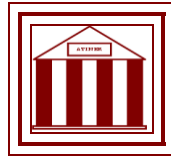


**Athens Institute for Education and Research
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**ATINER's Conference Paper Series
GEO2015-1618**

**Revitalising Agriculture and Water
Sectors in the Kurdistan Region, Iraq**

**Serwan Baban
Professor & Vice Chancellor
Cihan University
Iraq**

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Revitalising Agriculture and Water Sectors in the Kurdistan Region, Iraq

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Abstract

The agriculture and water resources sectors in the Kurdistan region, Iraq have suffered from a series of unfortunate damaging events which include war, political conflicts and harmful national and international policies. This paper will recount and examine the implementation of a specifically developed road map during the period June 2012- May 2014. The road map aimed to provide science based practical steps to rehabilitate, improve and to sustainably develop agriculture and water resources in the region. The ultimate goal is to achieve food sufficiency and security for the region.

The analysis shows that the challenges facing the realisation of strategic objectives include; urban expansion, the efforts by neighbouring upstream countries to build dams and irrigation projects, the allocated budget, governorate law, the Ministry's structure and workforce, lack of local data and not effectively employing research driven management options.

Overall, the outcomes show an optimistic picture of tangible and conceptual achievements include; realising self sufficiency with wheat and potato production. Work has started on building 22 dams and will also start on some larger dams, completing work on 86 ponds with plans for build another 50, additionally work has started on several large irrigation projects. In addition to success in implementing the plans based on participatory decision making, following a clear and transparent process and to giving the highest priorities to quality assurance and control processes.

Keywords: Agriculture, Development, Iraq, Kurdistan region, Water Resources

Introduction

The Kurdistan region is highly suited for agriculture as it boasts large areas of arable land and fertile soil. The varied topography and associated rainfall regimes have created three basic micro-climatic zones; high rainfall (700-1100 mm), medium rainfall (400-700 mm), and low rainfall (under 400 mm). In terms of produce; the high-rainfall zone contains mainly fruit orchards, wheat occupies most of the medium-rainfall zone, and barley is the main crop in the low-rainfall zone. Winter wheat and barley are planted in the autumn (October-November) and harvested in the late spring (April-June) in accordance with the rainfall pattern (Mahdi, 2000; Baban, 2006).

Unfortunately, agriculture and food production declined significantly due to several factors occurring in the period leading up to the Iraq War of 2003. These include; a three-year drought that devastated agricultural production in much of the Middle East during 1999-2001; a growing dependence, since early 1997, on the U.N. OFFP for basic foodstuffs which understated the need for local food production; central government's total focus on the military sector; failed policies, limited investment and deteriorating infrastructure; and serious land ownership and water rights issues (Mahdi, 2000; Baban 2012b; 2013a).

The Kurdistan region is rich in water resources having five large rivers running through it. These include the Khapoor, Great Zab, Little Zab, Awaspee, and Serwan. The total annual water flow capacity stands at 30 billion cubic meters (Baban, 2006). About 60% of the water sources of the rivers mentioned is from Kurdistan, and 40% is sourced outside of Kurdistan. The total arable land in Kurdistan is 1,535,794 hectares. If the water is used properly, it could irrigate the entire land instead of the 11% it currently irrigates. In addition to the five rivers mentioned above, Kurdistan has springs, groundwater, and rain water from the annual rainfall of 8 billion cubic meters (Baban, 2006; 2012b; 2013b; 2014).

Evidently, agriculture and water resources in the Kurdistan Region are critical sectors from a national food and water sufficiency and security perspective. Furthermore, they could become important public revenue stabilizers at a time when oil revenue is highly volatile putting the government and its programs at risk. Additionally, the rehabilitation of these sectors translates into reviving village life, creating more job opportunities, encouraging new industries, and upgrading the standard of living and quality of life (UNDP, 2012; Baban, 2012b; 2013a; 2014).

This paper will report on the progress of a specifically developed and implemented road map from June 2012-May 2014, aimed at taking serious science based feasible steps towards achieving food and water sufficiency and security for the region. The paper will examine the barriers to implementation; suggest ways forward and will summarise the overall tangible and conceptual outcomes.

The First Steps

In order to gather comprehensive knowledge about the Ministry of Agriculture and Water Resources in terms of its functions, structure, the workforce, stakeholders and related challenges and to develop science based options as the basis for sustainable planning, it was deemed necessary to be established a clear understanding regarding these issues at the following levels:

The Regional/National Level

Agriculture was systematically devastated throughout the Anfal years, as 4,500.0 out of 5,000.0 villages were destroyed; this was closely followed by internal conflicts, years of sanctions, and the UN oil for food program which ignored local food production and more recently by large quantities of relatively cheap food products from neighboring countries. Furthermore, the main cities in the region are located on the best available agricultural land, consequently, agriculture and food production has also been affected by the rapid urbanization in the region which is based on the current 'Master Plan' for cities (Baban 2012a; Baban, 2013a). Furthermore, the region is currently experiencing an increase in water demand due to an expanding population, improvements in quality of life and development activities (Baban, 2005; 2013b, 2014).

In terms of functions, the Ministry has a wide band of responsibilities including: Agriculture and food production, Land management and allocations, Water Resources (Surface, Ground, Storage and Irrigation), Veterinary and meat production and Forestry. Whilst in terms of structure it has 13 General Directorates and some 17,000 employees. The current organization has difficulties with establishing clear functions and line management duties amongst others (Baban 2012b, 2013b, 2014).

The International Level

The surrounding adjacent upstream countries have aggressive plans for, and are racing towards building large numbers of giant dams and vast irrigation projects. Examples include the Atatürk Dam, which was considered to be the world's largest construction site and was completed in 1990 in world record time of around 50 months. This giant dam is in the centre of 22 dams on the Euphrates and the Tigris rivers, which comprise the integrated, multi-sector, Southeastern Anatolia GAP Project.

There are several international agreements which are intended to manage the Euphrates and Tigris rivers. Namely, in 1946, these established information sharing. In 1987, Turkey and Syria signed a one-page protocol determining the water flow of the Euphrates at the Turkey-Syria border; the agreement was reconfirmed in 1992 and 1993. In 1996, brief agreement was signed between Iraq and Syria fixing the distribution of the Euphrates between them at 42% to Syria and 58% to Iraq. The difficulty is that to date, there have been no agreements between all three states and that existing National and International water laws, legislations and mutual collaborations are overtly weak and cannot

ensure the water rights of downstream countries and regions (Aysegul et al., 2013).

In terms of Agriculture, efficiently and massly produced relatively cheap agricultural products from neighboring countries and the wider region are flooding the local markets without the local produce being able to match or compete with imported agricultural goods in terms of quality, quantity and prices (Baban 2012b, 2013b, 2014).

Global Level

The Intergovernmental Panel on Climate Change (IPCC) uses the tools of climate models with future scenarios of forcing agents (e.g., greenhouse gases and aerosols) as input to make projections of future climate changes which illustrates the possibilities that could lie ahead. Based on the A1B Scenario, which presents the resulting projections of changes to the future climate, the Kurdistan region, is likely to be affected by climate change and will suffer from negative impacts on agriculture and food production due to changes to essential growth conditions of temperature, humidity and rainfall. These changes will have a direct impact on agricultural produce and productivity. The impacts on water resources include an overall low rainfall with higher intensity and low frequency (Lelieveld et al. 2012; Baban, 2005; 2013; IPCC, 2014).

Guiding Principles for Decision Making

Given the complexity of the issues, ongoing practices and decision making and delivery mechanisms in the Ministry, it was necessary to establish and to agree upon, some practical principle guidelines for decision making and to agree on a code of ethics and conduct to maintain a strategic focus whilst maintaining consistency and transparency. The agreed principles were as follows (Baban 2013a, 2013b; 2014):

- i. The region is one Economic and Management Unit and the Ministry will plan for full economic Integration and will be committed to nation building fundamentals.
- ii. The Ministry will make scientific and evidence based decisions, build effective and transparent systems, always follow process and ensure that Public interest and the law are supreme.
- iii. There will be commitment to 'Collective and Representative Decision Making' through Activating the Ministry Advisory committee monthly meetings which consist of all relevant people and take the meetings to different parts of the Region.
- iv. There will be a commitment to 'Participatory Decision Making' through meeting our stakeholders during regional visits and meetings as well as establishing weekly Ministerial face to face meetings with citizens and relevant syndicates to facilitate their

requirements and receive their suggestions for improving our services and performance.

- v. There will be a commitment to self evaluation and improvement, the Ministry will embark on continually reviewing its management and administrative system to serve the ultimate purpose, namely, improving quality and raising standards to achieve food and water sufficiency and security.

Planning for a Sustainable Future

The Vision and Challenges

The objective of the Ministry is to achieve food and water sufficiency and security. Hence, it is critical to deliver a healthy and nutritious diet to all citizens; such a diet should be based on local produce. Within this context, the Ministry is guided by the USDA approved standards (USDA, 2011) (MoAWR, 2012; Baban 2012b), in addition to sustainable development and serving all stakeholders in the best possible way. Hence, the vision was defined as attempting to achieve food and water sufficiency and security. In practical terms for agriculture, the vision means that citizens obtain a healthy diet based on internationally approved standards. Whilst in water resources, it means securing necessary water for drinking, farming, manufacturing and tourism.

Developing a Roadmap for Sustainable Agriculture and Water Resources in Kurdistan (a Consultative Process)

Ongoing frequent meetings with stakeholders and experts throughout the region regarding agricultural produce in terms of quantity and regional needs. In addition to the analysis of available statistics charting the progress of the Ministry's 5 year plan, which was established during 2009, (MoA, 2009) lead into developing a draft Roadmap which was gradually enhanced based the consultative process involving Ministry experts, all local universities, the farmers, the parliamentary group and the public (MoAWR, 2012). It was established that rehabilitating agriculture and water resources requires (Baban 2012a, 2013a):

1. A clear and a practical vision, defining the priorities to fulfill the nation's agriculture and water needs.
2. An effective roadmap with clear objectives and timeframe developed based on consultations with all stakeholders.
3. Effective structure and modern management, training, and reflective systems for agriculture and sustainable water resources management.

Implementing the Road Map

Short Term Priorities

These include the following planning and management Issues:

1. Preparing the Ministry and its Workforce and making it fit for purpose through higher degrees and training to deliver the Strategic Priorities
 - i. Revise Ministry's structure and enhance management services.
 - ii. Simplify the hierarchy and decrease bureaucracy.
 - iii. Provide direct, relevant and efficient services in all provinces.
2. Granting more support to productive farmers and link support to actual productivity in terms of quality and quantity.
3. Providing timely and effective services
4. Improving the quality assurance and control as well as reporting on technical, financial and management challenges and issues.
5. Enhance communication with stake holders.
6. Protection of human rights and achieving equity amongst Ministry staff.

Strategic Priorities

Agriculture

These include:

1. Achieving food self-sufficiency and security
2. A holistic approach for managing all sectors in agriculture including forestry, horticulture, plant and animal production, poultry projects, animal husbandry, irrigation projects, and research and development.
3. Provision of a basket of help to farmers and link to productivity
4. Support agricultural applied research to deal with issues of increasing production, disease control, modern irrigation, water harvesting methods and related climate change issues. Defining the role of Research, Training and Extension.
5. Finalise Agriculture Act's rules and regulations.
6. Provide sustainable sources of water for agriculture through increasing storage capacity, water harvesting and using effective irrigation methods.
7. Encourage and promote the private sector.
8. Managing agricultural land issues.

Water Resources

These include:

1. A Holistic Approach for sustainably managing all water resource issues.
2. Water self-sufficiency and security
3. Develop legislations and laws for sustainably managing water in the region.
4. Benefiting from the surface water and reserving the groundwater.

5. Making use of modern methods and technologies
6. Strengthening the relationship between the Ministry's research centres and Water resources and Engineering faculties within universities in the Region, nationally and worldwide.
7. Raising awareness regarding the sustainable use of water in all sectors.
8. Include all stakeholders in the decisions making process.
9. Encouraging private sector involvement.
10. Strengthen the role of the Region in planning and decision making in Iraq, regionally and globally.
11. Being prepared for natural disasters.

Policy Actions and Instruments

Evidently the successful implementation of the road map will require changes in policy driven by a number of policy actions and instruments including:

1. Thinking differently about agriculture and water resources. Integrating planning and management of food security, sustainable water resources and conserving ecosystems. For example, agriculture and water should be conceptualised as an integrated multiple-use system comprising of an agro-ecosystem and a hydro-ecosystem, providing services and actively interacting with other ecosystems rather than solitary production systems.
2. Improving access to agricultural land and water resources through land and water rights, provision of low interest loans, a package to help framers with improved seeds, fertilisers and extension services as well as investing in water storage, roads and markets.
3. Adopting science based planning and management approaches such as:
 - i. Planning and licensing to manage land and water use as well as upholding water quality to acceptable standards.
 - ii. Regulation and zoning to enforce code of good practices such as managing nitrate and pesticide vulnerable zones.
 - iii. Environmental taxation and environmental subsidies to obtain charges for land and water set on a cost recovery base.
 - iv. Self regulation/management agreements to manage land and water use and reducing pesticides and fertilizers.
4. Increasing the productivity of land and water. For example, gaining more yield and value from less water through limiting environmental degradation, adopting integrated systems and higher value production systems and through reductions in social and environmental costs. With careful targeting, the poor can benefit from water productivity gains in crop, fishery, livestock, and mixed systems.
5. Making irrigation more effective through a combination technological and managerial upgrading to improve responsiveness to stakeholder needs For example, as part of the package irrigation needs to be better integrated with agricultural production systems to support higher value agriculture and to integrate livestock, fisheries, and forest management.

6. Reforming and upgrading government institutions. A significant shift is required for breaking down the divides between departments dealing with different types of agriculture as well the sections dealing with ground water, irrigation surface water storage by introducing holistic and integrated management principles, better linking fishery and livestock practices to water management. This process requires negotiation and coalition building between all stake holders.

Achievements and Outcomes

Achievements and Outcomes Relating to Short Term Priorities

1. Some changes to the Ministry's structure (matching Form with Function) and management practices; measuring success based on productivity; project proposal and evaluation process; delegation of authority to provinces; revised training needs; job descriptions and performance evaluation based on merits
2. Defining the Productive Farmer, reviewing forms of support to farmers and linking them to productivity;
3. Activating the Follow Up section; Upgrading and Expanding the Central Veterinary Laboratory (CVL) and District Veterinary Laboratories to become fit for purpose in terms of disease reporting, disease surveillance and organisation of statutory vaccination programmes.
4. Developing an effective Website, weekly meetings with citizens; regular site visits; regular meetings with various syndicates; complaint and suggestion box; Taking the Ministry Advisory Committee to meet stakeholders at various cities and town throughout Kurdistan region.
5. Developing a health and safety section and program; reforming the process of staff appointment by improving transparency and fair competition by appointing through CV's and interviews; focusing on gender equality and promoting the role of women and youth.

Over all, the Ministry by May 2014 had a significant critical mass and believes in employing scientific concepts and evidence based planning. In addition to developing and implementing the scientific basis for developing the work force and developing systems and regulations to ensure human and public rights as well as health and safety issues.

Achievements and Outcomes Relating to Strategic Priorities

General

1. Developed a list of the Ministry's needs in Higher Education and training (Table 1)
2. Developing and implementing the Agricultural Calendar for KRG (Figures 1, 2); targeting support to productive farmers and planning to use Agro- climatic Zones as the basis for planning in the future.

Table 1. A Sample of the Ministry's Requirement for Higher Certification (Baban 2012a)

| No. | Experts | High Diploma | Master | doctorate |
|-----|--|--------------|--------|-----------|
| 1 | Plant Protection/ Fungus Disease | - | 3 | |
| 2 | Plant Protection/harmful fruits | | 3 | |
| 3 | Plant Protection/ gainful fruits | | 2 | |
| 4 | Plant Protection/Genetic and Breeding | | 2 | |
| 5 | Open Cultivation (For Vegetable) | | 4 | 1 |
| 6 | Managing and Developing Horticulture Nursery | | 4 | 2 |
| 7 | Effect of Purring on Fruit Production | | | |
| 8 | Organic Cultivation | | 6 | 2 |
| 9 | Cultivation by Hydroponic Method | | 3 | 1 |
| 10 | Effect of Weather on the Forest Environment | | 4 | 2 |
| 11 | Tissue Culture and Threat of Damage | | 2 | 1 |
| 14 | Reformation of Hereditary of forest tree | | 2 | |
| 15 | Soil Erosion (Events, Causes, Treatment) | | 3 | |
| 16 | Classification of Rangeland plant | | 2 | |
| 17 | Managing desertification | | 3 | |
| 18 | Plant Protection/ Forest Diseases | | 2 | |
| 19 | Plant Protection/IPM | | 8 | 2 |

Figure 1. Developed Agricultural Calendar Showing Cereal Production in the Region (Baban 2013b)

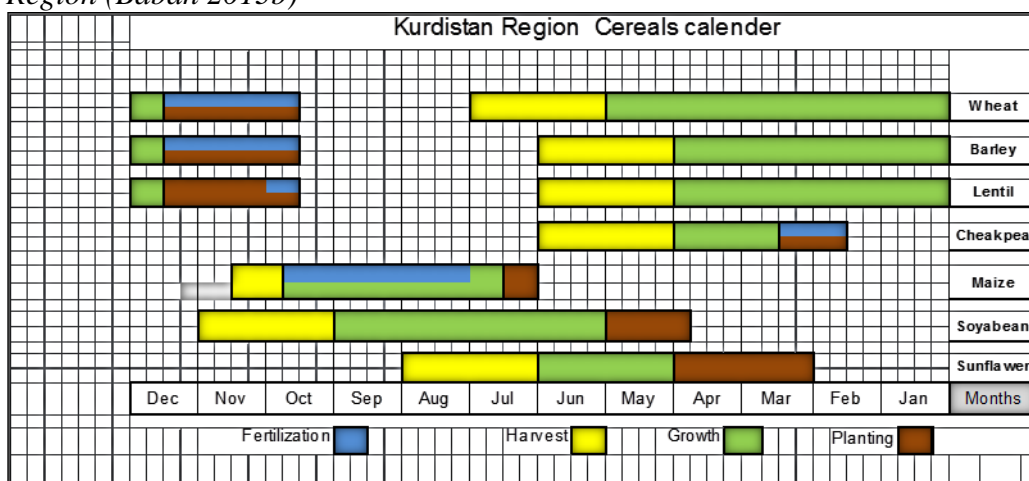
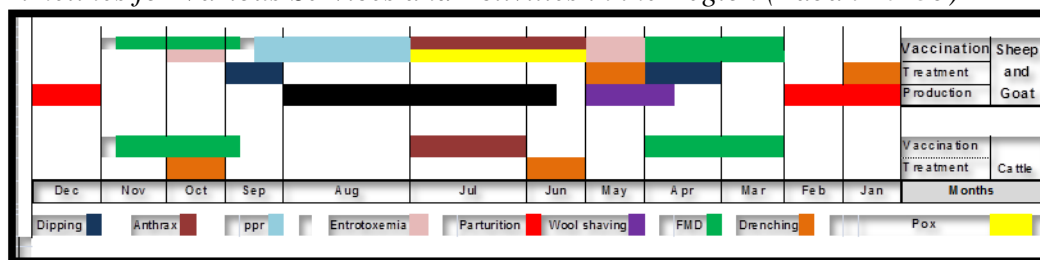


Figure 2. *Developed Calendar for Supporting Animal Health Showing the Timelines for Various Services and Activities in the Region (Baban 2013b)*



Agriculture

1. Planning based on all available data and experiences including the outcomes from and the barriers faced fully realising the objectives of the Ministry 5 year plan from 2009-2013.
2. Protecting local produce by managing imports as well as developing a concept note for adding taxes to imported agricultural produce when local produce is in season.
3. Developing the principles of a holistic approach for management; Kurdistan region is one economic and Management unit, planning to use Agro climatic Zoning for food production.
4. Provision of a basket of help to farmers including; loans, improved seeds, fertilizers, farm equipment, transport subsidy, machinery, agricultural extension service, feed for their animals, training in modern agricultural methods and techniques as well as health and safety issues. All of these were linked to Productive farmers and Productivity.
5. Supporting applied research, research facilities and revising the role of the General Directorate responsible for Research and Training as well as establishing links with Universities and research institutions.
6. Establishing sustainable sources of water for agriculture through building dams, ponds and irrigation projects.
7. Developing legal and practical options to manage agricultural land issues including encroachment.
8. Planning to increase the production of Wheat and Potatoes (Figures 3, 4).

Figure 3 is an illustration of the production of wheat in the region from 2009 – 2013 and shows that production has reached over 700000 tones; given what is required are about 500,000.0. The region has realized self sufficiency.

Figure 4 demonstrates the production of potatoes since 2009 and shows that at 2013, the production was more than 87000 tones. In practical terms, the region has realised self sufficiency for potatoes.

9. Gaining science based knowledge regarding the levels of production, required for self sufficiency in the Region, and the actual levels of production for a number of strategic produce (Figure 5). Evidently, the region has realized self sufficiency in Wheat, potatoes and tomatoes.

Garmen’s production is generally low. Hence, Agro climatic zones should become a principle driver for food production.

Figure 5 shows a comparison between the levels of production, required for self sufficiency in the Region, and the actual levels of production for a number of strategic produce

10. Gaining knowledge regarding the geographic distribution for strategic produce within Kurdistan region (Figure 6). Overall, some regions such as Duhok are showing a high level of productivity whilst Garmen’s production is generally low. Hence, Agro climatic zones should become the principle planning tool for food production.

Figure 6 shows the geographic distribution for strategic produce within Kurdistan region.

Figure 3. *Wheat Production, in Tones, in the Region from 2009- 2013 (Baban 2013b)*

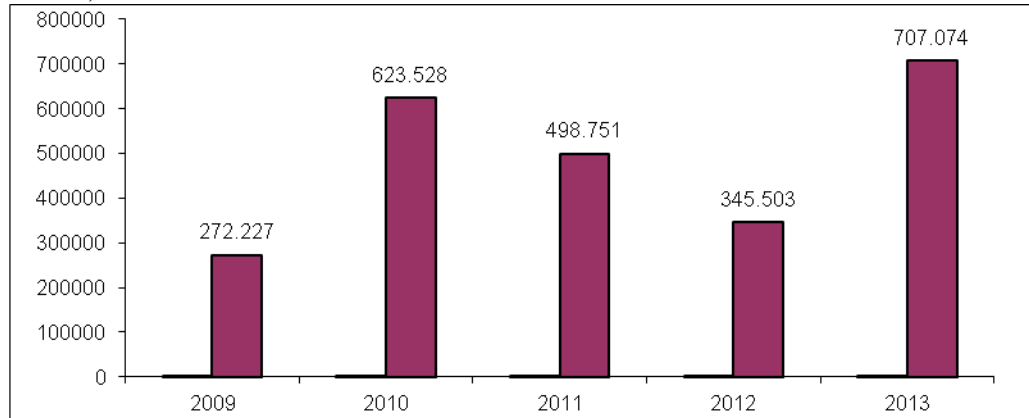


Figure 4. *Potato Production, in Tones, in the Region from 2009-2013 (Baban 2012b)*

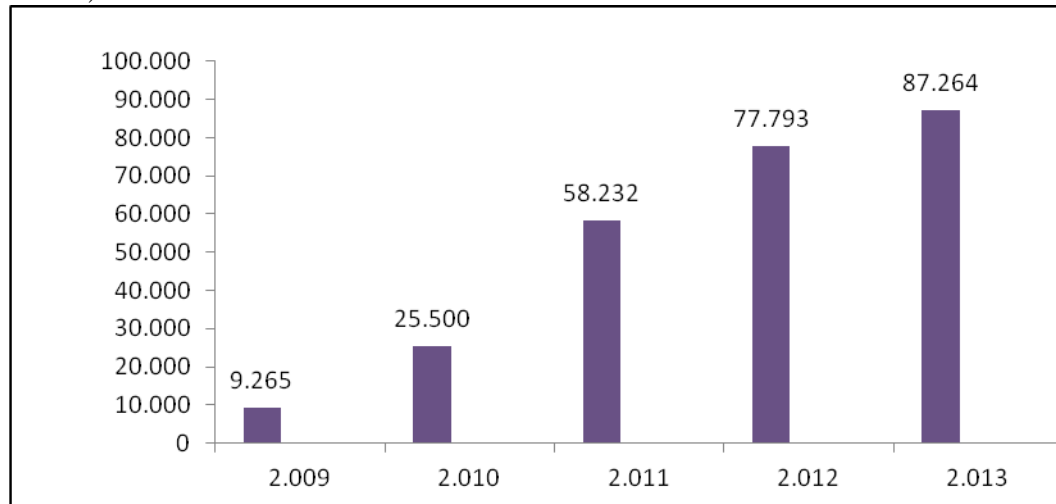


Figure 5. A Comparison between Real Production and Actual Needs for Crops in the Region during 2012 (Baban 2012a)

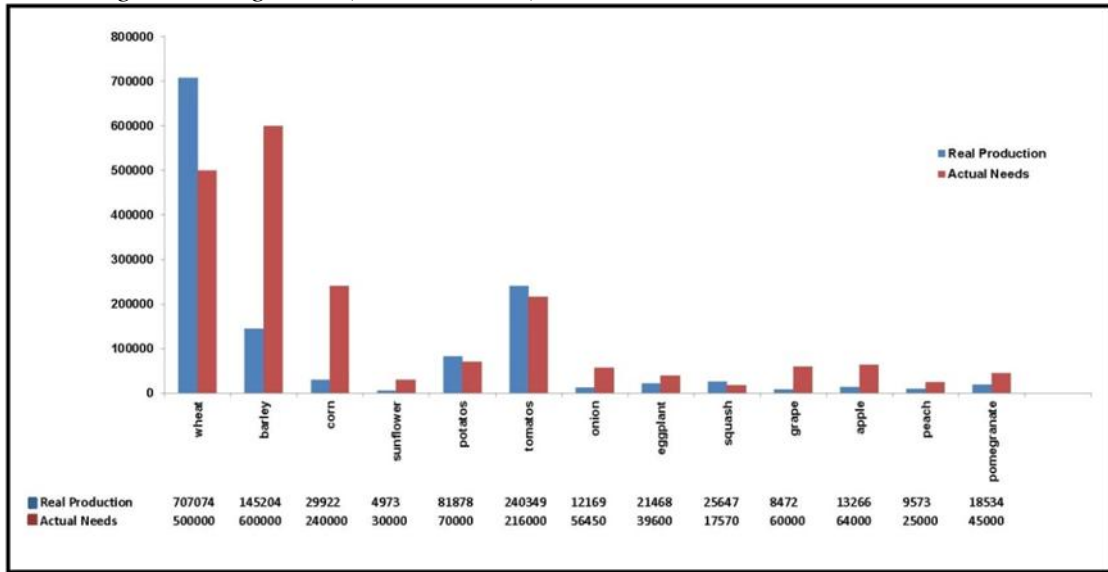
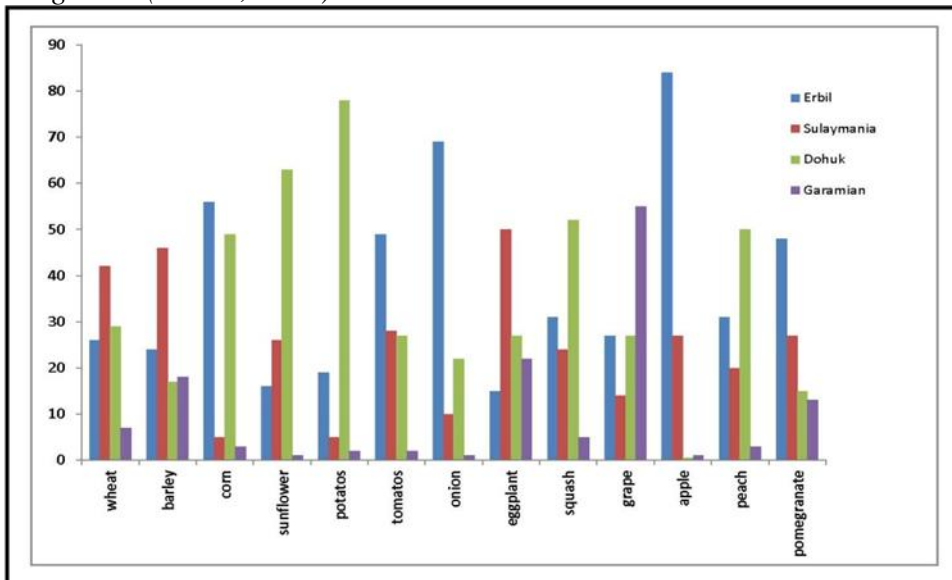


Figure 6. The Geographical Distribution and Productivity of Strategic Crops during 2012 (Baban, 2014)



Water Resources

1. A Holistic Approach for managment through focusing on Hydrological Catchment management and Carrying Capacity concepts.
2. Developing a draft law for preserving and protecting water resources in Kurdistan Region, this was submitted to the Council of Ministers and had its first reading and is now to be sent to the Parlament for approval after the necessary discusions.

3. Reserving the groundwater by developing and enforcing legislations in coordination with the Governors and the Ministry of Municipality to switch dominately from ground water to surface water.
4. Making use of modern methods and technologies such as promoting water preservation and harvesting, protecting hydrological catchments; protecting from erosion and promoting carrying capacity principles to minimize floods and landslides.
5. Developing meaningful collaboration between the Ministry and the local and international Universities and Research Institutions
6. Include all stakeholders in the decisions making process through filed visits, direct meetings and ongoing communication via a website.
7. Encouraging private sector involvement through attempts to build the necessary projects through ‘Build Operate Transfer’ (BOT) and long term loan schemes.
8. Building a number of dams, ponds and irrigation projects for realising water self-sufficiency and security. According to the ministry Road map the Storage Capacity by 2020 the region will reach 14.869 Billion m³ after completing the following projects:
 - ✓ 22 small and medium size dams.
 - ✓ 3 Large dams (Gomaspan (75 M. m³), Basara (60 M. m³) and Bawnoor (70 M. m³).
 - ✓ 30 small and medium dams are being designed and 15 will be tendered soon.
 - ✓ 7 Mega dams (Taq Taq, Sartick and Mandawa (Erbil), Bardasoor (Garmean), Deraluk-Rashawa and Bagrman (Duhok), Degala (Suli)) through BOT or long term loans (5/6 Billion USD).
 - ✓ A number of storage irrigation projects including; Shamammack will irrigate (80.000 D) and Klesa will irrigate (40,000D).
 - ✓ 175 Ponds: 54 completed, 27 being built and 95 are planned and designed.
1. Tanjable outcomes for reasling water self-sufficiency and security through building building a number of irrigation projects according to the Road map, by 2020:
 - ✓ Approved Projects: Shamammack will irrigate (80.000 D), Klesa will irrigate (40,000D) will be tendered soon.
 - ✓ Proposed Projects: Dashti- Hawler 1 and 2, Barazger and Garmean 1 and 2.Total Water requirement = (10 Billion m³) + Population needs and Industry = 11 Billion m³

Challenges Facing the Implementation of the Road Map and Possible Ways Forward

The difficulties facing the full implementation of the Road Map (MoAWR, 2012; Baban, 2013b; Baban, 2014) included:

1. **Unsustainable development**
The Kurdistan region is fundamentally an agricultural society; the main cities are built on the best available agricultural land, hence the ongoing massive urban expansion in all the cities are at the expense of agricultural land hence, squandering prime productive agricultural land.
2. **The challenge of reviving village Life.**
Historically, food was produced in the villages, hence, it is critical to provide a suitable living and working environment for people willing to return to the land and produce food. This process although agreed upon, to date has not been effective and has not been tackled in a systematic fashion.
3. **The extensive efforts by neighbouring upstream countries to build numerous giant dams and massive Irrigation Projects and the ineffectiveness of across boarder and international agreements to manage the process and the impact on availability of water resources for agriculture as well as industry and day to day use of citizens.**
4. **The budget allocation level not being sufficient to implement the plan or not being allocated in time to coincide with the agricultural calendars for agricultural products and water resources projects.**
5. **Climate Change.** The changes to vegetation boundary conditions in terms of temperature, humidity and rainfall will have a direct impact on agricultural produce. Hence there is a need to work on developing the next generation of crops that are capable of growing under the new projected conditions (Baban 2013a; 2014). The impacts on water resources include high evaporation, overall low rainfall with higher intensity and low frequency. Clearly, these in combination with point 3 above can have serious consequences on water availability in the region.
6. **The Ministry structure and Workforce, which is not effective in terms of Function and Form.**
7. **The lack of local data not effectively employing research driven management options will limit success. Hence, the need to focus on developing and using internationally approved applied research dealing directly with and solving current and future challenges in Agriculture and Water Resources.**
8. **A lack of reliable science based datasets and relevant research outputs. Hence, the need to focus on developing applied research outcomes in the areas of Climate Change Impacts, focusing on holistic management and sustainable development principles and using modern principles and technology for water preservation and harvesting.**

Conclusions

Achieving food and water sufficiency and security is critical for the regions sustainability. However, identifying and performing the necessary reforms in both the agriculture and water sectors in the region is a difficult and a complex challenge.

In terms of process, a clear and realistic vision for specifying the priorities in order to achieve food sufficiency and security is required. The implementation will need an effective roadmap with clear objectives and a timeframe developed based on consultations with all stakeholders.

This paper reported on the progress of the implementation of a specifically developed road map June 2012- May 2014, aimed to achieve food sufficiency and security for the region. The road map provided a way forward to rehabilitate and improve the agriculture sector based on a vision that introduces effective modern production, training, management and reflective systems for sustainable agriculture and food production in the region.

Challenges facing the full realisation of the strategic objectives and possible ways forward: include the ongoing unsustainable urban expansion based on the developed master plans, reviving village life, the extensive efforts by neighbouring upstream countries to build numerous giant dams and massive irrigation projects, the budget allocation level and not being approved on time delaying the plan, Climate change, Governorate law, the Ministry's structure and workforce, which is not effective in terms of function and form and the lack of local data and not efficiently using research driven management options. All of these factors will limit success. Hence, the need to focus on developing and using internationally approved applied research dealing directly with and solving current and future challenges in Agriculture and Water Resources. Suggested areas included; focusing on holistic management, sustainable development and carrying capacity principles, using Geoinformatics to manage climate change Impacts.

The outcomes, despite the implementation period being only 2 years, show an optimistic picture as self sufficiency has been achieved with some key agricultural strategic produce such as wheat and potatoes. Work has started on 22 dams and will also start on some larger dams as well as completing work on 86 ponds with plans for build some 50 more. The outcomes also show the difficulty of the task and the need for a reasonable time frame for implementation. In addition to the importance of implementing the plans based on participatory decision making, following a clear and a transparent process and to give the highest priorities to quality assurance and control processes.

Evidently, increasing the productivity of land and water in the region will require changes in policy driven by implementing a number of policy actions and instruments including:

1. Embracing practical policy instruments and approaches, to sustainably manage land and water resources, such as; planning and licensing,

- regulation and zoning, environmental taxation and environmental subsidies, and self regulation/management agreements.
2. Adopting advanced production techniques such as increasing the productivity of water through making irrigation more effective and reducing limiting environmental degradation and easing competition for water.
 3. Thinking differently about agriculture and water resources by integrating planning and management of food security, sustainable water resources and conserving ecosystems. Hence, managing agriculture and water resources as integral parts of an ecosystem with the view to improve ecosystem services. Good management practices can enhance other ecosystem services whilst managing land and water use as well as upholding water quality to acceptable standards.
 4. Supporting the implementation of these policy actions and instruments through reforming all relevant institutions, building a capable work force, developing research capacity and raising awareness amongst all stakeholders.

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