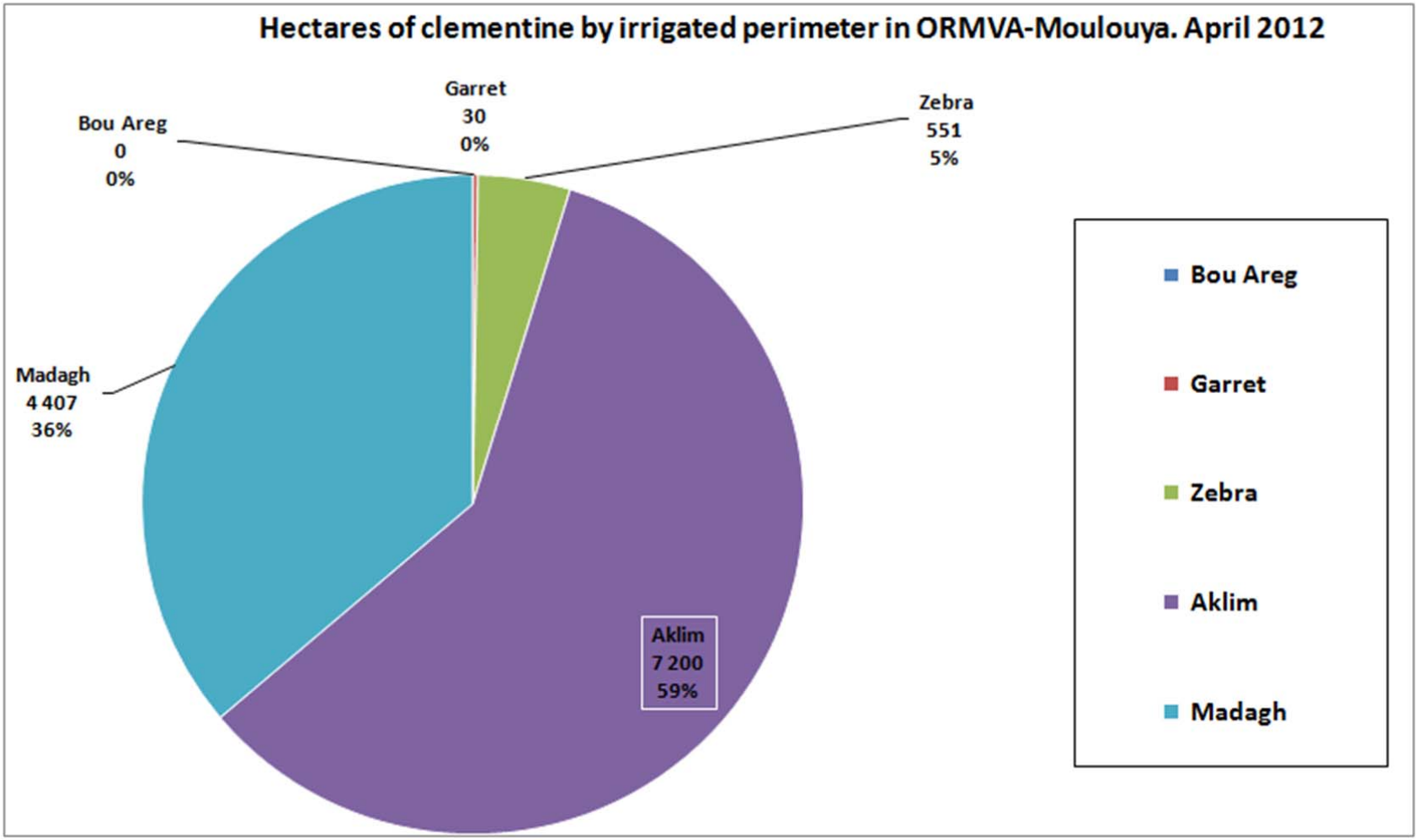
HECTARES OF MAIN CROPS AND MARGIN OF PRECISION IN MADAGH'S IRRIGATED PERIMETER: APRIL 2012



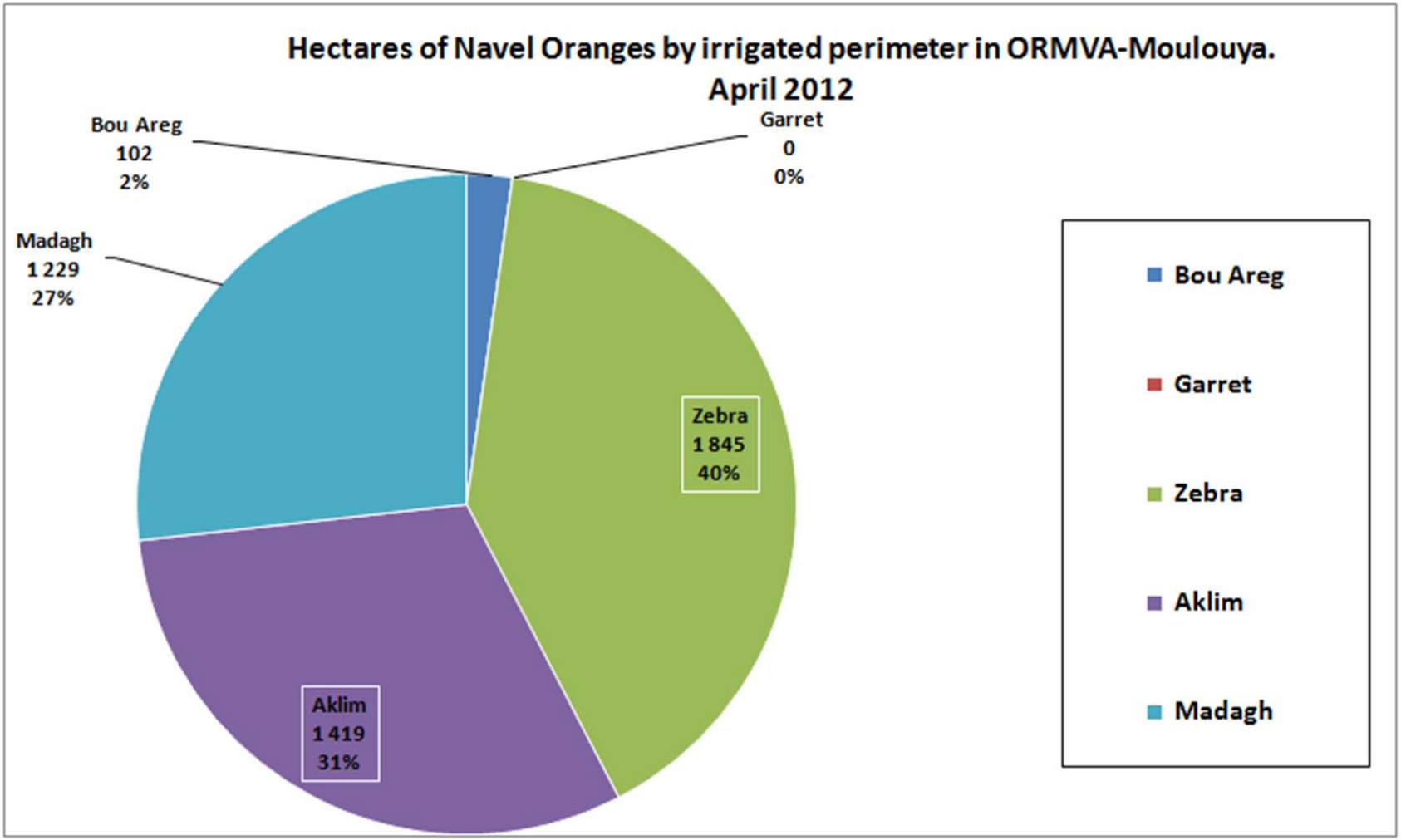
PIE CHART: MAIN CROPS IN MADAGH'S IRRIGATED PERIMETER: APRIL 2012



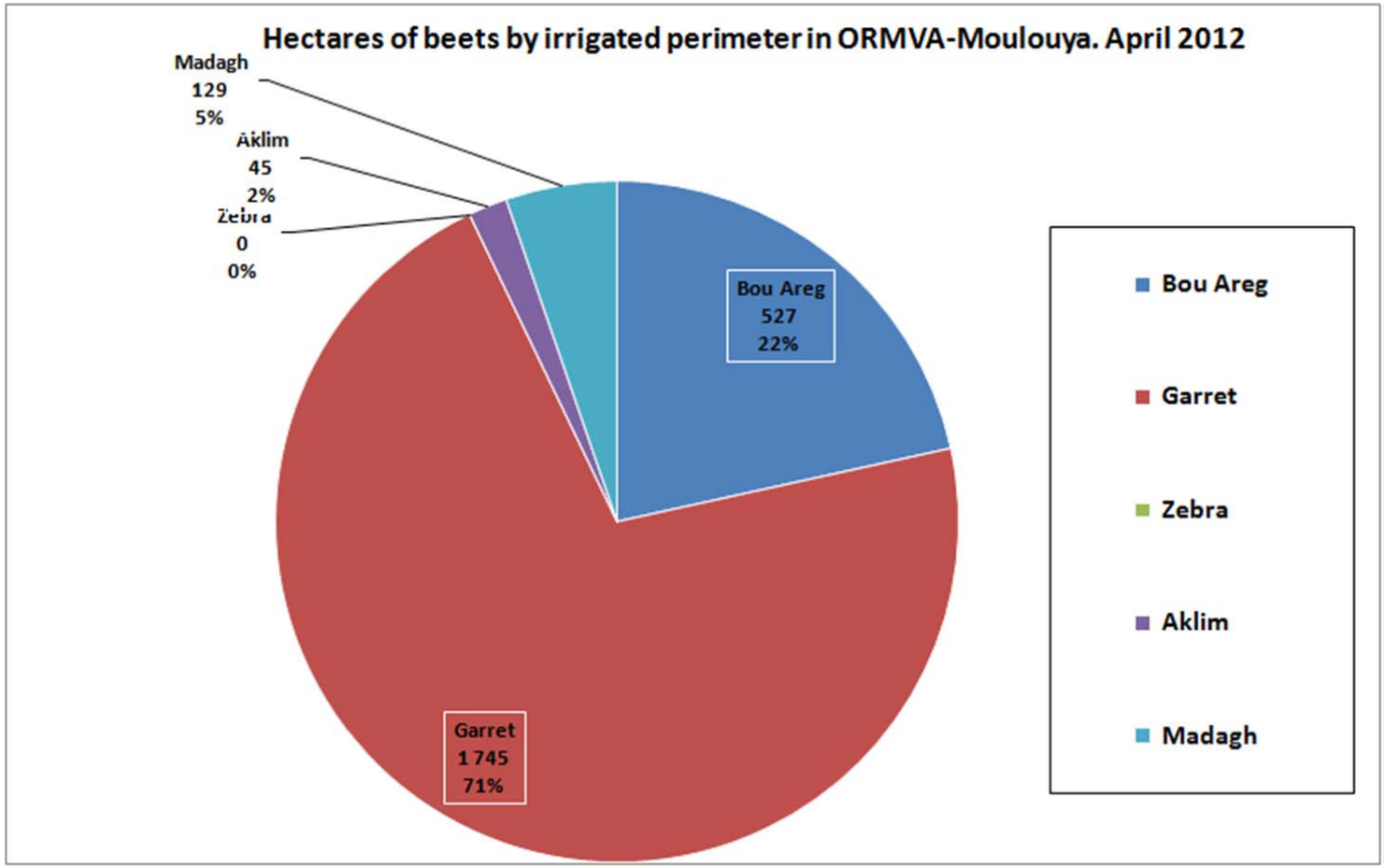
PIE CHART: HECTARES OF CLEMENTINE PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



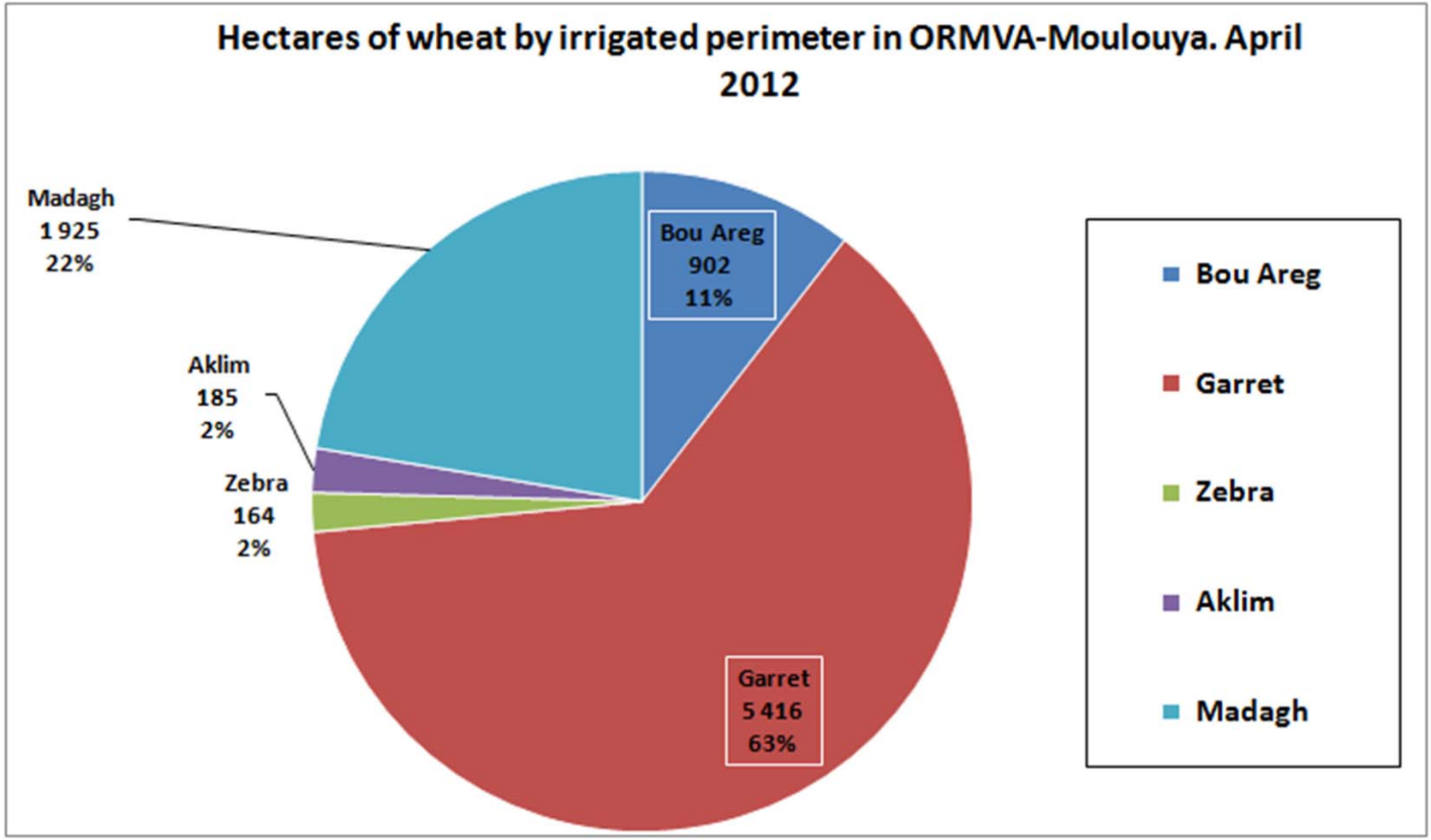
PIE CHART: HECTARES OF NAVEL ORANGE PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



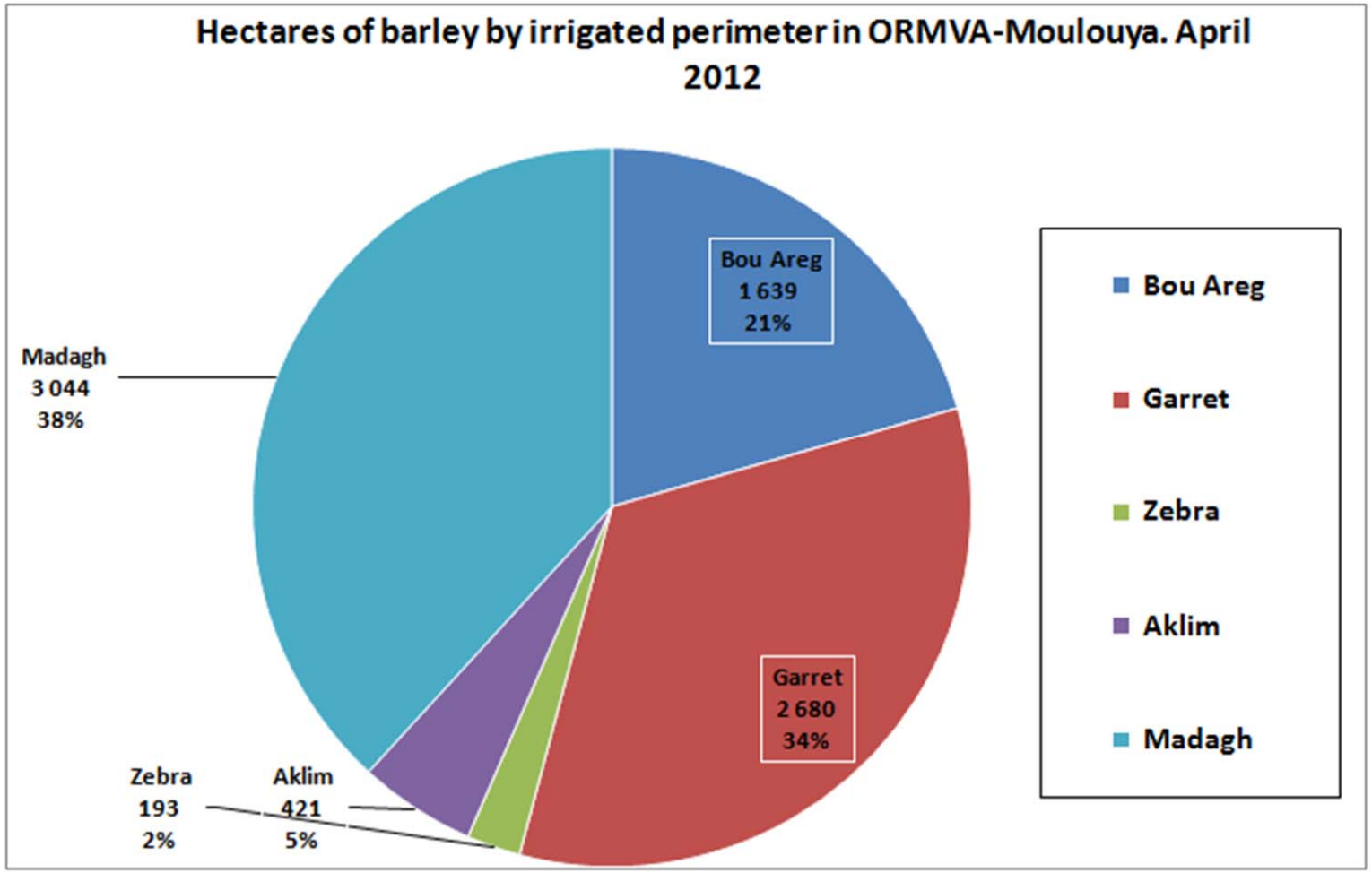
PIE CHART: HECTARES OF SUGAR BEETS PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



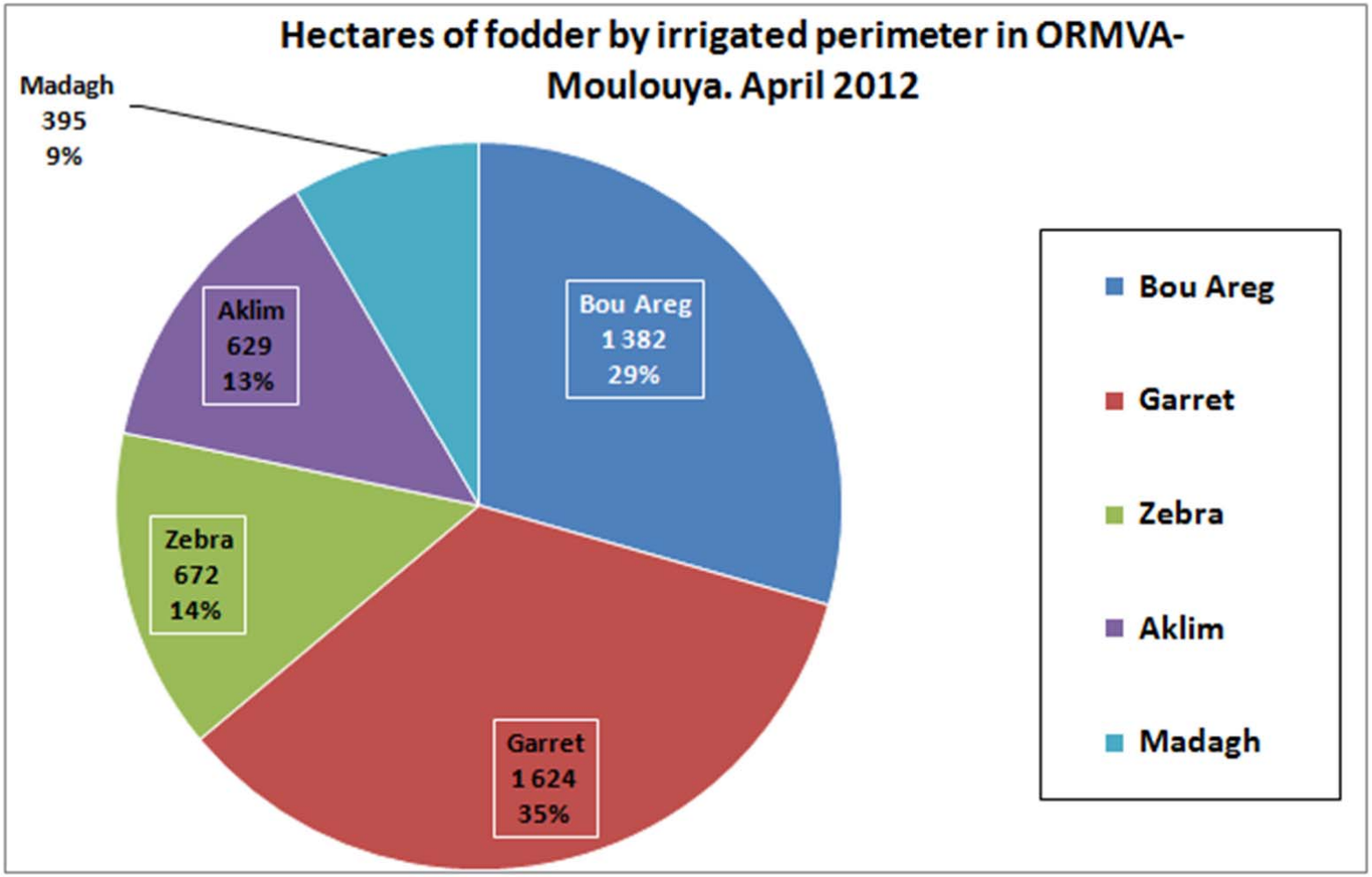
PIE CHART: HECTARES OF WHEAT PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



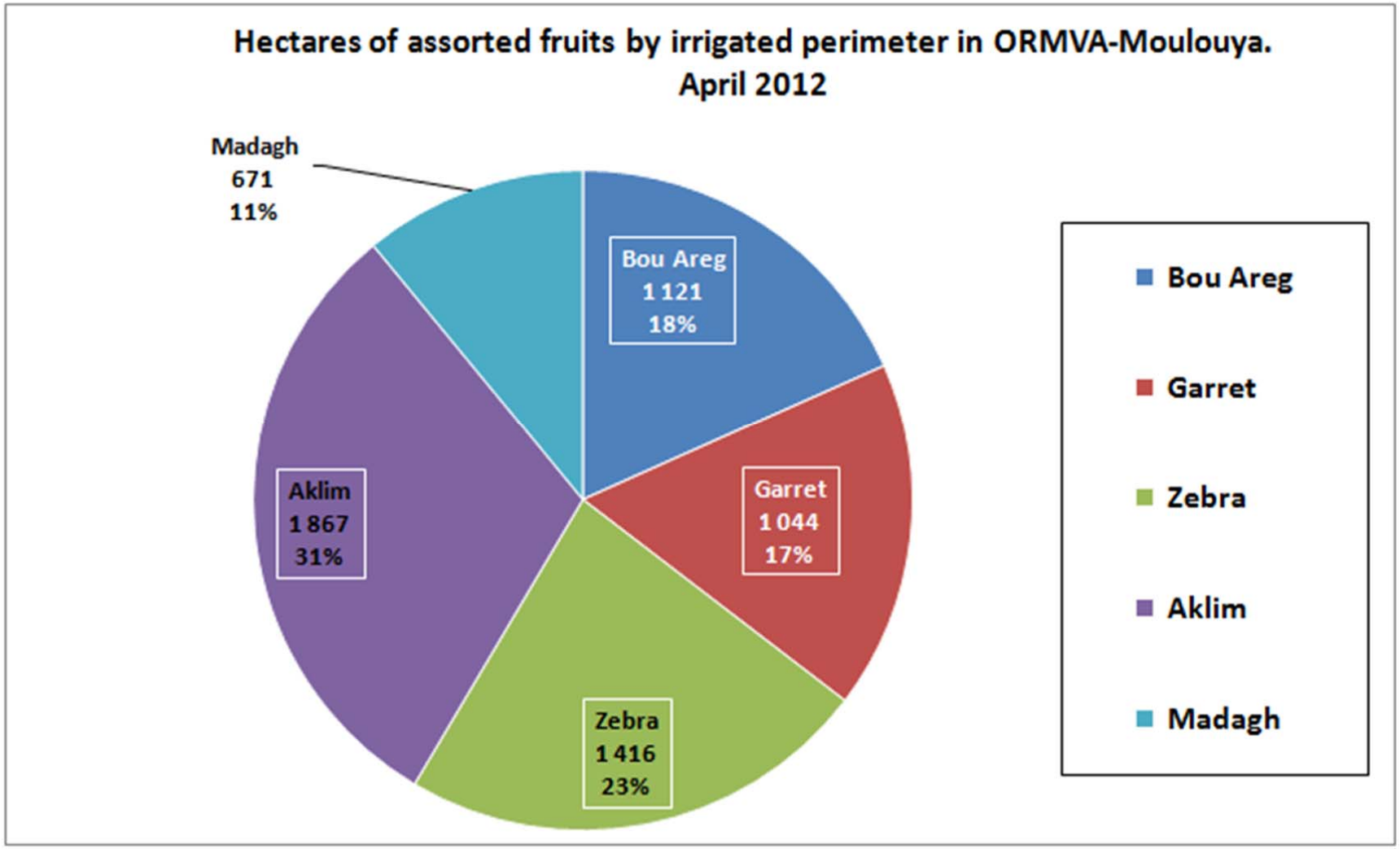
PIE CHART: HECTARES OF BARLEY PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



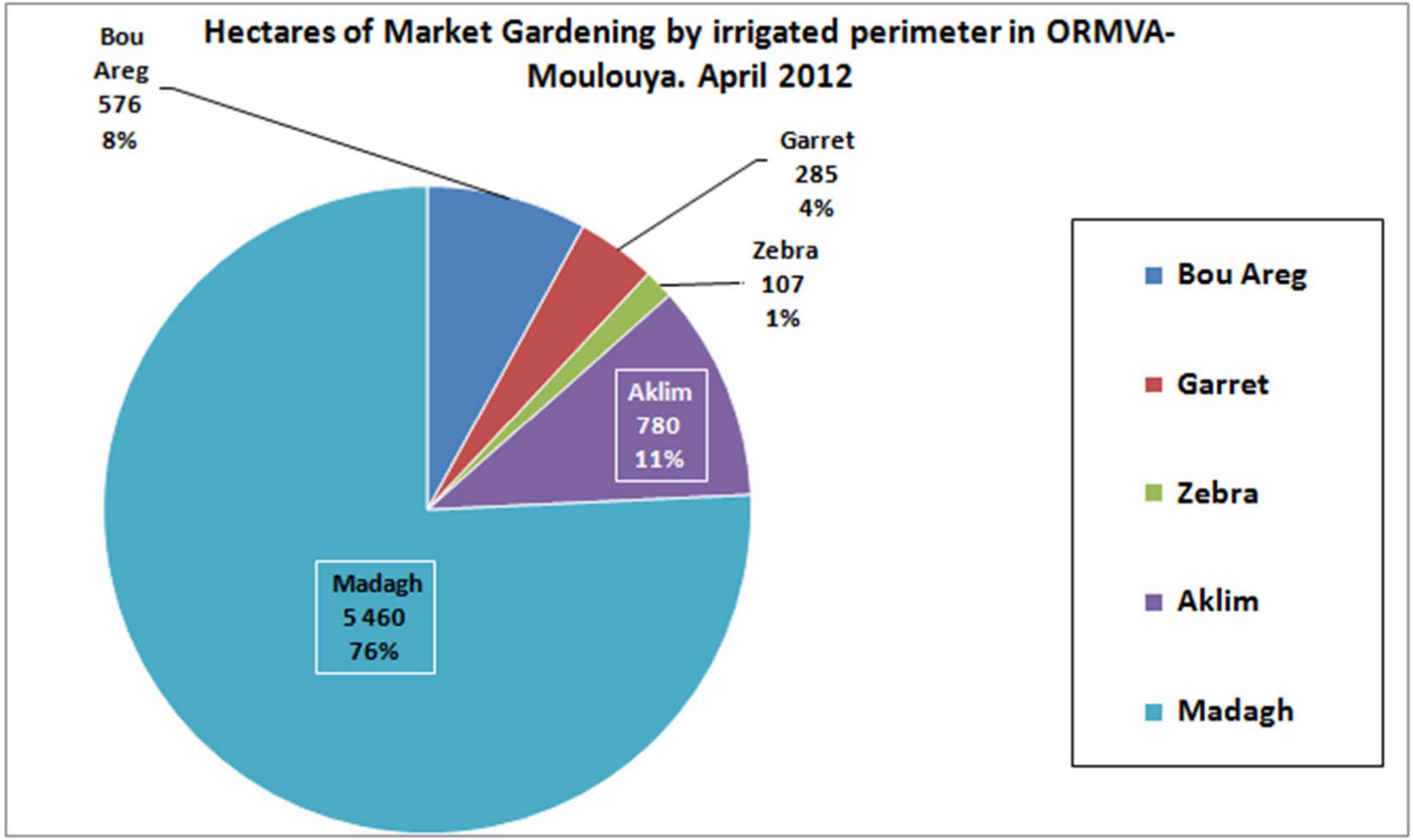
PIE CHART: HECTARES OF FODDER PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



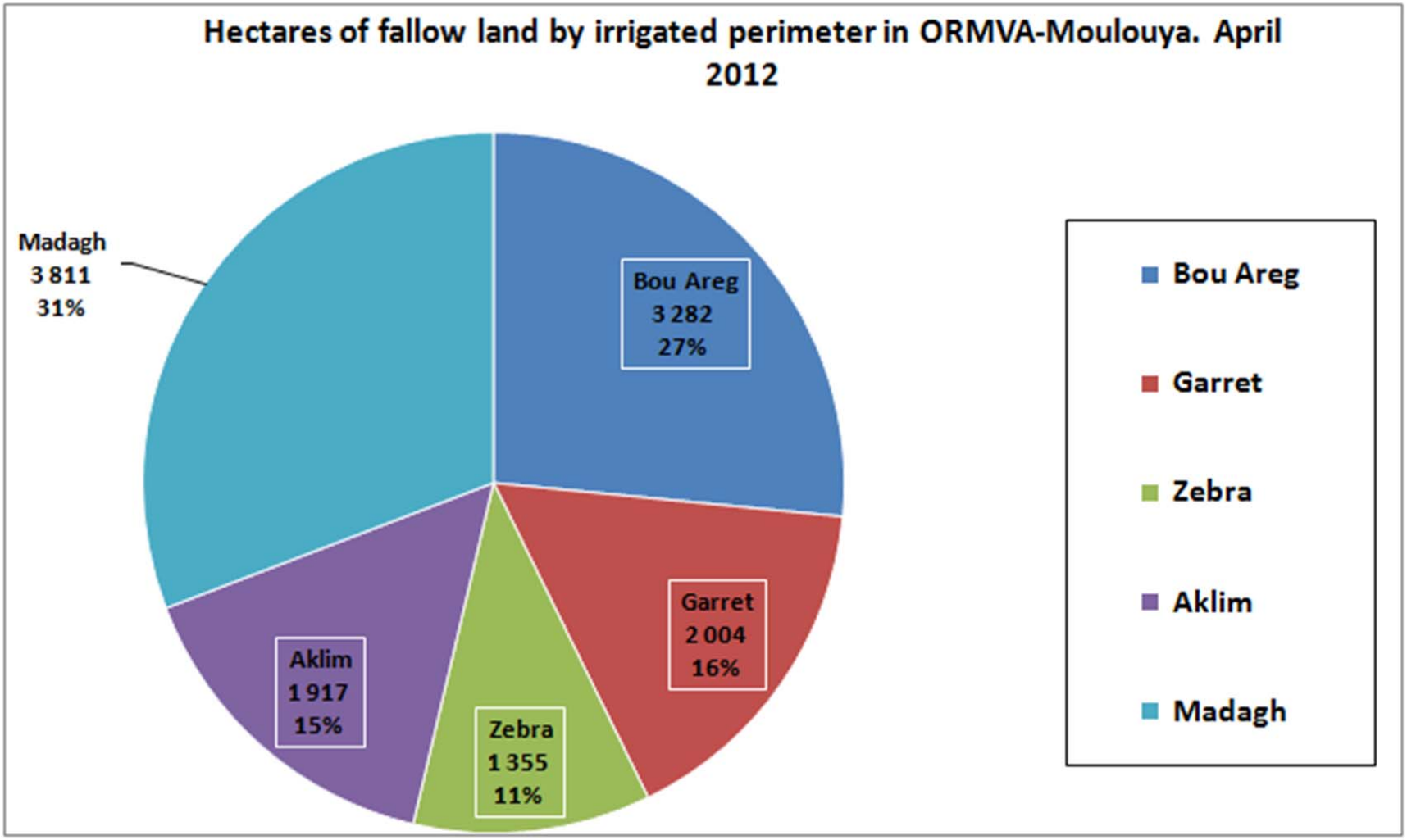
PIE CHART: HECTARES OF ASSORTED FRUITS PER IRRIGATED PERIMETER IN ORMVA MOULOUYA: APRIL 2012



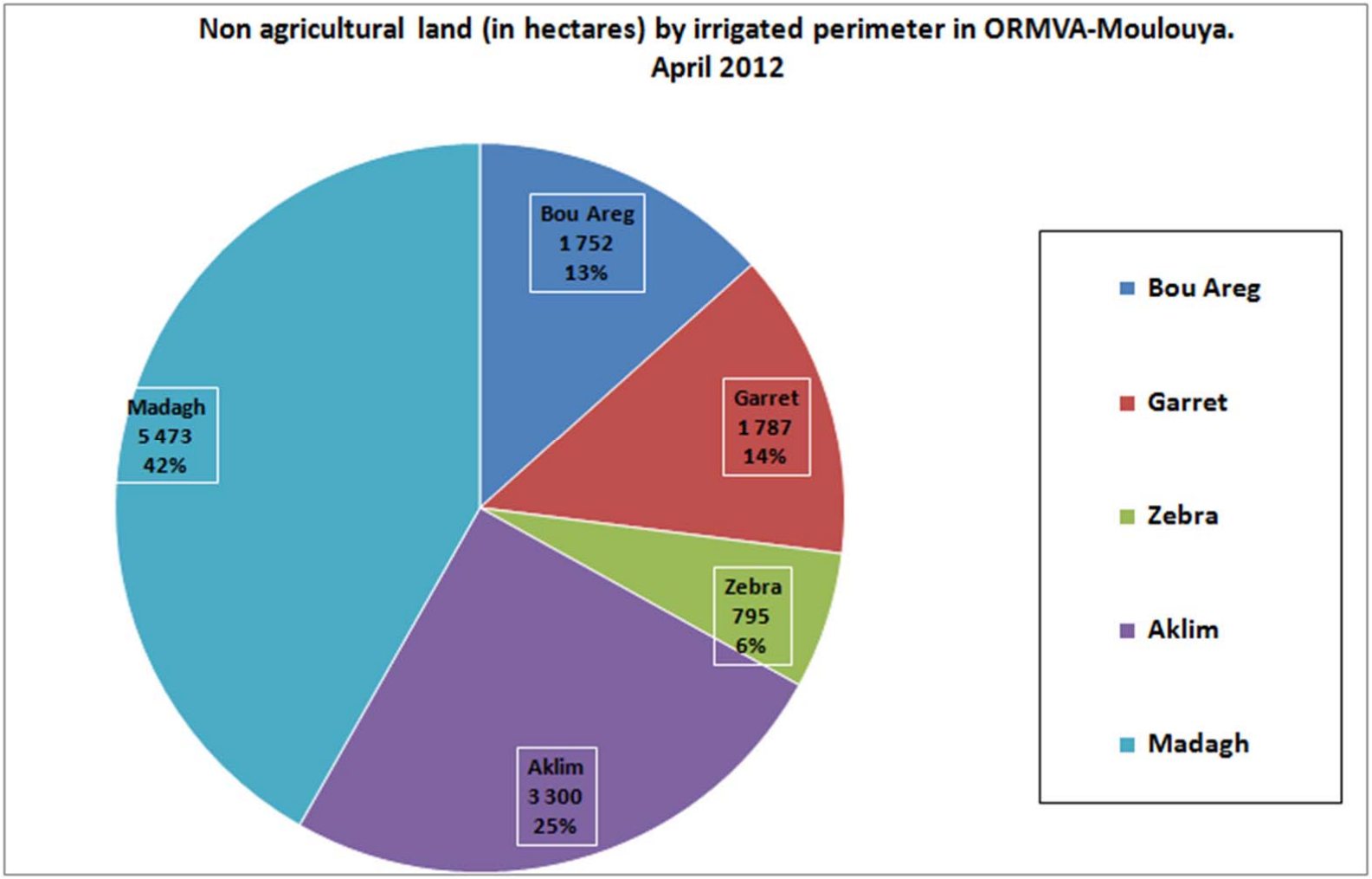
PIE CHART: HECTARES OF MARKET GARDENING CROPS PER IRRIGATED PERIMETER IN ORMVA MOULOUYA: APRIL 2012



PIE CHART: HECTARES OF FALLOW LAND PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012



PIE CHART: NON AGRICULTURAL LAND (IN HECTARES) PER IRRIGATED PERIMETER IN ORMVA-MOULOUYA: APRIL 2012

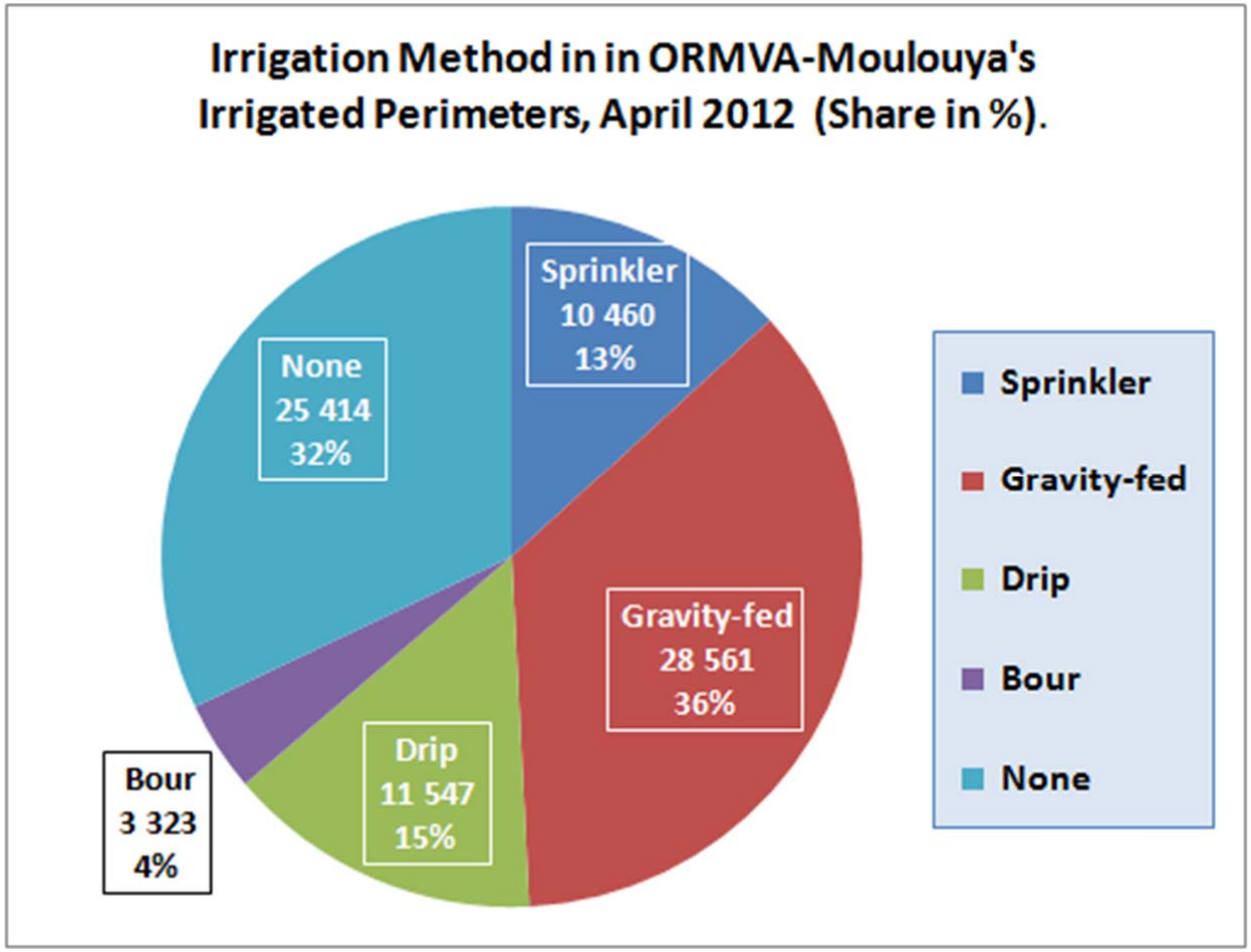


IRRIGATION METHOD IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012 (HECTARES)

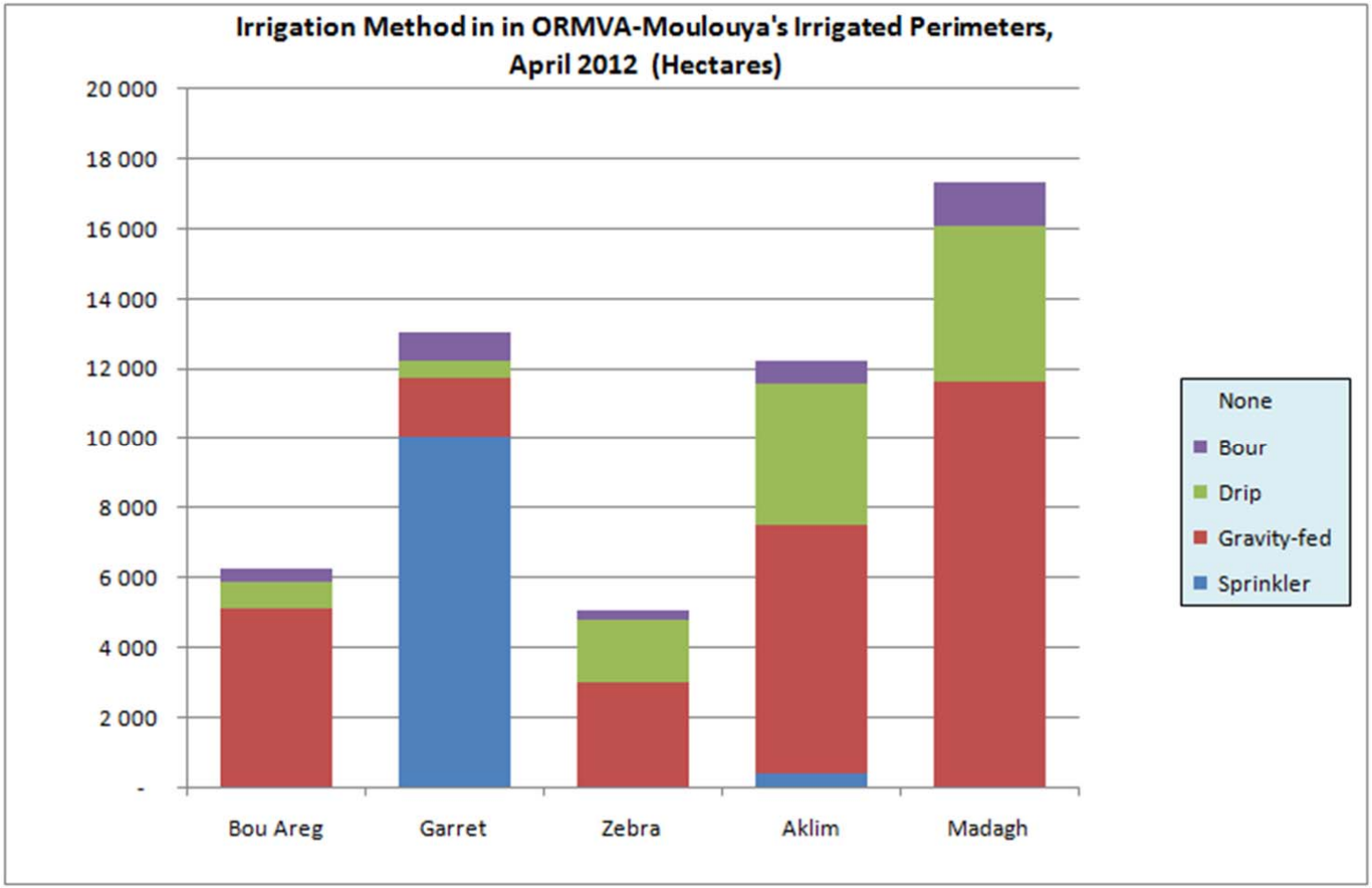
IRRIGATION METHOD IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS. APRIL 2012 (HECTARES)							
Perimeter	**Sprinkler**	**Gravity-fed**	**Drip**	**Bour**	**None**	**Total**	**Perimeter**
Bou Areg	-	5 129	762	379	5 015	11 285	**Bou Areg**
Garret	10 074	1 688	452	819	3 581	16 615	**Garret**
Zebra	-	3 003	1 800	257	2 038	7 098	**Zebra**
Aklim	386	7 105	4 090	639	5 543	17 763	**Aklim**
Madagh	-	11 636	4 443	1 229	9 236	26 545	**Madagh**
Total	**10 460**	**28 561**	**11 547**	**3 323**	**25 414**	**79 305**	**Total**

Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.

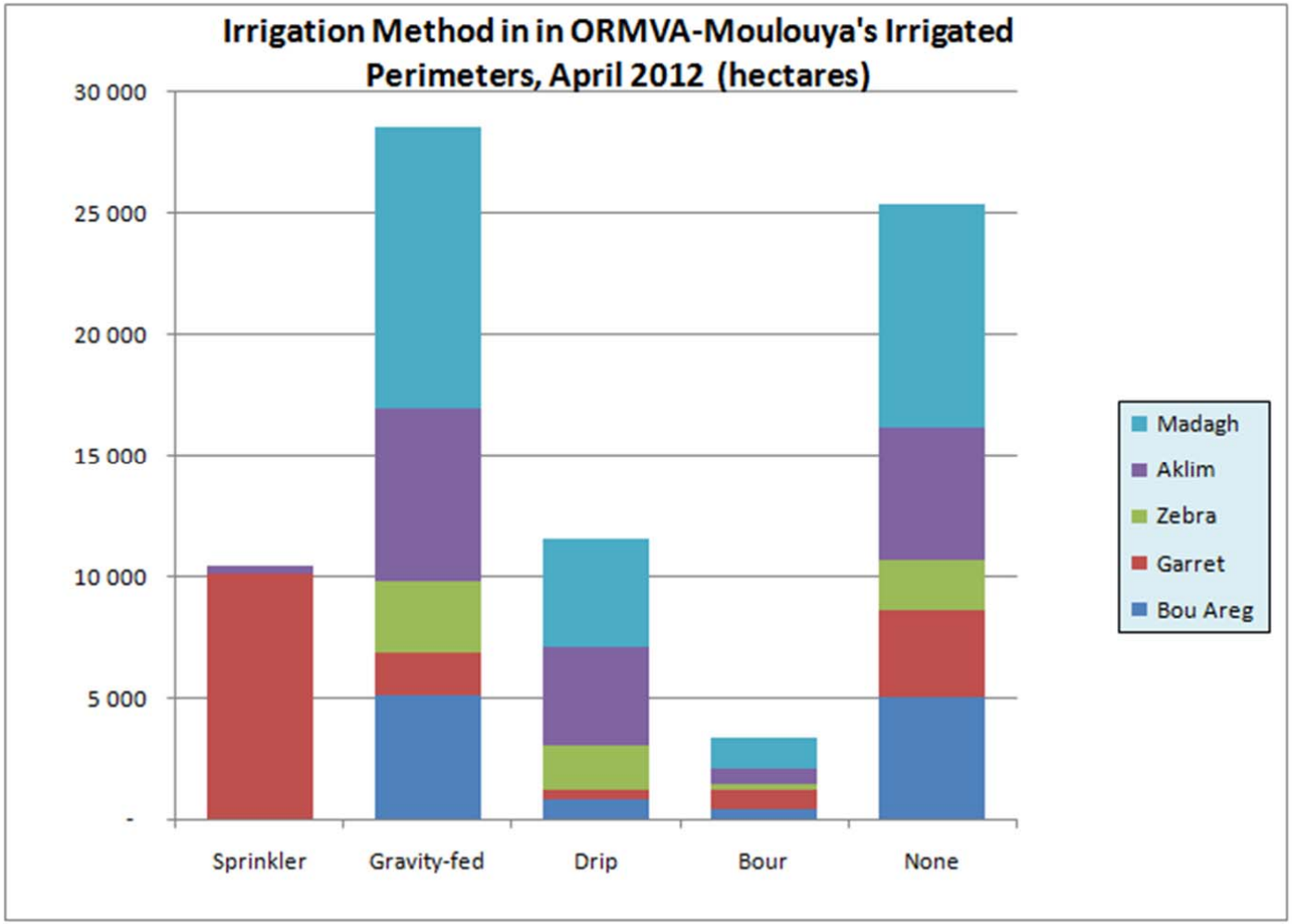
PIE CHART: IRRIGATION METHOD IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012 (HECTARES)



IRRIGATION METHOD IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS (HECTARES)

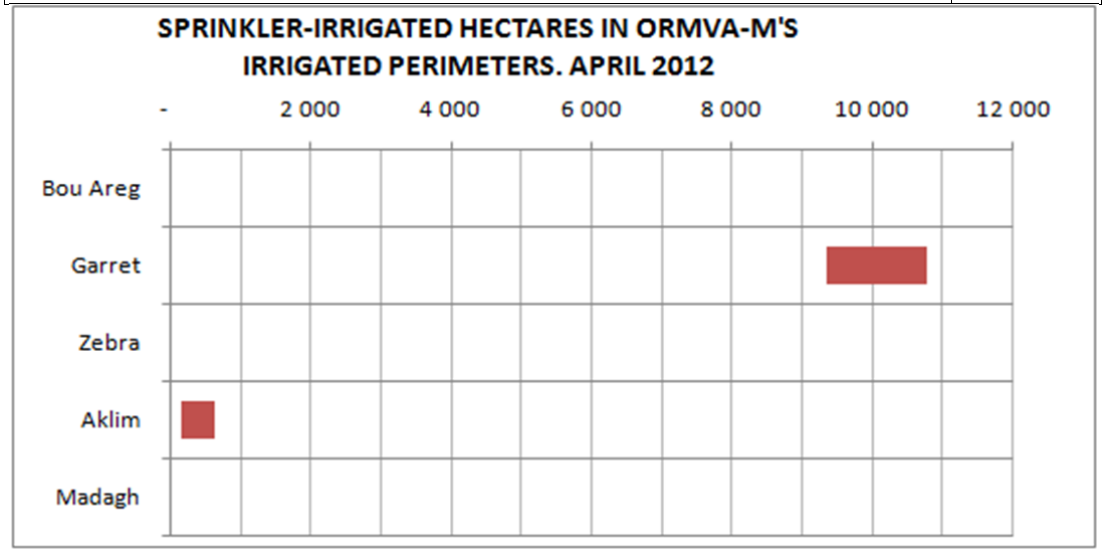


IRRIGATION METHOD BY IRRIGATED PERIMETER (HECTARES)



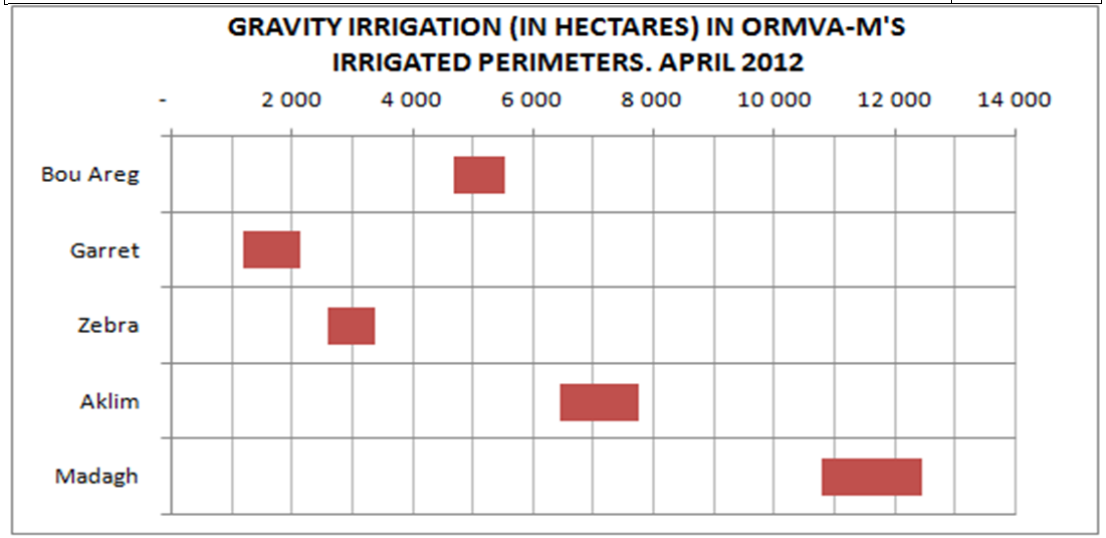
SPRINKLER-IRRIGATED HECTARES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

SPRINKLER-IRRIGATED HECTARES IN ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012							
Perimeter	**Has**	**Percent**	**Std Err**	**Coff Var**	**Low**	**High**	**Perimeter**
Bou Areg	-	0,0%	-	0,0%	-	-	**Bou Areg**
Garret	10 074	96,3%	724	7,2%	9 350	10 798	**Garret**
Zebra	-	0,0%	-	0,0%	-	-	**Zebra**
Aklim	386	3,7%	245	63,6%	141	631	**Aklim**
Madagh	-	0,0%	-	0,0%	-	-	**Madagh**
Total	**10 460**	**100,0%**	**764**	**7,3%**	**9 696**	**11 225**	**Total**
Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.							



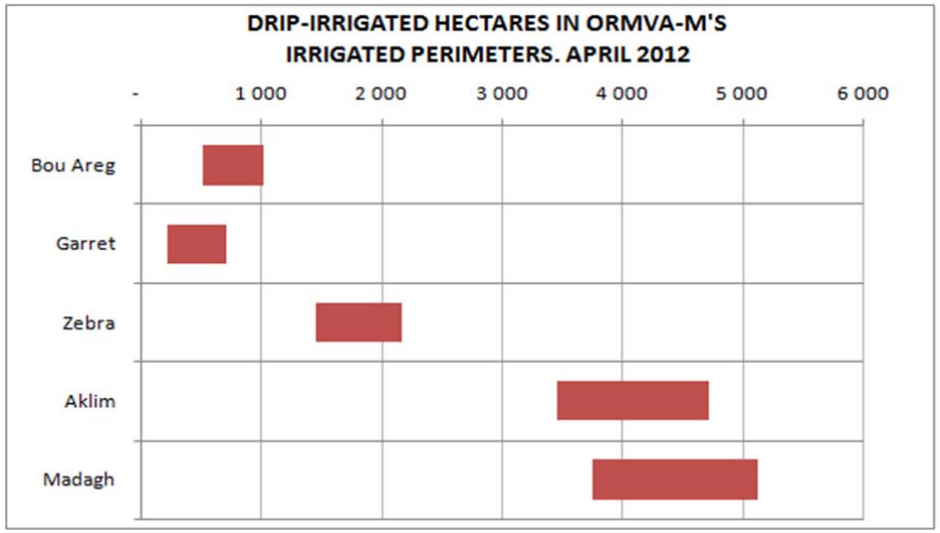
GRAVITY IRRIGATION (IN HECTARES) IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

GRAVITY IRRIGATION (IN HECTARES) IN ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012							
Perimeter	**Has**	**Percent**	**Std Err**	**Coff Var**	**Low**	**High**	**Perimeter**
Bou Areg	5 129	18,0%	433	8,4%	4 696	5 562	**Bou Areg**
Garret	1 688	5,9%	465	27,5%	1 223	2 154	**Garret**
Zebra	3 003	10,5%	384	12,8%	2 619	3 387	**Zebra**
Aklim	7 105	24,9%	655	9,2%	6 450	7 761	**Aklim**
Madagh	11 636	40,7%	821	7,1%	10 815	12 457	**Madagh**
Total	**28 561**	**100,0%**	**1 286**	**4,5%**	**27 275**	**29 847**	**Total**
Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.							



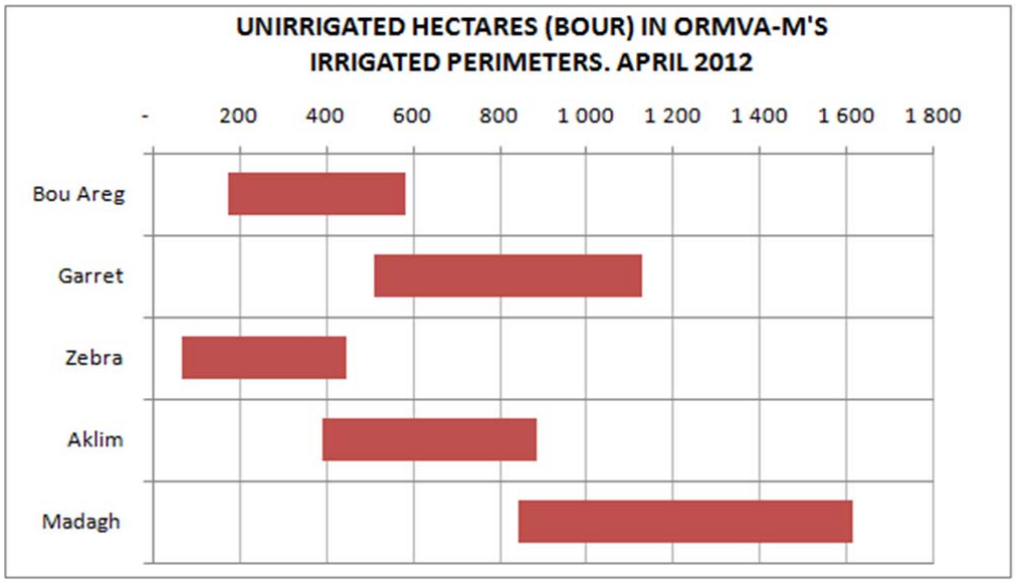
DRIP-IRRIGATED HECTARES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

DRIP-IRRIGATED HECTARES IN ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012							
Perimeter	**Has**	**Percent**	**Std Err**	**Coff Var**	**Low**	**High**	**Perimeter**
Bou Areg	762	6,6%	256	33,5%	507	1 018	**Bou Areg**
Garret	452	3,9%	244	53,9%	208	696	**Garret**
Zebra	1 800	15,6%	359	20,0%	1 440	2 159	**Zebra**
Aklim	4 090	35,4%	634	15,5%	3 456	4 724	**Aklim**
Madagh	4 443	38,5%	692	15,6%	3 751	5 135	**Madagh**
Total	**11 547**	**100,0%**	**1 065**	**9,2%**	**10 482**	**12 612**	**Total**
Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.							

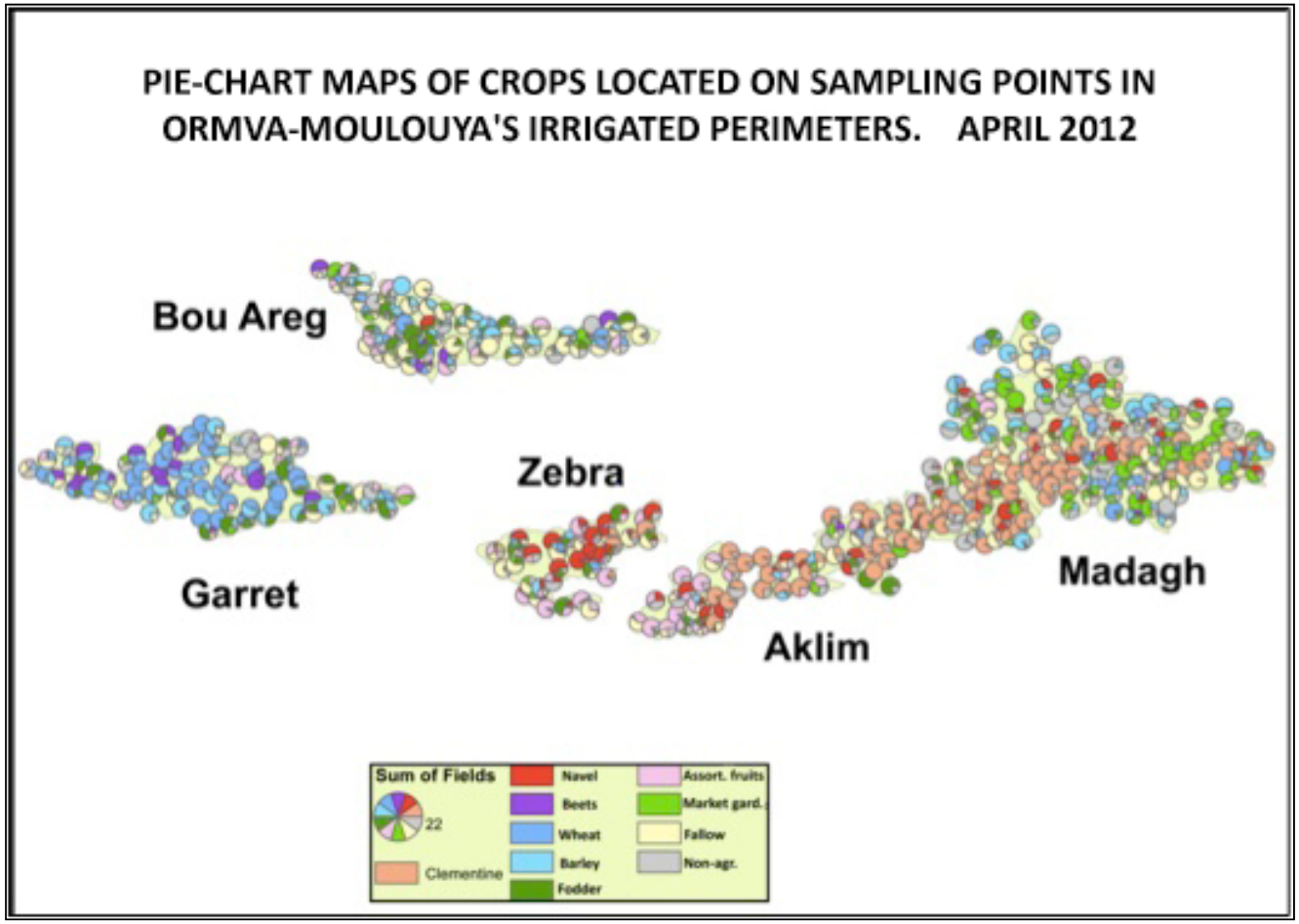


UNIRRIGATED (BOUR) HECTARES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012

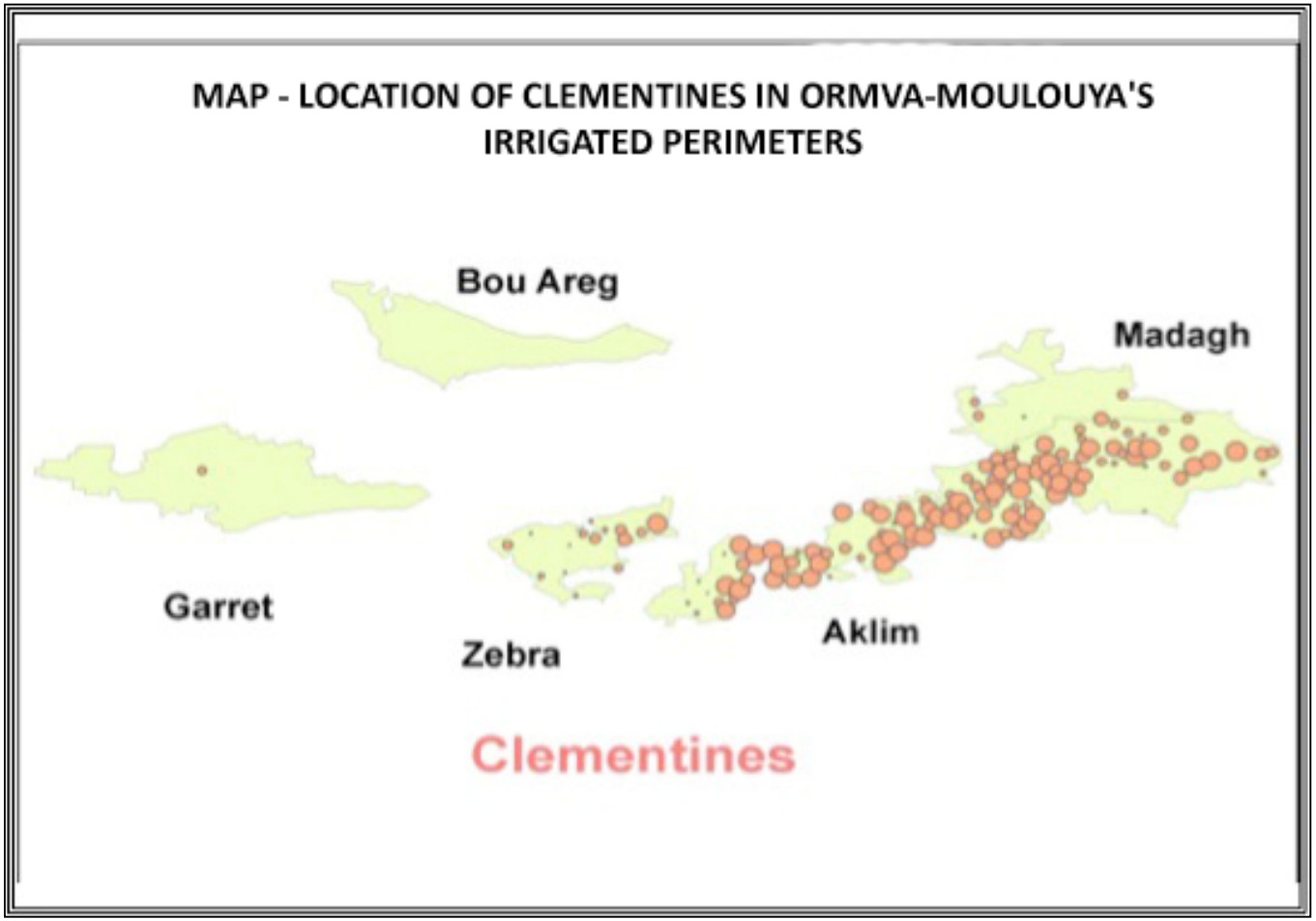
UNIRRIGATED HECTARES (BOUR) IN ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012							
Perimeter	**Has**	**Percent**	**Std Err**	**Coff Var**	**Low**	**High**	**Perimeter**
Bou Areg	379	11,4%	203	53,7%	175	582	**Bou Areg**
Garret	819	24,7%	308	37,6%	511	1 127	**Garret**
Zebra	257	7,7%	191	74,2%	66	448	**Zebra**
Aklim	639	19,2%	247	38,6%	392	886	**Aklim**
Madagh	1 229	37,0%	385	31,3%	845	1 614	**Madagh**
Total	**3 323**	**100,0%**	**617**	**18,6%**	**2 706**	**3 940**	**Total**
Source: ORMVA-Moulouya/USAID/MEC. CROP AREA SURVEY, Oriental 2012.							



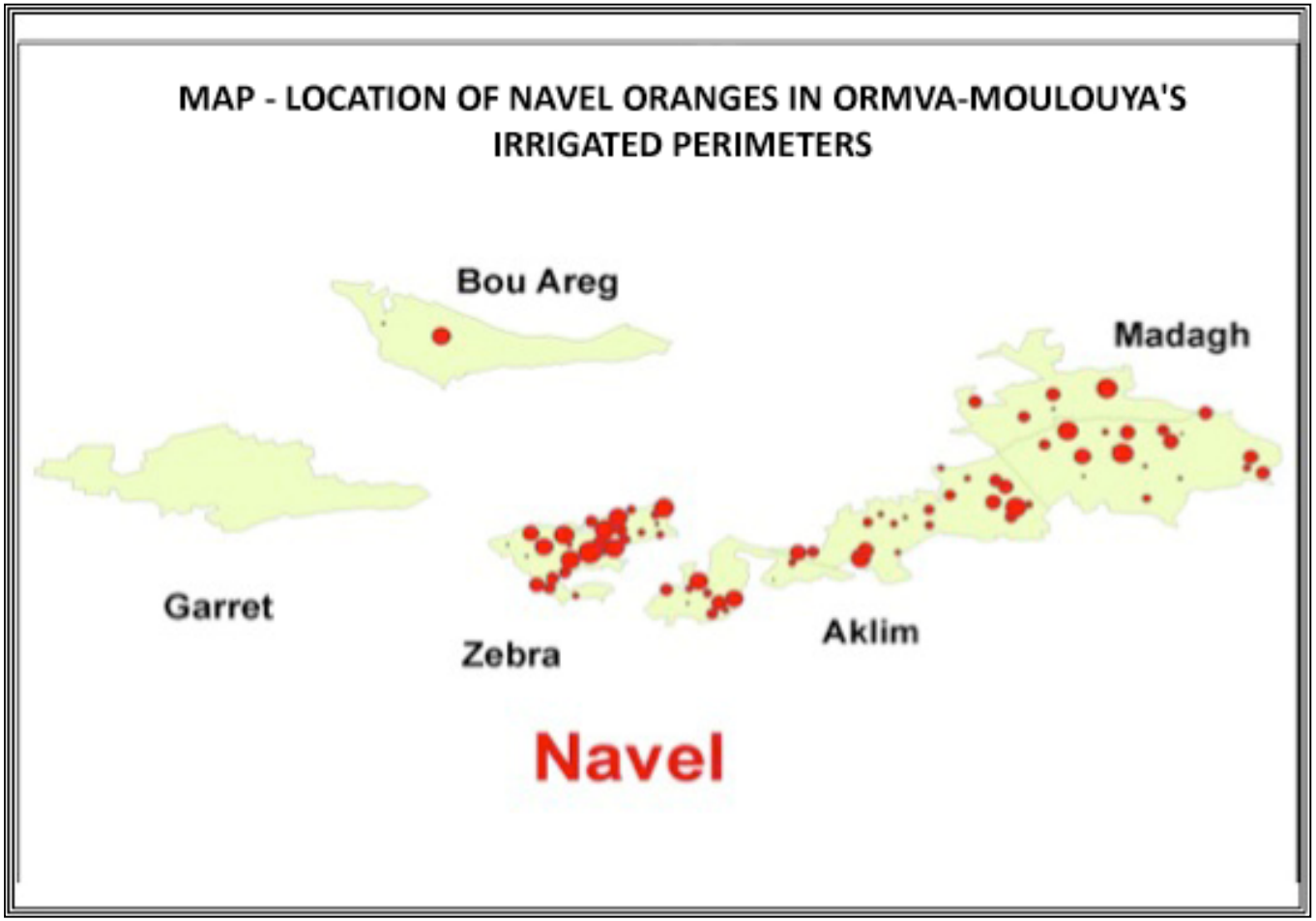
PIE-CHART MAPS OF CROPS LOCATED ON SAMPLING POINTS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



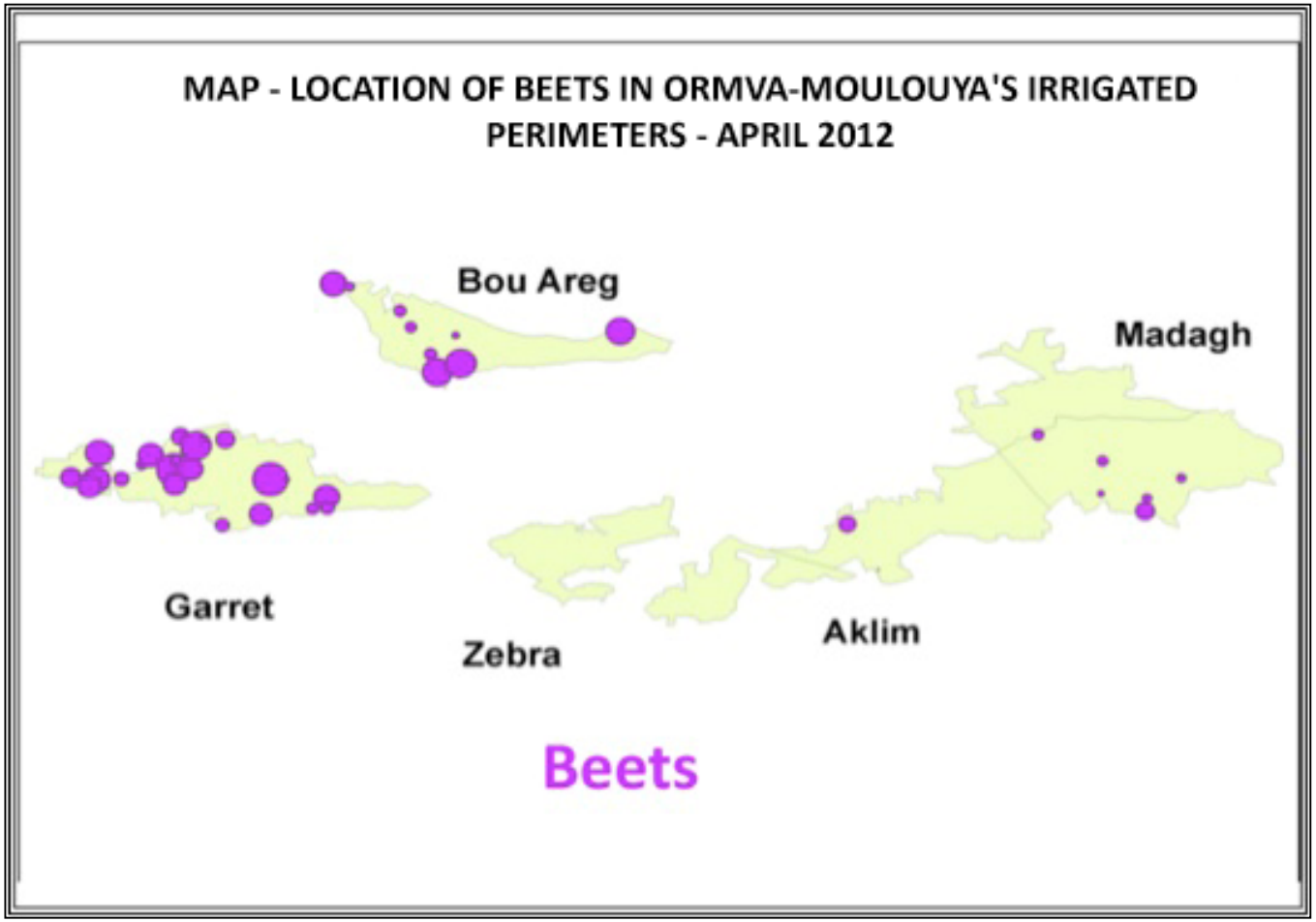
MAP - LOCATION OF CLEMENTINES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



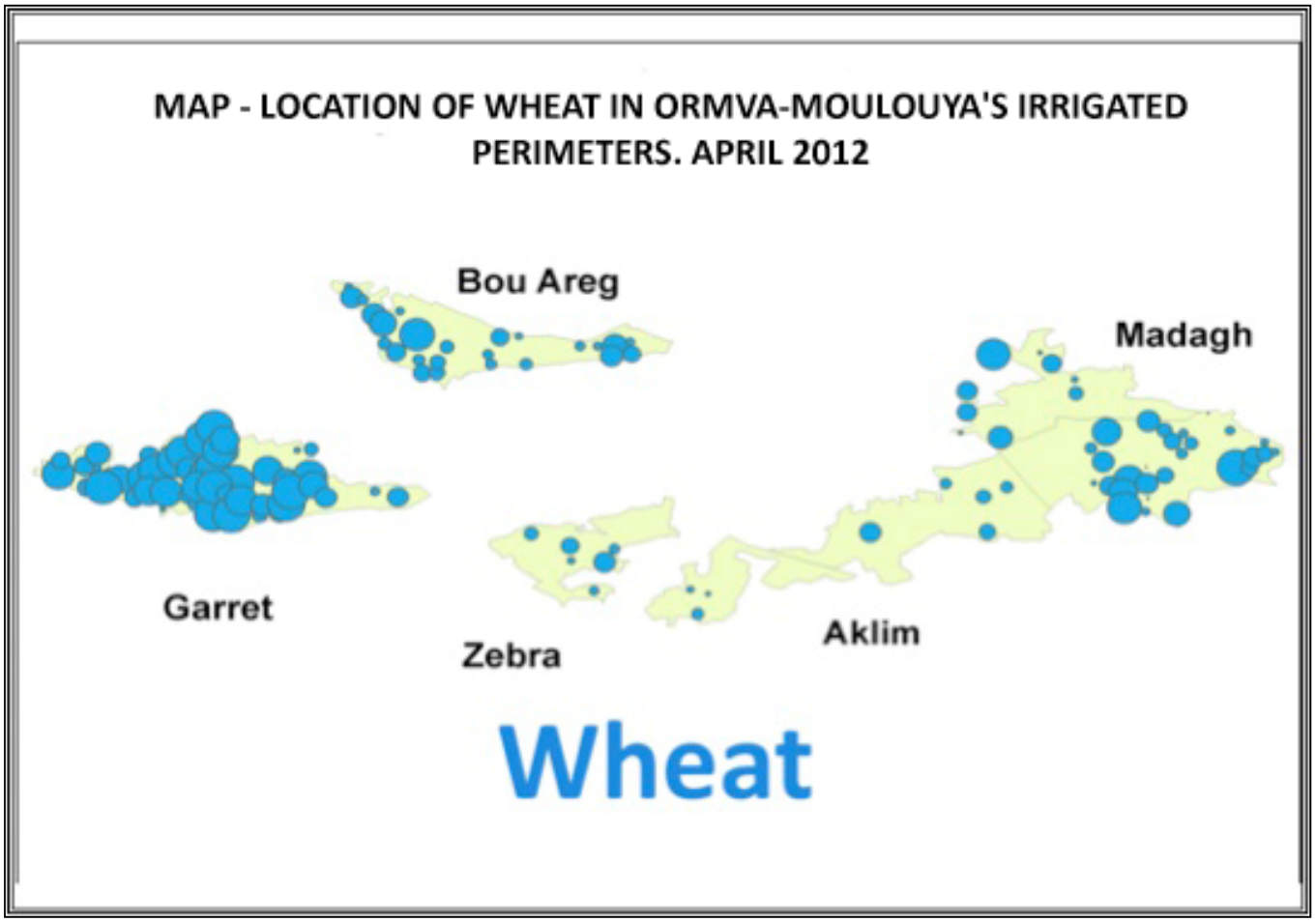
MAP - LOCATION OF NAVEL ORANGES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



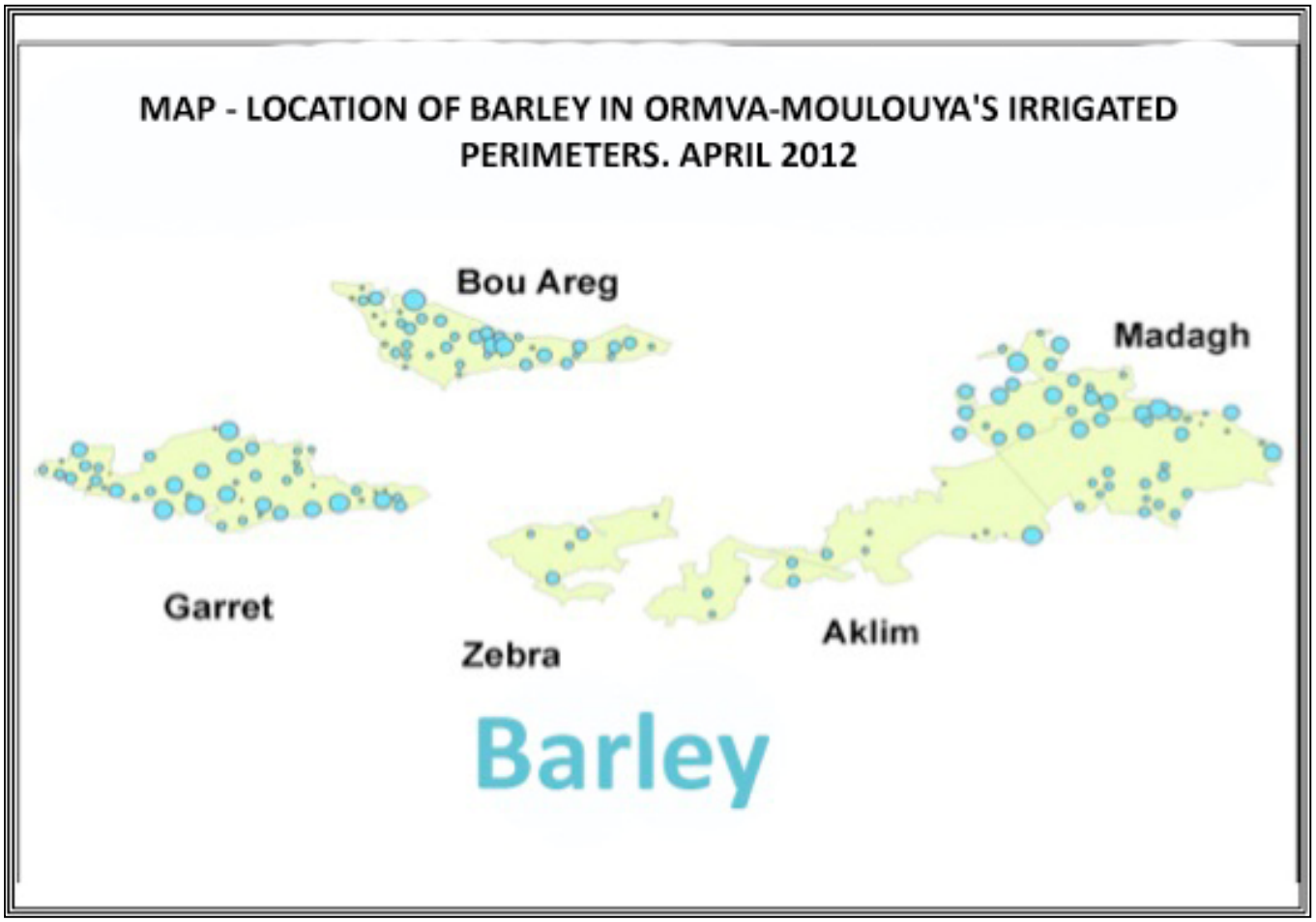
MAP - LOCATION OF SUGAR BEETS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



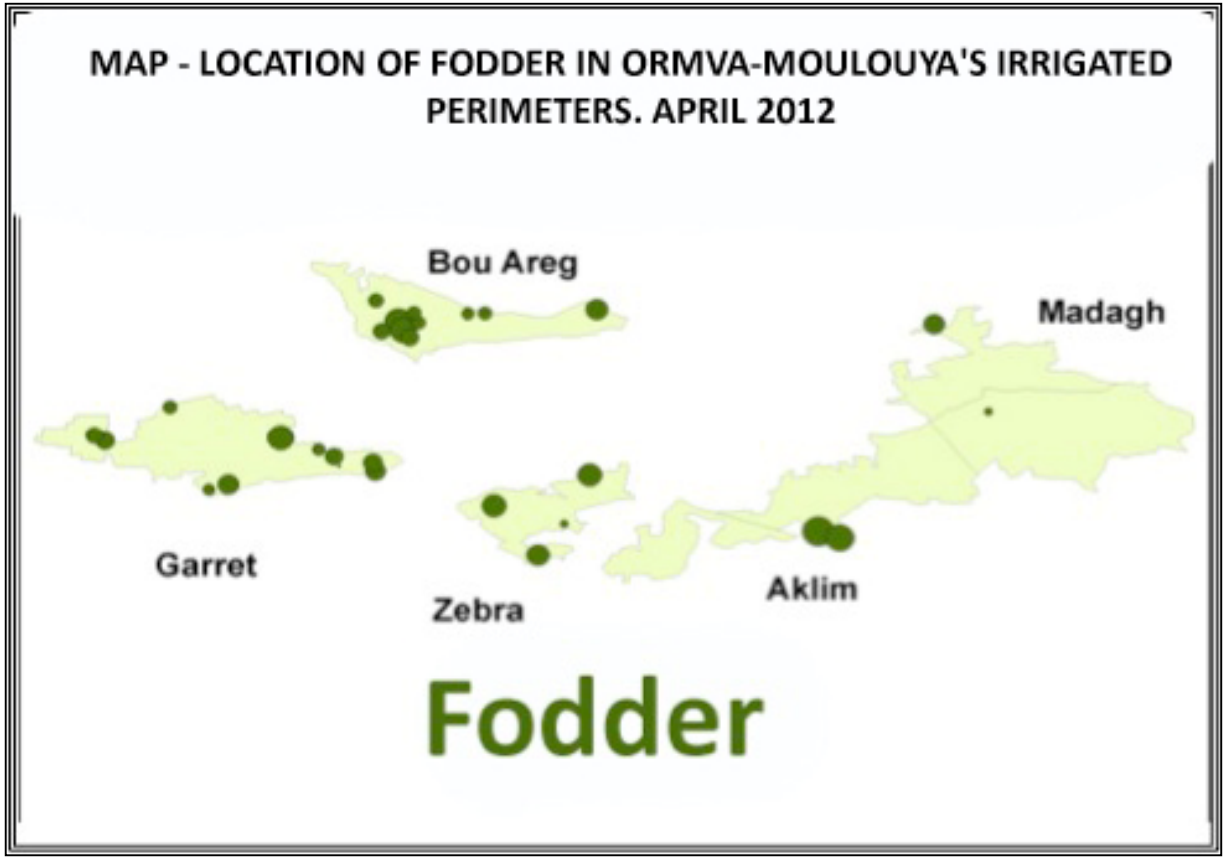
MAP - LOCATION OF WHEAT IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



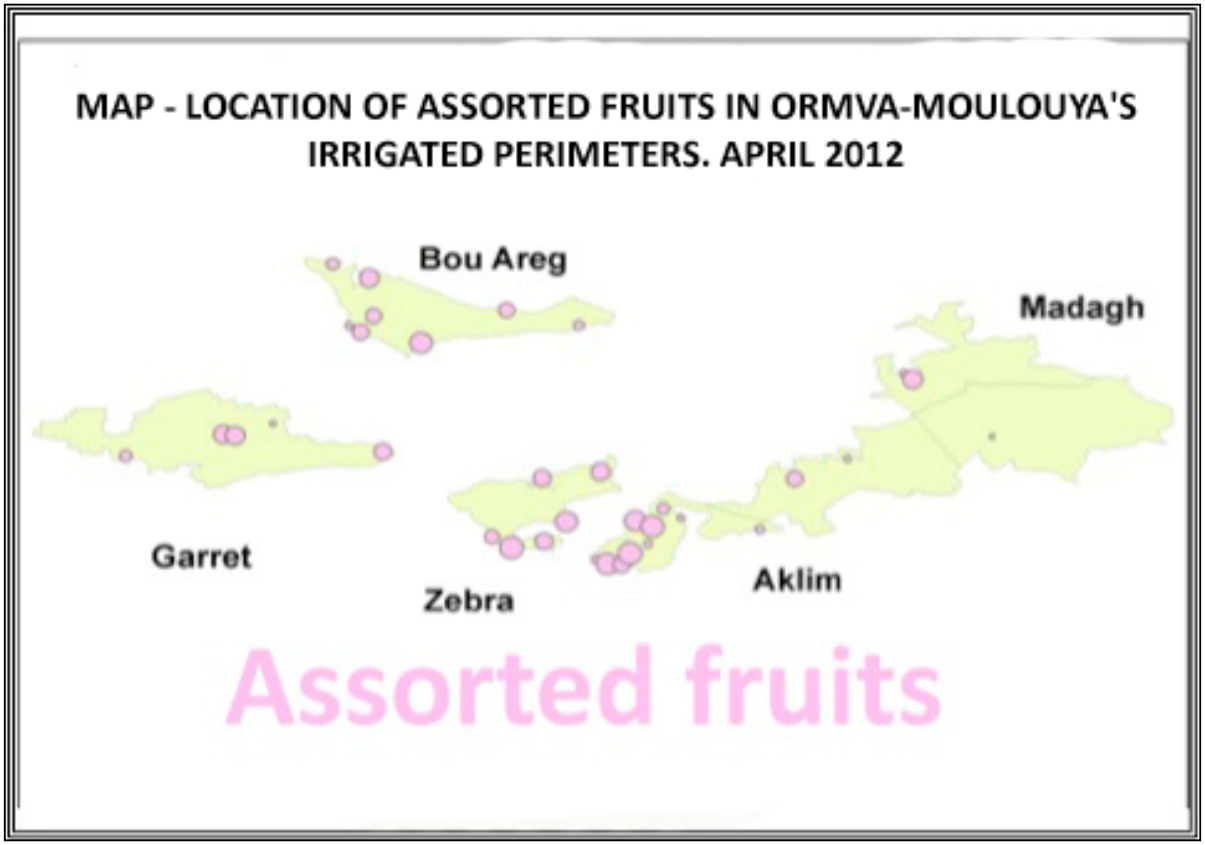
MAP - LOCATION OF BARLEY IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



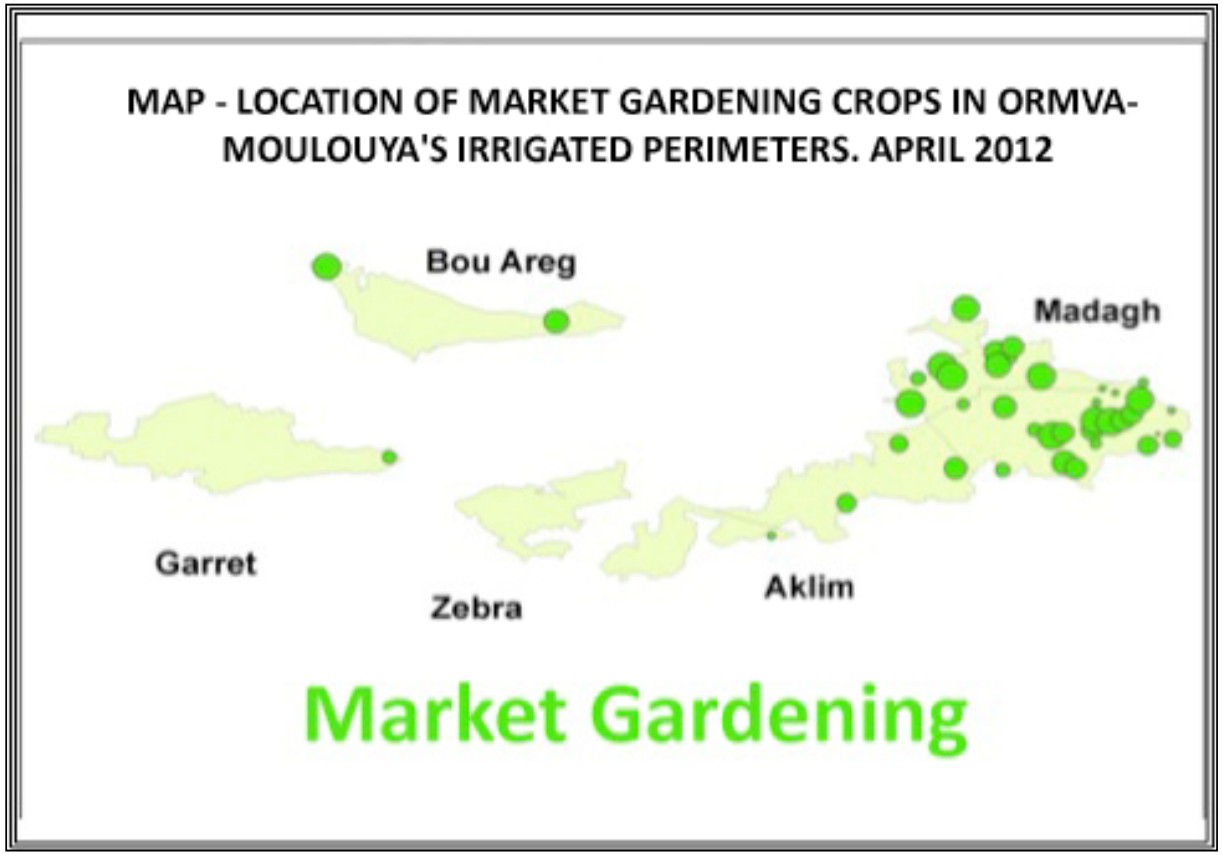
MAP - LOCATION OF FODDER IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



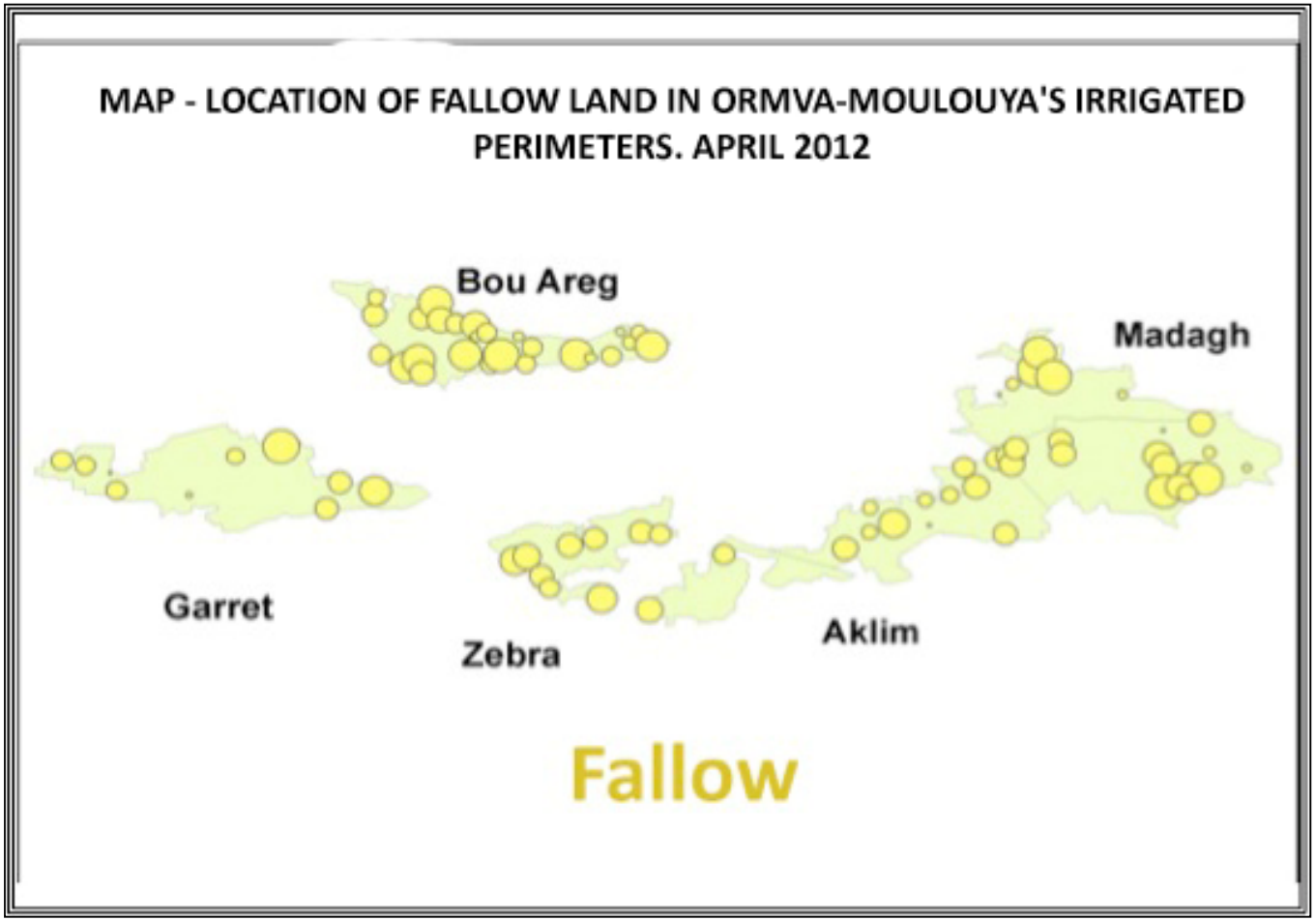
MAP - LOCATION OF ASSORTED FRUITS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



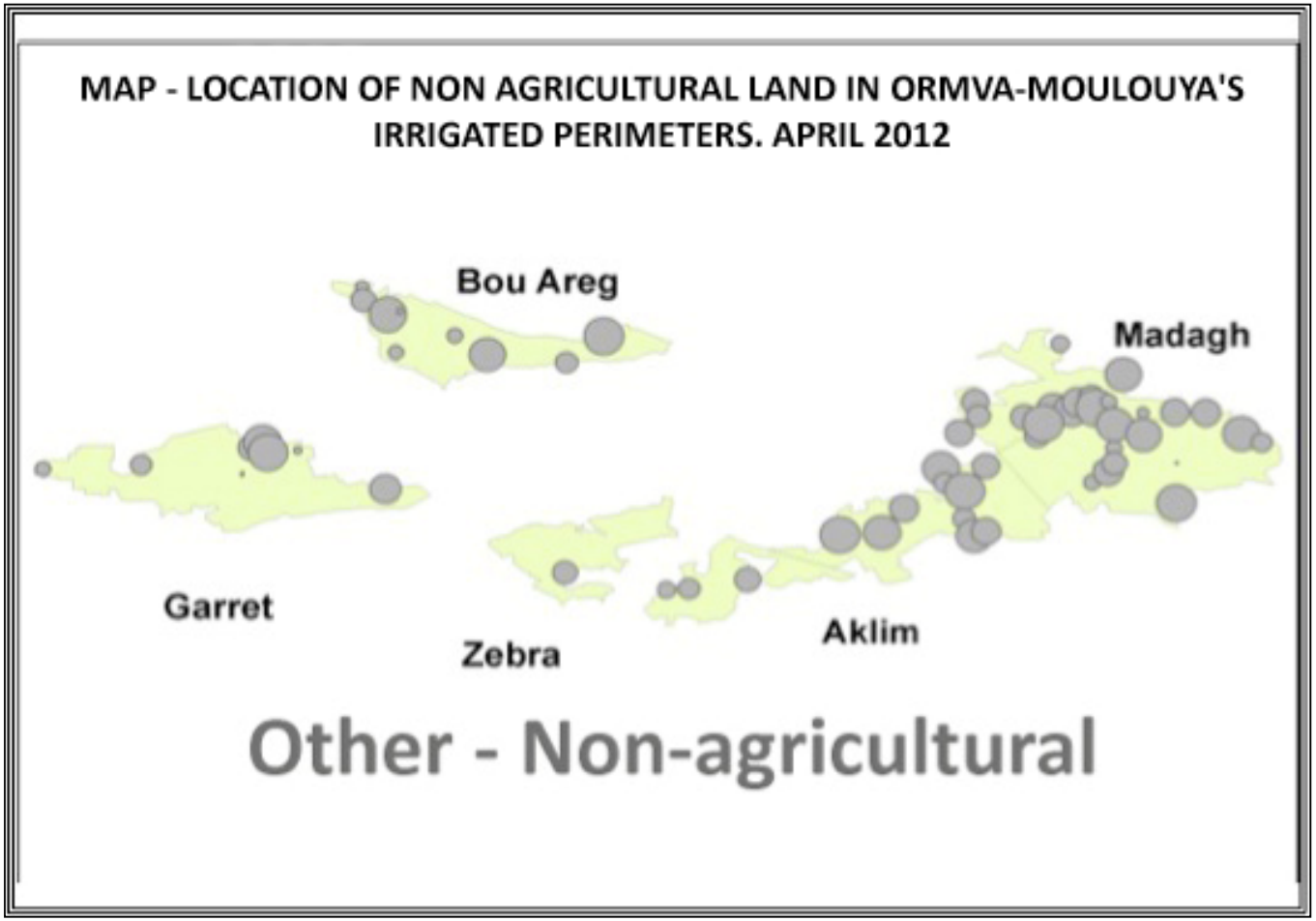
MAP - LOCATION OF MARKET GARDENING CROPS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



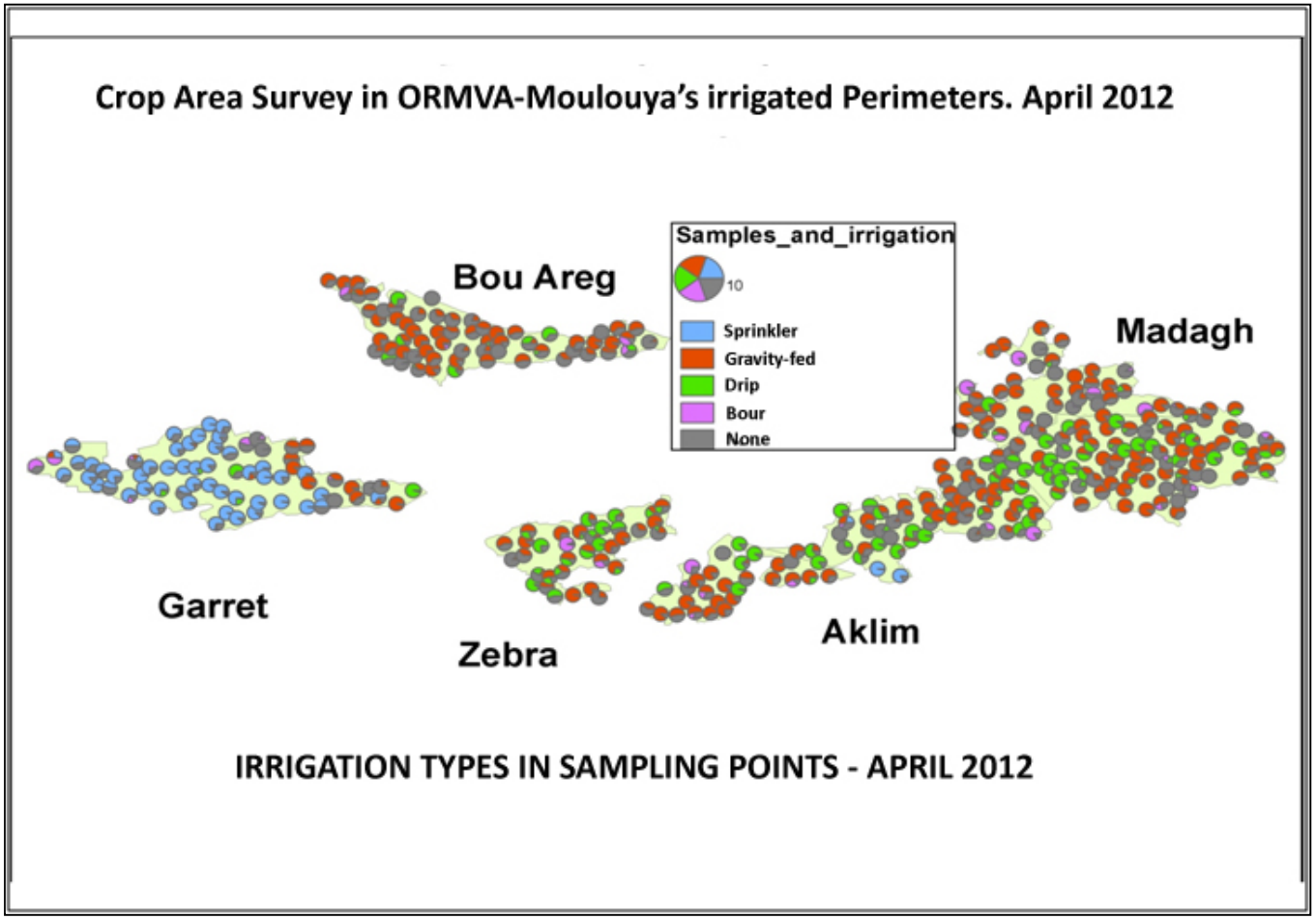
MAP - LOCATION OF FALLOW LAND IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



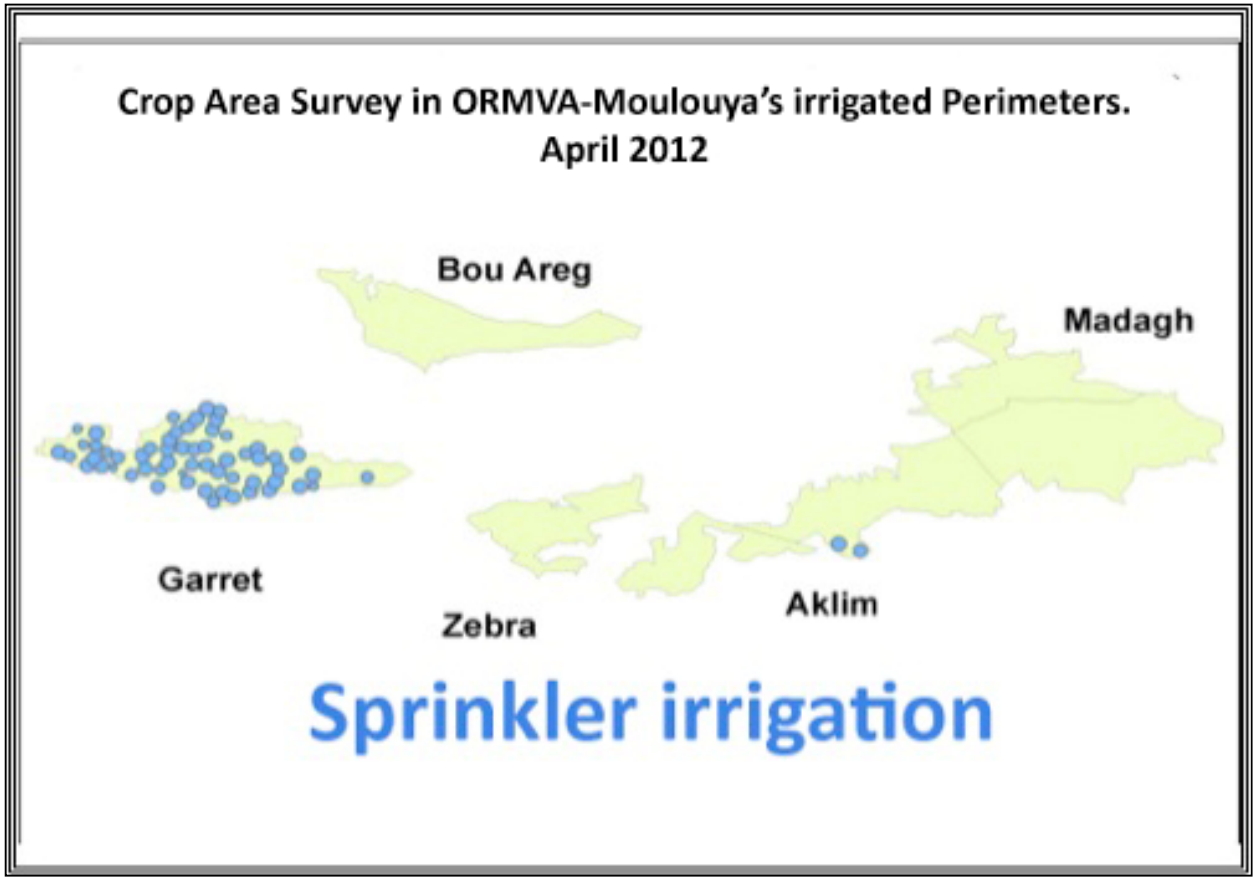
MAP - LOCATION OF NON AGRICULTURAL LAND IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



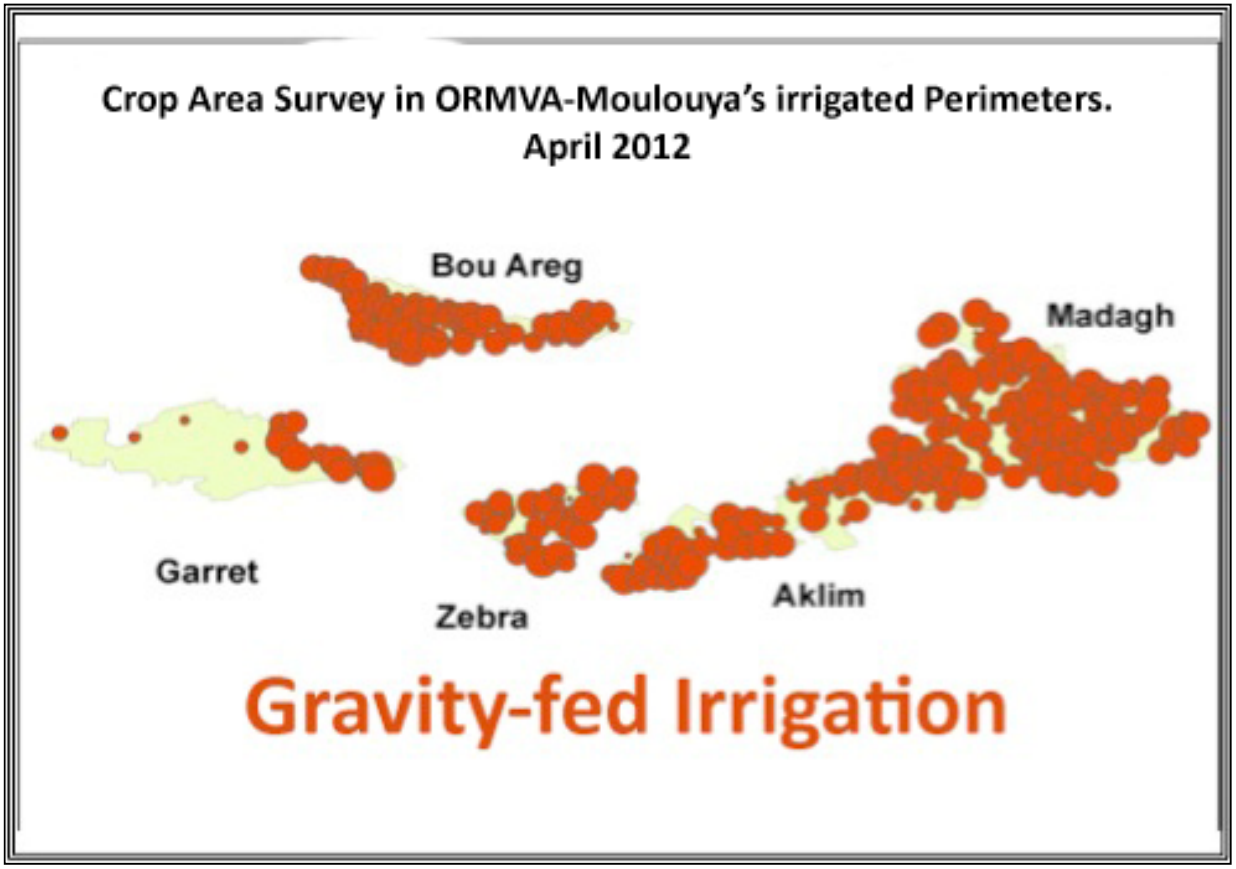
MAP - LOCATION OF IRRIGATION TYPES IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



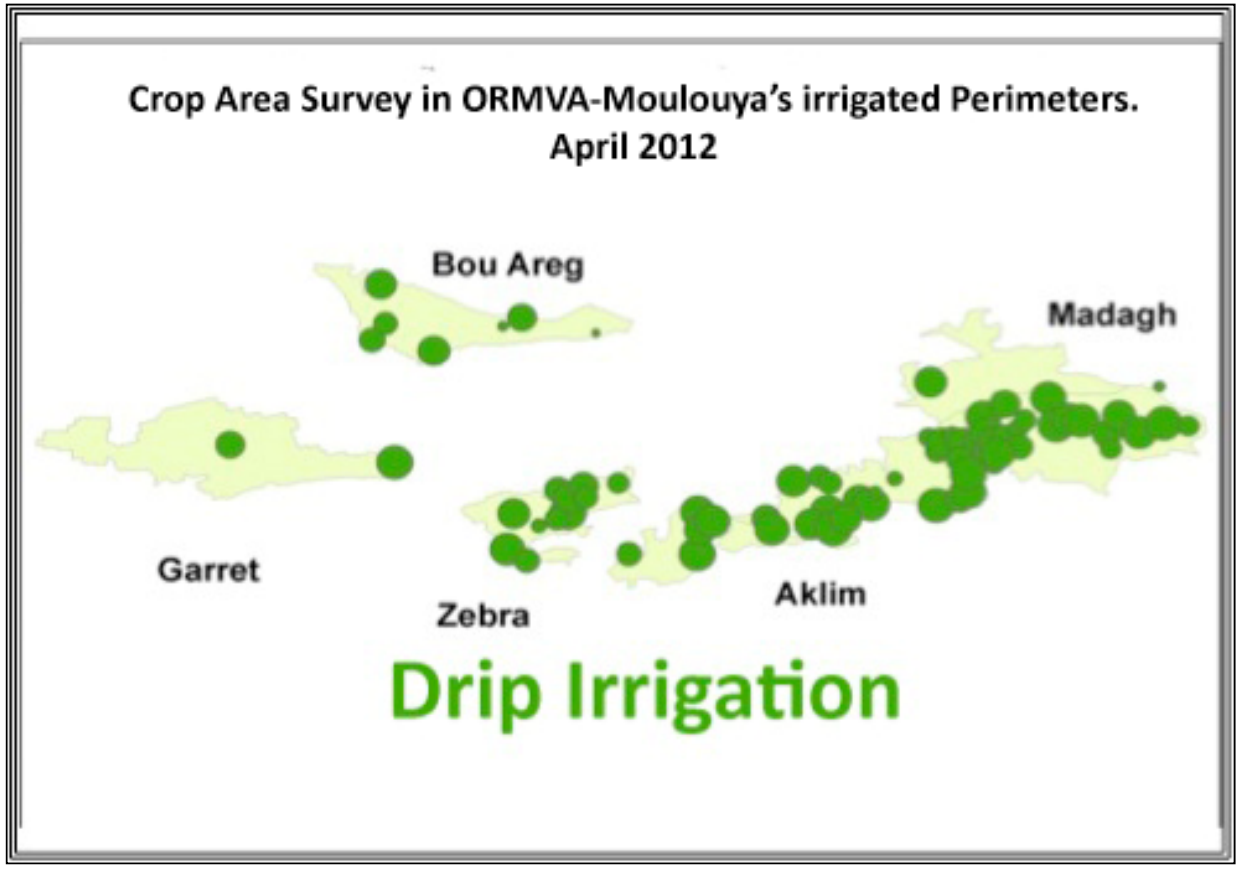
MAP - LOCATION OF SPRINKLER IRRIGATION IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



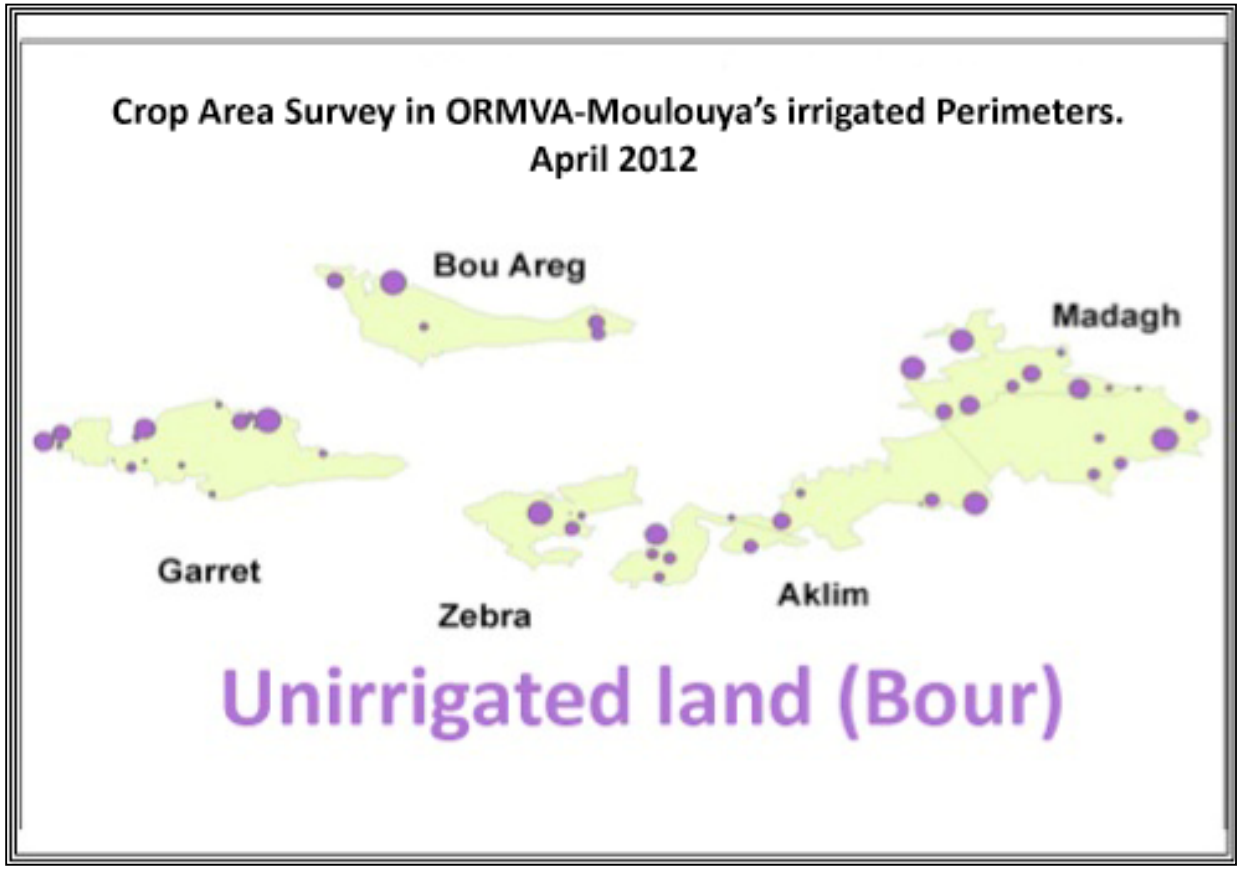
MAP - LOCATION OF GRAVITY IRRIGATION IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



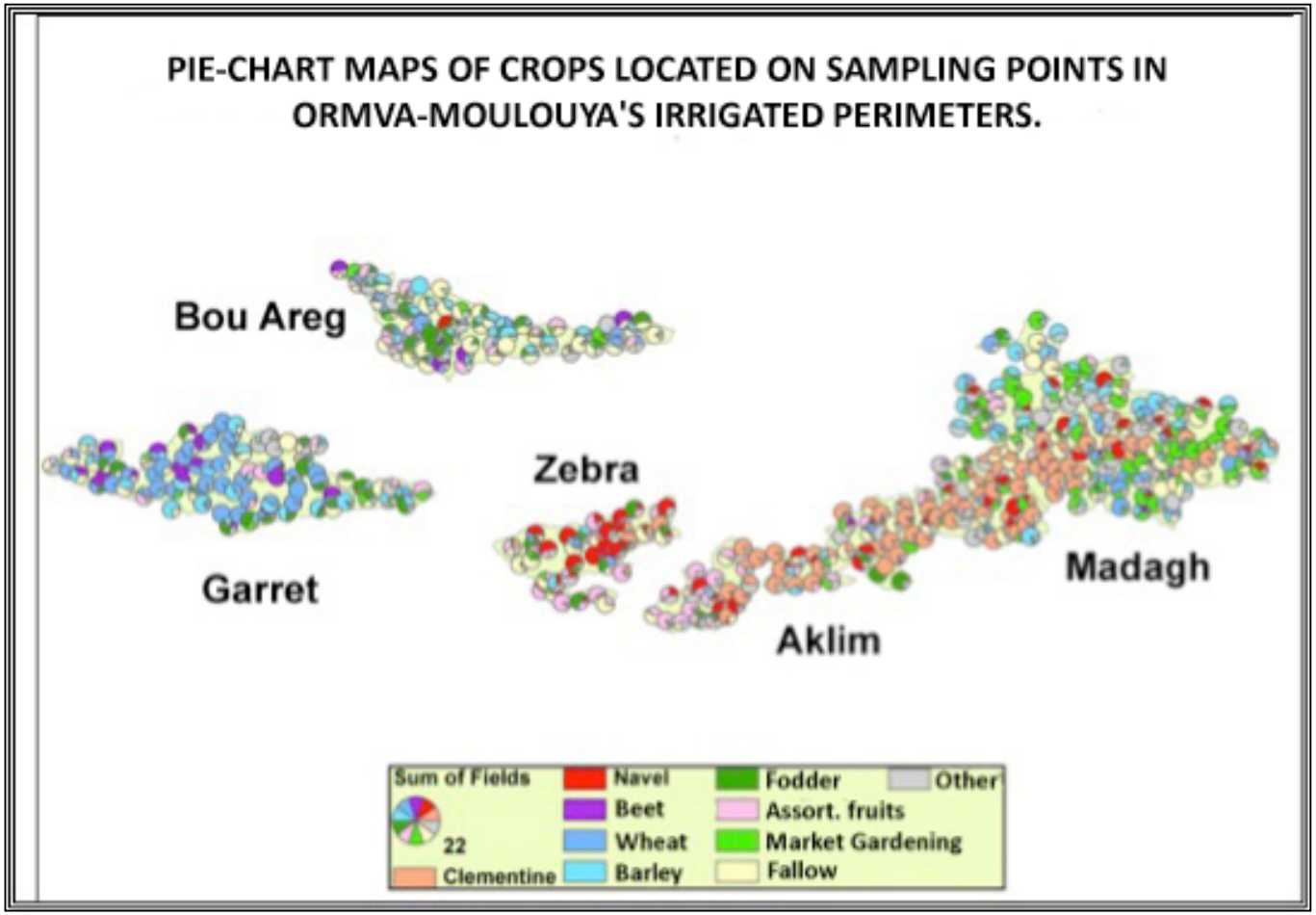
MAP - LOCATION OF DRIP IRRIGATION IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



MAP - LOCATION OF UNIRRIGATED LAND (BOUR) IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012



PIE-CHART MAPS OF CROPS LOCATED ON SAMPLING POINTS IN ORMVA-MOULOUYA'S IRRIGATED PERIMETERS: APRIL 2012 (COPY)



APPENDIX A – CROP AREA SURVEY METHODOLOGY

The 2012 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 2012 selected 500 sample points in Doukkala and of 400 points in the Moulouya irrigated perimeters. There are approximately 100,000 irrigated hectares in Doukkala and 60,000 in Moulouya. 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 500 sample points were scattered over a total area of 146,000 hectares, while the 400 points in oriental 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 200 meters in diameter, or 3.14 hectares; the total area sampled thus represents about 1 percent of the global survey area.

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.

Half of the points in both regions are the same as from last year (2011) and the other half are new points. This feature was incorporated this year at the suggestion of USDA's National Agricultural Statistics Service (NASS)[1] statisticians based on discussion of the results of the 2011 survey in Washington in December 2011. 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 the subsequent Crop Yield Survey of the main field crops are 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. 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

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

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 purposes. 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 Oriental, 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 down loaded 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.

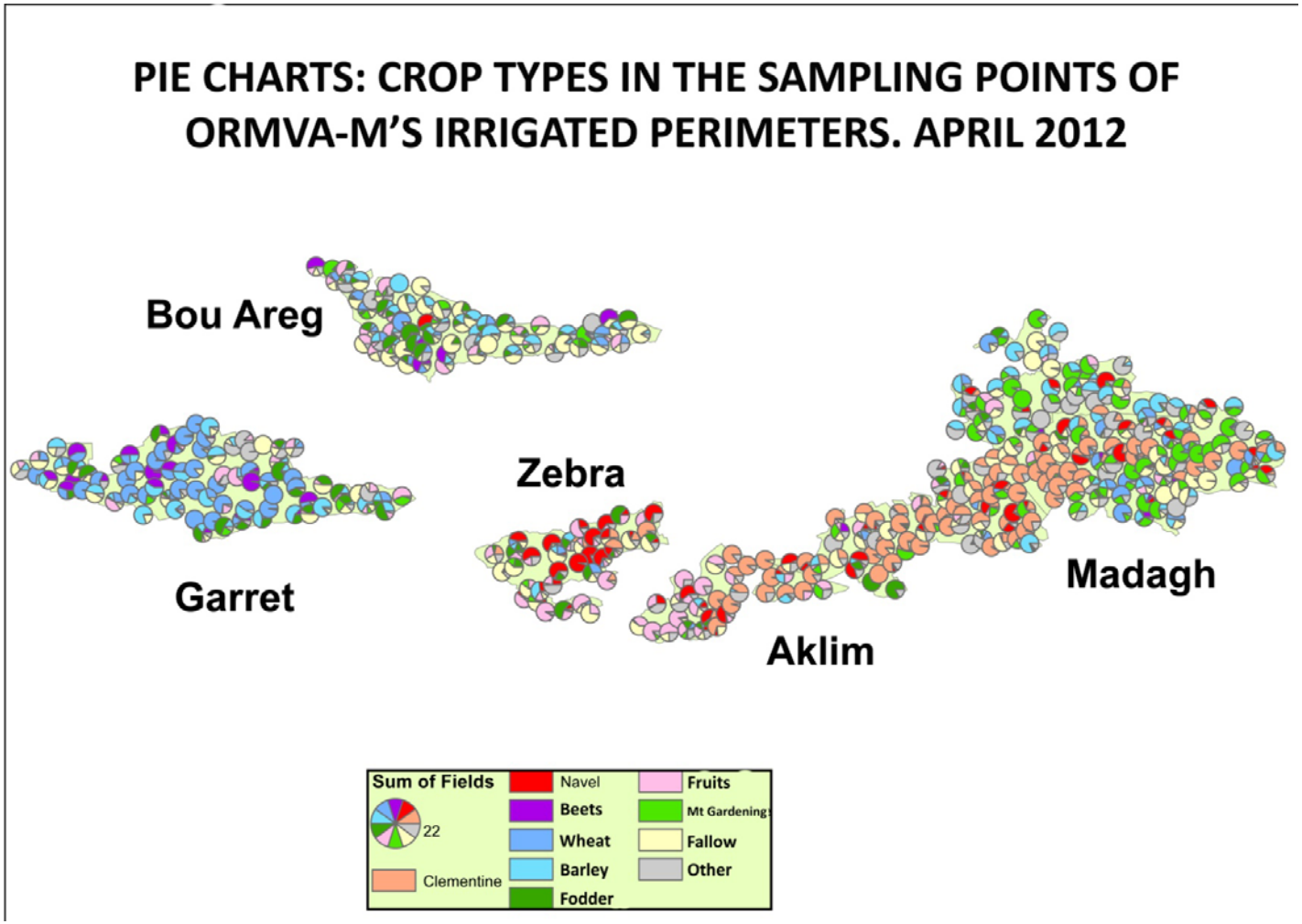
Once a consolidated database is put together, the statistical analysis becomes straight forward. But the first stage is to verify the accuracy and consistency of the data: missing and duplicated records, crop codes that don't correspond to the crop descriptions, new crops and codes encountered, area estimates that exceed 3.127 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 now and the situation last year. 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.

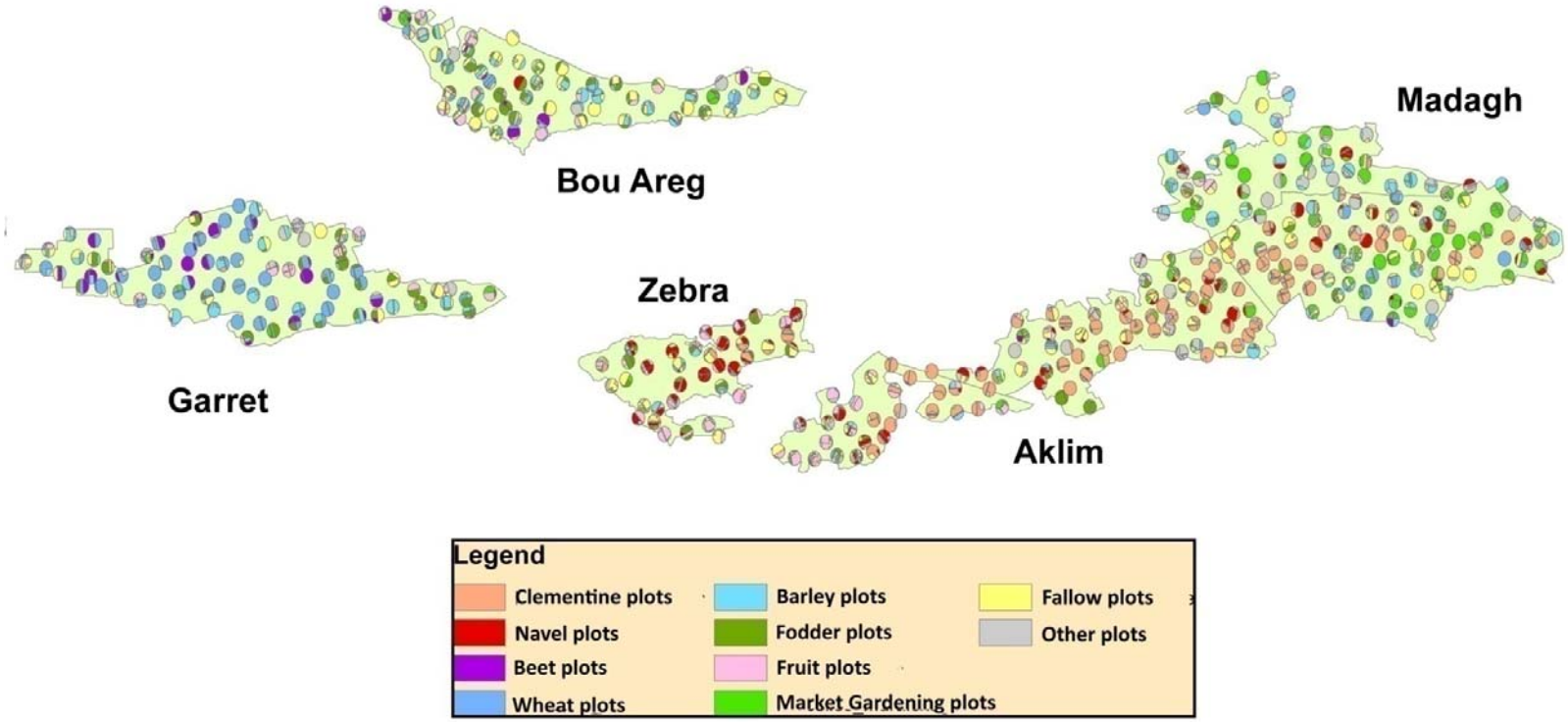
A major advantage of the Area Frame Spot Sampling methodology is that the statistical analysis gives an estimate of the precision and margin of error of the resulting area estimates. The goal was to obtain coefficient of variation of 10 % or less for the main crops. Floating bar charts are used to show 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.

APPENDIX B – PIE CHARTS: CROP TYPES IN THE SAMPLING POINTS OF ORMVA-M'S IRRIGATED PERIMETERS : APRIL 2012


PIE CHARTS: CROP TYPES IN THE SAMPLING POINTS OF ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012
Bou Areg
Garret
Zebra
Aklim
Madagh
Sum of Fields
22
Clementine
Navel
Beets
Wheat
Barley
Fodder
Fruits
Mt Gardening
Fallow
Other

APPENDIX C – MAIN CROPS IN ORMVA-M'S IRRIGATED PERIMETERS: APRIL 2012

CROP AREA SURVEY IN ORMVA-M'S IRRIGATED PERIMETERS. APRIL 2012

Plots and Crop Types in Sampling Points