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Relation Between Production and Agro-Climatic Factors in Pasture of the Khorasan Province (Iran)

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Abstract: In performance of this plan, it was firstly selected 3 slopes in regionsunder observation of the meteorological stations including from sea level to 1000 m, slope 1000-1500 to and mountainous regions 1500 m and more, thenwas determined reference, key and critical zones in each vertical area. Total production for 4 years (1996-1999) was determined by Cut and Weigh Method and statistical softwares, especially SAS were used to determine correlation.The results show dependence between 2 factors including spring rainfall ratio and total yearly evaporation on level 99.9% in amount of 94% and on the same statistical level between 2 other factors including average temperature and maximum temperature in the hottest month in amount of 90%, while it is not seen the above dependence on level 95% and 99%. Maximum dependence on level 99% between average minimum temperature with difference in minimum absolute temperature and average yearly temperature with average minimum temperature is 79%. The highest correlation on level 99% between average summer and autumn monthly evaporation has been observed 94% and the lowest correlation on the same; Finally, according to the information obtained from the rate of production in each vertical point and regional specifications for each one of reference, key and critical zones relation between production and agro-climatic factors was obtained.

Key words: Production · Agro-climatic factors · Rainfall · Temperature

INTRODUCTION

Khorasan province with more than 12 million hectares of pasturages is amongthe regions, where have important share in providing forages for livestock [1]. In last years because of be simplicity of food chains due to be shortened the length of energy route in food chains, there were some problems in organizationof this Ecosystem like the other natural Ecosystems in Iran. One of the effective factors to cause the above-mentioned matters is decrease of the variety of species in pasturages, which plays an important role in instability of pasturageEcosystem, frangibility in the Ecosystem of desert regions is a witness on thisclaim [2]. Although number of the extinct species in comparison with total number of thespecies is not statistically high and considerable, but they should not put out ofsight considering the important role, which they play as monitoring and conducting factors of system. Reviews have shown incorrect management of exploitation is one of the effective factors in reduction of valuable herbal species and finally production of the pasturages. Therefore, it is necessary to recognize the effective factors onproduction, especially agro-climatic factors and recommend it profiteers andtake an important step in re-cultivation of the pasturages and increase ofproduction [3, 4].

MATERIALS AND METHODS

Whereas one of the important parameters is determination of total productionand on the other hand, region contains various topographic specifications. Therefore, it was firstly selected 3 vertical slopes in regions under observation of the meteorological stations

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including p/am from sea level to 1000 m, mountain slope 1000-1500 m and mountainous regions 1500 m and more, then was determined reference, key and critical zones in each vertical area [5, 6]. Total production for 4 years (1996-1999) was determined by, in which was thrown some transects with 150-200 m long and 2 m wide in pasturages with thick cover and the ones with 300-400 m long and 4 m wide,after determining the number of required samples in descriptive and statistical manner was systematically thrown plat in lieu of each 10 m, separately cut grassy and shrubby samples and determined the weight of dry and wet forage [7-9]. Whereas the climate effects on scattering of the plants, each plant has a defined range of humidity and temperature and climatic changes control scattering of the plants; therefore, recognition of the climatic factors enjoys an exclusive importance in the region [7].

In order to obtain Information related to climatic factors, statistical information of meteorological stations including synoptic and climatologic stations were collected and it was taken necessary action for statistical rebuilding of the years, which missed the statistical information after study on various factors such as daily, monthly, seasonal and yearly rainfall and daily, monthly, seasonal and yearly (minimum, maximum and absolute) temperatures, etc. Obtained statistics was selected through 13 stations and the length of statistical period up to 20 years. Whereas the considered climatic specifications in some of the sampling points were not clear due to absence of information; therefore, it was tried to measure in all altitude points and evaluate relation between production-altitude and altitude-climatic factors. There is used suitable statistical software, especially SAS for determining correlation between production and climatic factors.

DISCUSSION AND CONCLUSIONS

As shown in Table 2, average yearly temperature has been since minimum 11.2°C in Ghouchan region and maximum 14.7°C in Esfarayen region, although the coldest month is accordingly February and January in 2 above-mentioned regions. Examinations have shown minimum temperature in thecoldest month is changed between-2.1-2.1°C, while maximum temperature inthe hottest month fluctuates between 22.4-28°C. Although average temperature in Shirvan region is relatively higher than the other regions andgets to 20.7°C, but average minimum temperature in Esfarayen shows an increase of 8.5°C. In the 13 regions maximum absolute temperature between36.5-44.2°C and minimum absolute temperature between-16.5--30.2°C fluctuate. The highest coefficient of dryness in Conrad method is related toGolmakan and Chaman Bid regions (57) and the lowest one is related to Esfarayen region (41.8). According to the importance of the number of soilfreezing days in plant growth, examinations have shown this factor is minimumin Dargaz region (61 days) and maximum in Chaman Bid region (122 days). Average yearly rainfall in researched region is different between 185-330 mm. Spring rainfall ratio fluctuate between minimum 30% in Mozdouran region andmaximum 39% in Shirvan and Chaman Bid regions. Although autumn rainfall contains 21-28% of total yearly rainfall, but it is lower than winter rainfall,which is changeable between 22-46%. Calculations have shown the mostnumber of dry days in Guessen method is 198 days and the plants of ChamanBid region with 146 dry days suffer less for this natural damage.

Table 3 shows correlation of yearly climatic factors and dependence between 2 factors including spring rainfall ratio and total yearly evaporation on level 99.9% in amount of 94% and on the same statistical level between 2 other factors including average temperature and maximum temperature in the hottest month in amount of 90%, while it is not seen the above dependence on level 95 and 99%. Maximum dependence on level 99% between average minimum temperature with difference in minimum absolute temperature and average yearly temperature with average minimum temperature is 79%. According to the importance of recognizing relation between climatic specifications of various seasons, statistical analysis based on table 4 shows the highest correlation on level 99% between average summer and autumn monthly evaporation has been observed 94% and the lowest correlation on the same statistical level between average spring and summer temperature, average spring temperature and average minimum temperature in the same season, average maximum winter temperature and maximum absolute autumn temperature, average maximum autumn temperature and minimum absolute autumn temperature, maximum absolute spring temperature and average summer monthly rainfall and finally average autumn monthly rainfall and average winter monthly rainfall observed 69%.Minimum production of grassy plants in plains related to source zone was in Barbar Ghale and in key and critical zone was accordingly in Barbar Ghale and Chaman Bid. The most amounts for production of shrubs in plains like the otherregions is in source zone and pasturages of Shirvan with 189 kg per hectare have preference over the other 13 researched pasturages.

Table 1: Researched pasturages based on altitude of sea level

	Plain			Slope			Mountain		
Zones	1	2	3	1	2	3	1	2	3
Bojnourd	1015	1005	980	1380	1247	1050	2450	1550	1520
Shirvan	986	1025	970	1450	1210	1320	2100	1850	1670
Ghouchan	1020	980	850	1510	1328	1180	1850	1680	1680
Mashad	1030	980	700	1390	1275	1350	2315	1757	1500
Golmakan	1030	1030	970	1250	1110	1280	1930	1650	1520
Dargaz	950	900	680	1520	1425	1035	2300	1700	1600
Esfarayen	970	1010	890	1200	1200	1200	1870	1740	1750
Aghomzar	930	825	558	1000	1245	1120	1520	1500	1500
Malek Abad	1055	1030	815	1310	1280	1050	1710	1620	1550
Barbar Ghale	940	1025	890	1220	1210	1070	1850	1680	1690
Chaman Bid	1010	970	890	1340	1325	980	1620	1530	1500
Chakoudar	720	810	640	1240	1380	1090	1580	1770	1470
Mozdouran	890	920	780	1420	1070	1230	1660	1690	1450

1= reference zone 2= key zone 3= critical zone

Table 2: Climatic specifications in north of Khorasan province

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
1	12.2	12.4	11.2	13.4	12.2	14.1	14.7	11.9	12.8	12.5	11.8	12.3	12.9
2	1	2	2	1	2	1	1	1	1	1	1	1	1
3	-1.1	-0.5	-0.4	0.8	0.2	1.5	2.1	-2.1	0.2	-0.7	-2.3	0.8	-0.2
4	The beginning of July to the beginning of August												
5	24.6	24.0	22.4	23.8	24.0	28.0	27.8	23.6	24.1	24.2	23.1	23.5	24.7
6	25.7	24.5	22.8	23.0	23.8	26.5	25.7	21.5	23.9	24.9	25.4	24.3	24.9
7	19.6	20.7	18.2	20.4	18.5	19.2	27.1	198.4	19.2	20.2	18.5	18.7	19.4
8	4.8	4.6	4.1	6.1	5.9	5.7	8.5	4.5	5.6	4.7	4.5	6.1	7.2
9	42.2	39.8	41.5	43.4	36.5	44.2	41.0	40.3	41.5	41.3	41.0	39.7	40.80
10	-29.5	-27.0	-30.0	-27.8	-20.5	-26.0	-16.5	-28.6	-29.6	-28.4	-30.2	-25.4	-26.3
11	71.8	66.8	71.5	71.2	60.0	70.2	57.5	68.8	71.1	69.7	71.2	65.1	67.1
12	54.0	46.1	56.5	47.5	57.0	45.4	41.8	52.3	45.6	49.2	57.0	49.4	52.1
13	7	7	7	7	8	6	7	7	7	7	8	7	7
14	115	106	118	98	98	61	119	116	112	110	122	108	98
15	230	227	278	268	195	330	216	216	217	209	249	295	185
16	37	39	33	32	34	36	31	37	34	38	39	31	30
17	6.5	7.7	3.5	1.0	2.5	1.0	1.8	6.6	2.2	6.9	6.3	2.5	3.4
18	23	24	22	21	22	23	25	24	24	23	23	27	28
19	35	32	22	46	42	41	42	32	40	32	31	39	39
20	161	184	155	182	187	173	198	152	195	173	146	176	192
21	57	52	59	62	56	51	56	61	69	54	63	52	66
22	1251	1210	1930	1840	1454	1630	2200	1310	1680	1320	1285	2124	2325

I= Bojnourd, II= Shirvan, III= Ghouchan, IV=Mashad,V= Golmakan,VI= Dargaz,VII= Esfarayen,VIII= Aghomzar,IX=MalekAbad,X= Barbar Ghale,XI= Chaman Bid,XII= Chakoudar,XIII= Mozdouran

Table 3: Correlation among yearly climatic factors

----------0.001----------		----------0.01----------		----------0.05----------	
1-5	0.90	1-3	0.79	1-10	0.62	7-8	0.67
1-12	-0.81	1-7	0.72	1-17	-0.57	7-11	-0.60
3-17	-0.81	1-8	0.79	1-20	0.65	7-12	-0.67
10-11	-0.95	1-19	0.73	3-5	0.66	8-17	-0.64
16-22	-0.94	3-8	0.74	3-10	0.67	9-13	-0.60
		3-20	0.73	3-12	-0.68	10-20	0.61
		7-10	0.69	3-16	-0.64	11-20	-0.56
		8-10	0.79	3-19	0.64	12-13	0.62
		8-11	-0.69	3-22	0.64	12-20	0.63
		8-16	-0.74	5-6	0.65	13-14	0.56
		8-19	0.73	5-7	0.63	17-19	-0.66
		8-20	0.76	5-8	0.63		
		8-22	0.74	5-10	0.60		
		16-17	0.76	5-12	-0.66		
		17-22	-0.70				
		19-20	0.69				

1-Average yearly temperature, 2-The coldest monthofyear,3-Minimum temperature in the coldest month of year, 4-The hottest month of year,5-Maximum temperature in the hottest month of year,6-Difference between minimum and maximum temperature in the hottest and coldest month,7-Average maximum temperature, 8-Average minimum temperature,9-Maximum absolute temperature, 10-Minimum absolute temperature,11-Difference between minimum and maximum absolute temperature,12-Coefficient of dryness based on, 13-Number of freezing months,14-Number of soil freezing days, 15-Yearly rainfall (mm), 16-Percent spring rainfall,17-Percent summer rainfall, 18-Percent autumn rainfall, 19-Percent winter rainfall,20-Number of dry days in Guessen method 21-Percent average humidity, 22-Total yearly evaporation

Table 4: Correlation between climatic factors of the seasons

----------1%----------				----------%5----------			
1(1)-1 (2)	0.69	1(2)-3 (2)	0.78	1(1)-3 (4)	0.56	1(2)-(3)	0.65
1(1)-3 (1)	0.69	1(2)-3 (3)	0.75	1(1)-9 (1)	-0.62	1(2)-1 (4)	0.68
1(3)-1 (4)	0.86	1(2)-3 (4)	0.76	1(3)-3 (3)	0.67	1(4)-3 (2)	0.56
1(3)-(4)	0.73	1(4)-2 (4)	0.83	1(3)-6 (4)	0.56	1(4)-5 (2)	0.57
2 (2)-5 (1)	0.74	2(3)-5 (3)	0.69	1(3)-8 (4)	0.66	1(4)-8 (4)	0.64
2(4)-4 (3)	0.96	3(1)-4 (4)	0.71	2(1)-2 (2)	0.64	1(4)-9 (3)	-0.56
3 (2)-3 (4)	0.79	4(1)-6 (2)	0.69	2(1)-2 (3)	-0.56	2(1)-5(2)	0.63
3(2)-8 (2)	0.71	4(3)-7 (1)	0.73	2(3)-3 (4)	0.67	3(1)-5 (3)	-0.60
3(2)-8 (3)	0.80	5(1)-5 (2)	0.89	2 (3)-5(4)	0.66	3(1)-9 (1)	-0.58
5(3)-5 (4)	0.89	6(3)-6 (4)	0.69	2(3)-6 (3)	-0.63	3(1)-9 (3)	-0.56
7(1)-7 (4)	0.84	7(4)-8 (1)	0.71	3(2)-8 (1)	0.62	3(4)-5 (4)	0.61
7(1)-9 (4)	0.70	8(1)-8 (2)	0.86	4(1)-4 (4)	0.62	3(4)-8 (3)	0.62
8(2)-8 (3)	0.94	8(1)-8 (3)	0.81	4(3)-7 (4)	-0.64	4(4)-5 (3)	-0.61
8(4)-9 (3)	0.75	8(1)-9 (1)	0.71	4 (3)-9 (4)	-0.60	5(2)-5 (3)	0.58
9(1)-9 (3)	0.96	9(3)-9 (4)	0.83	6(4)-8 (4)	0.58	7(2)-7 (3)	0.68
				8(1)-8 (4)	0.59	8(2)-8 (4)	0.62
				8(3)-8 (4)	0.56	8(4)-9 (1)	-0.60
						8(4)-9 (4)	-0.61

1-Average temperature 2-Average maximum temperature
3-Average minimum temperature 4-Maximum absolute temperature
5-Minimum absolute temperature 6-Average monthly rainfall
7-Average relative humidity (%) 8-Average monthly evaporation
9-Average monthly number of soil freezing days
(1)-Spring (2)-Summer (3)-Autumn (4)-Winter

Table 5: Productions of pasturages in vertical slopes up to 1000 m

	Source Zones			Key Zones			Critical Zones		
Zones	Grass	Shrub	Sum	Grass	Shrub	Sum	Grass	Shrub	Sum
Bojnourd	99	177	276	103	63	266	72	41	113
Shirvan	110	189	299	89	92	181	96	87	156
Ghouchan	110	170	280	85	142	227	93	75	168
Mashad	88	122	210	62	123	185	37	62	99
Golmakan	46	185	231	48	132	180	43	53	96
Dargaz	75	191	266	59	96	155	41	108	149
Esfarayen	65	105	107	58	77	135	27	73	100
Aghomzar	77	166	243	49	13	152	8	62	70
Maiek Abad	52	169	221	56	149	205	33	138	171
Barbar Ghale	23	153	176	29	86	115	14	69	83
ChamanBid	46	186	232	53	155	208	7	96	103
Chakoudar	59	119	178	46	107	153	21	77	98
Mozdouran	80	173	253	38	112	150	11	105	116
Average	72	162	234	60	111	171	37	84	121

Table 6: Productions of the pasturages in vertical slopes 1000-1500 m

	Source Zones			Key Zones			Critical Zones		
Zones	Grass	Shrub	Sum	Grass	Shrub	Sum	Grass	Shrub	Sum
Bojnourd	88	252	340	69	163	247	15	49	64
Shirvan	140	215	355	76	182	258	9	92	101
Ghouchan	184	307	491	78	202	280	14	76	90
Mashad	214	347	561	70	224	294	17	88	105
Golmakan	148	296	417	46	157	203	12	73	85
Dargaz	198	342	540	84	209	293	38	89	127
Esfarayen	66	289	355	55	141	196	8	68	76
Aghomzar	164	312	476	51	228	279	16	96	112
Maiek Abad	147	312	459	73	171	242	18	71	89
Barbar Ghale	78	291	369	83	163	276	23	94	117
ChamanBid	155	362	517	76	215	291	21	104	125
Chakoudar	160	382	542	69	243	312	22	87	109
Mozdouran	88	252	340	69	163	247	15	49	64
Average	140	215	355	76	182	258	9	92	101

Table 7: Productions of pasturages in vertical slopes 1500 m and more

	Source Zones			Key Zones			Critical Zones		
Zones	Grass	Shrub	Sum	Grass	Shrub	Sum	Grass	Shrub	Sum
Bojnourd	210	343	553	96	229	325	22	93	115
Shirvan	184	348	532	92	222	314	12	129	141
Ghouchan	218	454	672	110	273	383	29	98	127
Mashad	139	257	396	47	146	193	15	74	89
Golmakan	126	338	464	64	159	223	21	81	102
Dargaz	251	462	713	102	274	376	46	146	192
Esfarayen	173	289	462	73	189	262	19	76	95
Aghomzar	91	261	352	118	133	251	16	56	72
Maiek Abad	86	217	303	45	116	161	22	87	109
Barbar Ghale	157	349	506	68	173	241	15	63	78
ChamanBid	243	418	661	99	294	348	35	117	152
Chakoudar	134	225	359	54	219	273	19	93	112
Mozdouran	93	269	362	49	137	186	15	61	76
Average	162	325	487	78	194	272	22	90	112

Table 8: Relation between productions of various pasturages and altitude of sea level

Altitude of sea level (m)							
2200	1940	1680	1420	1190	900	640	Zones
Grassy Plants (Kg per Hectare)							
200	184	152	143	132	80	59	Source
-	-	74	84	70	60	48	Key
-	-	11	23	12	34	25	Critical
Shrubby Plants (Kg per Hectare)							
354	348	329	273	313	177	119	Source
-	-	204	183	196	116	105	Key
-	-	92	90	77	77	92	Critical
Total production (Kg per Hectare)							
554	532	481	415	445	256	178	Source
-	-	279	267	268	183	153	Key
-	-	110	113	89	112	117	Critical

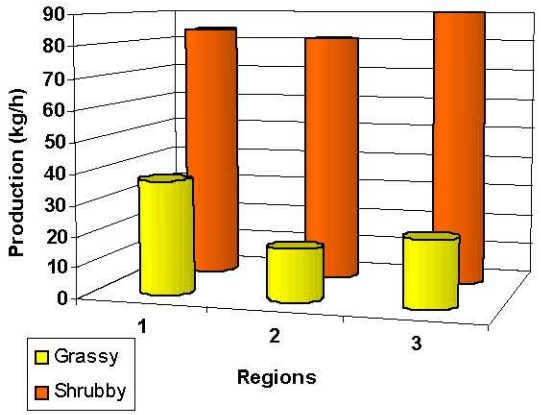

Fig. 1: Productions of critical zones in (1) mountainous regions (2) slopes (3) plains

Main production of pasturages is related to shrubs, although there are seen some differences in function of these plants with fluctuation of altitude of sea level, so that average production in source zones of plain, slope and mountain is accordingly 162, 294 and 325 kg per hectare. Also there are seen some differences between grassy and shrubby plants in slopes, so that production of shrubs is twice more than grassy plants in source zones, about triple in key zones and quadruple in critical zones. Minimum production is seen on source and key zones in pasturages of Mozdouran and on critical zones in pasturages of Bojnourd. Although production in altitudes more than 1500 m is more than the other vertical points, but there is not many differences in production with plains and slopes and even less in critical zones due to steep inclines and unsuitable conditions of soil.

The highest amount for production in protected mountainous regions is related to pasturages of Dargaz with 713 kg per hectare and the lowest one in the same regions is related to pasturages of Malek Abad with 303 kg per hectare. Among the key and critical zones of mountainous regions, the highest amount for production is accordingly in pasturages of Ghouchan and Chaman Bid with 383 and 152 kg per hectare and the lowest one is accordingly in 2 these regions 161 and 72 kg per hectare.

Attention on relations between production and altitude of sea level in each one of the source, key and critical zones ascertains increase in production along with

increase in altitude of the point. with looking at this procedure in critical zones, where damaging of the pasturages is high and production doesn't increase with increase in altitude of the point, but it decreases; thus, we can mention as a result in spite of the more favorable climatic conditions in mountainous regions, plants enjoy less water due to excessive erosion of soil, especially in steep inclines and decrease in hydrophilic coefficient of soil and production procedure has downward movement against increase in altitude. Therefore, based on yearly climatic data, production specifications and information related to altitude of the point for each one of the considered regions, statistical relations between production and agro-climatic factors with using the related softwares are as below:

For source zones:

$$Y = 468 - 36650(T/H) + 1.1568R \qquad R^2 = 0.63$$

$$Y = -159 + 0.7945H - 0.1816(10^{-3}H^2) + 0.8132R - 2.146G$$

$$R^2 = 0.65$$

For key zones:

$$Y = -348 + 0.8219H - 0.2612(10^{-3}H^2) + 0.4262R - 0.3916(10^{-2}G^2)$$

$$R^2 = 0.68$$

In these relations:

Y= Production in unit of area on the basis of Kg per Hectare T= Average yearly temperature on the basis of Centigrade (°C) H= Altitude of the point on the basis of Meter (m)

R=Average yearly rainfall on the basis of Millimeter (mm) G= Number of dry yearly days in Guessen method Relations arise from seasonal climatic information, altitude, etc. with production consist of:

For source zones:

$$Y = 658 - 0.2178(10^{-3}H^2) - 27.45R_s + 0.02306H.R_s$$

$$R^2 = 0.60$$

$$Y = 400 + 0.6386H - 0.2056(10^{-3}H^2) - 20.67R_s - 0.03406H.T_s + 0.01687H.R_s$$

$$R^2 = 0.67$$

For key zones:

$$Y = 173 - 0.6553(10^{-4}H^2) + 12.31R_s - (12990R_s)/H + 11.07F_s + 3.796R_a$$

$$R^2 = 0.68$$

For critical zones:

$$Y = 68 + 0.07303R_s.R_a \qquad R^2 = 0.80$$

In these relations:

Y= Production in unit of area on the basis of Kg per Hectare

Ts= Average spring temperature on the basis of Centigrade (°C)

H= Altitude of the point on the basis of Meter (m)

Rs= Average spring rainfall on the basis of Millimeter (mm)

Fs= Number of freezing spring days

Ra= Average autumn rainfall on the basis of Millimeter (mm)

REFERENCES

1. Papuly, E., 1992. Reservation in north Khorasan. Astane ghodse razavi.
2. Hassani, N., 2002. No.5 Productivity of pasture areas in the northern part of khorasan province (Islamic Republic Iran). Journal of Arid Ecosystem
3. Hassani, N., 2003. No.5 Temporary forecasting the productivity of pasture areas in the northern part of Khorasan Province (Islamic Republic Iran). Journal of Arid Ecosystem.
4. Hassani, N., 2001. No.1(16). Agrometeorological estimation of the yield on rangelands of Khorasan (Iran). Forest.
5. Kuheki, A., G. Kamali and M. Banaean, 1993. Application climate models in agriculture. The world climatology organ.
6. Ramzani, B., 1997. An introduction to agriculture climatology. Gilan university.
7. Malek, E., 1997. Knowledge and evaluation climate element effective in agriculture.
8. Hassani, N., 1999. No.1 Estimation of the influence of moisture providing on rangelands of Khorasan(Iran). Problem of Desert Development.
9. Hassani, N., 1997. No.2 A climatic drought and the yeild of the pastures on Turkmenistans plains. Problem of Desert Development.