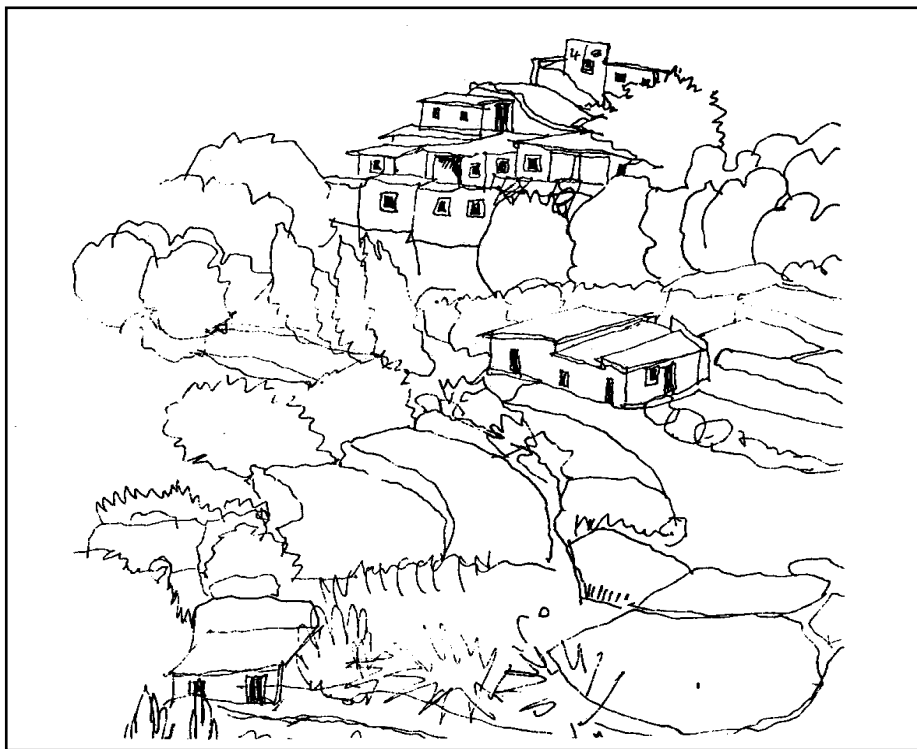


Agriculture in the High Atlas

A Case Study of the Ait Mizane Valley



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Agriculture in the High Atlas: A Case Study of the Ait Mizane

Introduction

Making an agricultural land use survey in the High Atlas Mountains is not an easy task but can be done quite effectively. There are many ways of achieving such a task, but the terrain limits the choices available in this region. Whilst random sampling methods are in some ways the best approach, especially if combined with some sort of stratification, they are almost impossible unless you are a mountain goat. It is therefore suggested that linear transects are used following the main paths.

Useful websites:

Moroccan ministry of Agriculture and Maritime Fisheries: <http://www.agriculture.gov.ma>

Background information: Agriculture in Morocco

Agriculture in Morocco:

The total land area of Morocco is 44,630km². 78% of the total land area is in desert and dry zones, with annual average precipitation of less than 250mm rainfall per year. 15% is in the semi-arid zone (250-500mm precipitation per year) and 7% in the sub-humid zone (more than 500mm precipitation per year).

Some 30,055 km² (ie. approximately two thirds) of the total land area is classified as agricultural land. 9,055 km² is classified as arable/permanent crops (2009, FAOSTAT) and most of the remainder as pasture land for grazing. 1386 km² are irrigated in Morocco.

In 1990, of a total population of 25,260,000, approximately 9,378,000 (37%) of the workforce were working in farming. In 2008, of a total population of 31,228,000 people, approximately 13,143,000 were employed in agriculture, ie. 42% of the workforce is working in farming, an increase of 5%.

About 43% of arable land is devoted to cereals, 7% to plantation crops (olives, almonds, citrus, grapes, dates), 3% to pulses, 2% to forage, 2% to vegetables, 2% to industrial crops (sugar beets, sugar cane, cotton) and oilseeds, and 42% was fallow. The bulk of the indigenous population carries out traditional subsistence farming on plots of less than five hectares (12 acres). A temperate climate and sufficient precipitation are especially conducive to agricultural development in the northwest.

Of the total cereal area, which covers 80 percent of arable land, 50 percent is sown to barley, 40 percent to bread and durum wheat and 9 percent to maize. Four percent of the arable land is sown to pulses, mainly fava bean, chickpeas, lentils and peas. The area under weedy fallow varies between 1,600,000 and 2,600,000 hectares and is more prevalent in the drier zones.

Moroccan agricultural production also consists of orange, tomatoes, potatoes, olives, and olive oil. High quality agricultural products are usually exported to Europe. Morocco produces enough food for domestic consumption except for grains, sugar, coffee and tea. More than 40% of Morocco's consumption of grains and flour is imported from the US and France.

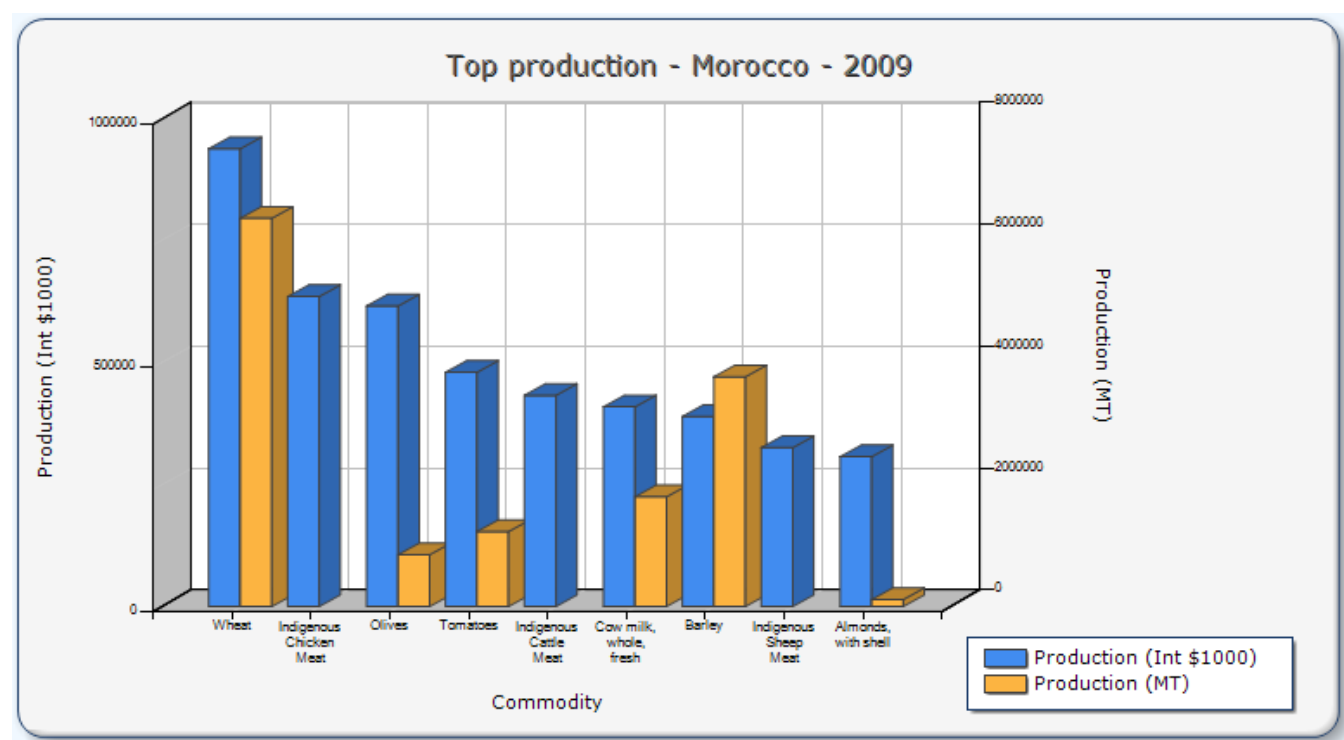
Agriculture industry in Morocco enjoys a complete tax exemption. Many Moroccan critics say that rich farmers and large agricultural companies are taking too much benefit of not paying the taxes, and that poor farmers are struggling with high costs and are getting very poor support from the state.

In 2001, agriculture (together with forestry and fishing) accounted for 16% of GDP. In 2009, the GDP of Morocco from agriculture was 17.2% (2009).

The government distributed some 500,000 hectares (1,235,500 acres) of farmland formerly owned by European settlers to Moroccan farmers in the late 1960s and the 1970s. To encourage Moroccans to modernize the traditional sector, the Agricultural Investment Code of 1969 required farmers in irrigated areas to meet the minimum standards of efficiency outlined by the government or lose their land. These standards applied to all farms of five hectares (12 acres) or more.

Dams and irrigation projects were begun under French rule and have continued since independence. In traditional areas, irrigation is by springs and wells, diversion of streams, and tunnels from the hills, as well as by modern dams and reservoirs. There are dams and irrigation projects on most of the country's major rivers, including the Sebou River in the northwest, which, along with its tributaries, accounts for some 45% of Morocco's water resources. Continued widespread variation in rainfall continues to produce serious droughts and occasional flash floods. In January 1994, the Kuwaiti Economic Development Fund agreed to lend \$60 million to the Moroccan government to help finance an irrigation project in the Haouz and Tassaout region of southern Morocco, which will provide irrigation services for 200,000 small farmers. Morocco had 1.29 million irrigated hectares (3.2 million acres) of agricultural land in 1998.

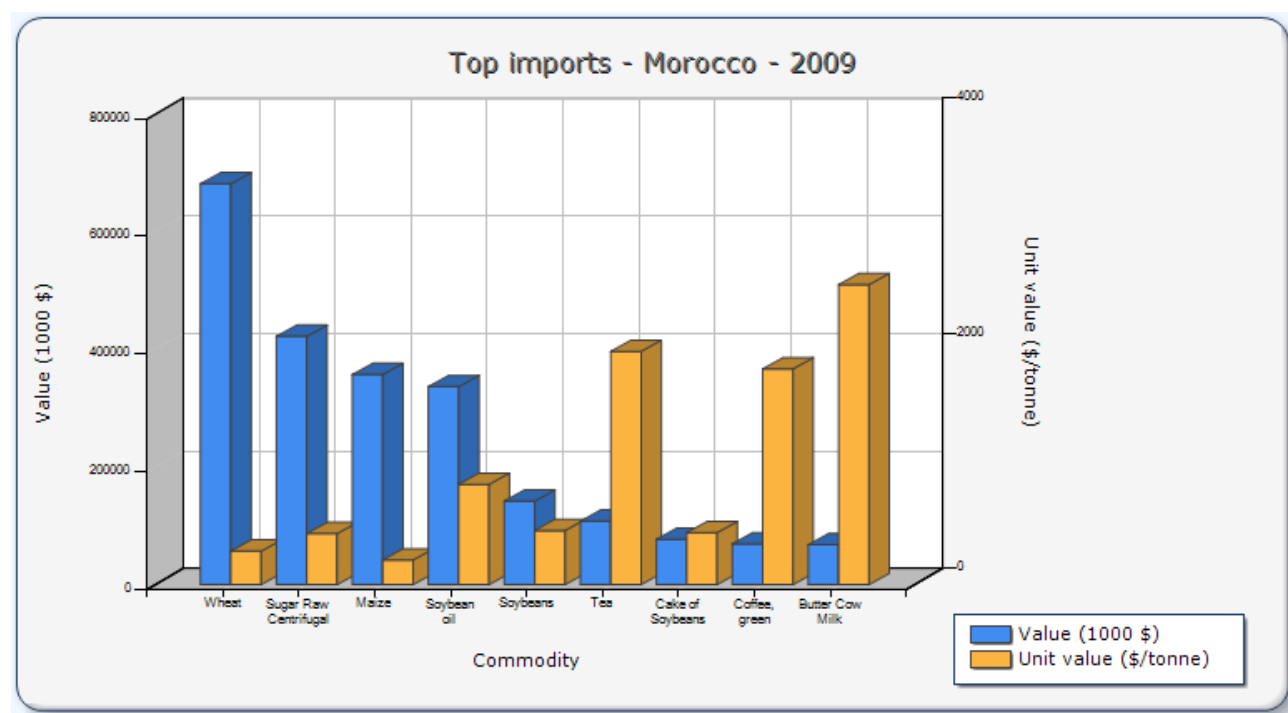
Food production in Morocco 2009. Top 20 food products in Morocco:



Rank	Commodity	Quantity (tonnes)	Flag	Value (1000 \$)	Flag	Unit value (\$/tonne)
1	Tomatoes	410118		303672		740
2	Tangerines, mandarins, clem.	264416		193166		731
3	Olives Preserved	64758		131644		2033
4	String beans	112328		127595		1136
5	Oranges	181962		114786		631
6	Processed Cheese	17698		94954		5365
7	Fruit Prp Nes	59965		71296		1189
8	Other melons (inc.cantaloupes)	55925		65634		1174
9	Food Prep Nes	13231		42327		3199
10	Chillies and peppers, green	56523		42020		743
11	Pumpkins, squash and gourds	43084		33630		781
12	Coffee Extracts	3000		32936		10979
13	Strawberries	21602		30653		1419
14	Veg.in Tem. Preservatives	13721		24520		1787
15	Flour of Wheat	67885		24387		359
16	Oil Essential Nes	624		23831		38191
17	Carobs	8422		21112		2507
18	Grapes	12212		18143		1486
19	Cigarettes	177		15286		86362
20	Vegetables fresh nes	13824		14380		1040

Source: [UN Food & Agriculture Organisation](#)

Moroccan agricultural imports:



Rank	Commodity	Quantity (tonnes)	Flag	Value (1000 \$)	Flag	Unit value (\$/tonne)
1	Wheat	2390340		681829		285
2	Sugar Raw Centrifugal	973611		422421		434
3	Maize	1703700		357385		210
4	Soybean oil	394711		336790		853
5	Soybeans	308244		142156		461
6	Tea	54400		107908		1984
7	Cake of Soybeans	174497		77058		442
8	Coffee, green	37874		69487		1835
9	Butter Cow Milk	26612		67923		2552
10	Dates	50479		64673		1281
11	Beet Pulp	371806		63308		170
12	Cigarettes	2225		59572		26774
13	Tobacco, unmanufactured	9166		53306		5816
14	Food Prep Nes	14879		50046		3364
15	Barley	271910		49010		180
16	Cotton lint	33057		48655		1472
17	Olive oil, virgin	16856		47777		2834
18	Cheese of Whole Cow Milk	10333		45147		4369
19	Prod.of Nat.Milk Constit	17022		38852		2282
20	Bran of Wheat	260629		34837		134

Source: [UN Food & Agriculture Organisation](#)

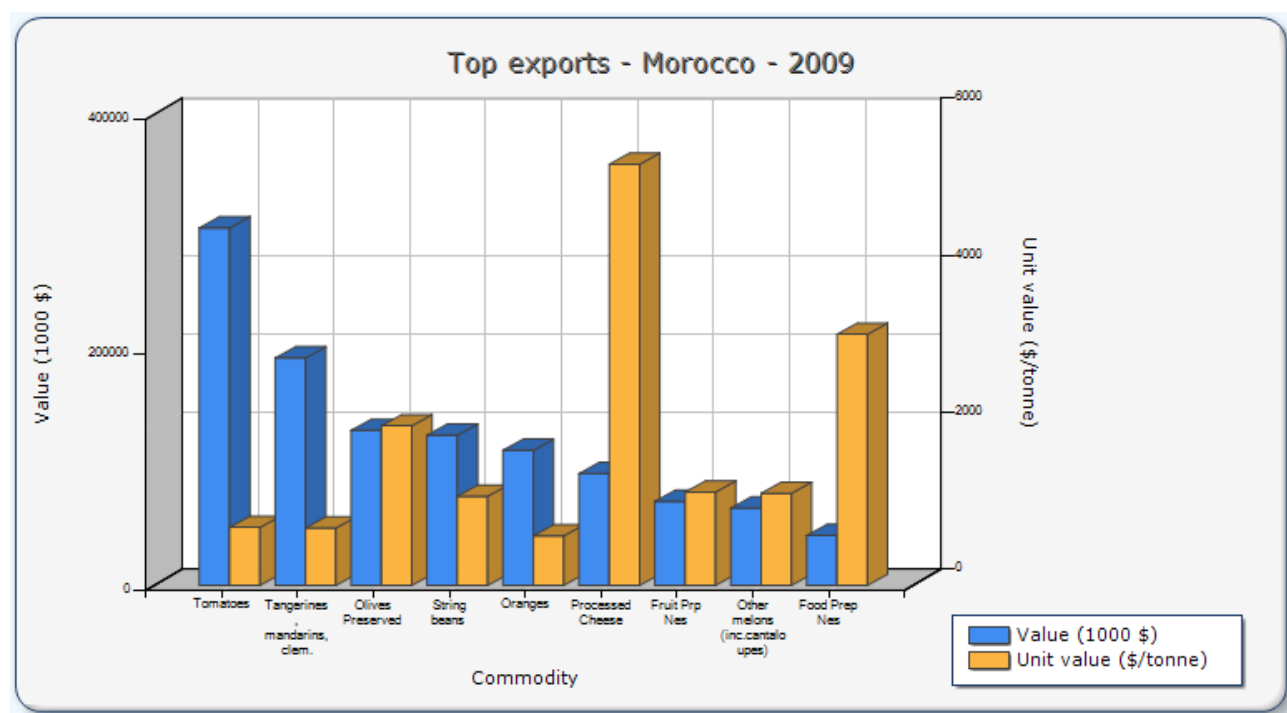
For comparison purposes the chief food/drink imports into the UK are as follows:

Rank	Commodity	Quantity (tonnes)	Flag	Value (1000 \$)	Flag	Unit value (\$/tonne)
1	Wine	1102910	*	4315070		3912
2	Food Prep Nes	1004610	*	2787500		2775
3	Cheese of Whole Cow Milk	414002		1828450		4417
4	Pastry	500715		1677020		3349
5	Chocolate Prsnes	275203		1420300		5161
6	Chicken meat	304254		1205220		3961
7	Bacon and Ham	322940		1196970		3706
8	Meat of Chicken Canned	237645		969044		4078
9	Beverage Non-Alc	451554	*	965948		2139
10	Meat-CattleBoneless(Beef&Veal)	164755		879051		5336
11	Cake of Soybeans	1895000		812450		429
12	Sugar Raw Centrifugal	1325770		805328		607
13	Bananas	942277		710203		754
14	Pet Food	415363		703259		1693
15	Bever. Dist.Alc	105449	*	679088		6440
16	Beer of Barley	773569	*	659112		852
17	Pork	218520		642604		2941
18	Tomatoes	396675		633999		1598
19	Sheep meat	115865	*	594572		5132
20	Grapes	244171		560832		2297

Source: [UN Food & Agriculture Organisation](#)

Table 2. Livestock Numbers and Production										
Items	1973-74	1980	1982	1984	1987	1995-96	2002*	2003*	2004*	2005*
Cattle (,000,000)	3.21	3.38	2.54	2.36	3.18	2.38	2.67	2.69	2.73	2.73
Sheep (,000,000)	11.44	16.51	10.16	12.86	16.14	16.73	16.34	16.74	17.03	17.03
Goats (,000,000)	4.23	6.15	4.09	4.22	5.81	5.70	5.09	5.21	5.36	5.36
Cow Milk (,000 mt.)	490*	780	625	705	783	865*	1,236*	1,250	1,300	1,300
Beef (,000 mt)	91*	102	111	77	99	113*	170	150	148	148
Mutton (,000 mt)	50*	66	47	54	64	101*	110	105	103	103
Goat meat (,000 mt)	26*	16	15	16	20	20*	20	21	21	21
Sources: Recensement Général de l'Agriculture (RGA), Ministère de l'Agriculture et du Développement Rural, Guessous 1991. *2002-2005 and others - data from FAO statistical database (2006)										

Moroccan agricultural exports:



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Source: [UN Food & Agriculture Organisation](#)

Agriculture of the High Atlas and around Imlil

The High Atlas is characterized, despite its high elevations, by a modest level of rainfall (400 to 800 mm on the north slopes, 200 to 500 mm on the south-facing slopes). This level of rainfall, combined with shallow soils and steep slopes, and cold temperatures, translates into a short growing season and low productivity, except locally (valley terraces, high altitude rangeland). Forests/range occupy about 76 percent of the land area, whereas crops are limited to about 20 percent (mostly in lowlands and valleys). These valleys are intensively cropped. The cropping system is based on cereals (71 percent), forages (11 percent), orchards (7 percent), pulses, vegetables and fallow (6 percent). Farms are subsistence type with less than 5 ha, combining crops on terraces, and livestock (sheep and goats grazing on range, cattle integrated with crops).

The Ait Mizane territory makes up the 'Assit' (the third largest population concentration in the High Atlas). 'Assit' means stream in the Berber dialect, and these stream villages peopled by Berbers, are located at between 1200m to 3000m. The physical environment is complex: deep, twisting v-shaped valleys create a variety of micro-environments. Precipitation varies from 600-800mm/year, falling as snow at higher altitudes. Temperatures are lower than on the Haouz plain around Marrakech by 10-12°C. In winter the average temperature in the Ait Mizane is -3°C, in summer the average is 28°C. Natural vegetation includes poplar, ash, oak, red juniper, Atlas cedar and carob. True ever green oak forest once covered much of the Rehraya basin but this is now restricted to an ever decreasing zone around 1100m and 1500m. Juniper dominates the valley slopes and this reaches as far as the natural tree line at 2400m. Slopes are steep throughout the Ait Mizane, in some parts the average slope angle is 21°. The River Rehraya is typical of the Mediterranean almost half of its annual discharge occurs between March and May, and a tenth between July and September.

Mean monthly rainfall: Asni

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
(mm)	53	53	68	71	41	8	2	7	26	44	49	64	686

Ecological decline is evident around the terraced slopes of the Imlil basin. There are many new areas of expanding soil erosion, further evidenced by increased bedload in the rivers. Thick, coarse, aggraded deposits have been laid down over the past thirty years. Summer thunderstorms have become more damaging as more people inhabit these mountains with their herds. Slumping of loose scree is an increasing problem and some of the higher villages face the problem of movement of erosional material through their villages. Riverside terraces are washed away during periods of flood, scree slumps down slopes into fields and onto terraces and slope movement damaged, blocks and breaks the seguias (irrigation channels).

There have been a number of changes in agricultural practices around Imlil in recent years. More apple and cherry trees have been planted around Imlil. The storm damage of August 1995 has increased this because those who lost valuable walnut trees were keen to get an earlier return on new saplings - 12 years for

reasonable return from walnut saplings compared to 6 - 8 years for apples. More pesticides are being used on small scale. Pesticide sprayers were hired in to spray the Kasbah's cherry trees in May 1996.

Walnut trees dominate as a cash crop. Trees can yield as much as 5,000/tree in a good year. The trees, however, are very sensitive to frost, which makes harvesting uncertain. Trees grow between 1,200 and 2,000 metres. Prices fluctuate by over 100%. People can "speculate" and buy and sell a year's crop in advance. Trees may be owned on someone else's land also. Walnuts are the major cash crop of the area. If a farmer wished to sell his walnuts, he tries to keep them until the following summer when a better price could be fetched due to their relative scarcity. If the farmer needed cash very quickly he could sell next year's crop but would obviously get a smaller return to the risks taken by the buyer.

Although the farming practices in Imlil have not changed for hundreds of years, outside influences are being considered and used more often due partly to population pressures in the area. As well as growing more cash crops, some villages like Aremdt and Imlil have set up village associations and women's co-operatives that can attract outside investment from NGOs. All proceeds and funds raised are used for the good of the village.

Agriculture, Crops and Cultivation Calendar: Imlil area – 1996/97

Land Use	Hectares	Percentage
Cereals	3,800	53.4
Fodder	140	1.9
Market Gardening	200	2.8
Olive Groves	773	10.8
Almonds	1,000	14.2
Apples	580	8.2
Walnuts	620	8.7
Total	7,113	100.0

Note: Valley floors grow hay and increasingly lucerne as a fodder crop.

Population change, Rehraya basin:

Village/clan	Population 1971	%	Population 1989	%	Population 2012
Ait Souka	134	6.9	234	10.8	
Arrhen	171	8.8	180	8.3	
Arremdt	618	31.9	732	33.7	
Ashain	107	5.5	105	4.8	
Imlil	164	8.5	149	6.7	
Mzig	362	18.7	290	13.4	
Taigadirt	50	2.6	121	5.6	
Tairgaimoula	80	4.1	130	5.9	

Talawal	45	2.3	32	1.5	
Tamaloirt	146	7.5	160	7.4	
Taourirt	61	3.1	37	1.7	
Totals	1,938		2,170		

Imlil Farming Calendar

October	Sowing of barley on 2/3 of land, 1/3 left fallow for vegetable planting next spring. Seed used is that saved from previous year. Fallow land heavily manured over winter. Last apples picked
Spring	Vegetables and lucerne (fodder) planted (completed by May)
May/June	Barley harvested (depending on altitude). Maize planted on cleared barley
Late Sept.	Maize harvested
Early Oct.	Walnuts picked

Mules and livestock ownership changes:

Village/clan	Mules		Goats		Cattle		Sheep	
	1989	2012	1989	2012	1989	2012	1989	2012
Ait Souka	15		308		53		128	
Arrhen	13		396		51		73	
Arremdt	51		1177		123		609	
Ashain	9		225		31		80	
Imlil	11		42		25		0	
Mzig	20		489		52		152	
Taigadirt	9		180		30		66	
Tairgaimoula	9		104		32		14	
Talawat	2		10		4		0	
Tamaloirt	8		175		38		92	
Taourirt	2		75		10		30	
Totals	149		3178		459		1244	

MOROCCO - Agricultural Census 1996 – Main Results

Please refer to the Explanatory Notes given at the end of the tables

Number and agricultural area of holdings		
	Number of holdings	Agricultural area (ha)
Total	1 496 349	8 732 223

Number and area of holdings by size of agricultural area of holdings		
	Number of holdings	Agricultural area (ha)
Total	1 496 349	8 732 223
Holdings without land	64 716	-
Under 1 ha	315 323	170 361
1 and under 3 ha	446 710	904 728
3 and under 5 ha	237 669	1 011 088
5 and under 10 ha	247 766	1 894 722
10 and under 20 ha	125 169	1 880 472
20 and under 50 ha	47 985	1 526 298
50 and under 100 ha	7 829	585 157
100 ha and over	3 182	759 397

Fragmentation		
	Number of fields	
Fields, total	9 528 685	-

Legal status		
		Area (ha)
Total	-	8 732 223
Civil person	-	6 618 130
Government	-	270 153
Other	-	1 843 940

Tenure of land		
		Area (ha)
Total	-	8 732 223
Owned	-	7 677 383
Rented	-	410 026
Other forms of tenure	-	644 814

Holders and household members by sex		
	Number of persons	
Total	1 492 844	-
male	1 426 449	-
female	66 395	-

Holders and members of their households engaged mainly in agriculture		
	Number of persons	
Total	3 452 194	-

Hired permanent workers		
	Number of workers	
Total	136 593	-

Livestock		
	Holdings reporting	Head/units
Cattle	768 960	2 383 113
Sheep	781 563	16 726 674
Goats	301 897	5 703 509
Horses	-	139 845
Mules	-	516 357
Asses	-	1 026 303
Camels	19 088	149 406

Aims

- To make a land utilisation survey of the Imlil and Aremdt basins and to see to what extent land use is affected by altitude, aspect (physical determinants) and human factors, such as economic viability, culture and tradition.
- To introduce some of the concepts of land use mapping

Hypothesis

- Land use in the Imlil and Aremdt basins changes with altitude and aspect.
- Land use in the Imlil and Aremdt basins reflects an increasingly commercial approach to farming.

Method

It is suggested that you use a number of the transects that radiate out from the Kasbah shown on the base map (see Appendix 1). More detailed “OS-style” maps are available on loan at the Kasbah. These will give a reasonable representation of total land use although some adjustment needs to be made for altitude, since the paths tend to follow the valley floors and the terraces climb well up the mountain sides in some places.

Allowances also need to be made for the time of year since most of the terraces are double- and even triple-cropped. It is important to read the Background Information Sheet on Agriculture before making your survey and especially before drawing any conclusions from your results.

It should be possible to assess percentage land-use in the basins and make comparisons; based on altitude and aspect. It is also possible to statistically test the significance of the data collected by using a simple statistical analysis.

Finally, to determine the importance of limiting factors on farming operations in the Imlil valley, students carry out the Land Capability Exercise in two contrasting fields (recording sheet 1.)

Recording Sheet 1
Land Capability Assessment

Field Location

SOIL FACTORS

a).Soil Texture
b).Soil pH
c).Stoniness
d).Soil Depth
e).Soil Moisture Evidence of gleying	None Moderate Severe
f).Soil Droughtiness Crop wilting in summer	None Moderate Severe
g).Soil Erosion Erosion by wind or water	None Moderate Severe

SITE FACTORS

h).Gradient
i).Microrelief Restrictions on machinery use.	None Moderate Severe
j).Flood Risk Frequency	Rare Occasional Frequent

CLIMATIC FACTORS

k).Annual Average Rainfall (AAR)
l).Aspect
m).Wind Exposure	Negligible Moderate Severe
n).Frost Risk (No of Days)

Land Capability Assessment Results

Soil Factors:		Grade:
a).Soil Texture	Sandy loam, Silty loam, Silty clay loam	1
	Sand, Clay loam, Clay	2
b).Soil pH	5.5 – 7.5	1
	> 7.5	2
	< 5.5	3b
c).Stoniness	0 - 5%	1
	6 – 10%	2
	11 – 35%	3
	36 – 50%	4
	> 50%	5
d).Soil Depth	> 60 cm	1
	45 – 60 cm	2
	30 – 44 cm	3a
	20 – 29 cm	3b
	15 – 19 cm	4
	< 14 cm	5
e).Soil Moisture	No gleying	1
	Moderate gleying	3a
	Severe gleying	5
f).Soil Droughtiness	No evidence of wilting	1
	Moderate crop wilting	3b
	Severe crop wilting	5
g).Soil Erosion	None	1
	Moderate	3b
	Severe	5
Site Factors		
h).Gradient	< 7o	1
	8 – 11o	3b
	12 – 18o	4
	>18o	5
i).Microrelief	No restrictions	1
	Moderate restrictions	3b
	Severe restrictions	5
j).Flood Risk	Rarely floods	1
	Occasionally floods	2
	Frequently floods	4

Climatic Factors:		Grade:
k).Annual Average Rainfall (AAR)	Less than 500mm	3
	500 to 750mm	2
	750 to 1000mm	1
	1000 to 1250mm	2
	1250 to 1500mm	3
	Over 1500mm	4
l).Aspect	SE, S, SW	1
	NE, E, W, NW	2
	N	3a
m).Wind Exposure	Negligible	1
	Moderate	2
	Severe	4
n).Frost Risk	Negligible (less than 5 days)	1
	Moderate (5 to 50 days)	2
	Severe (more than 50 days)	4

Agricultural Land classification grades:

Grade 1

Land with only minor climatic and no physical limitations to use. Will usually be farmed intensively for high value crops. (e.g. Market gardening)

Grade 2

Land with minor limitations, which will reduce the choice of crops or crop variety, and limitations which may interfere with cultivation, eg. Shallow soil.

Grade 3a

Land with moderate limitations that will restrict the choice of crops and crop variety. Cereals may be grown but careful management, and variety selection is required.

Grade 3b

Land with more restrictions than 3a. Similar crops may be grown but yields will be lower.

Grade 4

Land with severe limitations, which will restrict its use to pasture and hay/silage production.

Grade 5

Land with very severe limitations, which greatly limits its use. Without intensive management use is restricted to rough pasture or forestry.

Tasks:

Use the base maps and refer to the map (see Appendices 1 and 2) to identify the various features. Take note of altitude and aspect from the maps. You should divide up the work, with each group following a transect and recording the land use along it.

Conduct a brief preliminary pilot survey to create your own land use categories and a simple key for these. This should take about one hour. The whole group, to enable the comparison of the results at a later stage, should then use these categories.

Using the land use data collection sheets (see Appendix 4) record the land use every 20 paces on the left and right of the transect, both next to the path and at approximate distances of 10 and 20 metres from the path, again on both sides. You might want to extend the distance between the survey points depending upon what area you wish to survey and time available.

Make sure that you label your transects clearly so that you will be able to locate them on your base map when you get home.

Field sketches are a vital part of this exercise and photographs would be very useful - but remember to record where they were taken and in what direction you were facing.

Carry out the land capability study. It would be interesting to contrast a field in the valley-floor with one on the hill side. Your group leader will help you select suitable sites in consultation with your local guide.

The Transects:

- | | |
|------------|---|
| Transect 1 | Path from Imlil towards Tizi Tamatert (the Ait Souka Valley) |
| Transect 2 | Path from Imlil Tizi Mzik |
| Transect 3 | Path from Imlil to Aremdt, past Kasbah side (the Upper Ait Mizane valley) |

Questionnaire

It may be possible to arrange an interview with a local farmer. A questionnaire can be found in Appendix 5.

Results

- Each group should produce a good copy of their transects and the transects should be put together to give a complete picture of the area.
- Do certain crops only grow at certain altitudes or aspects? What is the pattern of vegetation distribution in the Imlil Valley area? To what extent are physical factors limiting what can be grown in the valley? To what extent are farming practises market-driven?
- Calculate the land capability grade using the sheets on pages 8 and 9.

Analysis

What effect does steepness of slope and aspect have on the land use?

Compare figures for the valleys east and west of Imlil with those for the Aremdt basin. Are there any significant differences?

Compare figures for these sample transects with the % areas in the Background Information Sheet on Agriculture (see Appendix 2). Is there any evidence of an increase in the amount of land used for cash crops (particularly walnuts)? Use the Background Notes at the beginning of this unit, and results from any questionnaires that you have carried out with local farmers to try to account for the differences.

The issue of land consolidation could be discussed in the context of the study area as an economic and social factor. The distribution of land has become more fragmented over the years as land has been divided and handed down to offspring in a family. You may wish to refer to "Marrakech and the High Atlas" edited by D.C. Funnell & R.B.G. Williams; page 149 Figure 12.7 for a typical example of a mountain irrigation system for a typical distribution of plots held by the same family.

Determine the importance of the limiting factors on farming operations in the Imlil valley. What factors are the most limiting to the farmer and to what extent could these be modified? What factors have not been considered? Points to consider are listed overleaf:

Physical factors:

Although precipitation amount is high, it occurs in heavy bursts. This introduces danger of erosion on cultivated areas. There is also an effective drought for much of the summer. What evidence did you observe to overcome this problem?

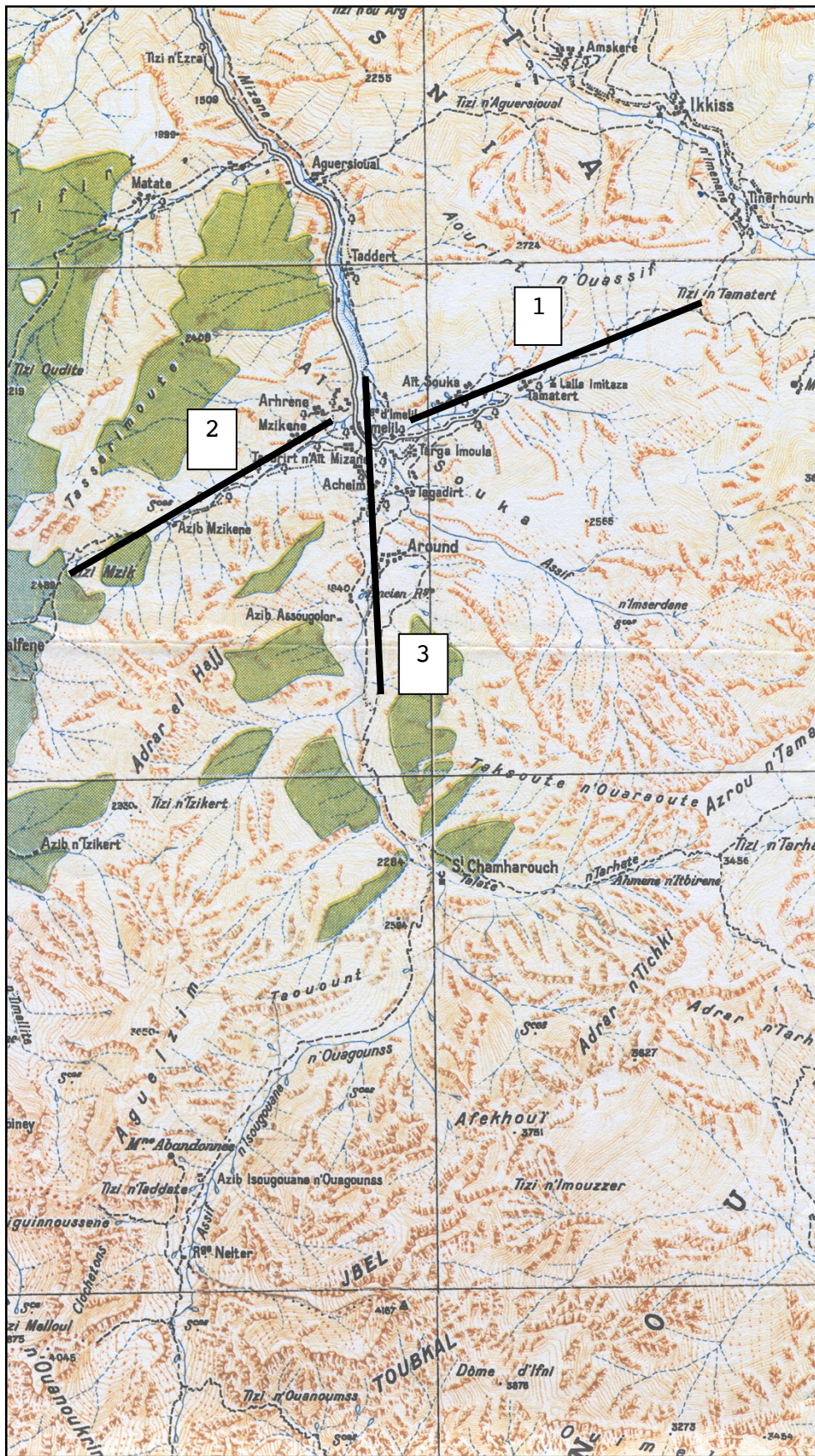
Temperatures are often sub-zero in winter requiring livestock to be kept inside for several months (at high costs).

The relief of the land (often boulder-strewn) limits the use of machinery so less efficient methods are employed. What influence does this have on the types of animals kept?

Appendices:

- Appendix 1 Base map of transects in Imlil and Aremdt basins showing transects
- Appendix 2 Map of Villages in the Upper Mizane, Ait Souka and Mzig valleys
- Appendix 3 Land Use Data Collection sheets
- Appendix 4 Questionnaire for a local farmer.

Appendix 1 1:50000 Map of the Imlil Valley showing suggested transects

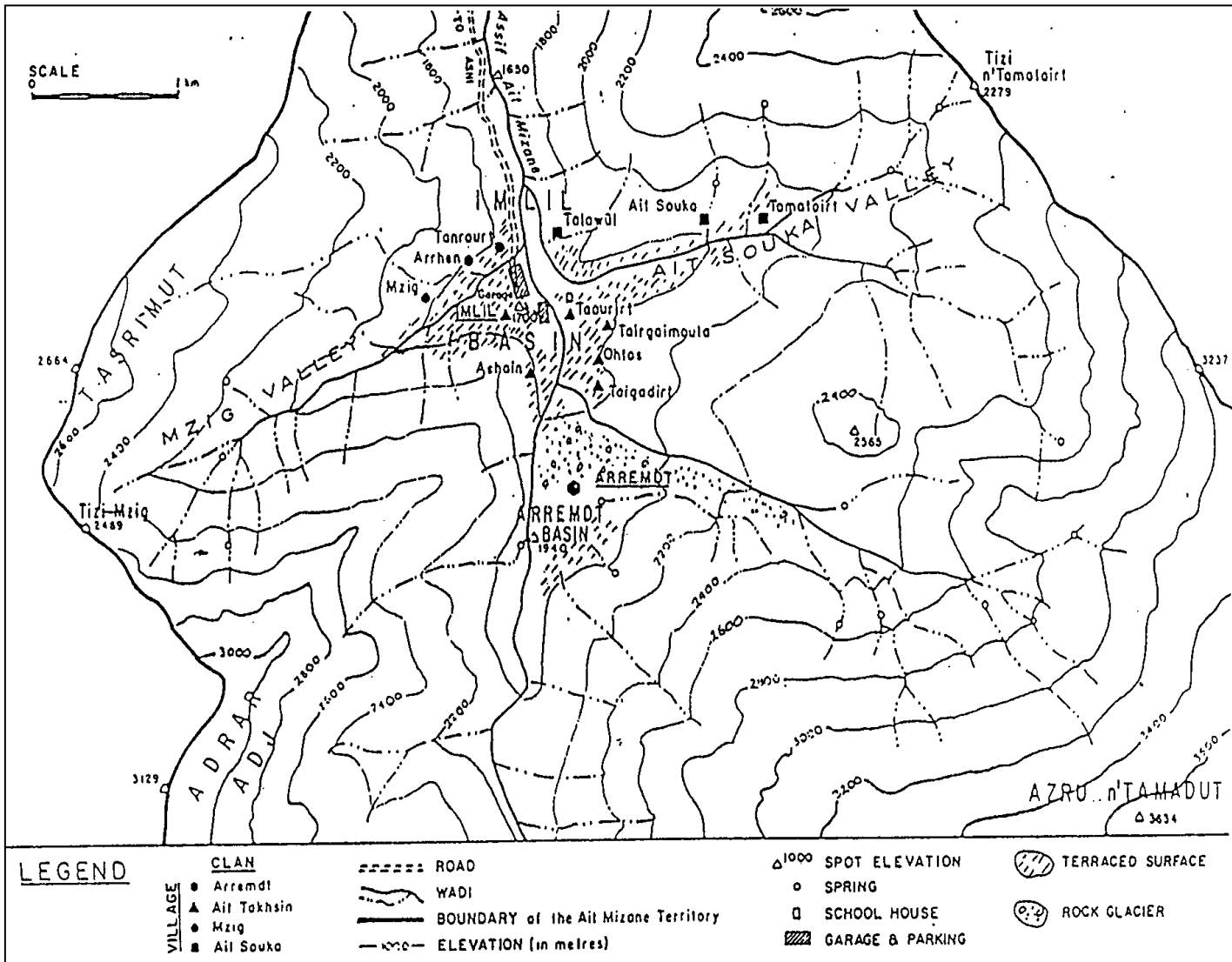


1 Imlil to Tizi Tamatert

2 Imlil to Tizi Mzik

3 Imlil to Around and beyond

Appendix 2 Map of Villages in the Upper Mizane, Ait Souka and Mzig valleys



Appendix 3 Land Use Data Collection Sheets (Imlil Area)

Remember to always start at the bottom of the transect, recording sheet and clearly label the transect on your base map, including the direction in which you are walking. You will need to create a land use code based upon the crops present. This will require a brief survey of the area before you start your recording. This initial survey could be started from the balcony or roof of the Kasbah. Use letters to represent the different crops e.g. M = maize, W = walnuts etc. Record the land use on either side of your transect or path route every 20 metres. The first column is for the land use at 20 metres from the path on both sides, the second column is for recording the land use at a distance of 40 metres from the transect path and the final column is for the land use at a distance of 60 metres from the transect path.

The image displays four vertical grid diagrams, each representing a 100m race track divided into 10 segments of 10m each. An arrow points from the 'START' line to the 10m mark. The diagrams are labeled (Left) and (Right) for each lane width.

- 60m (Left):** The track is 60m wide. The 'START' line is at the bottom. The arrow points to the 10m mark.
- 40m (Right):** The track is 40m wide. The 'START' line is at the bottom. The arrow points to the 10m mark.
- 20m (Left):** The track is 20m wide. The 'START' line is at the bottom. The arrow points to the 10m mark.
- 20m (Right):** The track is 20m wide. The 'START' line is at the bottom. The arrow points to the 10m mark.

Appendix 4 Suggested questions for local farmers

- How much land do you own? How many hectares/how many terraces?
- How close is your land to your home?
- How has your amount of land changed in the last 10 years?
- Did you inherit or buy your land?
- What crops do you farm?
- Which of these crops do you keep for your family?
- Do you have any left to sell?
- Do you have a cash crop?
- Have the types of crops you farm changed in the last ten years?
- Do you use artificial / chemical pesticides?
- What animals do you have?
- Do you sell any animals, live or dead?
- Have you been able to increase the number of animals you keep over the last ten years?
- Who will inherit your land?
- What problems are there with farming in this valley?
- Do you farm cooperatively (helped by others) or is it just your family who farm your land?
- What ways are farmers overcoming these problems?

Thank you for your cooperation!

“Sho’kran!” means “Thank you!” in Arabic

“Sho’kran bezzafi!” means “Thank you very much!”