Land Use Biological Water harvesting and water deficiency In Bazian Territory in 2013

Prof.Dr. Jamil Jalal Ali [1]
Assist.Lecturer. Mohammed Watman Mohammed [2]
Karwan Mhamad Raof [3]
Tara Salih Ali [3]

1. Geography Department- College of Humanities - University of Sulaimani (KISSR).
2. Geography Department- Faculty of Humanities - University of Raparin.
3. Kurdistan Institute for Strategic studies and Scientific Research

Abstracts:

This study was carried out in 2013 to study land use, biological water harvest and water deficiency in Bazian territory.

Results show that rainfall and surface water still the only sources for land classification to dry land farming and irrigated lands, which form 34.22% and 7.25% respectively, pastures or range land forms the biggest area 40.78% of the territory, whereas the natural forests form 14.47% from the total land.

Land investment in dry land farming are still low 61.76%while total investment for irrigated lands with summer crops and vegetables are extremely very low in comparison with dry land investment 13.0%.

Winter crops recorded the highest percent of biological water harvesting 53.45% while summer crops recorded very low biological investment 1.72%.

Water losing in dry land farming due to non-investment 38.24% of the area was 16,874,800m^3 while water deficiency for investment 86.99% of fallowed irrigated lands was 14,627,232 m^3 which forms around 8.2% of the total annual renewable water from rainfall 178,080,005 m^3. For changing the whole dry farming lands (11031.28Ha) to irrigate land in summer season, the water demand will be 79,425,216m^3 which forms 44.6% of total annual renewable water (178,080,005m^3).

Introduction:

Water is one of the most important resource for survival of human beings as much as food, air...etc., but very few attention are paid for its economical use and conversation of this precious resource.

Rainfall is the prime source of water and if the water is harvested the security of water can be eliminated [(1)].Water harvesting could be defined as the process of concentrating rainfall as runoff from a larger catchment area to be used in some target area [(2).] In this study we concern on biological water harvesting, which is among effective ways for measuring the land sue.

At present time water harvesting in Bazian district includes only biological water harvesting (BWH) from rainfall, ghanants and springs only due to non-construction any dams[(3)] for storage of flooding water for providing irrigation water in summer for agricultural area.

Although a study in Bazian district tested water inflows of 105 springs with average discharge of 0.5-3.1m^3/sec and founded the existence of two important ground water aquifers with 21-35m and 29-108m in thickness respectively, but at present time most ghanats and springs dried up due to extensive pumping of ground water which resulted in sever depletion of ground water level [(4)].

Agriculture activities are major forms of land use including row crops rangelands, animal farms. Land is required to support human ecosystem needs. Agriculture land is critical to provide food and fiber to growing population and is an important source of employment in many countries. Forest area provide raw materials for harvesting and are important habitats for wildlife. Water, lands and water bodies cover land and are important in sustaining aquatic habit and water supplies .Thus the basic needs of food, water, fuel, clothing and shelter are met from the land [(5).]

Absence of studies in Bazian territory about some important basics of food production, water, land and water deficiency are among motivates to perform this study.

The aims of this study are to investigate land, water use and water deficiency and water requirement in territory.

Methods and Materials:

This study was carried out at Bazian district which is located to the east of southern Kurdistan and southern west of Sulaimani governorate fig (1) and fig (2).

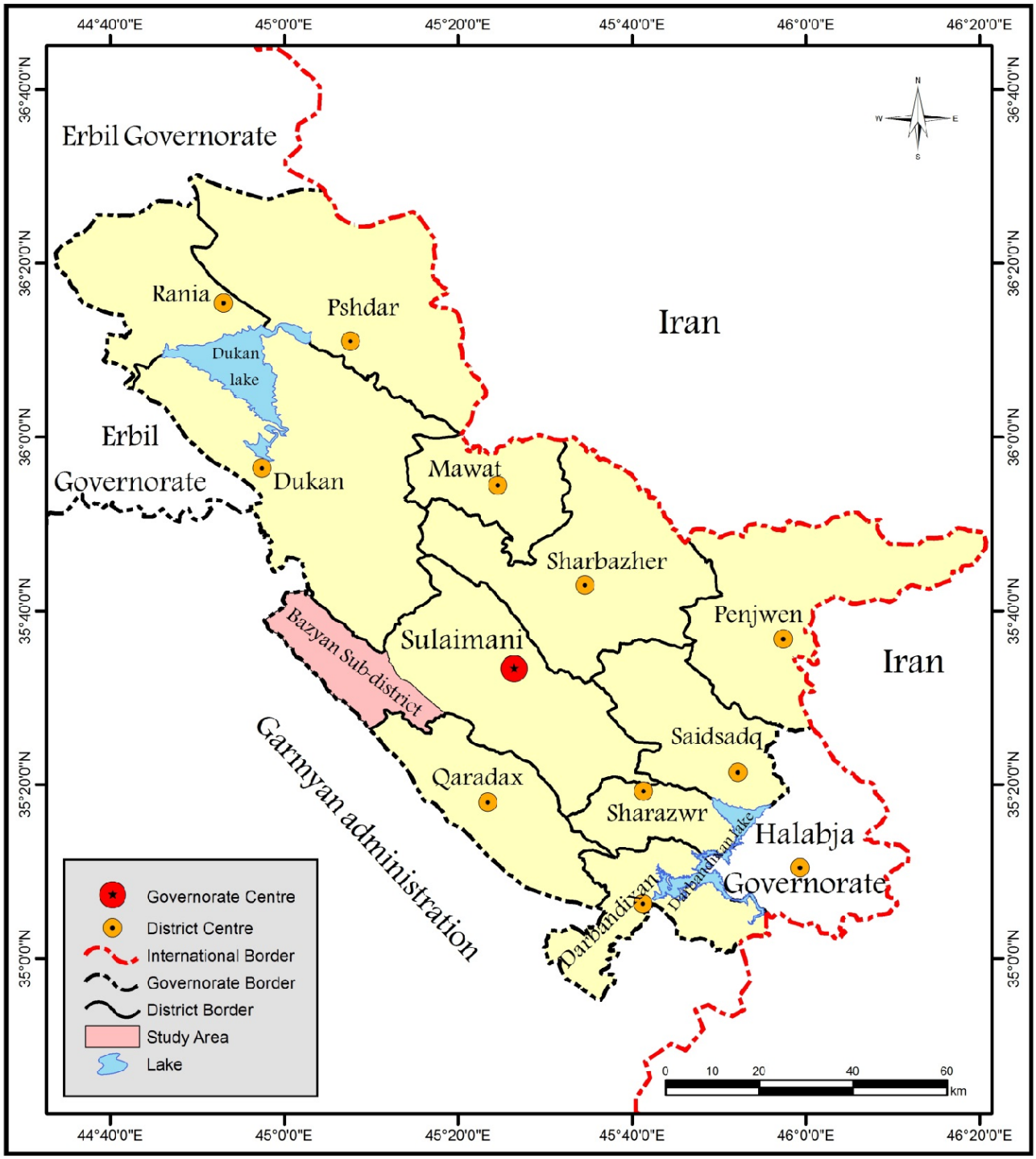

Fig (1) shows Bazian geographical sit according to Sulaimani governorate[1]

Bazian territory is located between longitudes 44^{0} ,58^{-} - 45^{0} ,13^{-} and latitudes 35^{0} , 27^{-} - 35^{0} , 37^{-} (1) . The total area of Bazian territory is about 322.375km^{3} (32237.51 ha). The topography of Bazian territory ranged between mountains, hills and plains such as Bazian plain with 1500ha (1).

[1] Reference ministry of planning – Sulaimani statistic directorate – GIS

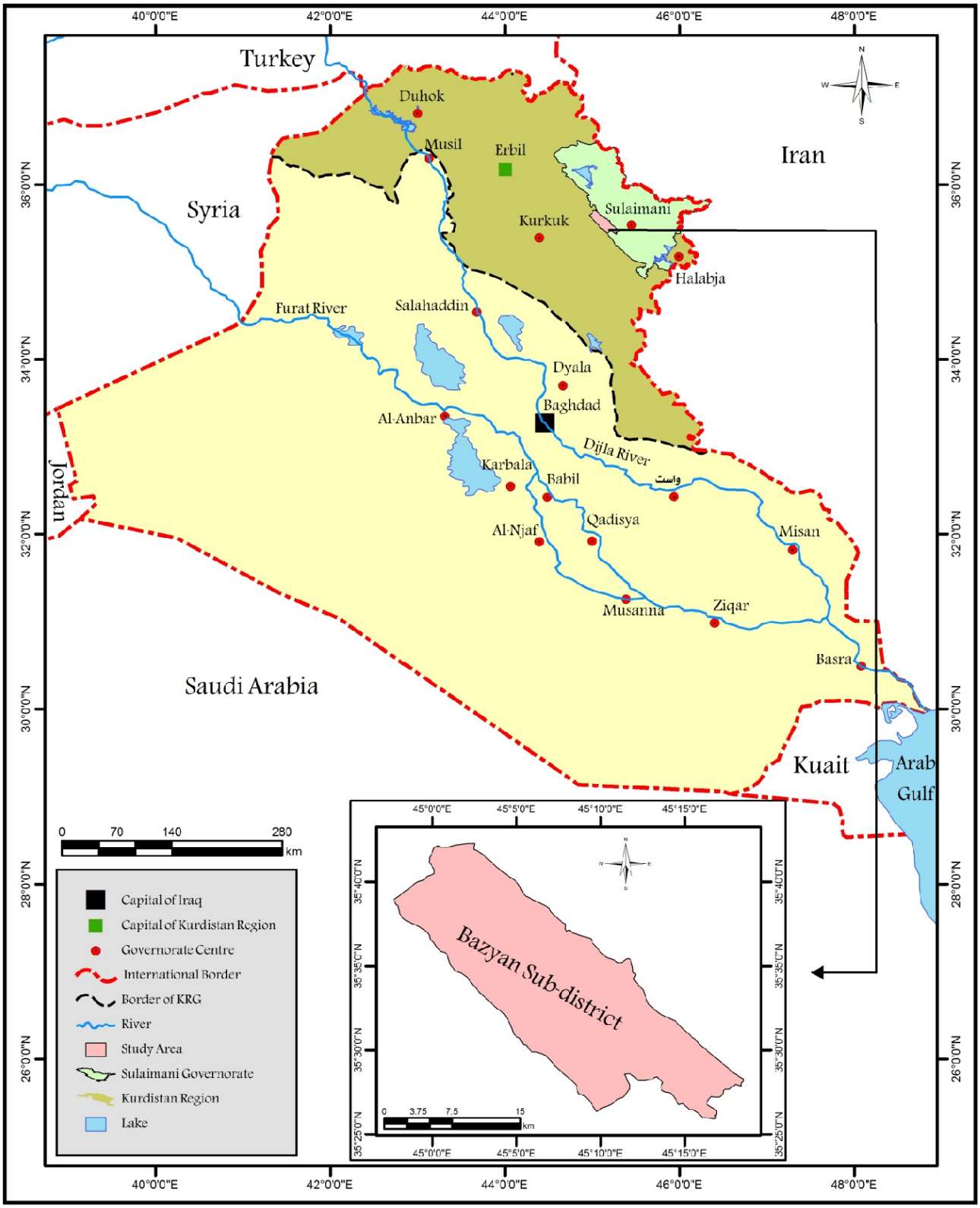

Fig (2) shows Bazian geographical sit according to Iraqi map.[2]

[2] Reference ministry of planning – Sulaimani statistic directorate – GIS.

Research method followed in this study includes:

1. Water resources and compilation of all related literatures to research problem.
2. Collection of different types of basic data including :

a. Metrological data of Bazian governorate station for the last 13 years including rainfall and temperature [7].

b. Land agricultural survey data of different agricultural offices of Sulaimani governorate [8].

3. Analysis and interpretation of the above mentioned data collection and linking those results with the future development.
4. Construction of a policy dialogue models [9]. The methods used for analysis was a modification of global policy dialogue model (PODIUM) which is interactive policy planning and scenario analysis tool which explores the trade-off and future demands on water resource on a national scale.

Results and Discussions:

Fig (3) shows annual rainfall distribution in Bazian territory during 2008 – 2015. The lowest rainfall was 230 .1mm in 2008 which is highly below the water demand of most winter crops (400 mm). While rest years was above the water demands of winter crops.

Rainfall above 700 mm was not recorded during 2008-2015 which is considered wet years, whereas years below 700 mm are considered semi-moisture for summer crops and below 400 mm dry years for winter crops.

In general the rainfall during the mentioned period were not enough for full yearly activation of springs and ghanats which are still the main source of summer cultivation in the region.

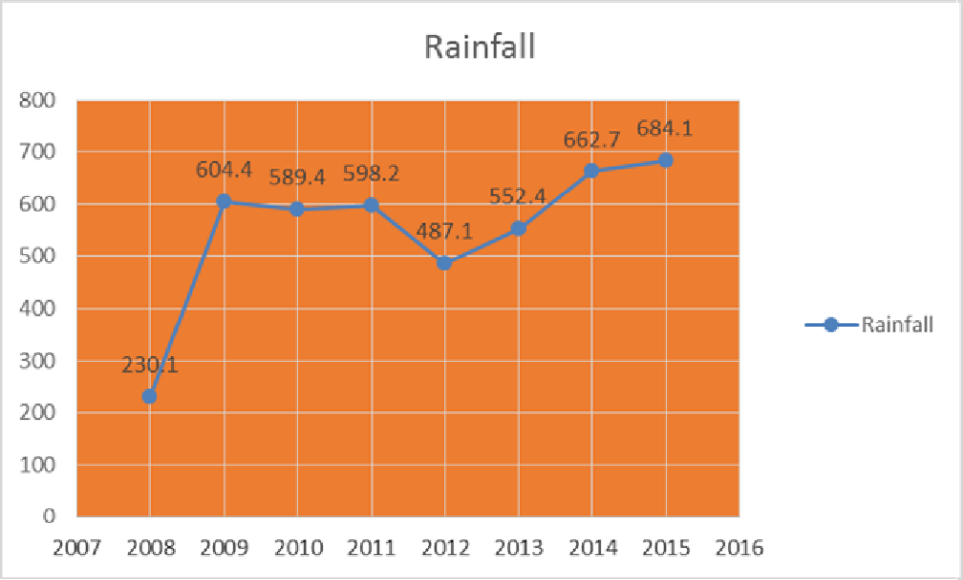

Fig (3) Annual rainfall distribution for Bazyian territory during 2008-2015

Demarton coefficient was calculated according to Demarton formula = annual rainfall / average yearly temperature +10 = 552.4/ 17.5 + 10 = 20.01 which was semi-moist (10, 11).

Fig (4) shows monthly average of relative humidity in Bazian territory during 2008-2015. High relative humidity was recorded in winter seasons. Whereas average of low relative humidity was recorded in summer growing seas (Jun. – Oct.). This low relative humidity with high evaporation affect negatively crop water demand [(1)].

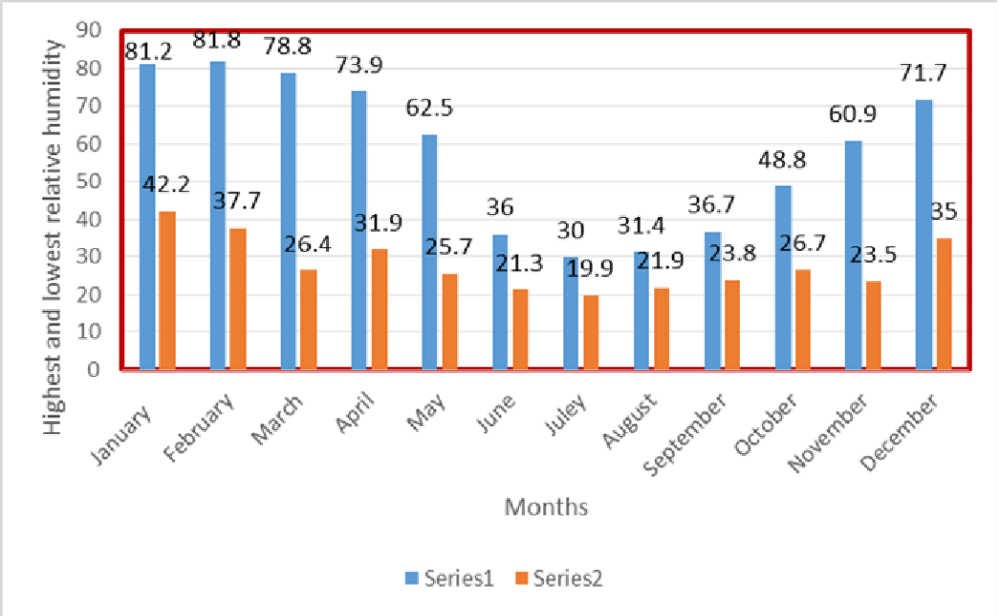

Fig (4) Average of highest and lowest relative humidity in Bazian territory during 2008-2015

Fig (5) shows average of high and minimal temperature during 2008 – 2015. High temperature starts from second half of many up to October. The highest temperature was recorded in July. High temperature increase crops water demand and affects water resource negatively.

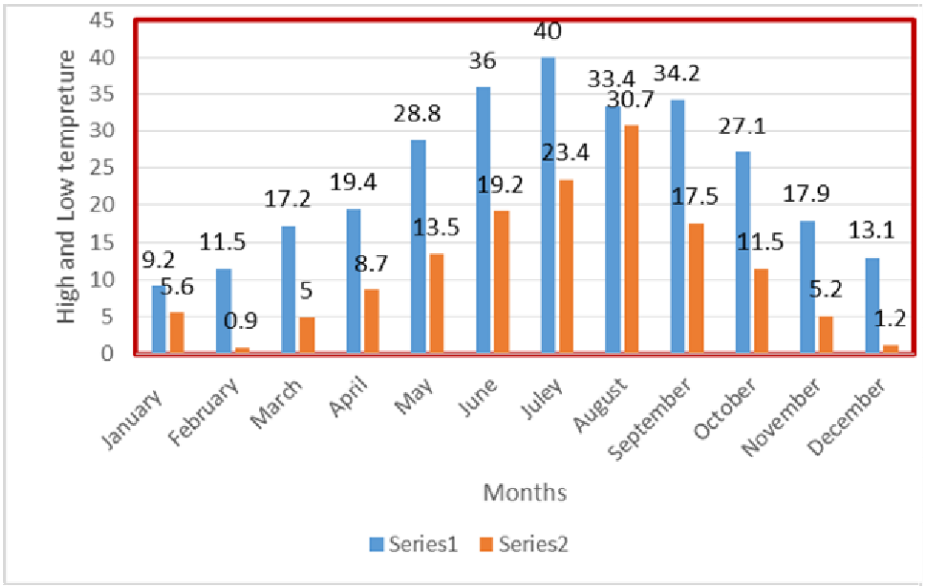

Fig (5) Average of highest and minimum temperature for Bazian territory in(C) during 2008-2013

Fig (6) shows average of monthly evaporation during 2008 2015.
The highest evaporation were during summer growing season May – October. The highest evaporation was in July (354.2 mm). High evaporation affects negatively water resource income and crops water demand.

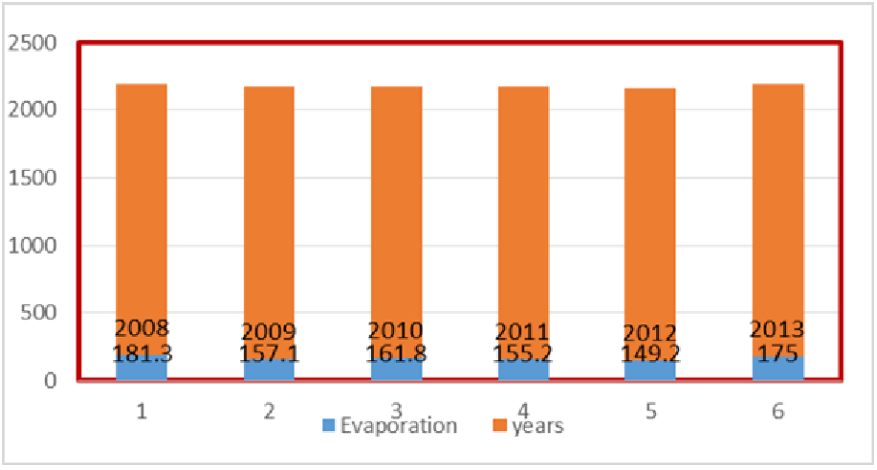

Fig (6) Show annual evaporation (mm) of Bazian territory during 2008-2015

Fig (7) shows average monthly rainfall distribution during 2008 – 2015 in Bazian territory.
In general winter and autumn months are wet except in April (35.97 mm) which was below the main winter crops demands for rainfall.
Summer months were completely dry except some showers

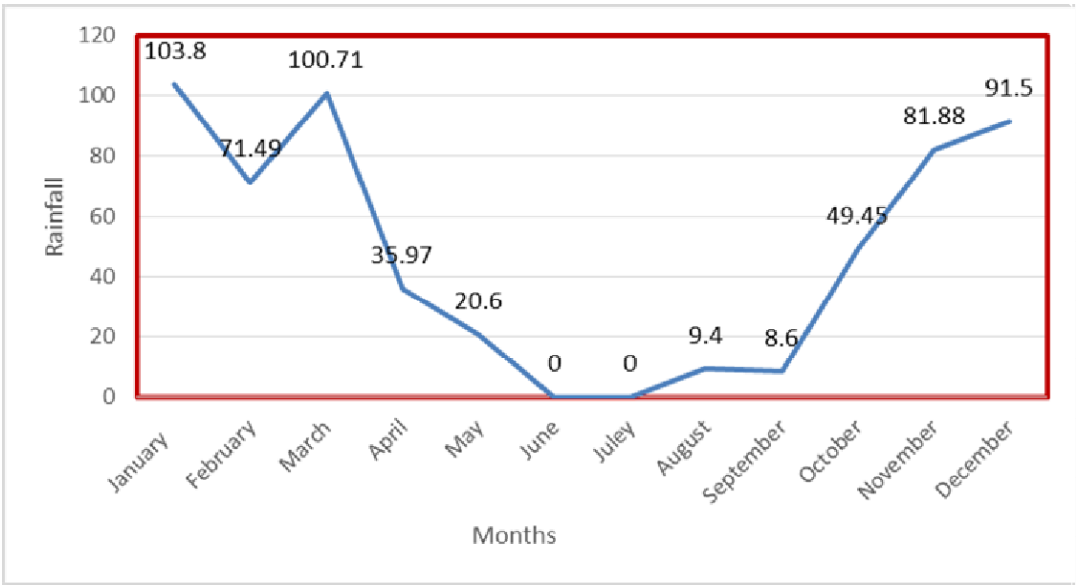

Fig (7) Average monthly rainfall distribution for Bazian territory during 2008-2015

Table (1) shows land classification in Bazian tirritory according to available water resources.

Land classification	Area (hectares)	%
Irrigated land	2336.56	7.25
Dry land farming	11031.28	34.22
Marginal lands	278.25	0.86
Irrigated orchards	224.04	0.69
Non Irrigated orchards	187.oo	0.58
Pastures	13146.56	40.78
Natural forest	4665.90	14.47
Artificial forest	36.28	0.12
Total	**32237.51**	

The amount of rainfall and water inflow from springs are still govern the land classification and according to that the land categories are shown in table (1).

1- Dry farming or dry lands in which rainfall is the only source for its cultivation in Bazian territory which can be invested in winter season for growing winter crops and fallowing in summer season due to lack of rainfall and other sources of irrigation.
2- Irrigation lands: include lands in which its elevation lower than spring's water inflow. Although it comprises 7.25% of the total area, but the available water for its irrigation is enough for cultivation 25% of that area even in best wet years when the annual rainfall is more than 700mm.
3- Pasture lands: it comprises the largest area (40.78%) of the total available land in the studied area.

Some of the area can be transformed to irrigated orchards if the water resource in the region will be organized. It is also possible to invest some pasture lands with dry farming orchards through cultivation wild almond, wild root stocks such as wild pears, hawthorn, wild cherry and budding them with commercial pears, peach, cherry and apricot(13) .

4- Natural forests: it comprises (14.47%) of the total area. It include hills and mountains slopping which is not suitable for field crops due to its topography.
5- Irrigated orchards: it comprises (0.69%) of the total area of the studied area. it is area is limited due to low water inflow of springs and ghanats.
6- Marginal lands; it from (0.86) of the area of Bazian district, mostly it include areas subjected to continues erosion.

Biological water harvesting:

1- Biological water harvesting from non-agricultural lands:

Table (2) shows biological water harvestings for non-irrigated orchards, pastures and forests in Bazian territory in 2013.

Forms of Biological water harvesting	Area Hectare	Water consummation (mm)	Biological water harvestsing m^3	%
Non-irrigated orchards	187.00	450	841,500	1.037
Pastures	13146.56	450	59,159,520	72.89
Natural forests	4665.90	450	20,996,550	25.87
Artificial forests	36.28	450	163,260	0.20
Total	18035.74	81160830		

Table (2) shows Biological water harvest from non-irrigated orchards, pastures and forests. Pastures recorded the highest percent of biological water harvesting, followed by natural forest, non-irrigated orchards and artificial forests respectively. The differences between dry land plants in biological water harvesting attributed to differences in their area.

2- Biological water harvesting from land investment during summer season 2013.

Table (3) shows land investment and biological water harvest in Bazian territory in 2013.

Crops	Land investment Ha	Water consumption mm	Biological water harvest m^3	%
Rice	20.0	880	176000	18.18
Corn	4.0	720	28800	2.98
sunflower	106.0	720	763000	78.84
Total	175.0		1,260,000	

Total growing area 305

Total allocated irrigate land 2336.56

Lands leaved without cultivation 2031.56 ha, thus water deficiency in summer season is estimated with 14,627,232m^3.

It was clearly appeared that land investment in summer season was very low (305ha) in comparison to allocated irrigated land (2336.56ha) with very low land investment percent 13.05% which might be attributed to low rainfall in comparison with wet seasons (700mm).

3- Land investment ,biological water harvest in Bazian district in 2013

Crops	Land investment Ha	Water consumption mm	Biological water harvest m^3	%
Wheat	4950.00	400	19,800,000	79.22
Barley	1583.25	290	4,591,425	18.37
Chickpea	116.50	190	221,350	0.89
Lentils	89.50	400	358,000	1.43
Broad bean	5.83	400	23,320	0.009
Total	6745.08		24,994,095	

Total allocated land for winter crops 11031.28 ha

Losing water due to fallowing area is calculated from multiplying fallowed area (4218.7 X wheat water requirement (400 mm) = 17,144,800 m^3.

Table (4) shows that land investment was 6745, 08 ha from total allocated land for winter crops or dry land farming (11031.28 ha) with 61.14% investment and biological water harvest of winter crops was 24,994,095 m^3 from total annual renewable water.

Table (4) shows growing area with dry farming vegetables at Bazian territory in 2013.

Dry farming vegetables	Area (Ha)	Water requirement (mm)	Biological water harvest (m^3)	%
Melon	65.0	400	260000	96.30
Snake cucumber	2.5	400	10000	3.70
Total	67.5		270000	

Total dry land farming 11031.28

Table (4) shows land investment with dry land farming vegetables from total dry land (11031.28 ha) with investment of 0.61% which was very low. Calculated from formula area (m) X rainfall (m) = 67.5 X 10.000 X 0.5524 = 372870.00 m^3.

Table (5) summary table of land use and biological water harvest in Bazian territory in 2013.

Forms of biological water harvesting	Crowing area (Ha)	Biological water harvest (m^3)	%
Summer crops	199.0	967,800	1.72
Irrigated vegetables	175.0	1,260,000	2.25
Winter crops	6745.08	29,994,095	53.45
Irrigated orchards	224.04	1,568,280	2.79
Non-irrigated orchards	187.0	891,500	1.59
Dry farming vegetables	67.5	270000	0.48
Natural forests	466.90	20,996,550	37.42
Artificial forests	36.28	163,260	0.29
Total biological water harvesting			

Table (5) shows that biological water harvesting of 56,111,485 of winter crops under dry land farming recorded highest percent 53.45% due to availability of rainfall in winter season of 2013 (550.4 mm) which resulted in investment of 61.15% of dry farming area.

Forests rank second with 37.42% due to availability of rainfall 552.4mm in 2013 which was more than forest seasonal water requirement (450mm) [(1)].

Table (6) shows summary table of land investment and winter deficiency in Bazian territory.

Farms of land investment	Area Ha	% land invest ment	Water lost	Water deficiency or water requirement
Dry land farming	11031.28			
Growing winter crops	6745.08	61.15		
Dry farming vegetables	67.50	0.61		
Total investment area in dry land	6812.58	61.76		
Non-investment area in dry land	4218.70	38.24	16,874,800	
Irrigated lands	2336.56			
Growing summer crops	130.0	5.56		
Growing summer vegetables	175.0	7.49		
Total investment area in irrigated lands	305	13.05		
Non- investment area in irrigated lands	2031.56	86.99		14,672.232
Total agricultural land	13367.84			

Table (6) shows that total investment area for dry land farming in 2013 was 6812.58 ha with 61.76% investment, whereas total investment area of irrigated land 305 ha with 13.05% investment.

Water losing due to non- investment of 4218.70 ha in winter season 2013 in Bazian district was 16,874,800 m^3 and water deficiency due to non- investment of 1962.56ha in irrigated lands was calculated from fallowed land area 2031.56 ha seasonal water required lands (720 mm) = 14,672.232m^3 while renewable water in 2013 was calculated from multiplying total area 32237.5 ha with rainfall 552.4 mm in 2013 which was =178,080,005m^3. Thus currently water deficiency forms 17.49% from total annual water from rainfall. The above water deficiency can be insured from construction simple small dam in the region.

Policy dialogue models for future development of Agriculture in Bazian territory [(9)].

There are many scenarios for agriculture development among them.

1- Transforming all the agricultural land to irrigated land.

Total Agricultural land in the territory (13367.84) with seasonal water requirement 720mm [(1)], for most of summer crops like corn, soybean, cotton….etc. The water requirement mint will be 13362.84 X 10000X 0.72 = 96,248,448 m^3.

2- Cultivation half of allocated agricultural land 6683.64 ha with rice and other demand 1000 mm. The water requirement for rice will be 6683.64 X 10000 X 0.880= 58,816,032m3 for rice and for tomato 6683.64 X 10000 X 1m = 66,836,400m^3.

Acknowledgment:

This study was performed in Kurdistan institute in for strategic studies and scientific research and university of Sulaimani.

The author wishes to express his deep thanks to Professor Pola Qhanaqa, the head of KISSR and Professor Salahadin Saed Ali the president of Sulaimani University for providing facilities to perform this study.

References:

1- Mohamed Ali.J.J. 2008. Water resource and its utilization for agricultural development in slemani governorate Ph.D. Dissertation University of Sulaimani.
2- Sigert,K,1994 introduction to water harvesting, proceeding of the FAO expert consolation Cairo, Egypt, Roma, Italy, FAO.
3- Aziz, B.K, Two dimension resistivity imaging tomography for hydrological study in Bazian west Sulaimani city, NE-Iraq, Ph.D. dissertation.
4- Ground water office in Sulaimani governorate 2013. Personal communication.
5- Food and agriculture Organization.2010 guidelines for land use planning. FAO development series,1. Rome, Italy. Food and agriculture.
6- www.google\earth.com
7- FAO, 2002. Annual statistic Bulletin, No.4 Erbil. Iraq.
8- Sulaimani metrological station, 2013 ministry of agriculture and water resources.
9- Sulaimani directorate of agriculture and land department, 2013.
10-Amin, A.N. 2006 policy dialog model for future development in Kurdistan region.
11-Alsobaihey, A.M 2002 Dissertation in Anbar governorate and its influence on agricultural lands. Ph.D. dissertation. University of Baghdad, 1998, in Arabic.
12-Alsalash, 1971.climatology of Iraqi Regional, journal of Reaz University Vol.2, p.159-187.
13-Amin, A, N.2003, principles of crops productivity under dry farming, University of Sulaimani.
14-Ali,J.J and Nori,I.M.2015 water harvesting through utilization of wild almond as root stocks fo production of peach , apricot and plum under dry land farming in Sulaimani region. IJISET, Vol.12, issue, 8.

الخلاصة البحث

الإستعمال الارض، والحصاد بايولوجى للمياهـ ونقص مياهـ الرى فى المنطقة بازيان فى سنة 2013

اجريت هذه الدراسة خلال الموسم الشتوي والصيفي لعام 2013 في منطقة بازيان التابعة لمحافظة السليمانية بهدف الاطلاع على أستعمالات الارض والمياه والنقص في كميات المياه لتحويل كامل الأراضي الزراعية الى أراضي مروية منتيجة لتلبية احتياجات المنطفة.

تشكل الأراضي الديمية 34.22٪ والمروية 7.25٪ ونسبة إستثمارها 61.76٪ و 13.01٪ على التوالي.

سجلت المحاصيل الشتوية أعلى نسبة للحصاد البايولوجي 53.45٪ بينما المحاصيل الصيفية سجلت اقل نسبة .

قدرت كمية المياه اللازمة الواجب توفيرها لرى الأراضي المروية المتروكة بدون زراعة لعدم توفير المياه لزراعتها بنحو 14,627,232 م^3 .

بينما قدرت كمية المياه اللازمة لتحويل كامل الأراضي الديمية والمتروكة صيفاَ بدون زراعة بنحو 79,425,216 م^{3}والني تشمل نحو 44.6٪ من مجموع كمية المياه المتجددة سنوياَ والبالغة نحو 16,874,800م^3 ، في حين قدرت كميات المياه الناقصة الواجبة توفيرها لتحويل كامل الراضي الديمية الى اراضي سحيحة والراضي المروية المتروكة بنحو 52.62٪ من مجموع المياه السنوية المتجددة في سنة 2013 ب 178,080,005م^3 .

پوختەی توێژینەوەکە

بەکارهێنانی زەوی و دروێنەی بایۆلۆجی ئاوو کەمی ئاوی ئاودێری

لەناوچەی بازیان لەساڵی 2013

ئەم لیکۆڵینەوەیە ئەنجامدرا لە وەرزی زستان و هاوینی ساڵی 2013 لە ناوچەی بازیان لە پارێزگای سلێمانی بە مەبەستی ئاشنابوون بە وەبەرهێنانی ئاو و زەویە کشتوکاڵیەکان و کەمی ئاوی پێویست بۆ ئاودێریکردنی زەویە کشتوکاڵیەکان و گۆڕینی هەموو زەویە کشتوکاڵیەکان بۆ زەوی بەراوی بەرهەمهێنەر بۆ دابینکردنی پێداویستی بەرهەمە کشتوکاڵیەکان.

زەوی دیم نزیکەی 34.22% و زەوی بەراو 7.25% و ڕێژەی وەبەرهێنانیان 61.76% و 13.01% کەمترین ڕێژە بووە.

بەروبوومە زستانەکان بەرزترین ڕێژەی دروینەی ئاوی تۆمارکردووە 53.45% و بەروبوومە هاوینیەکان 1.72%.

بڕی ئاوی پێویست بۆ ئاودێریکردنی زەویە بەراوە بەیارەکان مەزەندەکراوە بە نزیکەی 14.627.232 م^3 وە بۆ ئاودێریکردنی هەموو زەویە دێمیەکان بە نزیکەی 79.425.216 م ٣ وە بۆ هەموو زەویە کشتوکاڵیەکانی ناوچەکە 94.052.448 م^3 کە ڕێژەی 52.62% لە کۆی ئاوی تازەبوەوەی ساڵانەی ناوچەکە پێکدەهێنێت کە مەزەندەکراوە بە 178.080.005 م^3 لە ساڵی 2013 دا.