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Review of the Agricultural Sector In The Kurdistan Region Of Iraq:

Analysis On Crops, Water Resources And Irrigation, And Selected Value Chains

2019

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Dr Dara Rashid Mahmoud, Minister of Planning, is handing over the Study to Ms Begard Dilshad Talabany, Minister of Agriculture & Water Resources

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The report was prepared by UNFAO international Consultants, Dr. Nakd Khamis –Agronomist, Dr. María E. Milanés Murcia - Water Resources Specialist, Dr. Seán Mac an tSaoir – Value Chain Expert, under overall supervision of Dr. Fadel El Zubi, Country Director FAO Iraq, Mr. Paul Schlunke, Head of Office Erbil FAO Iraq and Mr. Halwan Bakhtyar, FFER-KRG Project Manager.

Executive Summary

This study is a collaboration between UNDP, Embassy of the Netherlands, USAID and FAO. Funds have been made available under UNDP's Funding Facility for Economic Reform – KRG (FFER-KRG) that has been approved by KRG Ministry of Planning. This Facility has mobilized expertise for providing an overview of the Kurdistan Region of Iraq's agricultural sector. Three international consultants have been recruited to focus on three areas: i) agricultural production; ii) water/ irrigation; and iii) agricultural markets and value chains. FAO has been responsible for the overall implementation of the study based on expertise available in its sub-Office in Erbil with technical support from a multidisciplinary team of specialists from FAO's Regional Office for the Near East and North Africa (RNE) in Cairo, Egypt. The results are anticipated to provide useful information for planning and policymaking, and assist in the practical outline of comprehensive and informed programming and for resource mobilization.

The outputs accumulated include a final analytical report integrating the three components of mainly crops, water/ irrigation and markets /value chains, in addition to three individual thematic reports providing more details on situation analysis, including strengths, weaknesses, opportunities and constraints.

The broad objective of the study was assessing the status of agricultural livelihood sub-sectors: crop, livestock, fishery and aquaculture, and forestry resources of the rural communities and highlight the necessary value chains of agricultural products, constraints, needs and propose relevant interventions. This would then provide inputs to identify:

1. Priority requirements in agriculture sector and market value chain in KRI;
2. Ways to make agriculture more productive, economic and sustainable.
3. Recommendations for inclusive value chain development of key agricultural commodities.
4. Capacity building needs to improve productivity.

More specifically, the study had nine specific research questions, listed here:

a. Assess the current needs on wheat seed with possibility of setting up commercial certified wheat seed growers in KRI to meet the farmers demand.

b. Analyze post-harvest losses and identify further techniques and practices towards reducing the losses, especially in horticulture, wheat and barley.

c. Assess fruits and vegetables production, the value chain development including handling and storage techniques to improve quality and promotional activities.

d. Analyze the current up agro, meat and milk processing practices; through value chain analysis identifying constraints, and mitigation measures and possibilities of improving and scaling up.

e. Assess water availability in KRI, analyzing the existing irrigation practices, maintenance of water delivery systems, at the same time exploring other techniques and practices for efficient use of water

f. Highlight ways to make forestry, fisheries and aquaculture systems more productive and sustainable.

g. Identify value chain development for local and international markets (wheat, barley, horticulture, milk, meat etc.).

h. Explore needs for agricultural research stations and need for improved or new crop varieties in KRI.

i. Identify capacity-building needs in extension services to improve farmers' skills and productivity.

Main challenges and recommendations

A. Assessment of water availability in KRI, and opportunities for more efficient use of water in agriculture.

Main challenges:

1. Lack of cooperation at the institutional level on water management
2. Need for land management and legislation reform

There is no regulation regarding the location of the land in terms of a basin or specific watershed and so does not take into consideration the interaction with water management. It only considers the mechanism to irrigate but there is no direct relation between the land, crops and basin promoting an integrate management system able to expand the irrigation sector. This lack of regulation, integrating the management of land and water, creates disequilibrium and limits the economic extension of the agriculture sector.

3. Deterioration of water quality

Use of pesticides, fertilizers, agriculture runoff and irrigation seriously damages the ecosystem, including the human food chain. Therefore, it is essential to take into consideration the negative effects of each irrigation project before the implementation of the project. Poor water quality below an irrigation project may render the water unfit for other users, harm aquatic species and because of high nutrient content, result in aquatic weed growth that obstructs waterways and has health, navigation and ecological consequences

4. Greater urgency for water management

Proper water management – aiming at more efficient use and effective use of available water sources is key to sustainability and food security for all. In fact, the lack of an appropriate management system to allocate water is the main issue in the KRI. Without proper pricing of a scarce natural resource such as water, waste of water is likely to occur if it is not used efficiently.

The study conducted offers an overview of the main concerns in relation to the management of water resources. Some 62% manage water independently from other farmers and 36% has some kind of cooperation on water management with other farmers. Furthermore, this study revealed that 51% of farmers interviewed pay for their water whilst 47% do not pay for their water supply. They have an indirect payment in terms of water delivery or abstraction from groundwater (electricity or diesel, hoses, etc.) In general, 73% of farmers interviewed said they were willing to pay for an improvement on water supply to help irrigate their lands. The most relevant improvements proposed by farmers include development of new irrigation projects, and drilling wells. Farmers responded positively to the question for a local organization to help them manage water in their area, 83% answered yes to this question, 16% said no. In particular, helping them with water conservation and means to reduce waste of water, as well as building modern irrigation projects.

Recommendations:

- Strengthen the capacity of water basin institutions as this would achieve water security while promoting sustainability in the use of water;
- Revise the institutional framework to guarantee that there is no overlapping of functions between the authorities in charge of water management, to foresee cooperation between different institutions and to apply the principle of subsidiarity.

- Modify laws and regulations about agriculture land ownership and management;
- Consider both the upland and downstream catchment areas when planning for Irrigation projects and conduct environmental impact assessments.
- Build awareness regarding the use and conservation of water and need for environmental protection are factors affecting the quality and quantity of water for irrigation purposes. Stricter rules, and enforcement need to used to avoid the loss of water resources. The Science Board Groundwater Directorate-Sulaymaniyah suggested it is possible to trade water rights between farmers as a mechanism to promote conservation.
- Financial, organizational and technical support may be considered to support more cooperation between farmers in the area of water management.

B. Importance of Strategic Crops of Wheat and Barley in KRI

Main challenges:

1. Most wheat and barley is being produced under rain-fed cultivation conditions vulnerable to impact of the weather/ climate change (wheat planted area- rain fed: 90 % versus irrigated 10 %). Supplementary irrigation should be beneficial in many areas (up to 3x higher yields).
2. Large subsidies on wheat pull in many farmers. It provides a disincentive for developing other grains, legumes, vegetables, etc. and involvement of private sector.

Recommendation

- Optimize the wheat value chain and subsidy system/ targeting farmers. Reduce waster along the value chain from post-harvest to consumption.

C. Wheat seeds, and opportunity for support to commercial certified wheat seed growers in KRI to meet the farmers demand.

Main challenges:

1. The main source of seed supply is the informal seed supply system (>96%) for wheat seed and 100% of barley seeds. Those seeds are of low quality and cannot be verified for their conformity with the original genetic characteristics of the variety, as well as not being subjected to laboratory analysis to demonstrate their suitability for agriculture cultivation. Such seeds adversely affect productivity and production and, as such, require more effort to improve their quality as much as possible.
2. The Seed Production and Certification Department combine the seed production process and the seed certification process under one management entity. This contradicts the principle of the neutrality of the seed certification authorities. The current seed production phase requires more control of production to reach a solid national seed program according to the field and laboratory certification standards for certified seed production.
3. The Agricultural Research Institute in KRI suffers from a severe shortage of qualified scientific staff, especially those with PhD degrees and in all agricultural aspects to design and lead agricultural research in connection with the difficulties facing the agricultural sector and to obtain a good scientific result that contribute to solving problems and dilemmas that hinder advancement and development of the agricultural sector.

Recommendations:

- Increase market controls and take necessary measures to avoid sale of uncertified and poor-quality seeds through the issuance of seed legislations which are regulating the functioning of the seed market and its application through the proposed the directorate of seed testing and Certification,
- Attention should be paid to the development of seed industry and seed policy in KRI through establishing the KR seed Board chaired by the Minister of Agriculture and water resources in KRI. Composition, Functions and duties of this board can be defined by legal act.
- Restructure of the seed production and certification directorate by establishing the (General) Directorate of Seed testing and Certification in the KRI.
- Enhance capacity to carry out seed testing according to the international seeds testing rules and facilitate the access to be accredited of the seed laboratories in KRI to the ISTA.
- Update field and laboratory standards used in field inspection and seed laboratory testing.
- Enhance capabilities of workers and raise their technical knowledge and skills.
- It is recommended to conduct performance trials (VCU, value for cultivation and use) and description trials DUS (Distinguish, Uniformity and Stability) which should be carried out for varietal evaluation

D. Post-harvest losses and opportunities for reductions

Main challenges:

1. The lack of storage facilities is a major issue for all farmers, but particularly in the horticulture sector. Apart from some potato stores there is no on farm storage facilities – crops get harvested and bounced to market as quickly as possible. The products are then sold covered with dust and bruised visually poor in comparison to imports. The absence of cooling technology post-harvest and during transport is a major issue, which requires to be addressed.

Recommendations:

- Modernize part of the agricultural sector that will allow for larger mechanized harvesting and post-harvest handling, storage and transport, and also invest in (cold) storage facilities, wholesale function, transport and marketing of produce;
- Support establishment of producer marketing groups, allowing them to pool funds and access larger markets and market players, including purchasing of (mechanized) equipment, storage, etc.

E. Fruits and Vegetables: production and opportunities for value chain development.

Main challenges:

2. Lack of infrastructure that promotes marketing of agricultural products;
3. Lack of specialized companies in agricultural marketing;
4. Lack of modern transportation means to maintain product quality during transportation such

as refrigerated trucks; and

5. weak industrialization of agricultural products for many reasons, including weak investment in the agro-food industry and the absence of markets encouraging the marketing of the manufactured product.

Recommendation:

– Undertake specific value chain studies for individual food products and look at opportunities to create added-value and replace certain imports. It is expected that several of the changes will not only focus inwards, but also on the enabling legal and regulatory environment, tackling red tape, improving rules and regulations – also related to food safety, and setting a common playfield for all.

F. Opportunities for value chain development for local and international markets.

Main challenges:

6. Lack of public sector reform that keeps rural poverty intact,
7. Lack of rural credit, access to banking system
8. Rural poverty due to small farm size is elongated
9. Quality of University education
10. Lack of technology transfer

Recommendations:

– Sector reform aiming at providing key services to the sector (supported by investments)

– Increase farm size that will help private sector involvement

– Consider introduction of agricultural shows and agri-tourism

– Boost financial liquidity in the rural environment through micro financing and community banks (credit unions).

G. Livestock, Sustainable Forestry, Fisheries and Aquaculture systems

Main challenges:

Three major issues have impacted the livestock sector negatively.

1. The quality of animal feed was very poor. Bags of cereal dust were being sold as fodder during the high summer when there was no plant growth. There did not appear to be any equivalent silage like material or quality hay suitable for keeping the animals growing during the summer period.
2. The collapse of the vaccination programme had reversed all the recent improvements in animal health. The native cattle were praised by the farmers for their durability in surviving in nature but as dual purpose animals did not produce either large quantities of milk or meat. The progress which had been achieved with the artificial insemination programme was being lost following its termination.
3. Both vets and farmers complained that since the economic crises, border security in relation to plant and animal health had collapsed. There was free movement of cattle between countries

and this promoted animal diseases and infection.

4. Lack of investments in production of fish fingerlings by government, which may or may not be taken up by the private sector.

Recommendations

- Support animal fodder seed growers and links to market
- Strengthen capacity of government to check borders – cross-border monitoring of animal and plant diseases and control (including laboratories and quarantine services)
- Start animal vaccination programme again and artificial insemination
- As can be seen from the reduction of imported fish, fish could be a high-value commodity already on its way to establish a niche market for itself in the KRI. Support for marketing fresh, raw, smoked, fish domestically and internationally could be considered.

H. Needs for agricultural research and improved or new crop varieties.

Main challenges:

1. There is too much focus on production rather than investing in the whole value chain to add value, including post-harvesting, handling, storage, processing, transport, wholesale, marketing and retail/ export. Seasonal surplus of vegetables and fruit is available but storage/ processing is not happening at scale.
2. Too little is invested in identifying existed varieties with high productivity, disease resistance and drought tolerant varieties could be selected and multiplied for further seed multiplication.
3. Due to the successive climatic changes in recent years (such as drought phenomena, high temperatures, low rainfall precipitation and delay and irregularity), which showed a clear impact on the agricultural production, both plant and animal production affect the livelihood of the population, especially in rural areas. Through agricultural research programs, the agricultural research centers should focus on production and/ or introduction of improved varieties resistant to drought, high temperature, less consumption of water, with a focus also on implementation of the good agricultural practices that are appropriate to the environmental and climatic conditions that affecting the region.
4. The agricultural situation in the KRI does not depend on a limited number of agricultural crops, but it also produces a large number of crops such as cereal crops, legumes, industrial crops, various vegetable crops and potatoes. The task of the research centers is to be lagging from the development of agriculture if its research programs focused only on one or a few crops. The active research programs must be extended to include different crops and to be included within the varietal developing programme for different agro-ecological zones with more emphasis on a number of crops that take priority in the needs of the population and food security.
5. Agricultural Zone Mapping: There are few studies related to the use of agricultural land and the identification of soils in terms of fertility and suitability for the cultivation various of agricultural crops using satellite technology.

Recommendations

- Replace the existed varieties with high productivity, disease resistance and drought tolerant varieties.
- Establishment of Gene Bank for KRI - There is an urgent need to fill gap in conservation, both ex situ and in situ, of agro-biodiversity in northern and northeastern areas, particularly in the semi-arid ecosystems. This represents a habitat of endangered natural populations of important wild relatives and landraces of wheat, barley, lentil, chickpea and a number of forage, pasture legume crops, fruit and nut tree species.
- Establish a gene bank (Ex situ conservation) in the KRI to collect, document and conservation of genetic resources and introduce/develop a strategy for conversation and utilization of plant genetic resources.
- Establish KRI Herbarium - to study the plant wealth (vegetation), which is rich in the region and the collection specimen for each kind of living plants for Identification, classification and description according to scientific approach.
- Plant natural reserves (In-Situ Conservation) and Germplasm stored ex situ (gene bank) for short, medium and long-term storage period while in site to preserve the biodiversity at plant where grown in the nature. For plant genetic resources (PGR), an integrated system is necessary considering the three principal ways of germplasm management—ex situ, in situ and on-farm and for that, the idea of establishing "natural reserves" which was created to protect biodiversity and to contain all living organisms from the danger of damage or extinction.
- Map agricultural land cover, as the remote sensing product, is important for crops development monitoring, crop rotation mapping, obtaining statistics on agricultural crops prevalence, as well as provision of information on soil quality in the form of biophysical parameters for better management. Data obtained using the remote sensing methods are also important for provision of information necessary for creating agricultural policy.
- Set up the agriculture zones (crop suitability) using climate (temperature, precipitation, growing day, and minimum winter temperature) and Soil (texture, pH, and drainage) requirements. This is assisting in planning for the cultivation of strategic crops to increase crop productivity through:
- Identify the agricultural zones suitable for growing crops (crop suitability map) in relation to climate and soil requirement in KRI using modern technology to improve productivity and production
- Provide cropping information on agriculture crop zone and on national level at various stage of crop development including climatic data (temperature, daily rainfall precipitation, growing days, vegetation index) and soil data (soil texture, PH, salinity, soil thickness, soil fertility).

I. Extension Services for Farmers

Main challenges:

1. Lack of operational budget seems to stop extension staff to play their potentially vital role in the field.

Recommendation:

- Conduct a SWOT analysis of the extension services and centers and undertake needs survey among their clients (farmers and value chain actors), and develop a plan that aims at full operational capacity of the most important parts.

Acronyms

DOARD	Directorate of Agricultural Research in Duhok
DOARE	Directorate of Agricultural Research/Erbil
DOARH	Directorate of Agricultural Research in Halabja
DOARS	Directorate of Agricultural Research in Sulaymaniyah
FAO	Food and Agriculture Organization of the United Nations
FAO-RNE	FAO's Regional Office for the Near East and North Africa
FFER-REG	UNDP's Funding Facility for Economic Reform
FGD	Focus Group Discussions
GDARTE	General Directorate for Agricultural Research, Training and Extension
Ha.	Hectare (equiv. of 10 donum)
IDP	Internally Displaced Persons
IQD	Iraqi Dinar
ISIL	Islamic State of Iraq and the Levant
PGR	Plant Genetic Resources
Kg	kilogram
KII	Key Informant Interviews
KRI	Kurdistan Region of Iraq
KRG	Kurdistan Regional Government
KRSO	Kurdistan Region Statistics Office
MoAWR	Ministry of Agriculture and Water Resources in KRI
MoP	Ministry of Planning
MT	Metric Ton
PDS	Public Distribution System
SPCD	Seed Production and Certification Directorate
SWOT	Strengths-Weaknesses -Opportunities and Threats Analysis
UNDP	United Nations Development Programme

Contents

CHAPTER 1: INTRODUCTION

1.1 Context

General Context

The Kurdistan Region of Iraq (KRI) is an autonomous region recognized by the Iraqi constitution located in northern Iraq. The region is officially governed by the Kurdistan Regional Government (KRG), with the capital being Erbil. According to Iraq's federal constitution, Kurdistan's institutions exercise legislative and executive authority in several areas, such as education and health policies, policing and security, natural resources management, infrastructure development, and Regional budget.(1) Its main institutions are the KRG, the Kurdistan Region Presidency, and the Kurdistan Parliament. Kurdish is one of two official languages of Iraq, Arabic being the other.(2)

The Kurdistan Region in Iraq (KRI) is located between latitude 34-37 and longitude 41-46. It includes the four governorates of Duhok, Erbil, Halabja and Sulaymaniyah. In 2016, the population has been estimated at 5.6 million and the annual growth rate is approximately 3%. Based on this rate a population of 7,650,000 inhabitants is foreseen by 2030. The area of the whole region extends to about 40.6 thousand square kilometers with a populace of around 15-20% of the total Iraqi population.

It includes mountains, hills and the most fertile plain part of Iraq. The borders include Syria in the west, Turkey in the north up to the Taurus Mountains, and Iran in the east. Kifris is the lowest point with an elevation of 140 meters above sea level. The Peak of Hasarost Mountain is the highest point with an elevation of 3,607 meters above sea level.

The KRI has a semi-arid and subtropical climate. Summers are hot and dry raising temperatures from 43 to 48 degrees Celsius. The winters are cold and rainy with a mean minimum of 2 degrees Celsius.(3) The annual average of snowfall is 2m in the regions where snow falls regularly and an average of rainfall has been estimated at 150-1500 mm/annually. The effects of climate change are impacting rainfall variability especially in areas which receive less than 400 mm of mean annual rainfall (see figure 2.2 in Part II).

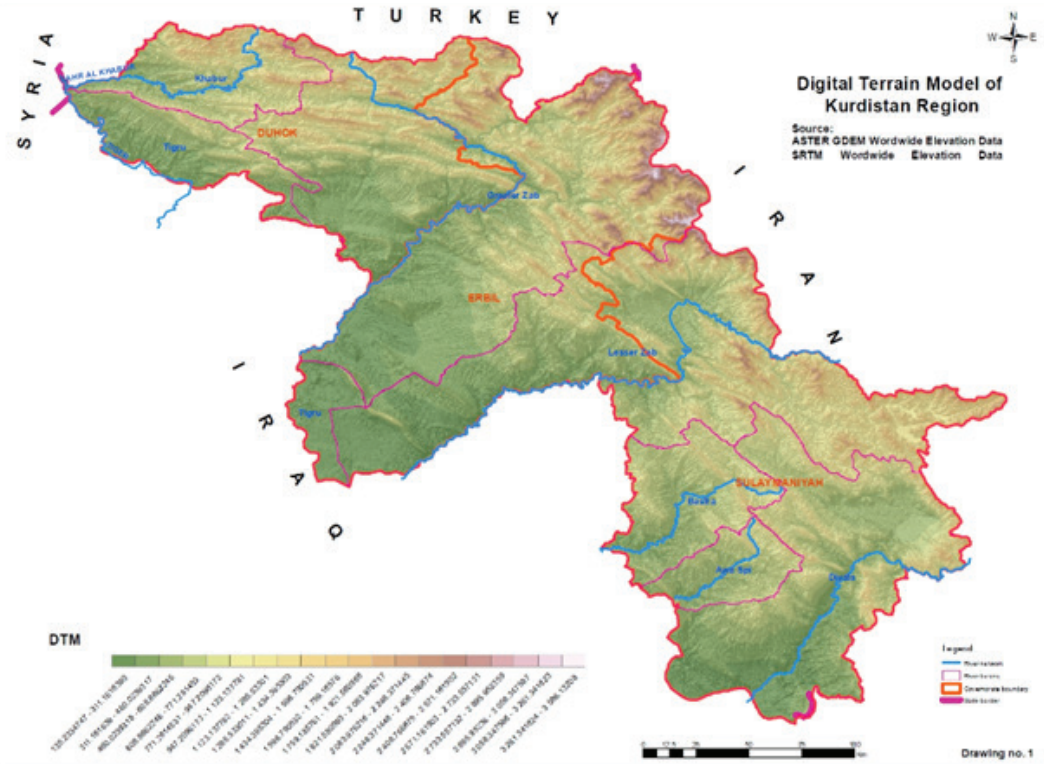
The Sulaymaniyah, Erbil, Duhok, and Halabja Governorates are in the KRI territory, which all have similar physiographic, geology, hydrogeology and climate conditions. The region is divided into three physiographic areas:

- The northern range of the Zagros Mountains,
- The central range of the Border Folds, and
- The northern plains of the Tigris River.(4)

The Digital Terrain Model used in figure 1 is a model which was carried out by the combination of the models obtained from ATER DEM Worldwide Elevation Data (1.5 arc-second resolution) and SRTM

(1) Iraq Constitution (2005) at Article 121. See also Government of the Kurdistan available at http://cabinet.gov.krd/p/p.aspx?l=12&p=180
(2) Iraq Constitution (2005) at Article 4.
(3) FAO, (2018). In-Depth study on the agricultural sector of KRG – IRWQ/17/001/01/34, Project proposal.
(4) UNDP Iraq, (2011). Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, January 2011 at 14.

Worldwide Elevation Data (3 arc-second resolution), in UTM projection, area 38° North, WGS84 ellipsoid with a resolution of 60 m. It covers the KRI "allowing the visualization of the studied configuration in order to understand the overall structure of relief, land using, obtaining of the hydrographical network, hydrographical basins delimitation, as well as determination of the lengths and surfaces of some geographicalelements."[5]



Source: MoAWR

Figure 1: Digital Terrain Model of Kurdistan Region

Soils in KRI are calcareous and originated from limestone and dolomite of different formations. "There are also scattered spots of blue Marle, red mud and chalky soils that belong to Kolosh, Gercus and Shiranish formations, but parent material, slope, runoff, soil depth and maturity affect soils variability." [6]The KRI is characterized by rich and fertile soils because of the effect of high precipitation and eroded material of rocks, modified by the richer plant cover.[7]

(5) General Directorate of Dams and Reservoirs, (2014). Dams Master Plan for Kurdistan. Report Phase III, Main text, v aug. 2014 at 54.
(6) UNDP Iraq, (2011). Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, January 2011 at 15.
(7) UNDP Iraq, (2011). Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, January 2011 at 15.

KRI region is falling under the Kirkuk agro-ecological zone having semi-arid and sub-tropical climate experiencing 200-600 mm rainfall annually. The summer hot and dry, the hottest months are July and August (43 degrees Celsius) some heat waves experienced in summer raising temperatures to about 48 degrees Celsius). The winter is cold and rainy with mean minimum temperatures around one to 2 degrees Celsius in January and February. During the cold waves the temperature drops down to negative 6 to 10 degrees Celsius (See Figure 2) with the mean annual rainfall ranges from 200 to 600 mm occurring in winter and spring (October to May, but mainly from November to April). The amount and time of rainfall is however, quite variable especially in the areas of less than 400 mm of mean annual rainfall. The soils are clay and loam types and non-saline. The plains and valleys are the main rain fed farming areas.

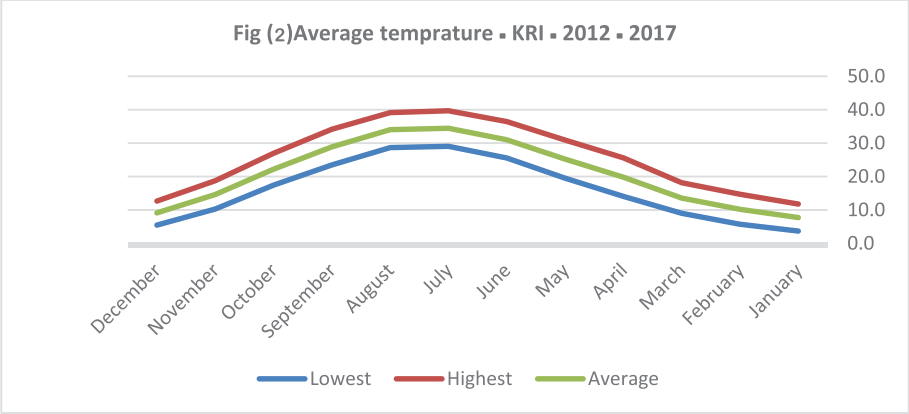


Figure 2: Average temperature in KRI 2012-2017

The region has high rainfall precipitation compared to the rest of Iraq in the center and south with annual averages ranging from 350mm in the Erbil area to more than 1100mm at Sherwan-Mazen in the high mountains bordering Iran. Rain precipitation increases from southwest to northeast, it starts in November and usually ends by May.

The average annual precipitation for 2012-2017 was 386, 496, 556 and 654 mm in Erbil, Halabja, Dohuk and Sulaymaniyah governorates respectively Figure 3. The maximum precipitation during the last seven years was 791 mm in Sulaymaniyah /2013 and the minimum precipitation was 266 mm in Erbil/2017[8] while some literatures said that precipitation vary between 300 and 1000 mm, with inter-annual variations of between 100 mm and 1300 mm. Annual rainfall in the mountains is more abundant and may reach 1000 mm in some locations. The substantial variation in amount and distribution of rainfall increases the risk to rainfed crop production.

(8) Kurdistan Region Statistics Office/ Weather statistics in Kurdistan Region s governorates 2012-2018

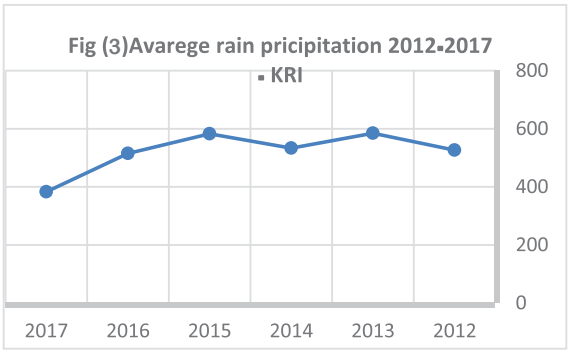


Figure 3

Roughly 90% of the annual rainfall occurs between November and April, most of it in the winter months from December through March. The remaining six months, particularly the hottest ones of June, July, and August, are dry Figure 3.

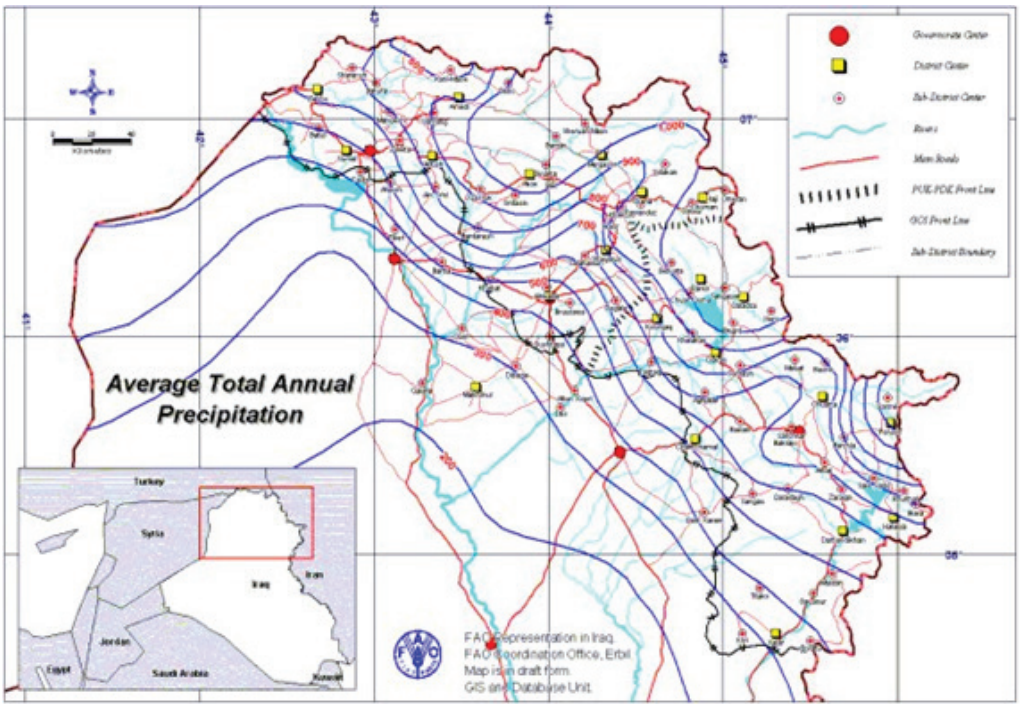


Figure 4: Average Total Annual Precipitation in KRI[9]

(9) Aziz Mohammed, 2014. Agrometeorology in Kurdistan of Iraq: a contemporary history

Political context

It is estimated that 70% of the population is engaged in agricultural practices. The KRI is naturally endowed with fertile agricultural land, water resources and favorable climatic conditions. However, following the first Gulf war and the ensuing sanctions, the Agricultural Sector in the region has significantly deteriorated. It was on April 5, 1991 when the United Nations Security Council provided Resolution 688, which condemned the repression of the Iraqi civilian population in many parts of Iraq, including the Kurdish-populated areas, the consequences of which threatened international peace and security in the region. The 688 Resolution demanded "that Iraq, as a contribution to removing the threat to international peace and security in the region, immediately end this repression, and in the same context expresses the hope that an open dialogue will take place to ensure that the human and political rights of all Iraqi citizens are respected." (10)

Although the region has not been directly affected by military damages during the current conflict, however, it has been affected by increased military spending and the influx of refugees from Syria (250,000) and internally displaced persons (IDPs) after the ISIL occupation. Their numbers, even after many IDPs have returned to their places of origin, make up around 750,000.

Since the struggle with ISIS and temporary occupation of several areas in Iraq, the Iraq Government and Kurdistan Regional Government (KRG) have been struggling to provide support to affected populations above minimum standards. The Government's social protection floor, which has helped to support millions of Iraqi families. Provision of the Public Distribution System (PDS) of food baskets to all families in Iraq has been inconsistent. Unemployment rates have rising sharply and public salaries went either unpaid or were dramatically reduced in the KRI. Host communities throughout the region are experiencing real social and economic hardship, especially farmers' households in poor rural areas.

Sectoral context

The total arable land suitable for agriculture is 1,535,794 hectares (6,143,176 donum) in the KRI. However, the total irrigated area by the ponds, deep-wells, small and big irrigation projects is assumed to be 327, 428 hectares (1,309,712 donum), which represents less than 22% of the total land available for irrigation. This situation is occurring despite the seemingly large water availability in the region. The current water resources have been estimated at 38 billion cubic meters annual flow of surface water and large aquifers in the KRI, which represent a major source of water. Additional research is required in order to estimate the storage capacity and total amount of groundwater available in the region.

The region covers an area of about 40.6 thousand square kilometers and its population is about 15-20% of total Iraq population. The agriculture sector in KRI lacks diversity and production is uncompetitive. The main crops grown in the region include barley, wheat, fruit orchards, lucerne, vegetables, potatoes and livestock grazing. The KRI might be self-sufficient in some commodities, or even producing surpluses. However, the ongoing conflicts and the influx of IDPs from conflict areas and significant number of Syrian refugees have put more pressure and competition on the existing resources of the region. The current instability and the political situation in the region imposes the need not to rely on trading with other countries and the need to assure greater self-sufficiency.

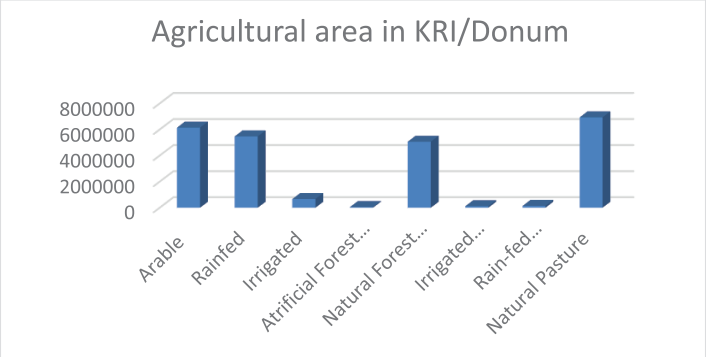
Besides famers' challenges in accessing inputs, market, and credits, the local agricultural production is in severe competition with foreign goods with largely lower prices. For Kurdish farmers, the competition comes mainly from Turkey and Iran, whose products have flooded Iraqi markets. Over

(10) United Nations Security Council Resolution 688 (1991) of 5 April 1991.

the past years Less than 4 percent of the KRG budget been allocated for agriculture over the past years while international standards demand around 10 percent. This might be linked to the history of embargoes, wars and chemical attacks that changed the area from an agricultural producer to a consumer, relying largely on oil production to import commodities and goods, making it vulnerable to oil price fluctuations. Reviving the agriculture sector is necessary to increase the resilience against any economic or humanitarian crisis. Farmers need to produce enough to feed Kurdistan's inhabitants and compete with the agricultural production and quality in neighboring countries. This is viable as KRI has all the necessary ingredients: good soil, underground water wells, climate and a population that can grow into good farmers. Extraordinary measures need to be taken to promote local production and expand the local and international exports. Application of best practices in agro, meat and milk processing will not only support the local farmers, but also reduce the reliance on foreign products, create more jobs in rural and urban areas, and grow the economy.

The appropriate climate, fertile soil, abundant water and geographical location encourage agriculture for various kind of agricultural crops where the total arable land in Kurdistan region is 6.6 million donums, the forest areas (natural and artificial) is 4,292,306 donum, orchards area 229,037 donum and pasture area (irrigated- natural) 4,892,779 donum Figure 5.

Figure 5: Agriculture area in Kurdistan Region



The MOP survey for 2015-2017 revealed that the total rainfed land in KRG is 4,833,466 donum representing 79% of the total cultivated areas and the irrigated land is 1,309,710 donum representing only 21% of the total cultivated areas. The rain-fed area covers 50% guaranteed rain-fed area, 35% semi-guaranteed and 15% non-guaranteed[(11)].

The agriculture workforce in the Kurdistan Region has about 3.1% of the total population and the number of winter crop farmers is 68,704 while the number of summer crop farmers is 23,160.

Decades of conflicts negatively impacted many agricultural areas in Kurdistan Region. However, the agriculture sector in KRI has undergone a tangible development in recent years up to the pre-financial crisis in 2014. Due to the financial crisis, the sector confronted many problems such as lack of agricultural equipment and field machineries, need for fertilizer and high quality seed supply, and lack of investment. The development happened in a number of agriculture aspects, resulted in the sector being considered as the key for revival of the economy and has the potential to play a prominent role in supporting the growth of the local economy.

(11) Anwar Omer Qader Agriculture and Water Resources in Kurdistan Region – Iraq: http://www.akier.org/agriculture.php

With the aim of agricultural development, KRG has has encouraged the local, national and international investments towards supporting the farming population both financially and technically with the aim of agricultural development. In fact, the KRG has prioritized the development of its agriculture industry to encourage greater foreign investment. The KRG's Ministry of Planning (MOP) and UNDP joint report noted that the Kurdistan Region boasts a combined 167,406 hectares (669,624 donums[12] of irrigated lands representing 10.9% of the total arable land, a diversified population of livestock, and strong environmental and natural conditions that have allowed for the development of a variety of agricultural products.

The development of the agricultural sector in all its aspects is the concern of the Ministry of Agriculture, where it put in its plans long-term goals to achieve self-sufficiency from food production to the food security of the region and has identified the ambitious target of becoming a major producer and exporter of wheat, vegetables, fruit, meat, dairy, and poultry to the Middle East and North Africa (MENA) region and beyond. In addition, the MOP has implemented a three-pronged plan for the future of the sector: i) promote food security for the people of the Kurdistan Region; ii) stimulate economic prosperity for its farmers; and iii) prosperity through the export of new agriculture and food products. Therefore, it is important to show the current situation of agriculture sector and to provide the necessary vision for productivity development and sustainability of agriculture production in KRI.

In short, the geographical location of Kurdistan is suitable for agriculture agriculture due to several factors, such as its weather, fertile land about 1,650,000 hectares (about 6.6 million donums), high level of precipitation compared to the center and south of Iraq, having access to big water sources such as Khabor river, Sirwan river, and Awa Spi river. These rivers supply 29.77 billion m3 of water annually (on average), in addition to 3662 springs and 68 soil dams which have capacity of storing 14 million m3 of water[13].

The agricultural production is the main source of many of the families living in the rural areas and produce crops in the forefront, especially the production of wheat, barley and rice as well as sunflower and legumes such as chickpeas and lentils in addition to livestock breeding, such as cattle, sheep and goats, as well as poultry.

Officials from MOA&WR have developed specifying the land for different agricultural uses in the Kurdistan Region Figure 6. In 2016, they used GIS based approach to develop the necessary datasets and to develop specific agro-climatic zone maps for growing 16 strategic crops (like wheat and barley) within the KRI. This was intended to better understand and manage the issue of low agricultural productivity in the region and then build to increase the productivity through matching optimum growing conditions (soils, rainfall and temperature) with growth boundary conditions for the strategic crops (14).

(12) Strategic development plan 2015-2016

(13) Kurdistan Region Statistics Office, 2014, agriculture department, Summer Crops agriculture report planting year 2013. Erbil, Kurdistan Region

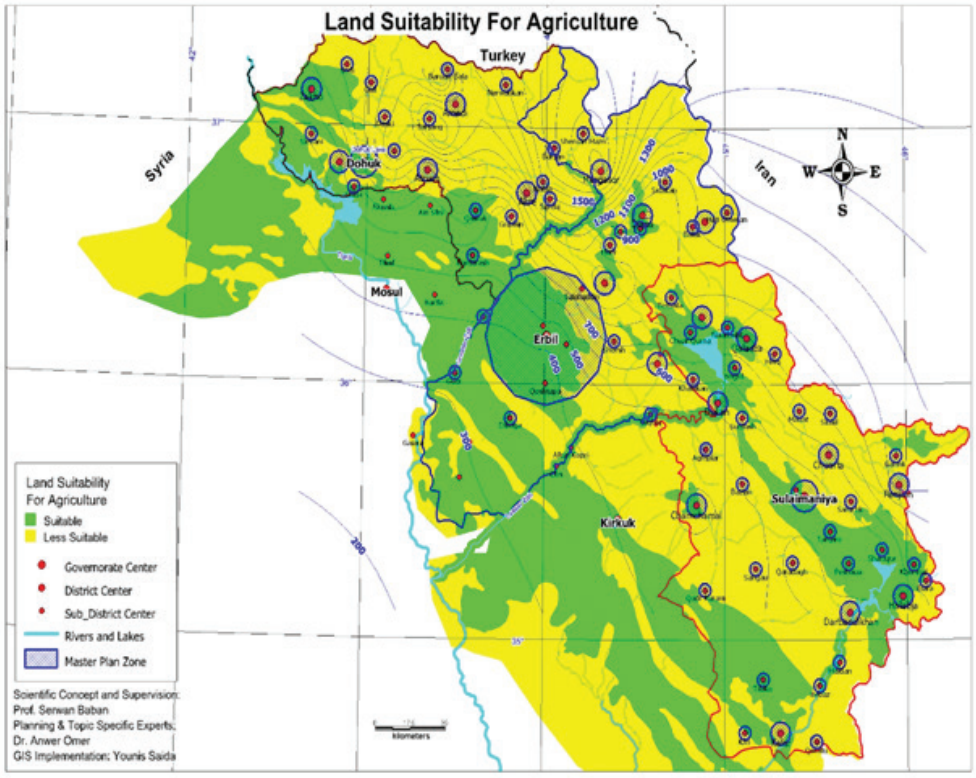


Figure 6: Land suitability for agriculture in KRI(14)

(14) Serwan MJ Baban: Managing the Impacts of Planned Urbanization on Sustainable Agriculture in Kurdistan Region, Iraq 2015

Kurdistan Region Vision 2020 for Agriculture and Agro-industry Development

The KRG has developed this vision to determine the milestones and define the goals generally to improve people's standards of living, through the development of the general framework by which the ministries implement their detailed policies and plans during the five years 2017-2020.

The Kurdistan 2020 Vision for Agriculture and Agro-industry is "Food security for the people of the Kurdistan Region, economic prosperity for farmers, and prosperity through the export of our agricultural and food products" (15). The vision foresees KRI to be a major food and agricultural producer and exporter of wheat, vegetables, fruit, meat, dairy, and poultry in the wider region and beyond.

The Kurdistan 2020 Vision has identified the challenges facing agricultural development such as: i) farmer preparation and training; ii) agricultural data, research, and planning; iii) water management; agro-industry; and land ownership. Priority has been set to revive and expand agriculture to improve productivity by focusing on the agricultural promotion priorities:

1. Improving the skills of our farmers;
2. Improving the investment environment for agriculture;
3. Improving irrigation to enable agricultural production;
4. Rehabilitating and managing the land;
5. Developing infrastructure for the agriculture industry;
6. Improving availability of agriculture data and information;
7. Implementing legal reforms for the agricultural sector;
8. Minimizing price distortions for agricultural products;
9. Developing export potential.

1.2 Study objectives, output and outcome

This study is a collaboration between UNDP, The Consulate General of the Kingdom of the Netherlands in Erbil, the United States Agency for International Development (USAID) and FAO. Funds have been made available under UNDP's Funding Facility for Economic Reform – KRG (FFER-KRG) that has been approved by KRG Ministry of Planning. This Facility has mobilized expertise for providing an overview of the Kurdistan Region of Iraq's agricultural sector. Three international consultants have been recruited to focus on three areas: i) agricultural production; ii) water/ irrigation; and iii) agricultural markets and value chains. FAO has been responsible for the overall implementation of the study based on expertise available in its sub-Office in Erbil with technical support from a multidisciplinary team of specialists from FAO's Regional Office for the Near East and North Africa (RNE) in Cairo, Egypt. The results are anticipated to provide useful information for planning and policymaking, and assist in the practical outline of comprehensive and informed programming and for resource mobilization.

The outputs accumulated include a final analytical report integrating the three components of mainly crops, water/ irrigation and markets /value chains, in addition to three individual thematic reports providing more details on situation analysis, including strengths, weaknesses, opportunities and constraints.

The broad objective of the study was assessing the status of agricultural livelihood sub-sectors: crop, livestock, fishery and aquaculture, and forestry resources of the rural communities and highlight the necessary value chains of agricultural products, constraints, needs and propose relevant interventions. This would then provide inputs to identify:

1. Priority requirements in agriculture sector and market value chain in KRI;
2. Ways to make agriculture more productive, economic and sustainable.
3. Recommendations for inclusive value chain development of key agricultural commodities.
4. Capacity building needs to improve productivity.

More specifically, the study had nine specific research questions, listed here:

a. Assess the current needs on wheat seed with possibility of setting up commercial certified wheat seed growers in KRI to meet the farmers demand.

b. Analyze post-harvest losses and identify further techniques and practices towards reducing the losses, especially in horticulture, wheat and barley.

c. Assess fruits and vegetables production, the value chain development including handling and storage techniques to improve quality and promotional activities.

d. Analyze the current up agro, meat and milk processing practices; through value chain analysis identifying constraints, and mitigation measures and possibilities of improving and scaling up.

e. Assess water availability in KRI, analyzing the existing irrigation practices, maintenance of water delivery systems, at the same time exploring other techniques and practices for efficient use of water

f. Highlight ways to make forestry, fisheries and aquaculture systems more productive and sustainable.

g. Identify value chain development for local and international markets (wheat, barley, horticulture, milk, meat etc.).

h. Explore needs for agricultural research stations and need for improved or new crop varieties in KRI.

i. Identify capacity-building needs in extension services to improve farmers' skills and productivity.

Methodology

The methodology of this study consists of primary and secondary data collection approach, using both quantitative and qualitative analytical methods. Secondary data has been gathered from various Ministries and complemented by additional studies and assessments conducted by NGOs, international organizations, as well as other humanitarian agencies. The qualitative data collection instruments and tools consisted of Focus Group Discussions (FGDs) and Key Informant Interviews (KII) with various MoA, MoAWR and MoP departments and its extensions, Kurdistan Region Statistics Office (KRSO), agricultural research centres, universities, traders and wholesalers, private companies, and farmers to allow triangulation and validation of the data. The study has targeted four Governorates in KRI namely Duhok, Erbil, Halabja, and Sulaimaniyah.

The outputs accumulated include a final analytical report integrating the three components of crops, water/ irrigation and markets /value chains, in addition to three individual thematic reports that provide more details on situation analysis, including strengths, weaknesses, opportunities and constraints.

In response to the objectives and research questions, the experts developed a detailed methodology for each of the individual studies that can be found in the individual reports.

Stakeholder analysis and Implementation arrangements

FAO has been responsible for the overall implementation of the project and worked closely with MoA, MoAWR and MoP to ensure, through proper technical expertise and monitoring capacity, project goals are achieved. This included the responsibility for direct monitoring conducted by its personnel at field level.

FAO hired three international consultants (agriculturalist, agriculture value chain specialist, and irrigation specialist) to conduct primary data collection and to produce the final report with support from the MoAWR and MoP.

The project implementation was supported by:

- Government Committee Coordination that included representatives from DoA, DoAWR, MoP as well as the Kurdistan Region Statistics Office (KRSO) and key directorates and departments. The committee's role was to ensure facilitation and address any problems encountered during the implementation of the study;
- Selected local institutions and partners such as agricultural research centres, universities, private companies, and farmers' unions.
- UNDP's Funding Facility for Economic Reform – Regional (FFER-REG) that was responsible, as a contributing agency, to provide administrative supports such as staffing, translation, data entry personnel and required internal transportation;The lead technical division of FAO, along with the relevant technical officers based in the FAO Regional Office for the Near East and North Africa (RNE).

Limitations to the study

The constraints on research design and methodology brought a number of limitations that might have impacted the findings of this study. The limitations include lack of data and information availability, when assessing the entire value chain of selected agricultural commodities. Therefore, the analysis and recommendations of this report are not specific but rather more generic sometimes

CHAPTER 2 RESULTS

In this chapter, the findings of the study are presented. As the scope of the study is wide, this final report has used the research questions as the main organizing principle for structuring the report. The individual reports provide in-depth details of each of the sub-sectors covering situation analysis, identification of strengths, weaknesses, opportunities and constraints.

2.1 Assessment of water availability in KRI, and opportunities for more efficient use of water in agriculture.

Water is a public good in the KRI. There are no water rights, nor concessions as in other countries under common law or civil law systems. Under Islamic civil law, which is the origin of water management in KRI, water is considered free and jointly owned by the public. Similarly, groundwater is not the property of any particular person although certain rights are acquired when water is supplied. An individual owns a well once they drill it and have a license. Rivers with a continuous flow cannot be privately owned. The Islamic law states that all persons and animals have the right to take water for drinking purposes. Regarding irrigation, everyone has the right to irrigate their lands from rivers and may dig canals and wells for this purpose. However, these activities will not be permitted when they cause any damage to other users (16). Required regulations have been developed to facilitate the implementation of the laws, particularly regarding wells and irrigation system (See water/irrigation report Part III).

Water sources

Precipitation

The KRI has high rainfall precipitation compared to the rest of Iraq in the center and south with annual averages ranging from 350mm in the Erbil area to more than 1100mm at Sherwan-Mazen in the high mountains bordering Iran. Rain precipitation increases from southwest to northeast, starting in November and usually ending by May The average annual precipitation for 2012-2017 was 386, 496, 556 and 654 mm in Erbil, Halabja, Dohuk and Sulymaniyah governorates respectively.

The maximum precipitation during the last seven years was 791 mm in Sulymaniyah/2013 and the minimum precipitation was 266 mm in Erbil/2017[15] Some sources said that precipitation varies between 300 and 1000 mm, with inter-annual variations of between 100 mm and 1300 mm. Annual rainfall in the mountains is more abundant and may reach 1000 mm in some locations. The substantial variation in amount and distribution of rainfall increases the risk to rainfed crop production.

Impact of Climate Change

A UNDP Report declared in 2011 that global warming and climate change has affected the regional precipitation patterns that resulted in reduced rainfall rates[16]. There is evidence that in certain regions, such as Central Asia, rising temperatures tend to cause earlier snowmelt and a smaller percentage of the total precipitation being stored as snow. Consequently, runoff in spring tends to become more “peaky” and to occur earlier, a phenomenon that reduces water availability during the growing season[17]. The impact varies from one area to another. In the KRI, Erbil has suffered more consequences of climate change than Sulaymaniyah and Duhok.

(15) Kurdistan Region Statistics Office/ Weather statistics in Kurdistan Region s governorates 2012-2018

(16) UNDP Iraq, (2011). Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, January 2011 at 8.

(17) Ali Rashid Ahmed Khoshnaw, January (2018), Water Evaluation and Planning System for Greater Zab River Basin, Hasan Kalyoncu University Graduate School of Natural & Applied Sciences. (Unpublished Ph.D. Thesis in Civil Engineering) at pp. 38.

In order to mitigate the effects of climate change and rehabilitate the agriculture in a sustainable way, more water management projects are needed to ensure the efficient use of available water. The irrigation sector, unlike other areas as sanitation, health and nutrition in the KRI, has not received the support (from the government and international donors) (20). More investments are needed in irrigation development in order to empower the economic sector, develop a more competitive market and create more jobs.

Other water sources

The water resources of the KRI are part of the Tigris-Iran system. In fact, the whole KRI is in the Tigris Basin (see figure 7). The region contributes to the basin with several tributaries, springs, groundwater, snowmelt and rain. The hydrological characteristics from one watershed to another are different in terms of type of water quality, size, length, catchment areas and flow. Groundwater and springs also represents a major source of water for drinking and irrigation in the four Governorates of Duhok, Sulaymaniyah, Halabja and Erbil[18].

Source: http://www.undp.org/content/dam/rbas/report/Drought.pdf

Figure 7: Overview of the Tigris and Euphrates basin

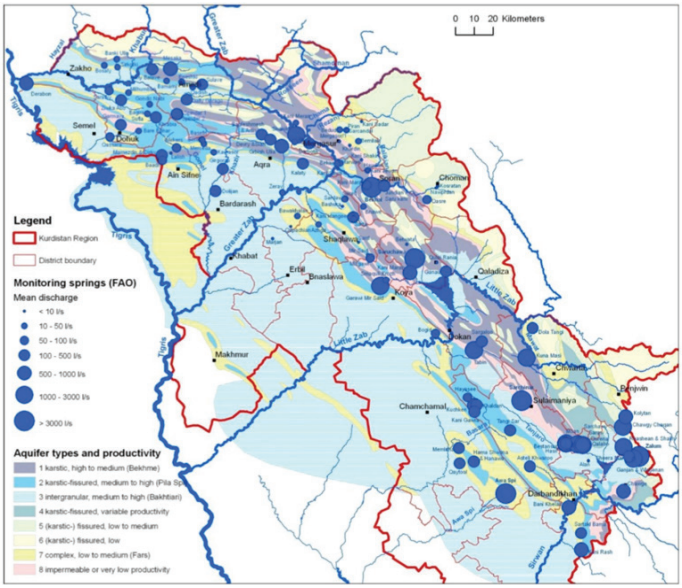
(18) UNDP Iraq, (2011). Drought Impact Assessment, Recovery and Mitigation Framework and Regional Project Design in Kurdistan Region, January 2011 at 17.

The KRI across the region, contains large amounts of groundwater. The quality of groundwater is generally good. Groundwater contributes to recharge springs and streams of the Tigris basin. There has been high level of water abstraction from the groundwater used for domestic consumption, agriculture/ irrigation and industry. This has affected the depletion of ground water table level in KRI which is estimated at an average of 100 m in the KRI [19].

Ground water

Ground water can be divided into the following sources:

1. Transboundary Aquifers: Iraq has several transboundary aquifers shared with neighboring countries (Syria, Turkey, Iran, Saudi Arabia and Kuwait). The International Groundwater Resources Assessment Centre (IGRAC) has assessed and mapped transboundary aquifers in the Transboundary Aquifers of the World, Special Edition for the 7th World Water Forum 2015.
2. Hydrogeological Basins of Kurdistan: The KRI includes several hydrogeological basins, which represent a major source of water for the region. One major aquifer system is contained in the carbonate layers of the Zagros Mountains. Two other large aquifers are found in the limestone and dolomite layers, as well as in the Quaternary alluvium deposits. The limestone aquifer contributes large volumes of water through a number of springs. The alluvial aquifers contain large volume reservoirs and annual recharge is estimated at 620 million m^3 from direct infiltration of rainfall and surface water runoff. Water quality is considered good, ranging from 150 to 1400 ppm[20].
3. Springs: The KRI includes large numbers of springs as it is reflected in Figure 8, which is part of the hydro-geological study done by FAO during the years (2000-2003) for KRI. FAO contributed to drill 95 deep wells in Sulaymaniyah, 33 in Erbil and 41 in Dohuk.



Source: FAO, 2003.
Figure 8: Springs in KRI

(19) Dr. Ghazi, (2018). General Director of Planning at the Ministry of Agriculture and Water Resources, (2018). Meeting November 22, 2018 (see Appendix II).

(20) FAO, AQUASTAT, IRAQ, (2008). Water Report 34. http://www.fao.org/nr/water/aquastat/countries_regions/IRQ/

Water Demand

The main demands for water reflected in this section are provided from statistics related to the consumptions for the population and animals, plus irrigation for agriculture. Although the industrial sector is growing, the water demand is still very low compared with irrigation and domestic consumption[21]. Table summarizes water consumption in the main categories of irrigation and domestic consumptions by river basin.

A survey developed for this report revealed that the main source of water for crop production is rainfall with 51% (over the winter season), groundwater represents 48% and rivers only 1% (Figure 9). The conjunctive use of the two sources over winter, when wells and rivers were supplementary sources, and became the main sources over the summer period. This study reveals the need to improve irrigation systems and infrastructure, to divert surface water to improved storage facilities, and improve groundwater management.

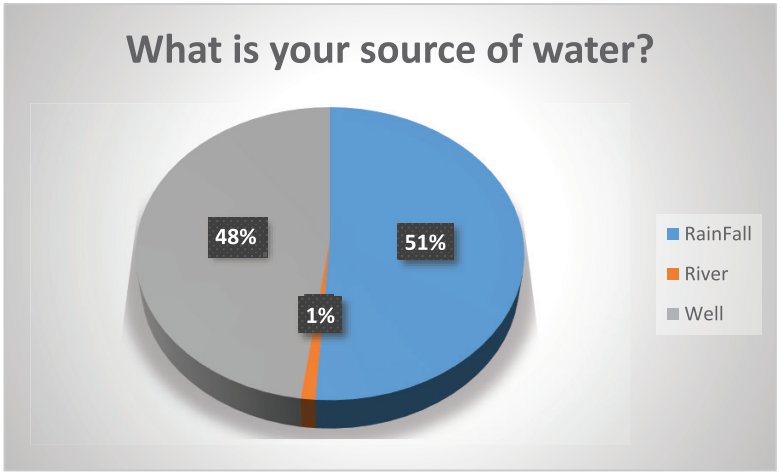


Figure 9: Sources of water

Rainfall is often not enough in most areas for the winter crops (mainly wheat and barley). In Dohuk for example, rain provides supplementary irrigation water to the river and groundwater to finish the crops in the latter part of the season. These supplementary sources represent 10% of the water used (25).

Table 1 also shows the objectives of the KRG to cover the needs of the region. The objectives proposed for 2018 has not been achieved and the current capacity is similar to the one in 2011. There is a need to invest in infrastructure for the irrigation sector. The intention to irrigate over 700,000 ha is unrealistic. However, an increase of 100,000 ha, over a five-year period could be considered feasible and even a longer period, maybe 10 years. In order to irrigate an area of that size it will need water storage of 1.5 to 1.7 billion cubic meters of water (26). Part VI of the detailed report on water/ irrigation lists the main selected irrigation projects proposed by the KRG to improve this sector

(21) General Directorate of Dams and Reservoirs, Dams Master Plan for Kurdistan. Report Phase III – Main text-v_aug2014, at 105

River basin	Total 2010 (mil cm/year)	in wich:				Total 2030 (mil cm/ year)	in wich:			
		domestic		irrigation			domestic		irrigation	
		(mil cm/ year)	%	(mil cm/ year)	%		(mil cm/ year)	%	(mil cm/ year)	%
Khabur	94.98	28.46	29.96%	66.52	70.04%	190.27	40.99	21.54%	149.28	78.46%
Tigris	133.91	59.15	44.17%	74.76	55.83%	873.63	85.07	9.74%	788.62	90.26%
Greater Zab	1 087.10	214.02	19.69%	873.08	80.31%	2 475.80	315.24	12.73%	2 160.56	87.27%
Lesser Zab	365	74.35	20.37%	290.65	79.63%	791.44	127.19	16.07%	664.25	83.93%
Sirwan	321.13	123.74	38.53%	197.39	61.47%	969.5	207.02	21.35%	762.48	78.65%
Basara	89.07	25.47	28.60%	63.6	71.40%	194.13	43.48	22.40%	150.65	77.60%
Awa Spi	8.03	2.79	34.74%	5.25	65.38%	63.43	5.46	8.61%	57.96	91.38%
TOTAL	2 099.22	527.98	25.15%	1 571.25	74.85%	5 558.25	824.45	14.83%	4 733.80	85.17

Table 1: Water Demand in KRI
Source: MoAWR

Groundwater Management

The number of wells is increasing day by day in the KRI, For example, in Sulaymaniyah the total number of wells according to information from the General Directorate of Water Resources was 37724 in 2017 and the number increased to 95000 wells legally in 2018 based on the information provided by the Directorate of Groundwater in Sulaymaniyah[22]. The main issues in the whole KRI is the difficulty to control illegal wells and the unregulated amount of water extracted by legalized wells, which are depleting the aquifers at a high rate. Table 2 provides an overview.

The KRGI contains in its regulatory framework the Instructions Number (1) of (2015) Water Well Drilling Instructions in Kurdistan Region-Iraq, which provides the guidelines to drill wells for different uses For example, it establishes that "[t]he distance between two wells is determined based on the type of aquifers and geological evaluation of the area where the wells are drilled as follows: The distance between two wells in the mountainous areas should not be less than 250m". This law also establishes the requirement of a license to drill a well. Article 7 sets out that farmer will submit an application to the General Directorate of Agriculture and after an evaluation of the legal requirements and physical conditions the request would be approved including a select location using GPS for drilling the well.

Article 7 (10) establishes that "[t]here should be a meter (gauge) installed on the well by the owner and he/she should only extract that amount of water determined by the General Directorate of Agriculture and General Directorate of Irrigation according to the type of the crop planted." However, the regulation does not provide specific provision addressing the control or inspection of water pumped according to the use. This lack of control is directly affecting the groundwater table, which is suffering a high level depletion of groundwater. A more restrictive regulation and control is needed to ensure groundwater resources for the future. In addition, there is a need to develop groundwater studies in order to specifically establish the amount of groundwater available in the region and the connectivity between

(22) This information was provided by the Directorate of Groundwater of Sulaimaniyah,.

different aquifers and surface water.

Water storage

Regarding the type of water storage facilities used for Farmers the survey developed for this report asked farmers regarding access to water storage facilities. The results are shown in figure 10. The

Gover-norate	Drinking Wells			Agriculture Wells			Industry-Wells			Totals in the 3 years	Totals in 2018
	End of 2016	End of 2017	End of 2018	End of 2016	End of 2017	End of 2018	End of 2016	End of 2017	End of 2018		
Erbil	3679	3800	4129	4198	4318	4407	160	161	164	25016	8700
Duhok	1374	1416	1426	1435	1650	1744	97	97	98	9337	3268
Suli	6077	6092	6129	2938	2956	2994	459	479	478	28602	9601
Garmiyan	489	495	499	951	1010	1054	172	173	176	5019	1729
Totals	11619	11803	12183	9522	9934	10199	888	910	916	67974	23298

Table 2: No. of permitted water wells in Kurdistan in the last three years till 31/12/201

survey revealed the need to develop additional water storage facilities or water harvesting techniques to be able to provide water security to farmers and therefore food security.

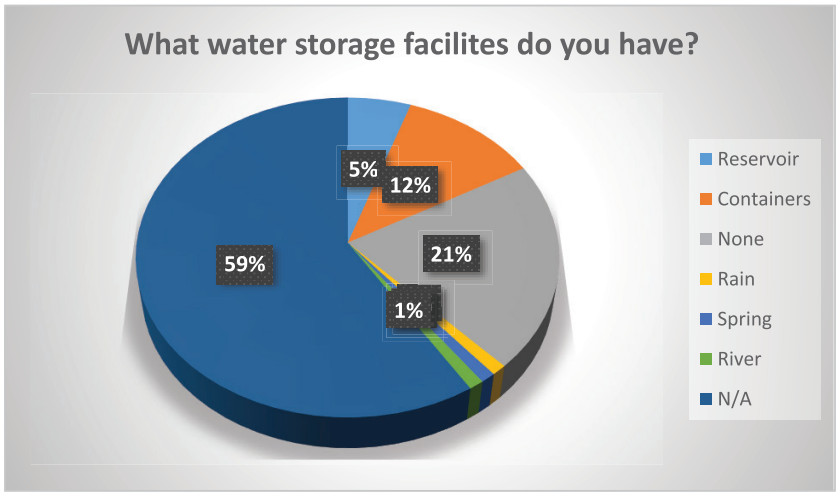


Figure 10: Water storage facilities in the KRI

Where surface water is not accessible due to lack of irrigation canals or dams, the main source is groundwater. In fact, on the Erbil plain, where there is a need to irrigation canals, the number of wells is growing as well as the level of groundwater abstraction, which is affecting the aquifer and the ground water level of the aquifers has been reduced at an average of 50 m. Farmers use diesel engine pumps to abstract water from wells and improve their water supply[(23)], which is expensive and affects CO2 emissions Private investments are the main source allowing wheat to be irrigated "by central pivot irrigation system or surface irrigation.[(24)]" Drip irrigation systems are used for regular irrigation of vegetable crops and in the mountain to irrigate fruit trees and vegetables.

(23) Ali Rashid Ahmed Khoshnaw, January (2018), Water Evaluation and Planning System for Greater Zab River Basin, Hasan Kalyoncu University Graduate School of Natural & Applied Sciences. (Unpublished Ph.D. Thesis in Civil Engineering) at 79.

(24) Id. at 79.

Orchards are mainly cultivated in the foothills, where the rain is higher. In the area around Erbil, the expansion of irrigated orchards and the hectares of fruit trees has increased mainly due to the access to groundwater, although the lack of planning and regulating water abstractions has increased pressure on the groundwater table[25].

Main challenges identified

1. Lack of cooperation at the institutional level

Although cooperation is reflected in the current aims of the government, additional strategic efforts for cooperation and collaboration are needed at the institutional level. There is a lack of specific mechanisms for coordination at different institutional levels in the water management sector. An agreement and mandate are needed at the institutional level in order to provide water management integration, able to strengthen cooperation and establish the guidelines in sharing the information about different institutions.

The above reveals that there is a lack of communication between different ministries, and even between departments and offices within the same ministry. In addition, there is no decentralized information processes between different institutions. This situation creates information and institutional asymmetries that contribute to a distribution of water below the appropriate standards for different uses such as agriculture, domestic and industrial uses.

> **Recommendation 1:** The integration and the development of water basin institutions would achieve water security while promoting sustainability in the use of water. an optimal integrated institutional framework would allocate surface water and groundwater in a sustainable manner, ensuring the integration of water resources and water security.
>
> **Recommendation 2:** To revise the institutional framework to guarantee that there is no function overlap between the authorities in charge of water management, to foresee cooperation between different institutions and to apply the principle of subsidiarity. To follow the proposed institutional framework as a guideline to improve water management in Iraq.

2. Need for a reform of the land management and legislation

The current legal framework for land management and agriculture is composed among other regulations of:

- Law No. 90 of 1975 Organizing Agricultural Land Ownership in Kurdistan
- Area Agrarian Reform Law No. 117 of 1970
- Law No. 1 of 2008 Organizing Rights to Disposal in Agricultural Land in Kurdistan Region – Iraq

Their approach establishes very restricted limits at the time to develop agriculture practices. Farmers are conditioned to use one type of crop or another according to the extension of the land limiting the development of the irrigation sector. There is no regulation regarding the location of the land in terms of a basin or specific watershed. The legal framework for land management does not take into consideration the interaction with water management. It only considers the mechanism to irrigate but there is no direct relation between the land, crops and basin promoting an integrated management system able to expand the irrigation sector. This lack of regulation, integrating the management of land and water, creates disequilibrium and limits the economic extension of the agriculture sec

The Law No. 1 of 2008 Organizing Rights to Disposal in Agricultural Land in Kurdistan Region – Iraq states that if the owner exceeds the limits, the area in excess shall be requisitioned and registered

(25) Id. at 79.

in the name of the state for agriculture purposes. This situation can be considered an abuse by the government over the private use

Although the law No. 117 of 1970 regulates agriculture cooperative societies, a new approach is needed in order to expand these cooperations and integrate them into the management of the basin, where water users associations and agriculture cooperative societies structure in the same physical and legal framework as one association without specific limitations to be part of it just depend on the limits of the basin. So, if an owner has properties in two different basins it will be belong to two different agriculture cooperative societies where the water user association is included.

Recommendation: Modification of the laws and regulations about agriculture land ownership and management. Developing an integrate land and water law management by basin where the limits of the area cultivated will be established according to the basin, watershed land and the availability of water to cultivate. The agriculture cooperative societies will be established based on the basin and watershed, similar to the water user associations, which will be included in the same basin, watershed framework as the agriculture cooperative societies.

3. Deterioration of water quality

Use of pesticides, fertilizers, agriculture runoff and irrigation can seriously damage the ecosystem and have a significant impact on the environment and the human food chain. Therefore, it is essential to take into consideration the negative effects of each irrigation project before the implementation of the project. This will ensure the sustainability of irrigation projects and avoid future harm. In order to achieve this goal, "adequate maintenance funds should be provided to the implementing organizations to carry out both regular and emergency maintenance." (26)

(26) FAO, Environmental considerations in irrigation development. Available at http://www.fao.org/docrep/W4347E/w4347e10.htm

Recommendation: Irrigation projects should be planned and managed in the context of river basins, taking into consideration both the upland and downstream catchment areas. When developing any irrigation project, all potential environmental impacts of irrigation development should be taken into consideration. Some of these impacts include "increased erosion, pollution of surface water and groundwater from agriculture biocides, deterioration of water quality, increased nutrient levels in the irrigation and drainage water resulting in algal blooms, proliferation of aquatic weeds and eutrophication in irrigation canals and downstream waterways. Poor water quality below an irrigation project may render the water unfit for other users, harm aquatic species and because of high nutrient content, result in aquatic weed growth that obstructs waterways and has health, navigation and ecological consequences."(27) Figure 11. illustrates the impacts of uncontrolled runoff in the water resources.

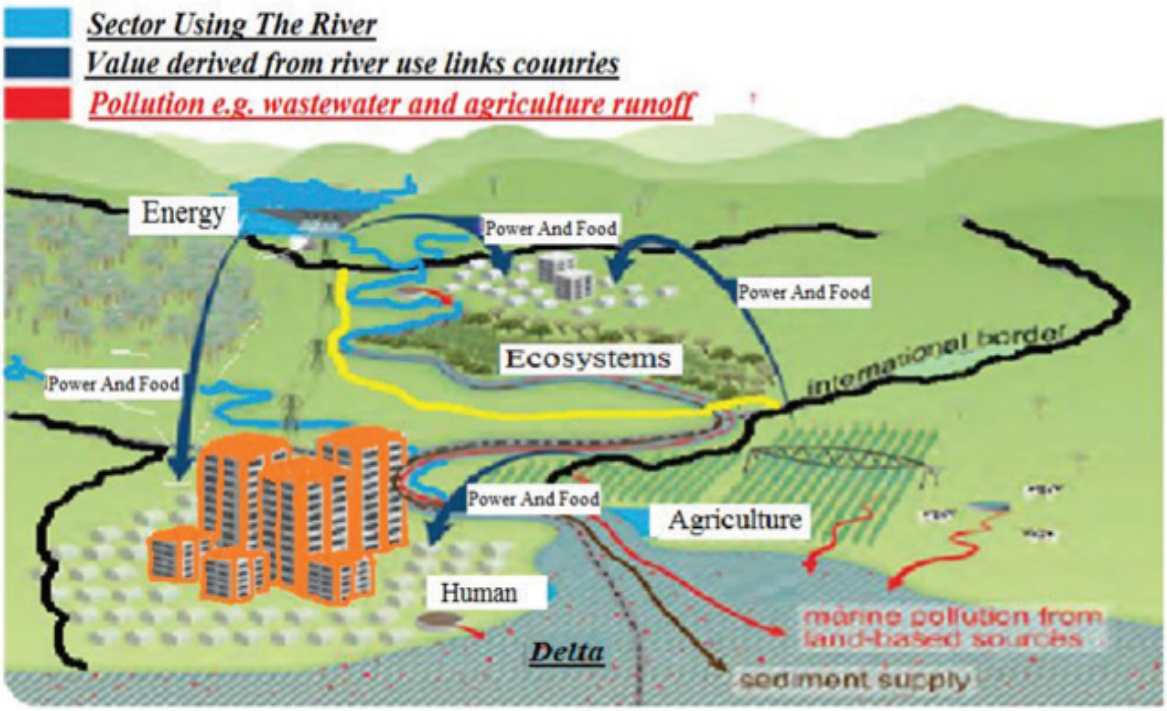


Figure 11: Graphic illustration of the impact of uncontrolled runoff in the water resources.

4. Greater urgency for water management

Proper water management – aiming at more efficient use and effective use of available water sources is key to sustainability and food security for all. In fact, the lack of an appropriate management system to allocate water is the main issue in the KRI. Without proper pricing of a scarce natural resource such as water, waste of water is likely to occur if it is not used efficiently.

The survey conducted offers an overview of the main concerns in relation to the management of water resources. Regarding the way farmers manage their water resource in cooperation with others, 62% manage water independently from other farmers and 36% has some kind of cooperation on water management with other farmers. Among the cooperation strategies that farmers use, it includes: sharing the money to obtain water with other farmers, renting water wells, distribution of water, share

(27) FAO, Environmental considerations in irrigation development. Available at http://www.fao.org/docrep/W4347E/w4347e10.htm

water with other farmers establishing turns by day or hourly, in some occasions, the number of farmers sharing water is only four, and small communities share water among themselves and they establish water harvesting mechanisms to collect rainfall.

Furthermore, this study revealed that 51% of farmers interviewed pay for their water whilst 47% do not pay for their water supply. They do not pay directly for water consumption; they have an indirect payment in terms of water delivery or abstraction from groundwater. They pay for the electricity provided for a water well, and due to the lack of public electricity supply, they pay for diesel to operate the generator, well maintenance, hoses for watering, etc.

In some cases, they share the cost of power generator according to the number of hours of irrigation of each farmer. About half of the farmers do pay for water, whereas the other half do not. The main costs involved are groundwater pumping, submersible water pump and pipes. Farmers said that when a river is close, they do not spend money on water because it is free and there is no indirect cost on delivering the water

In general, 73% of farmers interviewed said they were willing to pay for an improvement on water supply to help irrigate their lands. The most relevant improvements proposed by farmers include development of new irrigation projects, and drilling wells.

Farmers responded positively to the question of whether or not a local organization help them manage water in their area; 83% answered yes to this question, 16% said no. In particular, to help them with water conservation and means to reduce waste of water, as well as building modern irrigation projects.

Although water is a public good and free of charge, sometimes farmers need to buy water to supply their needs. Although the water transfers are not registered, there is clearly an informal water market, which needs to be regulated in order to avoid abuses and damages to third parties.

> **Recommendation** 1: Build awareness regarding the use and conservation of water and need for environmental protection, which are factors affecting the quality and quantity of water for irrigation purposes. Stricter rules, and enforcement are needed to avoid the loss of water resources. The Science Board Groundwater Directorate-Sulaymaniyah suggested it is possible to trade water rights between farmers as a mechanism to promote conservation.
>
> **Recommendation 2:** Financial, organizational and technical support may be considered to support more cooperation between farmers in the area of water management.

2.2 Importance of Strategic Crops of Wheat and Barley in KRI

Wheat which dominates the landscape of KRI, is the most important crop and is the staple food of the people, along with rice and legumes crop. Barley is mainly used as livestock feed. Wheat cultivation in the Kurdistan region is mainly rain-fed, which means that it is heavily influenced by rainfall (quantity and patterns).

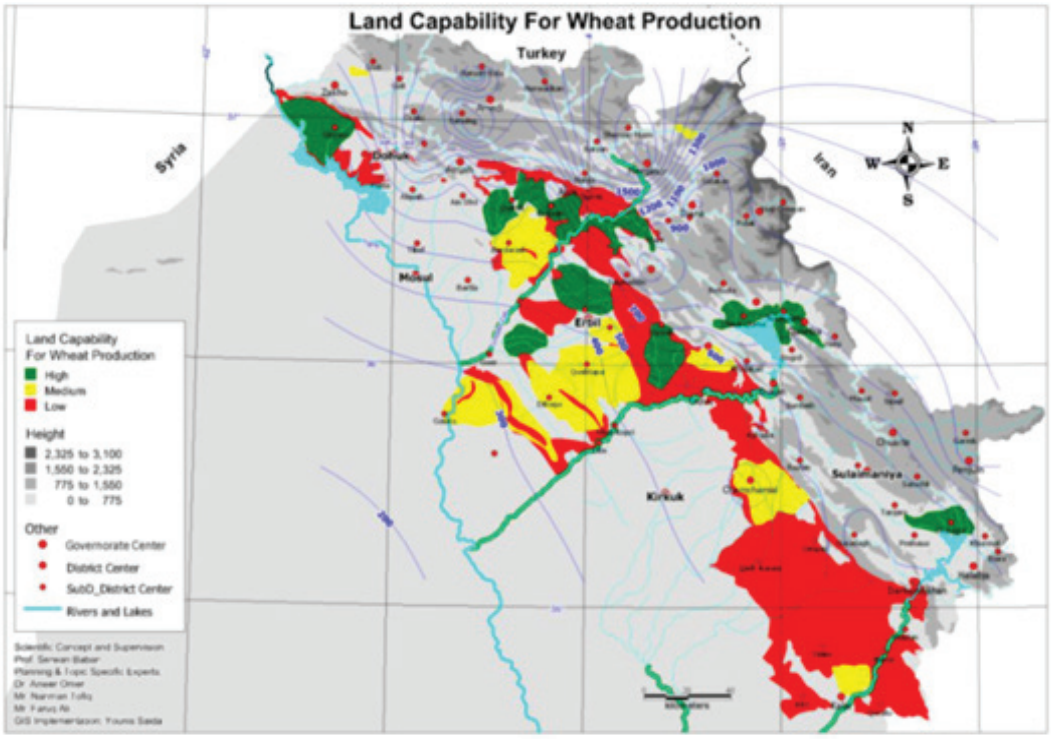


Figure 11: A map showing the specific geographical areas fulfilling all the conditions for Wheat production in Kurdistan Region[28] Typically, land suitability for barley and wheat cultivation are very similar.

The average area under cultivation in 2016-2017 of wheat was about 675,000 hectares (2.7 million donum) and barley 205,000 hectares (0.8 million donum), while production is estimated at about 0.8 million ton of wheat and 0.172 million for barley. Also, the average productivity is estimated at about 75 kg / hectare (299 kg/donum)for wheat and 53 kg / hectare (211 kg/donum) for barley (34) production Table 3&4.

Cultivatable land crop production is the main source of livelihood for many rural families, with wheat and barley serving as the two main crops under cultivation. Wheat fields in the Kurdistan Region occupy an average of 650,000 hectares (2.6 million donum) and produce an estimated 500,000 tons each year and for barley, an average cultivated area at 204,750 hectares (0.819 million donum) producing an average of 173,000 MT (35). It has been observed, however, that agriculture suffers from low productivity and is incapable of competing in a free market with imported produce from neighboring countries

(28) Serwan M. J. Baban, An Agro-Climatic Zoning Approach to Achieve Optimum Agricultural Production in the Kurdistan Region, Iraq 2016

Cereal crops are grown in both rain-fed and irrigated conditions. The main grain production in the KRI consists of wheat, barley and rice as well as sunflower and legumes. such as chickpea and lentil. Wheat crop is the most important grain and is the staple food of the people whereas barley is mainly used as livestock feed. Total non-irrigated land is surveyed in 2017 as 4,833,466 donum, whereas surveyed irrigated land stands at 1,309,710 donum. Rain-fed cultivation area of wheat represents about 90% of the total wheat cultivated area, and only 10% is cultivated in irrigated areas, As for the barley crop, it is almost entirely grown in rain-fed areas (98%) Figure 12&13.

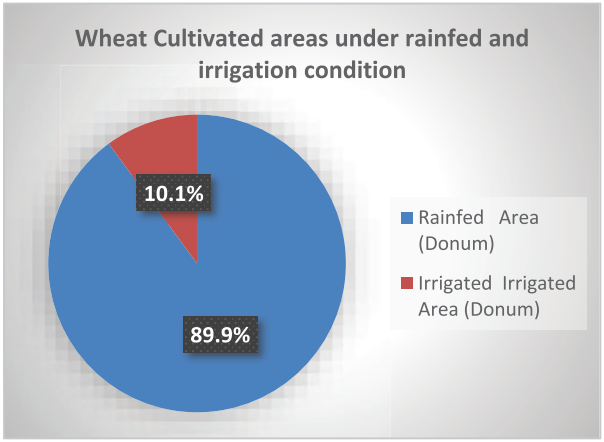


Figure 12: Wheat cultivated areas under rain-fed and irrigation condition

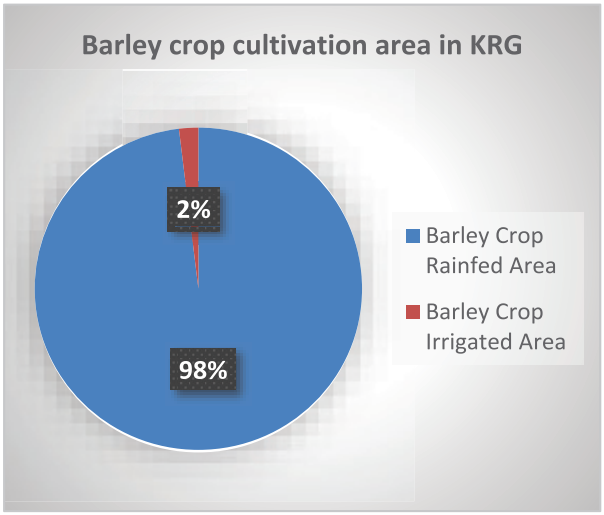


Figure 13: Wheat and Barley crops cultivation areas under rain-fed and irrigation condition

In the last decade, area planted under wheat ranged from about 2.3 million donum to 3.3 million donum while that of barley, the total cultivated area ranged from about 0.44 million donum to over 1.5 million donum. Total wheat production ranged from 0.390 million tons in 2011/2012 to 1.7 million tons in 2015/2016 Table 3. The total barley production ranged from 88,130 tons in 2007/2008 to 389,349 tons in 2008/2009 Table 4.

Area, Yield and Production of Wheat in KRI 2007-2017															
Governorate	Erbil			Sulaymaniyah & Halabja			Duhok			Garmian (Kalar)			Grand Total		
Season	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT
2007-2008*	623,448	20	12,469	421,500	287.3	121,084	452,156	182	82,518	283,125	46	13,024	1,780,229	129	229,095
2008-2009	715,190	250	178,798	885,645	147.5	130,602	615,452	405	249,258	283,125	83	23,499	2,499,412	233	582,157
2009-2010	793,267	276	219,245	875,650	196	171,682	845,288	277	233,751	283,125	125	35,391	2,797,330	236	660,069
2010-2011	973,666	145	140,944	740,652	68.6	50,777	886,921	233	207,031	283,125	64	18,120	2,884,364	145	416,872
2011-2012	628,828	161	101,292	930,527	176.0	163,749	711,148	163	116,243	202,880	37	7,507	2,473,383	157	388,791
2012-2013	636,829	502	319,856	640,117	402.8	257,853	710,008	520	369,296	272,719	196	53,453	2,259,673	443	1,000,458
2013-2014	1,032,892	326	337,224	599,400	376.5	225,698	866,410	327	283,125	161,595	226	36,520	2,660,297	332	882,567
2014-2015	1,491,220	301	448,869	908,400	305.4	277,428	776,478	431	334,519	104,950	349	36,628	3,281,048	334	1,097,444
2015-2016	1,380,049	436	601,396	817,745	718.4	587,454	690,751	477	329,228	307,051	549	168,571	3,195,596	528	1,686,649
2016-2017	948,983	434	411,676	718,242	316.5	227,316	641,461	404	259,456	350,400	203	71,131	2,659,086	365	969,579
Average	922,437	300	277,177	753,788	294	221,364	719,607	342	246,443	253,210	183	46,384	2,649,042	299	791,368
*Drought year:															
Source Kurdistan Regional Statistics Office (CSO) 2007-2017															

Table 3: Area, yield and production of wheat in KRI 2007-2017

Area, Yield and Production of Barley Crop in KRG 2007-2017															
Governorate	Erbil			Sulaymaniyah & Halabja			Duhok			Garmian (Kalar)			Grand Total		
Season	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT	Area Donum	Yield Kg/Donum	Production MT
2007-2008*	640,505	4	2,562	206,260	269.0	55,484	146,090	80.0	11,687	98,683	186	18,397	1,091,538	81	88,130
2008-2009	806,420	270.0	217,733	362,100	224.6	81,342	189,150	380.0	71,877	98,683	186	18,397	1,456,353	267	389,349
2009-2010	432,020	139.1	60,084	459,550	205.2	94,315	199,725	298.2	59,556	98,683	186	18,397	1,189,978	195	232,352
2010-2011	390,558	95.3	37,212	342,637	224.9	77,047	70,384	274.7	19,337	98,683	186	18,397	902,262	168	151,993
2011-2012	110,176	105.6	11,633	179,140	125.1	22,406	50,091	153.7	7,701	98,683	186	18,397	438,090	137	60,137
2012-2013	137,140	404.4	55,457	146,413	288.8	42,288	53,127	404.8	21,507	72,669	190	13,779	409,349	325	133,031
2013-2014	326,043	322.0	105,000	189,014	273.6	51,708	78,979	163.7	12,929	69,220	361	25,000	663,256	293	194,637
2014-2015	416,959	203.0	84,643	379,970	255.0	96,890	37,941	243.4	9,235	104,950	133	13,990	939,820	218	204,758
2015-2016	328,000	250.0	82,000	236,690	280.0	66,275	37,770	270.1	10,200	149,820	168	25,180	752,280	244	183,655
2016-2017	82,111	312.4	25,654	154,364	295.0	45,530	14,859	384.9	5,719	96,755	145	14,038	348,089	261	90,941
Average	366,993	185.8	68,198	265,614	238.4	63,329	87,812	261.6	22,975	98,683	186	18,397	819,102	211	172,898
*Drought year:															
Source Kurdistan Region Statistics Office (KRSO) 2007 - 2017															

Table 4: Area, yield and production of barley in KRG 2007-2017

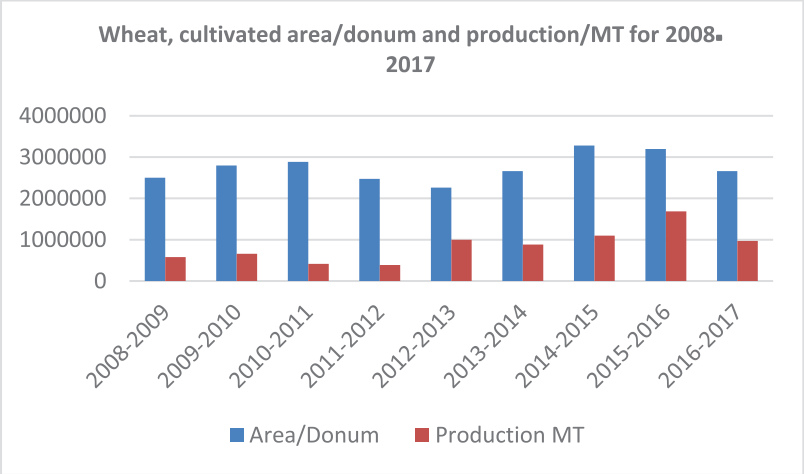


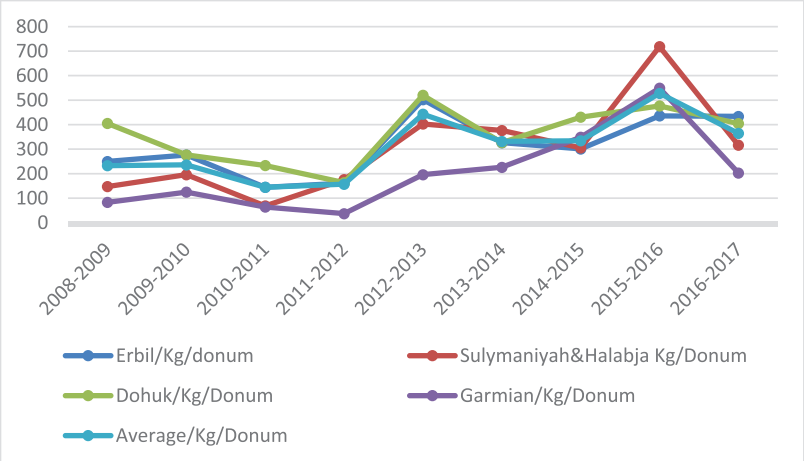
Figure 14: Wheat cultivated areas/donum and production/ MT for 2008-2017

The annual production varies from one season to another, depending mainly on climate condition impact such as water availability, temperature and moisture conditions, in addition to other factors such as soil fertility, farming management, agricultural input availability, access to the markets, security situation, etc.

Yield at farmer level in KRI varies considerably depending on the region, rain quantity precipitation and its pattern. Wheat cultivated under irrigated system is higher in productivity, followed by cultivation under guaranteed rain-fed, semi-guaranteed rain-fed and unsecured rain-fed areas. The disparity in productivity means that the land management practices in cropland areas need to be given attention.

The maximum wheat average yield in KRI is at Sulaymaniyah governorate reaching 240 kg/hectare (960 kg/donum) under irrigation condition, while the average was 183.3 kg/hectare (733 kg/donum) under the rainfed condition. In 2017, the average yield was 344 kg/donum and maximum yield reached 506 Kg/donum in Halabja in season 2016/2017.

Figure 15: Wheat, yield Kg/Donum in KRI governorates 2008-2017



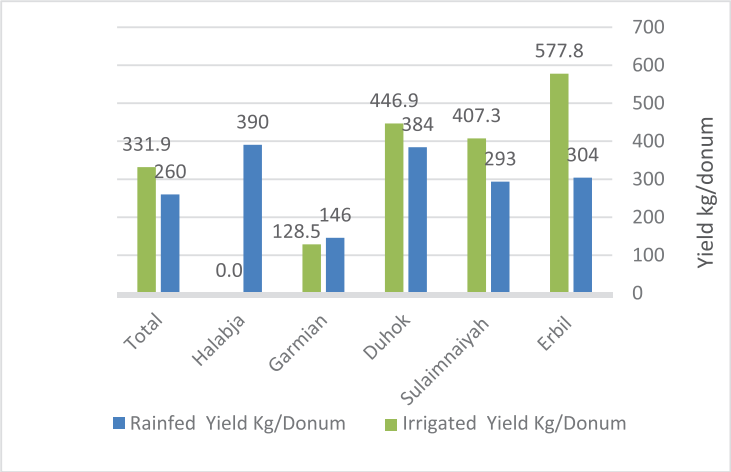
As shown by the statistical data, the productivity rate achieved in the irrigated land exceeds the proshown by the statistical data, the productivity rate achieved in the irrigated lands exceeds the productivity rate of the rainfed lands by two to three times, which indicates a large productive capacity of wheat varieties under irrigation conditions

For barley crop, the second strategic crop cultivated in Kurdistan Region, the statistical indicators of cultivated area, yield and production of barley crop over a decade indicate the following;

- The largest cultivated area was 1.5 million donum in 2008/2009 and
- the smallest cultivated area 0,440 million donum in 2011/2012.
- The highest production reached up to 390,000 MT in season 2008/2009,
- the lowest estimated yields were 60,137 MT in 2011/2012 with an average production of 172,898 MT.

Barley yield showed low productivity where the maximum yield reached 325 Kg/Donum in 2012/2013, the minimum 137 Kg/donum in 2011/2012 and the average yield the decade was 211 Kg/donum.

The largest barley yield was achieved in the season 2016/2017, which was 577.8 kg/donum under irrigation conditions in Erbil governorate comparing to 304 Kg/donum under rainfed condition. Garmian showed the lowest barley yield under irrigation condition only 128Kg/donum which is less than the



yield under rainfed condition Figure 16 and Table 5.

Figure 16 : Barley yield Kg/donum under rainfed and irrigation condition

Barly Crop rainfed and irrigated planted arewa in KRI 2016-2017											
Governorate	irrigated				Rainfed				Total		
	area (Donum	Yield Kg/ Donum	product on (Mt)	%	Area Donm	Yield Kg/ Donum	product on (Mt)	%	Area Donm	Yield Kg/ Donum	product on (Mt)
Erbil	79,605	304	24,206	23.30%	2,506	578	1,448	37.8%	82,111	312	25,654
Sulaimnaiyah	152,154	293	444,657	44.60%	599	407.3	244	9.0%	152,753	294	44,901
Duhok	14,681	384	5,639	4.30%	179	446.9	80	2.7	14,860	385	5,719
Garmian	93,401	146	13,605	27.40%	3,354	129	431	50.5%	96,755	145	14,038
Halanja	1,611	3990	629	0.50%	0	0	0	0.00%	1,611	390	629
total	341,451	260	88,738	100.00%	6,639	332	2,203	100.0%	348,089	261	90,941
Source Kurdistan Region Statistics Office (KRSO) 2016-2017											

Table 5: Cultivated area, yield & production for Barley crop in KRI 2016-2017

The indicators of wheat and barley production clearly show that rainfed cultivation of wheat and barley is dependent on the uncontrolled environmental conditions, and subject to the impact of climate change. This may therefore call for the establishment of supplementary irrigation systems that compensate for late rains or irregularity of rainfall.

The barley crop needs less water and is characterized by resistance to salinity and better to be cultivated in marginal areas. Rice, maize and sunflower are also grown in KRI but in small areas where the total cultivated area of rice 9,722 Donum, Maize 7,980 Donum and sunflower 7,796 dounum[29] tables 6, 7 and 8. It is noted that productivity is good for maize 2,654 Kg/donum,[30] which is similar to Turkey, and Jordan (10 Ton/Ha) more than Egypt (8Ton/Ha) . It is considered to be less productive for rice at 804 Kg/donum compared to Egypt, Turkey and USA (8 Ton/Ha).[31] Sunflower yield is 683Kg/Donum which considers well with Turkey and Egypt 2 Ton/Donum and Iran 1 Ton/Ha. Cultivation areas of these crops could be expanded to increase production, except rice, as its water needs are high.

Area Yield And production of RIICE crop in KRI												
Governorate	2015			2016			2017			Average		
	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)
Erbil	147	150	22	473	250	118	81	350	28	234	241	56
Sulaimnaiyah	1,705	800	1,364	1,709	800	1,367	1,651	800	1,321	1,688	800	1,351
Duhok	5,954	850	5,061	3,917	800	3,134	9,764	800	7,811	6,545	815	5,335
Garmian	440	680	299	210	500	105	1,783	650	1,159	811	642	521
Halanja							444	1,250	555	444	1,250	555
total	8,245	818	6,746	6,309	749	4,724	13,723	792	10,874	9,722	804	7,818
Source :Ministry of Agriculture and Water Resources/Horticulture Department												

Table 6: Area, Yield and production for Rice crop in KRI

(29) MOAWR 2018
(30) I Hectare equal to 4 donums
(31) US department of agriculture 2018

Area Yield and production of MAIZE crop in KRI*												
Governorate	2014			2016			2017			Average		
	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)
Erbil	4,750	2,000	9,500				10,178	3,500	3,623	7,464	3,023	22,562
Sulaimnaiyah	52	2,000	104				452	600	271	252	744	188
Duhok	6,805	2,000	13,610	658	3,500	2,303	210	3,000	630	2,558	2,156	5,514
Garmian	685	2,000	1,370	150	900	135	0	0	0	418	1,802	753
total	12,292	2,000	24,584	808	4,400	2,438	10,840	3,369	36,524	799,980	2,654	21,182
Source :Ministry of Agriculture and Water Resources												

Table 7: Area, Yield and production for Maize crop in KRI

Area Yield and production of Sunflower crop in KRI												
Governorate	2015			2016			2017			Average		
	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/ Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)	area (Do-num)	Yield Kg/Do-num	prod-uct on (Mt)
Erbil				4,892			1,270	2,000	2,540	1,270	2,000	3
Sulaimnaiyah	6,996	285	1,994	502	200	978	5,361	250	1,340	5,750	250	1,483
Duhok				116	4,000	2,008	625	400	250	564	2,004	1,129
Garmian					600	70	113	680	77	115	640	73
Halanja							98	1,500	147	98	1,500	147
total	6,996	285	1,994	5,510	4,800	3,056	7,467	4,830	4,354	7,797	6,394	2,835
Source :Ministry of Agriculture and Water Resources/Horticulture Department												

Table 8: Area, Yield and production for Sunflower crop in KRI

Wheat Marketing

Although the central government in Baghdad has provided a guaranteed market for wheat crop produced in Iraq by ensuring receipt of the product of this crop by the Iraqi Grain Company (part of the Federal Ministry of Trade) and prices are higher than world prices level thus providing stable income for farmers. Large amounts of Iraqi government subsidies target wheat farmers, encouraging them to grow this strategic crop and key staple in people's diet, ensuring food security for all in Iraq. The purchasing prices of the Grain Board of Iraq for the 2019 wheat crop remain unchanged since 2017, when they were sharply reduced from previous years following lower international oil prices. Prices range from IQD 420 000 (as of early April 2019, equivalent to USD 350) to IQD 560 000 (USD 467) per tonne depending on the quality. The wheat purchased is used for the Public Distribution System (PDS), which distributes subsidized basic food rations to the population.

In principal, government incentives allow farmers producing within approved geographical areas (listed in a National Agricultural Plan) to gain access to discounted inputs (i.e. fertilizers and seeds), as well as to improved marketing through the Grain Board of Iraq. Farmers planting outside those areas must procure their own inputs at full market value and can only sell their wheat as feed grade at a reduced price.

The Ministry distributs improved seed varieties to farmers across the country producing within those approved areas. Additionally, for farmers in the plan, the Ministry of Agriculture is subsidizing seeds and fertilizers, as well as offering free pesticides and discounted laser leveling of wheat fields. Currently, the government is distributing wheat seeds with a 70 percent discount, while offering fertilizers at half their market price.[32] This covers farmers in KRI as well. However, the problem faced by the wheat farmers in the Kurdistan region is the marketing of their wheat comes in two directions:

1. Wheat farmers in Kurdistan did not receive all their dues from the Federal Ministry of Trade for several previous seasons because of the ISIL crisis that faced the country even though the federal government facilitated payment of farmers' dues but in multiple installments. The ability of farmers to continue their agricultural activities often depends on receiving their dues and without which they cannot purchase the required inputs.
2. The federal government uses a guaranteed price for certain quantities of produce. This generally incentivizes more production, but the remainder is then marketed locally with prices much lower.

It is noted that the marketing of wheat in season 2008, a year of severe drought was less than all cropping seasons, reaching 17000 tons, which represent only 1.9% of the highest marketing season Table 9:

Year	Erbil (MT)	Dohuk (MT)	Sulaymaniyah	Total (MT)
2006	75,516	34,658	11,881	122,055
2007	35,767	83,980	27,594	147,341
2008	5	202	17,435	17,642
2009	72,897	83,210	61,675	217,782
2010	179,319	208,451	116,008	503,778
2011	112,699	165,521	120,549	398,769
2012	59,829	69,687	97,386	226,902
2013	210,887	212,047	143,231	566,165
2014	284,495	238,855	221,232	744,582
2015	373,282	278,188	261,157	912,627
2106	374,753	284,326	223,566	882,645
2017	164,822	111,984	52,351	329,157
Average 2013-17	281,648	225,080	180,307	687,035

Table 9: Wheat marketing MT in KRI/2006-2017

(32) USDA GAIN report No. 19001, May 2019

Wheat crop is marketed in Kurdistan to six receiving silos distributed in Kurdistan governorates; 2 in Erbil 3 in Dohuk and one in Sulaymaniyah, and the total storage capacity is up to 361,000 ton. However, the Ministry of Trade and Industry (MOTI) plans to construct new wheat and barley silos. The MOTI has concrete plans to increase that capacity to 1 million tons. Projects such as these could help promote further local development, paving the way for the possibility of export in the near future.

Main challenges

3. Most wheat and barley is being produced under rain-fed cultivation conditions vulnerable to impact of the weather/ climate change (wheat planted area- rain fed: 90 % versus irrigated 10 %). Supplementary irrigation should be beneficial in many areas (up to 3x higher yields).
4. Large subsidies on wheat pull in many farmers. It provides a disincentive for developing other grains, legumes, vegetables, etc. and involvement of private sector.

Recommendations

– Optimize the wheat value chain and subsidy system/ targeting farmers. Reduce waste along the value chain from post-harvest to consumption.

2.3 Wheat seeds, and opportunity for support to commercial certified wheat seed growers in KRI to meet the farmers demand.

Seeds play a vital role in agriculture and act as a carrier of the genetic potential of varieties and Every farmer should able to access healthy seeds which are genetically pure, with high seed vigor and good germination percentage. High quality seeds can make a substantial contribution to productivity independent of other purchased inputs. Timely availability of good quality seeds at reasonable price ensures good yield and profit to the farmers.

Quality of seed is considered as basic a basic and critical input for enhancing agricultural productivity. Good quality seeds mean good crops; it is well known that the good quality seed should be of uniform size, high yielding, pure and clean and free of seed born-disease and pest. The provision of high quality seed is the least expensive yet most effective measure to increase crops productivity.

Seed programme aims to ensure timely availability of required quantities of high quality seeds of improved crop varieties to farmers at reasonable prices and at appropriate locations. The essential components for any seed programme are:

- Crop variety improvement, evaluation and release,
- Variety maintenance and basic seed production,
- Seed multiplication,
- Seed processing/conditioning and storage,
- Seed quality control,
- Seed marketing and distribution,
- Seed regulation.

To achieve the integration and success of the seed program with high efficiency, in general, it requires coordination between the institutions designated by this program:

- National seed council (needs to be established) with the following main function:

  To enhance the coordination and facilitate the growth of seed industry activities in order to ensure rapid, orderly and balanced development in tune with requirements of agriculture,

  Advice the government on all matters relating to the seed policy issues,

  Seed industry planning and implementation.
- Committee for registration, release and protection of agricultural varieties (needs to be established),
- Research centers,
- Seed quality control directorate,
- Seed companies,
- Seed growers.

A historical look at the reality of seeds in the KRI, in 1980 the Seed Production Department was established at the Directorate of Agricultural Research in Erbil, which belonged to the General Directorate of Agricultural Research at the Ministry of Agriculture in Baghdad. In 1991, the certified seed production department was brought under the auspices of the General Directorate for Agricultural Research in the Kurdistan Region. In 2009, this department became the Directorate of Seed Production and Certification and is administratively followed to the General Directorate of Planning and Follow-up at the Ministry of Agriculture and Water Resources in Kurdistan Region. In July 2018, this Directorate was re-linked to the General Directorate for Agricultural Research, Training and Extension.

The seed production and certification directorate (SPCD) is located in Erbil city and has four branches, one in each governorate Erbil, Sulaymaniyah, Dohuk and Halabja and four seed processing plants. However, the responsibility of the SPCD is limited only to technical supervision of the branches and seed processing plants at the governorates, while these branches and plants are linked administratively to the directorates of agriculture in the governorates. In this directorate, there are a number of technicians (6-8) of bachelor's degree holders in agricultural sciences in each branch in addition to a number of administrators (2-3).

The current duties of the SPCD are limited to conducting a few laboratory tests for seeds such as purity test, number test, weight of 1000 grains test, seed heath test (only physical test for smut disease and storage insects, in addition to conducting field inspection of seed production fields and supervision of seed processing plants. The SPCD is responsible for providing certified seeds and purchasing seeds from seed growers after passing the field inspection at a price of more than 10% of the commercial price, and then processed, treated with pesticide and sold as certified seeds to the farmers at a subsidized price of 50%. The subsidies paid by MOAWR.

SPCD possess a number of seed analysis laboratories that contain a few laboratory equipment for testing mechanical purity, but lack of germination test equipment, seed health testing equipment and other important laboratory equipment.

Introduction/producing new varieties

One of the duties of the general directorate for agricultural research, training and extension (GDARTE) is the crop varietal development for different kind of crops through its agricultural research centers located at different part of agro-ecological zones in the Kurdistan Region. Varietal development is focusing on adaptability, yield, pest resistance and desirable characters.

Research centers usually work on the production and/or introduction of new varieties for different crops that are distinguished from dominant varieties with one or more characteristics, provided that these varieties are adapted to local environmental conditions.

It is noted that the research centers in KRI have introduced during the last eight years a number of new varieties, after being tested under local environment condition and approved by the National Committee for the Registration, Released and Protection of Agricultural Varieties/ Ministry of Agriculture in Baghdad. Release varieties in KRI showed in Table 10.

Crop	Variety name	Release/Year	Remarks
Durum Wheat	Simeto	2010	Introduction
	Ofanto	2011	Introduction
	Creso	2010	Introduction
	Sardar	2010	Introduction (Cyprus)
	Miki 3	2016	Introduction
Bread Wheat	Rizgari	2010	Introduction (ICARDA)
	Adana 99	2012	Introduction (Turkey)
	Aras	2016	Production(breeding)Sulymaniyah Research Center
	Al- Marouf	2014	Production (breeding)/Sulymaniyah University
	HSAD	2014	Production (breeding) Sulymaniyah University
	Slemani 2	2016	Introduction (ICARDA)
	Hawler 2	2017	Introduction (ICARDA)
	Hawler 4	2017	Introduction (ICARDA)

Table 10: Released Varieties in KRI

Varietal development and improvement is dominated by public sector Despite the Iraqi Seed Act, which gave the right to private sector to initiate research work for the varietal development and improvement, the private sector has not participated in this field. This can be explained by lack of experience, technology and financial capability.

GDARTE has maintained relationship with Seed production and certification directorate under the umbrella of the MOAWR in collaboration for seed production.

Varietal maintenance

Usually varietal maintenance is carried out by the General Directorate for Agricultural Research, Training and Extension on its research station's farm to maintain varietal genetic purity through production of breeder seed. The maintenance of the wheat varieties was conducted in Erbil, Sulaymaniyah and Duhok research stations. The varietal maintenance carried out at the research stations has been halted for three years due to the lack of financial allocations due to the financial crisis experienced by the region.

After the cessation of the implementation of the maintenance of varieties and the production of breeder seeds at the research stations, this led to the cessation of the seed multiplication program in KRI. Therefore, it greatly impacted the provision of high quality seeds for farmers and it also limits on-site inspections on a number of selected fields to indicate the possibility of using its production and improve seeds after subject for cleaning and seed treatment processes.

Seed Certification and Production

The Directorate of Seed Production and Certification founded in 2009 as a department within the General directorate of planning and follow up/ Ministry of Agriculture and water resources. Its tasks are limited to seed certification and laboratory seed analysis.

The current status of seed production system clearly indicates an overlap between seed production and seed certification. The Agriculture research centers produce breeder and foundation seeds, while simultaneously certifying their seed production fields, as well as with seed production and certification directorate where they contract seed growers and conducting certification arrangement. On the other hand, seed processing plant operate under the authority of the seed production and certification directorate.

Seed production, certification and cleaning will be carried out by the same directorate, contrary to the neutrality of the certification and testing requirement, which are considered as arbitrators between the producer and the consumer in order to determine the actual value of the product (seeds).

The concern for the neutrality of the certification and testing authorities is a fear of favoritism to the directorate working under its umbrella and thus leads to inaccurate assessment of seed quality of the seeds and their conformity with the required seed standers.

However, after the crisis and the decline in financial allocations, the seed multiplication program was halted at agriculture research stations and the production of certified seeds through growing certified seeds year by year, which is affecting its genetic purity and deteriorating seed specifications.

Seed Processing and Storage

What is produced from seeds in the Kurdistan Region does not apply to the specifications of the certified seed. Any certified seeds must be produced from registered or foundation seeds with certain genetic purity standards. However, with discontinuing research stations from carrying out the varietal maintenance, there is no indication that there exists a seed multiplication programme to produce breeder, foundation, registered and finally certified seeds.

The existing program does not exceed the selection of wheat fields with field standards close to the specifications of certified seeds and are subject to on-site inspection (field inspection) and successful fields are marketed to the seed processing plants as certified seeds.

It is clear that the lack of funding that KRI faced due to the financial crisis might have negative effects, such as halting the seeds activity and discontinuation of field inspections since 2014. At the same time, seeds received by seed processing plants are the seeds of farmers who desire to clean and treat them.

Farmers desire for their seeds to be cleaned from inert matter, weed seeds and dust, which is a necessary step. However, this does not guarantee the high genetic purity standards and their conformity with the specifications of the original variety and does not guarantee their high viability and vigor, except after being subject to the tests usually conducted by the seed testing and certification agencies. Still, this step is worthy of praise as it raises farmer awareness of the need for testing of their seeds.

Seed quantities received and processed at the four seed processing plants in KRI governorates for 2010-2018 are shown in table 11&12.

	Seed processing plant					Certified seeds Requirement (Mt)			
Gov.	No.	1.Plant Capacity Mt/Hour	2.Daily Working / hours	3. Season working days/day	4.Season Capacity (Mt)	5.Average Cultivated Area 2007-2017	6.Seeding Rate Kg / Donum	7.Quantity Seeds Required (MT)	Shortage Mt (7-4)
Erbil	1	10	10	100	10,000	922,437	33	30,440	20,440
Sulaymaniyah & Halabja	1	5	10	100	5,000	753,788	33	24,875	19,875
Duhok	1	10	10	100	10,000	719,607	33	23,747	13,747
Kalar	1	10	10	100	10,000	253,210	33	8,356	-1,644
Total	4	35	40	400	35,000	2,649,042	33	87,418	52,418

Table 11: Certified Seeds Requirement and seed processing plants capacities in KRG -Iraq

Actual Processing of Certified Wheat Seeds 2010-2018					
Year	Erbil	Sulaymaniyah & Halabja	Duhok	Garmian (Kalar)	Total
2010	2,253	3,613	1,350	1,804	9,020
2011	3,515	3,446	2,436	2,914	12,311
2012	3,498	4,654	3,631	2,488	14,271
2013	5,024	4,567	3,443	2,307	15,341
2014	3,719	3,882	3,753	3,837	15,191
2015	1,852	1,864	3,421	124	7,261
2016	3,700	1,954	3,031	0	8,685
2017	3700	0	0	0	3700
2018	0	0	0	0	0

Table 12: Actual Processing of Certified Wheat Seeds 2010-2018

The total processed (cleaning and treating) wheat seed quantities are representing 4.2% to 17.5% of the total required seed quantity of 87,418 MT.

The current total seed processing plants capacity available is 35 ton per hour and 35,000 ton for 100 working days in the season which represent 40% of the total seed quantity required Table 11.

It is worth mentioning that seed program in the Kurdistan region is limited only to cover wheat crop and does not include the seeds of other crops such as barley, rice, sunflower and legume crops such as chickpeas, lentils or vegetable seeds.

It is also noted that the private sector has some investment in the seed program, Even if it is a very small contribution through running a seed processing plant to meet some of the farmers' requests to clean their seeds, it is still considered as an encouraging step towards encouraging the private sector to expand investment in the seed industry. However, it should be under the technical supervision of the Ministry of Agriculture and water Resources.

Seed Quality Control and Certification

Seed quality control and certification arrangements in Kurdistan Region are mainly based on crop inspection and laboratory testing to ensure that the seed meets minimum quality standards. The purpose of seed certification is to maintain and make available to the public, through certification process, a high-quality seed of certain crop and varieties and distributed as to ensure genetic identity and genetic purity through a third-party inspection in the field and at the processing plant to ensure that all quality assurance requirements have been met.

The seed production and certification directorate are responsible for implementing seed quality control procedures including seed testing, field inspection and supervision of seed processing plants. It includes several seed laboratories in Erbil and its branches in the KR governorates to examine the seeds as mentioned earlier, but they do not have many necessary laboratory equipment such as germinators, seed health testing and varietal distinguish laboratory devices.

In this context, the technical staff in these laboratories showed lack of experience in their field, which requires strengthening their technical capacities in the seed laboratories analysis and seed certification aspects through participation in a number of training courses inside and outside the country.

Seed supply system

In general, the seed program has two types of seed supply system (See Figure 17):

- The formal seed supply system which comprises of the public sector supported by the private seed sector.
- The informal seed system in which the farmers produce seed for themselves and their neighbors

The informal seed supply system is providing seed supply when formal seed supply is absent, insufficient or expensive and hence, supplying low-income farmers. The current seed supply system is dominated by informal seed supply system in the Kurdistan Region, where it supplies 89% of the total need for wheat seeds and 100% for the seeds of other cereal crops.

Although the informal seed system provides all the required needs of the seeds, it does not provide seeds of high quality, which negatively affects productivity and production. The Farmer-saved seeds are important, but they are not subjected to laboratory testing to show their real seed quality and suitability for agriculture. The same goes for the seeds offered in the local market, which lack data on genetic and mechanical purity, germination percentage, moisture content, free of seed borne diseases and insect infections and free of weed seeds.

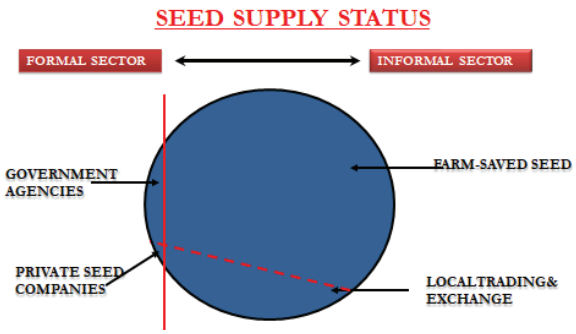


Figure 17: Current seed supply status in KRI

Among the farmers interviewed in 2018, only 24% state that they have saved seeds from their production and 76% using local market to obtain their needs of seeds. It is also showed that 94% of interviewed farmers use seeds (grains) available at the local market and only 6% of farmers purchase high quality seeds from seed companies for the coming season 2018/2019.

As for the vegetable seeds, all the need of the region is supplied through the private sector according to the mechanism of seed importation approved by the Federal Ministry of Agriculture after the importer obtains the approval of the Ministry of Agriculture and Water Resources in the KRI to the import request.

Vegetable growers obtained their seed requirement from farmer own saved seeds 27,4%, local market 53.4% and seed companies 19.20%. Without laboratory seed analysis, it is not possible to judge the seeds quality and their suitability for agriculture of those available from the above-mentioned sources. This means that vegetable seeds used in growing vegetable crops in KRI do not assure good quality and maximum yield Figure 18.

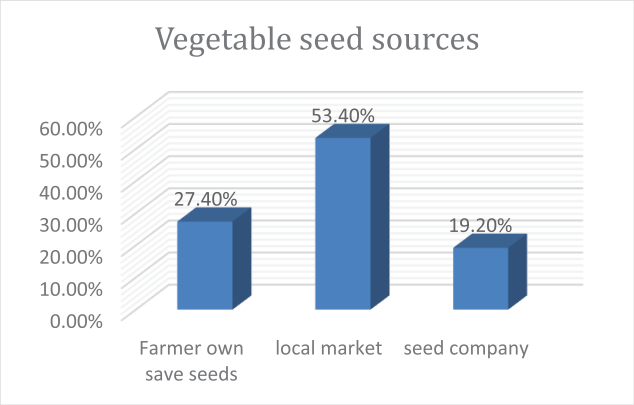


Figure 18: Vegetable seed sources

It is noted that the seeds imported to the region are not subject to quality control tests, but only the laboratory test certificate accompanying the shipment. Such a procedure does not guarantee the quality of the seeds and their conformity with the technical specifications of the seeds issued in accordance with Instructions No. 3 for 2014.

The prices of vegetable seeds are controlled by the private sector, the importers. In terms of farmers' views, vegetable seeds are expensive, especially hybrids, which may affect the budget of small farmers, which leads them to purchase seeds of lower quality but lower prices. At the same time, high prices of hybrid varieties do not encourage farmers to purchase and cultivate, and thus the farmer loses an important component that contributes to high productivity.

GDSPC and its branches at the governorates are responsible for selling at subsidized prices and distribution of certified (cleaned) seeds in coordination with agricultural directorates at KR governorates

Seed requirements - In light of the average wheat and barley area planted (2007-2017), the total seeds requirement is estimated at about 87,418 ton for wheat and 27,030 ton for Barley. Table 13 showed annual seed requirements for wheat and barley for each governorate in KRI.

Wheat & Barley Grops Seeds Requiremrnt in KRG-Iraq															
Grand Total			Garmian (Kalar)			Duhok			Sulaimanyah & Halabja			Erbil			Gov
Grops	Average Cuultivate Area 2007-2017 Donum	Seed-ing Rate KG/ Do-num	QTY Re-quired (MT)	Average Cuultivate Area 2007-2017 Donum	Seed-ing Rate KG/ Do-num	QTY Re-quired (MT)	Average Cuulti-vate Area 2007-2017 Donum	Seed-ing Rate KG/ Do-num	QTY Re-quired (MT)	Average Cuulti-vate Area 2007-2017 Donum	Seed-ing Rate KG/ Do-num	QTY Re-quired (MT)	Average Cuultivate Area 2007-2017 Donum	Seed-ing Rate KG/ Do-num	QTY Required (MT)
Wheat	922,437	33	30,44	75,788	33	24,875	719,607	33	23,747	253,210	33	8,356	2,649,042	33	87,418
Barley	366,993	33	12,111	265,614	33	8,765	87,812	33	2,898	2,898	33	3,257	819,102	33	27,030
Total	1,289,430		42,551	1,019,402		33,640	807,419		26,645	351,893		11,612	3,468,144		114,449

Table 13: Wheat & Barley Crop Seeds Requirement in KRG -Iraq

Certified seed requirement can be calculated based on replacement rate 1 to 4, which means farmers are required to replace their seeds with certified seed every 4 years. Based on this, the total certified seeds to be available each growing season, for wheat seeds are 21,854 tons and for barley 6,757 tons.

The certified seed quantities produced after the field inspection require processing of seeds and treatment. In Kurdistan region, there are four seed processing plants distributed in Erbil, Dohuk, Sulaymaniyah and Kalar with varying production capacities up to a total of 35 tons per hour.

In the assumption that all the required quantities of wheat and barley seeds, which are estimated at 114.449 tons, are to be cleaned, the capacity of the seed processing plants is not sufficient to clean this quantity of seeds during the season, which lasts about 100 working days. If seed processing plants are used for certified seeds, which are estimated at 28,611 tons, then the available capacities are sufficient to process and treated of this quantity; although some plants are old-manufactured, lack maintenance and lack spare parts, which reduces their efficiency.

It is appropriate to know, and according to the results of the questionnaire conducted in Oct 2018, that 76% of farmers interviewed saved their own seeds for coming season and 24% will purchase their required seeds from the local market. It is showed that the large seed quantities were obtained from the informal seed supply system.

The major source for seeds is farmers' own saved seeds for cereal and legume. 50-68.3% of low quality and small quantities of high quality seeds are obtained from seed companies 3.7-29.2% Figure 19. The low seed quality has a bad impact on the crop productivity and ultimately the production.

Main challenges

1. The Seed Production and Certification Department combine the seed production process and the seed certification process under one management entity. This contradicts the principle of the neutrality of the seed certification authorities.
2. The main source of seed supply is the informal seed supply system (>96%) for wheat seeds and 100% for barley seeds. Those seeds are of low quality and cannot be verified for their conformity with the original genetic characteristics of the variety, as well as not being subject to laboratory analysis to demonstrate their suitability for agriculture cultivation. Such seeds adversely affect productivity and production and, as such, require more effort to improve their quality as much as possible.
3. The Agricultural Research Institute in KRI suffers from a severe shortage of qualified scientific staff, especially those with PhD degrees. They are needed to design and lead agricultural research in connection with the difficulties facing the agricultural sector and to obtain a good scientific result that contributes to solving problems and dilemmas that hinder advancement and development of the agricultural sector.

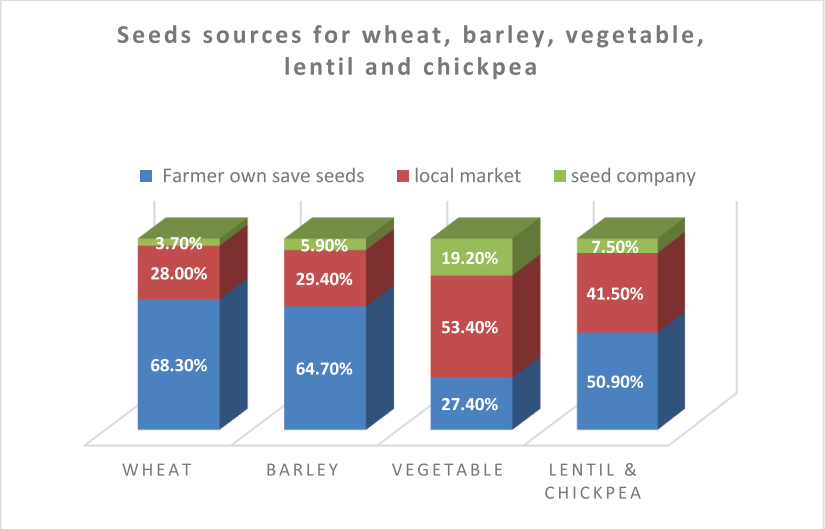


Figure 19: Seeds Sources for wheat, barley, vegetable, lentil and chickpea

Recommendations:

1. The current seed production phase requires more control of production in order to reach a solid national seed program, according to the field and laboratory certification standards for certified seed production. It is proposed to restructure the Seed Production and Certification Directorate by establishing the (General) Directorate of Seed testing and Certification in the Kurdistan Region (level of this directorate could be defined by MOAWR) and its administrative connection is preferable to the Ministry of Agriculture and Water Resources (the technical and administrative departments shown in Figure (33) in the main report).
2. Enhance capacity to carry out seed testing according to the international seeds testing rules and facilitate the access to be accredited of the seed laboratories in KRI to the ISTA (Detailing of the types of laboratory equipment required shown in Annex (4) in the main report).
3. Update field and laboratory standards used in field inspection and seed laboratory testing. They must be approved by the proposed National Seed Council to be developed as a working manual for field inspectors and laboratory examiners.
4. Enhance capabilities of workers and raise their technical knowledge and skills, through participation in training courses within and outside the region in a number of well-known identified institutions in Seed Technology topics (number of training courses, topics, number of trainees and duration are shown in Annex(5) in the main report),
5. It is recommended to carry out performance trials (VCU, value for cultivation and use) and description trials DUS (Distinguish, Uniformity and Stability) for varietal evaluation,
6. Increase market controls and take necessary measures to avoid sale of uncertified and poor-quality seeds through the issuance of seed legislations, which regulating the functioning of the seed market and its application through the proposed the directorate of seed testing and Certification,
7. Attention should be paid to the development of seed industry and seed policy in KRI through establishing the KR seed Board chaired by the Minister of Agriculture and water resources in KRI. Composition, functions and duties of this board can be defined by legal act.

2.4 Post-harvest losses and opportunities for reductions

The concept of 'post-harvest losses' in crops means a measurable quantitative and qualitative loss in a given productThese losses can occur during any of the various phases of the post-harvest system including product deterioration, covering from harvesting till consumption. An overview of such losses has been listed in the Table 14. [33]

				IQD/Kg		
Crop	**No. of Farmers**	**% Farmers**	**% loss**	**sales**	**(no of farmers reporting sale price)**	**Wholesale market prices**
Wheat	50	71	19	420	50	
Barley	27	39	20	368	27	
Chick peas	12	17	20	1072	9	
Maize	3	4	18	200	1	
Rice	2	3	40	300	1	
Potato	17	24	29	262	15	700
Cucumber	5	7	15	500	1	1000
Tomato	3	4	45	500	1	1500
Pepper	2	3	20			
Snake cucumber	5	7	33	350	3	
Aubergine	4	6	18	500	1	750
Okra	2	3	8	1000	1	3000
Zucchini	1	1	0			
Grapes	8	11	30	720	5	1750
Apple	5	7	40	975	2	
Pomegranate	5	7	18	650	4	1000
Peach	7	10	25	750	4	1000
Greengage	2	3	20	1425	2	
Fig	7	10	24	945	5	1500
Apricot	3	4	22	500	2	
Melon	9	13	29	650	3	
Water melon	3	4	27	205	3	
Radish	1	1	10			
Beans	1	1	10			
Onion	0	4	38	100	2	

Table 14: Crop production losses and sales prices

(33) Prices were sought from a second set of farmers in Erbil who volunteered their production costs, although it was not always possible to judge the accuracy of these costs (in the absence of any bench marking information). Nonetheless, the selling prices of the cereals and tomatoes were in line with data already gathered.

In general, the three main objectives of applying post-harvest technology to harvested fruits and vegetables are to: i) maintain quality of appearance, texture, flavor and nutritive value; ii) protect food safety; and iii) reduce losses between harvest and consumption.

The causes of losses are attributed to many factors related to cereal, vegetable and fruit crops. The factors include soil type and variety type; some of which are sensitive to shattering during mechanical or manual harvesting, handling, transport, storage, lack of sorting, inadequate packaging, weather conditions during harvesting process (especially for fruit and vegetable crops) and disease and pest.

According to the survey conducted by the team, the rate of losses in wheat crops was 19% and 20% in barley crops. The average losses are distributed among post-harvest processes at 9% during harvesting(where the interviewed showed Wheat harvesting starts in May 13.2 %, in June 76.3 %, in July 9.2%, and in August 1.3%, which is late and usually gets high percentage of losses Figure 20 and 21, 5% during transportation and handling and 6% during storage period figure 22.

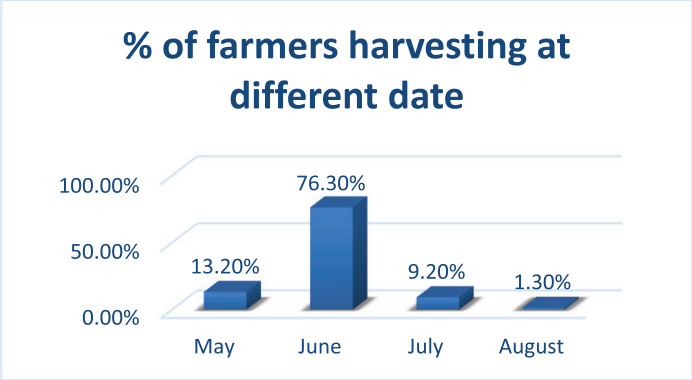


Figure 20 : % of farmers harvesting at different dates (month)

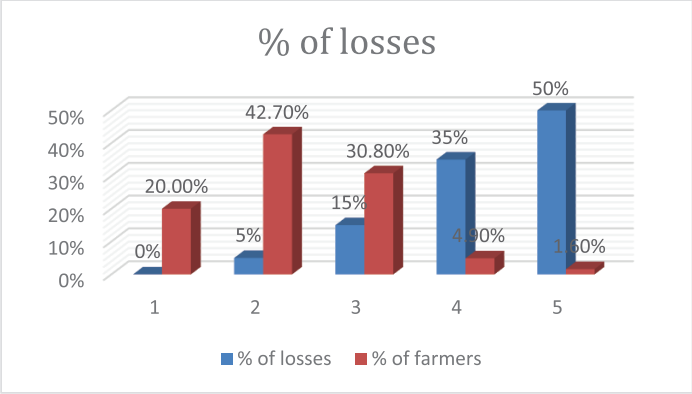


Figure 21: % farmers and % of losses

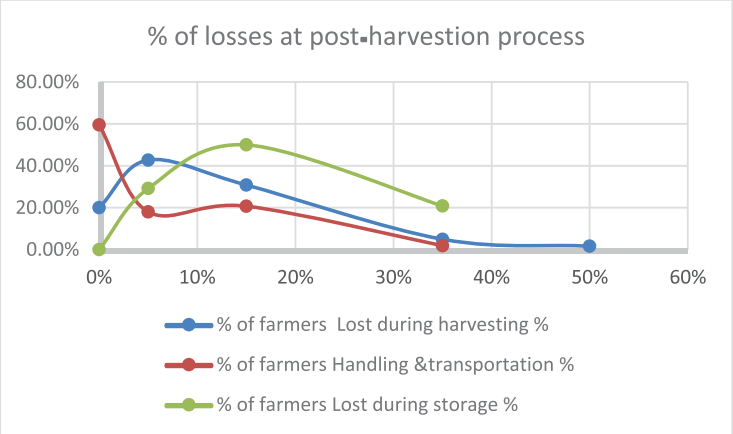


Figure 22: % of farmers and % of losses at post-harvesting stages

It also shows that an average of 17% of the harvested crops was lost during the three stages (harvesting, handling, and storage).

Crop storage methods vary. For instance, regarding the storage of grain, the survey showed that 69.3% use houses as stores, where there are no safe storage conditions, while 5.3 % prefer storage in small clay silos which are traditional storage methods and only 24% use safe storage methods. Meanwhile, for vegetable crops, the questionnaire showed that 70% of vegetable producers use traditional storage methods, 20% use cold storage, 10% of farmers sell their crops directly without waiting for a storage period, while 90% of the farmers need to store their crops for certain periods before selling them. This leads to an increase in crop damage, especially when storage is technically unsafe and outside storage is cold Figure 23 .

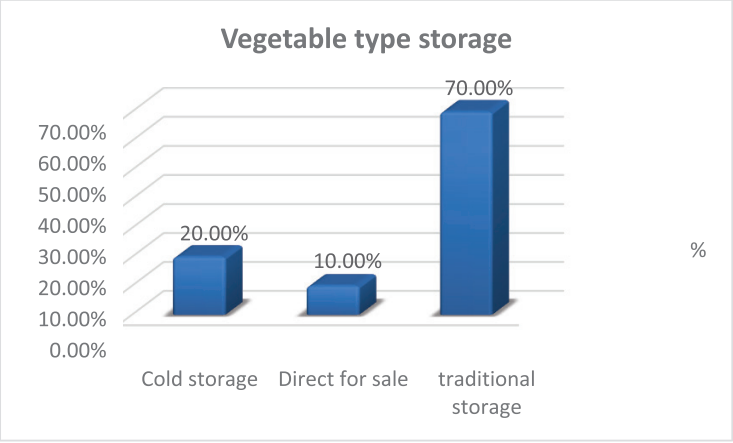


Figure 23: Vegetable type storage

Regarding fruits, interviewed farmers showed that 7.6% use cold store, 21.1% sell the products directly and 80% use traditional storage methods Figure 24 .

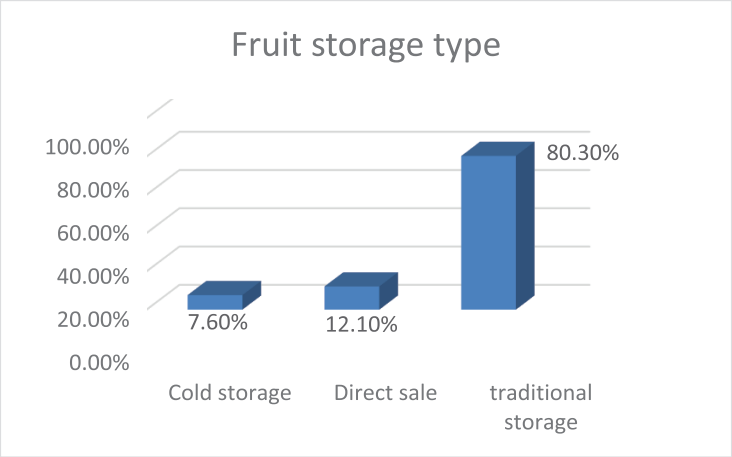


Figure 24 : Fruit storage type

It is clear that the large percentage of producers of vegetable and fruit crops use the traditional methods of storing their crops, which lack the simplest safe storage conditions, which in turn cause damage to the stored crops. In order to maintain the safety and quality of crops, the establishment of proper cold warehouses is required to meet the needs of producers.

Number of grocery owners pointed out that damage to vegetable and fruit crops is estimated at 10-20% and the causes of damage are as follows:

- Poor quality especially local produce;
- Poor product grading which leads to the transmission of infection if it is found to the rest of the content of the package
- Poor packaging;
- Pesticides, especially on fruit, are ineffective. They allow insect activity and damage to occur, taking into account that vegetable and fruit are perishable in nature and easily attacked by fungi and or bacteria causing diseases.

The results of the survey showed that the main causes of loss and damage to agricultural crops are 47% lack of mechanization, 24.8% lack of proper storage facilities, 11.1% bad transportation and 6.7% harvesting delay for cereal, vegetable and fruits crops Figure 25.

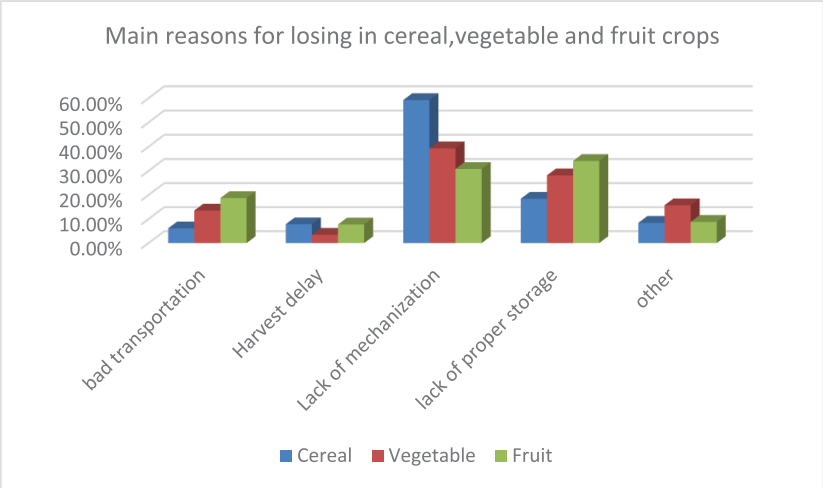


Figure 25: Main reasons for losing in cereal, vegetable and fruit crops

In the survey conducted, we found that regarding the main causes of the damage to products (vegetables and fruit), 40.5% said that the product was never sold, 20.7% due to lack of proper stores and 24.3% because of poor product quality and 13.2% due to lack of power.

Main challenges

1. The lack of storage facilities is a major issue for all farmers, but particularly in the horticulture sector. Apart from some potato stores, there are no on-farm storage facilities – crops get harvested and bounced to market as quickly as possible. The products are then sold covered with dust and bruises – visually poor in comparison to imports. The absence of cooling technology post-harvest and during transport is a major issue which ought to be addressed.

Recommendation:

1. Modernize part of the agricultural sector that will allow for larger mechanized harvesting and post-harvest handling, storage and transport. Also invest in (cold) storage facilities, wholesale function, transport and marketing of produce;
2. Support establishment of producer marketing groups- allowing them to pool funds and access larger markets and market players, including purchasing of (mechanized) equipment, storage, etc.

2. 5 Fruits and Vegetables: production and opportunities for value chain development.

In this section, a broad analysis is shown for various crops, including legumes, vegetables, potatoes, and fruit. It covers area planted, production levels and yield per unit.

Legumes Crops

LLegumes, such as chickpeas and lentils, are cultivated in KRI where the total area for the cultivation of legumes in the season 2016-2017 is (473 donums) of lentils and (12,259 donums) of chickpea. While production reached 66 ton of lentils and 2526 Ton for chickpeas, the average productivity reached up to (140 Kg/donum) for lentil crop and (206 Kg/donum) for chickpea crop. Area cultivated with lentils showed (248 donum) in Duhok governorate, followed by (113 donums) and (107 donum) in Sulaymaniyah and Erbil governorate respectively.

As for the crop of chickpeas, Sulaymaniyah is characterized by the largest area in the cultivation of 1,334.3 hectares (5,337 dunums) followed by Erbil 696.8 hectares (2,787 dunums), Dohuk 644.8 hectares (2,579 dunums), Halabja 313.8 hectares (1255 dunums), and Garmian 70.5 hectares (282 dunums Table 15.

Area, Yield and production of lentil Chickpea cops in KRG Iraq 2016-2017																		
Grop	**Erbil**			**Sulaimaniyah**			**Duhok**			**Garmian (Kalar)**			**Halabja**			**Grand Total**		
	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT	Area do-num	Yield Kg/ Do-num	Prod-uct toin MT
Lentil	107	158.0	17	113	117.0	13	248	143.0	35	5	117.0	1	0	0	0	473	140	66
Chickpea	2,787	162.0	451	5,357	158.3	848	2,579	371,4	958	282	244.6	69	1,255	159	200	12,259	206	2,526
KRSO	Kurdistan Region Statiscs Office																	

Table 15 : Area, yield and production of lentil and Chickpea crops in KRI 2016-2017

There are problems in the productivity per unit area for cereal and legume crops, where it is low. Meanwhile there is potential to achieve higher productivity, as much as twice and more than the current productivity rates.

The factors contributing to low productivity according to results of Baseline Survey conductedin 2015:

- Choice of variety
- Land usage – no crop rotation
- Inappropriate use of heavy machinery
- Lack of timely application to inputs due to its unavailability
- High costs of inputs
- Inadequate agricultural support policy for wheat production

Vegetable crops

Summer crop productsare continuously produced from summer till mid-fall. Of these products, we can mention potato, cucumber, tomato, okra, eggplant, peppers, onion, watermelon, bean, melon, squash and pea.

Vegetable gardening usually uses relatively modern techniques, including the use of chemical fertilizers, pesticides and modern irrigation systems (particularly drip irrigation system). Cucumber, tomato and onion were the most important crops, with average production amounting to 115,314, 182,151 and 57,630 tons for them respectively. Other vegetables produced in significant quantity were watermelon, melon, eggplant and okra. The average overall vegetable production for the most important vegetable crops was 758,488 tons, according to Table 16. The average yield for the most important vegetable crops are shown in Figure 26 and table (16). The detailed report shows detailed figures for planted areas, yield and production for vegetable crops for the years 2014-2017 Annex (3).

Crop	Planted area Donum	Yield KG/Donum	Production /Ton
Cucumber	34,156	3,376	115,314
Tomato	48,346	3,768	182,151
Onion	16,610	3,470	57,630
Eggplant	11,114	3,866	42,970
Pepper	4,166	3,092	12,882
Okra	11,545	1,829	21,115
Squash	7,029	1,841	12,939
Watermelon	35,519	5,706	202,673
Melon	77,266	1,434	110,813
Total	245,749		758,488

Table 16: Average planted area, yield and production for vegetable crops in KRI2014-2017

Source: Ministry of Agriculture and Water Resources

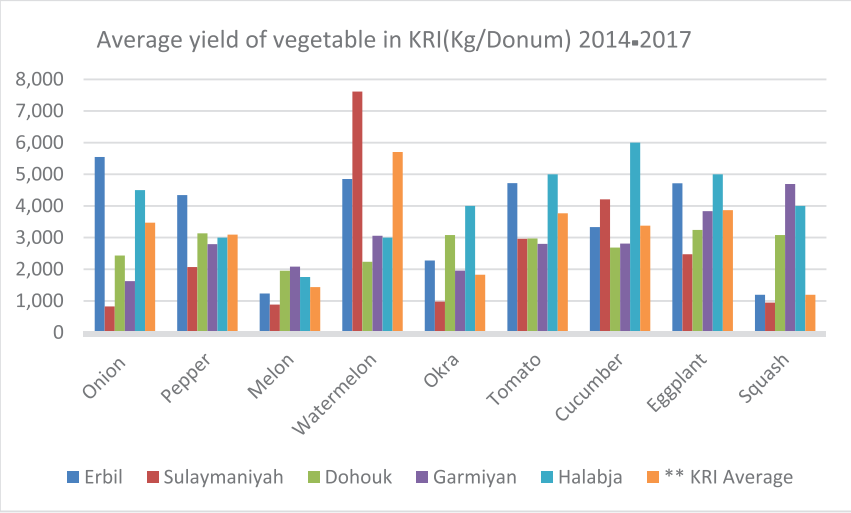


Figure 26 : Average yield of vegetable in KRI(Kg/Donum)2014-2017

Average Yield of Vegetable Crops in KRI (Kg/Donum) according to the planted areas and production									
Governo-rate	Onion	Pepper	Melon	Water-melon	Okra	Tomato	Cucum-ber	Eggplant	Squash
Erbil	5,549	4,343	1,235	4,849	2,276	4,719	3,334	4,718	1,192
Sulaimani	824	2,071	882	7,614	976	2,966	4,209	2,476	948
Duhok	2,433	3,134	1,955	2,236	3,078	2,973	2,684	3,243	3,080
Garmyan	1,627	2,791	2,084	3,057	1,959	2,803	2,809	3,835	4,692
Halabja	4,500	3000	1,753	3,000	4,000	5,000	6,000	5,000	4,000
**KRI Average	3,470	3,092	1,434	5,706	1,829	3,768	3,376	3,866	1,192

Table 17: Average Yield of Vegetable Crops in KRI (Kg/Donum)

Source: Ministry of Agriculture and Water Resources

Potato crop

Potato crop among wheat, rice and corn, is one of the most important crops in the world known for its high nutritional value. It has become widely cultivated in the KRI due to its soil fertility and the appropriate climatic conditions for the growth of the crop. Over the past three years, the number of farmers who grow potato crops increased and in 2017, it reached 705 farmers, which is double the amount in 2015 Figure 27.

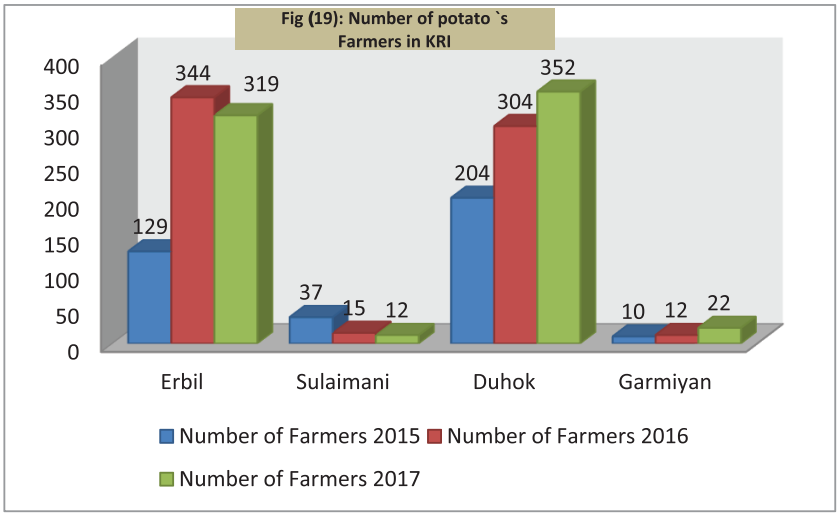


Figure 27: Number of Potato farmers in KRI

Potato cultivation is concentrated in the governorates of Dohuk and Erbil while a few farmers practice potato cultivation in Sulaymaniyah and Halabja Table 18.

Table : Number of Greenhouses in Kurdistan Region																
Gover-norate	Area (Donum)			See-din g Rate	Potato Tubers Re-quirement			Yield Kg/Donum			Total Production (MT)			Number of Farmers		
	2015	2016	2017	Kg/ Do-num	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Erbil	4,212	5,619	5,523	750	3,159	4,214	4,142	8,218	9,301	6,785	34,614	52,257	37,474	129	344	319
Sulaim-ani	880	821	180	750	660	616	135	7,250	7,857	21,111	6,380	6,453	3,800	37	15	12
Duhok	11,124	19,759	21,632	750	8,343	14,819	16,224	8,843	9,262	7,870	98,373	183,009	170,242	204	304	352
Garmyan	938	201	2,740	750	704	151	2,055	1,301	8,131	876	1,220	1,637	2,400	10	12	22
Total	17,154	26,400	30,075	750	12,866	19,800	22,556	25,612	34,551	36,642	140,587	243,356	213,916	380	675	705
Source: Ministry of Agriculture and Water Resources/Horticulture Department																

Table 18: Potato cultivated area, yield and production in KRI

Although the data isis inaccurate, but according to the data revealed by the Ministry of Agriculture, the planted areas with potatoes during the last three years has developed from 4,288.5 hectares (17,154 donum) in 2015 to 6,600 hectares (26,400 donum) and 7,518.8 hectares (30,075 donum) in 2016 and 2017 respectively. The development in growth in area is accompanied by a development in production from 140,587 tons in 2015 to 243,356 tons and 213,916 tons in 2016 and 2017 respectively Table 18.

The productivity showed a range of 7-9 ton per donum, but the production potential of the unit area is higher than actually achieved on the ground. It requires additional support and awareness in order to improve knowledge of farmers on how to cultivate and care for potato crops according to modern methods, especially with the treatment of virus infections.

According to the Ministry of Agriculture and Water Resources, 675 farmers cultivate tens of thousands of acres of land to grow potatoes in the Kurdistan Region. The private sector has also been helpful in developing potato production by introducing newly varieties of potato seeds from abroad, especially from the Netherlands.

A Dutch company has opened a branch in the Kurdistan Region as a result of increasing demand for its potato seeds. In addition to exporting its seeds to the region, this company also invites Kurdish farmers to the Netherlands annually to introduce them to the latest technology in the field of agriculture and show them potato fields there. “Growing potatoes in the Kurdistan Region is on the rise. Potato products are increasing year by year. We bring the latest seeds on demand from farmers,” the Dutch Company’s General Manager Hussein Arif told Rudaw TV channel.

Figures from the MoA reveal that potato products grown in the Kurdistan Region reached 213,916 tons in 2017(41). This is twice the amount that the region needs to meet its potato demands in the market. The surplus is exported to other Iraqi cities. “Potato products are increasing gradually in the Kurdistan Region. However, farmers have difficulties selling their products during the harvest period, and they cannot keep their products until a later time due to not having enough stores to keep them. This is also because the government levies taxes on imports only during the harvest. They open the borders afterwards,” Arif explained.

Potato crop production in Kurdistan region increases annually, and reaches self-sufficiency with a considerable surplus, which calls for marketing to other cities in Iraq or exporting outside of the region
.

This requires proper cold stores for potatoes until transferred to the possibility of internal and external marketing.

Potato is an important staple food for sectors of the society and should be given more attention in research to select disease-free varieties and to plan annual certified potato seed production in selected cool regions of Kurdistan. Attention should be focused on the production of virus free varieties with specific cooking qualities desired by the people. Further, cold storage facilities need to be provided to ensure adequate annual seed distribution that are fungus and virus free. Such seed production could also be produced under contract with farmers to produce certifies seeds.

Greenhouses technology for vegetable production

More intensive farming using greenhouses techniques is being introduced in the Kurdistan region aiming for quality improvement and increased production capacity. However, Greenhouse farming is a recent agricultural production trend in the Kurdistan Region. Local farmers have been encouraged to grow vegetable crops using greenhouses techniques following a group of Kurdish agricultural engineers that experimented greenhouse farming in 2008. The use of greenhouses in producing vegetable crops has expanded and reached more than 17,000 greenhouses in the Kurdistan region, where Sulaymaniyah governorate occupies the lead in the number of greenhouses in 2017 by 73%, followed by Erbil 12%, Dohuk 10.4% and Karamian 2.6% and Halabja with lower percentages 2%. Due to reduced wages and the effect of the financial crisis, many farmers from the governorate of Sulaymaniyah have turned to cultivating vegetable crops in greenhouses to benefit off of growing vegetables during winter time Table (19).

Table : Number of Greenhouses in Kurdistan Region												Gover-norate
Percentage %			Area m2			Number of Greenhouses			Number of farmers			
12	/	16	919,350	/	704,034	2,043	/	1,542	311	/	344	Erbil
73	75	65	5,610,150	3,501,000	2,800,550	12,437	7,780	6,316	1,108	878	798	Sulaimani
10.4	17	12.28	803,700	800,100	545,076	1,786	1,778	1,191	737	737	489	Duhok
2.6	8	6.67	212,850	360,000	277,848	473	800	647	37	207	242	Garmyan
2	0	0	152,550	0	0	339	0	0	24	0	0	Halabja
100	100	100	7,698,600	4,661,100	4,327,508	17,078	10,358	9,696	2,217	1,822	1,873	Total

Table 19: Number of greenhouses in KRI

Source: Ministry of Agriculture and Water Resources /Horticulture Department

However, the agricultural expansion plays a major role in raising awareness and knowledge of farmers and encourages them to further the use of greenhouses. It also helps resolve the marketing difficulties, which is the main obstacle facing the continuation of production in greenhouses, due to high costs.

There is a big demand for vegetables in KRI, and the production supply does not support this demand. Therefore, it is necessary to import from neighboring countries, which would lead to the expansion of the number of greenhouses to increase the domestic vegetable crops production and meet the needs of the market to reach self-sufficiency and also export. For planning future expansion of greenhouses, it is necessary to calculate the balance between the investment amount and income (production volume and sales price).

Greenhouse equipment companies are also active in providing technical support and training in the areas of seedling sales.

Fruit Crops

In the Kurdistan region, ffruits are largely grown in the northern part where the fruit farming provides promising income opportunities utilized in improving farmers livelihood and food security particularly in the mountainous areas. The most commonly grown fruit are grapes and apples; walnuts, apricots, pomegranates and peaches are also widely cultivated.

Fruit crops are grown in Kurdistan under irrigation and rainfed conditions. The orchards area is estimated at (248,000 donum) under irrigation conditions and (76,000 donum) in the rainfed areas Table 20.

Governorate	non-irrigated (Donum)	irrigated (Donum)	total/ donum	%
Erbil	23,728	65,346	89,074	27.25%
Slemani	26,563	88,241	114,804	35.4%
Duhok	25,730	94,484	120,214	37.1%
Total	76,021	248,071	324,092	

Table 20 : Orchard cultivated area under rainfed and irrigation condition

Source: Ministry of Agriculture and Water Resources /Horticulture Department

The total number of fruit trees in Kurdistan Region are about 68.2 million (M) trees of various types of fruit crops, while the fruited trees are about 59 M distributed as 18.8 M in Erbil,18.9 M in Sulaymaniyah and 21.3 M in Dohuk governorate Table 21.

Governorate	Number of Trees	Number of fruited trees
Erbil	21,555,908	18,753,640
Sulaymaniyah	22,386,780	18,921,306
Duhok	24,283,228	21,272,108
Total	**68,225,916**	**58,947,054**

Table 21: Numbers of fruit trees

Source: Ministry of Agriculture and Water Resources /Horticulture Department

The total number of orchards in the KRI is about 10,577 occupying an area estimated at 43,155 Donum[34].

The KRI produces about 423,029 ton of different kinds of fruit distributed over governorates as shown in Table 22.

(34) Source: Ministry of Agriculture and Water Resources /Horticulture Department

Fruit production/ton			
Erbil	**Duhok**	**Sulaymaniyah**	**Total**
87,606	119,086	216,337	423,029

Table 22: Fruit production Ton in KRI

Source: Ministry of Agriculture and Water Resources /Horticulture Department 2016

The yield of fruit crops is declining due to several reasons, the most important of which is the lack of irrigation water, especially in the rainfed areas and poor agricultural practices.

In conclusion, there is considerable potential to reach the self-sufficiency of a large number of fruit and vegetable crops, where statistical data refer to reach to self-sufficiency or close to it a number of vegetable crops such as okra, 95%, snake cucumber 99%, Kidney bean 98%, Green onion 99%. However, important crops are still far from the getting self-sufficiency such as tomatoes, 49% cucumber 76%, eggplants 69%, White onion 40% and red onions 31%, and the rest of the crops as shown in table (15). It is important to note that the percentages are calculated on the basis of the amount of domestic production to the total quantity of domestic production plus the imported quantity as representing total consumption. In total, local production of vegetables accounts for 64% in 2017 of total consumption.

Domestic production of Vegetable crops to the total (consumption) in KRI in 2016-2017*									
No	Crops	Local production (Mt)		Import (Mt)		Total (Mt)		% Local to total	
		2016	2017	2016	2017	2016	2017	2016	2017
1	Tomato	60,772	83,107	122,232	87,086	183,004	170,193	33	49
2	Eggplant	21,948	48,893	15,839	22,145	37,787	71,038	58	69
3	Cucumber	66,442	100,522	40,654	31,260	107,096	131,782	62	76
4	Okra	6,361	10,579	1,092	571	7,453	11,150	85	95
5	White-Onion	29,769	35,207	54,106	53,388	83,875	88,595	35	40
6	Red- Onion	11,753	12,987	26,301	29,099	38,054	42,086	31	31
7	Green -Onion	6,069	12,699	36	10,258	6,105	22,957	99	55
8	Potato	150,383	213,916	80,069	116,218	230,452	330,134	65	65
9	Melon	13,366	28,286	14,932	12,060	28,298	40,346	47	70
10	Snake Cucumber	10,030	7,029	234	36	10,264	7,065	98	99
11	Watermelon	50,124	87,551	39,139	34,456	89,263	122,007	56	72
12	Squash	17,630	24,953	10,883	9,985	28,513	34,938	62	71
13	Green Broad bean	5,030	4,607	2,135	4,242	7,165	8,849	70	52
14	Green bean	1,586	8,974	1,802	4,554	3,388	13,528	47	66
15	Sweet Pepper	12,840	17,465	10,801	13,153	23,641	30,618	54	57
16	Hot Pepper	3,120	8,965	1,996	2,364	5,116	11,329	61	79
17	Kidney Bean	5,221	6,853	34	139	5,255	6,992	99	98
18	Garlic	28	2,163	4,587	4,979	4,615	7,142	1	30
19	Table Beet	2,870	16,838	36	126	2,906	16,964	99	99
20	Carrot	7,350	91,383	17,501	23,728	24,851	115,111	30	79
21	Lettuce	8,486	30,633	14,540	12,539	23,026	43,172	37	71
22	Cauliflower	3,999	19,232	6,362	7,397	10,361	26,629	39	72
23	White Cabbage	6,837	19,025	14,021	15,593	20,858	34,618	33	55
24	Red cabbage	1,823	9,289	11,708	9,125	13,531	18,414	13	50
Total		503,837	901,156	491,040	504,501	994,877	1,405,657	51	64

Table 23: Domestic production of Vegetable crops to the total (consumption) in KRI in 2016-2017

***Source MOAWR/Directorate of Statistics and Human Development**

Fruit production is still far to get self-sufficiency where the total domestic production showed 25% to the total domestic production plus the imported (consumption) except black, red grape and fig which reach almost the self-sufficiency Table 24.

Domestic production of fruit crops to the total (consumption) in KRI in 2016-2017*									
No	Crops	Local (Mt)		Import (Mt)		Total (Mt)		% of total production to the total	
		2016	2017	2016	2017	2016	2017	2016	2017
1	Orange	792	54	70,701	55,129	71,493	55,183	1	0
2	Red Apple	6,767	2,807	32,288	39,133	39,055	41,940	17	7
3	Green apple	6,206	3,994	20,227	28,445	26,433	32,439	23	12
4	Yellow Apple	3,833	1,518	41,768	41,873	45,601	43,391	8	3
5	White Grape	3,011	4,817	494	2,303	3,505	7,120	86	68
6	Red Grape	2,741	1,072	70	923	2,811	1,995	98	54
7	Black Grape	5,663	4,931	269	1,156	5,932	6,087	95	81
8	Peach	9,707	2,528	10,174	10,432	19,881	12,960	49	20
9	Pomegranate	24,852	26,338	16,305	15,290	41,157	41,628	60	63
10	Plum	886	3,042	2,415	2,983	3,301	6,025	27	50
11	Red Plum	687	1,342	1,791	796	2,478	2,138	28	63
12	Pear	1,707	4,389	5,301	8,148	7,008	12,537	24	35
13	Apricot	3,437	3,815	4,446	7,175	7,883	10,990	44	35
14	Fig	2,950	5,686	0	2,093	2,950	7,779	100	73
15	Kiwi	105	0	17,124	8,877	17,229	8,877	1	0
Total	73,344	66,333	223,373	224,756	296,717	291,089	25	23	

Table 24: Domestic production of fruit crops to the total (consumption) in KRI in 2016-2017

***Source: MOA&WR/Directorate of Statistics and Human Development**

In general, the average number of fruit trees per one Donum is 213 trees with an average yield per tree is 7 Kg and the yield per one donum is 1,498 Kg Table 25.

Fruit trees in KRG/Yield

Governorate	Number of Trees/Donum	Yield kg/Tree	Yield kg /Donum
Erbil	242	6.35	1,537
Sulaymaniyah	195	4.63	903
Duhok	202	10.17	2,054
Average	213	7.03	1,498

Table 25: Fruit trees in KRG/Yield

Duhok governorate is characterized by the cultivation of many fruit trees, most notably grapes, apples, peaches and others. The province achieved self-sufficiency in a number of fruit crops, particularly grapes, with an annual production of 13,000 tons. The local need is only 3,000 tons, while the

production of apples is up to 18,000 tons and the need of up to 4,000 tons. There is a clear weakness in marketing apples reaches 18,000 tons and needs up to 4,000 tons. There is a clear weakness in marketing capabilities for grapes and all other agricultural products.

In the past, it was easy to market the products in other governorates of Iraq. However, currently, there are many obstacles (socio-political) that prevent free movement of goods outside the KRI.

According to agricultural technicians in Dohuk at the horticulture department, if the required facilities (such as cold storage, field machineries, applying good agricultural practicing and finding external markets) are available, then fruit crops will have a future in KRI.

At the same time, high quality fruits are imported which makes it difficult to market local fruit products. Therefore, local fruit products cannot compete in terms of quality, packaging and price. The fruit industry in KRI will not grow unless such improvements are made. Setting tariffs for specific imports may help, as well protecting specific value chains identified for expansion.

Main challenges

1. Lack of infrastructure that promotes marketing of agricultural products;
2. Lack of specialized companies in agricultural marketing;
3. Lack of modern transportation means to maintain product quality during transportation such as refrigerated trucks; and
4. weak industrialization of agricultural products for many reasons, including weak investment in the agro-food industry and the absence of markets encouraging the marketing of the manufactured product.

Recommendation:

Undertake specific value chain studies for individual food products and look at opportunities to create added-value and replace certain imports. It is expected that several of the changes will not only focus inwards, but also on the enabling legal and regulatory environment, tackling red tape, improving rules and regulations are also related to food safety, and setting a common playfield for all.

2.6 Opportunities for value chain development for local and international markets.

It was difficult to obtain information on the costs of production from farmers. No benchmarking figures were available from government sources. Within this project, such information has not been obtained from any other source. The crop production losses and sales prices are also shown in table 26. A direct comparison could be made with the wholesale market as their prices are given. In discussions with farmers, a margin of 25% over costs was average. This same mark-up was evident with retailers. Cattle dealers quoted stock selling prices 25% more than purchase prices although the margin increased with higher quality animals. Overall, the wholesale market was taking a margin of 100%, which explains the retailer's complaint of excessive charges.

IQD/Kg	Milk	Yogurt	Cheese	Tomato	Meat	Fish
cost	1333	1386	3214	300	3165	2800
sale	2667	2071	5214	500	4109	3000
(%) Margin	100	50	62	66	30	7
IQD/tonne	Wheat	Barley				
cost	314	336				
sale	425	433				
(%) Margin	35	29				

Table 26 Farmers costs of production and selling prices (Erbil)

Their results imply that the margins for the dairy products are excellent, with tomato also giving a good margin. Meat, wheat, and barley margins are satisfactory, but the fish margin is far too low especially when there is a market for it and not an oversupply situation, according to the production figures. In reality these figures suggest that there is a real need for proper benchmarking to be developed for the farmers.

Normally, the customer would be expected to pay three to four times the price for food compared to the payment to the farmer. This would indicate that the farmers in Kurdistan (whilst still not getting enough for their produce) are still in line with farmers from other countries. From a policy perspective ,this would suggest that a significant component of rural poverty arises not from the size of the margin ,but more so from the numbers of people sustained by each small farm.

In order to profit from the opportunities for value chain development, it is the public sector that needs to act and provide an enabling environment and support various entities and stakeholders in the agricultural sector. Without a strategy for public sector reform, an investment plan and buy-in from the top decision-makers will prove to be dificult

Interviews with key informants from the private sector showed that all business people complained about government red tape, particularly the use of licenses and the government charges relating to them. In all cases, people developing food businesses claimed that they could only do so if they could avoid interference from government. The survey of the farmers illustrated the power of government in manipulating the industry. All the farmers were growing wheat because of the high purchase price, which was significantly above the market price. The subsequent and sudden withdrawal of this support again caused severe market disruption. It is impossible for these sectors to develop normally when

government interference has no defined pattern. Without exception, the few existing processors criticised government processes for obstructing the development of their businesses.

Before the current funding issues, there was significant improvement in the health of the local herd as a result of proper vaccination programmes – delivered by government officials. Then the officials stopped, and there was no proper private sector to take over. So, health of the local herd has collapsed. Farmers who paid for private vaccinations complained that these vaccinations did not protect their animals.

Elements of an agricultural sector reform strategy would include:

Public sector reform - The public sector employs nearly half of the labor force and as much as 75% of working women (KRI demographic survey 2018). The private sector employment is small. The budget for MoA and its departments is not enough to perform all their duties (e.g. border control, food safety inspections, extension, etc.) and to create an enabling environment for a public and private sector to operate. For instance, pesticides, which have been banned in the EU for several years, are still readily available in agricultural suppliers in Kurdistan. In addition to this, contamination of ground water by agrochemicals is not being checked or managed (nor is the food being produced by these practices). There is no traceability system working for any products. Animal health is breaking down again. The food supply chain is being compromised by the form and function of the civil service.

University Education - Thousands of agricultural engineers have graduated from university, but significant numbers remain unemployed. There are two major reasons for this. The first reason is the lack of a successful private agriculture sector. Faculty staff said that they had no authority to modernise their courses to meet modern requirements. This appears to be a significant divergence from universities working in enterprise based societies, where faculties are expected to keep modernising their courses and ensuring they stay fit for purpose. There was no expectation of work experience requirements for students, no Erasmus style experience and no entrepreneur training.

Addressing Rural poverty - The average farm size in KRI is big enough to feed a family, but too small to provide a family with a modern standard of living. The gap between the urban dweller and rural dweller continues to widen; and as living standards continue to rise in Kurdistan, this gap will continue to promote urbanization. The government therefore needs to target rural poverty through a focused rural development programme. As farm sizes increase (and therefore farmer numbers decrease), the new non-farming families need alternatives or they will have to migrate. At the same time, as towns and cities become overcrowded and difficult, urban workers would likely move to the countryside to live there instead.

The rural community is generally impoverished, poorly educated and poorly serviced. The current farming systems depend on high levels of family labour, rather than machinery. This makes access to education difficult. Larger families dilute family income per member and impact negatively on living standards. The policy of increasing farm size, by definition removes families from farming. In turn, these families require alternate sources of income. When farm size is not increased, other streams of income are needed in order to raise living standards to match that of urban dwellers.

Rural development will require three strands – increased efficiency in farming, the development of agri-tourism (hosting visitors on farms, developing arts and crafts in addition to food products and providing guides to local points of interest); and improvement in rural infrastructure (roads, water, electricity, schools, health centres and internet access).

Increased Farm Efficiency - With a proper rural development strategy, the Kurdistan government can eliminate the misery of 'the rural peasant'. Farmers can sell their land and move to other activities whilst other farmers can increase their farm size. Alternatively, farmers can develop value-adding activities on the farm and raise their income accordingly. With equal access to services in the countryside, urban workers can move into the rural environment and commute into the towns. Such workers would add to the financial viability of the rural communities.

Increasing farm size will help the development of the private service sector for both machinery and agricultural supplies. More efficient equipment will require service engineers living in the rural environment. Private sector sales representatives are usually university graduates trained to provide technology transfer and they will be required to live and work in the rural environment. The larger agriculture firms that organise field trials to promote their seeds, chemicals and equipment, need efficient farms to justify their trials. Bayer informed this author that while they ran trials in Turkey, they did not consider that the current farming structure in Kurdistan was sufficiently advanced to justify trailing there. Overall, increasing farm size and efficiency increases the number of skilled well paid jobs in the rural environment.

Agri-tourism - The concept of agri-tourism does not yet exist in Kurdistan as a recognised industry (even though all the component parts are evident). There are three main components: local food (already covered), hosting and guiding of visitors by farming families and agricultural shows. The contribution of the Ministry of Agriculture and the Ministry of Tourism would have to be negotiated. Across all of the interviews conducted for this project only one civil servant understood the importance of this concept in rural development. Its value in sustaining rural communities cannot be over emphasised.

Hosting of visitors by using the European style of bed and breakfast is difficult given the social norms. Separate accommodation with clean water and toilet facilities would have to be established per village. A small motel type facility, managed by the village would work. Farmers trained in looking after and guiding visitors can take visitors to sites and relate the stories of the place to them. Local food producers and craft producers would be part of the visitor experience.

Agricultural shows - A significant amount of rural knowledge has been lost during the last thirty years due to all of the social upheavals endured by the people of the KRI, particularly in agriculture. In discussions with farmers and cattle dealers, it was obvious that pedigree herds of animals did not really exist. Generic herds of cattle, sheep and goats existed and artificial insemination had been used to improve the livestock characteristics but overall farmers could not easily improve the quality of their stock. The only apparent advantage of the native breeds was that 'nature cannot kill them'.

To re-establish family skills in animal breeding, food production and crafts, annual competitions should be hosted in each district with invited judges. These agricultural shows should match local holidays and act as festivals to attract outsiders to visit. Properly managed these shows can fill the summer with visitors and generate significant income for the rural economy.

In terms of equipment, the farmers first had little knowledge of what was available. They had not seen demonstrations at first hand of new technologies or techniques. Normally, to address this significant knowledge deficit, farmers would attend their local agricultural shows where commercial firms would demonstrate their wares and educate the farmers in the process.

The political interference, which caused the collapse of agriculture, also caused the demise of the agricultural shows. Without a profitable farming industry, commercial firms had no reason to attend and without their fees, the shows would not be viable. Therefore, a major technology transfer resource

has been lost along with opportunities for the farmer to improve his position in the supply chain.

Given the new circumstances, it is imperative that the Ministry re-establishes the Erbil Agricultural Show as a gateway into restoring this valuable part of the supply chain. A revived Erbil show would be used to train interested parties in the process of running an agricultural show – it would be used as a capacity-building event to train people in the organisational management so as to repeat the event in other cities.

Agricultural shows are simple to set up. An area of land is marked and fenced off. Competitions for all relevant agricultural practices are set up – breeds of animals, horticulture products, home produce, crafts and skills (and potentially horse riding skills). Stalls are available for traders – food producers, crafts, clothing, sweets etc are available to rent (and these can be managed to only allow local producers have a stall). One section of the land is reserved for music (entertainment) and eating food. All animals are checked by veterinarians before they can enter the enclosure and each animal type is kept in a separate area. The certificate to the farmer who has the best animal classifies his animals as a pedigree herd; and other farmer trying to improve their herd know to buy his animals – at a premium. The judging process educates all the farmers as to what is required to become a registered pedigree farm. The site must be near a population centre, have adequate parking and toilet facilities and is heavily advertised in the population centre. Urban visitors will outnumber rural visitors (who all pay to enter the show), will be able to buy farm products (food and craft); and the connection between the two communities will be strengthened.

Bring financial liquidity in the rural environment - There are two financial systems, which could make significant contributions to improving the agricultural supply chain – micro financing and community banks (credit unions). Neither of these systems are government based.

In its simplest form, micro-financing occurs when, a group of people pool their funds on a regular basis and each takes turns to invest the pool of money in their own value-added business. When this finance model was discussed with farming women, none had ever heard of such as system. Approximately half of the women were interested in the system and could identify a similar group that they could work with.

The community banks are small banks into which local people save and their money is used to finance community approved small projects for members. The amount of money that a member can access depends on their savings. The savings community appoints directors from its own members who run the bank. These directors are volunteers who decide on each application as to whether the community will fund the project. The individual receiving the money agrees to a repayment schedule by which the money is returned to the community bank. The repayment programme includes the appropriate administrative charge to cover the cost of managing the scheme. For the first project, the individual can only ask for the value of their savings. For their second project, they can ask for 1.5 times their savings, provided that another saver can cover the extra money in case the project fails. Once the member has established a good record with the savings community, they can borrow up to 3 times their savings without a guarantor. Such community banks keep the money safe, while ensuring that the farming communities can keep investing and developing their businesses.

Knowledge supply chain issues

The knowledge supply chain is the central component in the jigsaw wherein personal agricultural knowledge is developed, continuously increasing the efficacy of the farmer. A more knowledgeable farmer produces more food and safer food, whilst improving the production environment. However, in report after report, technology transfer is criticised as being absent or not functioning.

Successful technology transfer in Kurdistan depends on high quality agricultural graduates being able to break down complex agricultural issues into suitable messages which poorly educated farmers can comprehend and adopt. In other words, the specialist must be an excellent teacher – which requires specialist training. No mention was made of training in communication skills, as required for this type of work. It would certainly make a highly valuable work experience for undergraduates!

In general, the level of farmers' education is basic, which significantly increases the need for high quality technology transfer facilities. However, when the farmers were asked about the importance of technology transfer, few thought it relevant. This either suggests that the majority of farmers have no real knowledge of the benefits of good technology transfer or that they have given up waiting for it.

Main challenges:

1. Lack of public sector reform that keeps rural poverty intact,
2. Lack of rural credit, access to banking system
3. Rural poverty due to small farm size is elongated
4. Quality of University education
5. Lack of technology transfer

Recommendations:

- Sector reform aiming at providing key services to the sector (supported by investments)
- Increase farm size that will help private sector involvement
- Consider introduction of agricultural shows and agri-tourism
- Boost financial liquidity in the rural environment through micro financing and community banks (credit unions).

2.7 Livestock, Sustainable Forestry, Fisheries and Aquaculture systems

Livestock, poultry and fisheries

In addition to the agricultural production of many crops, livestock plays an important role in the economy of the KRI Cattle, Sheep and Goats provide meat, wool, and milk. There are a number of rural people who specialize in raising livestock, whether in addition to farming or breeding for livestock only. The people of the region practice transhumance-moving their flock of sheep and goats to higher mountain pastures in summer and down to the plains in winter. Poultry makes an important contribution to the availability of the animal protein for the population.

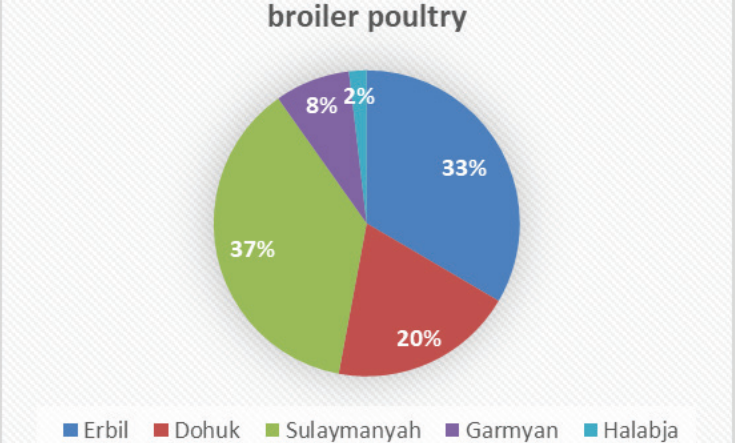


Figure 28 : Broiler poultry production in KRI

The total number of livestock in the Kurdistan Region is around 4 million. However, MOAWR figures indicate that the Region was only able to locally produce 22% of its estimated need of red meat, which was calculated at 100,000 tons. Similarly, in 2011, the Region produced only 1,430 tons of fish, constituting only 21% of the estimated need of 6,700 tons. Thus, significant development is needed in terms of local production of red meat and fish. Poultry production has fared significantly better, with the Region's farmers producing 55,000 tons of chicken (56% of total need) and 430 million eggs (67% of total calculated demand).

According to data from the KRSO(44) for 2017, the total number of livestock raised in villages, pastures and animal raising farms are 256,999 cows, 2,399,176 sheep and 1,223,949 goats.

The total local production of white meat (chicken) in 2017 is 108,000 ton representing 77.14% of the total estimated need at 140,000 ton. The red meat production is 78,000 ton representing 86.7% of the total estimated needs at 90,000 ton, in addition to the production of table eggs which reached 575.7 million eggs annually(45)

KRI has several livestock projects for various purposes such as breeding farms for sheep and goat, dairy farms (caw and buffalo), fattening farms (calve and sheep), ostrich breeding farms and slaughter houses (Table 27). In addition to poultry projects for broiler and layer, hatcheries and poultry slaughter houses (Table 28) are among such projects.

(44) KRSO 2017

(45) General Directorate of animal production and veterinary 2018

Animal projects in KRI/2018								
Governo-rate	**sheep and goat breeding farm**	**dairy cattle breeding farm**	**buffalo breeding farm**	**calves Fattening farm**	**Sheep Fattening farm**	**Ostrich farm**	**Animal feed plant**	**Animal Slaughter house**
Erbil	23	30	0	25	1	1	14	1
Dohuk	41	13	1	5	4	0	3	1
Sulayman-yah	6	16	0	12	0	0	5	1
Garmyan	0	1	0	0	1	0	4	0
Halabja	0	4	0	1	1	0	0	0
Total	70	64	1	43	7	1	26	3

Table 27: Livestock projects in KRI/2018

Poultry projects in KRI/2018							
Governorate	**Broiler poultry**	**layer poultry**	**Hatchery**	**chicken par-ent stock**	**chicken Hatchery**	**broody hens**	**poultry slaughter house**
Erbil	467	8	13	1	25	2	4
Dohuk	272	2	0	0	5	0	1
Sulaymanyah	520	0	3	0	10	0	2
Garmyan	111	0	0	0	3	0	0
Halabja	26	0	0	0	0	0	0
Total	1396	10	16	1	43	2	7
Total Capacity	20,328,145	1,595,410,000	95,508,880	4,500,000	271,282,000	8,500,000	27,500

Table 28: Poultry projects in KRI/2018

Fish production

The fish farms are spread in the governorates of Kurdistan and the total number of fish farms in Kurdistan are about 393, including 20 farms using fish cages technology, which was introduced by FAO through one of its projects implemented in Iraq and has been adopted by many fish farmers. The total production of fish farms using cages are 613 tons, which is satisfactory. Table 29.

Fish Project in KRI (2018)												
Governorate	Fish Pound Project		Concrete Fish Project (Salamon Fish)		Fish Cage Project		Closed project		Total		Fish Finger Project	
	No.	Capacity MT/ Year	No.	Capacity MT/ Year	No.	Capacity MT/ Year	No.	Capacity MT/ Year	No.	Capacity MT/ Year	No.	Capacity MT/Year
Erbil	176	320	3	126	1	18	2	93	182	557	0	0
Sulaymaniyah	78	236	8	686	7	463	1	11	94	11,396	1	100,000
Duhok	41	100	3	384	10	122	0	0	54	605	0	0
Garmiyan	61	253	0	0	2	28	0	0	63	281	0	0
Total	356	908	14	1,196	20	631	3	104	393	2,840	1	1,000,000
Source :Ministry of Agriculture and Water Resources /Fishes Department												

Table 29: Number of fish farms, capacity and production- location (governorate) (35)

The director of fish within agricultural research center said that the production of fish fingerlings for breeding propagation has decreased from millions to 200-300 thousand fingerlings per year, due to the lack of funding budget. This is a threat to the growth and development of fish production in Kurdistan. He also noted that commercial fish breeders do not have sufficient technical information about the management of fish farms and proper fish raising methods.

The region imports other required quantities in addition to the local production. Table 30 shows that the quantities of imported fish are decreasing from 12,475 tons in 2015 to 10,994 tons in 2016 and to 5,255 tons in 2017. The imported quantities have decreased to about half in just three years - which means domestic production is beginning to approachself-sufficiency. Opportunities may exist for exports.

Total fish quantities(Ton) imported 2015-2017			
Governorate	Y 2015	Y 2016	Y 2017
Erbil	1944	1778	629
Sulaymaniyah	5167	1858	996
Duhok	160	7219	5220
Garmiyan	5205	0	1110
Total	12475	10994	5255

Table 30: Total fish quantities imported 2015-2017

(35) General Directorate of Animal Production and Veterinary/fish production report for 9 months of 2018

Main constraints

Three major issues have impacted the livestock sector negatively.

1. The quality of animal feed was very poor. Bags of cereal dust were being sold as fodder during the high summer when there was no plant growth. There did not appear to be any equivalent silage ,like material or quality hay, suitable for keeping the animals growing during the summer period.
2. The collapse of the vaccination programme had reversed all the recent improvements in animal health. The native cattle were praised by the farmers for their durability in surviving in nature, but as dual purpose animals, produce neither large quantities of milk nor meat. The progress which had been achieved with the artificial insemination programme was being lost following its termination.
3. Both vets and farmers complained that since the economic crises, border security in relation to plant and animal health had collapsed. There was free movement of cattle between countries and this promoted animal diseases and infection.
4. Lack of investments in production of fish fingerlings by government, which may or may not be taken up by the private sector.

Recommendations

- Support animal fodder seed growers and links to market
- Strengthen capacity of government to check borders – cross-border monitoring of animal and plant diseases and control (including laboratories and quarantine services)
- Start animal vaccination programme again and artificial insemination
- As can be seen from the reduction of imported fish, fish could be a high-value commodity already on its way to establish a niche market for itself in the KRI. Support for marketing fresh, raw, smoked, fish domestically and internationally could be an option.

2.8: Needs for agricultural research and improved or new crop varieties.

Agriculture research

The General Directorate for Agricultural Research, Training and Extension (GDARTE) is responsible for agricultural research and technical training for worTraining and Extension (GDARTE) is responsible for agricultural research and technical training for workers in the agricultural sector, as well as providing agricultural extension services in the Kurdistan Region. GDARTE includes five directorates, one in each of Erbil, Dohuk, Sulaymaniyah, Halabjah Governorates and Garmian (Garmian is an independent administration). The Erbil Research Directorate has 138 employees, of whom only four have masters degrees and 56 have bachelor and diploma degrees, indicating that none are PhD holders.

Currently, research activities are limited to conducting varietal evaluation trials of new agricultural varieties, particularly wheat, barley and legumes.

In the light of these varietal trails, five strains were selected from ICARDA and CIMMYT for bread wheat varieties. Two of them were officially registered and released, while four varieties of durum wheat were not registered nor released yet. In addition to conducting comparative varietal trails, they are conducting breeding and crossing programme including wheat crop, but no results have been recorded so far.

GDARTE was established as a branch of the general directorates for agriculture research in Baghdad in 1987 and then became the General Directorate for Agriculture Research, Training and Extension (GDARTE) in 1991 at the Ministry of Agriculture and Water Resources/ Kurdistan Region-Iraq (KRI) to carrying out different kinds of research.

Not all these research topics are covered by the GDARTE research plans because of the lack of allocations or lack of qualified scientific personnel in a number of research disciplines to implement relevant research programs such as livestock research. Also a water use management department was created. One of the successful research activities is the establishment of a number of grape varieties orchids where grape seedlings are produced and distributed to the grape orchard`s farmers. Various research stations exist:

- The Directorate of Agricultural Research/Erbil (DOARE) based in Ainkawa that continues field trials for improving field crops production, certified seeds production, horticulture, forestry, soil, etc. in collaboration with farmers, including the production of certified wheat seeds for farmers. There are three laboratories in Erbil Research Directorate, namely i) Physic Laboratory; ii) Chemical Laboratory; and iii) Plant Protection Laboratory.
- The Directorate of Agricultural Research in Sulaymaniyah (DOARS). In 2007, a General Directorate of Agricultural Research has been established at the Ministry of Agriculture and Water Resources (KRG) where DOARS became one of its branches in Sulaymaniyah governorate. It has six technical departments in different agro-climate zones in Sulaymaniyah, namely Bakrajo, Kanipanka, Zirgwez, Bazayan, Girdyan and Sirwan.
- The Directorate of Agricultural Research in Duhok (DOARD) was established as other research centers belong to General Directorate of Applied Agricultural Research in Baghdad, and then became the Directorate of Agricultural Researches at the Ministry of Agriculture and Water Resources/KRG. Currently there are 5 research stations in Duhok: Malta (30 donum, Zakho (1888 donum); Husseniyah (40 donum), Kavalseen (12 Donum); and Kanikark (500 donum)

– Directorate of Agricultural Research in Halabja (DOARH) was established recently representing guaranteed rainfed areas focusing on research for the different crops planted in Halabja Governorate. The DOARH has two research stations, namely i) Halabja (12 donum) for wheat research activities and ii) Sirwan (67 donum) for orchard research activities.

The agricultural research activities in Kurdistan Region faced many fluctuations in their stages of development, which were not stable due to the prevailing security situation. This led to their discontinuation in many cases and as a result, destroyed several of their research facilities and many of their field machineries, laboratory equipment, research records, data and other reference material were lost. Currently, the KRG is working hard to restore the scientific activity of these important institutions in an effort to develop the agriculture sector and improve population prosperity. Still, there are still many obstacles that hinder the process of agricultural scientific research in Kurdistan.

The Agricultural Research Institute in Kurdistan suffers from a severe shortage of qualified scientific staff, especially those with PhD degrees and in all agricultural fields that can design and lead agricultural research through connecting with the difficulties facing the agricultural sector and that can obtain a beneficial scientific result helps solve problems and dilemmas that hinder advancement and development of the agricultural sector. Despite the great efforts of the General Directorate for agriculture research, the financial crisis has greatly affected the continuity of communication with farmer communities, where the two-way communication between research and the farmers should be as policy instruments to promote agricultural development.

The impact of the financial crisis that hit the region, forced the research directorates to reduce the various research activities and limited them to a number of research activities and to a certain number of crops, such as wheat.

It has been observed that there is poor communication with the mandated international agricultural research organization/ institutions, which contributes to the lack of communication with the developments that occur in the field of agricultural research and the development of technology. In addition, it also leads to the discontinuation of utilization of international expertise, training opportunities, periodicals, scientific journals, technology transfer and exchange of genetic resources materials for research development purposes

The GDARTE and its research stations demonstrate shortage of field machineries and laboratory equipment necessary to complete the agricultural research in a scientific approach and accurate manner to obtain accurate results.

One of the most important tasks of the GDARTE is to maintain varieties for various agricultural crops, especially those under the seed multiplication program, such as wheat and barley. However, it was observed that this activity was stopped due to the lack of necessary financial allocations, which led to a halt or reduced seed quantities produced of breeder, foundation and registered seeds.

Agricultural research plans are needed to guarantee many agricultural crops that have significant consumer demand, such as rice crops (characterized by special flavor), potatoes as a new and promising crop, vegetables and others need to be developed as major crops in terms of nutritional value and increasing local demand.

Mitigation of the risks of agricultural production under rain-fed condition

The continuous climate change and the increase in drought recurrence puts the agricultural production of both plant and animal in constant danger, as well as the food security and the livelihood of rural communities living at the rainfed areas, especially since it is know that the 89% of wheat cultivated area and 98% of barley cultivated areas are under rainfed condition.

There are four ways to reduce the risks of the impact of climate change and improve and stabilize rain-fed crop production:

1. Increase water-harvesting projects to increase water productivity and improved water management
2. Improve agricultural practices and inputs used such as crop varieties suitable to rainfed conditions as well as the other inputs
3. Expand supplemental irrigation as a highly efficient and yield stabilizing practice. Supplemental irrigation is an effective response to alleviating the adverse effects of soil moisture stress on the yield of rain-fed crops during dry spells.
4. Establishment of new irrigation projects, where it is possible to cover a portion of the rainfed land ,and convert it into irrigated agricultural land with the possibility of activating planned irrigation projects and those currently suspended due to the financial crisis

Main challenges:

1. Too much focus on production rather than investing in the whole value chain to add value, including post-harvesting, handling, storage, processing, transport, wholesale, marketing and retail/ export. Seasonal surplus of vegetables and fruit is available but storage/ processing is not happening at scale.
2. Little is invested in identifying existing varieties with high productivity, disease resistance and drought tolerant varieties which could be selected and multiplied for further seed multiplication.
3. Due to the successive climatic changes in recent years such as drought phenomena, high temperatures, low rainfall precipitation and delay and irregularity, which showed a clear impact on the agricultural production, both plant and animal production affects livelihood of the population, especially in rural areas. Support of the agricultural research requires that the agricultural research centers should focus through research programs on production and/ or introduction of improved varieties resistant to drought, high temperature, less consumption of water with a focus also on implementation of the good agricultural practices that appropriate to the environmental and climatic conditions affecting the region.
4. The agricultural situation in the KRIdoes not depend on a limited number of agricultural crops, but it also produces a large number of crops such as cereal crops, legumes, industrial crops, various vegetable crops and potatoes. The task of the research centers would lag compared to the development of agriculture if its research programs focused only on one or a few crops. The active research programs must be extended to include different crops and must be included within the varietal developing programme for different agro-ecological zones with more emphasis on a number of crops that take priority in the needs of the population and food security.

Recommendations

Strong recommendation to replace the existing varieties with high productivity, disease resistance and drought tolerant varieties.

- Establishment of Gene Bank for KRI - There is an urgent need to fill gap in conservation, both ex situ and in situ, of agro-biodiversity in northern and northeastern areas, particularly in the semi-arid ecosystems. This represents a habitat of endangered natural populations of important wild relatives and landraces of wheat, barley, lentil, chickpea and a number of forage, pasture legume crops, fruit and nut tree species.
- It is recognized that the KRI is one of the areas that are rich in genetic biodiversity and it is considered a large reservoir for the collection of genetic resources used in the genetic development of many crops, particularly wheat, barley, lentil and chickpea. In this context, we propose establishing a gene bank (Ex situ conservation) in the KRI to collect, document and conserve genetic resources and introduce/develop a strategy for conversation and utilization of plant genetic resources.
- Establishment of KRI Herbarium -Establish an herbarium to study the plant wealth (vegetation), which is rich in the region and the collection specimen for each kind of living plants for identification, classification and description according to scientific approach.
- Plant natural reserves (In-Situ Conservation) Germplasm stored ex situ (gene bank) for short, medium and long-term storage period, while in site to preserve the biodiversity at plant where grown in the nature. For plant genetic resources (PGR), an integrated system is necessary considering the three principal ways of germplasm management—ex situ, in situ and on-farm and for that, the idea of establishing “natural reserves” which was created to protect biodiversity and to contain all living organisms from the danger of damage or extinction. It is highly recommended to establish a number of natural reserves areas in a selection location rich with biodiversity material.

Agriculture zone mapping

- There are a few studies related to the use of agricultural land and the identification of soils in terms of fertility and suitability for the cultivation cultivation of various agricultural crops using satellite technology.
- Map of the agricultural land cover, as the remote sensing product, is important for crops development monitoring, crop rotation mapping, obtaining statistics on agricultural crops prevalence, as well as for the provision of information on soil quality in the form of biophysical parameters for better management. Data obtained using the remote sensing methods are also important for provision of information necessary for creating agricultural policy.
- For that, we propose to set up the agriculture zone mapping (crop suitability) using climate (temperature, precipitation, growing day, and minimum winter temperature) and soil (texture, pH, and drainage) requirements. This assists in planning for the cultivation of strategic crops to increase crop productivity through:
- Identify the agricultural zones suitable for growing crops (crop suitability map) in relation to climate and soil requirements in KRI using modern technology to improve productivity and production
- Provide cropping information on agriculture crop zone and on national level at various stages of crop development including climatic data (temperature, daily rainfall precipitation, growing days, vegetation index) and soil data (soil texture, PH, salinity, soil thickness, soil fertility).

2. 9 Extension Services for Farmers

Generally, agricultural extension can be defined as the "delivery of information inputs to farmers for better farming practices." Agricultural extension plays an important role in the development of the agricultural sector, where considered the bridge linking between the farmers and the agricultural research centers. Its role is identifying the problems facing farmers, transferring to scientific research to find appropriate solutions and transferring newly-found technologies from research institutions. Another role is providing recommendations to farmers' fields to improve the quality and quantity of agricultural products. Without this activity, research results will remain unused.

The Directorate of Agricultural Extension is mandated to provide extension services through 43 Extension and Training centers, covering most districts and sub-districts in the KRI in addition to the main training centers at Governorates (Table 31).

No	Governorate	No. of Extension Centers
1	Erbil	14
2	Sulaymaniyah	16
3	Duhok	9
4	Halabja	1
5	Garmian	3
Total		43

Table 31: Number of extension center in KRI

These extension and training centers are providing proper training for the technical staffs and farmers in addition the following activities:

1. Technical visits to the farmer's field;
2. Contact farmers by phone through extension staffs;
3. Conducting field demonstration (field day) on research farms;
4. Seminars and meetings with the farmers for current problems facing the agriculture production;
5. Broadcasting weakly agricultural TV programme, Radio and Social Media.
6. Printing folders, booklet and posters.
7. Organizing Agricultural fares.

The extension services seem to have been particularly affected by the Syrian crisis - the stream of Syrian refugees into the KRI followed by the large IDP flow from Governorates like Nineveh and Anbar. This triggered a fiscal crisis – to provide for refugees and IDPs as well as the political divide with the Federal government in Baghdad – which prevented many extension staff to go on field visits. An example can be seen from one of the research stations in able 32.

No.	Type of Activities	No. of activities					
		2013	2014	2015	2016	2017	First half of 2018
1	Field visit	1082	850	839	785	266	208
2	Farmer Meetings	99	22	15	2	1	5
3	Training for farmers	41	14	29	4	2	2
4	Training for employees	0	0	16	4	2	1
5	Field demonstration for wheat	9	0	0	0	0	0
6	Field demonstration	0	8	29	3	0	0
7	Field day	0	0	11	0	0	0
8	Wheat cleaning training	2	0	0	0	0	0
9	Agricultural exhibition	0	2	4	1	0	0
10	Workshop	3	4	10	3	1	0
11	Seminar	9	17	33	19	0	5
12	Animal numbering	42	0	0	0	0	0
13	Telephone communication with farmers	18	0	0	99	39	36
14	Summer trainings for students (College and institution of Agriculture)	3	0	0	0	0	0
15	Agricultural programs in radio	0	0	1	0	6	0
Total		1308	917	987	920	317	257

Table 32: Agricultural Extension Activities in Sulaymaniyah Governorate 2013-2018

Main challenges:

Lack of operational budget seems to stop extension staff from playing their potentially vital role in the field.

Recommendation:

Conduct a Strengths- Weaknesses- Opportunities and Threat (SWOT) analysis of the extension services and centers and undertake needs survey among their clients (farmers and value chain actors), and develop a plan that aims at full operational capacity of the most important parts.

List of detailed Reports

1. In-depth Study for agricultural sector in Kurdistan region of Iraq (covering mainly crops) Annexes
2. Analytical study of agricultural market and policy issues; affecting the Value Chain for Food Production in the Kurdistan region of Iraq
3. Report on Water and irrigation:

PART I BACKGROUND

PART II WATER RESOURCES AND CHALLENGES IN THE KURDISTAN REGION IRAQ

PART III INSTITUTIONAL AND LEGAL FRAMEWORK FOR WATER RESOURCES AND IRRIGATION IN THE KRI

PART IV CURRENT SITUATION OF THE IRRIGATION SECTOR IN KRI

PART V FINDINGS AND RECOMMENDATIONS

PART VI PROPOSED IRRIGATION PROJECTS AND IMPROVEMENTS

PART VII PROPOSED INSTITUTIONAL FRAMEWORK AND WATER MANAGEMENT IRRIGATION POLICY

Appendixe

REVIEW OF THE AGRICULTURAL SECTOR IN THE KURDISTAN REGION OF IRAQ:

Analysis On Crops, Water Resources And Irrigation, And Selected Value Chains