



ISOE-Materials Social Ecology 40

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Agriculture in the Zayandeh Rud Catchment



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Preface

This report presents and justifies data regarding agriculture in the Zayandeh Rud Basin in Iran used in the German-Iranian Research Project “Integrated Water Resource Management (IWRM) in Isfahan”, funded by the German Ministry of Education and Research. The report is composed by ISOE – Institute for Social-Ecological Research GmbH in order to describe the current status of scientific knowledge on agriculture and to serve as a database for the Water Management Tool (WMT) developed by DHI-WASY. Hence, the primary goal of the report at hand is neither to develop a comprehensive understanding of all agricultural activities in the basin or develop future trends of the agricultural sector nor to elaborate on available water resources or overall water demand of agriculture, but to deliver comprehensible basic data (cultivated area, crops and orchards) for the WMT and its future application. Both institutions and activities are part of the German-Iranian Research Project “Integrated Water Resource Management (IWRM) in Isfahan” (www.iwrm-isfahan.com), coordinated by inter3. The report, its contents and its validations are accounted solely by its authors.

The study is based on data received by close collaboration with (1) local institutions like Isfahan Regional Water Company and Agriculture Organization Isfahan – AOI, as well as (2) Interviews with farmers from the Western and Eastern part of the catchment and local experts of water management and agriculture and (3) a continuously literature review of articles and reports concerning the Zayandeh Rud catchment in Iran.

Acknowledgement

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1 Introduction

The use of water resources in the Zayandeh Rud catchment is characterized by water use of different socio-economic groups. Main consumer of the surface and ground water resources with over 90 % is the sector agriculture followed by the urban and the industry sector.

This report focuses on the agricultural sector, which still plays an important role in the Iranian economy. It comprises a considerably high percentage of production and employment: In earlier years about 25% of the Gross National Product (GNP), 33% of employment, 25% of non-oil exports and 80% of food requirements have been provided by the agricultural sector in Iran (cf. Karbasioun et al. 2008).

The Iranian year 1385 (2006) is the reference or base year of the above mentioned project. In this year the agriculture accounted for 14 percent of Iran's Gross Domestic Product (GDP) and 21 percent of the economically active population. According to Stads et al (2008) the agricultural sector was the fastest growing economic sector in Iran over much of the 1370s due to the construction of extensive irrigation schemes and the expanded production of export-based agricultural commodities such as dates, flowers and pistachios. Nevertheless, successive years of severe drought have substantially held back agricultural output growth. As a result, agriculture's share of GDP has fallen from one-quarter in the early 1370s to the aforementioned 14 percent in 1385.

2 Study area

In the Center of Iran the Zayandeh Rud is the highest-volume river which originates in the Zagros Mountains at an altitude of about 2,300 m and closes after a length of about 350 km in the Gav Khuni swamp at an altitude of about 1,500 m. The Gav Khuni swamp is an important wetland recognized by the Convention of Ramsar in 1975.

The closed Zayandeh Rud Basin covers an area of about 41,500 km² whereof the province of Isfahan contributes more than 90 % completed by the province of Chahar Mahaal & Bakhtiari (Figure 1).

While annually rainfall in the upper catchment area reaches an average of 1,700 mm the city of Isfahan (at an altitude of about 1,800 m) receives only 130 mm a year concentrated in the period of November to April. Temperatures in summer time are reaching 30 °C in July and are dropping down to an average minimum of 3 °C in January. The potential evapotranspiration is about 1,500 mm/y (Molle et al. 2004).

Agriculture is the main water consumer using more than 90 % of the available water resources in the basin followed by domestic and industrial sectors. Due to the low precipitation in the central part of the basin agricultural irrigation is dominant consisting of six main irrigation networks (Abshar, Nekouabad, Borkhar, Rudasht, Mahyar and Lenjanat) in the lower sub-basins along the Zayandeh Rud (Figure 2). Together with the northwestern Karvan network (Morghab spring, Khamiran dam) a net irrigation area of about 180,000 ha is supplied by surface water and groundwater.

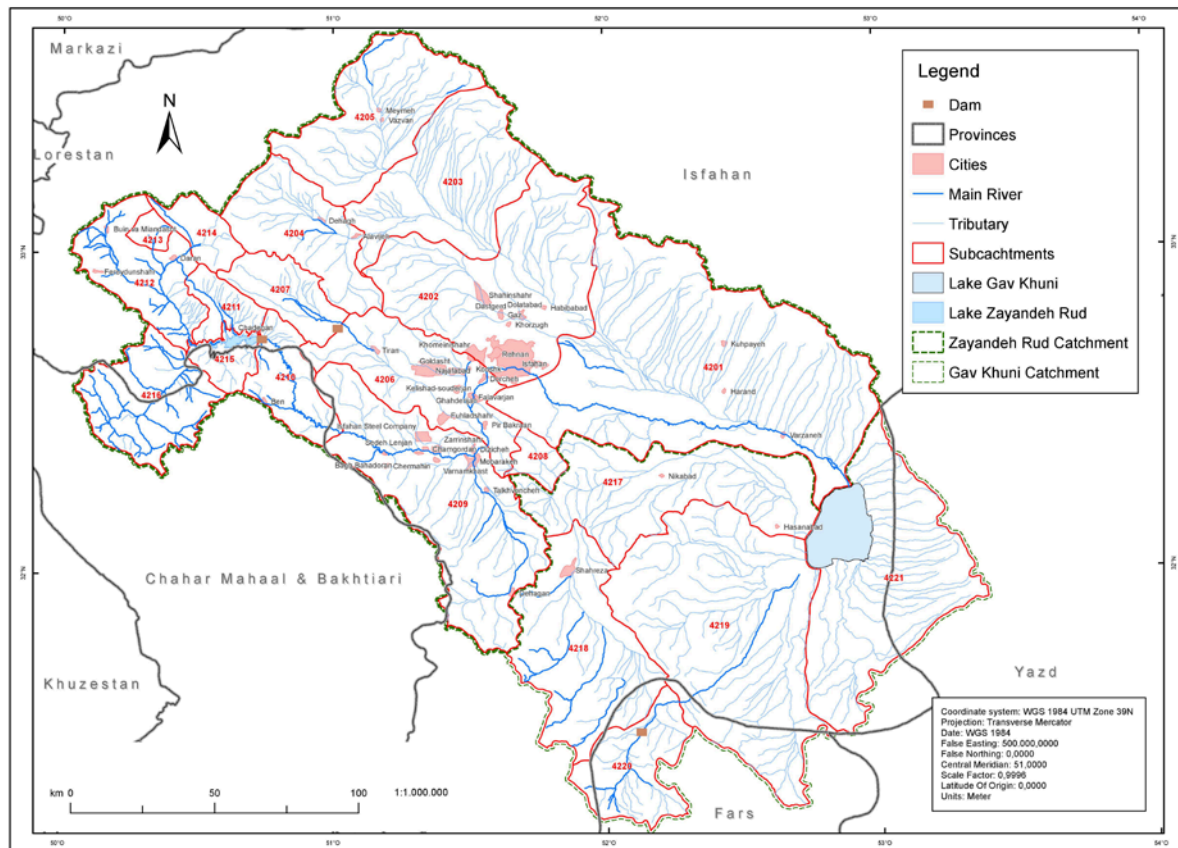


Figure 1: Map of the Zayandeh Rud Basin and hydrological sub catchments (source: DHI-WASY)

Regarding field scale the irrigation efficiency is approximately 40 % if percolation and run-off of irrigation water is considered as a loss (Madani and Mariño 2009). Against the background of a closed basin these water losses return to surface and ground water sources and can be used again. Due to this multiplier effect of water recycling the irrigation efficiency on basin scale can be assumed much higher up to 70 % (Zayandab 2008).

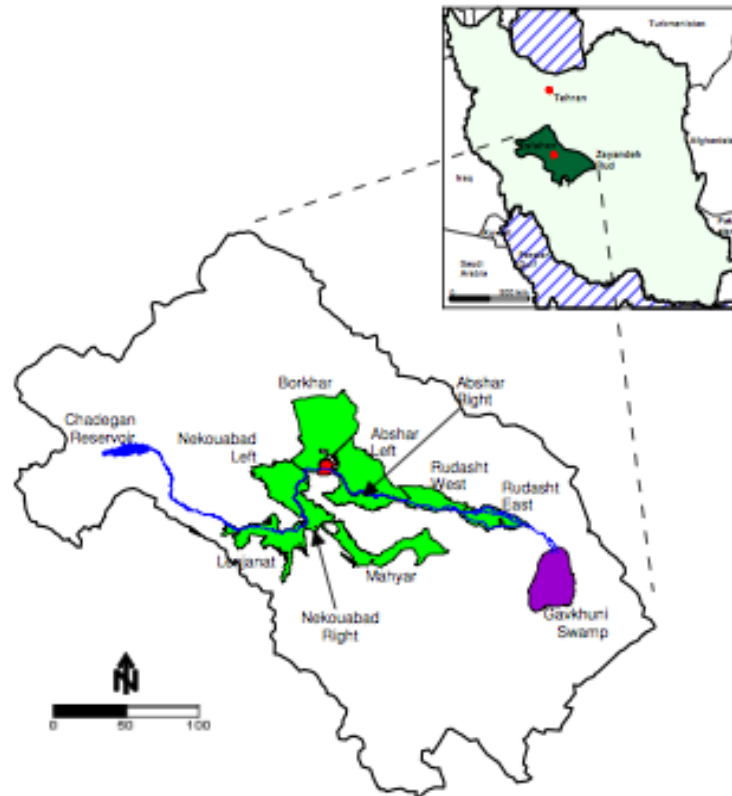


Figure 2: Main irrigation networks along the Zayandeh Rud (Droogers and Miranzadeh 2000)

3 Data basis

Existing studies regarding the Zayandeh Rud catchment respectively the Gaw Khuni catchment are mostly based on different hydrological sub-units (Zayandab 2008, Yekom 2010) and the appropriate agricultural data refer to these units (see example in Table 1). Within these studies basic agricultural data are only available for one specific year and for few selected products regarding farmland and orchards. In addition, the method of adapting the original data regarding agriculture to the hydrological sub-units is not clearly described.¹

¹ Furthermore, during a workshop with Yekom Consulting Engineers about the masterplan (Yekom 2010) the Agriculture Organization Isfahan was questioning the data base and appropriate results of this study, due to some data e.g. regarding water consumption in agriculture (see Appendix D) and scenarios of cropping patterns are not confirmed by AOI.

Table 1: Excerpt of aggregated agricultural data at level of hydrological sub-units (Yekom 2010)

Hydrological sub-units		Crops										
		Wheat	Barley	Rice	Sugar beet	Potato	Onion	Maize	Pulse	Fodder	Others	Total
4201	Area (ha)	21,330	5,068	1,520	1,534	433	1,341	1,988	23	3,949	4,061	41,248
	Area (%)	50.6	12.0	3.6	3.6	1.0	3.2	4.7	0.1	9.4	9.6	97.9
	Performance (kg/ha)	4,845.00	4,085.00	5,544.00	36,371.00	23,431.00	40,000.00	6,423.00	1,654.00	9,500.00	4,000.00	
	Yield (t)	103,343	2,070	8,425	55,793	10,143	53,635	12,769	39	37,519	16,246	318,615
4202	Area (ha)	8,527	3,038	140	562	7	144	1,332	2	1,178	4,345	19,274
	Area (%)	42.3	15.1	0.7	2.8	0.0	0.7	6.6	0.0	5.8	21.6	95.6
	Performance (kg/ha)	4,845.00	4,085.00	5,544.00	36,371.00	23,431.00	40,000.00	6,423.00	1,654.00	9,500.00	4,000.00	
	Yield (t)	41,313	12,410	775	20,428	156	5,772	8,555	4	11,188	17,378	117,981
4203	Area (ha)	1,999	757	0	224	2	0	6,852	0	157	634	10,625
	Area (%)	18.5	7.0	0.0	2.1	0.0	0.0	63.3	0.0	1.4	5.9	98.2
	Performance (kg/ha)	4,845.00	4,085.00		36,371.00	23,431.00		6,423.00		9,500.00	4,000.00	
	Yield (t)	9,686	3,092	0	8,155	52	0	44,011	0	1,487	2,523	69,018
...

On the other hand original data regarding agriculture (area, production, yield) are aggregated and documented by the Agriculture Organisation Isfahan (AOI) based on the counties of the province of Isfahan (see Table 2). These data show figures for each year and include all cultivated products separated for farmland and orchards.

Table 2: Excerpt of original data at county level regarding agriculture, provided by AOI (AOI 2012)

Year	Products	Province			County (Town ship)									
		Isfahan			Isfahan			Shahin Shahr			Tiran			...
-	Name	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield	Area	Production	Yield	...
-	-	ha	t	kg/ha	ha	t	kg/ha	ha	(Ton)	kg/ha	ha	t	kg/ha	...
1388/89	Wheat	90,000	439,329	4,881	28,601	160,166	5,600	4,200	20,160	4,800	2,500	10,500	4,200	...
	Rainfed wheat	18,010	18,855	1,047	0	0		0	0		500	300	600	...
	Barley	47,850	198,926	4,157	6,700	30,820	4,600	2,500	11,250	4,500	800	3,120	3,900	...
	Rainfed barley	7,006	5,870	838	0	0		0	0		75	53	700	...
	Rice (paddy)	11,468	61,016	5,321	1,400	7,000	5,000	0	0		13	40	3,100	...
	Corn	2,546	18,230	7,160	248	1,637	6,600	400	2,720	6,800	0	0		...
	Millet	1,534	4,008	2,612	140	322	2,300	4	11	2,750	0	0		...
	Pease	345	495	1,434	0	0		0	0		9	14	1,500	...
	Fedraind pease	718	201	280	0	0		0	0		0	0		...
	Beans	1,550	2,868	1,850	2	4	1,750	0	0		50	115	2,300	...
...

The Water Management Tool (WMT) developed by our project partner DHI-WASY is not based on hydrological sub-units because of the main purpose of the model to support detailed strategic decisions on monthly bases on a river basin scale (instead of other studies based on hydrological sub-units which generate average results over several years and balancing on small scale). Against this background and in order to limit the effort of data generation for future users of the WMT an easy and reproducible method of data adaption was necessary.

In a first approximating step already existing coefficients by Sally et al. 2001 were applied to be able to use the original data from AOI (Table 2). In addition, new coefficients for the remaining counties without irrigation networks within the Zayandeh Rud Basin were generated. Regarding the province of Chahar Mahaal & Bakhtiari there were no original data regarding cultivated areas and specific crops/fruits available. Therefore assumptions made by the AOI regarding the total area for crops and orchards in the year 1385 were used (see Appendix B).

Sally et al. 2001 used the aggregated administrative district-level data to get better estimates for cropping patterns with less time and effort comparing to the use of village data. Therefore, the irrigation system and administrative district boundaries were overlaid using the available ILWIS² maps to determine the proportion of area of each system that belonged to each of the administrative districts in the Zayandeh Rud basin. This enabled to determine a weighting factor for each irrigation system belonging to a particular district. Applying this factor to the recorded crop area of that district will give an estimation of how this cropped area are distributed among

² Integrated Land and Water Information System (ILWIS)

the irrigation systems that fall within that district (see Appendix B, figures with grey background). The appropriate map with the county borders and the catchment area of the Zayandeh Rud Basin is shown in Figure 3. The assumptions for the coefficients by Sally et al. 2001 are that (a) all the crop area in a given district can be attributed to one or more of the irrigation systems, and (b) the crop areas are distributed among the irrigation systems in a particular district in the same proportion as their overall boundary areas.

After applying these coefficients the Agriculture Organisation Isfahan stated that the results regarding the cultivated areas of farmland and orchards for the base year 1385 show excessive deviation compared to their real data. As a solution, new data regarding cultivated areas for the Iranian agricultural year 1385-86 were gathered and delivered by AOI at the end of the project.

With regard to this new data parts of the cultivated areas regarding farmland and orchards in five counties (Isfahan, Mobarakeh, Tiran&Karvan, Flavarjan, Lenjan) could not be allocated completely by AOI to specific irrigation networks within the Zayandeh Rud Basin. Based on the proposal of inter 3 these remaining areas were allocated to specific irrigation networks in the same portion as already existing parts within these five counties have been allocated. According to this assumption about 16% of cultivated areas of farmland and 29 % of orchards were completed.

Based on this data of the Iranian agricultural year 1385-86 (see Appendix F) new overall coefficients regarding the allocation of cultivated farmland and orchards for irrigation networks and remaining counties could be generated and were applied to the county data base. These differentiated coefficients for farmland and orchards are shown in Table 3.

For future application the above described method of allocating county data within the Zayandeh Rud Basin should be extended in a way that e.g. specific coefficients regarding farmland and orchards are not only available for a normal year (like the Iranian year 1385 which was determined by all project partners as the base year) but also for a dry and wet year. This would further improve the results of the allocation of county data of different years due to the fact that the cultivated areas and appropriate cropping patterns are changing depending on the availability of irrigation water.

Table 3: Allocation of counties to irrigation networks within the Zayandeh Rud Basin and appropriate coefficients

Province	no.	County name	Irrigation network	Coefficients (based on 1385-86)	
				farmland (-)	orchards (-)
Isfahan	1001	Ardestan ¹⁾	-	-	-
	1002	Isfahan	Borkhar Abshar left Abshar right Rudasht north Rudasht south Mahyar	0.001 0.17 0.20 0.17 0.19 0.003	0.00 0.01 0.57 - - -
	1003	Khomeinishahr	Nekouabad left	0.99	0.95
	1004	Khansar ¹⁾	-	-	-
	1005	Samirom ¹⁾	-	-	-
	1006	Faridan	-	0.80	0.59
	1007	Fereydoonshahr	-	0.75	0.69
	1008	Falavarjan	Nekouabad right Nekouabad left	0.36 0.64	0.37 0.63
	1009	Shahreza	Mahyar	0.51	0.07
	1010	Kashan ¹⁾	-	-	-
	1011	Golpaygan ¹⁾	-	-	-
	1012	Lenjan	Lenjanat up Lenjanat down	0.16 0.84	0.76 0.24
	1013	Nain ¹⁾	-	-	-
	1014	Najafabad	Nekouabad left	0.94	0.99
	1015	Natanz ¹⁾	-	-	-
	1016	Shahinshahr	-	-	-
	1017	Mobarakeh	Nekouabad right Mahyar	0.69 0.30	0.80 -
	1018	Aran & Bidgol ¹⁾	-	-	-
	1019	Tiran & Korun	Askaran /Karvan up Morghab spring Karvan upstream Khamiran Karvan downstream Khamiran	0.18 0.47 0.32	0.03 0.35 0.62
	1020	Chadegan	-	1.00	1.00
	1021	Dehaghan	-	1.00	1.00
	1022	Borkhar	Borkhar	0.93	0.60
	1023	Khor & Biabanak ¹⁾	-	-	-
Chahar Mahaal & Bakhtiari ²⁾	-	-	-	-	-

¹⁾ Counties outside of Zayandeh Rud Basin

²⁾ No coefficients available, but assumptions for cultivated area in 1384-85 by AOI

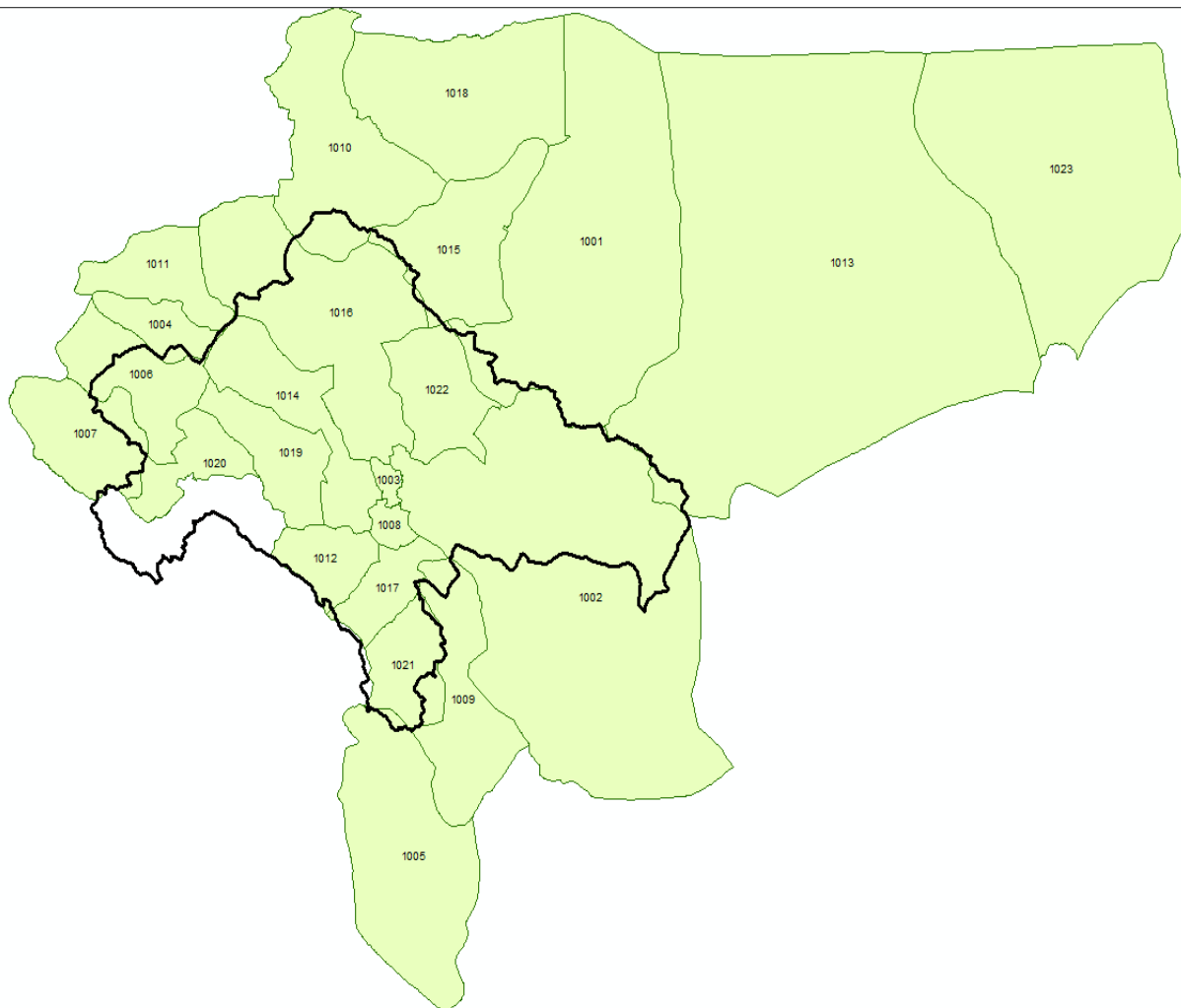


Figure 3: Counties of the province of Isfahan (no. 1001-1023) and border of the Zayandeh Rud Basin (bold black line) (source: DHI-WASY)

4 Status quo of agriculture in the Iranian year 1385

4.1 Cultivated areas and crop rotation

The overall coefficients for cultivated areas (Table 3) were applied to the original data of farmland and orchards on county level for the Iranian year 1385 resulting in appropriate cultivated areas within the Zayandeh Rud Basin (see Appendix E). The Iranian year 1385 was defined by all project partners as a “normal” year regarding agriculture and water availability and therefore chosen as the base year for the project. Regarding agriculture the base year lasts from October 2005 to October 2006.

The cultivated areas of different farmland products according to the irrigation areas in the base year 1385 are shown in Figure 4. In order to give a better overview only products with a sum > 1,000 ha in the Zayandeh Rud Basin are considered.

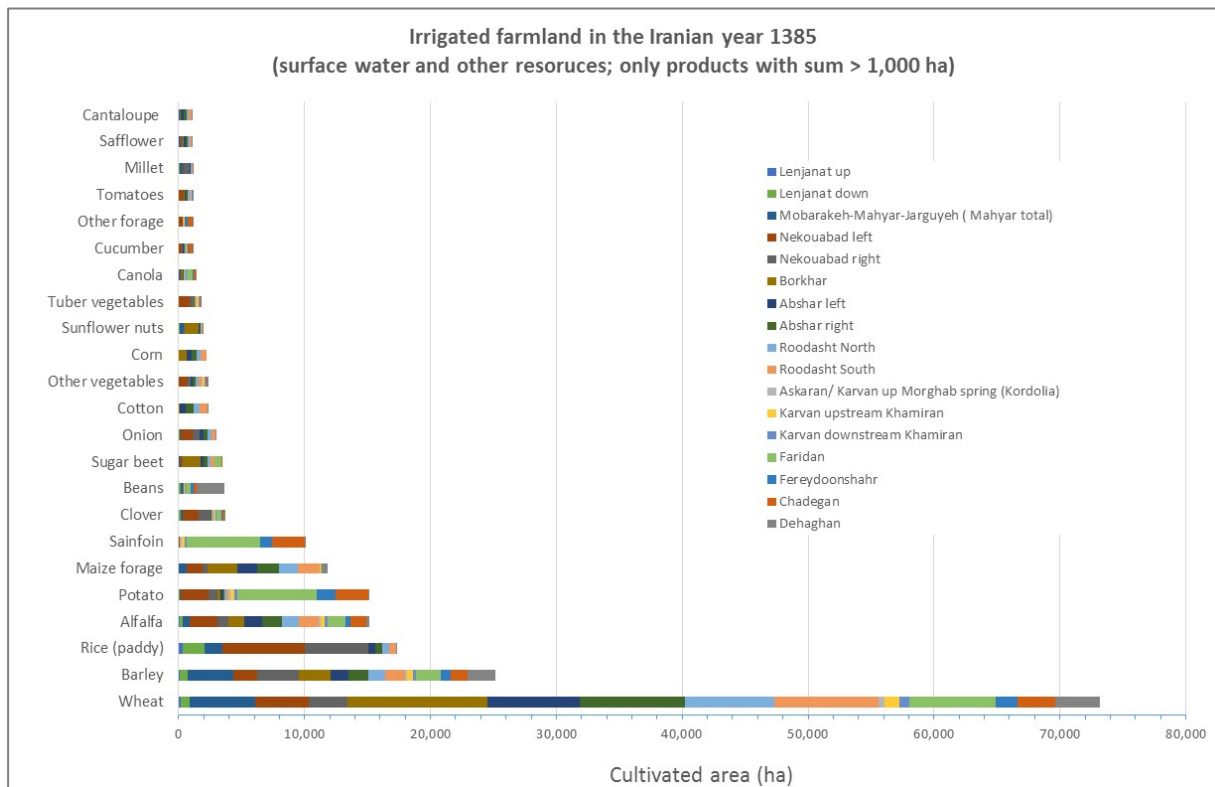


Figure 4: Cultivated areas of farmland in the Iranian year 1385 within the Zayandeh Rood Basin (supplied by surface water and other resources, only products with sum > 1,000 ha)

In total 46 products (or products groups)³ were listed in the statistics from the Ministry of Agriculture with a sum of 206,347 ha (see Appendix G, table 21) out of which 23 show a total cultivated area > 1,000 ha. With over 73,000 ha wheat is the most cultivated product by far. Barley, rice, alfalfa, potato, maize (forage) and sainfoin show cultivated areas between 26,000 and 10,000 ha followed by clover, beans and other commodities with less than 4,000 ha down to 1,000 ha. Wheat, barley, alfalfa, potato, maize and canola were grown in all the 17 irrigation areas (13 irrigation networks and 4 counties).

Regarding the irrigation areas Faridan (24,896 ha), Nekouabad left (23,692 ha) and Borkhar (23,044 ha) show the largest sum of cultivated farmland out of which Faridan is not belonging to an irrigation network supplied by surface water of the Zayandeh Rud.

According to the statistics about 57,539 ha of irrigated farmland was fallow land out of which Faridan (10,488 ha), Borkhar (10,365 ha) and Nekouabad right (8,117 ha) have the largest areas.

Figure 5 shows the cultivated areas of different products regarding orchards according to the irrigation areas in the base year 1385. In order to give a better overview only products with a sum >100 ha in the Zayandeh Rud Basin are considered.

³ In addition to these products supplied by irrigation, six products are produced by rainfed agriculture (wheat, barley, lentils, alfalfa, pea, sainfoin) with a total area of 20,138 ha located in the North of the Basin within the three Karvan networks and the counties Faridan, Fereydoonshahr and Chadegan. About 12,036 ha of rainfed land was fallow land.

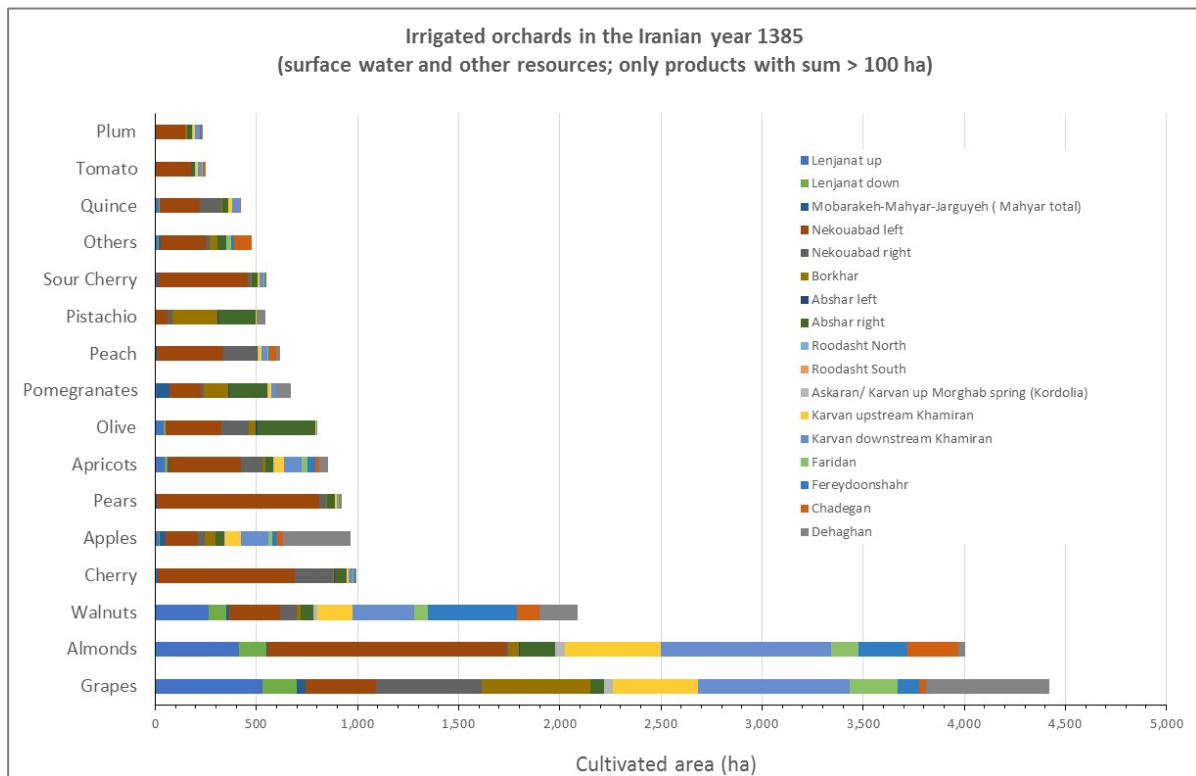


Figure 5: Cultivated areas of orchards in the Iranian year 1385 within the Zayandeh Rood Basin (supplied by surface water and other resources, only products with a total > 100 ha)

In total 25 products (or products groups)⁴ were listed in the statistics from the Ministry of Agriculture with a sum of 18,871 ha (see Appendix H, table 30) out of which 16 show a total cultivated area > 100 ha. Grapes and almonds each with over 4,000 ha and walnuts with over 2,000 ha are the most cultivated products by far.

Regarding the irrigation areas Nekouabad left (5,789 ha) and Karvan downstream Khamiran (2,310 ha) show the largest sum of cultivated orchards. These are followed by Nekouabad right (1,459 ha), Dehaghan (1,378 ha), Lenjanat up (1,370 ha), Karvan upstream Khamiran (1,304 ha), Abshar right (1,302 ha) and Borkhar (1,146 ha) each with over 1,000 ha cultivated areas.

In the irrigation networks Roodasht North and Roodasht South no cultivated areas are situated that have orchard functions.

The applied crop rotations in several counties and appropriate irrigation areas are shown in Table 4. The farmers in the remaining counties within the Zayandeh Rud Basin do not practice crop rotation.

⁴ In addition to these products supplied by irrigation, almonds are also grown by rainfed with a total area of 1,352 ha located in the North of the Basin within the irrigation networks of Karvan and Lenjanat and the four counties Faridan, Feraydoonshahr, Chadegan and Dehaghan.

Table 4: Crop rotation at county level (AOI, 2012)

County	Existing area (ha)	Total cultivated area, including crop rotation (ha)	Cultivated area with 2 rotations (ha)	Cultivated area without rotation (ha)	Crop rotation
Falavarjan	11,300	15,452	8,304	7,148	Barley-Rice, Wheat-Cabbage
Khomeinishahr	3,500	4,338	1,676	2,662	Hay-Rice, Barley-Maize
Isfahan	61,000	86,877	51,754	35,123	Melon-Cotton, Barley-Rice
Mobarakeh	10,500	17,286	13,572	3,714	Barley-Rice, Barley-Maize
Lenjan	4,000	4,767	1,534	3,233	Hay-Rice, Barley-Maize
Borkhar o Meymeh	18,734	24,653	11,838	12,815	Barley-Maize
Najafabad	7,250	10,113	5,726	4,387	Barley-Maize, Hay-Rice
Shahinshahr	0	0	0	0	Barley-Maize
Sum	116,284	163,486	94,404	69,082	-

4.2 Development of cultivated areas for farmland and orchards

Based on the Iranian year 1385 the statistical data for farmland and orchards of four years before and after that base year were adapted by the method described in chapter two.⁵ Figure 6 shows the appropriate development of total cultivated areas for the period of nine years within the Zayandeh Rud Basin (without the province of Chahar Mahaal & Bakhtiari).

After the three-years drought from 1999-2001 (Molle et al. 2008) the cultivated areas of farmland in the year 2002 amounted to 148,822 ha (see Appendix G) which are about 30 % less compared to the “normal” year 2006. In the years between the cultivated areas steadily increased up to the base year 2006 with a sum of 206,347 ha. The development of the cultivated area regarding orchards before 2006 was qualitatively similar to the farmland.

By contrast, after the base year 2006 the cultivated areas of farmland and orchards developed differently. Farmland areas decreased again up to 40 % less compared to 2006 whereas the cultivated areas of orchards increased to over 40% more compared to the base year although another dry period after 2007 can be observed (Faramarzi et al. 2010). Referring to this, the increase took place in every single irrigation area except Borkhar which shows a decline for cultivated area of about 70 %. The positive extreme can be identified for the county Faridan with an increase of about 217 % compared to the base year 2006 (see Appendix H).

⁵ Regarding cultivated areas of orchards only 8 years of agricultural data up to the Iranian year 1388 (10/2008-10/2009) were considered.

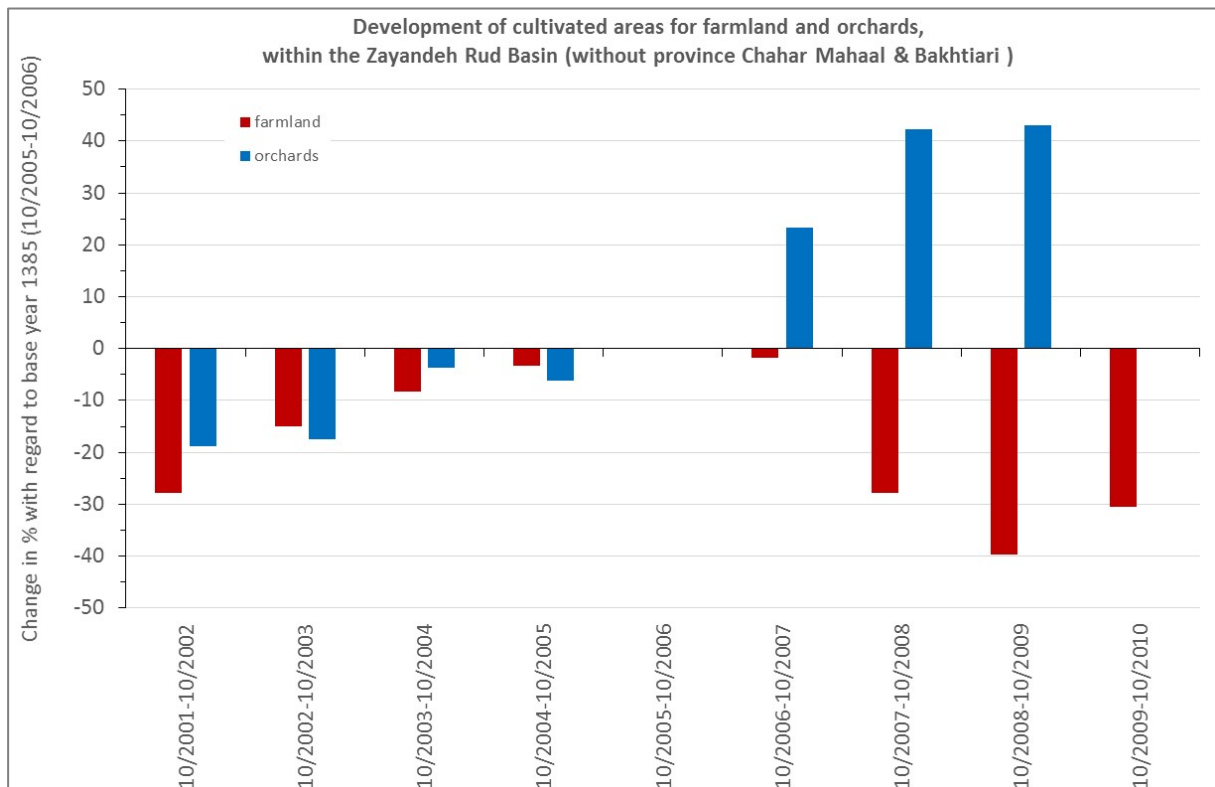


Figure 6: Development of cultivated areas for farmland and orchards for Iranian years 1380-89 (2001-2010)

4.3 Irrigation technology

Most of the irrigated agricultural area within the Zayandeh Rud catchment is irrigated by flood irrigation (e.g. furrow irrigation). In the Iranian year 1385 about 92 % of the cultivated areas were supplied with water by flood irrigation. About 8 % of the cultivated area belong to pressurized irrigation systems consisting of about 80 % of sprinklers regarding farmland and 20 % of drip irrigation regarding orchards (see Table 5). The data shown are based on bank loans granted to the farmers for funding pressure irrigation projects until 1385. There were no data available for the part of the province of Chahar Mahaal & Bakhtiari belonging to the Zayandeh Rud catchment.

Table 5: Implemented irrigation technology (AOI 2012)

Until 1385	Sprinkler		Drip		With low pressure		Sum	
County	Amount	Area (ha)	Amount	Area (ha)	Amount	Area (ha)	Amount	Area (ha)
Isfahan	58	1,766	39	403	0	0	99	2,168
Borkhar	65	2,440	10	306	2	20	77	2,765
Tiran o Karun	20	490	9	59	0	0	29	549
Chadegan	106	1,845	14	196	0	0	120	2,041
Khomeinishahr	3	14	4	26	0	0	7	40
Shahinshahr o Meymeh	0	0	0	0	0	0	0	0
Shahreza	14	286	50	473	0	0	64	759
Fereydun	382	7,083	34	379	0	0	416	7,461
Fereydunshahr	28	812	12	170	0	0	40	982
Falavarjan	6	50	23	76	0	0	29	124
Lenjan	9	224	17	244	0	0	26	468
Mobarakeh	18	385	11	68	0	0	29	453
Najafabad	26	687	69	1,791	0	0	95	2,478
Sum	735	16,082	292	4,191	2	20	1,031	20,288

4.4 Livestock

The livestock in the Zayandeh Rud catchment is dominated by poultry and sheep farming by approximately ten million respectively one million animals. Livestock data regarding the counties within the Zayandeh Rud catchment are shown in Table 6.

Table 6: Livestock in the year 1385 (AOI 2012)

County	Population: head/ piece							
	Sheep (head)	Goat (head)	Cow & calf (head)	Camel (head)	Poultry (1000 piece)	New born Fish(1000 Piece)	Decorating fish (tank fish) (1000 piece)	Honey bee colony (1000 piece)
Isfahan	190,606	47,625	70,313	73	2,268	0	3,000	25
Borkhar	126,842	52,610	36,530	265	2,134	0	100	18
Tiran & Karvan	28,591	7,757	12,567	0	975	116	0	3
Chadegan	133,226	35,784	14,373	0	71	0	0	2
Khomeynishahr	44,224	28,712	25,667	0	436	1,150	200	13
Dehaghan	25,748	22,498	5,027	0	274	2,080	0	5
Shahinshahr	0	0	0	0	0	0	0	0
Shahreza	50,700	44,398	14,464	0	179	0	0	33
Feridan	169,724	45,569	27,411	0	352	1,080	0	4
Falavarjan	44,566	23,927	16,338	0	939	6,242	0	0
Lenjan	45,595	16,649	29,980	30	300	0	0	1
Mobarakeh	68,855	9,571	24,400	0	619	300	0	1
Najafabad	60,610	20,943	23,615	305	1,523	0	1,500	176
Sum	989,287	356,043	300,685	673	10,070	10,968	4,800	279

4.5 Water consumption

The agricultural water consumption⁶ of surface water within the Zayandeh Rud Basin is measured and documented by Mirhab.⁷ For the year 1385 about 726 million m³ of surface water was extracted from the Zayandeh Rud and supplied to agriculture by canals within the new irrigation networks (Mirhab 2012). Table 7 shows the monthly water consumption of each irrigation network differentiated into the total water extracted from the Zayandeh Rud (canal, inlet) and the water supplied to farmland and orchards (canal, agriculture).

Table 7: Water consumption of irrigation networks for the Iranian year 1385 (Mirhab 2012)

Year	Irrigation network	Canal	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Sum	
			mio. m ³													
2005-2006	Mahyar and Jarghoyeh	Inlet	8.5	8.0	0.0	0.0	0.0	0.0	0.0	13.4	15.5	9.6	7.6	7.5	6.4	76.5
		Agriculture	5.0	6.9	0.0	0.0	0.0	0.0	0.0	11.2	13.1	8.0	6.4	6.5	5.4	62.5
	Nekoabad Left	Inlet	3.5	0.0	2.7	0.0	0.0	0.0	0.0	13.5	27.9	40.1	50.4	48.3	40.8	227.2
		Agriculture	2.3	0.0	2.0	0.0	0.0	0.0	0.0	10.8	23.8	33.0	43.0	39.4	32.6	186.9
	Nekoabad Right	Inlet	3.5	0.0	2.7	0.0	0.0	0.0	0.0	1.2	8.0	14.8	21.1	21.1	18.2	90.6
		Agriculture	2.3	0.0	2.0	0.0	0.0	0.0	0.0	0.9	0.6	10.1	17.2	17.9	15.2	66.2
	Borkhar	Inlet	3.9	0.0	0.0	0.0	0.0	0.0	0.0	5.3	12.3	13.1	13.9	14.7	14.2	77.4
		Agriculture	3.5	0.0	0.0	0.0	0.0	0.0	0.0	4.0	10.4	11.6	12.0	12.4	11.3	65.2
	Karvan	Inlet	0.5	1.7	0.3	0.0	0.0	0.0	0.0	0.0	1.6	2.8	3.9	3.7	4.1	18.6
		Agriculture	0.4	1.4	0.2	0.0	0.0	0.0	0.0	0.0	1.4	2.2	3.3	3.0	3.2	15.2
	Abshar Left	Inlet	3.3	8.5	7.9	0.0	0.0	0.0	0.0	19.5	20.6	14.0	12.5	13.4	13.4	113.0
		Agriculture	2.7	6.6	6.2	0.0	0.0	0.0	0.0	14.7	15.1	10.5	9.1	10.0	9.8	84.7
	Abshar Right	Inlet	3.3	8.5	7.9	0.0	0.0	0.0	0.0	18.0	19.3	12.1	12.5	13.4	13.4	108.3
		Agriculture	2.7	6.6	6.2	0.0	0.0	0.0	0.0	12.5	13.2	9.0	9.2	9.3	9.6	78.3
	Roudasht North	Inlet	0.0	2.1	23.8	0.0	0.0	0.0	0.0	20.5	23.6	13.3	8.1	10.7	11.0	113.1
		Agriculture	0.0	1.8	19.0	0.0	0.0	0.0	0.0	15.4	17.7	10.0	6.1	8.0	8.3	86.3
	Roudasht South	Inlet	0.0	2.5	21.0	0.0	0.0	0.0	0.0	15.3	20.9	13.2	7.9	9.6	11.1	101.5
		Agriculture	0.0	1.9	17.2	0.0	0.0	0.0	0.0	12.2	16.0	10.5	6.3	7.7	8.9	80.7
	Sum	Inlet	26.4	31.2	66.1	0.0	0.0	0.0	0.0	106.7	149.7	133.0	137.9	142.4	132.6	926.0
		Agriculture	18.8	25.2	52.8	0.0	0.0	0.0	0.0	81.7	111.3	104.9	112.6	114.2	104.3	725.8

Considering traditional networks and pumps in total about 1.2 billion m³ of surface water is assumed for water consumption in agriculture (Yekom 2010).

Regarding groundwater consumption only rough estimations of the groundwater extraction are existing. Based on the potential capacity of the installed pumps and their operating hours about 3.2 million m³ of groundwater are supplied to agriculture by wells. Considering also springs and qanats, each about 350 million m³, in total about 3.9 million m³ of groundwater is assumed to be used in agriculture⁸ in the year 1385 (Yekom 2010).

Appropriate data for surface water and groundwater consumption is summarized in Appendix D.

5 Future developments

Based on figures of the Iranian year 1389-90 the Agriculture Organisation Isfahan assumes that an increase of the cultivated area of about 68 % for agriculture and 23 % of orchards can be possible until 1404. At the same time the production is expected to increase of about 73 % for crops and 67 % for fruits, which indicates an improvement of the specific yield in addition to the expansion of the cultivated land (see Table 8). For this intensification of production greenhouses are taken into consideration by the Agricultural Organization of Isfahan. Also interviewed experts of the Agricultural Research Centre such as A.R. Mamanpoush emphasized

⁶ Statistical data regarding the use of fertilizers and pesticides are not available because these products are not sold by government anymore but by private companies which do not collect and provide data.

⁷ Mirhab is an independent semi-governmental institution responsible for the operation and maintenance of the irrigation networks within the Zayandeh Rud Basin, established in 1993.

⁸ Even though the water consumption regarding livestock might be negligible compared to total the water consumption in agriculture it is not clear if and how much water for livestock is included.

greenhouses besides improved plant protection and bio-engineering. The production regarding livestock is expected to increase of about 73 %.

Table 8: Expected developments in the sector agriculture (AOI 2012)

Scenarios				
	Area in the year 1389-90 [ha]	Production in the year 1389-90 [t]	Area in the year 1404 [ha]	Production in the year 1404 [t]
Agriculture	159,747	2,214,000	268,181	3,834,000
Orchards	40,917	144,273	50,500	240,225
Livestock	-	1,243,094	-	2,152,636
Sum	200,664	3,601,367	318,681	6,226,861

6 Socio-economic aspects

Within the Zayandeh Rud catchment only few data regarding socio-economic aspects are available respectively documented.⁹ Nevertheless, three main types of farming (1) agriculture, (2) livestock and (3) orchards and different combination of these types can be observed. Agriculture farms (arable farming)¹⁰ are the largest single farming type with about 19 % and agriculture & orchards is the largest combination with about 38 % of all farms. 22 % of all farms are located within the county Isfahan (see Table 9).

Besides a few cooperatives and industrial farms most of the farms are family enterprises (about 94 %, Yekom 2011). Most of the farms are relatively small farms between 0.1 ha and 10 ha and show low financial capacity e.g. for implementing new technologies. Therefore, the government is funding new irrigation technologies by 85 %. There are different reasons why only about 20,000 ha of the cultivated area is supplied by new irrigation technologies¹¹:

1. In reality the funding is not 85 % but about 50 %, due to necessary additional equipment e.g. storage tanks etc. is not included in the funding.
2. The funding amount is limited but in every year there are more proposals of farmers than funding capacity.
3. In the Western part of the Zayandeh Rud catchment there are more innovations funded due to higher water quality of the Zayandeh Rud (compared to the Eastern part) which is needed for new irrigation techniques such as drip irrigation. Therefore in the Eastern part mostly extensions of canals have been applied.

⁹ More detailed socio-economic data regarding the county Faridan exist, but are not available up to now. The acquisition of additional funding in order to conduct empirical investigation and to fill these data gaps by the German project team was not successful.

¹⁰ For more information on farmland characteristics see Nikouei and Ward (2012).

¹¹ Only private investments in new technologies are negligible, there are estimations about 100 ha to 200 ha (information by Zayandab Consulting Engineers Co. in 2012)

Table 9: Type of farms, without year (AOI 2012)

Typ of farm (amount of farms, without year)									
Row	County	Agri-culture	Livestock	Orchards	Livestock & Orchards	Livestock & Agriculture	Orchards & Agriculture	Agriculture, Livestock & Orchards	Sum
1	Isfahan	2,100	2,900	600	400	4,000	18,137	1,000	29,137
2	Borkhar	1,000	800	200	100	1,405	1,650	50	5,205
3	Tiran o Karun	100	287	300	800	1,500	5,000	950	8,937
4	Chadegan	1,800	500	400	300	900	1,250	100	5,250
5	Khomeinishahr	50	100	2,000	500	1,000	4,000	278	7,928
6	Dehaghan	380	200	500	115	700	1,500	280	3,675
7	Shahinshahr	800	900	150	200	1,300	1,770	180	5,300
8	Shahreza	1,100	400	700	140	1,600	1,360	300	5,600
9	Fereydun	4,500	1,000	100	200	3,500	800	401	10,501
10	Falavarjan	8,603	750	400	300	2,000	6,000	800	18,853
11	Lenjan	932	1,200	2,800	1,600	1,100	1,550	500	9,682
12	Mobarakeh	3,000	875	100	350	3,500	1,800	145	9,770
13	Najafabad	850	725	2,000	800	2,500	6,500	400	13,775
	Sum	25,215	10,637	10,250	5,805	25,005	51,317	5,384	133,613

According to Fred Pearce there are winners and losers in the agricultural process of adapting the farms to less water availability and of water allocation during the last 15 years: “Bigger, politically better connected farmers won. Small farmers and the old-age water distribution arrangements lost.” (Pearce 2012: 281) We are not sure that this abrasively perspective is adequate, especially in regard to the old-age water distribution, but see need for research regarding an establishment of new inequalities inside the agricultural sector due the changed water availabilities in the basin.

7 Problem perception and requirements to future water management

In November 2011 two workshops with farmers and representatives of agriculture from the Western and Eastern part of the Zayandeh Rud catchment were conducted. Most of the participants were farmers and smallholders being concerned because of having economic losses caused by water shortage during the last years. Besides basic information about their farms and regions these participants were also asked about their specific problem perception in terms of agriculture and water management. The following main aspects can be summarized:

- The way of water distribution during drought condition is not clear to farmers respectively it seems to them that their farming requirements (e.g. irrigation demand and water rights) are not taken into consideration accordingly.
- The accessible water in the province is obviously not enough for all sectors (especially under drought conditions) but there are water transfers to cities or provinces outside the catchment area which are not understood by the invited farmers.
- The payment of compensation (in terms of drought) by the government does in the view of the concerned not reflect their basic needs. According to the participating smallholders and farmers from the eastern part it is “not enough to live” and thus the peasant feel like not been respected. In this regard the total losses in agriculture (estimated 400 billion Tuman in the Eastern part of the basin) are much higher than compensation paid (only 12 billion Tuman according to the farmers).
- Land cultivation and grassland is reduced due to drought and puts pressure on livestock. In addition, there are water losses due to allocating agricultural lands into to smaller parcels (due to inheritance law).
- The quality of water from the Zayandeh Rud is also polluted by industry and gets decreased in terms of drought which puts additional pressure to agriculture.

- The (steel) industry is a major cause of concern. According to the farmers' opinion it is affecting the farmers in three ways: (a) it uses water which "belongs to agriculture", (b) increasing population due to immigrants from other parts of the country and (c) the pollution of water, soil and air.
- In the perception of the participating farmers the large dams (e.g. Khamiran) are one of the main reasons for the existing pressure on water resources in the catchment and for dry wells and qanats. The hydrological connection between groundwater and surface water was not considered accordingly.
- Many farmers have built houses and invested in their farms. Loans have to be paid back and future is uncertain to farmers. For the farmers participating in the workshops, it seems to be difficult to decide if their farms could be managed in the future. In addition for the older farmers it is hard to switch to other business than farming. According to the concerned participants of the workshop many people in the region have existential fears.

Based on the above summarized problem perception the following main requirements regarding future water management were named by the participants of the workshops:

1. The water management of the Zayandeh Rud should be organized according to its catchment area by one superior institution, independent of the political borders and integrating the provinces and sectors with their stakeholders belonging to the river basin.
2. Water transfers to other river basins/cities should be adjusted according to the water demand within the Zayandeh Rud catchment. Inter basin transfer and management of water is needed in order to optimize the distribution of water along the river. In this regard the existing water laws and rights to water by farmers should be considered and integrated. In addition, the shortage of water should be distributed to all sectors and the development of the different sectors to be adjusted accordingly.
3. The hydrological control of the Zayandeh Rud by dams and weirs should be minimized and optimized in order to reconstruct natural river bed and return flows.
4. The land use respectively the landscape architecture within the Zayandeh Rud catchment especially in the cities should be changed and adapted to the water shortages, e.g. plants with less water consumption should be considered and agricultural gardens around Isfahan should be supported instead of implementing new urban green (and also green around the factories which is unproductive in the view of the participating peasants).
5. The quality of water from the Zayandeh Rud should be improved according to agricultural purposes. With this regard a polluter-pays-principle should be implemented in order to minimize pollution (e.g. by industry) and co-financing the agriculture sector.
6. In order to optimize the agricultural water management a regrouping of rural land (larger parcels of land managed by one farmer) is needed. The modernization of the irrigation networks should be fulfilled, e.g. continuing the construction of 2nd and 3rd canal category in the eastern part of the catchment.
7. The water consumption in all sectors should be optimized by water substitution and recycling, e.g. reusing more water within the industry sector and implementation of wastewater treatment and reuse for agriculture irrigation.

It is obvious that at least in part these perceptions and validations are interest driven; nevertheless they contain "kernels of truth" which should be identified and carefully reflected. Organizational ideas and proposals might be worked out precisely during specific meetings in Phase II of the project (cf. part 9 of the report). Some essentials of water management in the province seem not to be understood by the broad mass of peasants (especially in regard to the water allocation during shortages and the water transfer to Yazd and other cities; there is also a somewhat overvalued idea of a specific water right of agriculture as the traditional water user). It is possible that better communication might minimize such misunderstandings and wrong interpretation of the possibilities of the Isfahan Regional Water Company. Rural sociologists might support the company and the governor of the province in their decisions if specific PR or awareness rising methods are suitable for closing these knowledge gaps and bringing the peasants to an improved acceptance of Isfahan's water policy.

8 Adaption strategies to water scarcity

Drought can be considered as a meteorological phenomenon of precipitation below average conditions in areas where the regional water resources used by a specific society originate. Scarcity which is induced by drought refers to situations where the socio-economic activities of that society are reduced or at risk and become limiting factors. The Zayandeh Rud Basin and its society have faced drought induced water scarcity in the past years which has led to several adaptation strategies at different management levels (Hoogesteger 2005).

Regarding water scarcity Molle (2003) defined the following three kinds of general responses by a society: (1) supply – augmenting water supply from existing resources, (2) conservation – efficiency of use and (3) allocation – reallocation of water (Figure 7).

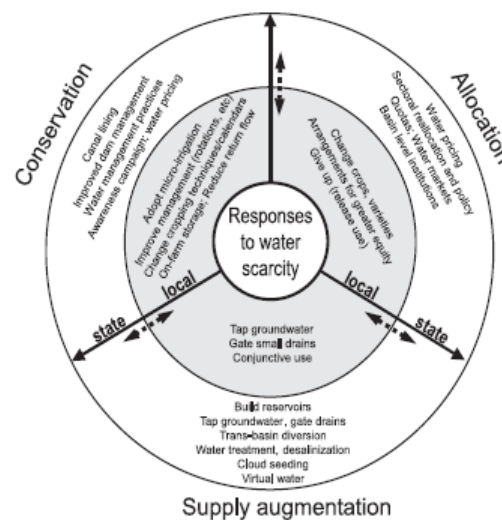


Figure 7: Types of responses to water scarcity (Molle 2003)

Against this theoretical background Hoogesteger (2005) observed different adaptation strategies at following three management levels:

- Basin scale: primarily spreading the scarce water among as many users as possible mainly by reducing agriculture water supply (allocation response).
- Irrigation system scale: distribution of water to all outlets according to the status of different kinds of water rights, the amount of water present in the area and several social and political motivations (allocation response).
- Field scale: first of all increasing the availability of water (supply response) by increasing groundwater supply e.g. due to longer pumping ours or deeper or new wells. After this possibility is exhausted strategies such as selling land, water sharing within outlets, reducing cultivated area, changing cropping patterns (conservation response), water stealing or renting land elsewhere or moving to activities outside of agriculture were developed.

The increased groundwater use and missing recharge of aquifers by return flows of surface water irrigation have led to overexploitations of groundwater resources in the basin. Focusing on the already practiced conjunctive use of surface and groundwater a conjunctive water management could be one possible measure to ensure a more equitable water distribution although several e.g. institutional obstacles have to overcome (Hoogesteger 2005).

9 Proposals for the second project phase

As basin water resources become tighter, there is a need for better accounting of water flows and a better understanding of the complex flow network and its dependencies. The Water Management Tool allows a development of such a better understanding. Adequate water accounting is essential to backup negotiations. Especially the data base for the agricultural groundwater extraction needs to be improved because there are only rough estimations of the extraction (using the pumping potential instead of the observable extraction).

For a qualitatively and quantitatively more sustainable management of water resources future strategies in the catchment area should be as well widely accepted but also realizable. To identify such strategies affected farmers have to participate actively in the realization of IWRM measures. For this purpose it is not sufficient to include solely the Board of Agriculture, as these cannot represent all the specific features of the extremely diverse agriculture in the catchment area during the IWRM process.

In order to identify needs and requirements on the part of agriculture, for project phase II four intensive participatory techniques are planned with the involvement of affected farmers and their representatives. Five events of 2 to 3 days' duration (each with two parallel meetings) should be carried out and as far as possible embrace the different cultivation circumstances in the catchment area (upper and lower reaches, river remote sites, greenhouse cultivation). As suitable method, the in Germany developed procedure called "Planning Cell" ("Planungszelle") is considered. This procedure combines local and expert knowledge and is aligned to the creation of concrete concepts, that serve as recommendations for action in the form of "Citizen Report". An alternative to this, which is also developed in Central Europe, is the "Future Workshop" ("Zukunftswerkstatt"), which is usually carried out in one day. With this method and the same budget it might be possible to involve two to three times more farmers and thus to consider more accurate the different social and physical base of agriculture in the Zayandeh rud basin.

In both cases, selected experts will be given the opportunity to present current challenges in terms of available water resources. In the Planning Cell the single proposed solutions and actions are presented and commented in each case by one proponent and one opponent. This finally gives a comprehensive picture of the desired land management, its water needs and the necessary measures. The land management states, their water dependence and the therefore necessary measures are evaluated and prioritized by individual participants after the discussion. The weighted and prioritized proposals for action are summarized in a "Citizen Report". They could be pictured in the WMT and handed over to the political authorities for implementation. Similarly in the possible alternative Future Workshop: The needs are obtained more precisely on the spot. They are the base for a bottom-up policy proposal which will be established for the consideration of the farmers in the IWRM process. It maps more accurate the farmers needs and for example focuses on the question, which field and garden fruits with particularly high added value can be grown in the different parts of the catchment area with high added value without having to give up certain agricultural production structures (small scale family farms for example).

Up to now the land use in the catchment area is mainly determined by the agricultural sector. Virtually as a by-product of the cultivation of field and garden fruits, the farmers contribute significantly to the environmental protection of the basin. With the agricultural vegetation cover they protect the soil from water and wind erosion and maintain its filter and buffer capacity for groundwater recharge. They also contribute potentially to a carbon sequestration in the soil humus. The ecosystem services rendered by agriculture are not only depending on the farmers' knowledge about these relations as well as on labour, machinery and capital, but also on an adequate supply of water. Until now this contribution of agriculture to environmental protection in the area was not addressed in the debate about the solution of the water distribution conflict in the catchment area. Also related to the development of measures for environmental protection in particularly vulnerable sub-areas a further participation process can be useful in phase II.

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11 Appendix

Appendix A: Chronology of data collection, discussion and adaption

The following table shows the main steps regarding the collection, discussion and adaption of data regarding the sector agriculture.

Table 10: Overview of main steps regarding data management

Time	Activity
Continuously	Study of literature.
2011-01-14	First enquiry regarding agricultural data.
2011-02-17	Second inquiry regarding agricultural data; concretized after kick-off workshop in Isfahan.
until 2011-11-22	Delivered data were translated into English and analyzed by ISOE (e.g. powerpoints regarding irrigation networks, Zayandab 2008 and Yekom 2010).
2011-11-22	Meeting with Agriculture Organisation Isfahan, department of planning and development and ESRW: Link from AOI to agricultural data on county-level since 1991; were downloaded afterwards and translated into English by ISOE.
2012-07-14/16	Meeting with ESRW and Mr. Mamanpoush: Mr. Mamanpoush introduced and explained existing coefficients to adapt county data to irrigation networks (Sally et al. 2001). Agreement: preparing adaption of county data to irrigation networks using "Mamanpoush-coefficients" by ISOE in order to discuss results at next visit.
2012-12-02	Presentation of Water Management Tool (WMT) and adaption of agricultural data to Iranian partners (ERSW, AOI, Mr. Mamanpoush): Participants realized that WMT is not based on sub-units due to other purpose of the model (WMT= detailed strategic decision on monthly bases; other studies based on sub-units are good for generating average over several years and balancing on small scale, but not on river basin scale). Adaptation of agricultural data (county level) was explained in two sessions (with managers of different departments and AOI only) and participants confirmed adaption method by Sally et al. 2001 and new coefficients for remaining counties by ISOE. During an additional meeting Mr. Ziai, Mr. Mamanpoush and Mr. Asadi confirmed that (a) coefficients of Sally et al. 2001 are still ok and should be used to adapt data from county level to irrigation networks and (b) no adjustment of existing coefficients by Mr. Mamanpoush is necessary due to areas of irrigation networks have not changed since 2001.
2012-12-05	Meeting with Yekom Consultant (Mr. Doroudian) at ERWB regarding the Masterplan (Yekom 2010) and appropriate agricultural data (basic data and scenarios): AOI did not accept some of the presented data in the Masterplan, e.g. data regarding water consumption in agriculture and scenarios of cropping patterns.
2013-07-10	Meeting with Iranian Partners (ESRW) in Dresden: Again explanation of coefficients and their inexactness which results for the different cultivated areas (irrigation networks and remaining counties) within the catchment area. Agreement: crop sequence should be sent to AOI for checking, including short description of method of coefficient and coefficients themselves.

Time	Activity
2013-09-26	<p>Visit and meeting with Iranian delegation (AOI and ESRW) in Witzenhausen:</p> <p>Discussion of crop sequences and hectares of cultivated areas: (a) around 90.000 ha difference between new AOI data and project data in WMT regarding total cultivated area of catchment area for base year, (b) differences regarding hectares of cultivated areas (irrigation networks) between new AOI data and project data in WM.</p> <p>Agreement: After visit in Germany discussion and check of differences within new AOI data and project data in WMT by ESRW and AOI.</p>
2013-10-15	<p>New data regarding cultivated areas of irrigation networks and remaining areas were sent by AOI:</p> <p>Total cultivated area for crops and orchards within the Zayandeh Rud catchment (without Chahar Mahaal & Bakhtiari) for normal year by AOI (about 248,000 ha) is comparable to project data for base year (about 246,000 ha).</p> <p>Some specific data for some irrigation networks fit (e.g. Nekouabad left and right, Abhar right, Roudasht West and East), others do not fit and show high differences (e.g. Abshar left, Borkhar).</p>
2014-09	<p>After clarification of contradictions regarding the agricultural data from 2013-10-15 new specific data for the Iranian year 1385-86 were sent by AOI in order to generate new coefficients for the allocation of county data to the Zayandeh Rud Basin</p>
2014-10	<p>Generating new coefficients based on AOI data and final revision of agricultural report</p>

Appendix B: First data set for the Water Management Tool (WMT)

Table 11: Former allocation of county data to Zayandeh Rud Basin and appropriate coefficients

Province	County no.	County name	Irrigation network	Coefficient (-)	Comments
Isfahan	1001	Ardestan	-	-	outside of catchment area
	1002	Esfahan	Nekouabad right	0,001	Sally et al. 2001
			Borkhar	0,12	Sally et al. 2001
			Abshar left	0,32	Sally et al. 2001
			Abshar right	0,14	Sally et al. 2001
			Rudasht west	0,15	Sally et al. 2001
			Rudasht east	0,14	Sally et al. 2001
			Mahyar	0,14	Sally et al. 2001
	1003	Khomeinishahr	Nekouabad right	0,03	Sally et al. 2001
			Nekouabad left	0,46	Sally et al. 2001
			Borkhar	0,51	Sally et al. 2001
	1004	Khansar	-	-	outside of catchment area
	1005	Samirrom	-	-	outside of catchment area
	1006	Faridan	-	1,00	confirmed by Iranian partners 12/2012
	1007	Fereydoonshah	-	1,00	confirmed by Iranian partners 12/2012
	1008	Falavarjan	Nekouabad right	0,44	Sally et al. 2001
			Nekouabad left	0,56	Sally et al. 2001
	1009	Shahreza	Mahyar	1,00	Sally et al. 2001
	1010	Kashan	-	-	outside of catchment area
	1011	Golpaygan	-	-	outside of catchment area
	1012	Lenjan	Lenjanat	0,98	Sally et al. 2001
			Nekouabad left	0,02	Sally et al. 2001
	1013	Nain	-	-	outside of catchment area
1014	Najafabad	Nekouabad left	1,00	Sally et al. 2001	
1015	Natanz	-	-	outside of catchment area	
1016	Shahinshahr	-	1,00	confirmed by Iranian partners 12/2012	
1017	Mobarakeh	Lenjanat	0,65	Sally et al. 2001	
		Nekouabad right	0,29	Sally et al. 2001	
		Nekouabad left	0,02	Sally et al. 2001	
		Mahyar	0,05	Sally et al. 2001	
1018	Aran & Bidgol	-	-	outside of catchment area	
1019	Tiran & Korun	Askaran /Karvan up Morghab	0,25	defined by cultivated area (google earth)	
		Karvan upstream Khamiran	0,65	defined by cultivated area (google earth)	
		Karvan downstream Khamiran	0,10	defined by cultivated area (google earth)	
1020	Chadegan	-	1,00	confirmed by Iranian partners 12/2012	
1021	Dehaghan	-	1,00	confirmed by Iranian partners 12/2012	
1022	Borkhar	Borkhar	1,00	Sally et al. 2001	
1023	Khor &	-	-	outside of catchment area	
Chahar Mahaal & Bakhtiari	-	-	-	-	Assumptions for total area by AOI

As an example the allocation of county data to irrigation networks is described for the irrigation network Borkhar regarding the crop wheat as follows:

1. Irrigation network Borkhar belongs to 11.77 % of the area of the county Esfahan, 51.13 % of Khomeinishar and 100 % of Borkhar
2. In the year 1385 about 42,600 ha of wheat were cultivated in the county Esfahan, 700 ha in Khomeinishar and 11,900 ha in Borkhar

3. Multiplying the factors under 1. with the appropriate area for wheat under 2. equals a total area of 17,272 ha of wheat cultivated in 1385 within the irrigation network Borkhar ($17,272 \text{ ha} = 42,600 \text{ ha} * 0.1177 + 700 \text{ ha} * 0.5113 + 11,900 \text{ ha} * 1.00$)

In order to limit the agricultural input data for the WMT to a level which is easy to handle but reflects the main agricultural information specific crops and fruits were selected. Therefore, all adapted figures regarding the irrigated area of crops and orchards within the Zayandeh Rud catchment were arranged in descending order to their size. Beginning with the largest areas only those products were chosen which in total cover 90 % of the entire cultivated area¹² each for crops and orchards in 1385. As a result 13 out of 46 crops and 11 out of 25 fruits were selected which in total cover 266,493 ha including the assumptions for the part of the province of Chahar Mahaal & Bakhtiari belonging to the Zayandeh Rud catchment (see Table 12 and Table 13).

Table 12: Area of main irrigated crops in 1385 as first data base for WMT

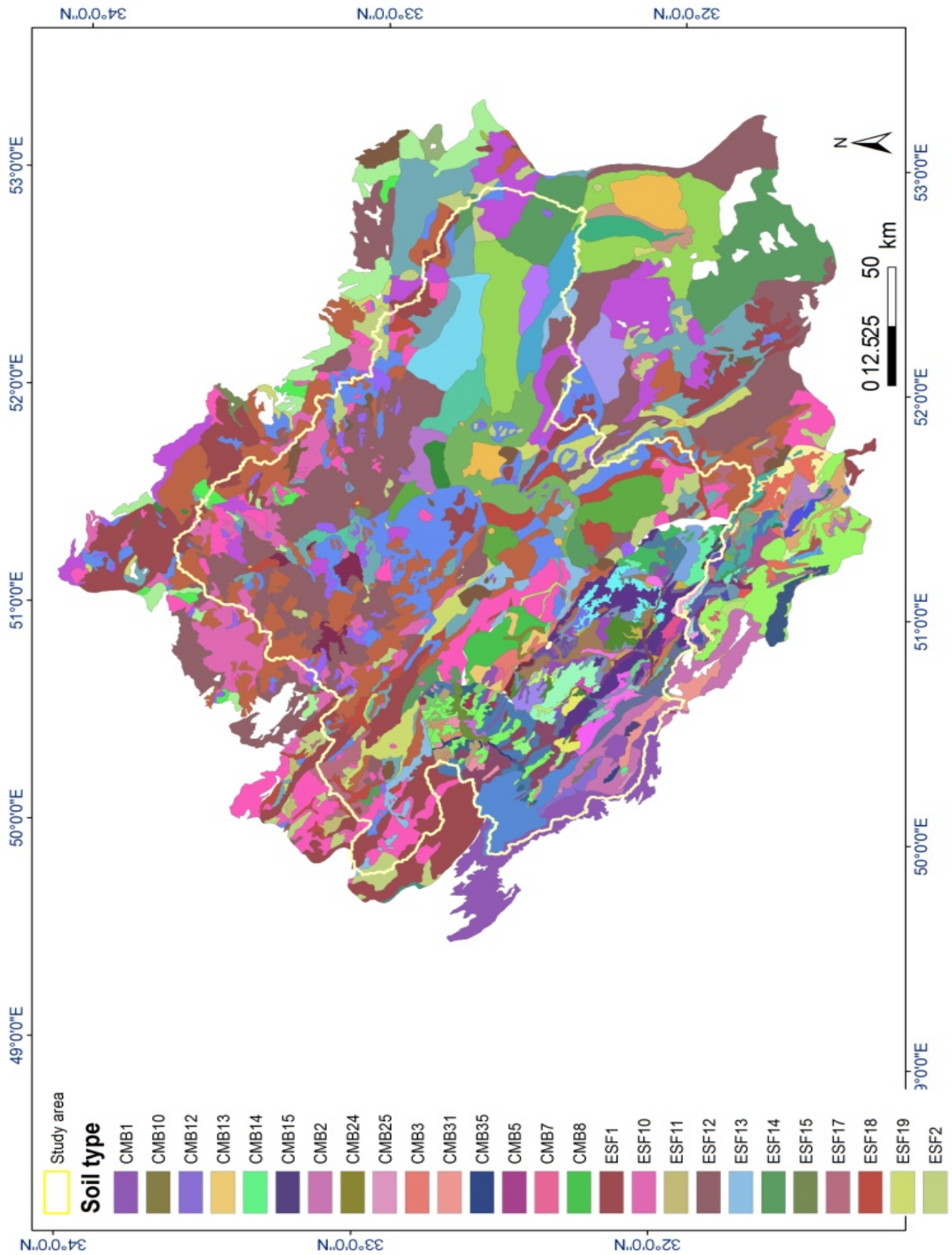
Irrigation networks and counties (all figures in ha)	Maize												Corn (Maize sweet)	Sum
	Wheat	Barley	Rice	Alfalfa	Potato	(fo- rage)	Sain- foin	Sugar beet	Beans	Clover	Onion	Cotton		
Lenjanat	3,124	3,475	4,946	794	117	208	0	97	166	473	238	13	5	13,658
Mahyar	14,228	5,884	658	1,750	159	2,345	30	344	317	89	292	432	296	26,824
Nekouabad left	3,888	1,811	5,995	1,866	1,765	1,196	100	105	19	1,059	910	0	0	18,714
Nekouabad right	1,926	1,625	3,762	692	824	273	0	42	22	819	488	7	3	10,483
Borkhar	17,272	3,903	711	2,660	768	3,704	0	1,717	3	175	240	383	942	32,478
Abshar left	13,449	2,557	947	2,557	268	2,810	0	474	8	126	521	947	650	25,314
Abshar right	5,785	1,100	407	1,100	115	1,209	0	204	3	54	224	407	279	10,889
Roodasht West	6,369	1,211	449	1,211	127	1,331	0	224	4	60	247	449	308	11,987
Roodasht East	5,836	1,110	411	1,110	116	1,219	0	206	3	55	226	411	282	10,985
Askaran/ Karvan up Morghab spring	621	226	12	170	169	35	137	5	47	48	5	0	0	1,477
Karvan upstream Khamiran	1,617	589	32	443	440	91	356	12	123	126	14	0	0	3,844
Karvan downstream Khamiran	261	95	5	72	71	15	57	2	20	20	2	0	0	621
Faridan	8,550	2,480	0	1,850	7,950	85	7,300	662	478	500	0	0	0	29,855
Fereydoonshahr	2,420	980	0	525	2,000	5	1,300	0	273	160	0	0	0	7,663
Shahinshahr & meymeh	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chadegan	3,000	1,380	0	1,200	2,619	14	2,600	12	300	158	0	0	0	11,283
Dehaghan	3,500	2,160	0	280	20	400	8	0	2,200	30	0	42	0	8,640
Chahar Mahaal & Bakhtiari	-	-	-	-	-	-	-	-	-	-	-	-	-	5,000
Sum	91,846	30,586	18,336	18,280	17,529	14,939	11,888	4,105	3,986	3,953	3,408	3,092	2,766	229,715

¹² Regarding detailed soil characteristics within the Zayandeh Rud catchment no original data were available. Therefore, existing data concerning land use and several single soil profiles were overlaid and a specific soil map was produced by Isfahan University of Technology (see Appendix C)

Table 13: Area of irrigated orchards and main products in 1385 as first data base for WMT

Irrigation networks and counties (all figures in ha)	Pome-											Sum
	Grapes	Al- mond	Wal- nut	gra- nates	Apple	Olive	Cherry	Pears	Apricot	Pis- tacho	Peach	
Lenjanat	1,105	543	365	20	31	152	25	6	69	23	57	2,397
Mahyar	710	110	243	949	502	83	18	16	41	103	50	2,824
Nekouabad left	332	1,211	225	154	117	251	607	477	301	56	297	4,028
Nekouabad right	190	2	79	6	27	58	214	63	118	10	142	909
Borkhar	950	127	66	243	142	150	68	350	82	408	20	2,607
Abshar left	38	97	36	105	23	157	32	21	20	101	3	634
Abshar right	16	42	15	45	10	67	14	9	9	43	1	273
Roodasht West	18	46	17	50	11	74	15	10	10	48	1	300
Roodasht East	16	42	16	46	10	68	14	9	9	44	1	275
Askaran/ Karvan up Morghab spring	302	339	123	10	54	3	8	4	35	1	12	891
Karvan upstream Khamiran	785	883	320	27	140	9	20	10	91	3	31	2,320
Karvan downstream Khamiran	127	143	52	4	23	1	3	2	15	1	5	375
Faridan	402	226	119	0	31	0	8	3	45	0	9	843
Fereydoonshahr	150	350	635	0	36	0	5	2	60	0	5	1,243
Shahinshahr & meymeh	0	0	0	0	0	0	0	0	0	0	0	0
Chadegan	37	252	113	0	31	0	1	1	19	0	32	486
Dehaghan	610	35	185	75	335	0	10	15	45	44	20	1,374
Chahar Mahaal & Bakhtiari	-	-	-	-	-	-	-	-	-	-	-	15,000
Sum	5,788	4,449	2,610	1,735	1,523	1,074	1,060	998	968	885	688	36,779

Appendix C: Soil map for the Zayandeh Rud catchment (Faramarzi 2013)



Appendix D: Surface water and groundwater extraction

Table 14: Surface water and groundwater extraction within the Zayandeh Rud/Gaw Khuni catchment in the Iranian year 1385 (Yekom 2010)

Hydrological sub-unit		Surface water (mio. m ³)				Groundwater (mio. m ³)			
Nr.	Name	New network	Old network	Pump	Sum	Spring	Qanat	Well	Sum
4201	Koh'payeh- Sagzi	281.4	-	-	281.4	1.4	8.4	1,130.9	1,140.4
4202	Barkhar- Isfahan	64.8	-	-	64.8	-	0.4	330.3	331.1
4203	Mourche'khort	-	0.1	-	0.1	5.8	13.4	77.2	96.3
4204	Alviche-dah'agh	-	-	-	-	5.1	24.6	26.6	56.3
4205	Meymeh	-	-	-	-	15.2	22.4	26.4	64.1
4206	Nadjafabad	306.5	40.5	0.0	347.0	-	21.2	810.3	831.5
4207	Karvan	8.6	36.0	0.0	44.6	13.0	57.2	87.9	158.1
4208	Mahyar-Nord	67.5	42.0	-	109.5	-	-	88.4	88.4
4209	Landjanat	-	89.4	1.1	90.5	9.6	83.9	121.0	214.5
4210	Bon-Saman	-	86.4	0.1	86.5	12.0	19.9	8.4	40.4
4211	Chadogan	-	1.8	-	1.8	5.5	11.3	39.8	56.6
4212	Bou'in-Daraán	-	56.1	0.7	56.8	86.9	32.3	214.4	324.2
4213	Chehel'khaneh	-	-	-	-	4.4	10.1	18.8	33.3
4214	Damaneh	-	-	-	-	2.3	2.7	111.3	126.4
4215	Yancheshmeh	-	0.1	0.0	0.1	8.2	5.3	10.9	23.5
4216	Chelgard-Ghale'shahrokh	-	128.3	0.6	128.8	180.2	27.8	4.8	213.1
4217	Mehyar-Süd Dashte Aseman	-	-	-	-	2.8	6.2	86.6	95.7
4218	Ghamshe	-	-	-	-	35.2	66.5	39.9	141.5
4219	Esfandaran	-	-	-	-	5.4	13.0	8.7	27.0
4220	Izadkhast	-	-	-	-	22.7	7.6	7.1	37.4
4221	Gaw'khoni	-	-	-	-	-	-	-	-
Sum Gaw Khuni Basin		728.8	480.5	2.5	1,211.8	415.8	434.3	3,249.7	4,099.8
Sum Zayandeh Rud Basin		728.8	480.5	2.5	1,211.8	352.5	347.2	3,194.1	3,893.9

Appendix E: Basic agriculture data for the Iranian year 1385 (Oct. 2005–Oct. 2006)

Table 15: Cultivated areas of farmland within the province of Isfahan, 1385 (AOI 2012)

Year	Products	County (Town ship)																								
		Isfahan	Aran&Bidgol	Ardestan	Barkhovar	Shahin Shahr	Tiran	Chadgan	Khomeini Shahr	Khansar	Samimom	Dehaghhan	Shah' reza	Ferdan	Freydon' shahr	Flaverjan	Kashan	Golpaygan	Lanjan	Mobarakeh	Najaf'abad	Na' ein	Khor & Biabank	Natanz		
-	Name	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area	Area		
-	-	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha		
10/2005 - 10/2006 (1384/85)	Wheat	42,600	1,450	4,960	11,900		2,500	3,000	700	1,350	4,510	3,500	7,925	8,550	2,420	1,962	1,510	4,500	875	3,514	2,400	600		1,600		
	Rainfed wheat						550	5,000		69	7,300			4,400	2,545				70							
	Barley	8,100	3,850	4,490	2,750		910	1,380	390	600	810	2,160	4,500	2,480	980	800	1,650	3,950	676	4,360	1,100	750		1,950		
	Rainfed barley						600	3,600			544			2,410	1,250											
	Rice (paddy)	3,000					50		700		70					5,500			2,085	4,500	2,500			40		
	Corn	2,058	162	1,000	700											10				8			10	250		
	Millet	300	217	60			22		10			3	220			100	1			50		600		13		
	Pease	10		60								16	350	150	70										5	
	Rainfed pease						50	10			4	750				88	200									
	Beans	25		120			190	300		56	200	2,200	310	478	273		120	125	120	75	15	60		3		
	Lentil	10		130			36	32		7	300	100	56	370	118			21	3	4		25				
	Rainfed lentils						10	300			70				650	550										
	Vetch			22			20					10	30							60	150		30		5	
	Watermelon	15	78	150	450		25					10	10				125	10	80	50	60	10		18		
	Melon	60	234	320	820		10					20	25				50	8	2	5		25		30		
	Cantaloupe	1,200	1,265	800	50		2					15	200				420	15	4	4		10		600		
	Cucumber	400	53	60	20		30	376	18	4	10	30	15	50	65	250	170	155	2	19	28	10		300		
	Squash variety			45													10	10								
	Potato	850		120	310		680	2,619	700	383	2,200	20	35	7,950	2,000	1,780	144	400	100	30	455	64		12		
	Onion	1,650	178	150	35		22		22	1			40			900	120	50	45	300	394	16		90		
	Tomatoes	700	31	100	71		90	50	80	5		10	15	20		70	203	350		9	250	10		80		
	Eggplant	100	137	100			6	3	27					5			200	14				10		50		
	Bean		25	2												160									2	
	Green beans	10		3			20	29							5		4			5						
	Garlic									6			2			4				1	30	32				
	Other vegetables	1,200	210	255			450	5	46		2	3	8	22		600	670	10	3	25	250	10		55		
	tuber vegetables	300	25	100	80		330	4	520				3	50		500	40	25	2	25	50	4		200		
	Alfalfa	8,100	720	1,050	1,400		685	1,200	600	520	2,200	280	550	1,850	525	1,050	575	5,300	350	700	990	200			500	
	rainfed Alfalfa							115		35	520			150	120											
	Clover	400					195	158	250	35	70	30	6	500	160	1,500	65	1,000	154	500	100			5		
	Sainfoin			2			550	2,600	650	1,000	8	30	7,300	1,300						100						
	Rainfed sainfoin							180		120	485				104											
	Forage sorghum			80			1		1				30						40	5		5	25		30	
	Grain sorghum	20		250									10													
	Maize forage	8,900	640	1,500	2,580		140	14	150	20		400	1,050	85	5	400	60	980	15	300	900			300		
	Turnip and fodder beet	325	224	500	240					3			40				100					140			10	
	Other forage	100		100			125	400		80			20		10	330	60	70	10		295	40			8	
	Sunflower	210		80	202								620							10	110					
	Sesame	30		150	20				5		4	3								2	15				35	
	Safflower	933	14	250	40				8		15	40					3				300				15	
	Canola	276	255	74	75		102	150	8	22	171	27	55	650	120	40	12	228	40	70	55	7			65	
	Sugar beet	1,500		6	1,540		19	12		10	3,300		121	662						4	145	102				
	Tobacco	20	22						50	31							12	237								
	Cotton	3,000	1,033	100	30								42				760								12	
	Madder																									
	Sunflower nuts	400	100	170	1,200		30	22	10	2		75	550				15	20	55	100	10	70			20	
	Saffron	35		20	40		17	3		2	2	2	2		15		18	3		7	24	52			65	
	Cumin			3									4								700					
	black cumin			2																						
	Cannabis			20					2												500					
Seed products	30		15	20		130	2	15				35	68						100					20		
Other products	10		5			8	2	28																		
sum of irrigated		86,877	10,923	17,344	24,653		7,465	12,381	4,338	3,802	15,209	9,351	16,607	31,262	8,361	15,452	7,455	19,056	4,767	17,286	10,113	2,385		6,360		
sum of rainfed							1,210	9,205		228	9,669			7,698	4,769				70							
area of fallow irrigation		2,625	1,471	3,344	11,127		3,858	5,670	921	1,464	12,095	3,363	6,439	13,170	2,347	2,734	4,292	9,154	2,287	10,413	777	2,524		1,792		
area of fallow rainfed							9,165		1,422	12,251				2,487	711			360								

Table 16: Cultivated areas of orchards (seedlings and fertile) within the province of Isfahan, 1385 (AOI 2012)

Year	Products	County (Town ship)																									
		Isfahan	Aran&Bigdel	Krdستان	Barkhovar	Tiran	Chadgan	Khomeini Shahr	Khansar	Sannitom	Behagghan	Shahr'reza	Ferdan	Freydon'shahr	Havertan	Kashan	Golpaygan	Lanjan	Mobarakeh	Na ein	Najaf'abad	Natanz	Shahin Shahr	K'tor & Biabank			
-	Name	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)	Area (ha)			
10/2005 - 10/2006 (1384-1385)	Sour Cherry	53.0		2.0	4.0	29.0	3.0	230.0	6.3	125.0																	
	Cherry	100.0		1.0	10.0	31.0	1.0	90.0	5.3	40.0	10.0	2.0	8.0	5.0	460.0	58.0	8.0	10.0	23.0		210.0	8.0					
	Tomato	35.0		3.0	4.0	34.0	6.0	150.0	11.0	4.0	2.0	4.0	5.0	2.0	456.0	5.0	3.0			11.0	30.0	60.0					
	Plum	47.0		5.0	10.0	35.0	4.0	124.0	157.0	65.0	2.0	6.0	3.0	5.0		37.0	20.0	3.0	3.0		27.0	95.0					
	Peach	9.0		10.0	4.0	48.0	32.0	30.0	0.4	250.0	20.0	45.0	9.0	5.0	264.0	16.6	27.0	4.0	83.0		135.0	400.0					
	Nectarine 1																										
	Apricots 1	64.0		8.0	28.0	141.0	19.0	90.0	94.5	90.0	45.0	31.0	45.0	60.0	250.0	169.0	36.0	63.0	12.0	33.0	120.0	117.0					
	Apricots 2															206.0	3.0					65.0	60.0				
	Nectarine 2															2.0											
	Apples	74.0		9.0	91.0	217.0	31.0	83.0	63.0	#####	335.0	490.0	31.0	36.0	42.0	125.3	58.0	20.0	18.0		55.0	200.0					
	Pears	68.0			10.0	15.0	1.0	650.0	8.0	10.0	15.0	6.0	3.0	2.0	92.0	18.0	10.0	5.0	1.0		130.0	110.0					
	Quince	51.0		20.0	8.0	57.0	1.0	5.0	2.0	57.0					265.0	107.0	14.0	20.0	7.0		28.0	650.0					
	Pomegranates	334.0	15.0	2052.0	200.0	42.0		7.0			75.0	900.0			2599.8	8.0	19.0			250.0	150.0	1300.0					
	Grapes	120.0	55.0	426.0	890.0	1214.0	37.0	90.0	680.0	120.0	610.0	660.0	402.0	150.0		380.5	365.0	700.0	650.0	21.0	265.0	310.0					
	Grapes (rainfed)																										
	Fig					10.0						4.0				73.0				10.0	15.0		30.0				
	Walnuts	114.0		146.0	28.0	495.0	113.0	49.0	768.3	1050.0	185.0	225.0	119.0	635.0	152.0	424.0	85.0	350.0	35.0	110.0	110.0	530.0					
	Hazelnut								0.6							20.0											
	Almonds	308.0		180.0	91.0	1365.0	252.0	10.0	420.1	45.0	35.0	65.0	226.0	350.0		520.9	173.0	550.0	7.0	225.0	1200.0	165.0					
	Almonds (rainfed)					10.0	655.0		71.5	2700.0	10.0	480.0	279.0					200.0									
Pistachio	320.0	1150.0	1020.0	370.0	5.0		1.0			44.0	55.0				942.0	10.0		35.0	490.0	55.0	155.0						
Date																				780.0							
Flowers	10.0			15.0		2.0									1110.0	12.0					2.0	30.0					
Others	75.0		678.0	67.0		85.0	218.0				2.0						10.0	18.0	25.0	60.0	15.0	100.0					
Persimmon												4.0			5.0						7.0	22.0					
Olive	496.6	102.9	55.3	63.2	13.6		55.3					4.0			23.9	400.0	11.7	52.2	156.7	90.2	208.9	75.0					
Jujube	3.0																										
Total		2281.6	1322.9	4615.3	1903.2	3741.6	587.0	1872.3	2216.5	#####	1378.0	2738.0	927.0	1277.0	1580.9	7678.0	864.7	1813.2	1086.7	2085.2	3057.9	4497.0					

Appendix F: New basic data from Agriculture Organization Isfahan for the Iranian year 1385-86, farmland and orchards

سازمان جهاد کشاورزی استان اصفهان
مدیریت بهره‌برداری و خدمات
دفتر احداث

(۶)

سال ۱۳۸۵-۸۶

سطح زیر کشت محصولات زراعی و باغی در شهرستان اصفهان
حوضه رودخانه زاینده رود
واحد: هکتار

شهرستان	شکله آبیاری	سطح زیر کشت شکله آبیاری		سطح زیر کشت با سایر منابع در شکله آبیاری		سطح زیر کشت محصولات شهرستان		سطح زیر کشت خارج از حوضه	
		باغ	زراعت	باغ	زراعت	باغ	زراعت	باغ	زراعت
فویردن	فویردن	۵۳۵/۷	۵۲۹۰	۲۳۵/۸	۱۶۴۱۸	۳۷۲۵۹	۱۲۸۸/۵	۵۵۵۱	۵۲۷
فویردن	فویردن	۹۰۰	۱۵۸۲	۵۰۰	۴۵۰۰	۸۱۳۵	۲۰۲۳	۳۰۷۱	۶۲۳
چاگمان	چاگمان	۱۰۰۲/۲	۲۴۰۱	۱۳۹/۸	۷۹۶۴	۱۰۳۶۵	۱۱۴۴	۰	۰
تیران-کردن	کردن (عمیق سطل)	۲۳۸۶/۹	۴۸۴۷	۳۱۰۹	۳۷۲۳/۳	۱۱۹۲	۵۱۱۰/۲	۲۳۶	۰
دهقان	شور	۷۲۳/۵	۵۲۵۳	۳۳۰/۵	۳۶۷/۹	۸۵۵۸	۱۰۹۱/۱	۰	۰
لیمان	سنتی و مدرن	۱۳۸۵	۳۵۴۳	۲۱۳۲/۳	۱۶۱۴/۸	۵۶۷۵/۳	۳۹۹۹/۸	۰	۰
صیبار (کرفس)	صیبار	۰	۳۵۵۰	۴۸۰۰	۱۵۲	۱۶۴۹۷	۲۲۱۸/۲	۸۱۴۷	۲۰۶۶/۲
صبارک	گلزار آبیاری (کرفس)	۷۵۷/۵	۱۱۸۹	۶۰۷۷	۴۱۵/۲	۱۶۴۱۵	۱۴۶۱/۳	۱۴۹	۲۸۸/۶
فلاردقان	گلزار آبیاری (کرفس)	۱۲۷۹	۱۰۶۴۰/۳	۴۶۷۵/۵	۵۶۲	۶۲۶۲۹	۱۸۴۱	۱۳/۲	۰
شیراز	گلزار آبیاری	۳۲۰۰/۳	۷۶۲۹	۸۸۰	۰	۹۰۸۴	۲۲۳۱/۸	۵۷۵	۳۱/۵
خیمشهر	گلزار آبیاری	۱۶۶۲/۸	۳۳۱۰	۱۸۶۲/۵	۲۹۰/۴	۴۲۱۶	۳۰۵۴/۳	۴۲/۵	۱۰/۶
بهرخار-صید	بهرخار	۷۱۱	۱۳۶۹۳	۶۷۴۵	۳۹۶/۷	۲۱۹۴۶	۱۸۳۹/۵	۱۵۰۱	۷۳۱/۸
اصفهان	شکله آبیاری (عمیق سطل) و شوری	۲۷۷/۵	۵۲۴۳۶	۱۶۵۸۵	۱۱۰۹/۱	۹۴۰۱۱	۲۳۶۷/۷	۳۵۰۰۰	۹۸۱/۱
جمع	حوضه رودخانه زاینده رود	۱۳۸۲۰/۷	۱۲۳۶۵۳/۳	۷۹۰۵۶/۳	۸۴۹۷/۲	۲۴۶۰۰۰/۳	۲۷۶۶۸/۷	۴۳۲۰۲/۷	۵۳۵۰/۸

Appendix G: Cultivated areas of farmland for agricultural Iranian years 1380-81 to 1388-89

Table 17: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1380-81

Year	Cultivated areas														Dehghan				
	Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kondolia)	Karvan upstream Khamiran		Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan
10/2001 - 10/2002 (1380/81)	Wheat	48,042	131	679	5,032	3,894	2,807	9,518	3,358	3,842	3,263	3,806	551	1,416	947	7,008	1,790	0	0
	Rainfed wheat	10,487	2	13	0	0	0	0	0	0	0	0	66	170	114	8,481	1,641	0	0
	Barley	18,655	61	319	3,160	1,729	1,488	2,522	1,253	1,434	1,218	1,421	157	403	270	2,548	671	0	0
	Rainfed barley	4,345	0	0	0	0	0	0	0	0	0	0	82	210	141	3,106	806	0	0
	Rice (paddy)	13,266	299	1,551	1,375	4,574	4,620	1	189	216	184	214	8	21	14	0	0	0	0
	Corn	1,468	0	0	7	0	0	2	343	393	334	389	0	0	0	0	0	0	0
	Millet	664	5	25	198	0	343	0	17	20	17	19	4	9	6	0	0	0	0
	Pease	430	5	25	82	0	14	0	3	3	3	3	8	20	13	223	30	0	0
	Rainfed pease	543	0	0	0	0	0	0	0	0	0	0	9	24	16	271	224	0	0
	Beans	2,235	5	25	1,558	1	18	0	3	4	3	4	19	50	33	329	184	0	0
	Lentil	452	0	2	61	0	0	0	2	2	2	2	6	14	9	263	90	0	0
	Rainfed lentils	630	0	0	0	0	0	0	0	0	0	0	2	5	3	247	373	0	0
	Vetch	134	2	8	30	6	72	0	0	0	0	0	3	7	5	0	0	0	0
	Watermelon	117	2	13	2	42	3	14	7	8	7	8	2	5	3	0	0	0	0
	Melon	905	0	0	21	0	0	764	28	32	28	32	0	0	0	0	0	0	0
	Cantaloupe	578	0	0	78	0	0	47	106	122	103	121	0	0	0	0	0	0	0
	Cucumber	947	0	0	20	330	85	19	69	79	67	78	6	14	9	119	52	0	0
	Squash variety	104	0	0	0	51	9	0	10	12	10	12	0	0	0	0	0	0	0
	Potato	14,685	8	42	58	1,924	712	309	94	108	92	107	147	378	253	8,739	1,716	0	0
	Onion	2,852	12	63	135	875	565	34	266	304	258	301	7	19	13	0	0	0	0
	Tomatoes	625	0	0	19	258	60	47	43	49	42	49	11	28	19	0	0	0	0
	Eggplant	57	0	0	0	21	0	0	9	10	8	10	0	0	0	0	0	0	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	32	0	0	0	15	0	0	0	0	0	0	3	7	5	0	3	0	0
	Garlic	17	0	0	0	9	0	0	0	0	0	0	0	0	0	0	7	0	0
	Other vegetables	1,560	0	0	8	505	228	1	94	108	92	107	79	203	136	0	0	0	0
	tuber vegetables	1,394	0	0	10	621	235	36	42	48	41	48	59	153	102	0	0	0	0
	Alfalfa	11,406	23	117	666	1,533	748	1,217	1,099	1,257	1,068	1,246	119	307	205	1,354	448	0	0
	rainfed Alfalfa	488	0	0	0	0	0	0	0	0	0	0	0	0	0	398	90	0	0
	Clover	2,745	0	0	153	1,047	771	0	41	47	40	47	28	71	47	319	134	0	0
	Sainfoin	8,371	32	168	40	56	0	0	0	0	0	0	138	354	237	6,451	895	0	0
	Rainfed sainfoin	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	0	0
	Forage sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grain sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize forage	5,681	2	13	409	641	206	1,457	687	786	667	779	7	17	11	0	0	0	0
	Turnip and fodder beet	432	0	0	11	0	0	224	46	53	45	53	0	0	0	0	0	0	0
	Other forage	317	0	0	0	0	0	0	0	0	0	0	18	45	30	0	224	0	0
	Sunflower	660	0	0	462	0	27	3	39	45	38	45	0	0	0	0	0	0	0
	Sesame	92	0	0	28	0	34	23	2	2	2	2	0	0	0	0	0	0	0
	Safflower	1,705	1	8	138	9	69	47	333	381	324	378	1	1	1	12	2	0	0
	Canola	66	0	2	10	23	10	1	1	1	1	1	1	3	2	9	1	0	0
	Sugar beet	4,050	9	46	74	56	69	941	644	737	626	730	0	0	0	119	0	0	0
	Tobacco	108	0	0	0	99	0	0	2	2	2	2	0	0	0	0	0	0	0
	Cotton	1,172	0	0	59	0	14	78	240	275	234	272	0	0	0	0	0	0	0
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	1,814	12	63	219	20	21	1,346	26	29	25	29	5	12	8	0	0	0	0
	Saffron	93	0	0	2	33	5	20	4	5	4	5	3	7	5	0	1	0	0
	Cumin	51	0	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	black cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cannabis	495	0	0	152	0	343	0	0	0	0	0	0	0	0	0	0	0	0
Seed products	259	0	0	30	36	69	0	2	2	2	2	22	57	38	0	0	0	0	
Other products	86	0	0	0	25	0	0	14	16	14	16	0	0	0	0	0	0	0	
Sum of irrigated	148,822	610	3,168	14,360	18,432	13,643	18,668	9,119	10,432	8,861	10,336	1,408	3,621	2,423	27,493	6,248	0	0	
Sum of rainfed	16,567	2	13	0	0	0	0	0	0	0	0	159	409	273	12,503	3,208	0	0	
Area of fallow irrigation	99,309	529	2,745	12,488	8,786	11,785	14,448	4,938	5,650	4,799	5,598	665	1,710	1,144	22,233	1,792	0	0	
Area of fallow rainfed	10,850	67	348	0	0	0	0	0	0	0	0	0	0	0	9,763	671	0	0	

Table 18: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1381-82

Year	Cultivated areas Products	Cultivated areas																		
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan	
10/2002 - 10/2003 (1381/82)	Wheat	62,908	166	864	5,909	4,628	3,292	9,615	5,666	6,482	5,506	6,423	529	1,359	909	6,769	1,790	3,000	0	
	Rainfed wheat	10,469	48	252	0	0	0	0	0	0	0	0	92	236	158	2,684	0	7,000	0	
	Barley	20,893	81	419	3,912	1,808	3,029	2,018	1,118	1,279	1,086	1,267	180	462	309	2,239	726	960	0	0
	Rainfed barley	7,148	5	25	0	0	0	0	0	0	0	0	73	189	126	2,230	0	4,500	0	0
	Rice (paddy)	15,353	307	1,593	1,376	5,891	5,049	1	258	295	250	292	8	20	13	0	0	0	0	0
	Corn	2,013	0	0	58	0	0	393	367	420	357	416	0	0	0	0	0	0	0	0
	Millet	803	6	34	254	0	343	0	34	39	33	39	4	9	6	0	0	0	0	0
	Pease	385	2	13	21	0	14	0	3	4	3	4	13	33	22	179	34	40	0	0
	Rainfed pease	633	0	0	0	0	0	0	0	0	0	0	9	24	16	255	0	330	0	0
	Beans	2,388	10	50	1,377	0	24	0	5	5	5	5	24	61	41	351	179	250	0	0
	Lentil	656	1	3	18	0	0	0	6	7	6	7	11	29	20	411	49	88	0	0
	Rainfed lentils	392	0	0	0	0	0	0	0	0	0	0	2	6	4	131	0	250	0	0
	Vetch	150	2	8	37	0	84	0	0	0	0	0	4	9	6	0	0	0	0	0
	Watermelon	127	3	17	6	47	14	14	5	6	5	6	1	2	2	0	0	0	0	0
	Melon	894	0	0	7	0	3	752	31	35	30	35	0	0	0	0	0	0	0	0
	Cantaloupe	605	0	0	80	0	3	47	112	128	108	127	0	0	0	0	0	0	0	0
	Cucumber	980	0	0	14	199	85	19	60	69	58	68	6	15	10	16	60	300	0	0
	Squash variety	50	0	0	0	41	9	0	0	0	0	0	0	0	0	0	0	0	0	0
	Potato	15,583	27	143	26	2,169	682	289	132	151	128	150	162	415	278	7,190	1,641	2,000	0	0
	Onion	2,929	17	89	132	889	561	34	275	314	267	311	7	19	13	0	0	0	0	0
	Tomatoes	714	0	3	13	311	64	48	38	43	37	43	11	28	19	5	0	51	0	0
	Eggplant	126	0	0	10	39	5	16	13	15	13	15	0	0	0	0	0	0	0	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	37	0	0	0	15	0	0	1	1	1	1	3	7	5	0	3	0	0	0
	Garlic	18	0	0	1	9	2	0	0	0	0	0	0	0	0	2	4	0	0	0
	Other vegetables	1,480	0	0	8	460	185	1	94	108	92	107	79	203	136	0	7	0	0	0
	tuber vegetables	1,325	0	0	10	580	217	38	47	54	46	54	51	132	88	0	7	0	0	0
	Alfalfa	12,938	23	117	673	1,762	776	1,218	1,224	1,401	1,190	1,388	128	330	221	995	492	1,000	0	0
	rainfed Alfalfa	276	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	0	180	0
	Clover	3,205	46	239	153	1,113	700	0	34	39	33	39	31	80	54	358	134	150	0	0
	Sainfoin	9,797	0	0	40	70	0	0	0	0	0	0	110	283	189	5,734	970	2,400	0	0
	Rainfed sainfoin	140	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	140	0	0
	Forage sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grain sorghum	15	0	0	0	0	0	0	3	4	3	4	0	0	0	0	0	0	0	0
	Maize forage	6,603	6	34	447	592	274	825	1,030	1,179	1,001	1,168	8	21	14	4	0	0	0	0
	Turnip and fodder beet	527	0	0	12	0	0	224	69	79	67	78	0	0	0	0	0	0	0	0
	Other forage	622	0	0	0	187	0	0	0	0	0	0	24	61	41	0	209	100	0	0
	Sunflower	1,338	0	0	615	2	69	178	112	128	108	127	0	0	0	0	0	0	0	0
	Sesame	38	0	0	4	0	3	23	2	2	2	2	0	0	0	0	0	0	0	0
	Safflower	1,294	0	2	302	16	105	49	180	206	175	204	3	8	5	12	11	15	0	0
	Canola	350	5	25	36	71	40	21	11	13	11	13	1	2	1	79	7	14	0	0
	Sugar beet	3,454	9	46	74	66	69	1,399	394	451	383	447	0	0	0	117	0	0	0	0
	Tobacco	110	0	0	0	99	0	0	3	3	3	3	0	0	0	0	0	0	0	0
	Cotton	1,785	0	0	64	0	14	102	378	432	367	428	0	0	0	0	0	0	0	0
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	1,333	6	34	250	15	0	931	17	20	17	19	5	12	8	0	0	0	0	0
	Saffron	96	0	0	2	19	5	23	4	5	4	5	3	8	5	8	1	3	0	0
	Cumin	530	0	0	248	0	274	0	2	2	2	2	0	0	0	0	0	0	0	0
	black cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cannabis	495	0	0	152	0	343	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed products	262	0	0	30	30	69	0	2	2	2	2	24	61	41	0	0	0	0	0	
Other products	79	0	0	15	30	0	0	3	4	3	4	4	9	6	0	0	0	0	0	
Sum of irrigated	175,288	719	3,731	16,390	21,158	16,405	18,278	11,734	13,424	11,403	13,301	1,432	3,682	2,464	24,469	6,326	10,371	0	0	
Sum of rainfed	19,059	53	277	0	0	0	0	0	0	0	0	177	454	304	5,395	0	12,400	0	0	
Area of fallow irrigation	75,221	421	2,183	10,468	5,930	9,080	14,850	2,033	2,326	1,976	2,304	646	1,661	1,112	10,854	1,662	7,715	0	0	
Area of fallow rainfed	8,684	16	84	0	0	0	0	0	0	0	0	0	0	0	2,251	374	5,960	0	0	

Table 19: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1382-83

Year	Cultivated areas Products	Cultivated areas																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereidoonshahr	Chadegan	Dehaghan
10/2003 - 10/2004 (1382/83)	Wheat	69,402	113	587	5,095	4,434	3,114	10,281	6,425	7,350	6,244	7,283	514	1,321	884	7,167	1,790	3,000	3,800
	Rainfed wheat	12,909	16	84	0	0	0	0	0	0	0	0	83	212	142	3,185	1,937	7,250	0
	Barley	22,020	73	377	3,124	1,796	3,166	2,148	1,107	1,267	1,076	1,255	165	425	284	2,230	746	980	1,800
	Rainfed barley	5,579	2	8	0	0	0	0	0	0	0	0	92	236	158	1,833	746	2,504	0
	Rice (paddy)	14,467	307	1,593	1,345	5,466	4,730	1	232	265	225	263	7	19	13	0	0	0	0
	Corn	1,866	0	0	32	0	0	374	343	393	334	389	0	0	0	0	0	0	0
	Millet	723	10	52	224	0	309	0	26	29	25	29	4	9	6	0	0	0	0
	Pease	462	2	13	21	0	14	0	3	4	3	4	9	24	16	191	22	35	100
	Fedraind pease	257	3	17	0	0	0	0	0	0	0	0	7	19	13	64	115	20	0
	Beans	3,231	8	42	194	0	48	0	5	5	5	5	24	62	42	365	196	231	2,000
	Lentil	551	0	2	18	0	3	0	3	4	3	4	6	17	11	239	90	50	100
	Rainfed lentils	697	0	0	0	0	0	0	0	0	0	0	3	7	5	64	373	246	0
	Vetch	281	15	75	46	0	103	0	0	0	0	0	4	10	7	0	0	1	20
	Watermelon	213	5	25	12	47	27	70	5	6	5	6	1	2	1	0	0	0	0
	Melon	929	2	9	12	0	7	717	43	49	42	49	0	0	0	0	0	0	0
	Cantaloupe	950	0	0	93	0	7	48	189	216	184	214	0	0	0	0	0	0	0
	Cucumber	1,235	0	0	16	193	92	19	103	118	100	117	6	16	10	16	60	350	20
	Squash variety	12	0	0	0	0	0	0	0	0	0	0	2	6	4	0	0	0	0
	Potato	16,302	30	155	21	2,147	659	299	137	157	133	156	156	401	268	7,155	1,656	2,700	70
	Onion	3,291	19	96	147	1,132	703	37	263	301	255	298	6	14	9	0	0	0	12
	Tomatoes	760	0	0	11	207	46	45	78	89	76	88	11	29	20	0	0	50	10
	Eggplant	127	0	0	3	16	0	9	22	26	22	25	1	2	1	0	0	0	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	70	0	0	0	15	0	0	3	4	3	4	4	9	6	0	1	20	0
	Garlic	13	0	0	0	9	0	0	0	0	0	0	0	0	0	0	1	0	2
	Other vegetables	1,691	0	0	15	602	230	1	94	108	92	107	83	212	142	2	0	2	2
	tuber vegetables	1,272	0	0	9	547	189	33	46	53	45	53	53	137	92	12	0	2	2
	Alfalfa	13,321	23	117	540	2,189	837	1,403	1,120	1,282	1,089	1,270	136	349	234	1,035	449	998	250
	rainfed Alfalfa	290	0	0	0	0	0	0	0	0	0	0	0	0	0	119	90	81	0
	Clover	3,413	16	84	158	1,268	878	0	37	42	36	42	33	85	57	382	134	150	10
	Sainfoin	9,657	0	0	20	70	0	0	0	0	0	0	110	283	189	5,688	895	2,400	0
	Rainfed sainfoin	76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	76	0
	Forage sorghum	8	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Grain sorghum	15	0	0	0	0	0	0	3	4	3	4	0	0	0	0	0	0	0
	Maize forage	11,242	12	63	428	836	310	3,454	1,382	1,581	1,343	1,567	12	32	21	0	0	0	200
	Turnip and fodder beet	546	0	0	14	0	0	252	64	73	62	72	0	0	0	0	0	0	10
	Other forage	686	0	0	0	187	0	0	17	20	17	19	22	57	38	0	224	85	0
	Sunflower	799	3	13	522	0	34	19	49	56	47	55	0	0	0	0	0	0	0
	Sesame	60	0	0	4	0	7	28	4	5	4	5	0	0	0	0	0	0	3
	Safflower	907	0	0	122	15	167	57	112	128	108	127	0	0	0	0	0	0	72
	Canola	946	10	50	68	156	140	71	34	39	33	39	7	19	13	183	26	32	24
	Sugar beet	2,082	5	25	60	66	69	979	197	226	192	224	0	0	0	40	0	0	0
	Tobacco	67	0	0	0	52	0	0	3	4	3	4	0	0	0	0	0	0	0
	Cotton	2,706	0	0	28	0	24	31	589	674	572	668	0	0	0	0	0	0	120
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	1,317	10	50	269	0	34	664	53	60	51	60	3	7	5	0	0	0	50
	Saffron	104	0	0	2	23	5	23	5	5	5	5	3	8	5	8	1	3	2
	Cumin	603	0	0	152	0	343	0	2	2	2	2	0	0	0	0	0	0	100
	black cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cannabis	498	0	0	152	0	343	0	0	0	0	0	0	0	0	0	0	3	0
Seed products	284	0	0	31	36	69	0	4	5	4	5	25	64	43	0	0	0	0	
Other products	140	0	0	26	30	0	0	11	13	11	13	1	4	3	0	0	5	25	
Sum of irrigated	189,269	661	3,430	13,042	21,539	16,707	21,064	12,817	14,663	12,455	14,528	1,409	3,623	2,424	24,713	6,292	11,097	8,804	
Sum of rainfed	20,641	21	109	0	833	0	0	0	0	0	0	184	474	317	5,266	3,260	10,177	0	
Area of fallow irrigation	63,068	479	2,484	7,341	4,717	8,778	12,064	950	1,087	923	1,077	0	0	0	10,610	1,696	6,953	3,910	
Area of fallow rainfed	15,232	48	252	0	0	0	0	0	0	0	0	669	1,720	1,151	2,380	828	8,183	0	

Table 20: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1383-84

Year	Cultivated areas	Products																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2004 - 10/2005 (1383/84)	Wheat	70,376	153	797	5,164	4,172	3,047	10,701	6,698	7,663	6,509	7,593	514	1,321	884	6,861	1,753	2,844	3,700
	Rainfed wheat	13,656	15	77	0	0	0	0	0	0	0	0	95	245	164	3,305	1,954	7,800	0
	Barley	23,788	121	629	3,356	1,866	3,035	2,336	1,301	1,488	1,264	1,474	147	378	253	2,007	735	1,200	2,200
	Rainfed barley	5,825	1	4	0	0	0	0	0	0	0	0	110	282	189	1,895	895	2,450	0
	Rice (paddy)	17,116	339	1,761	1,391	6,506	5,000	3	488	558	474	553	8	21	14	0	0	0	0
	Corn	1,930	0	0	10	0	7	563	318	363	309	360	0	0	0	0	0	0	0
	Millet	769	5	25	229	0	343	0	34	39	33	39	4	9	6	0	0	0	2
	Pease	421	2	10	24	0	26	0	2	2	2	2	11	29	20	167	19	20	85
	Fedraind pease	300	0	0	0	0	0	0	0	0	0	0	11	28	19	70	142	30	0
	Beans	3,141	7	37	167	0	55	0	4	5	4	5	26	66	44	341	189	236	1,955
	Lentil	450	0	2	17	0	3	0	2	2	2	2	6	17	11	227	90	30	40
	Rainfed lentils	1,053	0	0	0	0	0	0	0	0	0	0	4	9	6	64	522	448	0
	Vetch	302	19	100	41	0	93	0	0	0	0	0	5	12	8	0	0	0	25
	Watermelon	836	24	126	24	37	55	553	3	3	3	3	1	2	2	0	0	0	0
	Melon	971	0	2	10	0	4	837	27	31	27	31	0	0	0	0	0	0	0
	Cantaloupe	771	0	0	91	0	3	57	146	167	142	165	0	0	0	0	0	0	0
	Cucumber	1,074	0	0	14	211	104	21	47	53	45	53	6	15	10	21	58	400	15
	Squash variety	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Potato	16,302	21	109	15	2,199	637	290	146	167	142	165	155	399	267	7,201	1,716	2,600	75
	Onion	3,125	16	84	130	1,080	621	34	267	306	260	303	5	12	8	0	0	0	0
	Tomatoes	761	0	0	10	296	34	48	56	64	55	64	12	32	21	8	0	45	15
	Eggplant	183	0	0	4	30	0	0	34	39	33	39	1	2	2	0	0	0	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	67	0	0	1	0	1	0	2	2	2	2	5	13	9	0	1	30	0
	Garlic	22	0	0	0	19	0	0	0	0	0	0	0	0	0	0	1	0	2
	Other vegetables	2,256	0	0	17	770	277	1	170	195	166	193	84	217	145	16	0	2	3
	tuber vegetables	1,932	0	0	8	965	248	75	43	49	42	49	79	203	136	33	0	3	0
	Alfalfa	14,083	57	293	442	2,277	836	1,348	1,249	1,429	1,214	1,416	128	330	221	1,087	410	1,100	245
	rainfed Alfalfa	332	0	0	0	0	0	0	0	0	0	0	0	0	0	115	97	120	0
	Clover	3,604	24	126	160	1,299	878	0	52	59	50	58	37	94	63	394	139	150	20
	Sainfoin	10,106	0	0	22	73	0	0	0	0	0	0	103	264	177	6,052	904	2,500	10
	Rainfed sainfoin	193	0	0	0	0	0	0	0	0	0	0	0	0	0	0	75	118	0
	Forage sorghum	63	0	0	9	0	0	37	3	4	3	4	0	0	0	0	0	0	2
	Grain sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize forage	12,906	28	147	530	1,214	345	3,287	1,622	1,856	1,577	1,839	22	57	38	8	0	0	335
	Turnip and fodder beet	720	0	0	22	0	224	112	128	108	127	108	0	0	0	0	0	0	0
	Other forage	782	0	0	0	281	0	0	12	14	12	14	24	61	41	0	221	103	0
	Sunflower	460	2	13	158	0	36	29	52	60	51	59	0	0	0	0	0	0	0
	Sesame	55	0	0	4	0	8	26	3	3	3	3	0	0	0	0	0	0	6
	Safflower	1,133	1	6	134	10	266	37	135	155	131	153	0	0	0	0	0	0	105
	Canola	967	4	19	98	127	104	51	48	54	46	54	7	18	12	175	52	70	27
	Sugar beet	1,666	2	13	91	0	67	839	137	157	133	156	0	0	0	72	0	0	0
	Tobacco	49	0	0	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cotton	2,836	0	0	21	0	18	30	618	708	601	701	0	0	0	0	0	0	140
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	2,289	10	49	629	30	67	1,114	70	80	68	79	3	7	5	0	0	0	80
	Saffron	119	0	0	2	23	5	37	5	6	5	6	3	8	5	8	0	3	2
Cumin	99	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	95	
black cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cannabis	484	0	0	149	0	335	0	0	0	0	0	0	0	0	0	0	1	0	
Seed products	254	0	0	29	14	66	19	3	4	3	4	21	54	36	0	0	0	0	
Other products	112	0	0	35	30	0	0	2	2	2	2	2	5	3	0	0	0	30	
Sum of irrigated	199,378	837	4,346	13,258	23,577	16,623	22,598	13,911	15,915	13,519	15,770	1,419	3,647	2,441	24,678	6,289	11,337	9,214	
Sum of rainfed	21,360	16	81	0	0	0	0	0	0	0	0	220	565	378	5,449	3,685	10,966	0	
Area of fallow irrigation	62,041	302	1,569	7,147	3,511	8,862	10,808	893	1,021	868	1,012	660	1,696	1,135	10,645	1,699	6,713	3,500	
Area of fallow rainfed	10,335	54	279	0	0	0	0	0	0	0	0	0	0	0	2,196	403	7,404	0	

Table 21: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1384-85

Year	Cultivated areas Products	Cultivated areas																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2005 - 10/2006 (1384/85)	Wheat	73,164	141	734	5,231	4,201	3,110	11,124	7,314	8,368	7,108	8,291	1,180	789	6,809	1,805	3,000	3,500	
	Rainfed wheat	11,007	11	59	0	0	0	0	0	0	0	0	0	174	3,504	1,899	5,000	0	
	Barley	25,125	109	567	3,634	1,930	3,276	2,569	1,391	1,591	1,352	1,576	167	429	287	1,975	731	1,380	2,160
	Rainfed barley	7,034	0	0	0	0	0	0	0	0	0	0	110	283	189	1,919	932	3,600	0
	Rice (paddy)	17,323	337	1,748	1,381	6,567	5,049	3	515	589	501	584	9	24	16	0	0	0	0
	Corn	2,171	0	0	10	0	5	654	353	404	343	401	0	0	0	0	0	0	0
	Millet	1,110	8	42	295	74	447	0	52	59	50	58	4	10	7	0	0	0	3
	Pease	551	3	15	46	0	24	0	2	2	2	2	13	33	22	175	45	18	150
	Fedraind pease	278	0	0	0	0	0	0	0	0	0	0	9	24	16	70	149	10	0
	Beans	3,652	19	101	180	14	51	0	4	5	4	5	35	90	60	381	204	300	2,200
	Lentil	592	0	2	30	0	3	0	2	2	2	2	7	17	11	295	88	32	100
	Rainfed lentils	1,238	0	0	0	0	0	0	0	0	0	0	2	5	3	518	410	300	0
	Vetch	258	10	50	46	0	103	0	0	0	0	0	4	9	6	0	0	0	30
	Watermelon	655	13	67	20	56	34	419	3	3	3	3	5	12	8	0	0	0	10
	Melon	857	0	1	14	0	3	764	10	12	10	12	2	5	3	0	0	0	20
	Cantaloupe	1,050	0	0	107	0	3	48	206	236	200	234	0	1	1	0	0	0	15
	Cucumber	1,158	0	2	15	205	102	19	69	79	67	78	6	14	9	40	48	376	30
	Squash variety	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Potato	15,080	16	84	30	2,262	656	290	146	167	142	165	125	321	215	6,331	1,492	2,619	20
	Onion	2,918	7	38	117	969	527	34	283	324	275	321	4	10	7	0	0	0	0
	Tomatoes	1,143	0	0	13	358	31	67	120	137	117	136	17	42	28	16	0	50	10
	Eggplant	111	0	0	3	27	0	0	17	20	17	19	1	3	2	0	0	3	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	64	0	0	2	0	3	0	2	2	2	2	4	9	6	4	29	0	0
	Garlic	31	0	0	0	28	1	0	0	0	0	0	0	0	0	0	0	0	2
	Other vegetables	2,254	0	3	16	665	231	1	206	236	200	234	83	212	142	18	0	5	3
	tuber vegetables	1,748	0	2	10	883	196	75	52	59	50	58	61	156	104	40	0	4	0
	Alfalfa	15,152	57	293	520	2,196	855	1,312	1,391	1,591	1,352	1,576	126	323	216	1,473	392	1,200	280
	rainfed Alfalfa	324	0	0	0	0	0	0	0	0	0	0	0	0	0	119	90	115	0
	Clover	3,681	25	129	157	1,305	878	0	69	79	67	78	36	92	62	398	119	158	30
	Sainfoin	10,034	0	0	15	94	0	0	0	0	0	0	101	260	174	5,813	970	2,600	8
	Rainfed sainfoin	258	0	0	0	0	0	0	0	0	0	0	0	0	0	0	78	180	0
	Forage sorghum	101	1	4	15	6	0	75	0	0	0	0	0	0	0	0	0	0	0
	Grain sorghum	25	0	0	0	0	0	0	3	4	3	4	0	0	0	0	0	0	10
	Maize forage	11,792	2	13	654	1,248	348	2,411	1,528	1,748	1,485	1,732	26	66	44	68	4	14	400
	Turnip and fodder beet	484	0	2	21	0	0	224	56	64	54	63	0	0	0	0	0	0	0
	Other forage	1,155	2	8	0	276	0	0	17	20	17	19	23	59	39	8	246	400	20
	Sunflower	775	2	8	348	0	75	188	36	41	35	41	0	0	0	0	0	0	0
	Sesame	68	0	2	6	5	10	19	5	6	5	6	0	0	0	0	0	0	4
	Safflower	1,062	0	0	115	8	206	38	160	183	156	182	0	0	0	0	0	0	15
	Canola	1,392	6	34	50	85	62	70	47	54	46	54	19	48	32	518	90	150	27
	Sugar beet	3,397	1	3	111	96	99	1,436	258	295	250	292	3	9	6	527	0	12	0
	Tobacco	64	0	0	0	49	0	0	3	4	3	4	0	0	0	0	0	0	0
	Cotton	2,292	0	0	17	0	14	31	515	589	501	584	0	0	0	0	0	0	42
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	1,989	9	46	310	19	69	1,118	69	79	67	78	6	14	9	0	22	75	0
	Saffron	126	0	0	2	22	5	37	6	7	6	7	3	8	5	12	0	3	2
Cumin	847	0	0	217	0	480	0	0	0	0	0	0	0	0	0	0	0	150	
black cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cannabis	497	0	0	152	0	343	0	0	0	0	0	0	0	0	0	0	2	0	
Seed products	283	0	0	31	15	69	19	5	6	5	6	24	61	41	0	0	2	0	
Other products	114	0	0	34	28	0	0	2	2	2	2	1	4	3	0	0	2	35	
Sum of irrigated	206,347	770	3,997	13,976	23,692	17,368	23,044	14,916	17,065	14,496	16,909	1,370	3,523	2,357	24,896	6,237	12,381	9,351	
Sum of rainfed	20,138	11	59	0	0	0	0	0	0	0	0	222	571	382	6,130	3,558	9,205	0	
Area of fallow irrigation	57,539	369	1,918	6,441	3,396	8,117	10,365	451	516	438	511	708	1,820	1,218	10,488	1,751	5,670	3,363	
Area of fallow rainfed	12,036	58	302	0	0	0	0	0	0	0	0	0	0	0	1,981	530	9,165	0	

Table 22: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1385-86

Year	Cultivated areas Products	Cultivated areas																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2006 - 10/2007 (1385/86)	Wheat	68,576	152	788	5,038	4,290	2,768	9,912	7,125	8,152	6,924	8,077	440	1,133	758	6,052	1,567	2,500	2,900
	Rainfed wheat	8,135	2	9	0	0	0	0	0	0	0	0	46	118	79	2,389	1,492	4,000	0
	Barley	22,828	128	666	3,265	1,862	2,901	2,428	1,205	1,379	1,171	1,366	182	467	313	1,672	671	1,100	2,050
	Rainfed barley	6,352	3	14	0	0	0	0	0	0	0	0	83	212	142	1,593	806	3,500	0
	Rice (paddy)	16,495	383	1,987	1,197	6,046	4,602	3	498	570	484	564	30	78	52	0	0	0	0
	Corn	2,122	6	34	35	0	7	654	326	373	317	370	0	0	0	0	0	0	0
	Millet	1,365	10	50	287	25	411	1	129	147	125	146	4	9	6	0	0	0	15
	Pease	588	4	20	37	0	25	0	3	4	3	4	16	42	28	175	45	32	150
	Fedraind pease	382	0	0	0	0	0	0	0	0	0	0	48	123	82	0	114	15	0
	Beans	3,601	25	127	213	9	34	0	6	7	6	7	39	101	67	327	208	372	2,053
	Lentil	456	2	11	32	0	0	0	9	10	9	10	4	9	6	205	41	19	90
	Rainfed lentils	509	0	0	0	0	0	0	0	0	0	0	0	0	0	35	157	317	0
	Vetch	413	16	86	76	1	171	0	0	0	0	0	6	15	10	0	0	0	30
	Watermelon	796	5	29	109	47	211	300	5	6	5	6	12	30	20	0	0	0	10
	Melon	700	0	2	17	0	11	476	31	35	30	35	8	21	14	0	0	0	20
	Cantaloupe	577	0	0	71	0	0	36	107	123	104	121	0	0	0	0	0	0	15
	Cucumber	1,001	6	34	11	247	97	11	49	57	48	56	13	34	23	37	82	186	10
	Squash variety	17	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	11	0
	Potato	14,543	10	52	32	1,763	553	617	131	150	128	149	100	258	173	6,697	1,367	2,330	33
	Onion	5,001	12	61	343	1,034	1,076	63	557	638	542	632	8	22	15	0	0	0	0
	Tomatoes	1,006	2	12	19	233	44	43	112	128	108	127	17	43	29	11	0	67	10
	Eggplant	107	0	1	8	75	1	0	4	5	4	5	1	2	2	0	0	0	0
	Bean	12	0	0	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	128	0	0	2	0	3	0	2	2	2	2	4	9	6	0	25	71	0
	Garlic	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Other vegetables	2,474	2	12	38	783	313	1	211	242	205	239	75	193	129	19	0	5	5
	tuber vegetables	2,434	2	8	58	1,021	430	75	120	137	117	136	55	142	95	32	0	5	0
	Alfalfa	17,791	39	202	735	2,370	966	1,430	1,823	2,086	1,772	2,067	207	532	356	1,132	641	1,134	300
	rainfed Alfalfa	194	0	0	0	0	0	0	0	0	0	0	1	1	1	0	177	14	0
	Clover	3,862	88	454	69	1,501	800	0	40	46	39	46	31	81	54	321	110	164	17
	Sainfoin	7,226	1	7	10	94	0	0	0	0	0	0	93	238	159	3,823	821	1,973	8
	Rainfed sainfoin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Forage sorghum	53	0	0	25	0	0	28	0	0	0	0	0	0	0	0	0	0	0
	Grain sorghum	26	0	0	0	0	0	0	4	4	4	4	0	0	0	0	0	0	10
	Maize forage	14,021	4	20	659	1,098	334	2,140	2,023	2,314	1,966	2,293	115	297	199	44	4	13	500
	Turnip and fodder beet	1,000	1	6	144	1	0	197	153	175	149	174	0	0	0	0	0	0	0
	Other forage	901	3	14	57	4	14	112	0	0	0	0	5	13	9	139	412	89	32
	Sunflower	410	0	0	166	0	21	41	43	49	42	49	0	0	0	0	0	0	0
	Sesame	61	0	2	8	0	14	17	4	4	4	4	0	0	0	0	0	0	5
	Safflower	1,521	0	2	69	0	100	32	307	351	298	348	0	0	0	0	0	0	15
	Canola	1,810	5	26	138	114	98	138	34	39	33	39	22	57	38	717	90	195	27
	Sugar beet	1,983	0	0	39	0	21	638	242	277	235	274	1	3	2	251	0	0	0
	Tobacco	71	0	0	0	42	0	0	7	8	7	8	0	0	0	0	0	0	0
	Cotton	2,822	0	0	19	0	14	48	638	730	620	723	0	0	0	0	0	0	30
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	2,287	7	38	235	10	53	1,087	185	212	180	210	0	0	0	0	0	0	70
	Saffron	613	0	0	185	0	411	0	0	0	0	0	0	0	0	0	0	0	15
Cumin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cannabis	389	0	0	120	0	270	0	0	0	0	0	0	0	0	0	0	0	0	
Seed products	247	2	8	73	18	52	0	6	7	6	7	13	34	22	0	0	0	0	
Other products	174	0	0	40	30	0	0	0	0	0	0	0	0	0	55	0	0	48	
Sum of irrigated	202,510	917	4,758	13,680	22,721	16,834	20,530	16,141	18,466	15,686	18,297	1,504	3,866	2,587	21,708	6,082	10,266	8,468	
Sum of rainfed	15,572	5	23	0	0	0	0	0	0	0	0	177	454	304	4,017	2,746	7,846	0	
Area of fallow irrigation	65,429	339	1,761	6,640	4,331	8,389	12,412	189	216	184	214	855	2,198	1,471	12,423	1,902	7,670	4,235	
Area of fallow rainfed	14,170	65	335	0	0	0	0	0	0	0	0	0	0	0	2,777	1,194	9,800	0	

Table 23: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1386-87

Year	Cultivated areas	Products																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2007 - 10/2008 (1386/ 87)	Wheat	47,614	150	780	3,389	3,101	2,214	3,752	4,722	5,402	4,588	5,352	394	1,012	677	6,291	1,790	2,500	1,500
	Rainfed wheat	11,656	0	0	0	0	0	0	0	0	0	0	0	0	0	3,162	3,323	5,171	0
	Barley	20,264	152	791	2,967	1,804	2,737	984	1,128	1,291	1,096	1,279	240	618	413	1,752	841	1,100	1,070
	Rainfed barley	2,594	0	0	0	0	0	0	0	0	0	0	0	0	0	204	1,347	1,043	0
	Rice (paddy)	12,166	323	1,677	768	4,511	3,499	2	326	373	317	370	0	0	0	0	0	0	0
	Corn	1,268	0	31	0	0	30	284	325	276	322	0	0	0	0	0	0	0	0
	Millet	1,082	8	42	232	0	348	15	103	118	100	117	0	0	0	0	0	0	0
	Pease	179	0	1	31	0	32	0	0	0	0	0	0	0	0	40	0	15	60
	Fedraind pease	223	0	0	0	0	0	0	0	0	0	0	0	0	0	32	172	20	0
	Beans	1,472	25	129	61	0	12	0	1	1	1	1	27	68	46	223	127	450	300
	Lentil	114	0	0	0	0	0	0	0	0	0	0	0	0	0	64	0	37	13
	Rainfed lentils	509	0	0	0	0	0	0	0	0	0	0	0	0	0	0	290	219	0
	Vetch	126	6	29	16	13	44	0	2	2	2	2	2	4	3	0	0	0	0
	Watermelon	443	9	44	88	0	174	77	5	6	5	6	6	14	9	0	0	0	0
	Melon	573	0	2	21	0	3	381	39	45	38	44	0	0	0	0	0	0	0
	Cantaloupe	225	0	0	39	0	0	3	43	49	42	49	0	0	0	0	0	0	0
	Cucumber	777	5	28	8	207	88	0	29	33	28	33	8	20	14	7	0	254	15
	Squash variety	16	0	0	0	0	0	0	4	4	4	4	0	0	0	0	0	0	0
	Potato	14,749	13	69	10	1,755	491	2	325	372	316	368	88	225	151	6,554	1,232	2,760	19
	Onion	3,212	11	55	237	740	823	4	309	354	300	350	6	14	9	0	0	0	0
	Tomatoes	957	2	10	16	172	39	10	156	178	151	177	3	9	6	9	0	15	5
	Eggplant	88	0	1	4	46	0	0	9	10	9	10	0	0	0	0	0	0	0
	Bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	235	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	195	0
	Garlic	3	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Other vegetables	3,763	3	14	84	2,022	819	47	91	104	89	103	68	176	118	16	0	4	5
	Alfalfa	14,575	38	199	520	1,769	777	592	1,440	1,648	1,400	1,633	177	455	304	1,672	844	967	141
	rainfed Alfalfa	210	0	0	0	0	0	0	0	0	0	0	0	0	0	119	90	0	0
	Clover	3,067	48	249	36	1,466	745	0	26	29	25	29	13	34	22	182	65	99	0
	Sainfoin	5,426	0	0	0	66	0	0	0	0	0	0	61	156	104	2,787	709	1,544	0
	Rainfed sainfoin	107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	100	0
	Forage sorghum	278	2	13	157	9	23	5	10	12	10	12	4	9	6	4	3	0	0
	Grain sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize forage	9,023	15	80	827	1,130	356	1,868	889	1,017	864	1,008	88	227	152	64	4	57	378
	Turnip and fodder beet	512	0	1	22	0	19	110	126	107	125	0	0	0	0	0	0	0	0
	Other forage	433	0	0	61	70	23	0	6	7	6	7	2	6	4	40	127	74	0
	Sunflower	272	0	0	215	0	25	0	7	8	7	8	0	0	0	0	0	0	4
	Sesame	120	0	1	28	0	51	0	6	7	6	7	0	0	0	0	0	0	13
	Safflower	560	0	0	44	0	89	112	74	84	72	84	0	0	0	0	0	0	1
	Canola	1,182	1	5	0	26	14	0	20	23	19	22	15	38	25	757	67	150	0
	Sugar beet	224	0	0	0	0	0	93	14	16	13	16	0	0	0	72	0	0	0
	Tobacco	30	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0
	Cotton	2,301	0	0	11	0	0	3	537	615	522	609	0	0	0	0	0	0	4
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	720	0	2	178	0	29	300	49	56	47	55	0	0	0	0	0	0	3
	Saffron	103	0	0	2	42	5	1	4	4	4	4	5	12	8	8	0	2	2
	Cumin	100	0	0	30	0	69	0	0	0	0	0	0	0	0	0	0	0	0
	Cannabis	18	0	0	5	0	12	0	0	0	0	0	0	0	0	0	0	0	0
	Seed products	581	0	0	100	30	208	0	35	40	34	39	18	45	30	0	0	2	0
	Other products	97	1	3	74	0	3	0	3	3	3	3	1	2	2	0	0	0	0
Sum of irrigated	148,948	814	4,224	10,315	19,048	13,753	8,301	10,804	12,361	10,500	12,248	1,224	3,146	2,105	20,541	5,809	10,225	3,533	
Sum of rainfed	15,300	0	0	0	0	0	0	0	0	0	0	0	0	0	3,518	5,229	6,553	0	
Area of fallow irrigation	98,989	436	2,264	9,966	7,908	11,396	5,247	5,494	6,286	5,339	6,228	1,120	2,878	1,926	13,538	2,163	7,700	9,100	
Area of fallow rainfed	14,374	0	0	0	0	0	0	0	0	0	0	0	519	347	3,106	0	10,200	0	

Table 24: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1387-88

Year	Cultivated areas Products	Cultivated areas																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2008 - 10/2009 (1387/88)	Wheat	39,808	145	755	3,253	3,086	2,115	4,485	2,575	2,946	2,503	2,919	404	1,038	695	5,973	1,716	2,900	2,300
	Rainfed wheat	9,742	0	0	0	0	0	0	0	0	0	0	92	236	158	3,066	1,790	4,400	0
	Barley	19,651	149	775	2,905	1,715	3,064	1,960	773	884	751	876	143	368	246	1,599	671	1,000	1,772
	Rainfed barley	4,144	2	10	0	0	0	0	0	0	0	0	18	47	32	363	671	3,000	0
	Rice (paddy)	7,999	307	1,593	637	2,314	2,288	1	202	231	196	229	0	0	0	0	0	0	0
	Corn	617	0	3	0	0	0	31	137	157	133	156	0	0	0	0	0	0	0
	Millet	943	8	42	194	0	263	14	52	59	50	58	1	1	1	0	0	0	200
	Pease	115	0	0	21	0	24	0	0	0	0	0	3	7	4	32	0	20	5
	Fedraind pease	109	0	0	0	0	0	0	0	0	0	0	3	7	4	21	75	0	0
	Beans	1,066	0	0	63	0	27	0	3	3	3	3	8	20	13	281	186	220	236
	Lentil	141	0	0	0	0	0	0	1	1	1	1	1	2	2	40	75	20	0
	Rainfed lentils	539	0	0	0	0	0	0	0	0	0	0	4	9	6	20	149	350	0
	Vetch	100	5	25	15	13	41	0	0	0	0	0	0	0	0	0	0	0	0
	Watermelon	189	10	52	19	5	33	62	2	2	2	2	0	0	0	0	0	0	0
	Melon	452	0	0	28	2	0	367	13	15	13	15	0	0	0	0	0	0	0
	Cantaloupe	200	0	0	59	0	0	3	32	37	31	37	0	0	0	0	0	0	0
	Cucumber	870	4	22	2	150	56	5	97	111	94	110	2	5	3	9	4	198	0
	Squash variety	47	0	0	28	0	0	0	4	5	4	5	0	0	0	0	0	1	0
	Potato	13,078	16	80	14	1,848	542	1	106	121	103	120	59	151	101	5,973	1,417	2,350	75
	Onion	2,483	6	29	138	602	524	7	275	314	267	311	2	5	3	0	0	0	0
	Tomatoes	1,025	2	11	13	153	28	85	166	190	161	188	3	7	4	9	0	4	2
	Eggplant	117	0	1	5	50	0	0	12	14	12	13	2	5	3	0	0	0	0
	Bean	4	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	106	0	0	0	20	0	0	2	2	2	2	3	8	5	0	0	62	0
	Garlic	11	0	1	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0
	Other vegetables	3,127	1	8	70	1,435	416	55	152	174	147	172	90	233	156	0	0	18	0
	Alfalfa	13,217	32	168	494	1,607	625	585	1,262	1,444	1,227	1,431	123	317	212	1,870	618	1,000	200
	rainfed Alfalfa	222	0	0	0	0	0	0	0	0	0	0	0	0	0	104	73	45	0
	Clover	2,134	39	201	24	914	482	0	17	20	17	19	18	47	32	159	45	99	0
	Sainfoin	5,328	1	4	3	66	0	0	0	0	0	0	55	142	95	2,787	671	1,500	5
	Rainfed sainfoin	289	0	0	0	0	0	0	0	0	0	0	0	0	0	36	168	85	0
	Forage sorghum	110	1	6	61	6	0	34	0	0	0	0	0	0	0	0	0	2	0
	Grain sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize forage	7,123	5	23	716	653	233	1,587	687	786	667	779	82	210	141	119	15	70	350
	Turnip and fodder beet	243	0	1	33	0	0	22	44	50	43	50	0	0	0	0	0	0	0
	Other forage	296	0	0	27	80	3	0	2	2	2	2	5	14	9	12	97	43	0
	Sunflower	108	3	17	71	0	7	9	0	0	0	0	0	0	0	0	0	0	0
	Sesame	51	0	2	6	0	8	19	4	4	4	4	0	0	0	0	0	0	0
	Safflower	370	0	0	6	5	0	140	52	59	50	58	0	0	0	0	0	0	0
	Canola	397	1	4	1	3	1	9	7	8	7	8	1	3	2	207	45	90	0
	Sugar beet	415	0	0	1	0	0	209	26	29	25	29	0	0	0	82	0	15	0
	Tobacco	57	0	0	0	50	0	2	1	1	1	1	0	0	0	0	0	0	0
	Cotton	1,162	0	0	5	0	0	2	270	308	262	306	0	0	0	0	0	0	10
	Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sunflower nuts	625	0	0	186	0	41	296	24	27	23	27	0	0	0	0	0	0	0
	Saffron	106	0	0	3	37	5	4	3	4	3	4	6	17	11	0	1	3	5
	Cumin	120	0	0	37	0	82	0	0	0	0	0	0	0	0	0	0	0	0
	Cannabis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Seed products	202	0	0	67	33	99	0	0	0	0	0	0	0	0	0	0	2	0
	Other products	75	0	1	8	46	0	19	0	0	0	0	0	0	0	0	0	0	0
Sum of irrigated	124,287	736	3,820	9,215	14,903	11,012	10,012	7,001	8,010	6,804	7,936	1,011	2,598	1,739	19,152	5,562	9,616	5,160	
Sum of rainfed	15,043	2	10	0	0	0	0	0	0	0	0	116	299	200	3,609	2,926	7,880	0	
Area of fallow irrigation	122,517	517	2,683	11,185	12,056	14,513	3,777	9,100	10,410	8,843	10,315	1,303	3,350	2,242	14,334	2,387	8,000	7,500	
Area of fallow rainfed	14,903	0	0	0	0	0	0	0	0	0	0	128	330	221	3,185	2,238	8,800	0	

Table 25: Cultivated areas of farmland (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1388-89

Year	Cultivated areas	Products																	
		Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydonsahr	Chadegan	Dehaghan
10/2009 - 10/2010 (1388/89)	Wheat	52,685	108	563	3,899	3,243	2,321	4,684	4,911	5,618	4,772	5,567	459	1,180	789	6,231	2,182	3,459	2,700
	Rainfed wheat	9,742	0	0	0	0	0	0	0	0	0	0	92	236	158	3,066	1,790	4,400	0
	Barley	21,648	106	550	3,200	2,050	2,686	1,869	1,150	1,316	1,118	1,304	147	378	253	1,593	889	1,000	2,040
	Rainfed barley	5,864	2	12	0	0	0	0	0	0	0	0	14	35	24	637	671	4,469	0
	Rice (paddy)	11,035	327	1,699	1,071	3,206	3,696	1	240	275	234	272	2	6	4	0	0	0	0
	Corn	215	0	1	0	0	0	33	43	49	41	48	0	0	0	0	0	0	0
	Millet	1,046	3	14	305	5	549	61	24	27	23	27	0	0	0	0	0	0	8
	Pease	118	2	13	11	0	0	0	0	0	0	0	2	4	3	48	26	10	0
	Fedraind pease	164	0	0	0	0	0	0	0	0	0	0	0	0	0	40	112	12	0
	Beans	911	3	17	34	0	21	0	0	0	0	0	9	24	16	199	186	200	200
	Lentil	137	1	3	0	0	0	0	0	0	0	0	0	0	0	40	75	19	0
	Rainfed lentils	803	0	0	0	0	0	0	0	0	0	0	0	0	0	80	373	350	0
	Vetch	81	8	39	2	17	13	0	0	0	0	0	0	0	0	0	0	0	2
	Watermelon	282	0	0	23	0	5	213	10	11	9	11	0	0	0	0	0	0	0
	Melon	1,691	0	0	60	0	0	1,358	64	74	63	73	0	0	0	0	0	0	0
	Cantaloupe	257	0	0	30	0	0	27	47	54	46	53	0	0	0	0	0	0	0
	Cucumber	873	1	5	2	146	51	0	83	95	81	95	0	0	0	22	9	283	0
	Cucumber (greenhouse)	68	0	0	2	0	0	0	0	0	0	0	1	2	2	0	0	0	62
	Squash variety	35	0	0	1	3	0	0	7	8	7	8	0	0	0	0	0	0	0
	Potato	10,709	16	83	25	1,437	397	1	120	137	117	136	37	96	64	4,718	1,211	2,100	13
	Onion	2,624	7	39	127	622	520	5	295	338	287	335	1	2	2	44	0	0	0
	Tomatoes	774	1	5	23	172	55	98	95	108	92	107	1	2	1	7	0	5	2
	Eggplant	90	0	0	10	45	0	0	8	10	8	10	0	0	0	0	0	0	0
	Broad bean	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green beans	91	0	0	0	10	0	0	0	0	0	0	2	6	4	0	0	69	0
	Garlic	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Tomatoes (greenhouse)	74	0	0	1	0	0	0	0	0	0	0	3	7	5	0	0	0	58
	Eggplant (greenhouse)	11	0	0	0	0	0	0	0	0	0	0	1	2	2	0	0	0	6
	Bell Pepper (greenhouse)	17	0	0	2	0	0	0	0	0	0	0	3	7	5	0	0	0	0
	Other vegetables	3,335	6	32	51	1,673	474	47	185	211	180	209	45	116	78	0	0	0	28
	Alfalfa	13,093	56	290	538	1,770	716	566	1,194	1,366	1,160	1,354	110	283	189	1,633	671	996	200
	Rainfed Alfalfa	222	0	0	0	0	0	0	0	0	0	0	0	0	0	104	73	45	0
	Clover	1,793	26	133	21	851	349	0	12	13	11	13	10	26	18	143	33	134	0
	Sainfoin	4,430	0	0	0	11	0	0	0	0	0	0	85	219	147	2,071	597	1,300	0
	Rainfed sainfoin	289	0	0	0	0	0	0	0	0	0	0	0	0	0	36	168	85	0
	Forage sorghum	164	1	4	78	10	3	42	6	7	6	7	0	0	0	0	0	0	0
	Grain sorghum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Maize forage	8,652	2	9	911	729	243	2,333	858	982	834	973	64	163	109	64	30	45	302
	Turnip and fodder beet	504	0	0	105	56	7	85	59	67	57	67	0	0	0	0	0	0	0
	Other forage	149	0	0	23	0	0	0	0	0	0	0	0	0	0	33	11	82	0
	Sunflower	209	4	21	141	1	10	9	5	6	5	6	0	0	0	0	0	0	0
	Sesame	115	0	0	7	2	10	75	5	6	5	6	0	0	0	0	0	0	0
	Safflower	922	0	0	52	7	82	234	129	147	125	146	0	0	0	0	0	0	0
	Canola	182	1	4	0	3	0	20	3	4	3	4	2	5	3	84	12	34	0
	Sugar beet	1,147	0	0	14	0	449	98	112	95	111	0	0	0	0	267	0	0	0
	Tobacco	88	0	0	0	50	0	37	0	0	0	0	0	0	0	0	0	0	0
	Cotton	1,803	0	0	9	0	2	422	482	410	478	0	0	0	0	0	0	0	0
Madder	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sunflower nuts	730	0	0	215	9	27	326	34	39	33	39	0	1	1	0	0	3	1	
Saffron	106	0	1	3	42	7	4	3	4	3	4	6	14	9	0	2	3	0	
Cumin	198	0	0	61	0	137	0	0	0	0	0	0	0	0	0	0	0	0	
Cannabis	4	0	0	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	
Seed products	306	0	0	80	25	166	0	0	0	0	0	6	17	11	0	0	2	0	
Other products	95	0	0	54	36	2	3	0	0	0	0	0	0	0	0	0	0	0	
Sum of irrigated	143,500	679	3,526	11,190	16,231	12,550	12,583	10,113	11,569	9,828	11,463	996	2,561	1,714	17,195	5,932	9,743	5,624	
Sum of rainfed	17,083	2	12	0	0	0	0	0	0	0	0	106	271	182	3,962	3,188	9,361	0	
Area of fallow irrigation	103,304	574	2,977	9,210	10,729	12,976	1,206	5,988	6,851	5,819	6,788	1,317	3,387	2,267	16,291	2,016	7,873	7,036	
Area of fallow rainfed	12,866	0	0	0	0	0	0	0	0	0	0	139	358	240	2,833	1,977	7,319	0	

Appendix H: Cultivated areas of orchards (ha) for agricultural Iranian years 1380-81 to 1387-88

Table 26: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1380-81

Year	Cultivated areas Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Janguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askani/ Karvan up Morg hab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan	
10/2001 - 10/2002 (1380-1381)	Sour Cherry	499	5	2	5	423	7	2	1	21	0	0	1	10	17	3	3	0	0	
	Cherry	993	8	2	1	703	202	6	1	34	0	0	1	11	19	4	1	0	0	
	Tomato	198	3	1	0	155	0	2	0	17	0	0	1	6	11	0	1	0	0	
	Plum	215	9	3	0	139	2	6	0	17	0	0	1	12	22	0	3	0	0	
	Peach	286	2	1	2	177	31	2	0	10	0	0	2	17	31	8	3	0	0	
	Nectarine 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apricots 1	666	45	15	5	290	56	17	1	39	0	0	5	47	83	25	38	0	0	
	Apricots 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Nectarine 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Apples	644	19	6	42	193	36	55	1	40	0	0	7	73	128	25	19	0	0	
	Pears	979	11	3	2	855	45	6	1	38	0	0	1	5	9	2	1	0	0	
	Quince	357	26	9	1	156	78	4	1	26	0	0	2	19	34	1	0	0	0	
	Pomegranates	576	11	3	39	155	8	137	5	176	0	0	1	15	26	0	0	0	0	
	Grapes	4,128	808	262	87	383	403	536	2	65	0	0	41	422	747	277	96	0	0	
	Fig	8	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	
	Walnuts	1,361	242	78	28	208	44	17	1	39	0	0	12	122	216	77	277	0	0	
	Hazelnut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Almonds	3,357	298	97	7	937	4	55	4	172	0	0	49	504	892	137	201	0	0	
	Pistachio	479	0	0	5	54	10	199	5	202	0	0	0	2	3	0	0	0	0	
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Flowers	11	0	0	0	0	0	9	0	2	0	0	0	0	0	0	0	0	0	
	Others	413	5	2	26	223	6	40	1	29	0	0	0	0	0	70	11	0	0	
Persimmon	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0		
Olive	137	0	0	0	31	16	10	2	78	0	0	0	0	0	0	0	0	0		
Jujube	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Total		15,314	1,493	483	252	5,088	949	1,104	26	1,010	0	0	123	1,264	2,239	629	653	0	0	

Table 27: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1381-82

Year	Cultivated areas		Irrigation networks and counties																
	Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
10/2002 - 10/2003 (1381-1382)	Sour Cherry	493	5	2	5	404	7	2	1	30	0	0	1	10	18	2	3	3	0
	Cherry	1,019	8	2	1	703	202	6	1	57	0	0	1	11	19	4	3	1	0
	Tomato	163	3	1	0	107	0	2	1	20	0	0	1	7	12	2	1	6	0
	Plum	273	9	3	0	187	1	6	1	27	0	0	1	12	22	0	3	0	0
	Peach	251	3	1	2	164	14	2	0	5	0	0	2	16	28	0	3	10	0
	Nectarine 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apricots 1	656	45	15	5	276	56	17	1	37	0	0	5	48	85	24	40	4	0
	Apricots 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nectarine 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apples	666	19	6	44	193	36	55	1	42	0	0	7	74	132	14	22	21	0
	Pears	981	11	3	2	855	45	6	1	39	0	0	1	5	9	2	1	1	0
	Quince	356	23	7	2	161	78	4	1	25	0	0	2	19	34	1	0	0	0
	Pomegranates	579	10	3	40	159	8	120	5	191	0	0	1	15	26	0	0	0	0
	Grapes	4,146	808	262	86	380	417	536	2	69	0	0	41	422	748	236	99	40	0
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fig	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Walnuts	1,513	243	79	29	211	46	17	2	65	0	0	13	136	241	38	353	40	0
	Hazelnut	30	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	6	0
	Almonds	3,304	302	98	7	937	4	55	5	174	0	0	45	462	818	78	216	104	0
	Almonds (rainfed)	804	151	49	0	0	0	0	0	0	0	0	0	3	6	284	10	300	0
	Pistachio	489	0	0	5	54	20	217	5	183	0	0	0	2	3	0	0	0	0
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	15	0	0	0	0	0	9	0	6	0	0	0	0	0	0	0	0	0
	Others	479	0	0	13	271	6	40	1	43	0	0	0	0	0	24	12	68	0
	Persimmon	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Olive	140	8	2	0	23	16	10	2	79	0	0	0	0	0	0	0	0	0
	Jujube	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Total	15,562	1,497	485	243	5,090	957	1,105	28	1,092	0	0	121	1,239	2,195	435	771	303	0	

Table 28: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1382-83

Year	Cultivated areas		Irrigation networks and counties																
	Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
10/2003 - 10/2004 (1382-1383)	Sour Cherry	547	5	2	6	456	9	2	1	30	0	0	1	10	18	2	3	3	0
	Cherry	957	8	2	0	672	167	6	1	57	0	0	1	11	19	4	3	1	5
	Tomato	230	2	1	0	154	9	2	1	20	0	0	1	10	19	2	1	6	2
	Plum	231	9	3	0	143	0	6	1	27	0	0	1	12	22	0	3	2	2
	Peach	379	4	1	1	234	48	2	0	5	0	0	1	15	27	2	3	25	10
	Nectarine 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apricots 1	780	45	15	2	324	104	17	1	37	0	0	5	48	86	26	42	8	20
	Apricots 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nectarine 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apples	896	19	6	29	185	30	55	1	42	0	0	7	74	132	15	25	25	250
	Pears	946	8	2	0	823	37	6	1	39	0	0	1	5	9	2	1	1	10
	Quince	357	19	6	1	162	78	5	1	25	0	0	2	20	35	1	0	2	2
	pomegranates	830	8	2	45	155	253	120	5	191	0	0	1	15	26	0	0	0	10
	grapes	4,009	793	257	49	95	17	536	2	69	0	0	41	423	749	238	100	31	610
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fig	12	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0
	Walnuts	1,948	247	80	12	237	159	17	2	65	0	0	15	157	278	56	433	61	130
	Hazelnut	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0
	Almonds	3,540	310	100	3	937	177	55	5	174	0	0	44	453	803	108	231	116	25
	Almonds (rainfed)	1,144	151	49	0	0	0	0	0	0	0	0	0	3	6	284	120	530	0
	Pistachio	852	0	0	3	54	345	223	5	183	0	0	0	2	3	0	0	0	34
	Date	626	0	0	0	626	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	27	0	0	0	0	0	9	0	6	0	0	0	0	0	2	0	10	0
	Others	488	0	0	8	235	40	40	1	43	0	0	0	0	0	25	12	83	0
	Persimmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Olive	221	14	4	0	44	33	16	2	96	0	0	0	4	7	0	0	0	0
	Jujube	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Total	18,162	1,490	482	162	5,181	2,145	1,118	29	1,109	0	0	123	1,259	2,230	482	869	374	1,110	

Table 29: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1383-84

Year	Cultivated areas		Irrigation networks and counties																
	Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
10/2004 - 10/2005 (1383-1384)	Sour Cherry	537	5	2	6	440	13	2	1	30	0	0	1	10	18	4	3	3	0
	Cherry	975	8	2	0	664	186	6	1	57	0	0	1	11	19	6	3	1	10
	Tomato	238	2	1	0	169	0	2	1	20	0	0	1	11	19	2	1	6	2
	Plum	233	9	3	0	143	2	6	1	27	0	0	1	12	22	0	3	3	2
	Peach	528	2	1	2	296	126	2	0	5	0	0	2	16	28	2	3	27	15
	Nectarine 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apricots 1	823	45	15	2	344	95	17	1	37	0	0	5	49	87	26	42	15	45
	Apricots 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nectarine 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apples	927	19	6	33	165	23	55	1	42	0	0	7	75	133	15	25	29	300
	Pears	942	8	2	0	814	38	6	1	39	0	0	1	5	9	2	1	1	15
	Quince	401	19	6	1	188	98	5	1	25	0	0	2	20	35	1	0	1	0
	pomegranates	649	8	2	51	155	15	120	5	191	0	0	1	15	26	0	0	0	60
	Grapes	4,673	718	232	45	357	522	536	2	69	0	0	41	423	750	238	100	31	610
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fig	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Walnuts	1,949	247	80	13	249	84	17	2	65	0	0	16	164	290	56	429	88	150
	Hazelnut	24	0	0	0	0	0	0	0	0	0	0	0	0	0	12	12	0	0
	Almonds	3,480	310	100	4	937	8	55	5	174	0	0	45	464	821	108	223	192	35
	Almonds (rainfed)	1,144	151	49	0	0	0	0	0	0	0	0	0	3	6	284	120	530	0
	Pistachio	535	0	0	4	54	28	223	5	183	0	0	0	2	3	0	0	0	34
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	27	0	0	0	0	0	9	0	6	0	0	0	0	0	2	0	10	0
	Others	490	34	11	8	222	8	40	1	43	0	0	0	0	0	25	12	85	0
	Persimmon	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Olive	256	14	5	0	60	108	23	1	45	0	0	0	0	0	0	0	0	0
Jujube	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	
Total	17,698	1,447	469	171	5,262	1,352	1,125	27	1,058	0	0	124	1,276	2,260	498	857	492	1,278	

Table 30: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1384-85

Year	Cultivated areas		Irrigation networks and counties																
	Products	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
10/2005 - 10/2006 (1384-1385)	Sour Cherry	546	5	2	6	446	13	2	1	30	0	0	1	10	18	3	3	3	0
	Cherry	995	8	2	0	680	189	6	1	57	0	0	1	11	19	5	3	1	10
	Tomato	245	2	1	0	172	0	2	1	20	0	0	1	12	21	3	1	6	2
	Plum	230	2	1	0	145	2	6	1	27	0	0	1	12	22	2	3	4	2
	Peach	616	3	1	3	328	165	2	0	5	0	0	2	17	30	5	3	32	20
	Nectarine 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apricots 1	856	48	15	2	361	102	17	1	37	0	0	5	49	87	27	42	19	45
	Apricots 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Nectarine 2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Apples	968	15	5	34	160	30	55	1	42	0	0	7	76	134	18	25	31	335
	Pears	924	4	1	0	804	35	6	1	39	0	0	1	5	9	2	1	1	15
	Quince	418	15	5	2	199	104	5	1	29	0	0	2	20	35	1	0	1	0
	Pomegranates	672	6	2	62	155	15	120	5	191	0	0	1	15	26	0	0	0	75
	Grapes	4,422	529	171	45	347	522	536	2	69	0	0	41	423	750	238	104	37	610
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Fig	14	0	0	0	0	8	6	0	0	0	0	0	0	0	0	0	0	0
	Walnuts	2,087	264	86	15	251	85	17	2	65	0	0	17	173	306	70	439	113	185
	Hazelnut	15	0	0	0	0	0	0	0	0	0	0	0	0	0	12	3	0	0
	Almonds	4,006	415	135	4	1,183	6	55	5	176	0	0	46	476	843	134	242	252	35
	Almonds (rainfed)	1,352	151	49	0	0	0	0	0	0	0	0	0	3	6	284	193	655	10
	Pistachio	546	0	0	4	55	28	223	5	183	0	0	0	2	3	0	0	0	44
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	21	0	0	0	2	0	9	0	6	0	0	0	0	0	2	0	2	0
	Others	476	14	4	8	222	20	40	1	43	0	0	0	0	0	25	13	85	0
	Persimmon	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Olive	803	39	13	0	274	135	38	7	283	0	0	5	8	0	0	0	0	0
Jujube	2	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	
Total	18,869	1,370	444	188	5,789	1,459	1,146	34	1,302	0	0	127	1,304	2,310	548	884	587	1,378	

Table 31: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1385-86

Year	Cultivated areas		Products																
	Sum inside catchment area (surface water + other resources)	Lenjanat up	Lenjanat down	Moharakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Moughlab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Fardan	Fereydounshahr	Chadegan	Dehghan	
10/2006 - 10/2007 (1385-1386)	Sour Cherry	946	12	4	2	742	115	4	1	21	0	0	12	21	1	3	10	0	
	Cherry	857	8	3	0	621	137	13	1	33	0	0	6	10	6	9	4	6	
	Tomato	476	23	7	0	269	7	7	0	19	0	2	21	37	0	68	12	2	
	Plum	264	15	5	0	148	7	15	0	18	0	0	6	10	20	6	12	2	
	Peach	823	18	6	3	406	222	16	0	12	0	3	26	47	3	17	25	18	
	Nectarine	4	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	
	Apricots	1,184	71	23	1	521	158	23	1	42	0	6	61	108	9	76	65	20	
	Nectarine	16	0	0	0	0	12	0	0	3	0	0	0	0	0	0	0	0	
	Apples	1,346	52	17	43	272	16	97	1	58	0	11	109	193	28	30	20	400	
	Pears	1,124	6	2	0	993	30	34	1	40	0	0	2	3	2	3	5	3	
	Quitte	483	50	16	1	229	135	6	0	10	0	1	12	20	0	0	1	0	
	Pomegranates	569	36	12	56	148	26	78	2	92	0	1	14	24	0	0	0	80	
	Grapes	4,406	560	181	21	502	386	367	1	28	0	56	578	1,023	198	189	31	285	
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Berries	116	21	7	0	11	15	6	1	48	0	0	1	1	1	0	3	0	
	Fig	28	1	0	0	5	13	0	0	8	0	0	0	0	0	0	0	0	
	Walnuts	2,676	378	122	15	291	99	18	3	133	0	19	191	337	51	617	227	175	
	Hazelnut	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
	Almonds	4,730	624	202	4	780	16	73	2	84	0	71	732	1,297	255	285	263	40	
	Almonds (rainfed)	1,806	76	24	0	0	0	0	0	0	0	1	10	19	469	417	570	220	
	Pistachio	554	3	1	4	20	18	244	5	211	0	0	4	6	0	0	0	38	
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Flowers	24	0	0	0	4	19	0	0	0	0	0	0	0	0	0	0	0	
	Safran	103	1	0	0	30	6	18	0	14	0	1	7	12	10	1	2	2	
	Russian olive	42	8	2	0	6	10	2	0	11	0	0	0	0	0	0	3	0	
	Hawthorn	32	14	5	0	13	0	0	0	0	0	0	0	0	0	0	0	0	
	Persimmon	22	0	0	0	4	4	0	0	13	0	0	0	0	0	0	0	0	
	Olive	700	50	16	1	236	78	54	7	259	0	0	0	0	0	0	0	0	
	Jujube	4	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	
	Poplar and other trees	1,266	305	99	0	41	6	6	3	106	0	0	0	0	171	68	461	0	
	Other Irrigation Pr.	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
	Other Rainfed Pr.	470	4	1	0	10	332	3	2	85	0	0	0	0	6	28	0	0	
Total	23,266	2,258	731	152	6,297	1,856	1,108	35	1,352	0	0	173	1,779	3,151	762	1,400	1,142	1,071	

Table 32: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1386-87

Year	Cultivated areas		Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
	Products	Sum inside catchment area (surface water + other resources)																	
10/2007 - 10/2008 (1386 -1387)	Sour Cherry	725	8	3	8	548	64	3	2	60	0	0	1	7	13	1	1	4	2
	Cherry	762	21	7	0	514	116	0	2	71	0	0	1	7	12	5	3	1	2
	Tomato	359	18	6	0	211	6	0	1	19	0	0	1	10	19	1	62	1	3
	Plum	332	7	2	1	204	33	1	0	17	0	0	0	1	2	19	7	35	4
	Peach	910	51	17	3	438	227	0	1	28	0	0	2	23	40	14	8	23	35
	Apricots	1,030	113	37	3	440	112	1	2	91	0	0	2	19	34	18	96	27	35
	Nectarine	12	0	0	0	3	9	0	0	0	0	0	0	0	0	1	0	0	0
	Apples	1,048	73	23	37	191	12	3	1	51	0	0	14	139	247	35	22	40	160
	Pears	744	8	2	1	692	6	1	0	15	0	0	0	1	2	3	1	7	4
	Quince	654	70	23	0	290	172	0	1	24	0	0	2	23	41	1	0	2	5
	Pomegranates	1,206	54	17	89	462	45	23	8	291	0	0	1	13	23	0	0	0	180
	Grapes	3,666	526	170	34	400	273	157	1	25	0	0	48	497	881	224	133	58	240
	Grapes (rainfed)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Berries	130	20	6	0	26	10	1	1	54	0	0	0	0	1	3	2	4	2
	Fig	32	2	1	0	4	17	0	0	7	0	0	0	0	0	0	0	0	1
	Walnuts	2,850	493	160	17	308	109	0	3	126	0	0	21	218	387	95	513	217	183
	Hazelnut	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Almonds	4,678	642	208	4	701	10	0	5	211	0	0	71	732	1,297	152	311	278	55
	Almonds (rainfed)	1,442	76	24	0	0	0	0	0	0	0	0	1	10	19	339	361	462	150
	Pistachio	387	2	0	5	49	4	62	5	206	0	0	0	3	5	0	0	0	45
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	20	0	0	0	10	0	0	0	6	0	0	0	0	0	0	4	0	0
	Russian olive	63	16	5	0	8	8	5	0	11	0	0	0	0	1	1	0	5	3
	Hawthorn	13	6	2	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0
	Persimmon	24	0	0	0	2	12	0	0	10	0	0	0	0	0	0	0	0	0
	Olive	528	42	13	1	184	59	5	6	219	0	0	0	0	0	0	0	0	0
	Jujube	8	0	0	0	3	0	0	0	4	0	0	0	0	0	0	0	0	0
Poplar and other trees	2,459	171	55	1	112	23	14	36	1,373	0	0	0	0	0	254	62	355	3	
Other Irrigation Pr.	13	0	0	0	0	0	0	0	7	0	0	0	0	0	1	4	0	0	
Other Rainfed Pr.	2,745	676	219	1	192	1,398	9	4	137	0	0	0	1	8	15	11	54	7	
Total	26,842	3,095	1,002	205	5,994	2,729	284	79	3,062	0	0	167	1,715	3,037	1,181	1,641	1,527	1,124	

Table 33: Cultivated areas of orchards (ha) and appropriate products of irrigation networks and counties within the Zayandeh Rud Basin, agricultural Iranian year 1387-88

Year	Cultivated areas		Lenjanat up	Lenjanat down	Mobarakeh-Mahyar-Jarguyeh (Mahyar total)	Nekouabad left	Nekouabad right	Borkhar	Abshar left	Abshar right	Roodasht North	Roodasht South	Askaran/ Karvan up Morghab spring (Kordolia)	Karvan upstream Khamiran	Karvan downstream Khamiran	Faridan	Fereydoonshahr	Chadegan	Dehaghan
	Products	Sum inside catchment area (surface water + other resources)																	
10/2008 - 10/2009 (1387-1388)	Sour Cherry	735	8	3	8	566	63	3	1	29	0	0	1	8	14	7	4	19	3
	Cherry	754	21	7	0	498	110	0	2	73	0	0	1	7	13	9	5	5	2
	Tomato	369	18	6	0	236	4	2	1	23	0	0	2	22	38	3	3	10	3
	Plum	293	7	2	1	201	34	1	0	17	0	0	0	1	2	1	4	16	5
	Peach	979	59	19	4	433	263	0	0	11	0	0	2	23	40	8	13	67	35
	Apricots	1,092	114	37	3	430	120	4	2	95	0	0	5	51	90	31	57	34	20
	Nectarine	46	0	0	0	2	43	0	0	0	0	0	0	0	0	0	0	0	0
	Apples	1,057	63	20	38	174	3	3	1	31	0	0	10	105	185	27	23	73	300
	Pears	741	8	2	0	671	7	1	1	23	0	0	1	6	11	2	2	2	4
	Quince	698	55	18	3	317	184	2	1	24	0	0	3	28	50	3	0	3	8
	Pomegranates	1,336	28	9	90	500	45	35	8	316	0	0	2	16	28	0	0	0	260
	Grapes	3,440	389	126	41	318	441	169	1	39	0	0	42	434	769	222	104	46	300
	Grapes (rainfed)	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Berries	124	20	6	0	20	4	1	1	51	0	0	1	6	10	0	2	0	2
	Fig	12	2	1	0	4	3	0	0	1	0	0	0	0	0	0	0	0	0
	Walnuts	2,608	531	172	18	282	78	0	3	104	0	0	18	185	327	70	493	138	190
	Hazelnut	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Almonds	4,716	663	215	4	1,232	10	0	5	209	0	0	56	575	1,019	134	323	240	30
	Almonds (rainfed)	1,431	76	24	0	0	0	0	0	0	0	0	1	10	19	255	385	510	150
	Pistachio	445	2	0	5	28	4	90	7	257	0	0	0	3	5	0	0	0	44
	Date	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Flowers	18	0	0	0	10	0	0	0	6	0	0	0	0	0	0	1	1	0
	Russian olive	49	16	5	0	4	1	5	0	11	0	0	0	1	2	1	0	0	3
	Hawthorn	12	4	1	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
	Persimmon	14	0	0	0	4	4	0	0	6	0	0	0	0	0	0	0	0	0
	Olive	447	45	14	0	178	31	7	4	168	0	0	0	0	0	0	0	0	0
	Jujube	4	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Poplar and other trees	2,735	171	55	1	132	25	14	36	1,373	0	0	0	1	2	170	62	690	3	
Other Irrigation Pr.	148	0	0	10	0	0	1	3	120	0	0	0	0	0	0	15	0	0	
Other Rainfed Pr.	2,674	676	219	1	97	1,399	9	4	137	0	0	0	2	17	31	9	54	7	
Total	26,981	2,975	963	230	6,344	2,876	346	81	3,128	0	0	146	1,499	2,654	952	1,551	1,860	1,376	

Appendix I: Hints for the scenario development

Since the 1990es a high pace of expansion in greenhouse cultivation can be observed in numerous countries around the world. M. Ali (2008) regards this trend as an equivalent to the so-called Green Revolution of the 1960ies and accordingly names it “the Horticulture Revolution”. According to his estimation this revolution is able to benefit particular the poor, brings prosperity and by the way helps to achieve food safety – but this only in case of adequate policy measurements being taken.

Some transition countries, such as China, but also Tunisia, already intensively profited from the introduction of greenhouses and improved horticultural systems. The success of protected cultivation was perceivable through growing cultivation areas, an increasing trading quantity, as well as through augmented availability of fresh food per capita. This was mainly accompanied by an adaption of cultivation systems (Ali 2008).

In general, resource use efficiency is higher with horticulture cultivation, especially with the main inputs water, area and labour: water is used more cost-efficiently in comparison to rice cultivation; both, land area and labour, are always applied at higher gains. This resulted from the individual consideration of each single input and its resource use efficiency and also from the overall benefit-cost-ratio of four Southeast Asian countries. The benefit-cost-ratio of horticulture exceeded rice cultivation about two- to threefold and in the case of Bangladesh even about sixfold (Ali und Abedullha, 2002 quoted in Ali 2008). In addition, due to high management demands in vegetable cultivation, farmers broaden their skills and learn to perform better in general cultivation management. This circumstance becomes evident in their 20 % higher efficiency compared to the performance of pure (exclusive) rice farmers (Ali & Abedullha, 2002 quoted in Ali, 2008).

In consequence of the increase in productivity and the higher yields of greenhouse farming there is basically a smaller demand in land area. For instance, in the Netherlands greenhouses occupy merely 1 % of land area, while producing considerable 40 % of the total agricultural gains (Dutch Central Statistical Office, 2008 quoted in Stanghellini, 2011). This ratio perfectly reflects the high (enormous) land use efficiency of greenhouse farming.

In the end, the increase in productivity and profits tackled by greenhouse practises enables a reduction of cultivated area while maintaining the same output quantity. As a result, an increasing concentration on horticulture production in greenhouses can very well compensate losses in land area. However, not all areas put out of conventional cultivation simply have to be abandoned, but can be instead used for other additional agricultural purposes, such as for accommodating storage tanks or store houses for fertilizers and machinery.

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