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Report of the

EXPERT MEETING ON THE REVIEW OF FISHERIES AND AQUACULTURE ACTIVITIES IN THE EUPHRATES–TIGRIS BASIN

Erbil, Iraq, 11–12 November 2012

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PREPARATION OF THIS DOCUMENT

This report was funded by the FAO Regional Office for the Near East and North Africa, and it was edited by Lori Curtis, Piero Mannini and Tony Thompson.

The report presents an overview of the state of fisheries and aquaculture in the Euphrates–Tigris Basin as at 2012. Despite the impact of recent events in the region, the information contained in this report remains of value and serves as a pre-crisis baseline.

The meeting and discussions on which it is based were facilitated by the efforts of FAO Iraq in both Amman and Erbil, with special thanks being due to Anwer Jafar. The kind efforts of Heba Fahmy for her support from the FAO Office of the Regional Office for the Near East and North Africa are acknowledged, as is the support from the Republic of Iraq and the Kurdistan Regional Government for allowing the meeting to be hosted in Erbil.

The three technical country reports are included in the appendixes to this report.

FAO. 2014.
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ABSTRACT

This report, in its main body and appendixes, provides an overview of the state of fisheries and aquaculture in the Euphrates–Tigris Basin, including country-level overviews for Iraq, the Syrian Arab Republic and Turkey, as well as the summary record of an expert meeting held in Erbil, Iraq, in 2012, and the outcomes. A list of species for the Euphrates–Tigris Basin is also included.

The expert meeting on the review of fisheries and aquaculture activities in the Euphrates–Tigris Basin was the first to purposely address, at the regional level, the sustainable management and development of capture fisheries and aquaculture in the Euphrates–Tigris Basin.

A regional cooperation framework was agreed upon. This framework focuses on: resource sustainability; a comprehensive management plan, as well participatory co-management involving resource users and stakeholders; and the promotion and establishment of regional technical cooperation and dialogue with the purpose of establishing regionally harmonized fisheries and aquaculture management plans and actions.

CONTENTS

ABBREVIATIONS AND ACRONYMS

ABPRS	Address Based Population Registration System (Turkey)
ACB	Agricultural Cooperative Bank (Syrian Arab Republic)
CAR	crude active rate
CBD	Convention on Biological Diversity
Code	Code of Conduct for Responsible Fisheries
DLPAL	Draft Law on Protection of Aquatic Life (prepared by the consultant)
DOF	Department of Fisheries Resources (Syrian Arab Republic)
DPT	State Planning Organization (Turkey)
DSI	General Directorate of State Hydraulic Works (Turkey)
EAA	ecosystem approach to aquaculture
EAF	ecosystem approach to fisheries
EFTS	Environmentally Friendly Taxation System (Syrian Arab Republic)
FAO RNE	FAO Regional Office for the Near East and North Africa
FCR	feed conversion rate
FCRF	Fishery Circulated Revolving Fund
FFP	family fish pond
FFS	Fisheries Field Services of ex DOF (Syrian Arab Republic)
FPF	Fishery Pension Fund (Syrian Arab Republic)
FSF	Fishery Subsidy Fund (Syrian Arab Republic)
GAP	Güneydoğu Anadolu Projesi (Southeastern Anatolia Project)
GCFR	General Commission for Fisheries Resources (Syrian Arab Republic)
GDAPD	General Directorate of Agricultural Production and Development (Turkey)
GDAR	General Directorate of Agricultural Research (Turkey)
GDPC	General Directorate of Protection and Control (Turkey)
GDOS	General Directorate of Organisation and Support (Turkey)
GEF	General Establishment of Fish (Syrian Arab Republic)
GTZ	German Agency for Technical Development
IAA	integrated aquaculture–agriculture
ICARDA	International Center for Agricultural Research in the Dry Areas
IFAP	Syrian–German Inland Fisheries and Aquaculture Development Project
IIA	integrated irrigation–aquaculture
IRBM	integrated river basin management
IUU	illegal, unreported and unregulated (Fishing)
MARA	Ministry of Agriculture and Rural Affairs (Turkey)
MAAR	Ministry of Agriculture and Agrarian Reform (Syrian Arab Republic)
MOWR	Ministry of Water Resources (Syrian Arab Republic)
MSY	maximum sustainable yield
PBC	Political Backstopping Committee
SRC	Scientific Research Committee
SSA	small-scale aquaculture
SETB	Syrian part of the Euphrates–Tigris Basin
TAC	Technical Advisory Committee
TEMA	Turkish Foundation for Erosion Control and Afforestation (Turkey)
TUBITAK	Scientific and Technical Research Council of Turkey (Turkey)
TIKVESLI	Tikvesli Agricultural Enterprises Inc. (Turkey)
WANA	West Asia North Africa
WWF	World Wildlife Fund

FOREWORD

The Euphrates–Tigris Basin is one of great historical importance for many reasons, not least for the civilizations that have originated and grown from here. This report is an attempt to draw attention to a discipline that receives very little consideration in this important basin. Fisheries and aquaculture constitute a key source of livelihoods and food for many people and communities, yet they tend to be undervalued at both the country and regional level. In general, fisheries and aquaculture in inland basins have a tendency to be rather neutral in terms of effecting major changes in any country. However, they are extremely sensitive to changes that occur in the surrounding environment, be these biological, social, economic or political. As a global society, it has become clear how even small changes that affect the environment can have impacts much farther away and of a much greater magnitude than the original change itself. Research that highlights the needs of the fisheries and aquaculture sector and those that depend on it (either directly or indirectly) for their livelihoods is critical. The purpose of the report that follows is to provide a review of the fisheries and aquaculture activities in the Euphrates–Tigris Basin at the basin level in order to see more clearly how the problems of this sector can be presented in a manner that is as holistic, effective and appropriate as possible.

The meeting and the technical papers for each country that form the content of this report were undertaken when the conflict in the Syrian Arab Republic had begun, and while the regional impacts were still in their initial stages. While this tragic upheaval continues, it is impossible to gauge the full impacts on the countries concerned, and how long such impacts will last. Forced migration, natural-resource devastation, infrastructure destruction and the dissolution and separation of families and communities are just some of the consequences of this conflict. Rebuilding from this will be extremely challenging, and the hope is that this can begin soon.

The normal challenges that exist for fisheries and aquaculture – those that are highlighted in this report – will inevitably have changed in ways that are potentially difficult to conceive of at this stage. However, the usefulness of this report is that it may now serve as a baseline for the rebuilding of the sector for the sake of those people who have been engaged in fisheries and aquaculture for generations. The main focus of the expert meeting was one of regional cooperation and how to use the naturally made basin to serve as a guide for this cooperation. This approach will be more needed than ever before if there is to be a chance of rebuilding livelihoods in the Euphrates–Tigris Basin.

EXECUTIVE SUMMARY

The Euphrates–Tigris Basin is the largest and most important river system between the Nile River and the Indus River. This basin has not been studied as well as other transboundary basins, such as that of the Nile, and in particular a basin overview of the fisheries and aquaculture activities has not been undertaken. This work represents a first attempt to review fisheries and aquaculture activities in three of the countries in which the Euphrates–Tigris Basin is contained: Iraq, the Syrian Arab Republic and Turkey. This is attempted through two primary components of this report: (i) the proceedings and outcome from the Expert Meeting on the Review of Fisheries and Aquaculture Activities in the Euphrates–Tigris Basin; and (ii) three technical country reports reviewing fisheries and aquaculture in Iraq, the Syrian Arab Republic and Turkey. The expert meeting provided an opportunity to highlight and discuss major challenges in the fisheries and aquaculture sectors within the Euphrates–Tigris Basin, in particular the following:

- Inland capture fisheries and aquaculture provide an important source of employment and income for rural communities in the Euphrates–Tigris Basin.
- The capture fisheries and aquaculture natural-resource base is deteriorating.
- Illegal, unregulated and unreported (IUU) fishing is an important issue of concern.
- Fishers and fish farmers associations/cooperatives either do not exist or lack the capacity to effectively provide services for their members.
- Participatory management needs to be established.
- The social and economic relevance of fisheries and aquaculture in the Euphrates–Tigris Basin should be appraised for sound sector policy and planning.
- Adaptation to climate change impacts was recognized as a crucial and important issue in the three countries, in terms of consideration for fisheries and aquaculture development, and one that needs to be addressed at a regional level.
- Addressing issues and challenges at a regional level would provide additional value to sustainable fisheries management and aquaculture development throughout the Euphrates–Tigris Basin.

The expert meeting on the review of fisheries and aquaculture activities in the Euphrates–Tigris Basin was the first to purposely address, at the regional level, the sustainable management and development of capture fisheries and aquaculture in the basin. One outcome of the meeting was the formulation of a list of common species for the Euphrates–Tigris Basin. This list includes the identification of species of economic importance and local names for each species. This list will serve as a reference for future work at the regional level.

The regional cooperation framework was agreed upon. It focuses on: resource sustainability; a comprehensive management plant as well participatory co-management involving resource users and stakeholder; and the promotion and establishment of regional technical cooperation and dialogue with the purpose of establishing regionally harmonized fisheries and aquaculture management plans and actions.

1. INTRODUCTION

The Euphrates–Tigris Basin is the largest and most important river system between the Nile River and the Indus River. Despite this importance, this basin has not been studied as well as other transboundary basins, such as that of the Nile, and in particular a basin overview of the fisheries and aquaculture activities has not been undertaken. This work represents a first attempt to review fisheries and aquaculture activities in three of the countries in which the Euphrates–Tigris Basin is contained: Iraq, the Syrian Arab Republic and Turkey.[1] This is attempted through two primary components of this report: (i) the proceedings and outcome from the Expert Meeting on the Review of Fisheries and Aquaculture Activities in the Euphrates–Tigris Basin, which includes priority areas for fisheries and aquaculture in the Euphrates Tigris Basin, and a list of fish species occurring in the Euphrates-Tigris Basin, with an indication endemic and economically important species (Appendix 3); and (ii) an overview of the basin as well as technical reports reviewing fisheries and aquaculture in the three countries (Appendixes 5, 6 and 7).

This review of fisheries and aquaculture in the Euphrates–Tigris Basin is intended to be a first attempt to address fisheries and aquaculture at a basin level, to understand as much as possible the state of fisheries and aquaculture, and to identify the challenges that may be common throughout the basin. Inland fisheries in general have characteristics that are different from those of marine capture fisheries, and each river basin is different from other river basins in terms of species caught, methods used, climate, geography, location, livelihoods and current country context. All these factors have an impact on the challenges to be met and the management measures needed.

Inland fisheries are a key source of both livelihoods and protein for those communities located within this river basin. The value of inland fisheries is often underestimated in terms of both economic value and ecosystem importance. Those involved in capture fisheries in inland systems may not identify themselves as fishers, owing to the diversity of income sources and livelihood activities, yet fisheries is still an important component. For some communities, fish may be their most important source of protein. Yet these are the same communities that may be overlooked when undertaking water management decisions. Inland fisheries ecology is profoundly affected by changes in water availability, which can be affected by precipitation and runoff changes that may occur due to climate change, or by human activities changing either the quantity or quality of water available. These, as well as other factors and in combination with a growing population and increasing demand for fish, can lead to overfishing, and increasingly destructive fishing practices as less fish is available. Appropriate fisheries management, including an ecosystem approach to fisheries and aquaculture, are needed in order to ensure the sustainability of the sector and the livelihoods of those communities living in this basin.

The priorities identified in the main body of this report serve as a first step in the process of formulating appropriate management and development actions at the basin level. The technical reports in the appendixes provide the necessary information and background to address these measures with the best available information, while highlighting the gaps in statistics and knowledge that are critical for understanding the dynamics of fisheries and aquaculture activities in the Euphrates–Tigris Basin.

[1] Iran (Islamic Republic of) is also a riparian country to the Tigris River; however, it is not included in this review.

2. EXPERT MEETING ON THE REVIEW OF FISHERIES AND AQUACULTURE ACTIVITIES IN THE EUPHRATES–TIGRIS BASIN, ERBIL, IRAQ, 11–12 NOVEMBER 2012

Summary record of the meeting

1. The expert meeting on fisheries and aquaculture activities in the Euphrates–Tigris Basin was held on 11–12 November 2012 at the Erbil International Hotel, in Erbil, Iraq. It was attended by ten participants from Iraq, the Syrian Arab Republic and Turkey. The meeting was convened by the Food and Agriculture Organization Regional Office for the Near East and North Africa. The agenda is in Appendix 1, and the list of participants in Appendix 2.

2. Mr Hilal Mohamed, Deputy FAO Iraq Representative, welcomed participants to the meeting and invited participants to introduce themselves. Mr Piero Mannini, Senior Fishery Officer, FAO Regional Office for the Near East North Africa, on behalf of Mr Abdessalam Ould Ahmed, Regional Representative for the Near East and North Africa, welcomed the participants and highlighted the need for this work, particularly referencing Article 6 and Article 9 in the Code of Conduct of Responsible Fisheries (the Code),[2] as well as the ecosystem approach to fisheries (EAF)[3] and the ecosystem approach to aquaculture (EAA).[4] He focused in particular on the issue of international rivers, lakes and reservoirs including the protection of transboundary aquatic ecosystems.

3. The participants were invited to nominate a chairperson for the meeting; Mr Vartan Sarkissian, Senior Fish Biologist, General Board for Fish Resources Development, Ministry of Agriculture, Iraq, accepted the nomination by participants.

4. Meeting participants were reminded of the objectives of the meetings:

- Enhance the information base on the fisheries and aquaculture activities on the Euphrates–Tigris system, in particular the upper basin region.
- Identify common priority issues in the fisheries and aquaculture sectors.
- Develop a common regional work plan for the sustainable development and management of the fisheries and aquaculture sector in the Tigris–Euphrates Basin.

5. According to the agenda, the following presentations were made and discussed:

6. Mr Basem Juma, Fisheries Advisor, FAO Iraq, presented on the FAO projects and activities in the fisheries and aquaculture sector of Iraq over the last ten years, as well as future cooperation between FAO and Iraq. It was noted that the long-term objectives of the FAO fisheries programme in Iraq include the contribution to the sustainable development of inland fisheries, and the improvement of livelihoods, employment opportunities and food security.

7. Mr Vartan Sarkissian presented the current status of the inland fisheries sector in Iraq, noting the challenges faced in developing the capacity and knowledge of those involved in the fisheries and aquaculture sectors due to being isolated from the scientific community during the period of the embargo on Iraq. He also noted the progress and development of fisheries and aquaculture since that time, as well as the vast potential for continued development in Iraq.

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[2] FAO. 2011. *Code of Conduct for Responsible Fisheries – special edition*. Rome. 91 pp.; includes a CD–ROM. (also available at www.fao.org/docrep/013/i1900e/i1900e00.htm).

[3] FAO. 2005–2014. Fisheries and Aquaculture topics. The ecosystem approach to fisheries management. Topics Fact Sheets. Text by S.M. Garcia and K.L. Cochrane. In: *FAO Fisheries and Aquaculture Department* [online]. Rome. Updated 27 May 2005. [Cited 5 September 2014]. www.fao.org/fishery/topic/13261/en

[4] FAO. 2006–2014. Aquaculture topics and activities. Ecosystem Approach to Aquaculture (EAA). In: *FAO Fisheries and Aquaculture Department* [online]. Rome. [Cited 5 September 2014]. www.fao.org/fishery/topic/16035/en

8. Mr Naser El-Dlawy then presented the country report on the fisheries and aquaculture activities in the Euphrates–Tigris basin for Iraq. It was noted that socio-economic enhancement of those involved in the sector is needed, as well as the activation and enforcement of particular legislation. The need for fishers associations was highlighted, as was that of ensuring a holistic approach to river basin management, in particular the consideration of fish migration when proposing new damming projects and considering stock enhancement for fisheries in the Euphrates–Tigris Basin.

9. Mr Issam Krouma, fisheries and aquaculture expert, presented the country report on the fisheries and aquaculture activities in the Euphrates–Tigris Basin for the Syrian Arab Republic. A description of the fisheries and aquaculture situation was provided, including a description of activities, demographics, fisheries and aquaculture institutions and their roles, as well as marketing, services available and some of the challenges to the sector. The need and opportunities for regional cooperation at a river-basin level were highlighted, as was the incorporation of a participatory approach to fisheries management. In addition, improved fisheries management and enhanced marketing and processing systems were highlighted as recommendations. Possible options were presented to establish regional technical cooperation for fisheries and aquaculture management and development.

10. Mr Erhan Ünlü, fisheries expert and Professor in the Department of Biology at Dicle University, presented the country report on the fisheries and aquaculture activities in the Euphrates–Tigris Basin for Turkey. The fisheries and aquaculture activities have been, and continue to be, shaped by the extensive water resources management plans of Turkey, including the Southern Anatolia Project (GAP). Fisheries and aquaculture activities and development are extensive in the Turkish part of the basin, and provide a source of employment for thousands of people, although some of these people are forced into fishing because of a lack of employment opportunities elsewhere.

11. Mr Serwan Saeed Mohammed, Director for Fish Resources for the Ministry of Agriculture and Water Resources, Kurdistan Regional Government, Iraq, provided an overview of the main aquaculture and hatcheries in the Kurdistan Region, highlighting the construction and production capacity of hatcheries in different governorates, as well as the challenges faced and future development plans in the aquaculture sector.

12. The following points summarize the discussions arising from the information given in the presentations:

- Inland capture fisheries and aquaculture provide an important source of employment and income for rural communities in the Euphrates–Tigris Basin.
- The capture fisheries and aquaculture natural-resource base is deteriorating.
- Illegal, unregulated and unreported (IUU) fishing is an important issue of concern.
- Fishers and fish farmers associations/cooperatives either do not exist or lack the capacity to effectively provide services for their members.
- Participatory management needs to be established.
- The social and economic relevance of fisheries and aquaculture in the Euphrates–Tigris Basin should be appraised for sound sector policy and planning.
- Adaptation to climate change impacts was recognized as a crucial and important issue in the three countries, in terms of consideration for fisheries and aquaculture development, and one that needs to be addressed at a regional level.
- Addressing issues and challenges at a regional level would provide additional value to sustainable fisheries management and aquaculture development throughout the Euphrates–Tigris Basin.

13. The participants noted that the expert meeting was the first to purposely address, at the regional level, the sustainable management and development of the capture fisheries and aquaculture of the Euphrates–Tigris Basin. They concurred that this approach was fully consistent with the principles of the Code and that it should be maintained and pursued further in the future.

14. Meeting participants agreed to formulate a list of common species for the Euphrates–Tigris Basin, including the identification of species of economic importance, and that list be translated so that the local names for each species would be listed. The agreed list will serve as a reference for future work at the regional level. This list is presented as Appendix 3.

15. The meeting identified common priority issues in the fisheries and aquaculture sector in terms of environmental, economic and social considerations, according to the three pillars of sustainability. The conclusions of the discussion and the recommendations for the common priority issues are outlined in Table 1.

Outline for a regional cooperation framework

16. Based on the country reviews and identified common priority issues for environmental, economic and social considerations, the meeting participants formulated the following elements as key components of a regional cooperation framework in support of the fisheries and aquaculture sectors in the Euphrates–Tigris basin.

17. The regional cooperation framework would entail the following technical components:

i) fisheries and aquaculture resources sustainability;
ii) fisheries and aquaculture management and planning developed by government and the appropriate fisheries and environmental ministries;
iii) participatory co-management involving resource users and stakeholder involvement;
iv) promotion and establishment of regional technical cooperation and dialogue with the purpose of establishing regionally harmonized fisheries and aquaculture management plans and actions.

18. The four components will consist of activities that will be detailed by the regional experts and relevant institutions with the cooperation of FAO.

The way forward

19. The meeting participants discussed and agreed on the following action plan for the way forward:

- Outcome of meeting to be shared with relevant authorities in each country/territory (Iraq Central Government and Iraqi Kurdistan Regional Government, the Syrian Arab Republic and Turkey).
- Upon endorsement by relevant authorities, the formulation of a regional project proposal for a field programme on the management and development of fisheries and aquaculture activities.
- The formulation of the regional project/programme to be developed with the full participation of regional experts and relevant regional and national institutions.
- The participants agreed to bring the outcomes of the meeting to the attention of relevant regional and national fisheries and aquaculture authorities for consideration.

20. The meeting participants acknowledged with thanks the Republic of Iraq and the Kurdistan Regional Government for hosting this important meeting, as well as the support of FAO.

Table 1 Priority areas for fisheries and aquaculture in the Euphrates–Tigris Basin

Fishery	Environmental	Economic	Social
Capture fisheries	• Pollution: chemical, biological (including impact of rearing systems, drainage water) • Restoration of damaged habitats: identification of deterioration, restoration • *Barbus* spp. constraints: upstream–downstream movement, lack of water resources, need further information on life and food cycle • IUU fishing: affect stocks, poor fishing practices • Climate change: water levels, water discharge, water quality and quantity, water sources, water temperature • Biological cycle of economically important species (life cycle, maturity age and size, etc.): need research on this to inform appropriate management • Vulnerable species: threatened by overfishing, environment • Impact of exotic and introduced species • Precautionary approach to the introduction of species • Stock assessment of significant key species • Fishing technique and gear selectivity • Stock enhancement / re-stocking	• Livelihoods • Fishing capacity • Transportation: marketing • Food security • Rural incomes, employment • Fishing gear: abandoned fishing gear, ghost fishing • Post-harvest: marketing, industry • Fish supply chain: price of inputs, operating costs, value-added, processing, market • Number, quantity and types of commercial fish available for trading • Timing/legal fishing season • Fishing output control (quota) • Policy, strategy and legislation	• Health and education • Marriage, family size, household characteristics • Cooperatives / fishers associations • Credit schemes • Increase investment in the area • Co-management, participatory approach to management • Capacity building: increase skills • Source of alternative income following forced migration/displacement
Aquaculture	• Fish disease and parasites • Availability of water resources: quality and quantity • Environmental impact of aquaculture • Materials to be used • Aquaculture procedures and practices • Interactions between environment and aquaculture • Best practices for sustainable aquaculture development • Aquaculture cages impact on water quality • Climate change impacts on aquaculture (e.g. water temperature, quantity, loss) • Interactions with irrigation schemes/practices	• Electricity and fuel availability • Availability of good-quality feed • Access to markets • Livelihoods • Value-addition practices • Integrated aquaculture agriculture systems or integrated aquaculture irrigation systems • Family rural aquaculture / family fish ponds • Increasing production through changing systems (e.g. cages) • Consumer acceptance of fish produced • Organic aquaculture (plant by-products)	• Health and education, e.g. diet • Increasing knowledge of farmers • Increasing incomes • Opportunities for rural women • Rural employment • Stopping rural–urban migration • Increased resilience to rural communities to crisis • Stability of family and household • Diversify income • Access to credit and services • Producer associations / fish farmer associations

APPENDIX 1: AGENDA

Day 1: 11 November 2012

09:00 • Opening session including welcome and opening addresses

• Overview of meeting objectives and expected outputs
- Introduction of participants
- Appointment of chair

09:30 *Group photo and coffee break*

10:00 Country presentations:

- Fisheries and Aquaculture in the Tigris and Euphrates basin in Iraq
  - FAO Iraq Fisheries Programme
  - Iraq Fisheries and Aquaculture Programme (General Board for Fish Resources Development)
  - Country presentation Iraqi Kurdistan
- Fisheries and Aquaculture in the Tigris and Euphrates basin in the Syrian Arab Republic
- Fisheries and Aquaculture in the Tigris and Euphrates basin in Turkey

12:30 *Lunch*

14:00 Priority areas for capture fisheries

Priority areas for aquaculture

15:30 *Coffee break*

16:00 Elements for a regional cooperative plan of work

17:00 The way forward

17:30 *Day closure*

Day 2: 12 November 2012

09:00 Morning free

14:00 Adoption of the summary report of the meeting

16:30 Closing of the meeting

APPENDIX 2: LIST OF PARTICIPANTS

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APPENDIX 3: FISH SPECIES OCCURRING IN THE EUPHRATES–TIGRIS BASIN

Table A3.1 Fish species occurring in the Euphrates–Tigris Basin

Scientific name	FAO	Iraq			Syrian Arab Republic		Turkey
	English	Arabic	Transcription (Arabic)	Kurdish	Arabic	Transcription (Arabic)	Turkish
Cyprinidae							
Acanthobrama centisquama Heckel 1843							
Acanthobrama lissneri Tortonese 1952	Bream				تريس	Tar'rees	
Acanthobrama marmid Heckel 1843	Silver bream	سمنان عريض	Samnan Arred		مرميد أبيض	Marmid abiad	Kizilkanat, Tahta balığı
Alburnoides fasciatus (Nordmann 1840)							
Alburnus caeruleus Heckel 1843	Black-fin bleak	لصافة	Lassafa		تفاف أزرق	Tef'faf azraq	Inci balığı
Alburnus mossulensis Heckel 1843	Mossul bleak	سمنان كبير الرأس	Samnan Abu Ras		سنك	Sink	Musul incibalığı
Alburnus heckeli Heckel 1843*							Heckel incibalığı
Alburnus orontis Sauvage 1882		سمنان اورنتس	Samnan Orontis				
Alburnus sellal Heckel 1843	Sellal bleak	سمنان سلال	Samnan Sellal		سمنان سلال	Samnan selal	
Aspius vorax Heckel 1843* (E)	Oriental asp	شلق	Shilik		مطواق	Motwuak	Sisbaligi
Barbus barbulus Heckel 1847	Biglip kersin	ابو براطم	Abu Baratum		كرسين أصفر	Kersin asfar	Bıyıklı balık
Barbus grypus Heckel 1843 (E)	Rumi	شبوط اعتيادي		Soora	رومي	Rhumi	Şabot
Barbus lacerta Heckel 1843	Spottet kersin	شبوط مرقط	Shabbout Moraqqat		شبوط مرقط	Shaboot moraq'qat	Benekli bıyıklı balık
Barbus schejeh	-				نباش	Nebbash	
Barbus subquincunciatus Günther 1868*	Leopard barbel	عجزان	Adjzan		صخري	Sakhry	Leopar sazan, komando balığı
Barilius mesopotamicus Berg 1932	Mesopotamian barilius	بارليوس عراقي	Barilius Iraqi		صبورة جزيرية	Sboura jazee'riyah	Mesopotamya bariliusu
Caecocypris basimi Banister and Bunni, 1980*							
Capoeta aculeata (Valenciennes 1844) (E)							
Capoeta barroisi Lortet 1894 (E)		تيلو باروز	Tela Barroisi				Benekli balık
Capoeta damascina (Valenciennes 1842) (E)		تيلة دمشقية طويني , برطين	Touni,Birtein	Qurawi	صبورة دمشقية		Siraz balığı
Capoeta trutta (Heckel 1843) (E)	Trout barbel	تيلة مرقط	Tela Moraqqat		حوار	Haw'war	Benekli siraz balığı
Capoeta umbla (Heckel 1843) (E)		تيلة اعتيادية	Common Tela				Karabalik, Sitaz balığı
Carasobarbus canis (Valenciennes 1842)		شبوط كانس	Shabbout Canis				Bıyıklı balık
Carasobarbus chantrei (Sauvage 1882)		شبوط شانتري	Shabbout Chantrei				Bıyıklı balık
Carasobarbus kosswigi (Ladiges 1960)							
Carasobarbus luteus (Heckel 1843) (E)	Brown barbel, bynny	حمري	Himri		بني حمري	Bynny himry	Karagöz, Sarıbenli

Scientific name	FAO	Iraq			Syrian Arab Republic		Turkey
	English	Arabic	Transcription (Arabic)	Kurdish	Arabic	Transcription (Arabic)	Turkish
Carassius auratus (Linnaeus 1758)		كارب ذهبي	Carp Thahabi				Japon balığı
Carassius carassius (Linnaeus 1758)		كارب كرسين	Crucian Carp				Havuz balığı
Carassius gibelio (Bloch 1782)							Gümüşi havuz balığı
Chondrostoma regium (Heckel 1843) (E)	Bride soufie	بلعوط ملوكي	Baloot Muluki	Teera	عروس	Arous	Kababurun
Ctenopharyngodon idella (Valenciennes 1844) (E)	Grass carp/white amur	كارب عشبي	(E)		كارب عاشب	Carp asheb	Otsazanı
Cyprinion kais Heckel 1843*	Small mouth cyprinion	بنيني صغير الفم	Bunni Saghir		قيس	Kais	Küçük ağızlı bunni
Cyprinion macrostomum Heckel 1843	Large mouth cyprinion	بنيني كبير الفم , حمرية صفرة	Himriya Safra Bunni Kaper	Panka	مشط أبيض	Musht abiad	Bunni balığı
Cyprinus carpio Linnaeus 1758 (E)	Mirror carp				ناصري	Nassery	Aynalısazan
	Scaled carp				ظاظان	Zazan	Pullu sazan
	Common carp	كارب عادي		Carp, Hukamati	كارب	Carp	Sazan
Garra rufa (Heckel 1843)	Red garra	كركور احمر	Karkoor Ahmar		كركور أحمر	Karkoor ahmar	Yapışkan balık
Garra variabilis (Heckel 1843)	Garra				كركور متلون	Karkoor mit-la'waen	Yağlıbalık
Hemigrammocapoeta elegans (Giinther, 1868)*							
Hypophthalmichthys molitrix (Valenciennes 1844) (E)	Silver carp	كارب فضي	(E)		كارب فضي	Carp feddy	Gümüşsazanı
Iranocypris typhlops Bruun and Kaiser, 1944*							
Luciobarbus esocinus Heckel 1843* (E)	Giant barbel	بز	Bizz	Bizza	فرخ	Farkh	Caner, Fırat Turnası
Luciobarbus kersin (Heckel 1843)*	Blue kersin	جصان ,برزم	Jassan,Barsam		كرسين أزرق	Kersin azraq	
Luciobarbus kosswigi (Karaman 1971)*	Kosswigs barbel				كرسين	Kersin	
Luciobarbus mystaceus (Pallas 1814)* (E)							
Luciobarbus pectoralis (Heckel 1843) (E)		شبوط اورنتس	Shabbout Orontis				
	Yellow kersin	شبوط بكترالس			كرسين أصفر	Kersin asfar	Bıyıklı balık, küpeli
Luciobarbus xanthopterus Heckel 1843* (E)	Kersin	قطان	Gattan	Zarada	قطان	Qattan	Maya balığı
Mesopotamichthys sharpeyi (Günther 1874)* (E)	Weed barbel	بني	Bunni		بني	Bynny	
Petroleuciscus kurui (Bogutskaya 1995)*							
Squalius berak Heckel 1843		برعان براق	Biran Barrak				Berak tatlısu kefali
Squalius cephalus (Linnaeus 1758) (E)	Chub (skelly; graining)	برعان سفاليس	Biran Siphalous		براق	Burak	Tatlısu kefali
Squalius lepidus Heckel 1843 (E)	Oriental chub	برعان ابيض	Biran Abiadh		براق أبيض	Burak abiad	Akbalık
Typhlogarra widdowsoni Trewavas, 1955*							

Scientific name	FAO	Iraq			Syrian Arab Republic		Turkey
	English	Arabic	Transcription (Arabic)	Kurdish	Arabic	Transcription (Arabic)	Turkish
Cobitidae							
Cobitis elazigensis Coad and Sarieyyüpoglu, 1988*							Taşyiyen balığı
Cobitis kellei Erk'akan, Atalay-Ekmekçi & Nalbant 1998*							Taşyiyen balığı
Cobitis taenia Linnaeus, 1758							Taşyiyen balığı
Nemacheilidae							
Nemacheilus smithi Greenwood, 1976*							
Oxynoemacheilus argyrogramma (Heckel 1847)							Çöpçübalığı
Oxynoemacheilus brandti (Kessler 1877)							Çöpçübalığı
Oxynoemacheilus frenatus (Heckel 1847)*	Loach				طأطئي	Ta`e,ta`i	Çöpçübalığı
Oxynoemacheilus hamwii (Krupp & Schneider 1991)							
Oxynoemacheilus insignis (Heckel 1843)	Lukh Mucallum	لخ مقلم					Çöpçübalığı
Oxynoemacheilus kermanshahensis (Bănărescu & Nalbant 1966)*							
Oxynoemacheilus panthera (Heckel 1843)							Çöpçübalığı
Oxynoemacheilus tigris (Heckel 1843)	Lukh Dijla	لخ دجلة					Çöpçübalığı
Paracobitis malapterura (Valenciennes 1846)							
Schistura chrysicristinae Nalbant 1998*							
Turcinoemacheilus kosswigi Bănărescu & Nalbant 1964*							Çöpçü balığı
Bagridae							
Mystus pelusius(Solander 1794)	Mesopotamian squeaker	ابو الزمير العميق	Abu Zummair		زقزوق	Zaqzouq	Tahtakafa baligi
Siluridae							
Silurus glanis Linnaeus 1758 (E)	Danubian wels	جري اوربي			جري	Jerry	Yayın
Silurus triostegus Heckel 1843* (E)	Euphrates wels	جري اسيوي			جري	Jerry	Yayın
Clariidae							
Clarias gariepinus (Burchell 1822) (E)	African catfish				سلور أسود	Sallor assuad	Karayayın
Sisoridae							
Glyptothorax armeniacus (Berg, 1918)*							
Glyptothorax cous (Linnaeus 1766)*	Hillstream catfish				بابوج	Babhudj	Kedibalığı
Glyptothorax kurdistanicus (Berg 1931)*	Hillstream catfish				أبو شوارب	Abu Shawareb	Kedibalığı
Glyptothorax silviae Coad, 1981*	Hillstream catfish				أبو شوارب	Abu Shawareb	Kedibalığı
Glyptothorax steindachneri (Pietschmann, 1913)*							

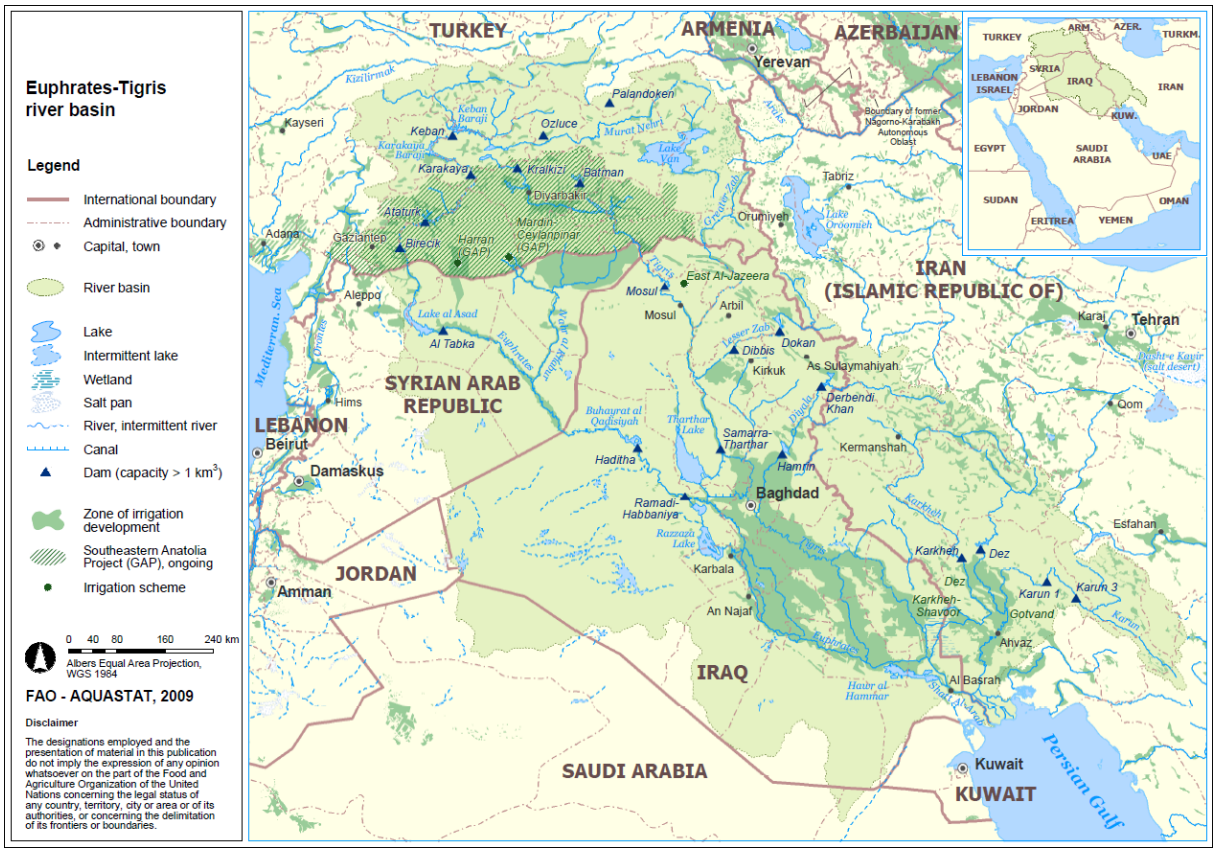
Scientific name	FAO	Iraq			Syrian Arab Republic		Turkey
	English	Arabic	Transcription (Arabic)	Kurdish	Arabic	Transcription (Arabic)	Turkish
Cichlidae							
Oreochromis aureus (E) (Steindachner 1864)	Blue tilapia				مشط أزرق	Musht azraq	Tilapia
Tilapia zillii (Gervais 1848) (E)	Redbelly tilapia				مشط عادي	Musht adady	Tilapia
Salmonidae							
Salmo tigridis Turan, Kottelat & Bektaş 2011							Alabalık
Poeciliidae							
Gambusia holbrooki Girard 1859	Mosquito fish	كمبوزيا	Gambuzia (E)		كمبوزيا	Gambuzia	Sivrisinekbalığı
Cyprinodontidae							
Aphanius asquamatus (Sözer 1942)							Hazar Dişli sazancık
Aphanius dispar (Rüppell 1829)		بطريخ متغير	Batrekh Mutaghiar				Dişli sazancık
Aphanius mento (Heckel 1843)	Oriental toothcarp				بطريخ	Battreekh	Dişli sazancık
Aphanius sophiae (Heckel 1847)		بطريخ صوفيا	Batrekh Sophia				Dişli sazancık
Mugilidae							
Liza abu (Heckel 1843) (E)	Euphrates mullet	خشني , ابو خريزة	Khishni,Abu Khraiza		بوري	Bhuri	Dicle kefali
Mastacembelidae							
Mastacembelus mastacembelus (Banks & Solander 1794) (E)	Spiny eel	مرمريج , سلبوح ابو سيان	Marmaritc, Salbouh Abu Sian	Marmasi	حنكليس	Hanklees	Mesopotamya yılanbalığı, Tatlısu yılan balığı
Heteropneustidae							
Heteropneustes fossilis (Bloch 1794)	Stinging catfish	جري لاسع , ابو الحكم	Djirri Lassey,Ab-Alhakam(E)	هندي سلور	Sallor hindy		Zehirliyayın

* = endemic species; (E) = economically important species.

APPENDIX 4: BRIEF OVERVIEW OF THE EUPHRATES–TIGRIS BASIN

The Euphrates–Tigris Basin is the largest and most important river system between the Nile River and the Indus River (Murakami, 1995; Coad, 1996). From a purely hydrological point of view, the Tigris and Euphrates basins are separate basins and only join at the Shatt Al-Arab waterway in Iraq, which also has its own distinct characteristics. However, they can be considered as a single basin because of the three riparian countries that have shares in both basins (the Islamic Republic of Iran, being the fourth, only has a share in the Tigris Basin) (Kalpakian, 2004). In fact, the Euphrates–Tigris Basin is distributed among six countries: Iran (Islamic Republic of), Iraq, Jordan, Saudi Arabia, the Syrian Arab Republic and Turkey. Iran (Islamic Republic of) is a riparian country to the Tigris River, as well as to the Shatt Al-Arab through the Karun River, while Jordan and Saudi Arabia contribute surface water to the Euphrates River under very rare and extreme climatic conditions (Figure A4.1).

Figure A4.1 Map of the Euphrates–Tigris Basin



Source: FAO-AQUASTAT (2009).

4.1 Hydrology and geography overview

Both the Tigris and Euphrates Rivers rise in the mountains of southern Turkey and flow southeastwards, the Euphrates River crossing the Syrian Arab Republic into Iraq, and the Tigris River flowing directly into Iraq from Turkey. The two rivers join at Qurnah, Iraq, to form the Shatt Al-Arab, which is fed by the Karun River in Basra, after which the waterway flows until it empties into the Persian Gulf (Murakami, 1995; Kangarani, 2005). The Tigris River, and to a lesser extent the Euphrates River, have a number of tributaries that feed into them along their path, many of which are transboundary as well. The Euphrates River is the longest river in Southwestern Asia, with a length of more than 2 700 km, and an actual annual volume of 35.9 billion cubic metres (Kangarani, 2005). The Tigris River is the second-longest river in the Southwestern Asia at more than 1 800 km, and it carries more water than the Euphrates River, owing to its tributaries from the Zagros Mountains (Table A4.1).

Table A4.1 Overview of Euphrates–Tigris Basin

	Tigris River	**Euphrates River**
Riparian countries	Iran (Islamic Republic of) Iraq Syrian Arab Republic Turkey	Iraq Syrian Arab Republic Turkey
River length	**1 800 km** Iraq: 1 350 km Turkey: 400 km Syrian Arab Republic: 47 km	**2 786 km** Iraq: 1 680 km Syrian Arab Republic: 661 km Turkey: 455 km
Basin area	**221 000 km²** Iraq: 123 981 km² Iran (Islamic Republic of): 41 990 km² Turkey: 54 145 km² Syrian Arab Republic: 884 km²	**440 000 km²** Iraq: 206 800 km² Turkey: 123 200 km² Syrian Arab Republic: 96 800 km² Saudi Arabia: 13 068 km² Jordan: 132 km²
Basin population	**23.4 million** Iraq: 18 million Turkey: 3.5 million Iran (Islamic Republic of): 1.5 million Syrian Arab Republic: 50 000	**23 million** Iraq: 10.2 million Turkey: 7.15 million Syrian Arab Republic: 5.69 million
Main dams	**14** (max. storage capacity 116.5 BCM)	**12** (max. storage capacity 144 BCM)
Main tributaries	**9** **(including headwaters)** Batman (Turkey) Botan (Turkey) Feesh Khabour (Turkey & Iraq) Greater Zab (Turkey & Iraq) Lesser Zab (Iran [Islamic Republic of] & Iraq) Adhaim (Iraq) Diyala (Iran [Islamic Republic of] & Iraq) Tib (Iran [Islamic Republic of] & Iraq) Dwairej (Iran [Islamic Republic of] & Iraq)	**5** **(including headwaters)** Karasu (Turkey) Murat (Turkey) Sajur (Turkey & Syrian Arab Republic) Balikh/Jallab (Turkey & Syrian Arab Republic) Khabour (Turkey, Syrian Arab Republic & Iraq)
Mean annual flow	20 BCM (Mosul, Iraq Station) 25.7 BCM (Kut, Iraq Station)	26.6 BCM (Jarablus, Syria Station) 27.1 BCM (Hit, Iraq Station)
Riparian contribution to annual discharge	Turkey: 40–65% Iraq: 10–40% Iran (Islamic Republic of): 5–25%	Turkey: 89% Syrian Arab Republic: 11%

Source: UN-ESCWA/BGR (2013).

In southern Iraq, the Euphrates River joins the Tigris River near the city of Qurna, and the combined rivers are called the Shatt al-Arab. The Karun River from Iran (Islamic Republic of) joins the Shatt Al-Arab at Basra, after which it travels through southern Iraq to empty into the Persian Gulf. The Shatt

Al-Arab is an important and dynamic waterway, fed by freshwater from the Tigris, Euphrates and Karun Rivers, as well as sea water from the Persian Gulf. The rivers have several small tributaries that feed into the system from shallow freshwater lakes, swamps, and marshes, all surrounded by desert.

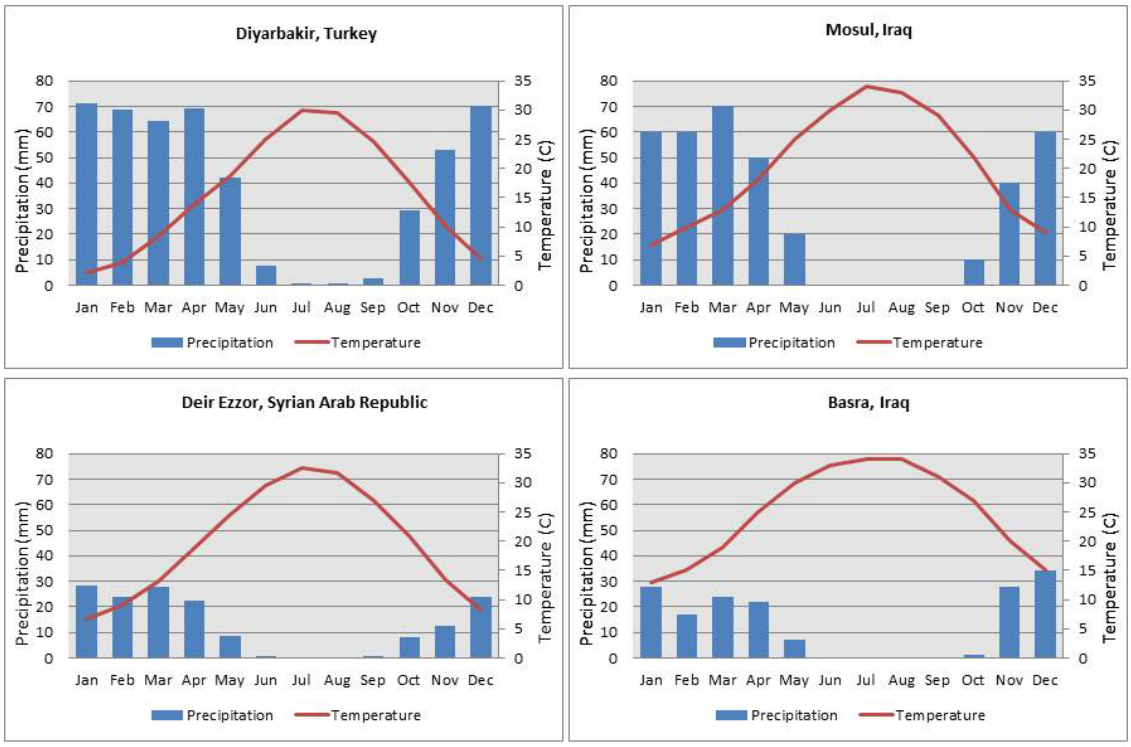
The regime of the Tigris and Euphrates Rivers depends most heavily upon winter rains and spring snowmelt in the Taurus and Zagros mountains. The Tigris River, which receives more of its flow from tributaries relying on precipitation, is more susceptible than the Euphrates River to short-term flooding, and brings its annual flood period a month earlier. The mean annual discharge of the Tigris is estimated at 1 240 m^3 per second, and the silt load at about one tonne per second. These estimates are roughly twice those calculated for the Euphrates River. In flood time, the two rivers together carry as much as three million tonnes of eroded material from the highlands in a single day. Natural climate variability affects water supply to the Mesopotamian region and consequently to the northern Gulf waters (Al-Yamani *et al*., 2007).

The increase in flow begins in March, when the snow begins to melt, with maximum floods occurring between mid-April and early May under the combined effect of melting snow and rains. The flow rapidly diminishes after June, reaching its minimum values in September and sometimes October. The period of the greatest discharge for the Tigris system as a whole is from March through May and accounts for 53 percent of the mean annual flow. For the Euphrates River, the period of maximum flow in Iraq is shorter and later than the Tigris, usually confined to April and May (Beaumont, Blake and Wagstaff, 1988; Shahin, 1987).

4.2 Climate

Both the Euphrates and Tigris Rivers begin in an area that is considered semi-humid and flow towards a semi-arid climate close to the confluence of the two rivers in southern Iraq. Temperatures and amounts of precipitation vary considerably depending on the location in the river basins, as indicated in Figure A4.2. The rivers flow from an area with higher levels of precipitation and lower winter temperatures in Turkey, to one that is much drier and hotter. The Tigris River has a higher mean precipitation annually than the Euphrates River, owing to high precipitation rates in certain parts of the Tigris River Basin (UN-ESCWA and BGR, 2013).

Figure A4.2 Select climate data in the Euphrates–Tigris Basin



Climate change predictions

In recent years, a number of models and studies have made various predictions of changes in precipitation and temperature in the Euphrates–Tigris Basin. Surface temperatures are projected to increase by about 1.5–5 °C throughout the entire basin, with higher levels of temperature increase in the highlands. The different models calculate different temperature increase according to different emissions scenarios. In addition to overall temperature changes, Bozkurt and Sen (2013) indicate there will also be an increase in extreme temperatures, with as increase in the number of days that fall above or below present-day high and low temperatures thresholds. It is estimated that the Euphrates–Tigris Basin is one of the basins most vulnerable to drought and extreme heat (Bozkurt and Sen, 2013). The simulations studied in Bozkurt and Sen (2013) also indicate decreases in precipitation in the highlands and northern part of the basin, with increases in the southern part of the basin. Some estimates include decreases of 20–30 percent in the northern parts, with increases between 30 and 150 percent in the southernmost parts of the basin.[1]

Snow cover and melt, an important source of water for the Euphrates–Tigris Basin, are anticipated to experience substantial decreases in the area that feeds the headwaters of the basin, and be more pronounced at lower elevations. Surface runoff is anticipated to decrease by about 25–55 percent, and timing of this runoff will also probably occur the (Ozdogan, 2011). It is important to note the importance of seasonal snowpack in a basin such as the Euphrates–Tigris Basin, both in terms of timing and amount. This snow cover acts as water storage; too much snowmelt generated too early could mean that it would come prior to when the hydroelectric, agricultural, and ecological demands are greatest, which is usually in the summer. In particular, it could affect ecosystem functions such as aquatic habitat, fish migration and wetland replenishment (Ozdogan, 2011).

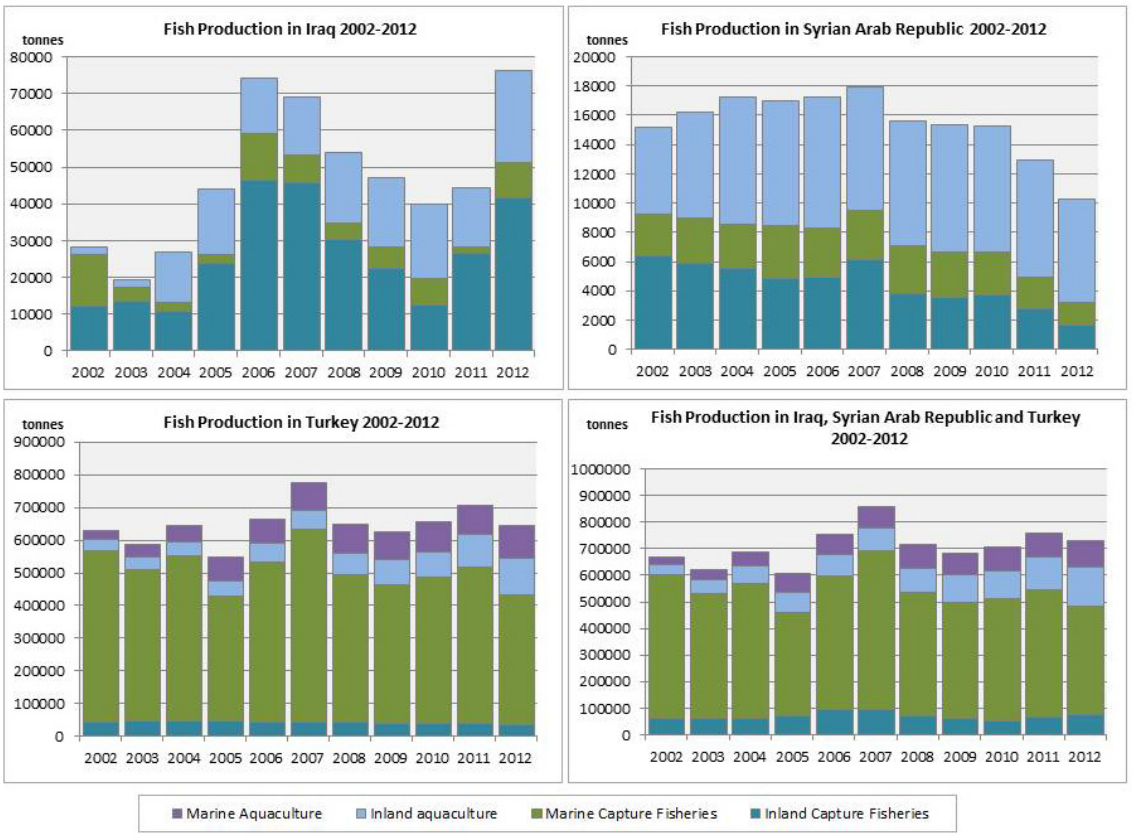
4.3 Fisheries and aquaculture

Turkey, the Syrian Arab Republic and Iraq all have access to a coastline, and their fisheries include both inland and marine. For aquaculture, all three countries have inland production while only Turkey has developed a marine capture fisheries industry. In terms of overall fisheries production, the importance of inland fisheries varies between countries, as highlighted in Figure A4.3.

In Iraq, inland capture fisheries represent more than 50 percent of total fisheries production, and combined with inland aquaculture this share increases significantly. In addition, there is high year-to-year fluctuation in inland fisheries production, ranging between slightly more than 10 000 tonnes to more than 40 000 tonnes, while inland aquaculture production has experienced a fairly steady increase, mainly tied to the increase in production of common carp. In the Syrian Arab Republic, inland capture fisheries have experienced a slow decline in the past decade, even prior to the beginning of the conflict in 2011. Inland aquaculture production has been fairly stable, with a slight decline in 2011 and 2012. In both Iraq and the Syrian Arab Republic, inland capture fisheries and aquaculture play an important role in overall fish production, where marine capture fisheries appears to be of less importance in this respect. The situation is slightly different in Turkey, where marine capture fisheries production accounts for the majority of fisheries production. However, with its extensive network of rivers and lakes, production from inland capture fisheries and aquaculture is still relatively high, at 36 121 and 111 557 tonnes, respectively, in 2012. While these same statistics are not available for the Euphrates–Tigris Basin itself, the country reports in Appendixes 5, 6 and 7 provide a more detailed picture of the fisheries and aquaculture in this area.

[1] The study reviews three different datasets under emission scenarios A2, A1F1 and B1.

Figure A4.3 Fisheries and aquaculture production in Iraq, the Syrian Arab Republic and Turkey, 2002–2012



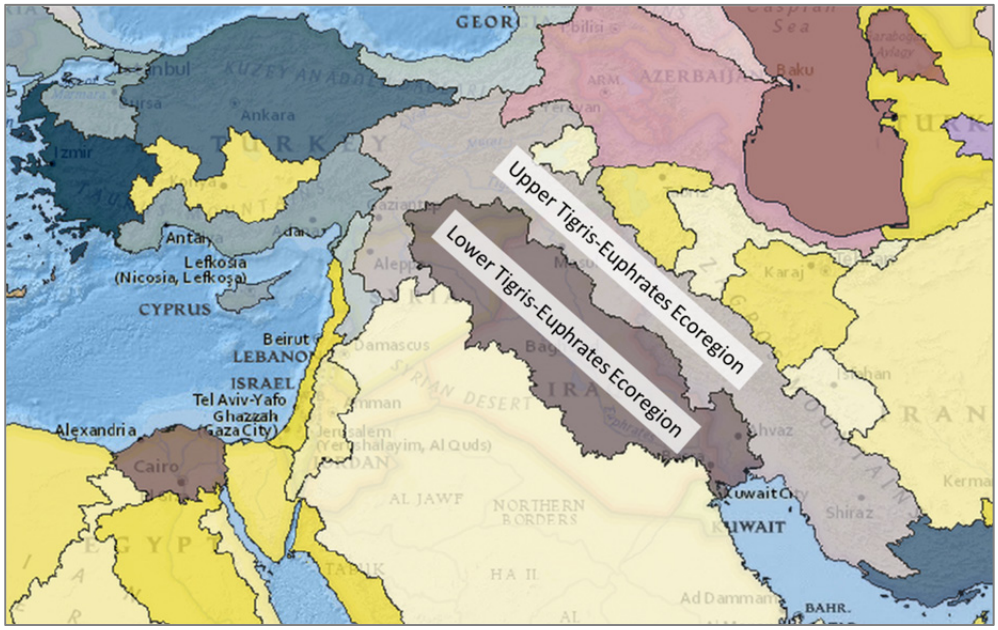
Source: FAO (2014).

Fisheries are an ancient tradition on the Tigris and Euphrates Rivers, and even today fisheries are generally traditional and small-scale. In the past few decades, damming has segmented the rivers and significantly changed the surrounding environment, with noticeable impacts on aquatic life, while also creating new opportunities for fishing.

The Euphrates–Tigris Basin can be broadly divided into two separate freshwater ecoregions,[2] (Figure A4.4) which are delineated "based on the distributions and compositions of freshwater fish species and incorporate[s] major ecological and evolutionary patterns" (Abell *et al*., 2008; WWF–The Nature Conservancy, 2008). While the two ecoregions share much of their fish, the lower Euphrates–Tigris ecoregion is unique in its extensive marsh and lake habitats. In addition, there are a number of fish species that are endemic to the upper Euphrates–Tigris ecoregion and not shared with the lower ecoregion.[3]

[2] A freshwater ecoregion is defined as a large area encompassing one or more freshwater systemswith a distinct assemblage of natural freshwater communities and species (Abell *et al*., 2008).
[3] The delineation of the two ecoregions includes sections that are considered outside the Euphrates–Tigris Basin in Iran (Islamic Republic of).

Figure A4.4 Map of Euphrates–Tigris Basin – ecoregions delineation



Source: WWF–The Nature Conservancy (2008).

There are more than 70 fish species in the Euphrates–Tigris Basin (including the Shatt Al-Arab), which is a fairly rich range when compared with other freshwater ecoregions in the Near East and North Africa. In the upper Euphrates–Tigris Basin, more than half of these species are of the family *Cyprinidae*, while this same family accounts for about 75 percent of all the species found in the lower Euphrates–Tigris Basin. The composition of the species changes in the section of the Shatt Al-Arab, where brackish water and tidal influences are important characteristics of the water. Here, where marine species can be found, notably the bull shark (*Carcharhinus leucas*), hilsa shad (*Tenualosa ilisha*), and yellowfin seabream (*Acanthopagrus latus*).

The Shatt Al-Arab waterway is important for fisheries and aquaculture not only in the Shatt Al-Arab itself, but also for the Persian Gulf in terms of the freshwater influx and the associated delivery of nutrients, organics and pollutants (e.g. hydrocarbons, trace elements, and pesticides) to the Gulf, but also serving as a nursery ground for some shrimp species as well as the silver pomfret (*Pampus argenteus*), which is important for northern Gulf fisheries (Al-Yamani, 2008; Al-Husaini, 2003).

Inland capture fisheries and aquaculture provide an important source of employment and income for rural communities in the Tigris and Euphrates Basin in Turkey, the Syrian Arab Republic and Iraq. Despite this, there is relatively little support for inland fishers in terms of associations or cooperatives, and there has not been a proper appraisal to determine the social and economic relevance of this sector in any of the three countries. In Turkey, the region in which the Euphrates–Tigris Basin lies (Eastern Anatolia) has lower development indicators and higher levels of unemployment than the rest of the country. While inland fisheries have a lower contribution in terms of production when compared with marine fisheries in countries with a significant coastline (Turkey), the importance to local livelihoods, food security and communities in the local areas is much greater.

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APPENDIX 5: FISHERIES AND AQUACULTURE IN THE EUPHRATES TIGRIS BASIN IN TURKEY

By: Erhan Ünlü[1]

5.1 Introduction to the area

5.1.1 Geography

Turkey has, overall, considerable marine and freshwater resources with long coastlines and plentiful flowing and still freshwater bodies (Table A5.1, Table A5.2). Owing to recent developmental policies regarding irrigation schemes and hydroelectric power generation, Turkey has created a considerable number of new water bodies by the damming of rivers.

Table A5.1Marine resources in Turkey

Marine resources	Coastline (km)	Surface area (ha)
Mediterranean, Aegean, Marmara and Black	7 144	23 475 000
Istanbul and Dardanelles	1 189	1 133 200
Total	8 333	24 607 200

Source: MARA, 2012

Table A5.2Freshwater resources in Turkey

Freshwater resources	Number of resources	Surface area (ha)	Length (km)
Natural Lakes	200	900 118	-
Dam Lakes	159	342 377	-
Ponds	750	15 500	-
Rivers	33		177 714
Total	1 142	1 261 995	177 714

Source: MARA, 2012

The area of interest for this paper is the Tigris and Euphrates Basins occurring in the southeastern part of Turkey. The main sources of the Euphrates in Turkey are the tributaries of the Karasu, Murat, Munzur and Peri Rivers that originate at altitudes of 3 000 m or more in the mountainous areas of eastern Turkey. The upper part of the Euphrates Basin has a catchment area of 63 874 km² at the confluence of the Euphrates and the Murat River near Keban, which produces 80 percent of the total annual flow at Ataturk reservoir.

The Tigris River originates from the Taurus Mountains of eastern Turkey and flows southwards forming the border between Turkey and Syria before entering Iraq. The main tributaries in Turkey are the Khabour and the Great Zab. Much of the discharge of the Tigris results from the melting snow that accumulated during the winter in Turkey. However, winter rains, which are common in late winter and early spring, fall on ripe snowpack in the highlands and greatly augment the flow of the main river and its tributaries, giving rise to violent floods for which the Tigris is notorious.

5.1.2 Climate

The Tigris and Euphrates Basin encompass two different geographical regions, East Anatolia and Southeast Anatolia, that have two different climates. The region's annual temperature difference very high; the Euphrates-Tigris Basin make one of the habitable and productive harshest environments in world. The region contains 11 percent of the total forested area of Turkey.

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East Anatolia is far from the sea and is at a high altitude; as a result it has a harsh continental climate with long winters and short summers. It is cold and snowy during the winter, and cool in the highlands and warm in the lowlands during summer. The region has the lowest average temperature of all Turkish regions at -25 °C. The average summer temperature is around 20 °C. Within the region, some areas have separate microclimates, for example Iğdır (near Mount Ararat) has a milder climate.

The Southeastern Anatolia region has a semi-arid continental climate with very hot and dry summers with average daily highs of 40 °C in July-August and cold and often snowy winters with average daily lows around zero in December-February. In the Mesopotamian plains, the most characteristic climatic feature is the extreme heat of the summer, with scattered rainfall. Mean annual rainfall decreases from over 1 200 mm in the north to 311 mm in the south adjacent to the Syrian border. Mean monthly rainfall is very low between June and September and reaches maximum in December and January with a high degree of inter-annual and intra-annual variability. Mean annual potential evapotranspiration rates are 1164 mm in the north of the Southeastern Anatolia Project (GAP) region and 1 257 mm in the south with the highest mean monthly rates in July of 211 mm in the north, and 224 mm in the South (Unver, 1997). Humidity in most areas is as low as 15 percent (Kangarani, 2005). The region has high potential for hydroelectric power.

The building of the dams in Southeastern Anatolia has caused the relative humidity to increase in summer months, though little difference has been seen in the winter months. The yearly average relative humidity was 50.7 percent before the dams building and 54.7 percent after the dams building. In addition, it was noticed that precipitation increased in the Autumn, decreased relatively less in the winter, and was similar in the other seasons (Özkan, 1996).

5.2 Demographics

5.2.1 Demographic Indicators

According to the results of Address Based Population Registration System (ABPRS) census for 2010, 7 592 772 people live in the Southeastern Anatolia and 5 775 225 people live in the Eastern Anatolia Region (Table 2.1), totalling 13 367 997 people in the two regions. This figure corresponds to 18 percent of Turkey's population. The most important indicator in terms of the demographic structure of the region is that the population has continued to increase in the Southeastern Anatolia Region, while the population of the Eastern Anatolia decreases gradually (Erkan and Aydın, 2012). The populations of the provinces in the two regions are shown in Table A5.3.

Table A5.3Total population of Southeastern Anatolia and Eastern Anatolia

Southeastern Anatolia Region		Eastern Anatolia Region	
Province	**Population**	**Province**	**Population**
Adıyaman	590 935	Ağrı	542 022
Batman	510 200	Bingöl	255 170
Diyarbakır	1 528 958	Elazığ	552 646
Gaziantep	1 700 763	Erzincan	224 949
Kilis	123 135	Erzurum	769 085
Mardin	744 606	Malatya	740 643
Siirt	300 695	Muş	406 886
Şanlıurfa	1 663 371	Tunceli	76 699
Şırnak	430 109		
Totals	7 592 772		5 775 225

Source: Compiled by Erkan and Aydın (2012) from the ABPRS database of the Turkish Statistical Institute (TurkStat, www.tuik.gov.tr).

The ratio of the young population in the Southeastern Anatolia is higher than the Turkish average of 42.6 percent under the age of 24. The proportion of this age group in the Tigris and Euphrates Basin is

greater than 60 percent. This younger population structure in the region is a result of the region's higher fertility rate.

5.2.2 Urbanization and migration

The Eastern and Southeastern Anatolia regions located in the Tigris and Euphrates Basin show different population patterns. The urbanization level in the Southeastern Anatolia region is 68.4 percent, compared to 76.2 percent in Turkey overall (Table A5.4). Kurdish separatist attacks and military operations resulted in large migration from villages to city centres, especially in 1990-2000 when the population of the cities of Diyarbakır, Batman, and some others in the region more than doubled (Erkan and Aydın, 2012).

Table A5.4Urban-rural population distribution in Southeastern Anatolia

Province	Urban Population	Ratio of Urban Population (%)	Rural Population	Ratio of Rural Population (%)
Adıyaman	347 236	58.7	243 699	41.2
Batman	370 388	73.1	136 812	26.8
Diyarbakır	1 090 172	71.3	438 786	28.6
Gaziantep	1 501 566	88.2	199 197	11.7
Kilis	85 923	69.7	37 212	30.3
Mardin	428 899	57.6	315 707	42.3
Siirt	181 410	60.3	119 285	39.6
Şanlıurfa	922 539	55.4	740 832	44.5
Şırnak	269 494	62.6	160 615	37.3
Region	5 197 627	68.4	2 392 145	31.6
Turkey	56 222 356	76.2	17 500 632	23.7

Source: Compiled by Erkan and Aydın (2012) using TurkStat data (www.tuik.gov.tr).

The urbanization level in the Eastern Anatolia region was 55.5 percent in 2010, which is lower than for the Southeastern Anatolia region (Table A5.5). The urbanization rate is below the average for Turkey in all provinces in the region.

Table A5.5Urban-rural population in Eastern Anatolia

Province	Urban Population	Ratio of Urban Population (%)	Rural Population	Ratio of Rural Population (%)
Ağrı	275 785	50.8	266 237	49.1
Ardahan	33 701	31.9	71 753	68.0
Bingöl	138 069	54.1	117 101	45.8
Bitlis	168 787	51.3	159 980	48.6
Elazığ	400 675	72.5	151 971	27.4
Erzincan	134 028	59.5	90 921	40.4
Erzurum	489 486	63.6	279 599	36.3
Hakkari	136 050	54.1	115 252	45.8
Iğdır	95 550	51.8	88 868	48.1
Kars	123 452	40.9	178 314	59.0
Malatya	480 144	64.8	260 499	35.1
Muş	143 624	35.2	263 262	64.7
Tunceli	47 531	61.9	29 168	38.0
Van	539 619	52.1	495 799	47.8
Region	3 206 501	55.5	2 568 724	44.5
Turkey	56 222 356	76.2	17 500 632	23.7

Source: Compiled by Erkan and Aydın (2012) using TurkStat data (www.tuik.gov.tr)**.**

5.2.3 Education indicators

Enrolment in secondary education and literacy rate in the region is less than the average in Turkey. The average of secondary school enrolment rate in Turkey is 66.5 percent, while it is 45.1 percent in the Eastern Anatolia Region and 42.7 percent in the Southeastern Anatolia Region. Exploration into education by gender and residential area reveals further inequalities. For example, the ratio of females enrolled in secondary school is 28.8 percent in the Southeastern Anatolia, and 31.3 percent in Eastern Anatolia. The ratio of students per classroom in Southeastern Anatolia is 38 students per classroom and 23 students per teacher, while the average in Turkey is 32 students per classroom and 17 students per teacher (Erkan and Aydın, 2012).

The illiterate female population ratio in the Eastern and Southeastern Anatolia regions reveals the difference between the levels of education when compared with Turkey's western provinces. Illiteracy rates in the total female population of Dicle, Southeastern Anatolia, are44-45 percent, while this rate in Istanbul, Tekirdağ and Kirklareli is 11 percent.

5.2.4 Family structure

The ratio of the traditional family is 29.6 percent in the Southeastern Anatolia Region, and the ratio of consanguineous marriage in this region is about 40 percent. Polygamous marriage is not as common as before in this area but it still exists as a tradition in the region. The rate of polygamous marriage is approximately 5.6 percent in the region. In Southeastern Anatolia Region, 50.3 percent of women get married by the age of 19. The average fertility rate in Turkey is 2.4, whereas it is 6.1 in the Southeastern Anatolia Region (Erkan and Aydın, 2012).

5.2.5 Ethnic structure

Turkey has a number of ethnicities and languages spoken in the various regions. The proportion of the population that is Turkish is approximately 76.7 percent, while those who are Kurdish represent approximately 14.7 percent of the total population. In Table A5.6below, one can see the result of the distribution of the population according to the mother-tongue language, and is an indication of the social structure throughout the Southeastern Anatolia Region (Erkan, 2005).

Table A5.6Population by native language in Southeastern Anatolia

Provinces	Turkish	Kurdish	Arabic	Syriac	Zaza
Adıyaman	38.4	57.2	0.0	0.0	4.4
Diyarbakır	6.9	73.8	0.6	0.0	18.7
Gaziantep	81.5	10.5	6.0	0.0	2.0
Mardin	10.3	69.1	17.2	3.4	0.0
Siirt	11.2	48.5	37.7	0.0	2.0
Şanlıurfa	25,7	56.6	13.1	0.6	4.0
Batman	13.5	81.0	4.0	1.0	0.5
Şırnak	9.7	89.7	0.0	0.0	0.6
Kilis	95.4	3.2	1.4	0.0	0.0
Total	32.5	54.4	8.9	0.6	3.6

Source: Erkan (2005).

5.2.6 Land use

The Upper Mesopotamia plains of the Tigris and Euphrates rivers are important agricultural areas and known as the "Fertile Crescent". Throughout history, the Southeastern Anatolia region served as a bridge connecting Anatolia with Mesopotamia. The region is bordered by Syria to the south and Iraq to the southeast. The surface area of the region is 7 535 800 ha, constituting 9.7 percent of the total surface area of Turkey. The GAP projecthas been implemented in this area (www.gap.gov.tr/english). GAP is one of the most ambitious regional development efforts worldwide and the largest and most comprehensive development effort ever launched by the Republic of Turkey (Erçin, 2006). The project area includes watersheds of the lower Euphrates and Tigris rivers and the upper Mesopotamian

plains. In total, 22 dams, 19 of which will generate electricity, will impound 122×10^9 m^3 of water covering 300 000 ha (Al-Yamani *et al*., 2007; DSI, 2012). In Southern Anatolia, the land is 42.2 percent cultivated (36 percent rain-fed), 33.3 percent pastures, and 20.5 percent forest and bush. The average gradient over 94 percent of the total surface area is less than 12 percent, which is considered the threshold of cultivability. Salinity and alkalinity problems are minimal, and most of the soil is well drained. Wind erosion is minimal, but water erosion can be moderate to strong in places (Ünver, 1997). The GAP is an integrated regional development project based on sustainable human development covers many sectors including the water resources development programme. Upon the completion of the project, 1.8 million hectares of land will be brought under irrigation, and energy production in the region will reach 27 billion kWh. It is expected that per capita income will rise by 209 percent and approximately 3.8 million people will be provided employment opportunities (DSI, 2012). So far, 300 000 hectares of land has been brought under irrigation in the region. Irrigation started in the Şanliurfa-Harran Plain in 1995, first covering an area of 30 000 hectares. The per capita value in agricultural production was US$ 596 before irrigation and rose to US$ 1 135 in 2004 after irrigation (http://www.gap.gov.tr).

5.2.7 Crop production general status in GAP region

The main grain crops are wheat and barley, with corn as a secondary crop. In 2005, wheat was cultivated over472 100 ha of land and produced 2 932 322 tonnes of grain, which accounts for 13 percent of the total production in Turkey. This is the main region in Turkey for legumes, including lentils and chickpeas. In 2005, red lentils were cultivated over 153 900 ha of land producing 511 236 tonnes of the product, which amounts to 98 percent of Turkey's production. Pistachio nuts in particular have met a large proportion of demand in recent years, and the production of grapes, olives, almonds, walnuts and pomegranate has also increased considerably. In 2005, there were more than 24 million fruiting pistachio trees producing 44 823 tons of nuts. Cotton is basic crop in irrigated areas in GAP Region. The Government Administration provides support to projects and activities, and fruit trees. In particularly fruit growing and value-added cotton plants could create alternatives to be considered.

5.2.8 Land Property

There is approximately 7 500 000 ha of land in the GAP region and approximately 3 100 000 ha of arable areas in this field (Table A5.7). The amount of land suitable for Class I. II., and III agriculture covers 32 percent of the area. This jumps to 42.3 percent of the area when the restricted actionable land (Class IV) is included. The amount of class VI and VII lands in the region is around 54%, and these are suitable for pasture and forest (http://www.gap.gov.tr/).

Table A5.7Land use changes in the Southern Anatolia GAP region

Land use	1978		1984		1991		2005	
	ha	%	ha	%	ha	%	ha	%
Cultivated land	3 081 170	41.9	3 295 548	43.8	3 154 974	41.9	3 068 526	40.8
Dry Farming	2 628 703	85.3	2 705 648	82.1	2 584 428	81.91	805 317	26.24
Irrigated Farming	120 740	3.9	231 123	7.01	223 127	7.07	1 714 150	55.86
Viticulture-Horticulture	251 627	8.2	188 383	5.71	259 825	8.23	354 834	11.56
Special Products	80 074	2.6	170 311	5.17	87 594	2.77	194 225	6.32
Meadow-Pasture	2 427 229	32.3	2 241 587	29.8	2 714 780	36.1	2 097 519	27.9
Meadow	587	0.02	801	0.03	---	---		---
Pasture	2 426 642	99.98	2 240 843	99.97	---	---		---
Forest and Shrubbery	1 493 327	19.8	1 446 378	19.2	1 240 005	16.5	1 758 422	23.3
Forest	60 401	4.04	135 280	9.35	53 704	4.33		---
Shrubbery	1 433 027	95.95	1 311 078	90.64	1 186 301	95.66		
Settlement areas	25 561	0.3	31211	0.4	---	---		---
Water surfaces	20 256	0.3	---	---	10 406	1.4	187 964	2.5
Others	248 174	3.3	---	---	311 135	4.1	413 169	5.5
Total	7 525 600	---	---	---	7 525 600	---	7 525 600	---

Source: www.gap.gov.tr

5.2.9 Water potential

Turkey can be divided into 25 basins or catchment areas. The total annual amount of surface water flow for these basins is 186 billion cubic meters, with about half of this being collected by the four main basins of the Euphrates - Tigris, Eastern Black Sea, Eastern Mediterranean, and Antalya. The remaining half is shared over the other 20 basins. The share of the Tigris and Euphrates Basins constitutes 30 percent of the total surface flow, comprising of 32 billion cubic meters for the Euphrates and 21 billion cubic meters for the Tigris; a total of 53 billion cubic meters is located in this basin. Currently, there is a net water potential 112 billion m³ in Turkey, of which the estimated total consumption in Turkey was some 44 billion m^3 in 2012.

5.2.10 Realization of GAP Irrigation Projects

In the region, 1.822 million hectares of land are planned to be brought under irrigation. By the end of 2009, a total of 300 397 ha had been brought under irrigation in the Euphrates and the Tigris Basin (Table A5.8). A total of 72 093 ha of irrigation network construction is still underway, 1 448 556 ha isin the planning stages, and 16.5 percent of irrigation projects are operating.

Table A5.8Irrigated area in the GAP region

Year	Irrigated Area (ha)	Net irrigated area opened during the year
2002	198 854	4 758
2003	206 954	8 100
2004	224 604	17 650
2005	245 613	21 009
2006	262 335	16 722
2007	272 972	10 637
2008	287 295	14 323
2009	300 397	13 102

Source: General Directorate of State Hydraulic Works, 2010.

Due to GAP activities, this region has undergone the “largest human-induced hydrologic development in Turkey over the past two decades”. In particular, in the central western portion of the GAP region, over 100 000 ha of land were placed under irrigation with surface water from the Euphrates River between 1980 and 2002 (Ozdogan and Salvucci, 2004). Cotton is the dominant crop in these irrigated lands, but other water intensive crops, including corn and sorghum, are also grown. The use of irrigation water in the GAP region has not only transformed the former precipitation-dependent agriculture into high yield acreage, it has also significantly altered the hydrologic cycle in the region. A tenfold increase in water usage is expected when the GAP project is fully completed in 2015.

The practice of irrigation and its efficiency is closely associated with the appropriate timing and coordination of other supporting services. Considering this fact and based upon the earlier interventions of the DPT (State Planning Organization), the GAP administration launched the largest ever land consolidation project in Turkey.

As stated above, the cultivable land in the GAP area extends over 3 200 000 ha, of which about 1 700 000 ha of this land can be irrigated through the initiatives of the General Directorate of State Hydraulic Works(DSI), Ministry of Agriculture and Rural Affairs and communities, and 1 200 000 ha of land cannot be irrigated technically and will remain as dry farming area. This is likely to result in an income gap between irrigated and dry farming areas. In order to raise the living standards of people in dry farming areas, the GAP administration is engaged, together with provincial governorates and provincial directorates of the Ministry of Agriculture and Rural Affairs, in various income generating activities and projects. These will take due account of local characteristics, habits of the inhabitants of these localities and marketing possibilities. These activities and projects are based on the trial and

replication of and model development for relevant technologies and crop-farming/stockbreeding techniques (www.gap.gov.tr).

5.2.11 Industries

The region's industry is largely based on agriculture. With the expected increase in agricultural production, the Turkish government is investing in factories and processing plants for agricultural produce so that it can be processed locally instead of being shipped across the country to factories elsewhere. The government is encouraging local business owners to invest in these factories and to hire local employees. The government is hoping that this partnership will convince potential workers to stay in the area instead of migration to Turkey's largest cities (Istanbul, Ankara, and Izmir) where there are high unemployment rates. The GAP administration expects at least 60 000 new jobs to be created through this program.

The main industries are textiles (32 percent), metal products (21 percent), food and beverage (19 percent), wood products (15 percent), and chemicals (5 percent). Industrial employment comprises 5 percent of the regional labour force as compared with 16 percent for the whole of Turkey. The growth rate of unemployment in the region reached its peak in 1985, at 19 percent per annum, which was 4.7 times higher than the national average. The public sector was more successful in generating value-added activities during this period. The annual growth rate of industrial value-added activities was 15.5 percent during 1980-1985, but it declined after this. Industry consumed nearly 60 percent of the region's electricity.

Mining is an important activity in the region's economy. Twenty-two types of ores have been identified as being economically feasible for production. All Turkey's petroleum and phosphate reserves are in the project region. In 1985, the GAP region contributed 4.4 percent of the total value-added activities of the mining sector in Turkey.

5.2.12 Livestock

In the Tigris and Euphrates Basin, livestock farming is generally extensive and pasture-based. The livestock farming is approximately 6 percent of cattle, 14 percent of sheep and 26 percent of goats in Turkey in the region. It is anticipated that a good plan and support for this sector will lead the region to export live animals and animal products (Karahocagil, 2010).

In the livestock farming sector, the GAP Project will provide opportunities to improve animal husbandry and fodder crop production and will contribute to the economy of the country in many ways, for example increase in the population and income over the next ten years will be accompanied by an increase in the demand of animal products (such as meat, milk, eggs). Additionally, it will also help to export products to countries in the Middle East, North Africa and Middle Asia with which Turkey currently has economic and cultural ties, leading to an increased inflow of foreign currency.

According to results of several studies by the International Center for Agricultural Research in the Dry Areas (ICARDA), between the years 2000 to 2020, a deficit in the quantities of animal products and animal feed production will appear in the 24 countries situated in the West Asia North Africa Region (WANA) as well as in six countries situated in the Central Asia Region. It is estimated that the total population of two regions will reach 1.1 billion by 2020. In WANA, a deficit of 1.5 million tonnes of meat and 11.4 million tonnes of milk is expected over the same period. Additionally, in the WANA region the deficit of cereal and legume production will reach 82 million tonnes by 2025 (Karahocagil, 2010).

5.2.13 Agro-based industry

Following the implementation of irrigated agriculture in the region, significant developments have occurred in the industry. The number of industrial enterprises has approximately doubled between the years 1995-2001. The number of enterprises in the GAP region increased from 1 102 in 2003, to 2 083

in 2009, with the number of employees increasing 39 000 and 87 000 over the same time period. Approximately 60 percent of the enterprises are in textiles and clothing sectors, 25 percent are in food, 11 percent are in petrochemical, 9 percent are in machine, 8 percent are in mining, and 2 percent are in the forest-paper sector (Karahocagil, 2010). By the end of 2009 there were 13 Organized Industrial Areas in the region. The coverage of the Organized Industrial Areas for the region is about 31km^{2}comprising approximately 16 percent of the total Organized Industrial Area in Turkey. There are two free trade zones in the region; one is in Mardin the other is in Gaziantep. Export from GAP has increased significantly year by year, from US$ 709 million in 2001 to US$ 4.4 billion in 2009. The share of GAP in the total export of Turkey increased gradually between the years 2002 to 2009 from 1.8 percent in 2002 to 3.3 percent in 2008 and 4.45 percent in 2009. The main export material from the GAP region is industrial products at 70 percent of the total exports, followed by agricultural products at 28 percent, and mining products at 2 percent. The main part in the industrial export is processed agricultural-based products at 50 percent of which 92 percent are plant products (Karahocagil, 2010).

5.3 Capture fisheries

5.3.1 Current status and trends

Capture fisheries in Turkey comprises of the marine and inland sectors has been given in Table A5.9. Approximately 92 percent of the capture fisheries production is from marine species and approximately 8 percent from inland capture fisheries production. There are indications that capture fish production has declined for both marine and inland fisheries but there is considerable scatter around the trend. Aquaculture has been growing rapidly during this period. From 2002 to 2010, the proportion of Turkey's total fish production from capture fisheries declined from 90 percent to 74 percent respectively, due to the increasing production from aquaculture (see Aquaculture section).

Table A5.9Capture fishery production for 2002-2010 in Turkey

Year	Marine		Inland		Total
	tonnes	%	tonnes	%	tonnes
2002	522 744	92	43 938	8	566 682
2003	463 074	91	44 698	9	507 772
2004	504 897	92	45 585	8	550 482
2005	380 381	89	46 115	11	426 496
2006	488 966	92	44 082	8	533 048
2007	589 129	93	43 321	7	632 450
2008	453 113	92	41 011	8	494 124
2009	425 275	92	39 187	8	464 462
2010	445 680	92	40 259	8	485 939

Source: MARA, 2012.

5.3.2 Fish species in the Euphrates and Tigris River Basins

In Turkey, studies regarding fish species in the Euphrates and Tigris Rivers area of Turkey started in the 1940s (Battalgil, 1941,1942, 1944; Sözer, 1941; Kosswig and Battalgil, 1943; Kosswig, 1954; Kuru, 1975, 1978-1979, 1986, 1996; Kelle, 1978). In addition, some taxonomic revision studies are also relevant to fish in the region (Ladiges, 1960; Banarescu and Nalbant, 1964; Banarescu, 1968; Karaman, 1969, 1971, 1972; Banarescu and Herzig-Straschil, 1995; Ekmekci and Banarescu, 1998;Bogutskaya, 1997). The first detailed studies in region were carried out by Kuru (1975) and Kelle (1978). Recently in the Tigris River, there have been taxonomy and biology studies of some species (Balcı *et al*., 1990; Ünlü and Balcı, 1990; Ünlü, 1991; Ünlü and Balcı, 1993; Ünlü, Balcı and Akbayın, 1994; Ünlü and Bozkurt, 1996; Bozkurt, Şevik and Ünlü, 1999; Ünlü, Balcı and Meriç, 2000), karyotype characteristics studies (Kılıç-Demirok and Ünlü, 2001; Kilic-Demirok and Ünlü,

2004), protection status for the Ramsar Pact (Kuru *et al*., 2001), and changes in fish fauna (Ünlü, 2008).

5.3.2.1 Native species

Forty-one native fish occur in the Turkish section of the Euphrates and Tigris River (Table A5.10). Among the fish species in the Euphrates-Tigris Basin, the family of the Cyprinid is the most common.

Table A5.10Native fish species in the Euphrates-Tigris Basin in Turkey

Family/Species	Family/Species
Salmonidae	**Cyprinidae (ctd)**
Salmo sp. (=*Salmo trutta macrostigma)*	*Petroleuciscus kurui* (Bogutskaya 1995)
Salmo tigridis Turan, Kottelat and Bektaş 2011	*Squalius cephalus* (Linnaeus 1758)
Cyprinidae	*Squalius lepidus* Heckel 1843
Acanthobrama marmid Heckel 1843	**Cobitidae**
Alburnoides fasciatus (Nordmann 1840)	*Cobitis kellei* Erk'akan *et al*. 1998
Alburnoides recepi Turan, Kaya, Ekmekçi and Doğan 2014	*Cobitis elazigensis* Coad and Sarieyyüpoglu 1988
Alburnoides velioglui Turan, Kaya, Ekmekçi and Doğan 2014	**Nemachileidae**
Alburnus caeruleus Heckel 1843	*Oxynoemacheilus tigris* (Heckel 1843)
Alburnus heckeli Battalgil 1944	*Oxynoemacheilus argyrogramma* (Heckel 1843)
Alburnus mossulensis Heckel 1843	*Oxynoemacheilus brandti* (Kessler 1877)
Barbus esocinus (Heckel 1843)	*Oxynoemacheilus frenatus* (Heckel 1843)
Barbus grypus Heckel 1843	*Oxynoemacheilus panthera* (Heckel 1843)
Barbus lacerta (Heckel 1843)	*Paracobitis malapterura* (Valenciennes 1846)
Barbus subquincunciatus Günther 1868	*Schistura chrysicristinae* Nalbant 1998
Barilius mesopotamicus Berg 1932	*Turcinemacheilus kosswigi* Banarescu and Nalbant 1964
Barilius mesopotamicus Berg 1932	**Siluridae**
Capoeta trutta (Heckel 1843)	*Silurus triostegus* Heckel 1843
Capoeta umbla (Heckel 1843)	**Sisoridae**
Carasobarbus kosswigi (Ladiges 1960)	*Glyptothorax armeniacus* (Berg 1918)
Carasobarbus luteus (Heckel 1843)	*Glyptothorax kurdistanicus* (Berg 1931)
Chondrostoma regium (Heckel 1843)	**Mugilidae**
Cyprinion kais Heckel 1843	*Liza abu* (Heckel 1843)
Cyprinion macrostomus Heckel 1843	**Mastacembelidae**
Garra obtusa (Heckel 1843)	*Mastacembelus mastacembelus* (Banks & Solander 1794)
Garra variabilis Heckel 1843	Cyprinodontidae
Leuciscus vorax Heckel 1843	*Aphanius asquamatus* (Sözer 1942)
Luciobarbus kosswigi (Karaman 1971)	**Bagridae**
Luciobarbus mystaceus (Pallas 1814)	*Mystus pelusius* (Solander 1794)
Luciobarbus xanthopterus Heckel 1843	

5.3.2.2 Introduced species

The introduction of new species of fish to an area can be of great value but may also result in future problems. For example, new parasites or diseases may be introduced to a water body and exotic fish can compete with local species that can cause drastic reductions in the native population. The impact of exotic fish may take different forms. They may be either serious predators or competitors of the indigenous fish.

Six introduced species have so far been recorded in the region. These are:

- *Cyprinus carpio*
- *Ctenopharyngodon idella*
- *Gambusia holbrooki*
- *Carassius auratus*
- *Carassius gibelio*
- *Heteropneustes fossilis*
- *Oncorhynchus mykiss*

Among the other exotic species that may soon be found in the Turkish section of the Tigris which originate in Iraq, are silver carp (*Hypophthalmichthys molitrix*), *Pseudorasbora parva*, pike-perch (*Sander lucioperca*), sheatfish (*Silurus glanis*), and tilapias (Coad, 1996).

5.3.2.3 Definitively and virtually extinct species

Despite a previous report, *Barbus subquincunciatus* was stated as extinct from the Euphrates and Tigris Rivers. By chance, the samples of this species were captured during the study period in the Tigris River around Ilısu village and Cizre. *Glyptothorax cous*, *Cobitis kellei* and *Schistura chrysicristinae* have not been observed until now. Their statuses are undefined.

5.3.2.4 Status of fish species

It can be seen that only 11 species are in lower risk, and 20 species are suffering a strong decline resulting from the destruction or alteration of the spawning grounds in the main river (Table A5.11). Five species have not been evaluated

Table A5.11Proposed status of fish species in the Tigris River

Family/Species		Family/Species	
Salmonidae		**Cyprinidae (ctd)**	
Salmo sp. (=*Salmo trutta macrostigma)*	VU	*Petroleuciscus kurui* (Bogutskaya 1995) *	VU
Salmo tigridis Turan, Kottelat and Bektaş 2011	VU	*Squalius cephalus* (Linnaeus 1758)	LR
Cyprinidae		*Squalius lepidus* Heckel 1843	LR
Acanthobrama marmid Heckel 1843	LR	**Cobitidae**	
Alburnoides fasciatus (Nordmann 1840)	LR	*Cobitis kellei* Erk'akan *et al*. 1998 *	VU
Alburnoides recepi Turan, Kaya, Ekmekçi and Doğan 2014 *	NE	*Cobitis elazigensis* Coad and Sarieyyüpoglu 1988 *	VU
Alburnoides velioglui Turan, Kaya, Ekmekçi and Doğan 2014 *	NE	**Nemachileidae**	
Alburnus caeruleus Heckel 1843	LR	*Oxynoemacheilus tigris* (Heckel 1843)	NR
Alburnus heckeli Battalgil 1944 *	VU	*Oxynoemacheilus argyrogramma* (Heckel 1843)	NE
Alburnus mossulensis Heckel 1843	*LR*	*Oxynoemacheilus brandti* (Kessler 1877)	*NE*
Barbus esocinus (Heckel 1843) *	*VU*	*Oxynoemacheilus frenatus* (Heckel 1843)	*NE*
Barbus grypus Heckel 1843	VU	*Oxynoemacheilus panthera* (Heckel 1843)	NE
Barbus lacerta (Heckel 1843)	LR	*Paracobitis malapterura* (Valenciennes 1846)	NE
Barbus subquincunciatus Günther 1868 *	VU	*Schistura chrysicristinae* Nalbant 1998*	VU
Barilius mesopotamicus Berg 1932	VU	*Turcinemacheilus kosswigi* Banarescu and Nalbant 1964*	VU
Capoeta trutta (Heckel 1843)	LR	**Siluridae**	
Capoeta umbla (Heckel 1843)	LR	*Silurus triostegus* Heckel 1843*	VU
Carasobarbus kosswigi (Ladiges 1960) *	VU	**Sisoridae**	
Carasobarbus luteus (Heckel 1843)	LR	*Glyptothorax armeniacus* (Berg 1918)*	VU
Chondrostoma regium (Heckel 1843)	LR	*Glyptothorax kurdistanicus* (Berg 1931)*	VU

Cyprinion kais Heckel 1843*	VU	**Mugilidae**	
Cyprinion macrostomus Heckel 1843	VU	*Liza abu* (Heckel 1843)	LR
Garra obtusa (Heckel 1843)	VU	**Mastacembelidae**	
Garra variabilis Heckel 1843	VU	*Mastacembelus mastacembelus* (Banks & Solander 1794)	VU
Leuciscus vorax Heckel 1843	VU	Cyprinodontidae	
Luciobarbus kosswigi (Karaman 1971)*	VU	*Aphanius asquamatus* (Sözer 1942)*	VU
Luciobarbus mystaceus (Pallas 1814) *	VU	**Bagridae**	
Luciobarbus xanthopterus Heckel 1843*		*Mystus pelusius* (Solander 1794)	VU

VU (Vulnerble), DD (Data deficient), NE (Not evaluated), LR (Lower risk). *=endemic species (Modified from Kuru, *et al*., 2001).

5.3.2.5 Grouping of species in ecological classes

a) Lotic Species:, with high oxygen requirements and clean shallow gravel beds for spawning (lithophilous reproducers): *Salmo sp. Salmo tigridis, Barbus esocinus, Luciobarbus mystaceus, Luciobarbus xanthopterus, Barbus lacerta, Luciobarbus kosswigi, Barbus subquincuncinatus, Barbus grypus, Barilus mesopotamicus, Carasobarbus kosswigi, Garra rufa, Petroleuciscus kurui, Cobitis kellei, Cobitis elazigensis, Oxynoemacheilus tigris, Oxynoemacheilus argyrogramma, Paracobitis malapterura, Schistura chrysicristinae, Turcinemacheilus kosswigi, Glyptothorax armeniacus, Glyptothorax kurdistanicus*.

It can also be stated that lotic systems must be protected since, most of them are endemic for Tigris and Euphrates River System.

b) Lentic species: that are most influenced by the destruction of the aquatic vegetation used as a spawning substratum are: *Alburnus heckeli,* and *Aphanius asquamatus*

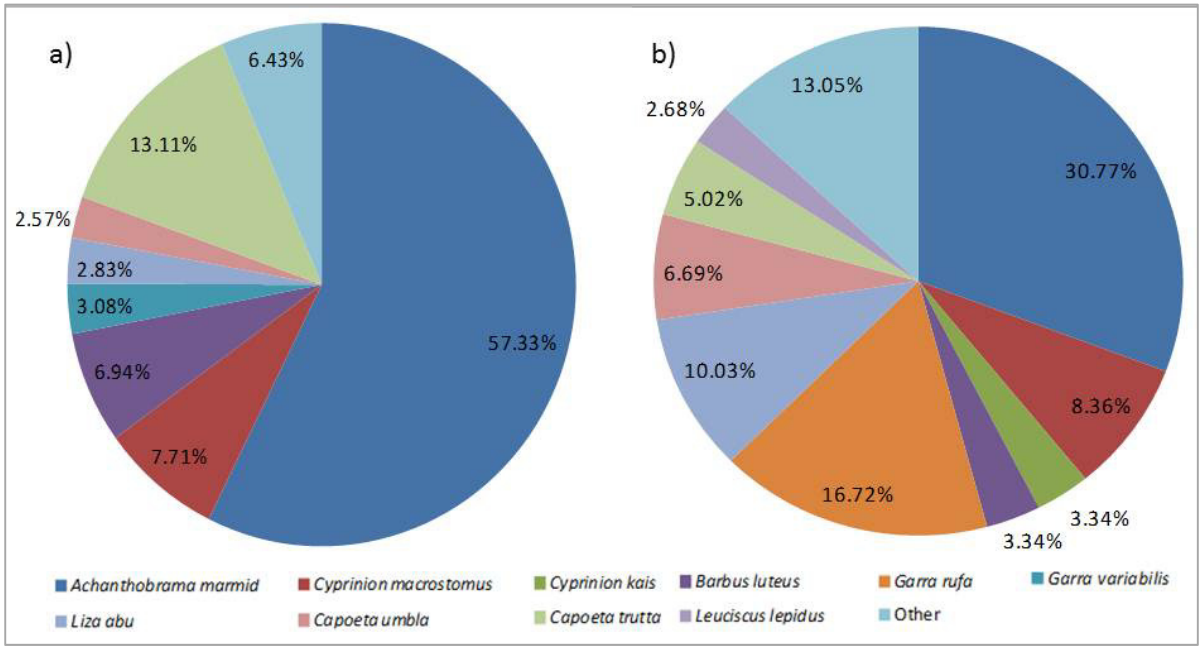
c) Species are found both in lentic and lotic environments:*Achanthobrama marmid, Alburnoides fasciatus, Alburnus caeruleus, Alburnus mossulensis, Leuciscus vorax, Carasobarbus luteus, Capoeta trutta, Capoeta umbla, Chondrostoma regium, Cyprinion macrostomus, Cyprinion kais, Garra variabilis, Leuciscus cephalus, Leuciscus lepidus, Silurus triostegus,and Liza abu and Mystus pelusius*.

5.3.2.6 Fish populations

The dominant species of the Tigris fish community belong to genera *Capoeta*, *Barbus*, *Luciobarbus, Chondrostoma, Achantobrama* and *Alburnus* and the secondary species are those belonging to the genera *Garra*, and *Mastacembellus*. Observations at the fish markets and incidental sampling in various waters would indicate that *Luciobarbus rajanorum*, *Carasobarbus luteus*, *Capoeta trutta*, *Capoeta umbla* and *Achantobrama marmid* constitute about 60 percent of the total production. The proportions of *Silurus triostegus*, *Barbus grypus* and *Barbus esocinus*, although smaller, are nonetheless important because they make delicious eating and are sold at a high price, especially when alive.

In the Bismil and Hasankeyf areas of the Tigris River, fish samples were caught and counted to assess the fish composition and dominant fish species occurring in the Tigris River. The results obtained from the analyses of the fishing assessment are given in Figure A1.1

Figure A5.1. Distribution of fishing composition of species in the (a) Hasankeyf area, and (b) in the Bismil area.



5.3.2.7 Biology of species of economical importance

Data have been collected with respect to length and weight of the important species, the age of maturity, the period required for the development of the gonads; and the breeding season. These observations were made, partly on material available at fish markets in Diyarbakir and data taken in the field (Table A5.12).

Table A5.12Some biological features of fish in the Tigris Euphrates Basin in Turkey

Family/Species	Preference	Economic	Age at 1st maturity	Spawning Period	Spawning ground
Salmonidae					
Salmo sp.	Lotic	E	3-4	February	Stones and gravel
Salmo tigridis	Lotic				Stones and gravel
Cyprinidae					
Acanthobrama marmid	Lentic / lotic	E	2	May-July	Marshes / rivers
Alburnoides fasciatus	Lotic		1	May-June	Marshes/lakes;Gravel, plants
Alburnus caeruleus	Lentic / lotic		2	May-June	Marshes/lakes;Gravel, plants
Alburnus heckeli	Lentic		2	May-June	lakes; Gravel, plants
Alburnus mossulensis	Lentic / lotic	E		May	Sand / gravel
Leuciscus vorax	Lentic / lotic	E	4	Jan-Mar	Marshes/lakes;Gravel, plants
Barbus esocinus	Lotic	E	>8	March	Between large stones
Barbus lacerta	Lotic		2	May-June	Gravel, sand plants
Luciobarbus kosswigi	Lotic		2	May-June	Gravel, sand plants
Luciobarbus mystaceus	Lotic	E	3,4	April-May	Gravel, sand plants
Luciobarbus xanthopterus	Lotic	E	>5	March	Between large stones
Barbus subquincuncinatus	Lotic	E		April-May	Sand / stone / gravel
Barbus grypus	Lotic	E	4	May-June	Sand / stone / gravel
Carasobarbus luteus	Lentic / lotic	E	2,3	April-July	Marshes/lakes;Gravel, plants
Barilius mesopotamicus	Lotic		1	May	Sand / gravel
Carasobarbus kosswigi	Lotic	E			Fine gravels

Capoeta umbla	Lentic / lotic	E	2,3	April-May	Sand / stone / gravel
Capoeta trutta	Lentic / lotic	E	2-4	May-June	Marshes/lakes;Gravel, plants
Chondrostoma regium	Lentic / lotic	E	3	March-April	Fine gravel, plants,
Cyprinion kais	Lentic / lotic		2	May-June	Sand / stone / gravel
Cyprinion macrostomus	Lentic / lotic		2	May-June	Sand / stone / gravel
Garra rufa obtusa	Lotic			May-June	Sand / stone / gravel
Garra variabilis	Lentic / lotic			May-June	plants
Squalius cephalus	Lentic / lotic	E	2,3	May- June	Sand / stone / gravel
Petroleuciscus kurui	Lotic	E	2,3	May- June	Sand / stone / gravel
Squalius lepidus	Lentic / lotic	E	2,3	May- June	Sand / stone / gravel
Cobitidae					
Cobitis kellei	Lotic				
Cobitis elazigensis	Lotic				
Nemachileidae					
Oxynoemacheilus tigris	Lotic				
Oxynoemacheilus argyrogramma	Lotic				
Paracobitis malapterura	Lotic				
Schistura chrysicristinae	Lotic				
Turcinemacheilus kosswigi	Lotic				
Siluridae					
Silurus triostegus	L Lentic /lotic		3-4	March	Plants, Stones
Sisoridae					
Glyptothorax armeniacus	Lotic				
Glyptothorax kurdistanicus,	Lotic				Sand / stone / gravel
Bagridae					
Mystus pelusius	Lentic / lotic				Plants
Cyprinidontidae					
Aphanius asquamatus					
Mugilidae					
Liza abu	Lentic / lotic	E	1	March/May	plants
Mastacembelidae					
Mastacembelus mastacembelus	Lentic / lotic				Plants

5.3.3 Fishing season

Marine and fresh water fishing is prohibited between 5April and 1 September throughout Turkey; outside of this period fishing activities take place in the region every day of the year. The numbers of days spent fishing are between 150-170 in the GAP region. Fishing periods of the important commercial fish species in the Tigris and Euphrates River are presented in Table A5.13.

Table A5.13Fishing periods on the Euphrates-Tigris system in Turkey

Fish Species	Fishing Period	Peak Fishing Period
Luciobarbus rajonorum	October-April	Feb-March
Barbus grypus	October-April	March
Leuciscus vorax	Dec-Feb	January
Barbus esocinus	Dec-April	March
Carasobarbus luteus	Sept-April	November, March
Achantobrama marmid	Sept-April	October
Capoeta umbla	Sept-April	Dec-Feb
Capoeta trutta	Sept-April	Oct-Nov-March
Chondrostoma regium	Sept-April	Feb-March
Liza abu	Sept-April	Octobrer-Nov.
Silurus triostegus	Sept-April	May-July

It has been reported that October, November, and December are the months of heavy fishing activities. A fisherman with nets of 2 000 meter long can capture around 20-30 kg fish per week. The quantity of captured fish declines to 5-6 kg in progressive months and falls to 2-5 kg during January, February, and March. Sometimes fishermen fail to catch any fish (Anonymus, 2004).

5.3.4 Fishing methods

Fish production is increasing in more developed areas due to improvements in fishing techniques. However, traditional methods are used in rural areas. The quantity of nets owned by fishermen is directly related to the economic situation of fishermen and this implies that fishing activities are performed without the consideration of future fish stocks (Can and İğne, 2005). There is little or no control or enforcement in rural regions and fishers take the opportunity to use whatever fishing methods are available to them without concern for the effects on the fish stocks and environment. Prohibited fishing methods, such as electro shocking and use of dynamite or toxic substances, are among the common fishing methods in use today in rural areas. With these unselective methods, fishes of different sizes are caught and small ones are usually thrown away. This action would have a direct negative impact on future fish stock in the area.

5.3.4.1 Gillnets and trammel nets

With the aid of surveys in dam lakes with local fishers and field work in fishing areas, it has been observed that gillnets and trammel nets are the main fish capturing equipment used by local fishers. Gillnets are mostly operated with motor boat. Their simplicity of construction and operation makes them one of the most basic and widespread methods for fishing in the inland waters and the preferred method in most lakes. Gillnets are among the most selective fishing gears with respect to the size range of target species captured. They can be highly selective for size classes of the target species provided the net is well serviced and tended regularly. As fish attempt to swim through the mesh of the net, they become snagged by their gill operculum or fins.

The mesh size of the trammel nets has changed from 35-40 mm to 70-110 mm in recent years. The length of fishing nets owned by most of fishers varies from 500 to 2 000 meters, depending on fishermen's economic situation. It has been reported that fish stocks, especially fish between 1 and 3 years of age in the region have been heavily exploited with gillnets of 30-70 mm mesh size (Anonymus, 2004). It has been estimated that total catch per person is 16.2 kg fish/day, and that the total yearly catch obtained in 150-170 active fishing days for all fishers varies from 952 to 1 016 tonnes. With these numbers, it has been calculated that the mean fish catch per hectare area and fishing boat are 22.1 kg/year and 25.7 kg/day, respectively (Anonymus, 2004).

Monofilament and multifilament gill nets are both reported to be used in dam lakes. During 2008 and 2009, a total of 123 400 meters of gillnets and trammel nets were examined in the Pertek region of Keban Dam Lake (Dartay and Duman, 2007). They consist of 69 900 meters monofilament and 53 500 meters multifilament nets. It was reported that 154.8 tonnes of fish were caught in a fishing season (2008-2009) from this region of Keban Dam Lake (Dartay *et al*., 2010).

5.3.4.2 Cast nets

Cast nets are used by traditional fishermen in small stream in rural areas. The cast net is circular, measuring from 5 to 6 meters in diameter, with lead bars attached to the edge, and is used by a single fisherman. The cheapness and transportability make cast nets one of the most common gears in inland capture fisheries (Jawad, 2006). They are popular with artisanal and subsistence fisheries. Cast nets are selective for lower size ranges, and larger, faster-moving fish can usually escape the falling net but may become entangled in the process. There are some illegal versions of this net where a small mesh size is used.

5.3.4.3 Fishing spears

Fishing spears are also a traditional method used in rural areas. The use of spears to catch fish is among the most ancient forms of hunting and is still used today. The type of spear commonly used in the marshlands has a 2 meter handle, usually of hard palm tree wood, tipped with single or multiple pointed heads. Spear fishing is a quick fishing method, but it is dangerous from a hygiene standpoint, as the spear head is seldom clean and so can contaminate the catch.

5.3.4.4 Hook and line

Local people also use hooks and line to catch fish. Fishes are caught with a fishing line by encouraging fish to bite on a fish hook. A fish hook will pierce the mouthparts of a fish and is normally barbed to make escape less likely. Hook and lines are operated for catching bigger specimens such as mirror carp (*Cyprinus carpio*), shillik (*Leuciscus vorax*) and Bizz (*Barbus esocinus*) in dam lakes.

5.3.4.5 Tiriviri (monofilament tangle nets)

Tiriviri are made of a nylon net generally 70 cm by 100 cm and is attaching to a rod and weighted with lead. This forms a loose curtain of net and entangles fish. Due the material of thin nylon; it risks sticking with other materials in the water. It can stay in the water for 200 years without breaking down and causes great damage to water life such as fish, water birds, frogs and other living things in the habitat.

5.3.5 Fishing Locations

Furthermore efficient fishing, there are many areas that are designated fishing areas in the reservoirs on the Euphrates. Mirror carp (*Cyprinus carpio*) and rainbow trout (*Onchorhynchus mykiss*) are generally introduced by the relevant units of DSI and Ministry of Agriculture (Table A5.14).

Table A5.14Annual number of fish introduced to Keban Dam Lake by Directorate of State Hydraulic Works

Year	Mirror carp (piece)	Rainbow trout (piece)
1983-1988	2 000 000	-
1991	231 000	-
1992	428 000	-
1993	550 000	17 500
1994	250 000	5 500
1995	735 000	50 000
1996	600 000	100 000
1997	165 000	100 000
1998	50 000	150 000
1999	600 000	250 000
2000	1 220 000	200 000
2001	900 000	150 000
2002	700 000	200 000
2003	1 000 000	150 000
2004	1 000 000	200 000
2005	835 000	-
Total	10 429 000	1 573 000

Source: Celayir *et al*., 2006.

The DSİ has two hatcheries and fry rearing stations near Atatürk and Keban Dams, which are generally used for fish rearing and releasing in dam lakes and ponds. During the releasing process of mirror carp, some other species such as *Carassius gibelio* and *Carassius auratus* have been accidently introduced (Balık and Ustaoğlu, 2006). Most designated fishing areas are in dam lakes on the Euphrates, of which Atatürk Dam Lake is the largest. Keban, Karakaya and Birecik dam lakes are also important designated fishing areas. According to 2000 statistics (Anonymus, 2004), 43 fishing areas covering 106146 ha in the GAP region were recorded (Table A5.15)

Table A5.15 Important fishing locations on the Tigris and Euphrates Rivers in Turkey

Dam Lakes	Province	Number of fishing locations	Area (ha)	Fishable stock (tonne)	Fishery number	Boat number	Gillnet and trammel long (m)	River System
Keban	Elazığ	16	51 720	648	386	217	519 000	Euphrates
Kalecik	Elazığ	1	116	9.5	6	2	2 000	Euphrates
Karakaya	Elazığ Malatya Adıyaman Diyarbakır	10	26 320	354	214	162	264 000	Euphrates
Atatürk	Adıyaman Şanlıurfa,Diyarbakır	21	63 850	600	306	217	600 000	Euphrates
Çat	Malatya	1	1 430	5	26	8	4 000	Euphrates
Birecik	Şanlıurfa Gaziantep	1	750	120	20	11	10 000	Euphrates
Dicle	Diyarbakır	2	750	90	15	3	15 000	Tigris
Kralkızı	Diyarbakır	2	920	90	16	5	15 000	Tigris
Devegeçidi	Diyarbakır	1	3 565	30	5	2	5 000	Tigris
Batman	Batman	2	1 545	50	15	3	15 000	Tigris

Source: Adapted from Anonymus, 2004; Ural and Canpolat, 2009; Bayhan and Göçer, 2012.

5.3.5.1 Keban fishing areas

Keban Dam Lake is an important fishing locality. First fishing activities commenced in 1976. Today, 16 different fishing area fields with 16 fishery cooperatives are active in the Keban Dam Lake (Table A5.16). Fishing areas for each cooperative are clearly defined and fishing is not allowed outside of this area for cooperatives. According to survey studies, currently 306 registered cooperative members and 217 motor boats were operational in this area. Although the water level in the dam is 845 m above sea level, due to falling water levels the average water level has been now calculated as 841 m above sea level with a surface area of about 56 040 hectares (Celayir *et al*., 2006). It has been reported that the annual productivity of the Çemişgezek region in Keban Dam Lake was estimated as 2261.08 kg/per fishing vessel, one unit net 99.27 kg, and 8.52 kg/hectare. It has also been stated that fishing in this area is not currently economically sustainable without a fisheries management programme (Orsay and Duman, 2008).

Table A5.16Fishing area in the Keban Dam Lake

Fishing location	Area (ha)	Number of cooperative members	Number of boats	Province
No. 1. Kemaliye	2 000	20	9	Erzincan
No. 2. Agin	4 700	16	15	Elazig
No. 3. Keban	5 000	17	20	Elazig
No. 4. Çemişgezek	9 550	42	40	Tunceli
No. 5. Pertek	6 500	17	10	Tunceli
No. 6. Aydincık	7 200	36	22	Elazig
No. 7. Goktepe	1 550	12	8	Tunceli
No. 8. Peri	2 000	7	5	Tunceli
No. 9. Ilemi	2 600	26	18	Elazig

No. 10. Koçkale	2 000	16	8	Elazig
No. 11. Içme	2 370	13	8	Elazig
No. 12. Şeyhhaci	1 000	8	5	Elazig
No. 13. Uzunova	150	16	10	Elazig
No. 14. Yolüstü	500	25	6	Elazig
No. 15. Gülüşkür	1 900	15	15	Elazig
No. 16. Yurtbaşı	2 700	20	18	Elazig
Total	51 720	306	217	

Source: Celayir *et al*., 2006.

5.3.5.2 Karakaya fishing areas

There are 10 fishing areas of different sizes covering a total of 26 320 ha in Karakaya Dam Lake bordered by the cities of Malatya, Elazığ, Adiyaman and Diyarbakır.Approximately 120 boats are used in the dam lake area.

5.3.5.3 Atatürk Dam Lake fishing areas

There are 21 fishing areas with different sizes covering 63 850 ha in Ataturk Dam Lake bordered by the city of Gerger in north, Adiyaman in west, Bozova (a county of Sanliurfa) in south, and Hilvan in east (Table A5.17). Rent contracts are currently not being renewed here probably due to fact that there is no "determined" concept of cooperation and illegal fishing is easily carried out in the region.

Table A5.17Fishing areas in the Ataturk Dam Lake

Fishing area	Area (ha)	Number of cooperative members	Stock (ton/y)	Number of boats	Province
No. 1. Bozova	2 200	10	21	5	Şanlıurfa
No. 2. Bozova	8 600	12	80	7	Şanlıurfa
No. 3. Bozova	4 100	10	39	6	Şanlıurfa
No. 4. Hilvan	3 100	8	44	3	Şanlıurfa
No. 5. Hilvan	4 300	8	62	3	Şanlıurfa
No. 6. Siverek	3 100	12	45	6	Şanlıurfa
No. 7. Siverek	3 100	12	45	7	Şanlıurfa
No. 8. Çermik	350	15	3.3	7	Diyarbakır
No. 9. Çermik	450	11	4,2	6	Diyarbakır
No. 10. Çüngüş	300	9	1.5	8	Diyarbakır
No. 11. Gerger	1 700	6	13.5	4	Adiyaman
No. 12. Gerger	2 100	8	16.5	6	Adiyaman
No. 13. Kahta	4 400	16	60	8	Adiyaman
No. 14. Kahta	5 500	21	74	8	Adiyaman
No. 15. Kahta	4 900	25	66	26	Adiyaman
No. 16. Samsat	11 000	12	83	11	Adiyaman
No. 17. Samsat	5 650	25	42	24	Adiyaman
No. 18. Adiyaman	4 000	30	37	12	Adiyaman
No. 19. Adiyaman	3 200	20	31	16	Adiyaman
No. 20. Adiyaman	4 000	14	37	25	Adiyaman
No. 21. Adiyaman	4 700	20	45	20	Adiyaman
Forbiden areas	950				
Total	81 700	304	850	218	

Source: Celayir, Pala and Yüksel, 2006; Anonymus, 2004;Olgunoğlu *et al*., 2009.

5.3.6 People involved

Large numbers of people are involved in small-scale fisheries as fishers, and in the supply chain and service sectors. The importance and contribution of the service sectors cannot be over emphasized. More than 1 500 families are involved in the fishery, indicating that over 10 000 individuals are dependent upon fisheries for their livelihoods. Table A5.18 shows fishery data obtained from Food, Agriculture and Livestock provincial directorate of some provinces.

In the Keban Dam Pertek region, the people actively engaged in fishing are between 23-52 years old, and 80.6 percent of them are primary school graduates, 12.9 percent are secondary school graduates, and 6.4 percent are high school graduates. Of these people, 77.4 percent are forced into fishing due to unemployment and carry on their father's professions. Approximately 61.3percent of them are recorded to social or health security, the other 38.7 percent to the SSK and BAGKUR system[2]. In addition to fishing, they also deal in agriculture and livestock farming. Of these people, 27 (87.1percent) are married with 1 to 4 children. Their gross annual income is on average TL 40 179 (=US$ 21 500) per person and their overall expenses are TL 30 979 (=US$ 16 500) per year. Their average monthly expendable income was calculated as TL 1 150 (US$ 610). (Dartay *et al*., 2009).

Table A5.18Fishery data by province in the Euphrates Basin in Turkey

Quantity	Elazığ	Şanlıurfa	Adıyaman	Malatya	Diyarbakır
Number of licensed fisheries	343	78	192	129	-
Number of licensed fishing boats	133	65	142	101	-
Number of fishing areas	17	7	11	10	3
Number of fisheries cooperatives	13	4	9	6	-
Number of members of cooperatives	285	140	178	120	-
Weight of fish caught (ton/y)	314	320		86	-

Source:Data from Food, Agriculture and Livestock provincial directorate.

5.3.7 Processing

Turkish consumers have a preference for whole fresh fish. Traditional drying of fish is undertaken in remote fishing sites. In the Tigris and Euphrates River Basins area, there are no fish processing facilities. Captured fish are usually sent fresh to markets or restaurants with no processing.

5.3.8 Trading/Marketing

In contrast to aquaculture products, capture fisheries catch are transported to markets without any cold chain links; generally fish are transported with car baggage. This type of transport for fish leads to a decrease in the quality and price of fish.

The GAP region is a huge basin in which fishery produce from within and outside of the region are sold and consumed. The number and people involved in some of the provinces of the Tigris and Euphrates Basin are given in Table A5.19. Fish are sold in small and simple markets. The producers of the region cannot sell their products outside of the region. There is no organized cool distribution channels and marketing. In addition, it is hard to talk about an efficient marketing plan (Anonymus, 2004).

[2]Insurance funds in the Turkish Social Security System. In 2007 these two funds, along with Emekli Sandigi were merged into a sole body called Social Security Institution (SSI), serving 81 percent of the population.

Table A5.19Distribution of Retail Markets in the GAP provinces

Province	Number of fish markets	Number of people
Elazığ	12	50
Malatya	5	12
Bingöl	3	5
Tunceli	3	8
Adıyaman	15	60
Şanlıurfa	8	15
Gaziantep	12	25
Kilis	1	3
Mardin	1	2
Diyarbakır	5	30
Şırnak	1	2
Batman	10	24
Siirt	2	13
Total	78	249

The frequent changes in the prices of animal products have had a significant impact on the food habits of Turks, who are now encouraged to eat fish rather than meat. For instance, fish has become increasingly available in most of the private restaurants where fish farming is performed.

5.3.9 Institutions: fishing cooperatives, organizational structures, and the role of community leaders

5.3.9.1 Public Organizations

The only authorised public sector for both fishing and fish farming are the regional directorates of The Ministry of Agriculture and Rural Affairs (MARA). The fishery duties of such directorates are undertaken by four branches: Farmer Education and Extension Branch, Support Branch, Project and Statistics Branch, and Controlling Branch. The General Directorate of State Hydraulic Works (DSI) supports the fishery activities in GAP Region. The Fisheries Section Directorate carries out research and development studies for dam reservoirs (DSI, 2012). The DSI Fishery Research and Propagation Centers are near to the Keban and Atatürk dam reservoirs in Elazığ and Şanlıurfa provinces (Akyürek, 2005). In addition, the Elazig Fishery Research Institute has contributed a lot to the fishery of the region by the investigations that it has conducted. The institute is both supervising and educating the producers of the region. There are 64 employees of the institute, of whom 36 are fishery engineers, veterinary, agricultural engineer and chemist, biologist and laboratory technicians. In addition to the institute, there is a fishery production unit belonging to the 16thRegional Directorate of State Hydraulic Works. Agricultural credit cooperatives and Agricultural banks are the other organizations that undertake the public duties. There are fishery programs in Harran University (Şanlıurfa), Firat University (Elazığ), İnönü Üniversity (Malatya), Tunceli University (Tunceli), Erzincan University (Erzincan), and Atatürk University (Erzurum).

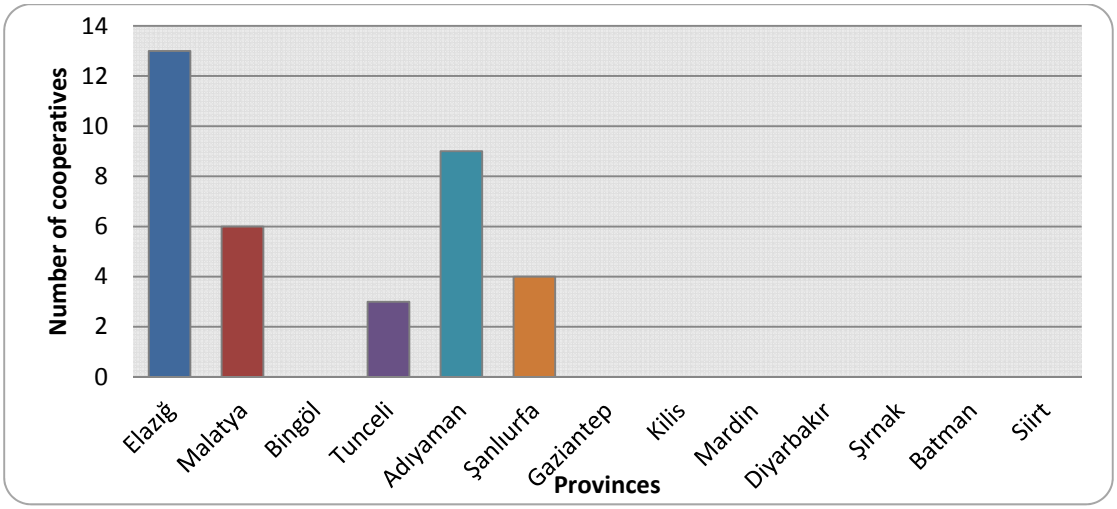
5.3.10 Fishery cooperatives in the Tigris and Euphrates Basins

After the building of dams on the Tigris and Euphrates Rivers, the majority of fishers began to be organised into fishery cooperatives, in line with the previous policy of the Government (Figure A5.1 and Table A5.20).

They are active in freshwater fisheries as well as in aquaculture and can have a significant impact on making both small scale fisheries and large scale fisheries sustainable. Recently, many fishery economists generally agree that the most promising solution is to adopt fishery management regimes that create private property-based systems in fisheries. Fishery cooperatives could be taken into consideration as a substitute for a property rights system. Therefore, cooperation is one of the most effective tools to reach the objectives of fisheries management (Ünal and Yercan, 2006). MARA has

granted commercial fishing rights only to fishermen's associations, each of which has to pay a royalty in return for the privilege of exploiting a given water body.

Figure A5.2 Fishery cooperatives by province in the Euphrates-Tigris Basin in Turkey



Source: Ural and Canpolat, 2009.

The fishery cooperatives have many difficulties, problems and failure characteristics in the region and, according to research by Ünal (2006), include the following:

- There is lack of solidarity among members. Lack of solidarity, which is one of the most important factors involved in success/failure of fishery cooperatives, has been declared by the leaders of all cooperatives.
- Difficulties in collecting membership fees
- Lack of financial resources and government support
- General educational level is low among the members and even leaders of fishery cooperatives
- Selling fish outside the cooperatives that inhibit cooperative development
- Non-fishermen among members in some cooperatives
- Cooperatives do not represent interests of business management, education services, and patronage refund to their members
- Legislative support provided by government is insufficient.

Table A5.20Fishery cooperatives in the Euphrates-Tigris Basin in Turkey

Reservoir	Name of Fishery Cooperative	Establishment year
Keban Dam Lake	Ağın Fishery Cooperative	1974
	Aşağı İçme Fishery Cooperative	1975
	Aydıncık Fishery Cooperative	1977
	Güzelyalı Fishery Cooperative	1977
	Koçkale Fishery Cooperative	1977
	Aşağıbağ Fishery Cooperative	1977
	Örencik Fishery Cooperative	1977
	Uzunova Fishery Cooperative	1978
	Keban Fishery Cooperative	1978
	Yolüstü Fishery Cooperative	1983
	Kumlutarla Fishery Cooperative	1989
	İmikuşağı Fishery Cooperative	1990
Hazar Lake	Kezin Fishery Cooperative	2001
Karakaya Dam Lake	Doğanyol Fishery Cooperative	
	Kıyıcak Fishery Cooperative	
	Kuluşağı Fishery Cooperative	
	Hasırcı Fishery Cooperative	
	Ambarcık Fishery Cooperative	
	içmece Fishery Cooperative	
Sultansuyu Dam lake	Karapınar Fishery Cooperative	
Atatürk Dam Lake	Fıstıklı Fishery Cooperative	1993
	Kızılcapınar Fishery Cooperative	1996
	Taşpmar Fishery Cooperative	1996
	Geldibuldu Fishery Cooperative	1997
	Oluklu Fishery Cooperative	1997
	Kızılöz Fishery Cooperative	1997
	Yazıca Fishery Cooperative	1998
	Açma Fishery Cooperative	1999
Çat Dam Lake	Çelikhan Fishery Cooperative	1999
Dicle dam lake	-	
Kralkızı dam lake	-	
Birecik Dam lake	-	
Karkamış Dam lake	-	

Source: Adapted from Ural and Canpolat (2009) and Bayhan and Göçer (2012).

5.3.11 Other livelihood information

Fisher folk and persons involved in the fishery sector can increase capture, improve processing and marketing of fish products when they unite in a cooperative. Individuals, who alone would find it difficult to maintain their livelihoods, pool their human and financial resources to enable them to make their operations viable. Equipment and fishery inputs can be purchased, loans can be sought, insurance cover can be obtained, operating expenses can be rationalized, fish capture efficiency can be increased by education and training especially as regard to fishery resource management, exploitative situations can be countered, and this all helps to promote job security and eventually sustainable management of the resource. Cooperatives in this way contribute to food security by allowing fisher folk not only to provide food for them, but also make high quality protein available to their communities (Ünal and Yercan, 2006; Ünal, 2006).

As a result of the survey targeted to increase fishery products production and consumption in the region are given as follows (Anonymus, 2004):

- The age of most respondents ranged between 31and 40 and they were married
- Most respondents were living in their place of birth and have not migrated out
- Region faces unemployment problems; many people indicated they were unemployed
- The gaps in the social security system are high, particularly in Diyarbakır, Sanlıurfa and Mardin
- The majority of respondents were holding elementary school degrees and illiteracy was highest among women
- Most of the respondents were living in a nuclear family ranging from 4 to 6 persons
- The producers who had 200-300 million TL (=US$ 100-150 m)were in majority
- Most of the respondents who had regular income were living in Gaziantep and Sanliurfa
- Approximately 20 percent of the respondents indicated that they consumed less than 100 million TL for food
- Most of the respondents owned their homes, and the infrastructure and physical characteristics of homes were similar to the average condition in Turkey
- Most of the respondents did not have agricultural land
- Off farm economic activity was significant in the region
- Most of the respondents' families were producing thin-dough bread and tomato paste for their own consumption
- The respondents had general attitudes in child developments (particularly when sending their children to school)
- For most residents, the ideal number of children they want to have was three
- Most of the residents were positive for the family planning idea
- The majority of the respondents were in favour of both public and religious weddings
- Eighty-eight percent of the respondents were watching TV for 2-3 hours a day
- The respondents' membership to the civil society organizations was low
- Among the civil society organizations, the membership to the official unions was more significant
- The official credit usage was significantly low
- The majority of the respondents indicated that the way they live has changed in recent years, being notably negative in feeding and consumption behaviours
- The new production method should be tested before spreading widely
- The traditional way of thinking and dependence seems to be highly appreciated
- For most of the respondents, the price of a product was more important than the quality
- The difficulty of obtaining the basic necessities of life is increasing over time
- Most of the producers want to use the new products after they have been used by others for long time
- The majority of the respondents were not in favour of the idea that they increased the consumption of properties that they previously consumed less
- A total of 30.7 percent of the respondents indicating that they did not care about their health in feeding

5.3.12 Legislation and policy

The fisheries laws give the major responsibility of fisheries to the MARA, and during the 1980s, significant effort was devoted to preparing laws, and by laws which are related to the management of coastal and inland resources. A significant part of legislation prepared in this period deals with protection and conservation issues. These include laws on environmental protection, national parks and the protection of cultural and national wealth, which may limit some fisheries and aquaculture activities. As a result, several ministries and institutions established in the 1980s, such as the Ministry of Environment and Forest, Under Secretariat of Maritime, etc., are involved in the decision making process regarding fisheries and aquaculture.

The Control Sections of the 81 Provincial Directorates of MARA are responsible for implementing fishing regulations and control the fishery as stated in the annual ministerial circulars. Additionally, coastguards from the Ministry of Internal Affairs also have the responsibility of controlling the fishing in some defined areas.

The State Planning Organization prepares long-term development plans and annual programs conforming to the targets of the sector determined by the government, and coordinates activities of the ministries and public institutions concerning economic, social and cultural policies, to ensure efficient implementation and advise the government regarding fishery policy issues,

Fisheries Production data are gathered and evaluated by the State Statistics Institute in collaboration with MARA. The institute uses a complete technique for large-scale fishers, and sub-sampling for small-scale fishers. The Under Secretariat of Foreign Trade of the Prime Ministry is the public organization which regulates fish exports and imports. The Agricultural Bank of Republic of Turkey and Under Secretariat of the Treasury operate to provide credit and incentive schemes to support the fishery and aquaculture sectors. The Scientific and Technical Research Council plays an important role in organising and funding research activities. The Export Promotion Centre of Turkey, which is the only public organisation in this field, acts as an intermediary in establishing business contacts between foreign importers and Turkish exporters to develop and to promote Turkish fisheries exports.

MARA is the main state organization responsible for the administration, regulation, protection, promotion and technical assistance of fisheries and aquaculture through four General Directorates. All activities in fisheries and aquaculture are based on the Fisheries Law No. 1380, enacted in 1971. With this law, and its related bureaucracy, definitions were codified. Based on this law, regulations and circulars are prepared to regulate fisheries. The Fisheries Law No. 1380 of 1971 was amended by Law No. 3288 of 1986. According to Law Nos. 1380 and 3288 and Continental Waters Law No. 2674 of 1982, foreigners are not allowed to take part in commercial fishing activities. In accordance with the laws, every year commercial fisheries and sport fishing circulars are published and announced in the official Journal about the restrictions for stock control (OECD, 2008).

The main fisheries duties of MARA are:

- to perform and to assign the duties specified in the Law Nos. 1380 and 3288
- to determine and implement the major fisheries and aquaculture policies
- to assist the services of the provision, supply and distribution of fisheries and aquaculture credits and other inputs that fishers and fish farmers use
- to establish and operate the quality control systems and organizations required to ensure and regulate that fish and other fishery products are captured, processed, stored, marketed and exploited in accordance with the international quality standards
- to establish and operate research activities on the improvements, controlling, production, processing units, agencies, laboratories and establishments, and to provide technical assistance to private sector organizations desiring to establish and operate such kind of institutions
- to prepare and implement extension and training systems, programs and projects for fishers and farmers
- to collaborate with the private agencies, universities, research institutions and international organizations to increase the productivity, conservation of natural stocks and to protect them from biotic and abiotic hazards
- to promote and support to fishery organizations, associations and co-operatives

MARA undertakes its duties in fisheries management through four General Directorates, as well as the District and 81 Provincial Directorates.

5.3.13 Past or current development and capacity building projects

Elazig Fishery Research Institute under MARA has contributed capacity building projects related to sustainable fisheries and aquaculture in Euphrates and Tigris River systems (Table A5.21)

Table A5.21Projects carried out by Elazig Fishery Research Institute

Completed projects	Start Date	Finish Date
The determination of suitable areas for aquaculture in the inland waters	Jan 2002	Dec 2003
The determination of suitable areas for cage aquaculture of natural lakes and dam lakes in Eastern and Southeastern Anatolia Regions	Jan 2004	Dec 2005
The determination of stock and fishable stock of *Capoeta capoeta umbla* in Hazar Lake, Elazığ	Jan 2008	Jan 2010
Culture feasibility study of *Barbus grypus* (Şabut) and *Barbus esocinus* (Bıyıklı Balık) fish species	Jan 2007	Jan 2010
The Determination Of Fishbase Fauna In Keban Dam Lake	Jan 2008	Jan 2010
Detection Of Point Source Heavy Metal İn Keban, Karakaya And Atatürk Dam Lakes And İmpacts On Some Fish Species With Economic Value	Jan 2003	Dec 2008
Seasonal Distrubition Of Water Quality In Lake Hazar	Jan 2003	Dec 2007
Study Of Existing Waterresources in Gap Region And Facilities in Terms Of Organic Aquaculture	Dec 2002	Dec 2005
Survey Project For Increasing Consumption And Production Of Aquaculture In The Gap Region	Jan 2001	Dec 2003
The Research Project Of Catch Tool And Material Present State Determination In The East And Southeast Anatolia	Jan 2001	Dec 2003
The Research Project Of Structural And Technical Properties Fisheries Farms East And Southeast Anatolia	Jan 2001	Dec 2003
Continuing Project		
Improving of a new cage model for temperate region Dam Lakes for sustainable aquaculture	Jan 2010	
Environmental effects of trout breeding in Karakaya Dam Lake	Jan 2010	
Infectious Pancreatic Necrosis (IPN) Virus Isolation, Identification in Rainbow Trout (*Oncorhynchus mykiss*) Farms in Cities of East and Southeast	Jan 2011	
An Investigation Of Some Population Parametres Of Some Economic Fish Species Of Keban, Karakaya And Atatürk Dame Lake	Jan 2009	

5.4 Aquaculture

5.4.1 Current status and trends

Turkey is a peninsula, and given the large availability of lakes, dammed lakes, ponds, reservoirs, rivers and springs. It has a major potential for aquaculture. With a coastline of 9 333 km and 177 714 km of rivers, the marine and inland water sources suitable for aquaculture are approximately 26 000 000 ha (Deniz, 2010).

The marine aquaculture production of fish farming is mostly located in the Aegean Region (53 percent), while the freshwater aquaculture is in the Eastern Anatolia. The lowest production share is from the Southeastern Anatolia Region (State Statistics Institute). Official figures indicate the production form aquaculture increased from 61 165 tonnes in 2002 to 167 141 tonnes in 2010. The contribution from aquaculture to Turkey's total fish production rose from 10 percent to 26 percent during this period (Table A5.22; MARA, 2012).

Table A5.22Aquaculture production in Turkey from 2002-2010

Year	Aquaculture production	Contribution to total fish production
	tonnes	%
2002	61.165	10
2003	79.943	14
2004	94.01	15
2005	118.277	21.7
2006	128.943	19.5
2007	139.873	18.1
2008	152.186	23.5
2009	158.729	25.5
2010	167.141	25.6

Source: MARA, 2012

Aquaculture has a relatively short history in Turkey and began with the farming of rainbow trout (*Onchorhynchus mykiss*) and common carp (*Cyprinus carpio*) in the late 1960s and developed further with gilthead seabream (*Sparus aurata*) and European seabass (*Dicentrarchus labrax*) culture in the mid-1980s (Memis *et al*., 2002; Akbulut, 2004; Tüfek and Yalçın, 2007; Deniz, 2010;FAO, 2012). Production of the three major species, namely rainbow trout, sea bass and sea bream increased rapidly during the 1990s with production now reaching 158 000 tonnes/year in 2009 and 167 141 tonnes/year in 2010 of rainbow trout, sea bass, sea bream, mussel, common carp and other species, produced in 1 935 farms (MARA, 2012). Carp production in Turkey is stable at a low level. Carps are mainly used for stock enhancement of lakes and reservoirs, and there is limited market demand for the fish (Yavuzcan-Yildiz, 2005). In 2010, portion-sized farmed rainbow trout (78 165 tonnes) constituted nearly 47 percent of total aquaculture production in Turkey (MARA, 2012). Rainbow trout is ranked as number one cultured species followed by sea bass and sea bream (Memis *et al*., 2002; Akbulut, 2004; Rad and Rad, 2012; FAO, 2012).

5.4.2 Aquaculture in the Euphrates and Tigris River Basins

The Euphrates and Tigris Basins are very rich in water resources. Within the framework of the Southeastern Anatolian Project (GAP), a total of nearly 220 000 ha will be added to the inland freshwater capacity of Turkey. Even if only a fraction of this area were used for aquaculture, it would make a significant contribution to fish production. The presence of artificial lakes, in particular, makes it more advantageous in these areas in terms of dissemination of cage aquaculture. A significant increase in aquaculture facilities in the region was observed between the years1996-1997 and this growth has continued exponentially. A large majority, approximately 75 percent, of the facilities in the region are operational. A majority of them, some 68 percent, would prefer spring water. Despite the high potential of the natural lakes and dam lakes in the region, the rate of net cage fish farming covers only 16 percent of the level of the share of the total production. Increased economic returns would be generated by increasing this ratio (Ural and Balcı, 2007).

Inland aquaculture, especially rainbow trout farming, is increasing and emerging as a major supplier and player in market for freshwater fish species, whereas capture fish production is showing slight declines. Taking into account the importance of inland fisheries from socio-economic perspective, effective policies and management measures are to be implemented to ensure economic sustainability of this subsector (Rad and Rad, 2012).

Many of the farms are small-scale family-run enterprises with capacities ranging from 1 to 30 tonnes per year. However, recent years have seen the emergence of large-scale operations and there are now

over 100 rainbow trout farms with annual capacities of 500 to 2 500 tonnes on the Euphrates. Most of the trout farms do not have their own hatchery .

There are also cage farms operating in dam reservoirs. Most of the farms operate their own hatcheries during the natural spawning season of brood stock, but the use of imported summer eggs and photoperiod techniques are now common practices in many farms. These practices help towards a more efficient use water and of the hatchery and race way facilities, by starting a second production cycle in summer months. On-growing period for fish of 250 to 300 g varies between 10-12 months, depending on water temperatures. Better feed management and the use of extruder feeds in recent years has improved feed conversion ratios (Rad and Rad, 2012).

The goal of aquaculture is grow in a manner that does not harm to aquatic ecosystems. Therefore, monitoring of environmental impacts of aquaculture is very important for aquatic ecosystems conservation (Dirican *et al*., 2009)

The aquaculture sector in Turkey and particularly in the Tigris and Euphrates River System are facing some constraints (Akbulut, 2004; Canyurt *et al*., 2009):

- The complexity of licensing procedures
- Site selection problems
- The complexity of project preparation and application
- Problems with some other sectors, like tourism, protected areas and navigation ways
- High prices of inputs and difficulties in supply
- Disease risk with imported eggs and fry
- Marketing and quality control problems
- Lack of organization of the sector
- Limited diversity of species and rearing methods
- Guidelines on production, use of feed and medication are lacking

Aquaculture is an entirely different activity to fisheries, requiring different disciplines and there is often a lack of understanding of aquaculture by fisheries personnel in some places and this can lead to aquaculture not getting the promotion and support it needs. Depending on the level of management inputs, especially in feeding, fertilization and liming, pond culture systems can be classified as extensive, semi-intensive or intensive.

5.4.2.1 Extensive aquaculture systems

Extensive aquaculture occurs in dam lakes where common carp, grass carp, silver carp and rainbow trout are stocked. This process is not used for native species. For this purpose, mirror carp and rainbow trout are generally supplied by the relevant units of DSI.

5.4.2.2 Semi-intensive aquaculture systems

In the Tigris and Euphrates Basins, semi-intensive aquaculture is limited to common carp production in small ponds near to the agricultural areas. Also, in the small-scale family farms, pool culture is used with capacities ranging from 1 to 30 tons.

5.4.2.3 Intensive aquaculture systems

Intensive aquaculture is an emerging sector in Euphrates Basin. The most widely used intensive system for trout is floating cages.

5.4.3 Cage culture

The GAP Project has developed 220 365 ha of new dam lake and pool areas in the Southeastern Anatolia region. This provides excellent opportunities for the employment of thousands of rural people

on long-term basis in developing aquaculture in several promising water bodies which are now unutilised. There is a need to introduce new culture techniques to make use of these water bodies.

Cage culture is a new activity in the Euphrates-Tigris Basins having commenced in early 2000 upon encouragement by the government as a development priority. This is because the government believes that aquaculture will provide employment opportunities in the region through the GAP Project.

Cage fishing is practised in the Keban, Karakaya and Karkamış dam lakes. It has been stated that total production capacity of 111 fish farms in Keban and Karakaya Dams reached to 22 135 tonnes per year in 2011. Fish producer farms in the region rear only trout in cages. In addition to these three farms, fish are also rear in ponds (Yüngül *et al*., 2012). Production capacity of eight pond farms in Karkamış Dam was 5 500 tonnes per year in 2011. More substantial aquaculture operations are not permitted in Atatürk and Birecik dams as they supply the region with drinking water. However, a few small farms occur in these two dams.

Cage culture currently employs more than 200 people in the region but is expected to increase within the next five to ten years. Cages can be square measuring from 5 x 5 x 5 m or circular, hexagonal or octagon in shape and up to 12-20 m in diameter. Recently, off-shore systems have been built in the Keban and Karakaya Dam Lakes (Figure A5.3).

Figure A5.3 Cage culture examples

a) Square shaped floating cages in the Keban Dam Lake

b) Polygon shaped floating cages in the Karakaya Dam Lake

c) Offshore floating cages in Karakaya Dam Lake

Recently collected information indicates that there are 40 firms and 80 aquaculture farms in Keban and Karakaya Dams. In each farm, there are 20-30 cages and total production is less than 900 tons. About 20 people are working as fisheries engineers, technicians, workers and drivers for each firm.

The Keban Alabalık Company is the biggest firm. They produce 10 000 tonnes of trout per year and acts as an intermediary in selling 20 000 tonnes of products per year from other companies. This company has about 250 workers and staff. Of these, 100 people are working at the cages and fish breeding (approximately 90 percent male, 10 percent female), 100 people at the fish processing unit (approximately 90 percent female, 10 percent male), and the remaining 50 people work at the picnic and restaurant area. Employee age distribution ranged from18-50 years at the fish processing unit, and from18-30years at cage fishing. Keban Alabalık Kompany built its fish processing unit that has a capacity about 20 000 tons per year and additionally, in 2011, produced 150 million fry trout pieces. Details of other aquaculture facilities in the Euphrates Basin are given in Table A5.23. The Euphrates Development Agency is the most important unit that provides loans to the fisheries sector in the region.

Table A5.23Aquaculture data in some provinces in the Euphrates Basin

	Elazığ[1]	Şanlıurfa[2]	Gaziantep[3]
TheNumber ofAquacultureFacility	146	**16**	**8**
Potential aquaculture capacity (t / y)	30	**8 028**	**15 200**
AquacultureActualCapacity (tonnes / year)	15	**2 300**	**5 300**

Data obtained from: [1]ElazigFood, Agriculture and Livestock provincial directorate;[2] Şanlıurfa Food, Agriculture and Livestock provincial directorate; and[3] Gaziantep Food, Agriculture and Livestock provincial directorate.

Ataturk Dam Aquatic Product Center produces fish larvae and fry for the lakes and dams of DSI. It is considered the Middle East's biggest production capacity center and is situated about 22 km northwest of Bozova town. The production center has an area about 134 hectares near Ataturk Dam Lake. It contains 10 units of concrete pools, 20 units ground pools, 800 m^2 of administration buildings, 350 m^2 open tea house, 1 740 m^2 amphitheatre, a large artificial lake, recreation area and the rest is park. Furthermore, there is 1 100 m^2 closed incubation unit. The capacity of the center is 40 million larvae/year and 10 million juvenile fish/year.

There are some small-scale family businesses in Şırnak and Hakkari provinces. The most important one is trout business that is located in Uludere Gülyazı village. Here, 25 tons of portion trout are prepared and 5 million juvenile trout are produ ced each year. It currently provides the local needs and there is also a wish to export fish to neighbouring Iraq. There are also two hatcheries producing a total of about 12 million fry per year. Fry are stocked in growing units during the spring and summer period and are harvested during the autumn, winter and spring months and marketed as whole fresh fish.

5.4.4 Pool culture

Small-scale family farms use generally pool culture that is undertaken using natural water sources. Fish culture in ponds is realized in the Eastern Anatolia Region (Figure A5.4). However, these potentials are not used in full. Munzur and Peri water flows, the two important tributary of Euphrates, have a good potential for pool culture. Some small businesses in Ovacık town belonging to Tunceli provide the needs of area, but political problems are the main barrier for growing this sector in the region.

Figure A5.4 A pool culture in Şırnak province with a small picnic area

Euphrates Basin has a significant potential in terms of aquaculture. Cage fishing has been run at the lower part of the river due to the lower temperature of water. Businesses often operate as

manufacturing plants producing less than 950 tonnes per year as this level of production does not require Environmental Impact Assessment (EIA) reports where as a larger amount does.

5.4.5 Species farmed

Aquaculture in the region started with farming of common carp and rainbow trout. However, portion-sized rainbow trout farming is now the major fish species farmed in the Tigris and Euphrates Basins in southeastern Anatolia region. The development of aquaculture in Eastern Anatolia region may require different species owning to the different ecological conditions, such as tilapia (*Oreochromis* spp.), pike (*Esox lucius*), European catfish (*Siluris glanis*), and eel (*Anguilla anguilla*) (Memis *et al*., 2002).

5.4.6 Inputs required

Critical inputs include the desired size and species of fingerlings. The biggest brood firm is the Keban Alabalık Company in the region. Feed is considered to be the most expensive input required for semi-intensive and intensive type of aquaculture systems.

Credit availability is important for the promotion of inland water aquaculture. Following this, is hte need for organizational, technical and production inputs required for the expansion or introduction of aquaculture. People dealing with aquaculture are complaining about higher fish feed prices. Feed is a major factor limiting the production of fish. Processing plants and feed mills are needed in the region, but there is little economic incentive for businesses to do this. The materials needed for making fishing nets and cages are produced outside of the region. This increases the overall costs of fish production.

5.4.7 Land ownership and Finance,

In Turkey, rivers and lakes are in state ownership, with only a few of the smaller ponds are owned by local entrepreneurs. The Ministry of Finance is the authority for letting of land. Of 26 firms, 18 have established their firms mainly with their own financial capital (Table A5.24). There were 15.4 percent of the respondents who used some level of credit in addition to their own budgets. That is why the fishery firms of the region appear to be of small scale, which survive with their own opportunities. Almost in all the provinces of the region, the firms generally have been established by the financial opportunities of the entrepreneurs. This shows that either there is not enough compensation from the government or the producers are not willing to use their sources.

Table A5.24Distribution of the firms according to their establishment finance

	Number of firms	%
Own finance	18	69.2
Own finance and credit	4	15.4
Other	4	15.4
Total	26	100.0

5.4.8 People involved

More than 1 000 people are interested in aquaculture, transport and marketing within the region around Keban and Karakaya Dam Lakes. In addition, a number of people are working in fish restaurants located in this region.

The average monthly wage paid to the workers was roughly 600 TL (=US$ 300). This amount is less than the minimum wage determined by the government. That is why the sectoral employment opportunities that can be created by the other sectors are low. In other words, the contribution of the income distributed by the sector to the trade of the region is very limited.

5.4.9 Water quality

When considering water requirements for aquaculture potential, it is useful to have some idea of the general requirements of water temperature ranges and water volume necessary when used with the targeted species and production systems (Conte, 1993). According to Environmental Law No. 2872, recipient environment standards concerning the fisheries production areas are defined by MARA. The main legislation concerning water quality and the discharge of wastewater is Fisheries Regulation No. 22223. Article 11 of the Regulation bans the discharge of any pollutants into marine and freshwater bodies used for fishery production that might harm fish well-being and consumer health. In general, Regulation on Control of Water Pollution No. 25687, based on Environmental Law No. 2872, is the major legislation governing control of water pollution. This Regulation comprises quality classifications of water bodies and utilization of these classes, planning principles concerning protection of water quality, guidelines and permits, wastewater processing plants, and monitoring and control principles to prevent water pollution. Water bodies are classified as:

- Class I: High quality
- Class II: Slightly polluted
- Class III: Polluted
- Class IV: Over polluted

Class I waters are classified according to their utilization purposes. It has been emphasized that high quality water is suitable for trout farming, while other fish species can be farmed in slightly polluted waters (Table A5.25). Fisheries and aquaculture activities are forbidden in reservoirs used to supply drinking water. Fisheries production areas are classified as Class ID. Aquaculture effluent discharge standards are given under discharge standards of food industry wastewaters into recipient environment as chemical oxygen demand of 50 mg/l and 30 mg/l for 2 hour and 24 hour composite samplings.

Table A5.25Suggested water quality criteria for aquaculture hatcheries or production facilities, derived from salmonid quality standards with modifications for warmwater situations

Chemical	Upper Limits for Continuous Exposure and/or Tolerance Ranges
Ammonia (NH_3)	0.0125 ppm (un-ionized form)
Cadmium[a]	0.004 ppm (soft water < 100 ppm alkalinity)
Cadmium[b]	0.003 ppm (hard water > 100 ppm alkalinity)
Calcium	4.0 to 160 ppm (10.0-160.0 ppm[d])
Carbon dioxide	0.0 to 10 ppm(0.0-15.0 ppm[d])
Chlorine	0.03 ppm
Copper[c]	0.006 in soft water
Hydrogen sulfide	0.002 ppm (Larsen -0.0 ppm)
Iron (total)	0.0 to 0.15 ppm (0.0-0. 5 ppm[d])
Ferrous ion	0.0 ppm
Ferric ion	0.5 Doni (0.0-0.5 ppm[d])
Lead	0.03 ppm
Magnesium	(Needed for buffer system)
Manganese	0.0 to 0.01 ppm
Mercury (Organic and inorganic)	0.002 ppm max, 0.00005 ppm average
Nitrate	0.0 to 3,0 ppm
Nitrite	0. 1 ppm in soft water, 0.2 ppm in hard water (0.03 and 0.06 ppm nitrite-nitrogen)
Nitrogen	Maximum total gas pressure 110% of saturation
Oxygen	5.0 ppm to saturation; 7.0 to saturation for eggs or broodstock
Ozone	0.005 ppm
PH	6.5 to 8.0 (6.6-9.0[d])
Phosphorous	0.01 to 3.0 ppm
Polychlorinated biphenyls (PCBs)	0.002
Total suspended and settleable solids	80.0 ppm or less
Total alkalinity (as $CaC0_3$)	10. 0 to 400 ppm (50.0-400. 0 ppm[d])
% as phenolphthalein	0.0 to 25 ppm (0.40 ppm [d])
% as methyl orange	75 to 100 ppm (60.0-100.0 ppm[d])
% as ppm hydroxide	0.0 ppm
% as ppm carbonate	0.0 to 25 ppm (0.0-40.0 ppm[d])
% as ppm bicarbonate	75 to 100 ppm
Total hardness (as $CaC0_3$)	10 to 400 ppm (50.0-400.0 ppm[d])
Zinc	0.03 ppm (Larsen - 0.05 ppm)

Source: (Conte, 1993).

[a] To protect salmonid eggs and fry. For non-salmonids 0.004 ppm is acceptable.

[b] To protect salmonid eggs and fry. For non-salmonids 0.03 ppm is acceptable.

[c] Copper at 0.005 ppm may suppress gill adenosine triphosphatase and compromise smoltification in anadromous salmonids.

[d] Wami water situations

-Many freshwater species are grown in waters with low salinity (1-3 ppm), but low salinity can interfere with maturation and/or reproduction of species such as black bass.

5.4.10 Processing

Keban Alabalık Company is the only processing firm for fish in the Tigris and Euphrates Basin, through there are other companies that have processing plants in other regions of Turkey. Processed fish, such as filleted, smoked or frozen trout, are exported to European countries, mainly Germany, and are required to conform to the EU quality standards (Figure A5.5).

Figure A5.5 Keban Labalik Company processing unit and products

5.4.11 Trading and marketing

The annual per capita consumption of fishery products in Turkey is around 6 kg, although this figure is declining steadily (TUIK, 2006). Cultured fish products constitute only around 10 percent of the total domestic fish consumption, which is quite low in comparison to globe and Europea average figures and also compared to Turkey's availability of aquatic resources. Fish are mainly sold as whole fresh products in Turkey. Rainbow trout is consumed almost entirely on the domestic market. In general, market prices reflect supply and demand.

Fish produced from freshwater farms are marketed as portion-size fish. No pigmentation has been used in Turkish trout farming, as a result, all trout produced are white fleshed. Rainbow trout is consumed generally on the domestic market, while the Keban Alabalık Company has exported processed fish such as filleted, smoked or frozen trout to European countries. Also, Antalya Alabalık Company has produced their fish in the Karkamış Dam Lake and transported them to Antalya. They have exported processed fish to Europe. Fish are harvested daily and marketed as fresh product usually directly by the farmers to restaurants, hotels and factory catering services**.** Many farms have their own restaurants at or close to the farm. Trout are also sold through major wholesale markets in major cities such as Istanbul, Ankara and Izmir.

In the southeastern Anatolia region, consumption of fish is significantly lower than the other Turkish regions. In some places, inadequate transport of fish due to the insufficient cold chain conditions is probably the main reason inhibiting fish consumption and trade. Developing the fish processing sector and cold chain conditions will improve the consumption and export of fish. In order to increase the market share and competitive strength of processed seafood, consistent governmental policies should be sustained. To improve aquaculture industry, cooperation must be provided, taxes, and fees should be decreased, and convenient supporting system should be maintained. Obligatory food safety system

for seafood processing establishments and for wholesale fish markets, improvement of the cold chain conditions are necessary (Mol and Ulusoy, 2010; Tekelioğlu *et al*., 2007).

5.4.12 Institutions

Businesses engaged in aquaculture are also dependent on the fishing cooperatives. Therefore, fishers who want to operate fishing business have to be a voluntary member of these cooperatives to get permission for fishing. There are about 35 water productions and evaluation cooperatives in the region. These cooperatives involve keeping the legal right of its members who work in fishery and aquaculture. The main purpose of an aquatic products cooperative is:

- To serve its members in the issues about production, processing, storage, marketing of all kinds of aquatic products, and
- To organize and manage its partners fishing activities and other aquatic products.

All Aquatic Products Manufacturing and Evaluation Co-operatives in the region are gathered under the Aquaculture Co-operatives Union Some entrepreneurs, who have good relations politically and financially with the government, and have been carrying out the leadership. While they manage their own business, at the same time, they get a position in the co-operative to solve the problems of their and other producers.

5.4.13 Other livelihood information

Detailed field research on this subject should be done in the future because there are not adequate studies that have been performed.

5.4.14 Legislation and policy

The Ministry of Agriculture and Rural Affairs (MARA) is the main state organization responsible for fisheries and aquaculture administration, regulation, protection, promotion and technical assistance through four general directorates: the General Directorate of Agricultural Production and Development (GDAPD), the General Directorate of Agricultural Research (GDAR), the General Directorate of Protection and Control (GDPC) and the General Directorate of Organisation and Support (GDOS). Production, development and management of aquaculture and inland fisheries activities are implemented by GDAPD, while GDAR is responsible for research and GDPC for movements of live fish, diseases and fish as food issues. MARA has provincial directorates in 81 provinces responsible for implementing policies issued by its central office in Ankara. Most of the licensing and monitoring/control activities are carried out by these provincial directorates (FAO, 2012) Aquaculture and fisheries are regulated by the Turkish Fisheries and Aquaculture Law No. 1380. This law, however, is incapable of solving all aquaculture-related problems (Memis *et al*., 2002). The government of Turkey recognizes and supports aquaculture as a growing sector, but the following issues still need to be addressed: (a) the absence of a general plan for economical aquaculture development and effective marketing; (b) the low quality and high price of feed caused by the high price of imported fishmeal; (c) insufficient technical knowledge; (d) the absence of a private sector organization; (e) insufficient early diagnosis and prevention of fish diseases and the establishment of environmental standards; (f) availability of healthy fry and production of live food organisms and artificial feeds for post-larvae and juveniles; (g) conflicts between tourism authorities and the marine culture industry; (h) bureaucracy involved in establishing fish farms. The licensing process is complicated, time-consuming and bureaucratic and requires authorizations from the Ministry of Agriculture and Rural Affairs, the Ministry of Forestry, the Ministry of Environment, the Ministry of Tourism, the Ministry of Transportation, the Ministry of Culture, the Ministry of Public Works, the Ministry of Health, the Ministry of Finance, the Ministry of Energy and Natural Sources, the Council of Navigation, the Council of Foreign Trade and the State Planning Organization; (i) the absence of a plan for utilizing freshwater reservoirs for aquaculture; (j) insufficient cooperation between universities and the private sector.

5.4.15 Licensing

The following procedures must be followed to obtain a license for a fish farm construction project (Memis *et al*., 2002).

Pre-application. Farmers are required to submit a pre-application to the Province Agricultural Administration. The Agriculture Production and Development Center is then required to acknowledge the pre-application. The following documents must be prepared and submitted within six months as part of the pre-application process:

- location and type of farm
- production targets and farm units to be constructed
- a declaration of ownership of the land or permission to use the land issued by the Ministry of Forestry
- a detailed map of the site including all farm units
- neighbouring farm operations and their capacity
- presence of fish diseases
- report of consultations held with the local administration for water exploitation.

Application. Construction projects must follow the form determined by the Ministry of Agriculture and Rural Affairs and be completed within eight months or, if given an extension, within 12 months. Permission must be given in order to proceeding with the venture.

The project must be submitted to the Province of Agricultural Administration together with the following documents:

- pre-application documents described above
- document from the Ministry of Health stating that the farm poses no hazards to human health
- document from the Ministry of Transportation stating that the farm does not interfere with transportation
- document from the State Water Works stating that the project presents no flood or landslide dangers

The permission for the construction project to proceed is issued by the Ministry of Public Works and the publication of the project in the Journal of Trade Register.

The approval of the Province of Agricultural Administration is required for projects with a production target of less than 60 tons per year. Approval of the Agriculture Production and Development Center is required for projects with a production target of more than 60 tons per year. After approval of the project, the Ministry of Agriculture and Rural Affairs asks the State to rent the land. If, for example, the land belongs to the Ministry of Forestry, the request is addressed to them. In theory, land can be rented for 49 years but, in practice, rentals are limited to 15-25 years. Hence, implementation of the project should begin without delay. Extensions of up to twice the amount of time allowed for applications can be obtained.

5.4.16 Past or current development and capacity building projects

The Scientific and Technical Research Council of Turkey (TUBITAK) plays an important role in supporting high priority research projects, while the State Planning Organization has responsibility for the preparation of the Government's long-term development plans (5-year periods), annual programmes and coordination of the activities of various ministries and public institutions. Fisheries production data are gathered and evaluated by the State Statistics Institute in collaboration with MARA. Elazig Fishery Research Institute under MARA has contributed to capacity building projects related to sustainable fisheries and aquaculture in Euphrates and Tigris River systems.

5.5 Recommendations for interventions

5.5.1 Enhancing livelihoods

The Euphrates-Tigris Basin faces many of the problems that are typical of other underdeveloped regions in the world. Compared with the rest of Turkey, the region has had higher fertility rates and lower literacy rates, as well as lower school enrolment rates – especially among girls – and lower access to education, health care and sanitation.

Economic support to people who work in the fish aquaculture sector is poorly developed. Most people lack financial resources to buy or rent suitable land and cannot establish an aquaculture business near where they live. The micro-credit that is already in use by the Turkish Government needs to be made more available to improve financial support for aquaculture. This will be a useful step to support the businessmen in this sector, especially is backed up by positive taxes and insurance benefits.

5.5.2 Improving fisheries management

Capture fisheries and aquaculture activities bear a large potential for employment in Southeastern Anatolia. Considering this potential, the GAP Administration and Tikvesli Agricultural Enterprises Inc. (TIKVESLI) cooperate to promote and train local people in these activities. TIKVESLI, as one of the leading Turkish business concerns in the field of foodstuffs, has taken steps to establish its fish processing and marketing facilities in the Bozova township of Sanliurfa. TIKVESLI plans to process local fish here for domestic and foreign markets. The southeastern Anatolia region has abundant water and a potential in capture fisheries and aquaculture almost equivalent to the Sea of Marmara. The development of capture fisheries and aquaculture in this region requires a production management geared to market conditions and needs. The project on fishing has the aim of encouraging fishing in the Euphrates and Birecik Dam Lake. According to the project, fishing will be actually performed by local people in a participatory manner, purchased by the company mentioned above, and then processed at water products facilities to be established in pilot spots. A team of experts from the GAP Administration, Turkish Foundation for Erosion Control and Afforestation (TEMA), and TIKVESLI examined the area and decided that presently idle facilities in Bozova, owned by the Municipality and Agricultural Equipment Agency would be suitable for project purposes. Furthermore, existence of a Fishing Vocational School in Bozova and proximity of both Ataturk and Birecik Dams were influential in selecting Bozova as the pilot area of the project. Meanwhile, some big business concerns like Alarko and Yasar Holding are also considering investing in the region in the field of fishing (www.gap.gov.tr).

5.6 Enhancing processing and marketing

Overall, the quantity of fish marketed by the farmers was found to be quite low. One of the reasons for this is that the production of aquaculture is quite small except Keban and Karakaya Dams. The domestically produced fish sell for higher price in the market, than imported fish. Improved marketing facilities will help farmers sell the local fish to fetch a higher price and to compliment this with imported fish that also enhances the family income.

To improve processing and sales fish, education programmes are required to raise the awareness of employers. Furthermore, there is a need for the use of appropriate and relevant expertise and greater participatory inputs when designing projects to get efficient productions.

5.7 Opportunities for cooperation at a sub-regional level

Banks seek large guaranties for credit claims. To solve the problem of entrepreneurs, political support is also needed. In this regard, to use of international capital should be promoted and some tax regulations are to give a favourable effect to this sector should be taken.

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APPENDIX 6: FISHERIES AND AQUACULTURE IN THE EUPHRATES-TIGRIS BASIN: SYRIA

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6.1 Introduction to the area

The Southwestern edge of the Asian continent would have been no more than an extension of the Syrian Desert or Arabian Desert without the existence of the Tigris (Arabic *Dajlah*, Turkish *Dicle*) and the Euphrates (Arabic *Al-Furat*, Turkish *Firat*) Rivers. As a result of the strategic geographical and commercial location and rich water supply, the Euphrates-Tigris Basin availed a fertile cradle for the development of several great ancient civilizations. The Assyrian, Babylonian and Sumerian civilizations flourished in Mesopotamia and the surrounding areas. For centuries, the Euphrates River formed the eastern limit of Roman control. During the supremacy of the Eastern Roman Empire, numerous towns and centers of art and literature thrived along its banks. Much historical data has been yielded by archaeological excavations on the banks of the Tigris and the Euphrates (Holt et al., 2000).

The Syrian quarter of the Euphrates-Tigris Basin will be referred to in this Syrian review, hereinafter, as the "STEU-Basin", while when the whole basin comprising Iraq, Syria and Turkey becomes in question, it will be referred to as the "the Basin".

6.1.1 Ecological characteristics of the STEU-Basin

Springing from the Armenia Highlands and from the Lake Hazar in the Taurus Mountain of Turkey and flowing together southeastwardly through Syria and Iraq, the Tigris and the Euphrates rivers merge together at the Iraqi village Al-Qurnah in the confluence called "Shat El-Arab" that runs down to discharge into the Persian Gulf.

Along a segment of some 44 km (Isaev and Mikhailova, 2009) or 50 km of its western bank, the Tigris River borders the Northeastern beak of the Syrian territories, while its eastern bank borders Turkish and Iraqi territories along 37 km and 13 km respectively (Khalil, 2002). The Tigris basin area, estimated at 471 606 km^2, is distributed between Turkey (12%), Syria (0.2%), Iraq (54%) and Iran (34%) (Isaev and Mikhailova, 2009). It stretches insignificantly across or possibly overlaps with the Euphrates Basin on the Syrian territories. However, owing to the prevailing restriction of water pumping operations along the shared Syrian-Turkish segment to the Turkish side, the Tigris River has no actual significant impact on Syrian economy. Therefore, the Syrian review will mainly concentrate on the Euphrates Basin and only partially on the small part of shared Tigris Basin when relevant. As related to water resources, special attention will be given to the Euphrates River, its tributaries and dam lakes. The man-made surface water retention lakes harvesting seasonal wadies and rainwater within the basin area will also be taken into consideration.

6.1.2 Geography

The Euphrates Basin lies 28 percent in Turkey, 17 percent in Syria, 40 percent in Iraq and 15percent in Saudi Arabia (Daoudy, 2005; FishBase, 2012). The Euphrates twin sources, the Murat Su (Eastern Euphrates) (650 km) and the Kara Su (Western Euphrates) (450 km), meander southwest from the Armenia Highlands of Turkey and join near the town of Keban in southeastern Turkey where the Euphrates River emerges and continues southwest then turns southwards and enters Syrian territory. Stretching from the very source of the Murat Su to the confluence with the Tigris, irrespective of the Murat Su length, the Euphrates River runs some 3 000 km, out of which 1 230 km falls in Turkey, 710 km in Syria and 1 060 km in Iraq (Collelo, 1987; Isaev and Mikhailova, 2009; FishBase, 2012). According to various sources, Shat El-Arab runs 145 km up to 195 km (Isaev and Mikhailova, 2009) before discharging into the Persian Gulf.

According to Syrian Statistical Yearbook, the Euphrates segment in Syria is estimated at 610 km (Central Bureau of Statistics, 2011), (Presumably, the length given excludes the length of Al-Assad Lake equaling to 80 km). The river passes the Syrian-Turkish border to the close east of Syrian city Jarabulus at the coordinates 36°49′N 38°02′E. It runs southeasterly across three Governorates; Aleppo, Raqqa and Deir Ezzor, then it passes the Syrian-Iraqi border through the Syrian city Albou-Kamal at the Coordinates 34°29′N 40°56′E.

Although large areas of former floodplain wetlands have been converted into agricultural land or dam lakes, islands in the river and dam lakes continue to support remnants of the native riverine woodland, while oxbow lakes, quiet backwaters and riverine marshes remain important for fish spawning grounds and nursery areas and for migratory waterfowl.

Following its entry into the Syrian territories, the Euphrates River receives two minor tributaries, the Sajour River and the Balikh River, prior to receiving its major tributary the Khabour River. These rivers rise in the foothills of the Taurus Mountains along the Syrian-Turkish border where springs mostly emerge on both sides. Once the Euphrates enters Iraq, no further natural tributaries to the Euphrates exist. Nevertheless, canals connecting the Euphrates Basin with the Tigris Basin in Iraq do exist. The Sajour River is 108 km long emerging from two streams near the Turkish city of *Gaziantep* and draining the plain around the Syrian city of Manbij before emptying into the reservoir of the Tishrin Dam Lake on the Euphrates. It is the smallest of the three tributaries of the Euphrates in Syria, and the only one that joins the Euphrates on its right or western bank (Besançon and Sanlaville, 1985; Hillel, 1994). The Balikh River is a perennial river that originates in the karstic spring of Ayn Al-Arus in the north of Syria. It flows 100 km due south and joins the Euphrates at the city of Ar-Raqqah. The Balikh is the second largest tributary to the Euphrates on the Syrian soil. It is an important source of water and large parts have recently been subjected to canalization (Hillel, 1994; Balikh River, 2012). The Khabour River with its 486 km is the largest perennial tributary to the Euphrates on the Syrian territories. Although the Khabour originates in Turkey, the karstic springs around the Syrian village of Ras Al-Ayn are the river's main source of water. On its run through the Governorates of Hassakeh and Deir Ezzor, several important wadis join the Khabour north of Al-Hasakah, together creating what is known as the Khabour Triangle, or Upper Khabour area. From north to south, annual rainfall in the Khabour Basin decreases from over 400 mm to less than 200 mm, making the river a vital water source for agriculture throughout history. The Khabour River discharges into the Euphrates near the town of Busayrah (Hillel, 1994; Wikipedia, 2012c).

6.1.3 Topography

The two sources of the Euphrates; Murat River and Kara River rise at an elevation of 3 520 m and 3 290 m respectively (Murdoch, et al., 2005) and merge near the city of Keban forming the Euphrates River at an elevation of 693 m. From Keban to the Syrian-Turkish border, the river drops another 368 metres. On the Syrian plateau the Euphrates River falls 163 m from an elevation of 325 m at Jarabulus city down to 162 m at the Syrian-Iraqi border (Bilen, 1994), (Albou-Kamal) with an average slop of 0.024 percent. Along this course, the river generally winds flat plains and in a few cases it passes through small hills of various heights. Over its last stretch in Iraq between Hīt and Shatt al-Arab, the river drops only 55 metres (IME, 2006).

6.1.4 Hydrology and hydrogeology

Neither flowing through the Syrian territories nor used for irrigation thereabouts, the Tigris River with its average water discharge of 1 014 m^3/s (Isaev and Mikhailova, 2009; Kolars and Mitchell, 1991), is actually of no direct hydrological importance to Syrian agriculture or to any other economic activity.

The Euphrates River, with its water discharge, ranging between a maximum of 2 514 m^3/s and a minimum of 58 m^3/s and an average of 356 m^3/s (IME, 2006; Isaev and Mikhailova, 2009), plays a vital role in the Syrian economy. Within the Governorate of Raqqah, downstream of the Assad Lake in the close proximity of the Euphrates river banks, vast areas appeared to have soil rich in gypsum. Such

soils are incapable of holding masses of water, as gradually dissolved gypsum creates cracks and caverns and consequently seepage greatly increases. Several fish ponds in the area have failed to continue holding water. Attempts to seal the soil and prevent water seepage failed and thus ponds were closed.

The Euphrates tributaries; Sajour, Balikh and Khabour with their average water discharges of 4.1 m^3/s, 6 m^3/s and 45 m^3/s respectively (Hillel, 1994) are comparatively of minor role in subsidizing the water flow of the Euphrates River. It is worth mentioning that, up to prevailing drought along the past few decades, the progressively diminishing water flow of the Khabour River, especially downstream, brought its discharge into the Euphrates in many years to nil.

6.1.4.1 Natural lakes

At one time in the extreme northeast of the country, a series of large springs used to exist and supplied water to a number of small lakes and marshes, which eventually drained into the Khabur, Balikh and Jaghjagh Rivers. Most of these wetlands have been drained for agriculture or had their water supplies taken for irrigation. One exception remained; this is Al-Khatouniyeh Lake, although now much reduced in size. Vast areas of natural steppe in the STEU-Basin have now been converted into intensive irrigated cultivation. A natural saline lake also exists within the STEU-Basin.

Al-Khatounieyah Lake (36°24'N, 41°14'E), also known as Al-Hol Lake, is a small freshwater lake in a region of semi-desertic steppe located 45 km southeast of Al-Hasakah city and 6 km east of Syrian-Iraqi border. At an elevation of 452 m Al-Khatouniyeh surface area was formerly 12 km^3 but is currently 3 km^3. It is a natural mesotrophic spring-fed lake surrounded by "clay" desert (Luther and Rzoska, 1971). Its mean depth is estimated at 8 meters, nevertheless, many fishers in the lake tell stories about extremely deep cracks at its bottom that are believed to connect the lake water with far underground water basins. The lake is surrounded with two villages from which a few fishermen practice traditional fishery.

Sabkhat Al-Jabboul (36°04′N 037°30′E / 36.067°N 37.5°E) is a saline lake30 km southeast of the city of Aleppo in Aleppo Governorate, is the largest natural lake in Syria. Its area varies from year to year with a maximum of239 km^2. The salt flats are extensive and can be seen from space. During the Pleistocene, the Jabboul Basin filled, overflowed and formed a tributary of the Euphrates River whereas presently the lake is confined to a closed basin (Wikipedia, 2102d). Traditionally, the lake used to flood in the spring and shrink back during the summer and autumn. However, since 1988 when irrigation projects started, irrigated adjacent lands began to discharg significant amounts of partially saline water into the saline basin, stabilizing the water table and creating a stabile minimum area of 100 km^2. Al-Jubboul is the major source of salt in Syria. Other primary uses of the lake include tourism, waterfowl hunting and livestock grazing on the surrounding steppe. Fish farming is partially practiced in the fresh most end of the lake where a considerable discharge from agricultural lands occurs. Sabkhat al-Jabbul has been declared as Nature Reserve for waterfowl under RAMSAR. The site is also protected by the Ministry of Agriculture as a natural lake supporting salt tolerating aquatic life and associating amphibians and birds

6.1.4.2 Dam lakes on the Euphrates River

In Syria, regulation of water flow, irrigation and generation of electricity were reasons behind erection of three dams on the Euphrates course. Chronically those are Tabqa Dam and Ba'ath Dam both in the Governorate of Raqqa and Tishreen dam upstream in the Governorate of Aleppo. Consequently, three dam lakes: Al-Assad, Ba'ath and Tishreen were formed. Syria now plans to construct a fourth dam "the Halabiye Dam" on the Euphrates, downstream in the Governorates of Deir Ezzor.

Al-Assad Lake (36°00′N 38°10′E / 36°N 38.167°E) is a reservoir first flooded in 1974 when the Tabqa Dam was closed. Actually, it is Syria's largest man-made lake with a maximum storage capacity of 11.7 km^3 and a maximum surface area of 610 km^2. A vast network of canals uses water from Lake

Assad to irrigate lands on both sides of the Euphrates. In addition, the lake provides the city of Aleppo with drinking water and supports considerable fishing industry. The shores of Al-Assad Lake have developed into important ecological zones. The western shore has developed into an important marshland area. Some areas on the southeastern shore have been reforested with evergreen trees including the Aleppo pine and the Euphrates poplar. Lake Assad has become an important wintering location for migratory birds and the government has recently undertaken measures to protect small areas along its shores from hunters by downgrading access roads (Murdoch et al., 2005). The remarkable island of Jazirat Ath-Thawra has been designated a nature reserve for amphibians and waterfowls. In 1991, the Tabqa Dam was elevated few meters more, what increased the lake storage capacity up to 14 km^3 and its maximum surface area up to 665 km^2.

Al-Ba'ath Lake (35°53′07″N38°44′50″E) is a regulatory reservoir located 22 kilometers upstream from the city of Ar-Raqqah in the Governorate of Ar-Raqqah. It was firstly flooded in 1986. Its maximum storage capacity equals to 0.09 cubic kilometres (CBS, 2011; Baath Dam, 2012) and its maximum surface area is round 27 km^2 (CBS, 2011). It is intended to generate hydroelectric power as well as regulate the irregular flow from the Tabqa Dam, which is located 18 km uptream from the Baath Dam (CBS, 2011; Baath Dam, 2012). The lake supports modest fishing activities.

Tishreen Lake (36°22′53″N38°11′00″E) in the Governorate of Aleppo stretches along the Euphrates course from the Syrian-Turkish border to the site of Tishreen Dam located 80 km southwards at the close proximity of the northern peak of Al-Assad Lake. The lake was firstly flooded in 2000. It is Syria's second largest manmade freshwater lake with a maximum storage capacity estimated at 1.3-1.88 km^3 (Kolars, 1994; CBS, 2011) and a maximum surface area of 166 km^2 (Eschmeyer, 2012). The Tishreen Lake, of 60 km length (Kolars, 1994), is characterized by its shallowness not exceeding a couple of meters on average. The lake supports fishing activities. The major criteria of the dam lakes on the Euphrates River within Syrian territories are shown in Table 3.1.

6.1.4.3 Dam lakes on Al-Khabour River

Three dams have been constructed on Al-khabour River. Two of the dams are on tributaries to the Khabur between Ras El-Ayn and the city of Al-Hasakah. Those are "Hasakah West" (also called 7 Nissan) and "Hasakah East" (8 Athar). The Hasakah West Lake supplies the city of Al-Hassakeh with drinking water. The third dam, Al-Khabour dam was constructed on the Khabur 25 km south of the city of Hassakeh behind which "Al-Hassakeh South Lake" was formed. All the three lakes witness active fishing activities. The major criteria of the dam lakes on Al-Khabour River are also shown in Table A6.

Table A6.1 Artificial dam lakes on the Euphrates and Al-Khabour Rivers in the STEU-Basin

	Euphrates River			Al-Khabour River		
	Al-Assad	Al-Ba'ath	Tishreen	Al-Khabour	Hasakeh W.	Hasakeh E.
Year of formation of lake	1974	1989	2000	2001	1990	1990
Dam maximum height (m)	60	14	40	26	31	28
Max. storage capacity (km^3)	14.16 (11.7)*	0.09	1.88 (1.3)*	0.6	0.091	0.23
Lake surface area (km^2)	665	27	166	9.25	1	3.1
Lake length (km)	80	n.a.	60*			
Lake max. width (km)	8	n.a.	n.a.			

Sources: Statistical Yearbook, CBS, Syria, 2011
*Kolars, 1994
Baath Dam, 2012

6.1.4.4 Surface water retention lakes

Several surface water retention lakes have been formed as a result of damming seasonal wadies and rainwater runoffs (Table A6.2). Such lakes have a variable water volume that, after reaching its peak, soon starts to regularly diminish owing to consumption in irrigation, evaporation and seepage. Being deep enough close to the body of the dam and being extended horizontally on shallow areas, the water surface area changes significantly against any slight change in its water volume. Thus, for a certain retention lake, water surface area differs a lot from month to month in a given year, and from year to year according to annual precipitation and/or level of water use. Consequently, area of water surface does not correspond with a fisheries or aquaculture potential.

Table A6.2 Surface water retention lakes in the STEU-Basin (on Al-Khabour River)

Name	Governorate	Maximum dam height (m)	Storage capacity (million m^3)	Lake surface area (ha)	Year of dam completion
As-Saffan	Al-Hassaheh	35	50	407	1983
Bab Al-Hadid	Al-Hassaheh	22	23	320	1973
Al-Jarrahi	Al-Hassaheh	30	19,5	205	1980
Al-Jawadiyeh	Al-Hassaheh	17	8	182	1974
Al-Hakmiyeh	Al-Hassaheh	22	7,5	135	1984
Al-Mansourah	Al-Hassaheh	17	3,5	73	1983
Ma'ashouq	Al-Hassaheh	19	2,5	408	1980
Karima	Al-Hassaheh	11	1,9	82	1967

Source: Statistical Yearbook, CBS, 2011

6.1.5 Climate

The climate of Syria is Mediterranean with a continental influence: cool rainy winters, warm dry summers, and relatively short spring and autumn seasons. This influence is more clearly expressed in the arid interior including the STEU-Basin. Large parts of Syria are exposed to high variability in daily temperature. The maximum difference in daily temperature can be as high as 32 C, especially in the STEU-Basin. In summer, the desert region of Syria has an average daytime temperatures of 40 C. Nevertheless, the temperature is a bit milder in the STEU-Basin.

Total annual precipitation ranges from 100-150 mm in the north-west, 150-200 mm from the south towards the central and east-central areas, 300-600 mm in the plains and along the foothills in the west, and 800-1 000 mm along the coast, increasing to 1 400 mm in the mountains. The Average annual rainfall in the country is 252 mm yielding 46.6 km^3 of water over the country (CBS, 2011).

The northern narrow strip of Syrian territories bordering Turkey is classified either as Zone 1B or Zone 2 agricultural settlement zone. With an annual precipitation of either ≤600 mm but not less than 350 mm or between 350-250 mm, Zone 1B allows for unirrigated culture of wheat, legume and summer crops, while Zone 2 is suitable only for barley culture. Southwards, excluding costal area, precipitation gradually decreases to match Zone 2 down to Zone 3, Zone 4 (marginal) and Zone 5 (steppe).

Evaporation and horizontal water diffusion on the Tigris River affect air humidity and the underground water-table level. This affects the composition of natural vegetation and wildlife and results in a milder climate in the close proximity of the Tigris River at Northeastern Syria. The same applies for the narrow strips along the banks of the Euphrates River and its tributaries. Nevertheless, long segments of the river banks are void of vegetation or even cultivated areas.

The mean annual relative humidity in Aleppo is recorded as 55.7 percent and on a monthly basis it ranges from 39 percent in August to 79 percent in January (Climatemps, 2012). The weather averages for the city of Aleppo are given in Table A6.3. Aleppo has the mildest weather in the STEU-Basin.

Table A6.3 The weather averages for the city of Aleppo

Months	Average Minimum Temperatures (°C)	Average Maximum Temperature (°C)	Average Temperature (°C)	Average Precipitation (mm)	Wet Days (>0.1 mm)	Average Sunlight Hours/ Day	Relative Humidity (%)
January	2	11	6.5	81	11	4.1	79
February	3	14	8.5	57	9	5.5	69
March	5	16	11	43	8	7.5	65
April	8	23	16	32	5	9.3	58
May	12	29	21	12	3	11.5	48
June	17	34	26	2	0	13.5	41
July	20	36	28	0	0	13.7	41
August	20	37	28.5	0	0	13.1	39
September	17	33	25	3	0	11.6	46
October	11	29	20	21	4	9.2	47
November	6	19	13	36	7	7.1	59
December	3	12	7.5	72	9	4.3	76

Source: Climatemps, 2012

No specific weather averages for Raqqah, Hassake, or Deir Ez-Zor Governorates were found, but generally speaking, those Governorates are known to be warmer during summer seasons with higher variations in daily temperature, particularly within the zone of steppe area.

6.2 Demographics and labour force

6.2.1 Demographics

According to the civil records, the Syrian population in 2011equaled to 24 504 million while the number of inhabitants actually living on the Syrian territory was only 20 806 million. The annual growth rate, calculated according to censuses of 1981, 1994 and 2004, appeared to have been in slight decline from 33 percent for the period 1981-1994 to 27 percent for 1995-2000, and down to 24.5 percent for 2000-2010. In 2011, the average population density is 114 people per km^2 and the total fertility rate was estimated at 2.85 children born to each woman (CBS, 2011). As to age distribution in 2011, the Syrian nation is known to be a young nation. More than 37 percent of the Syrian population is less than 14 years old; younger than the age of labor force. The age category of ≤19 years made 47.9 percent, ≤24 years made 57.3 percent, and ≤29 years made 65.5 percent (CBS, 2011).

The gender ratio in Syria has always been balanced with slight variations in sex ratio amongst Syrian Governorates (0.97-1.03 males/females) with an average ratio of 1.01 for whole Syria. The gender ratio in the STEU-Basin is also balanced, as its male/female ratio for urban, rural and total population equals to 1.013, 1.002 and 1.007, respectively (CBS, 2011) (Table A6.4). It is noteworthy that the Governorate of Aleppo shows higher number of people in urban areas than in rural areas, the ratio of which equals to 1.45 urban to 1 rural. The other three governorates of STEU-Basin displays opposite balance: 0.55:1.0 in Raqqah, 0.69:1.0 in Deir Ez-Zor and 0.50:1.0 in Al-Hassakeh (CBS, 2011). The discrepancy of Aleppo Governorate is attributed to the migration of rural populations to the major city of Aleppo. Unlike other central cities in the STEU-Basin, the city of Aleppo, known as the industrial capital of Syria, is much developed compared with its rural areas. Thus, it secures sufficient livelihood opportunities for rural inhabitants of neighboring governorates including those of the STEU-Basin area. This is not the case with major cities of Raqqah, Deir Ez-Zor and Hassakeh Governorates, whose inhabitants, particularly youths, head for Damascus and/or Aleppo. Generally speaking, the great majority of inhabitants of Syrian rural areas are older people. This is a common phenomenon for Syrian countryside but is more prononced in the STEU-Basin.

Table A6.4 Number of people, proportional structure (gender, urban-rural) in the STEU-Basin

Governorate (Mohafaza)	Pop density	Urban%		Rural%		Total%	
		Male	Female	Male	Female	Male	Female
Aleppo	260	26.8	26.3	18.5	18.2	22.9	22.5
Raqqah	46	3.3	3.1	5.9	5.7	4.5	4.3
Deir-Ezzor	37	4.8	4.9	6.8	6.9	5.7	5.8
Hassakeh	64	4.7	4.8	9.6	9.9	7.0	7.2
STEU-Basin	89	39.6	39.1	40.8	40.7	40.1	39.8
Syria	114	100	100	100	100	100	100

Source: Statistical Yearbook, Central Bureau of Statistics, Office of Prime Minister, Syria, edition 64, 2011

The general trends of migration patterns indicate that migration has been increasing in volume, and becoming more urban-oriented. However, there is evidence of slight decrease in the volume of migration since the early 1980s, and perhaps a recent decline during the 1990s. As revealed by the net migration rates and inter-provincial flows, Damascus and its surroundings areas, remain the primary place of destination for Syrians. Additionally, there has been a relative rate of decline in governorate centers as main migration destinations since 1980s. There are significant movements within provinces, especially towards the provincial centers, but movements between provinces are generally uncommon. Rural-urban migration is the dominant form of population movement in Syria, but there are high rates of urban-urban, especially in the urban towns, and rural-rural migration in the countryside.

The trend of population movement towards the urban areas is also one of the main characteristic of population movement at the household level in Syria. Reliable findings indicate that over a quarter of households in provincial cities have at least one person originating from rural areas. Here, migration seems segmented in its regional character. The majority of provinces have rural-urban households, but other provinces, including the Capital, households with urban-urban or mixed-origin migrants.

6.2.2 Administrative divisions

Syria is administratively divided into 14 Governorates (locally called Mohafaza). Each governorate is divided into Districts (locally called Mantiqa), district into smaller administrative units (Nahia), nahia into villages, the smallest administrative unit. The centre of a Governorate is always the major city after whose name the governorate is named. The term “City” or “Town” is attributed to its population number, thus a town, may be given the category of a city as a result of its population growth.

The STEU-Basin includes four out of the 14 Governorates of Syria, covering 94 500 km^2 equaling to 51 percent of the country total surface area of 185º180 km^2 (CBS, 2011), According to population estimations for mid-2011, the STEU-Basin hosts 40 percent (8 445 000) of Syria’s population (21 124 000) (CBS, 2011). Obviously, the population density in the STEU-Basin, equaling to 89 people per km^2, is considerably lower than the average for whole Syria. Administrative divisions of the Governorates of the STEU-Basin, their surface areas and populations in comparison with the totals of the country are shown .in Table A6.5.

Table A6.5 Administrative divisions, their surface areas and population in the STEU-Basin

Governorate (Mohafaza)	Surface area (km^2)	Population	No. of Districts (Mantiqas)	No of Nahias	No. of cities	No. of towns	No. of Villages	No. of farms
Aleppo	18 500	4 806 000	10	46	22	39	1 476	1 312
Raqqah	19 610	933 000	3	10	5	13	467	1 057
Deir-Ezzor	33 060	1 221 000	3	14	17	35	86	68
Hassakeh	23 330	1 485 000	5	19	6	15	1 195	1 606
STEU-Basin	94 500	8 445 000	21	89	50	102	3 224	4 043
Syria	185 180	21 124 000	69	295	141	323	6 263	7 287
STEU-Basin / Syria	51%	40%	30%	30%	35%	31%	51%	55%

Source: Statistical Yearbook, Central Bureau of Statistics, Office of Prime Minister, Syria, edition 64, 2011.

6.2.3 Labour force

The census made in 2010 on Syrian labour force ≥15 years as to its age percent distribution and economic activity rates, showed that Syrian labour force with a proportion of some 26% of the population equaled to 5 531 000. Broken down into age categories, it appeared that labour force age 15-17 years was economically active at a rate of 30 percent as to male labour and 2.9 percent as to female, with a average activity rate for both genders of 17.1 percent for this very young category. This total activity rate came up to its peaks (50-57 percent) in the age categories between 25 and 54 years (CBS, 2011) (Table A6.6).

Table A6.6 Percent distribution of labour force (≥15 yrs) and economic activity rates by age groups and gender (urban-rural) 2010 and age percent distribution of population in mid 2011

Age group	Age percent distribution of population (mid 2011)	Age percent distribution of labour force, 2010 (≥15 yrs)	Economic activity rates by age groups				
			Total	By place of residence		By gender	
				Rural	Urban	Female	Male
≤14	37.1	--	--	--	--	--	--
15-17	10.8	4.5	17.1	16.3	17.9	2.9	30.0
18-19		4.1	27.8	29.7	26.2	5.6	48.1
20-24	9.4	13.4	41.8	43.9	40.1	14.8	70.2
25-29	8.2	15.0	53.1	52.3	53.8	18.6	91.0
30-34	6.5	14.2	55.7	55.2	56.1	18.2	97.0
35-39	5.8	12.4	56.4	55.4	57.3	17.5	97.6
40-44	5.2	11.8	57.7	55.9	59.1	18.3	96.8
45-49	4.1	9.1	55.9	54.6	58.9	17.9	94.1
50-54	3.8	7.0	50.0	48.4	51.1	11.7	87.7
55-59	2.7	4.3	43.0	41.4	44.1	8.7	75.5
60-64	2.3	2.1	23.5	27.5	20.6	2.0	42.4
65+	4.1	2.1	13.2	15.7	11.1	1.3	22.2
Total	21 124 000	5 531 000	-	-	-	-	-
Refined economic activity rate	-	-	42.7	42.4	43.0	12.9	72.2
crud economic activity rate	-	-	26.0	25.3	28.1	8.3	44.6

Source: "Statistical Yearbook", Central Bureau of Statistics, Office of Prime Minister, Syria, edition 64, 2011.

The balance female/male of economic activity rate of labour force remained on the side of males for all age categories but with an obvious increase in female share along with middle age categories. Roughly speaking, the balance active female/males increased from 1:10 for age 15-19 to 2:10 for the age 20-49 after which it declined down to 0.5:10 for ≥60 years. By place of residence, active labor force did not display any significant differences between urban and rural areas, except for the high aged categories of over 60 years where male labor exceeded female (CBS, 2011).

The refined economic activity rate measured for Syria in 2010 equaled 42.7 percent of which 42.4 percent came from rural areas and 43.0 percent from urban areas (CBS, 2011). However, when gender is considered, the discrepancy between males and females becomes much wider. The rate generated by male labour equaled to 72.2 percent while by female labour equaled to 12.9 percent (CBS, 2011). Worth mentioning that this common figure for whole Syria does not realistically reflex the fact that rural women in the STEU-Basin take over most of the farm works besides their heavy domestic work and child up-bringing. It is a common and well known tradition that a big share of rural households in STEU-Basin depends on income from women, what appeared not to have been realistically measured. Nevertheless, the earning power of women neither contributes to their independence nor to their profile in public arena, but most often it merely adds to their already heavy domestic burdens.

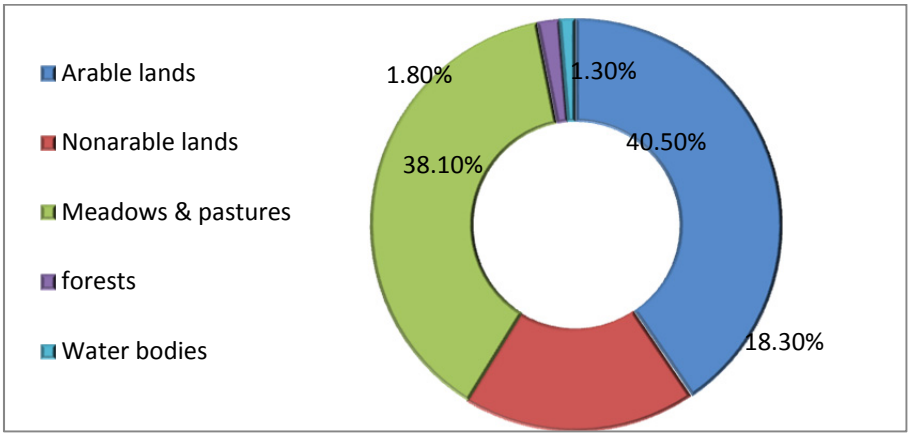
6.2.4 Activities

The celebrated "Fertile Crescent" is a remarkable area of the Euphrates-Tigris Basin. Comprising southeastern part of Turkey, northeastern half of Syria and almost all Iraq, the Euphrates-Tigris Basin proved to be of great economic importance to the Mesopotamia region.

6.2.4.1 General land use

Lands on the Euphrates-Tigris Basin are mainly used for agriculture and to a lesser extent for grazing, transport, housing, industry, tourism, and aquaculture. Agricultural activities in this area consist of horticulture, crop culture, and sheep grazing (Figure A6.1**Error! Reference source not found.**).

Figure A6.1 Land use composition



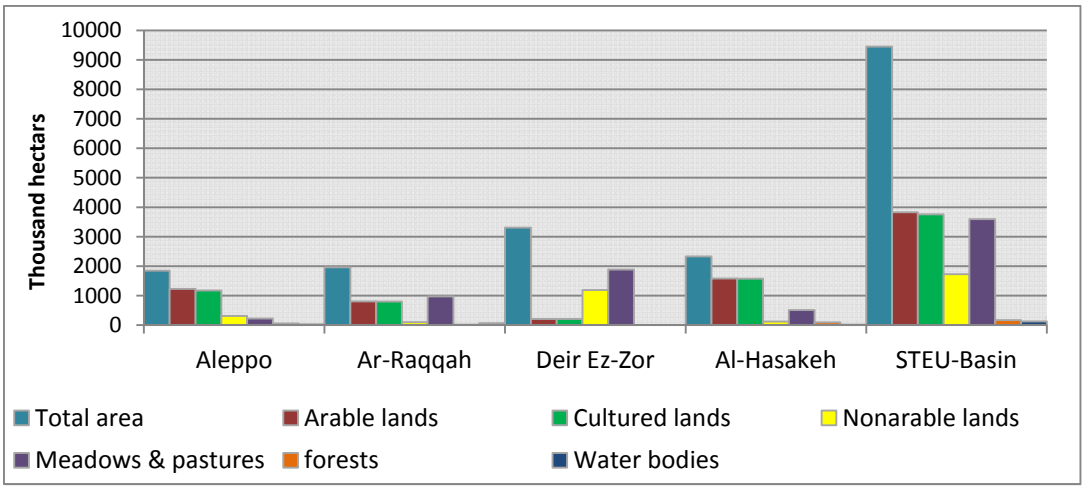
Source: Annual Agricultural Statistical Abstract, Ministry of Agriculture and Agrarian Reform, 2010

The Syrian arable lands equals to 33 percent of Syrian land, while meadow and pasture land, non-arable land, and forests occupy 44 percent, 20 percent, and 3 percent, respectively (Ministry of Agriculture and Agrarian Reform, 2011). When only the STEU-Basin is considered, the proportion for arable lands is higher at 40.5 percent, and a bit lower for the meadows and pastures at 38.1 percent, none arable lands at 18.3 percent, and forests at 1.8 percent, while contribution of water bodies becomes evident at 1.3 percent (Ministry of Agriculture and Agrarian Reform, 2011). Non-arable land includes rocky, sandy and saline lands are meant in addition to buildings and public utilities. Considerable parts of these lands might be exploited during the development of pond culture of fish.

6.2.4.2 Agricultural activities

The alluvial plains in Mesopotamia are perfectly suitable for high food production. The agriculture used to be based on the cultivation of unirrigated barley. However, following the construction of irrigation canal systems, other crops, vegetables and horticultural products, all became viable. The extreme south of Mesopotamia has always had a different agriculture (dates and fishing). The Syrian Governorates of Aleppo, Raqqa, Hassakeh and Deir Ezzor embrace the main agricultural croplands where currently wheat, barley, fodder crops are dominantly cultured. Vegetables and fruit tress rank second and third in term of cultured area and herds of sheep and goats graze the meadows outside the season. Vast pastures are also dominating areas with law precipitation, particularly in Deir Ez-Zor Governorate.

Figure A6.2 Natural land features and level of agricultural use (cultured-arable).



Source: Annual Agricultural Statistical Abstract, Ministry of Agriculture and Agrarian Reform, 2010.

The Khabur Valley is Syria's main wheat cultivation area. The northeastern part is also the center for Syria's oil production (sesame seeds, linseed and in some areas cotton). Proportions of arable lands in STEU-Basin vary widely among its Governorates; 63.6 percent in Aleppo, 40.7 percent in Ar-Raqqah, 6.3 percent in Deir Ez-Zor and 67.7 percent in Al-Hassakeh (Ministry of Agriculture and Agrarian Reform, 2011) with an aggregated proportion of 39.8 percent in the STEU-Basin. Worth mentioning that arable lands in STEU-Basin are almost fully cultured. Exploitation levels varied in 2010 from 95.8 percent in Aleppo to 99.7 percent in Al-Hassakeh (Ministry of Agriculture and Agrarian Reform, 2011) with a general average of 98.26 percent (Figure A6.2Figure A6.).

6.2.4.3 Industrial activities

The majority of industrial activities in STEU-Basin are based on agricultural products. Wool production was large and converted to an assortment of textile fabrics. Mill plants, Sugar plant, fodder plants, canning plants for agricultural products and several cotton ginneries make use of agricultural products and avail considerable working opportunities for the area. Domestic small scale diary industry prevail in almost all villages and rural households of STEU-Basin.

Other than agricultural industries, wide spectrum of industrial activities are met in STEU-Basin such like excavation and exploitation of fossil fuel, electricity generation, chemical industry, cement plants, transformational industry, and some heavy industry such like tractors and agricultural machineries.

No numerical data were available on land areas occupied by industrial activities in the STEU-Basin.

6.3 Fisheries Activities

Fisheries are an ancient tradition on the Euphrates River. It is practiced in a conventional manner and small scale category. Damming processes, during the past few decades, have segmented the river, significantly changed its surrounding environment and had noticeable impacts on aquatic life. Aquaculture activities, particularly cage culture of fish, has periodically added more biological pressures through the passive introduction of exotic species that has changed fish stock composition.

6.3.1 Fish Catch

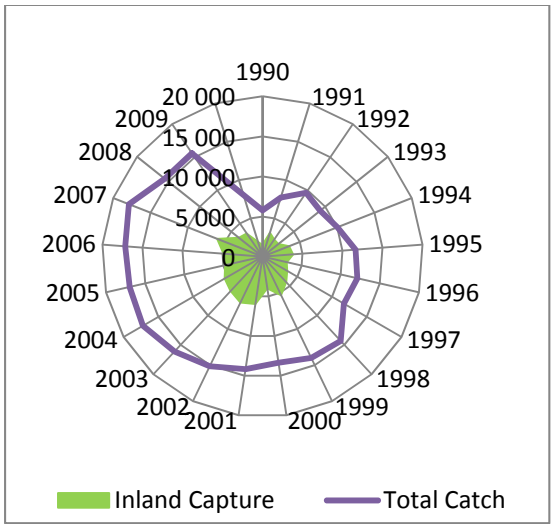
Until 1995, catch data was taken from the whole fish markets. Inland fishery development initiatives resulted in the construction of landing sites and fishing watch-points on major water bodies from 1995. A parallel monitoring system on landings at major landing sites was then launched and more realistic crosschecked data were produced from 1995.

6.3.1.1 Major catch profile and relative importance of STEU-Basin

The inland fisheries contribution to total catches has fluctuated over the past two decades between 22.4-42.1 percent with an overall average of 31.6 percent (Figure A6.3) (Ministry of Agriculture and Agrarian Reform, 2011; Fisheries and Aquaculture Information and Statistics Service, 2012). The Cyprinids have always dominated the catch in the inland capture fishery. Statistics data for 2009 showed that Cyprinids contributed 2 174 tonnes comprising 62.1 percent of the total inland catch. Catfishes contributed 796 tonnes (22.7 percent), mullets 350 tonnes (10 percent); eels 65 tonnes (1.9 percent), and other species 115 tonnes (3.3 percent) (Arab Fishery Statistics Yearbook, 2010).

The Euphrates River with its lakes has continuously ranked first in inland capture. Statistics for 2005 showed that the Euphrates system contributed 4 127 tonnes (86.5 percent) of total inland capture, Al-Khabour River 316 tonnes (6.6 percent), while Orontes River and coastal rivers contributed modestly; 216 tonnes and 111 tonnes respectively (Krouma, 2006). Thus, when the STEU-Basin is in question, inland capture thereof equals to over 90 percent of the total national inland capture (Figure A6.3).

Figure A6.3 Inland fisheries contribution to total catches, 1990-2009



Source: FAO Fisheries and Aquaculture Information and Statistics Service. 2012.

6.3.1.2 Species composition

Sufficient identification studies were carried out in the Basin targeting a specific fish species or fish group. Many species lists were also made for various water bodies of the Basin. However, far less attempts aimed to produce a comprehensive list of species for the whole Basin. There have been many general works of the late 19th and throughout the 20th Century. The more recent literature on the Tigris and Euphrates Basins include Banister, K.E. (1980) study on the fishes of Tigris and Euphrates Rivers. Coad, B.W., produced a provisional annotated checklist of freshwater fishes of Iran (1980), and a checklist and bibliography of freshwater fishes of Iran (1990). Lortet, L. (1983) studied on fishes of Syria collected by Chantre, M.E. in his mission to Mesopotamia of 1881. Krupp, F. worked on recent changes in the distribution of Syrian freshwater fishes (1984) and on systematic and zoogeography of freshwater fishes of the Levant (1985 and 1987). Krupp, F. (1984) highlighted recent changes in the distribution of Syrian freshwater fishes. Al-Hassan, L.A. et al prepared a preliminarily annotated checklist of fishes of Shatt Al-Arab (1985). Coad and Kuru (1986) produced a bibliography of fishes of Turkey. Coad (1991) prepared a critical checklist of fishes of the Euphrates-Tigris Basin and prepared a study on zoogeography of the fishes of the Euphrates-Tigris Basin (Coad, 1996). IFAP (1999) contributed to the knowledge of species, their biology and distribution in the Middle Euphrates Basin of Syria (Syrian-German Inland Fisheries and Aquaculture Development Project (IFAP), 1999).

In his comment on Beckman's list of freshwater fishes of Syria of 1962, Coad, W.B. (1991) considered that the list included species endemic to the drainages outside the Euphrates-Tigris Basin.

Coad also stated that the fauna of the Euphrates-Tigris Basin comprises 12 native families containing about 66 species (Coad, 1991). The recent Syrian survey on fish species of the Euphrates system, was preliminarily based on a long term monitoring by DOF on catches over two decades, but particularly on intensive field study by IFAP (DOF/COFAD/GOPA) in the period 1997-1998 (Table A6.7). IFAP has produced a provisional list of fish species of the middle Euphrates River system in Syria. The list identified four Orders, 12 Families, 24 Genera and 46 species. Over two thirds of the fish species appeared to be Cyprinids (29 native and two exotic spp). In addition, two more exotic Cyprinids (grass carp and silver carp) that were introduced to aquaculture by IFAP, were also met there but are believed not to be able to reproduce in the Euphrates system. Noteworthy is that the World Conservation Monitoring Centre (WCMC), in its biodiversity study, mentions that the total number of fish species in the Euphrates-Tigris Basin equals to 71 (WCMC; 2011).

Table A6.7 Provisional list of fish species of the Euphrates River System, Syria

Family/Species	Family/Species
Cyprinidae	**Bagridae**
Acanthobrama lissneri Tortonese, 1952 °!	*Mystus pelusius* (Solander)
Acanthobrama marmid Heckel, 1843 °!	**Claridae**
Alburnus caeruleus Heckel, 1843 °!	*Clarias gariepinus* (Burchell
Alburnus sp. °•!	**Heteropneutidae**
Aspius vorax Heckel, 1843 °!	*Heteropneustes fossilis* (Bloch, 1794) ° + !
Barbus barbulus Heckel, 1849 °! ?	**Siluridae**
Barbus esocinus (Heckel, 1843)*°!	*Silurus glanis* Linnaeus
Barbus kersin (Heckel, 1843)°! ?	*Silurus triostegus* Heckel
Barbus grypus Heckel, 1843 *°!	**Sisoridae**
Barbus kosswigi (Ladiges, 1960)°	*Glyptothorax cous* (Linnaeus, 1766) * °!
Barbus lacerta Heckel, 1843 °! ?	*Glyptothorax kurdistanicus* (Berg, 1931) * °
Barbus luteus (Heckel, 1843) °!	*Glyptothorax* sp. °•!
Barbus pectoralis Heckel, 1843 ° !?	**Cyprinodontidae**
Barbus schejeh (Heckel, 1843) °	*Aphanius mento* (Heckel)
Barbus sharpeyi Günther, 1847 * °	**Poeciliidae**
Barbus subquincunciatus Günther, 1868 * ° !	*Gambusia holbrooki* (Girard, 1859) + !
Barbus xanthopterus (Heckel, 1843) °! ?	**Cıchlıdae**
Barilius mesopotamicus Berg, 1932 °!	*Oreochromis aureus* (Steindachner
Capoeta trutta (Heckel, 1843) °!	*Tilapia zillii* (Jervais,1848)+!
Chalcalburnus mossulensis Heckel, 1843 !	**Mugilidae**
Chalcalburnus sellal (Heckel)	*Liza abu* Heckel, 1843 !
Chondrostoma regium (Heckel)	**Mastacembelidae**
Cyprinion kais Heckel	*Mastacembelus mastacembelus* (Banks and Solander in Russel, 1794) ° !
Cyprinion macrostomum Heckel	*Mastacembelus* sp. °•!
Cyprinus carpio Linnaeus	**Exotic cyprinidae**
Garra rufa Heckel	*Ctenopharyngodon idella* (Valenciennes in Cuvier & Val., 1844) +°!
Garra variabilis Heckel	*Hypophthalmichthys molitrix* (Val. in Cuv. & Val., 1844) +°!
Leuciscus cephalus orientalis (Nordmann)	
Leuciscus lepidus (Heckel)	

** = endemic species (9)*
! = occurrence confirmed by IFAP (40)
° = primary freshwater fishes (38)
+ = exotic species
? = taxonomic validity questionable (5)
• = not identified (3)
Source: IFAP, 1999.

It is up to the continuous systematic works on the ichthyofauna, some species of the Basin mentioned by IFAP in 1999 (Table A6.7), have been modified. Current nomenclature status of those species compared to old nomenclature is shown inTable A6.8.

Table A6.8 Current classification status of some species of the ichthyofauna of the Basin in comparison with their classification status as per IFAP, 1999 mentioned in Table A6.9

Classification status of some species (currently invalid)[1]	Current classification status[2, 3]
Aspius vorax Heckel, 1843	*Leuciscus vorax* Heckel 1843 *
Barbus esocinus (Heckel, 1843)	*Luciobarbus esocinus* Heckel 1843 *
Barbus kersin (Heckel, 1843)	*Luciobarbus kersin* (Heckel 1843) *s
Barbus kosswigi (Ladiges, 1960)	*Luciobarbus kosswigi* (Karaman 1971) *
Barbus luteus (Heckel, 1843)	*Carasobarbus luteus* (Heckel 1843) *
Barbus pectoralis Heckel, 1843	*Luciobarbus pectoralis* (Heckel 1843) *
Barbus sharpeyi Günther, 1847	*Mesopotamichthys sharpeyi* (Günther 1874) *
Barbus xanthopterus (Heckel, 1843)	*Luciobarbus xanthopterus* Heckel 1843 *
Chalcalburnus mossulensis Heckel, 1843	*Alburnus mossulensis* Heckel 1843 *
Chalcalburnus sellal (Heckel, 1843)	*Alburnus sellal* Heckel 1843 *
Leuciscus cephalus orientalis (Nordmann, 1840)	*Squalius cephalus* (Linnaeus 1758) *
Leuciscus lepidus (Heckel, 1843)	*Squalius lepidus* Heckel 1843 *
Nemacheilus frenatus (Heckel, 1843), Family Balitoridae	*Oxynoemacheilus frenatus* (Heckel 1843), Family Nemacheilidae *
Nemacheilus hamwii n.sp. Krupp. Schneider, 1991, Family Balitoridae	*Oxynoemacheilus hamwii* (Krupp & Schneider 1991), Family Nemacheilidae *
Tilapia zillii (Jervais, 1848)	*Tilapia zillii* (Gervais 1848)

Sources: [1](IFAP, 1999; [2]Eschmeyer, 2012; *FishBase, 2012.

6.3.1.3 Fishing gears

Gill nets are the main fishing gear used in the Euphrates River, its tributaries, backwaters, and artificial lakes. Fyke nets are sometimes used in rocky areas and cast nets in shallow waters. The single sided gill net is used in the surface water retention lakes as set nets. Nevertheless, fishing technique differs according to water velocity. In still waters or waters of insignificant velocity, set nets of up to four joint pieces (1 piece = 35 m long and 1.5-2.0 m deep) are set in productive areas before sunset and checked out at sunrise. While in running waters, a stretch of some 150-250 meters and 2.0-2.5 m deep of the so called “drift net” is used. The drift vessel, steered by a long stick, rides the water current and floats downstream unfolding the gill net. The net is left to drift behind for a kilometer or so then lifted up onto the board with the caught fishes. A drift fishing boat is managed by two fishermen, one of whom takes care of steering while the other works the net. After several drifting operations, drift fishing boats are landed in certain landing points where the catch is handed over to fish marketing agents and the boats are loaded on trucks to be driven back on road to the starting points upstream for new courses.

Fyke nets and traps are also known and, irrespective of water velocity, used in deep waters and close to waterweed growths. The common form of a trap is a cubic or cylindrical wire cage with funnels driving the fish inwards. Each fyke net or trap is connected to a buoy at the surface.

Detrimental fishing practices do also exist and create serious threat to aquatic life and the sustainability of the resources. In 1975, direct electric current was firstly introduced as fishing device for fish fauna studies in the newly formed Assad Lake. Worth mentioning that up to its high yield comparing to the effort exerted, use of electricity allured fishermen to quickly shift to electric fishing. Unfortunately and up to insufficient awareness on both sides and under inefficient control on fishing activities, hundreds of alternating electricity generators invaded the lake fishery and formed a dangerous threat to fish stocks and more importantly to swimmers and fishers themselves.

Another detrimental fishing practice is use of explosives. This started with dynamite and soon fishermen learned how to prepare their homemade explosives out of thermal treatment of nitrate fertilizers with sugar.

Moreover, illegal fishing practices with posterior detrimental effects gradually evolved. Following the use of narcotics, derived from wild plants, pesticides were introduced as more efficient fishing mean. The most recent improvised fishing device was the butane gas, where a gas bomb with open valve is sunk in locations known to be of high productivity.

Expansion of IUU fishing allured immoral people to enter and dominate the fishing sector. This resulted into the decrease in the number of legal fishing units. More importantly, fish stocks began to suffer and, consequently, the yield of conventional fishing devices progressively diminished. Presently, and despite the strict control on fishing activities and regular monitoring on catches that have been practiced over the past decade, deter fishing devices still represent a big threat to fish stocks in the Euphrates and surrounding fisheries. Due to detrimental fishing practices and environmental degradation, the current fish catches from many of the rivers and lakes, most probably, will not be sustained.

6.3.1.4 Fishing seasons and locations

The off-season in freshwater fishing lasts two and a half month starting from 15 March to 30 May (MARR, 1965). This closed period applies to all continental freshwater bodies where fishing activities take place. No other location restrictions do exist in open waters. However, some surface water retention lakes and reservoirs intended for drinking water supply makes an exception, where both fishing and aquaculture are forbidden.

6.3.1.5 Fishing fleets

Artisanal fishery is the only capture fishery in inland waters. Small scale fishing vessels (3-5 m long) dominate the fishery in rivers and shallow and surface water lakes. Vessels are undecked, made of iron and driven by manpower. Long sticks or rows are used for steering. Comparatively bigger vessels (6-15 m long) of which some are decked, motored (5-30 hp) and built of wood or fiberglass are used in lake fisheries. The latest survey on fishing fleet in the Syrian inland waters was in 2005 showed that 1 283 boats are involved in inland fishery, out of which 436 have motors (2009) (AOAD, 2010). The Euphrates and Al-Khabour River system in the STEU-Basin, being the major inland fishing ground with over 90 percent of the total inland capture, had around 400 motored boats and 700 row boats (Krouma (2013) from Estmates based on information from AOAD (2010)).

6.3.1.6 People involved in fisheries

Inland fishers are either traditional river fishers or new entrants to fishery from the agricultural sector after having his agricultural land flooded with water as a result of a damming processes. For example, the flooding of Al-Assad Lake led to the forced displacement of circa 4º000 families, who were resettled in northern Syria. A 2009 survey showed that there are 4 455 fishers directly engaged in the Syrian inland capture fisheries, of which 2 286 people are fulltime, 784 people are part-time, and 1 385 people are occasional (AOAD. 2010). Inclusive are 780 pedestrian fishers, one third of which is fulltime and two thirds fall in the part time category.

Fishing communities in the STEU-Basin comprise the majority of inhabitants of villages on the banks of the Euphrates River and its man-made lakes. Roughly speaking, each un-decked boat is usually managed by two fishers while a motored boat carries 2-3 fishers. Calculations and field surveys available showed that there are 3 545 fishers in the STEU-Basin, out of which 2 170 are fulltime fishers, 760 part-time and 615 occasional fishers. This represents almost 80 percent of the total inland capture fishers in Syria. The people engaged in inland fisheries vary widely in age, starting from under ten yeasr old and up to 65 or even 75 years of age in some areas. They are all males with very rare exceptions. However, surface water retention lakes are usually managed by all family members including women. Literacy in general is basic and family size is usually sufficient i.e. 6-8 persons or even more.

6.3.2 Fish processing

Fish is locally produced in Syria in general and in STEU-Basin in particular. Fish are sold consumed as whole fresh fish. The limited landings do not avail any surplus for eventual processing. Therefore, there is no specific fish processing activities or fish processing plants.

6.3.3 Fish marketing

Location or size of individual landing sites for the inland capture fishery does not reflect its importance to the local community as to fish consumption. Landing sites can be major fishing harbours or fishers' villages where from catch is collected and sent to main fish markets.

6.3.3.1 Marketing system

Major fish traders have agents designated on the main landing sites along river banks and shores of lakes. They receive catches from fishers and then grade the fish. The more valuable fish are iced and transported to distant central markets, and the remaining fish is sold at the provincial markets. The city of Aleppo, being the closest principal city to fishing areas, represents the major fish market in North Syria. It is at a distance of 120 km up to 210 km from the most productive fishing sites on the Al-Assad and Tishreen Lakes. Upon arrival of catches to the central fish market of Aleppo, the fish is graded again and put in ice flakes to be sent to the other principal fish market of Damascus or sold to local retailers in Aleppo. Species and categories preferred in Damascus are urgently shipped in insulated trucks to the central fish market of Damascus at a distance of 365 km. Catches from the remaining segment of the Euphrates River are mainly sent to the cities of Raqqah and Deir Ez-Zor, the biggest fish market in Eastern Syria, whereas catches from the distant Khabour River Basin are totally consumed within the Governorate of Hassakh.

Fish caught or cultured in Syria is completely consumed at home. Exportation of fish is not a common practice, with some exceptions not exceeding few tonnes of locally unwanted species.

6.3.3.2 People involved in fish marketing

There are 3 680 permanent workers and 1 270 seasonal workers employed in fish marketing in Syria. This directly includes fish traders, their agents, transport, drivers, store men, and indirectly input traders and maintenance services involved in the sector. In the STEU-Basin these are estimated at 1 950 persons, making for around 40% of national fish marketing sector.

6.3.4 Fisheries institutions

6.3.4.1 Sponsoring authorities

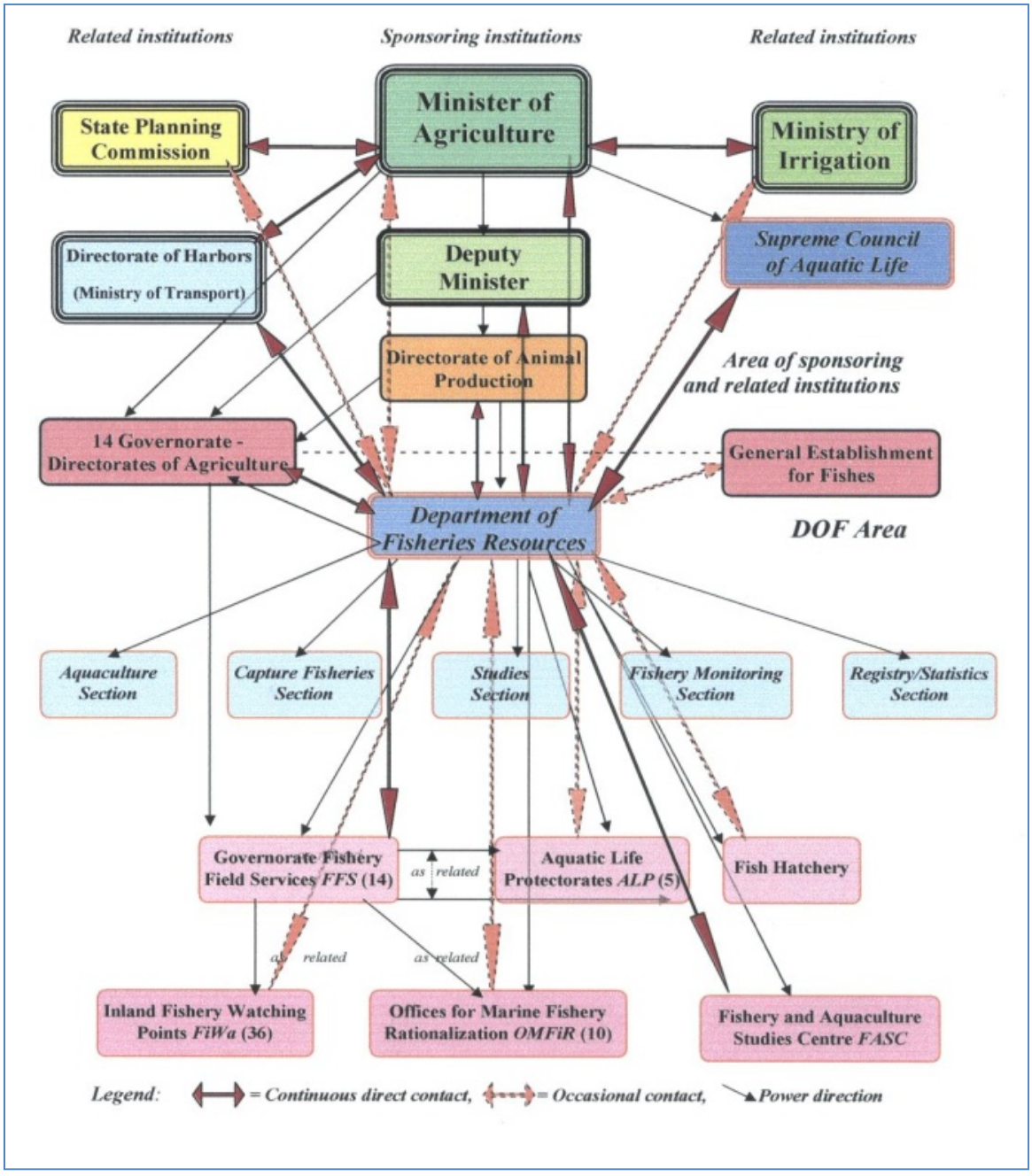
Until 2009, the fisheries and aquaculture sector used to be managed by the Department of Fisheries Resources (DOF) in the Ministry of Agriculture and Agrarian Reform (MAAR). The DOF was established in 1986 as central department in the headquarters of MAAR with the task of managing and promoting the fisheries and aquaculture sector, and had five central sections:

- Capture Fishery
- Aquaculture
- Studies
- Fishery Monitoring and control, and
- Registry and Statistics

It also had 13 Fisheries Field Services (FFS) in the centers of the Governorates. The DOF established regular contacts with fishing societies and scientific bodies, revitalized and put to practice the law on protection of aquatic life, produced a set of fisheries acts and regulations, issued regulatory resolutions for licensing of fishing boats and fish farms, designed a system for monitoring on fishing activities and catches and entitled its FFSs to monitor the compliance of fishers with relevant rules and regulations

and to monitor on landings. The organogram of DOF, its location in MAAR, its structure breakdown and nature of its relations with relevant national institutions are shown in (Figure A6.4)

Figure A6.4 Organogram of Department of Fisheries showing its location in the Ministry of Agriculture, its structure breakdown and nature of its relations with relevant national institutions

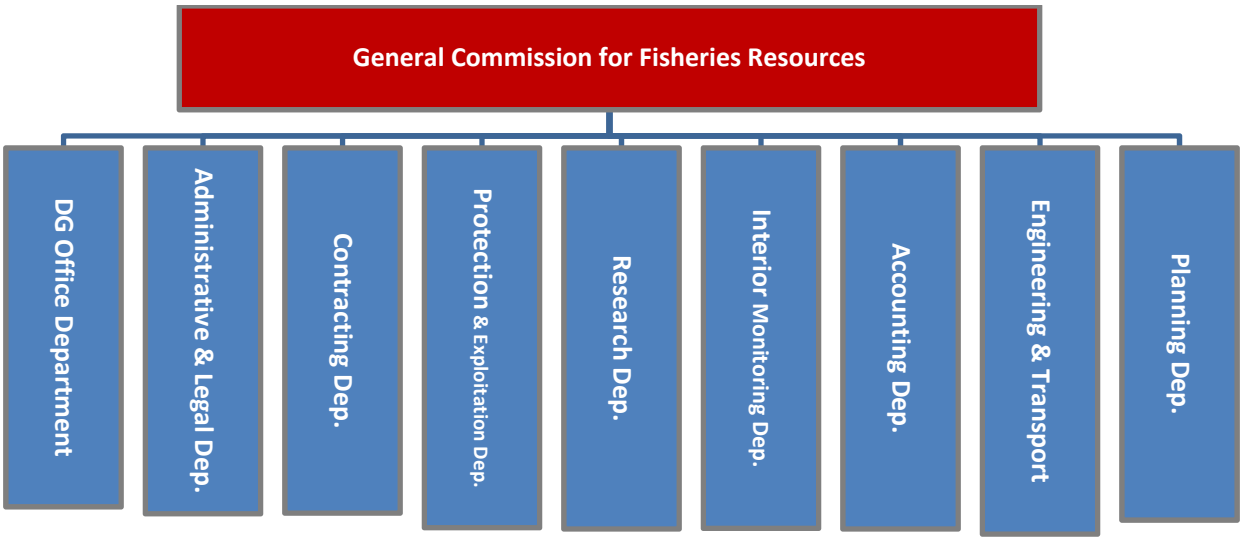


During its mandate of 24 years from 1986-2009, DOF established a system for collecting, cross-checking and elaborating on field statistics data what helped produce reasonably reliable statistics on the sector.

In 2009, DOF was upgraded to an administratively and financially independent fisheries body under the name of General Commission for Fisheries Resources (GCFR) that incorporated the then known General Establishment for Fish (GEF),whose objectives were to run existing fish farms and build new production units for further exploitation of water bodies. Presently, the GCFR is in the context of

setting its organizational structure, responsibilities and strategies. Figure A6.5 shows GCFR preliminary organizational structure.

Figure A6.5 Organizational structure of General Commission for Fisheries Resources (preliminarily)



The GCFR is planned to comprise five main branches:

- Coastal Area Branch incorporating the Governorates of Lattaqia and Tartous
- Sothern Area Branch, Idleb, Aleppo and Raqqah Governorates
- Eastern Area Branch, Deir Ezzor and Hassakeh Governorates
- Central Area Branch, Homs and Hamah Governorates
- Southern Area Branch for Damascus, Quneitra, Dara'a and Souweida Governorates.

Each Governorate would consequently have its own Fisheries Service.

6.3.4.2 Fishing cooperatives

All fishers in STEU-Basin are in the private sector and most belong to organized fishing cooperatives. Objectively speaking, fishing boats, fishing gear and other equipment are privately owned. Fishing activities and the marketing of catches are undertaken privately. The fishing grounds are not managed by the cooperatives. The reason for the cooperatives is that in the mid 1970s, the General Establishment for Fishes (GEF); the then governmental body responsible for fisheries management, imposed higher fees on private fishers. Presumably, this was to promote the formation of further cooperatives in the agricultural sector. This intent was not accompanied with parallel efforts that would have promoted and created real and fully functional cooperatives. The main outcome was the formation of cooperatives whose role was to meet just to produce the lists of members that was required by GEF for the issuing of fishing licenses.

The chairman of a fishing cooperative is often seen as the community leader and may be the Head of Peasant Association in pertinent village. In practice, the leader of the cooperative appears to have little impact on the activities of his or neighboring fisheries or fishing activities.

6.3.5 Livelihood information

6.3.5.1 Financial services

By law, financial services to fisheries sector are available through the Agricultural Cooperative Bank (ACB). The bank offers soft medium-term loans of 2-3 years for the construction or procurement of

fishing boats, and short-term loans of 10 months for the procurement of fishing gears. Such loans are restricted to members of fisheries cooperative and are granted against the guarantee of the properties of fishing cooperatives in question. The current poor structure of cooperatives and their lack of assets means that fishers are unable to secure loans.

This financial shortage is luckily compensated by an exchange of benefits system between fish traders and fishers. The system is based on financial subsidies offered by the fish trader to the fishers who would regularly pay debts back in the form of a share of catch-value and would make a commitment to market his catches exclusively through the subsidizer. Such subsidies go beyond procurement of fishing geasr and equipment and include direct prepayments for daily living, particularly during low yielding seasons and off seasons. The system have proved to be workable and efficiently sustainable.

6.3.5.2 Interactions with other sectors

The dominancy of rowboats in STEU-Basin fishery (≈64%) minimizes the negative environmental impact of fishing activities on aquatic environment and on other water using sectors. Even negligent and occasional seepage of engine fuel of motored boats, that exclusively operate in lakes of vast surface area and massive water volume, represents only a minor harm comparing to the volume of recipient.

On the other hand, several hampering or limiting effects from other sectors using or neighboring open water bodies have emerged. Fuel pipelines installed from the East most quarter of Syria to the oil refineries in the cities of Homs in the Midwest and Banyas on the coast, when occasionally damaged, fuel seepage ends in some retention lakes or sometimes in open waters. Sewage water from cities and villages neighboring water system has become more and more harmful to aquatic life with the recent gradual increase in use of detergents. Similarly, over use of fertilizers carries considerable amounts of nitrogen and phosphorus in to the aquatic environment. This promotes sudden algal blooms and increases the nutrient loading and biochemical oxygen demand in the longer term with their known negative impacts on safety and composition of aquatic life. Justifiably, the use of motored fishing boats in small lakes designated for drinking water is prohibited. This applies to the small artificial lake of Khabour West which supplies the city of Hassakeh with drinking water.

6.3.5.3 Livelihood diversification

As mentioned before, a fisherman in the STEU-Basin is either a traditional person coming from the river fishery or a new entrant from agriculture whose land was taken during the flooding of an artificial lake. Traditional river fishermen, though poor, usually have a small land property to cultivate during low seasons and off seasons. This is not the case with lake fishermen whose land became parts of the lake bottom who can barely procure and maintain fishing gears and vessels. A lake fisherman with other employable or income earning skills is an exception. In general, choices are limited and do not always correspond time wise with low or off seasons.

6.3.5.4 Climate changes in past decades

The climate that prevailed in Syria until the 1960s displayed four distinct seasons: rainy cold Winter, dry hot Summer and temperate Autumn and Spring. Spring and particularly Autumn, thereafter, have begun to progressively shorten and are now only two short transitional seasons. This has been correlated with synchronized progressive time-wise extension and warming of the summer season accompanied with long lasting drought. Water temperature has accordingly been impacted and lost its previous gradual increase and decrease during summer and winter seasons and has been replaced by quick short-term variations.

These climate induced changes have had impacts on the physiological development of the gonads of aquatic species in a way that might have impeded normal evolution of mature roe and/or efficiently active sperm. Intensity of illumination and length of photoperiod have had consequently changed and imposed additional pressures affecting smooth maturity and fitness for natural spawning. These

climatic changes have presumably influenced the fertilization processes, the development of fertilized eggs, the synchronized development of natural food, and the growth and/or survival rate of larvae. Recent apparent imbalance in species composition may be due to these changes.

6.3.5.5 Man-made changes in past decades

In the past two decades, the negative consequences of illegal fishing that had prevailed before, such as electric fishing and other detrimental fishing practices, began to become more evident. These were displayed in diminishment of catches per fishing unit, destruction of habitats, deterioration in stocks, disappearance of some juveniles like Farkh (*Luciobarbus esocinus*) or total disappearance of some species like the rock barbell (*Barbus subquincunciatus*) (Coad, 1991; IFAP, 1999).

These consequences have had significant impact on observing fishers and their livelihood, what forced some of them out, while others preferred to shift to illegal fishing. This grey period coincided with initiation of DOF efforts in reconsidering previous fisheries management practices and combating against illegal fishing.

6.3.5.6 Main constraints to inland capture production and livelihood development

The Syrian inland fishery sector is faced with wide spectrum of constraints, most of which is generating other constraints and/or generated from other constraints. These can be grouped as:
Know-how constraints

- Scarcity of expertise in resource management and several other fisheries fields
- Lack of regular updating of biological and/or limnological indicators and criteria needed for proper management
- Insufficiency of research on fish stocks, on preliminary or secondary productivity or on maximum sustainable yields
- Limited attendance of Syrian fisheries officers to regional and international meetings, workshops or conferences seriously affects the rhythm of sector development

Administrative constraints

- Limited collaboration of police forces with fisheries local authority
- Insufficiency of mobility of fisheries rangers
- High risk of confrontation with aggressive illegal fishers
- Limited budget earmarked for fisheries control

Environmental constraints

- Fishing began to lose its good reputation as environmental-friendly activity as long as detrimental fishing is not totally eradicated
- Detrimental fishing represents the major environmental hazard to the stock size, aquatic biodiversity and eco-diversity
- Some illegal fishing practices introduce harmful substances to the aquatic environment

Marketing-infrastructural constraints

- Scarcity of specialized transportation means
- Inadequacy of fish handling and packaging
- Scarcity or insufficiency of covered and well insulated or cooled containers

Livelihood constraints

- Illegal fishing progressively minimizes outcome from legal fishing, what would hardly sustain the family or even afford boat and gear maintenance cost
- Conventional real fishermen are susceptible either to give off legal fishing and join current unemployed masses or to shift to illegal fishing

6.3.6 Legislation / policy enforcement

6.3.6.1 Inland fishing legislations

In harmony with the public laws in force, the activities of fishery sector are governed by the following major laws, ministerial resolutions and regulations:

- **The Law on Protection of Aquatic Life** (Legislative Decree No. 30 of 1964), a comprehensive law that sets headlines for fishery sector; marine and inland capture, aquaculture and water environment, identifying legal and illegal fishing practices and constituting the so called "Supreme Council for Aquatic Life" under the chairmanship of the Minister of Agriculture assigning to it the responsibility of endorsing the national fisheries policy (MARR, 1964).
- **Resolution on Regulation of Inland Fishery** (No. 1983 of 1965), sets further rules and regulations for inland capture fishery identify legal and illegal fishing practices (MARR, 1965).
- **Regulations on licensing of fishing vessels** (1989), describes vessels construction designs, their criteria and safety outfits and identifies official procedures to be followed in the context of licensing of an existing fishing boat or construction of a new fishing boat (MARR, 1989a).
- **Regulations on licensing of pedestrian fishers** (1989) describes documents and physical qualification criteria needed for licensing of pedestrian fishermen (MARR, 1989b).
- **The National Strategy and Work Plan on Biological and Ecological Diversity** (officially endorsed by the Syrian Government (2001).
- **Resolution on specifications of imported frozen fishes** (No. 86/t of 2003), sets the biological and chemical tests to be made in checking on of safety and healthiness of imported aquatic organisms (MARR, 2003). Apparently irrelevant to fisheries, but following decades of banning of fish imports, this decision was taken for purpose of securing further offer of cheap fish in the market. Two points were targeted: a) compensating for the shortage of national fish supply, b) indirectly hampering the big rush of immoral entrants to illegal fishing. This has proved to be of considerable effect on minimizing pressure on capture fishery.

6.3.6.2 Inland fishing policy

The policy set by DOF for inland fishery aims to: "Sustain existing conventional small scale fishing units under a rationalized exploitation of resources in an environmental friendly and sustainable manner".

6.3.6.3 Management initiatives

Most of fundamental initiatives made in the past two decades, more or less, secured some backgrounds and prerequisites for the multilateral managerial aspects needed for materializing adopted policy. However, owing to inefficient coordination with other governmental and civil stakeholders, and/or their insufficient responses or compliance on a timely manner, harmony or synchronization in the sequence of actions appeared to have been retarding full policy implementation.

Upgrading inland fisheries management measures and intensifying field monitoring and control activities in the past two decades have, to a reasonable extent, put some limits to long term sufferings and damages to fish stocks, aquatic eco-diversity and biodiversity. The management measures applied can be grouped as follows:

Administrative & extension measures

- Declaring Al-Djabboul Lake a closed areas as natural wetland protectorate for euryhaline fish species and waterfowl (1997).
- Declaring the small branch of the Euphrates River in Deir Ez-Zor as natural protectorates for freshwater life (2001).
- Organizing several meetings and workshops with fishermen and explaining the necessity for rebuilding fish stocks and rehabilitating of aquatic environment.

Input controls

- Banning of bottom trawls in inland waters for a transitional period of three years, May 1987. This banning period has been continuously prolonged.
- Enforcing minimum mesh sizes on gill nets, cast nets and traps (30 mm) and trawls and beach seines (50 mm), (1995) as per the act on inland fishing of 1965 (MARR, 1965).
- Banning new vessels to enter the fisheries, 2002.
- Freezing of existing fishing effort as to number of vessels, GRT and horse power, 2003.

Output controls

- Checking on safety and seaworthiness of fishing vessels on an annual basis.
- Continuous patrols on fishing sites to prevent deter, illegal and offseason fishing.
- Random checking on backbone solidity, gills' bleeding, body cohesiveness and air bladder.

Economic incentives

- Availing easy loans from the agricultural bank for cooperative fishermen to procure gears and boats, provided that the applicant for a new boat is replacing his existing licensed boat.

Fundamental initiatives mentioned above need continuation and persistence, otherwise achievements might easily vanish. Still, a lot of efforts should be invested on the basis of continuous evaluation of efficiency of managerial measures and promotion efforts.

6.3.6.4 Policy implementing body

Fisheries sector management had been the responsibility of DOF since its foundation in the headquarters of MAAR in 1986 until 2009 when the new GCFR was established. Fisheries policy implementation was practiced by DOF and GCFR accordingly.

With its headquarters in Damascus, ex DOF had 13 Fishery Field Services (FFS), under the 13 Directorates of Agriculture in the 13 Governorates of Syria. An FFS used to sponsor 1-12 peripheral fishery related sites; watching point(s), marine fishery offices, a reserve area, a hatchery, a study centre, as locally needed. The FFS was responsible for implementing DOF strategy and plans in its area, licensing of capture fishery and aquaculture and leasing the aquaculture and fishing rights in surface-water retention lakes and canals, controlling fisheries activities and enforcing the laws on protection of aquatic life, monitoring fish markets; prices, demand, species, etc. and extending training, extension and advices to fish producers.

Embracing the most important water resources of Syria, STEU-Basin represents the major inland fishing area. Consequently, FFSs in the STEU-Basin have had comparatively more spacious fisheries to control, and thus a hundredfold of financial budget were annually allocated by DOF to each of them. Fisheries staff, transportation means and field monitoring outfits of FFSs in question always outreached all the remaining FFSs.

6.3.6.5 Policy enforcement

Fisheries monitoring capacity of FFSs has had annual promotion through procurement of new patrol boats, motorbikes, telescopes, cell phones, life jackets, and some field cars. Being unarmed, fish rangers were to be supported by police forces. Illegal or out-seasoned fishing devices were to be confiscated together with the illegal catch while fishers were to be sent to the courts.

6.3.6.6 Legislation affecting activities

Specific legislation seriously affecting fishing activities do not exist. However, as aforementioned, fisheries is prohibited in closed water bodies dedicated for drinking water. The same applies to those surface water retention lakes located in the stepps area, which are basically meant to supply shepherds and sheep with water.

6.3.7 Past and ongoing development

6.3.7.1 Fisheries management

Headlines on past development initiatives have been itemized under item Management initiatives and are, presumably, still applied. Whereas, current or newly planned development actions are expected to be agreed upon and declared by the newly established GCFR.

6.3.7.2 Capacity building

There have been no specific capacity building projects in the field of fisheries. This was confined to the limited opportunities financed by Arab, regional or international organizations. Such opportunities have mostly been restricted to one participant from each country and rarely to two. Some of these occasional training were made use of, while many others were lost for several bureaucratic, administrative or linguistic incapability reasons.

IFAP (1993-1998) has, comparatively, secured considerable training opportunities for Syrian fisheries officers through abroad (45 man-week) and at home field training courses (60 man-month). These courses comprised both fisheries and aquaculture topics. On the job training, in addition, availed to the counterparts full three years in continuous contact with foreign fisheries and aquaculture experts. Few other field training workshops were locally organized for fishers and new entrants to the aquaculture sector. Such training of pilot fish producers was supplemented by regular field visits of experts to the pilots.

It is noteworthy that the common foreign language-barrier has always been and still limiting opportunities for admission of Syrian candidates to high level training courses, or at least minimizing the experience expected to be gained from field training. The GCFR is, therefore, advised to invest in upgrading linguistic capabilities of its technical staff.

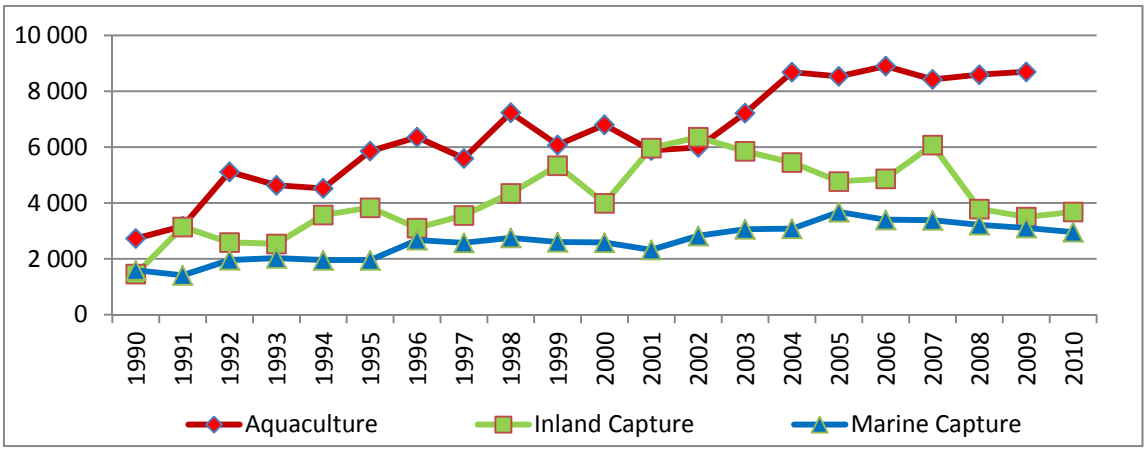
6.4 Aquaculture activities

6.4.1 Fish farming

6.4.1.1 Production volume

Modern aquaculture in Syria dates back to the late 1950s. It has been and still exclusively practiced in fresh waters and is currently restricted to warm water fishes. Aquaculture production has progressively increased during the nineties from 2 729 tonnes in 1990 to 6 079 tonnes by 1999 and came up to its peak of 8 902 tonnes in 2006 after which it slightly declined to 8 697 tonnes in 2009, Figure A6.6 (FAO. 2012).

Figure A6.6 Aquaculture, inland and marine capture fisheries production (tonnes, 1990-2009)



Source: FAO Fisheries and Aquaculture Information and Statistics Service, 2012.

6.4.1.2 Species cultured

Commercial aquaculture has, so far, been limited to carps and tilapias. These are the common carp *Cyprinus carpio* (mirror type) and the tilapias that are believed to be a mixture of random hybrids of *Oreochromis aureus* and *Oreochromis niloticus*. In 2009, carp and tilapias contribute almost equally to aquaculture production, at 3 739 tonnes and 3 914 tonnes respectively. African catfish *Clarias gariepinus*, the culture of which is confined to the few warm springs, is gradually becoming a considerable component of aquaculture production at around 1 000t per annum. Grass carp *Ctenopharhyngodon idella* and silver carp *Hypophthalmichthys molitrix*, introduced respectively in 1975 and 1994 as secondary species in fish ponds, contributed 44 tonnes and nil in 2009 (AOAD, 2010).

6.4.1.3 Fish farming systems

As to production systems in 2005, pond culture predominates with a production volume of 88 percent, while cage culture in big reservoirs and culture-based fisheries (CBF) in small barrages contribute to aquaculture tonnage at 10 percent and 2 percent respectively (Krouma, 2006b). These proportions can, more or less, reflect the production values thereof.

With the exception of the few governmental fish farms that use pelletted fish feed, private fish farms depend on barley, wheat bran, cotton seed cake and different inedible cereals. In cases of feed shortcomings, slaughterhouse by-products, illegally, find their way to private fish ponds. Cage culture is carried out solely with common carp being fed with pelletted feed. In culture-based fisheries, common carp coming from restocking dominates the wild Cyprinids and Cichlids. Productivity of barrage lakes is rarely enhanced by inedible cereals or different by-products from the feed industry. Aquaculture productivity, accordingly, varies from 0.3-0.8t/ha/year in culture-based fisheries in barrages, to 4-16t/ha per season of 7-8 months in earth ponds and 20-35kg/m³/8-10 months in cages (Krouma, 2006a).

Except for cage culture of common carp in medium to big size cages of individual size of 160 or 300 m^3 and state owned earth fish farms, aquaculture enterprises are considered small scale (FAO, 2012). The majority of private fish farms being comparatively small (0.5-5 ha). Nevertheless; these provide a good living standard in comparison with other agricultural activities.

6.4.1.4 Inputs required

Knowledge is necessary for responsible sector management, starting from sponsoring authority level and ending with direct day-to-day farm management. Multilateral expertise is needed for the promotion of aquaculture in the STEU-Basin. Priority areas could be collective planning and management, sustainable use of resources, aquaculture environmental approach, sector-monitoring,

collecting of information and training of final beneficiaries. Training programmes, therefore, are badly needed, especially for national managers, trainers and field extension officers.

Land to be allocated for aquaculture, till few years before, was generally expected to be of minor importance to agriculture, such as being rocky, swampy or saline. Nevertheless, this was not compulsory if the owner decides to construct a fish farm on his own property. In 2007, MAAR categorized agricultural lands in five categories up to their fertility and exposure to precipitation or to availability of neighboring water resource. Up to this classification, the upper two categories are to be exclusively used for plant production, the third category needs extraordinary permission for other uses, whereas the forth and fifth categories could be used for setting up animal production units, including aquaculture. The said regulatory procedure appears to have been issued prior to sufficient discussion with relevant MAAR departments. Evidently, adjacent water source is not a pressing need for some animal production projects much as for aquaculture, for the latter of which the concomitance between land and water cannot be simply ignored. Unfortunately, when such basically needed land-water integrity seems to be available, the said new regulation excludes aquaculture. This issue remains to be deeply discussed with MAAR for eventual reconsideration.

Water allocation is the most critical issue that limits the possibility of setting up new fish farms. Drought is known to be a common phenomenon for the Near East including Syria. Water withdrawal, in most cases, exceeds water regain. The Ministry of Water Resources, previously named The Syrian Water Authority and before that the Ministry of Irrigation, has always given priority of water use to agriculture for the irrigation of plants. The water need for aquaculture was considered as unauthorized water use. Notwithstanding, in the context of drafting the licensing regulations of 1991 for aquaculture activities, (see Aquaculture legislations), the permission of water authority for water use was normally set as prerequisite. Such permission is supposed to figuratively identify the quantity of water allowed to be withdrawn, and the licensing system sets a balance between permitted water quantity and underwater pond area. This is generally 4 liters/sec/hectare, while in swampy and marshy lands it is 2 liters/sec/hectare. The underwater pond area to be licensed is calculated accordingly. Luckily, the majority of existing fish farms, located in Al-Ghab Valley, the once Al-Ghab Swamp, were initially based on the use of drained water. Presently, water saving culture systems are expected to meet the needs of agriculture, including animal production and aquaculture. Integrated aquaculture systems; IAA, IIA and FFP, the concepts that have been lobbied for by DOF over the past two decades, are advised to be widely adopted for rational use of the scarce water resource. The STEU-Basin is not an exception where integrated aquaculture systems are expected to be seriously considered for further expansion in national fish production.

Seedling material is also an essential expansion prerequisite. On-going fish propagation in private and state-owned fish farms is mainly based on oriented natural spawning. Two cases are exceptional; a) the small hatchery built by GEF in collaboration with Korean experts in Al-Ghab Vally in 1970s for the propagation of grass carp, and b) the hatchery built by DOF in the context of IFAP close to the city of Deir Ez-Zor in 1994 for grass, silver and common carp spawning in support of aquaculture expansion in the STEU-Basin. Unfortunately, owing to the unexpected displacement of DOF hatchery and the construction of a new one in Deir Ez-Zor, the production of fingerlings has recently diminished. The fry production from the old hatchery, that were grown up in some ponds of the new hatch which is still incompletely functioning, equaled to circa 22 000 fingerlings of silver carp and 414 000 fingerlings of grass carp.

Currently, there is an estimated demand for around 5-6 million common carp fingerlings of an individual weight of 20-50 grams. For the cage culture of carp, larger size fingerlings of 35-50 grams are selected. Tilapias have never been artificially propagated, but undersized fishes were usually wintered for seedling material. Around 20-24 million small tilapias of 3-60 g are estimated to be required for meeting the present tilapia production.

Fish feed composition is not always adequate to meet the needs of the cultured fish. Up to the availability of cheap raw material at the time of pellet manufacturing or at the time of direct use for feeding, the fish feed quality or the feed conversion rate (FCR) varies. Therefore, the FCR for pellets manufactured locally has always been rather high over the past 35 years and varies between 2.1-5.7, with an average of 3. The use of pelleted feed is restricted to state owned farms contributing around 10 percent of national aquaculture production. Private fish farms use raw material such as barely, wheat bran, and cotton seed cake. In seasons of feed shortage, slaughterhouse byproducts used to be cooked and fed to the fish. This practice was soon banned and the establishment of slaughterhouse-byproduct processing plants was encouraged.

Fish medicines specially manufactured for fish treatment are not yet available. General antibiotics, anti-parasite and disinfectants are being used.

Fish farming equipment excluding nets are generally locally manufactured. As to cage culture system, the cage body is constructed from iron and timber, or sometimes irrigation hoses are used. Ad libitum feeders are also homemade.

6.4.1.5 Land ownership

State owned earth fish farms are basically constructed on state properties or on by-the-state appropriated properties. Whereas licensing of private fish farms necessitates an ownership document or a legal leasing contract of the land area in question with the application. As to cage fish culture, the ex-GEF, up to its establishing decree, had the authorization to make use of water bodies for self-exploitation for both fisheries and aquaculture. Private cage culture, up to the prevailing licensing system, requires collective approval from fisheries, environmental, local and water use authorities. It is because of the difficulty of obtaining such collective approval that, hitherto, no private cage fish farms have been established.

6.4.1.6 Spatial distribution

In accordance with the availability of land and water resources suitable for aquaculture, the spatial distribution of existing pond fish farms appears to be mainly confined to the Mid-west of the country. That is to say primarily in Al-Ghab Valley in the Governorate of Hama, where first pilot training fish farm was built (1957), and secondarily in the Governorate of Homs on the Orontes Basin midway between Damascus and Aleppo. There are a few other pond fish farms in the other Governorates around the country.

The first experimental cage farm was constructed in Al-Assad Lake in 1975. Presently, only two cage culture sites exist on state owned farms: Al-Assad Lake in the Governorate of Raqqah and Tishreen Lake close to the coast in the Governorate of Lattqia (Figure A6.7).

Figure A6.7 Spatial distribution of fish farms in Syria.

The STEU-Basin witnessed the introduction of four fish farming systems new to Syria:

- cage culture system in 1975
- well-organized culture based fisheries in 1989
- fish farming in drainage canals in 1994
- pond aquaculture as remedy for rehabilitation of saline lands in 1994

The STEU-Basin presently contributes 70 percent of national cage culture output, while on the contrary, pond aquaculture is still to establish itself therein with an estimated present contribution of no more than 5 percent. For culture based fisheries, the relative importance of areas differ widely on an annual basis up to precipitation and availability of water bodies. Both fish farming in canals and in saline lands have been proved as feasible concepts but still at their initial stages. However, the STEU-Basin represents the most promising potential for expansion in all fish culture systems and new concepts mentioned.

6.4.1.7 People involved

Almost 1 760 labourers are currently estimated to be engaged full-time in aquaculture activities, mainly fish farming. If CBF in surface water retention lakes is taken into account, another 90 labourers can be added. Other seasonal activities, directly related to aquaculture, such as disinfection of ponds, harvesting of fingerlings, stocking, experimental fishing, harvesting and pond maintenance, as well as indirectly related activities; manufacturing of feed, machinery maintenance, avail additional employment opportunities on a part time basis to approximately 1 100 labourers.

Field workers in the state owned farms are usually in the range of 18-60 years of age and are all males. These do not exceed 200 people out of the total mentioned. Whereas private sector has neither lower nor upper age limits; all male children are partially engaged during school season and fully engaged in

summer seasons. Females are rarely engaged in pond fish farming, while in CBF they are, comparatively, more active.

Initially, the educational level of pioneer fish farmers was elementary. Their successors have achieved higher levels of education, in some cases a university degree. Notwithstanding, people involved in aquaculture in STEU-Basin can hardly acounts for 5% of those at the national level.

6.4.1.8 Water quality

In term of farm location, the licensing system requires certain criteria to be checked prior to issuing preliminary permission for setting up a fish farm. Some of these criteria consider water quality as follows:

- Water supply source should be clean, not receiving untreated sewage, toxic industrial or fuel discharges for a minimum distance of 2 km in stagnant water or upstream in running water from the water inlet of the planned farm. In suspicious cases, the approval of public health authority, based on the nature and concentration of pollutants compared to size of recipient, is needed.
- The water outlet of the planned farm should be at least 1 km distance from the inlet of a downstream existing fish farm. The same applies for the distance between the water inlet of the planned farm and water outlet of an upstream existing fish farm. This minimum distances can be reduced by half if the water supply resource is a permanent running water body with a minimum water discharge of 5 cm^3/sec.

The same criteria apply to cage fish farms planned to be constructed in inland water bodies.

6.4.2 Processing

National aquaculture products are totally consumed as whole fresh fish. Limited supply relative to a high market demand does not justify any fish processing plant.

6.4.3 Trading and marketing

Simple marketing chains, from producers through contractors to markets, do not preclude side or direct trade between producers and retailers or even consumers. Approximately 75 percent of aquaculture products from the Mid-west (the Ghab Valley) are usually consumed in the cities of Hama (50 km), Homs (60 km), Aleppo (150 km) and Damascus (230 km). Products from scattered fish farms are mainly marketed locally in their governorates. Starting from late September, contractors make deals with producers for marketing their products. Based on a daily basis fish ponds are successively drained and harvest is graded, put on ice and carried away by contractors. The infrastructure of fish marketing chains mostly suffers of scarcity or insufficiency of covered and well insulated or cooled containers. In the past ten years, some traders tended to market the fish alive, carrying the fish in aerated cistern to be placed in big glass aquaria for marketing. This has attracted further fish consumption, achieved higher price and is being practiced on wider scale.

Aquaculture marketing, i.e. transportation of inputs and outputs and fish trading sustains round 700 jobs on a part time basis.

6.4.4 Institutions

6.4.4.1 Sponsoring authority

Aquaculture and fisheries are sponsored by the same authority. This has been discussed under section Fisheries institutions6.3.4 in this paper.

6.4.4.2 Cooperatives

Most of private fish farmers in the Ghab Valley have in the early 1990s coordinated themselves in a reasonably powerful cooperative. This was driven by the need for feed, whose distribution in the years of feed scarcity was more easily accessible by cooperatives. The cooperative is led by a board of major fish producers known to be of high social rank. Another advantage of the cooperative is the coordinated plan of marketing the tilapias in the valley before the cold spells. In the 1980s and 1990s, there were significant loses of up to 60 percent in tilapia production in the valley owing to sudden or early drop in water temperature.

6.4.5 Other livelihood information

6.4.5.1 Financial services

The rules of the ACB restricts its financial services to aquaculture cooperatives. Loans are also granted against the guarantee of the cooperative and not private properties. As a result, all fish farmers do not qualify for this advantage. In the context of his efforts to secure financial services to new entrants to aquaculture, DOF convened several meetings with ACB after which a draft was prepared to revolve medium and short term loans for peasants willing to practice aquaculture in drainage canals. This was to facilitate setting up screens in the canal and paying for fingerlings and feed respectively. The amendment to the ACB law has yet to be issued.

6.4.5.2 Interactions with other sectors

Fish ponds can be harmful to other sectors if their water discharge inundates agricultural lands or introduces toxic or excessive organic loads to the environment. However, under the prevailing shortage of water along the past four decades, fish farms could hardly fill their ponds and compensate for seepage or evaporation. Most farms do not discharge water at their outlets. Luckily, chemicals and medicines are also rarely used. On the other side, competition on water use with agriculture always ends up with prioritizing agriculture.

Cage culture is regarded as a potentially polluting activity and water authority generally refused to grant permission to private investors willing to start cage culture activities in open water bodies.

When feed shortages were prevailing, other animal production sectors were given priority, while fish was considered as capable of grazing the natural food production in the water. DOF invested sufficient effort to convince decision makers that the issue is not to let the fish survive but to secure its growth to the economic size in a given time span.

6.4.5.3 Livelihood diversification

Fish farmers, in general, are landlords coming from agriculture and thus agricultural activities continue to occupy certain extent of their lands, financial capabilities and efforts. This diversification helps overcome seasonality of income and makes better use of manpower. Comparatively, most fish farmers have good living standards, which is not the case for many of those involved in capture fisheries.

6.4.5.4 Climate changes in past decades

Climate changes in the past decades, summarized under point 2.5.4, has impacted aquaculture activities. Comparatively early seasosnal warming has prolonged the growth season and is somehow expected to have contributed to fish weight gain. On the contrary, when accompanied with drought and shortage in water supply, the replenishment of the pond water has dropped to minimum with all accompanying biological, limnological and pathological consequences. These were manifested in lower growth rate, lower FCR, malformations and higher mortality rate. Additionally, the short autumn and sudden drop in temperature has become a critical factor threatening tilapia culture. Sudden cold spells have evoked mass mortalities in tilapias on several occasions.

6.4.5.5 Man-made changes in past decades

In the mid 1980s, MAAR started to apportioned full feed needs for fish farms. This was based on classification of farms into extensive, semi-intensive or intensive fish culture system. The classification was made by DOF in collaboration with the General Establishment of Fodder and the Union of Peasants and based on field checking on water availability, experience of fish farmer and previous records achieved. This initiative have promoted many farms and brought their productivity up to 3-5 tonnes/ha, 6-8 tonnes/ha and 12-15 tonnes/ha in extensive, semi-intensive and intensive fish culture system respectively. Up until the drought and shortage of water and feed that started in late 1980s and badly increased in the 1990s, some 10-15 percent of former fish farms were scaled out during the past two decades.

6.4.5.6 Main constraints to aquaculture production and livelihood development

Syrian aquaculture sector has been and still faced with many constraints, the most important of which are as follows:

Knowledge constraints

- Scarcity of expertise in fish spawning, feeding and more importantly in fish diseases.
- Lack of regular updating of biological and/or limnological indicators and criteria needed for proper management.
- Insufficiency of research on fish health and prevailing diseases or pests. This explains the lack of prophylactic measures or programmes.
- Limited participation of Syrian aquaculture officers to training or technical workshops.

Administrative constraints

- Exaggeration and reluctance of water authority in granting permissions for cage culture even in vast lakes.
- Hesitation of water authority in use of irrigation and drainage canals in aquaculture.

Environmental constraints

- Shortage in feeds that leads to the use of illegal slaughterhouse byproducts might threaten aquaculture activities.
- Fish from aquaculture, following the introduction of slaughterhouse byproducts, has begun to lose its good reputation as a clean and healthy product.

Marketing-infrastructural constraints

- Scarcity or insufficiency of covered well-insulated or cooled containers.
- Delay in marketing of tilapias might end up with mass mortality if cold spells come earlier than usual.

Livelihood constraints

- Fish farmers, under the a.m. pressures, are still susceptible to losing their income as a result of low quality feed or sudden mass mortalities.

6.4.6 Legislation and policy

6.4.6.1 Aquaculture legislations

In harmony with the public laws in force, the activities of fishery sector are governed by the following major laws and regulations:

- **The Law on Protection of Aquatic Life** (Legislative Decree No. 30 of 1964), the content of which has been identified under6.3.6.1 6.3.6.1 in this paper in section 6.3.6.1.
- **Resolution on Regulation of Fish Culture and Licensing of Fish Farms** (No. 12/t of 1991), sets legal and technical criteria for licensing different types of fish farms; conventional pond,

land-based marine fish farms, inland and marine cage culture, closed fish farms using re-circulated water system, valiculture and fish culture in irrigation water reservoirs in agricultural lands (MARR, 1991b).

- **Resolution on Regulation of Farming of Aquatic Organisms Other than Finfish** (No. 8/t of 2004), sets criteria for licensing the farming activities of aquatic organisms other than finfish; bivalves, frogs and aquatic mammals and reptiles (MARR, 2004).
- **Regulations on culture-based fishery** (of 1991), identifies conditions for leasing of small surface water retention lakes for culture based fishery (MAAR, 1991a).
- **The National Strategy and Work Plan on Biological and Ecological Diversity** (officially endorsed by the Syrian Government (2001)

6.4.6.2 Aquaculture policy

The policy set by DOF for aquaculture development is expressed in two points:

- Promote sustainable and environmental friendly aquaculture in inland and marine waters.
- Integrate aquaculture with agricultural and irrigation activities whenever and wherever possible.

6.4.6.3 Aquaculture management initiatives

Initiatives made in the past two decades have helped to organize new fish culture systems that would make use of natural productivity in barrage water, and shed light on the pressing need for adopting some new aquaculture concepts under the prevailing water scarcity. The following points highlight some of main initiatives carried out in this respect:

- Setting up a leasing system of small surface water retention lakes (≤50 ha) for CBF. For a period of five years, and under the supervision of FFS, the tenant can stock the lake and, starting from the 2nd growth season, can fish oversized fishes. Banning (natural spawning) season is to be strictly respected.
- Introduction of exotic species, such as Chinese carp and silver carp, and new strains of existing grass carp and common carp for increasing aquaculture output based on natural productivity and refreshing blod.
- Establishing experimental hatchery for induced spawning of Chinese carps.
- Investigating the feasibility of aquaculture as remedy for exploitation or reclamation of salinised lands in a so called “aquaculture-crop culture rotation”.
- Investigating the feasibility of aquaculture in maintainance of irrigation and drainage canals in experimental segments.
- Establishing pilot fish farms in private properties in the STEU-Basin and supplying them with fishpond-designs, stocking material and follow up in an attept to promote aquaculture in the area that did not know other source for fish than fishing.
- Training and Extension services on aquaculture basics.

6.4.6.4 Policy implementing and enforcing body

As aforementioned for fisheries, aquaculture subsector management had been the responsibility of DOF for the period 1986-2009 after which the new GCFR took this responsibility over.

6.4.6.5 Legislation affecting aquaculture activities

Aquaculture, which seems to be the most promising potential area for further fish production and an attractive option for investment, is indirectly hampered by some extra-sectorial driving forces. Expansion in cage culture and culture based fisheries, as well as initiation of fish farming in irrigation canals encounter exaggerated reluctance lest water pollution or harming the canals. DOF long-term negotiations with the Ministry of Irrigation hoped to bring about realistic understanding of the need for

rational water use and the importance of environmental friendly aquaculture systems, but this has yet to yield results.

6.4.7 Development and capacity building projects

Past initiatives were highlighted under section 6.3.6.3. Whereas, current initiatives are expected to be officially declared by GCFR. With regards to capacity building in aquaculture, and owing to financial shortages, there has been no special government training project. Training opportunities offered by pertinent organizations were, for the previously given reasons, partially utilised. Nevertheless, an extraordinary training opportunity was comparatively undertaken by IFAP in the period 1993-1998.

6.5 Recommendations for interventions

The STEU-Basin appears to be an area rich with natural or manmade resources, that are irrationally, insufficiently or inefficiently exploited. This is displayed in the following manifestations:

- Around 8.34 million people, corresponding to over 40 percent of the Syrian population, live in the STEU-Basin of 94 500 km^2 (CBS, 2011) or 51 percent of total land area of Syria with a density of 89 people per km^2. With a gender ratio of 1:1 and a total fertility rate of 2.85 children born/woman, the annual growth rate of population equals to 2.45 percent (CBS, 2011). The population, of which 37.1 percent are ≤14 years old or below working age and 65.6 percent are ≤29 years old (CBS, 2011), is classified as young.
- Living standards are generally low and unemployment, not to mention seasonal or masked unemployment, is comparatively high. The total activity rate comes up to its peaks (50-57 percent) in the age categories between 25-54 years (CBS, 2011). Dependence on female labour in agricultural activities and rural households is a common phenomenon that imposes higher pressures on rural women, while male manpower is moderately engaged. Internal migration from rural areas towards major cities and the capital, despite its recent decrement, is still evident especially in the younger generation, leaving behind aged communities in rural areas.
- Fishing activities are conventional and small scale (Krouma, 2006b). Fishers in the river are usually traditional, while in dam lakes are ex-land farmers whose properties have become inundated. Inland capture fisheries have mostly ranged along the past 25 years from 25-35 percent of total fish catches with only three peaks of 41 percent (FAO, 2012) and a general average of 31.6 percent. Fishing capacity is high enough and believed to have exceeded natural productivity of most fisheries (Krouma, 2006b).
- The Euphrates River, over the past four decades, has been subjected to augmenting environmental and biological pressures. These have originated from urbanization, intensification of agricultural and industrial activities, fossil fuel excavation and installations and massive water works. Hygiene, biological and environmental consequences have gradually emerged threatening human health, eco-diversity and biodiversity. The giant barbel *Luciobarbus esocinus*, one of the largest freshwater fish species, locally called Farkh with a Syrian record of 220 kg (IFAP, 1999), has retreated to the Euphrates downstream east of its confluence with Al-Khabour River. Juvenile giant barbel's have no longer been seen. The beautiful leopard barbel *Barbus subquincunciatus* has almost totally disappeared in catches (IFAP, 1999). The Rumi barbel *Barbus grypus* and *Mesopotamichthys sharpeyi* have become highly threatened owing to damming, absence of spawning grounds and/or fish passes (IFAP, 1999). Noteworthy is that the first and third species are endemic to the Euphrates-Tigris Basin and thus are treatened with eventual extinction.
- It is worth noting that the exotic common carp *Cyprinus carpio* has efficiently established itself in all freshwater systems in Syria. In the "Euphrates" system, common carp has been grown for the past four decades in cages in Al-Assad Lake where undersized fingerlings have sneaked to the open waters, or cage stocks escaped from dismounted cages subjected to strong winds and/or high waves.

- Illegal fishing threatens aquatic eco-diversity and biodiversity while overfishing and off-season fishing threaten natural fish stocks (Krouma, 2006b). Big and easy harvest of detrimental fishing practices together with inefficiency in enforcement of legal preventive measures allured immoral newcomers to join fishing activities. This has forced out many traditional fishers. Some fish species were reported to have disappeared in catches while others are only met as aged mature specimen but do not appear as juveniles.
- Efforts invested by fisheries authorities to monitor fishing activities, delimit fishing capacity, ration random expansion of fishing and put an end to detrimental and illegal fishing have considerably impeded deterioration of fish stocks in STEU-Basin. Nevertheless, the single reserve area that was feasible to establish and control was declared in mid 1990s in the small 3 km long branch of the Euphrates River within the close center of the city of Deir-Ez-Zor. This area is certainly unable to secure calm and peaceful reproduction area sufficient to enhance natural riverine fish stock. Further efforts in term of monitoring, control and establishing more and spacious reserve areas are essential for protection and enhancement of aquatic life in STEU-Basin.
- Modern aquaculture, having started in late 1950s and expanded in 1980s, soon surpassed the marine and inland capture production (Krouma, 2006a) and kept a range of contribution to national fish production of 40-55 percent over the past 25 years (FAO, 2012) with an average of 48.4 percent. It is practiced in fresh waters and is currently restricted to warm water fishes, mainly carps and tilapias. All the three prevailing culture systems face difficulties in expansion. Semi-intensive pond culture faces severe restrictions in water allocation. Cage culture is met with exaggerating concerns by the water authority, while culture based fisheries in barrage lakes is declining as a result of drought.
- Despite being still in its initial stages and hampered by the above constraints, aquaculture, particularly the newly investigated production systems, appear to be the most qualified activities for increasing fish production in the STEU-Basin. Almost all pilot activities have proved to be feasible and promising. The four aquaculture systems, introduced and investigated therein, revealed to be of high economic return and/or of multilateral positive social and environmental impacts. Nevertheless, these integrated aquaculture systems; Integrated Aquaculture-Agriculture (IAA), Integrated Irrigation-Aquaculture (IIA) and Family Fish Pond (FFP), are still unable of establishing themselves. Several opportunities for investments in responsible and integrated aquaculture systems do exist but are, up to prevailing regulations, inaccessible and sometimes refused or neglected.
- One-sided resource management approaches are still dominating. Most enforced laws are unilateral and tend to legitimate a specific single use of resources. This does not give implementing authorities any room for flexibility in resource allocation, even if they are convinced of the feasibility or multilateral benefits of newly proposed management approaches. This is mainly attributed to the fact that a certain law is drafted mainly solely by the pertinent sponsoring authority, which is normally cautious about its obligations and responsibilities but not about potential side interests or other resource users. In addition, integrated river basin management (IRBM) approaches are not practiced, that would help to diversify opertunities and increase security.

Based on that, intervention areas are numerous but of different natures and variable approaches.

6.5.1 Enhancing livelihoods

Fishing activity is one of the principal activities of rural communities in the STEU-Basin and the major activity on the banks of the Euphrates and Khabour Rivers and shores of lakes. Inland fishing communities are known to be of the lowest living standard, fish farmers of better standard while manpower from the marketing sectors usually earns higher income against less effort. Enhancing livelihood starts with sustaining the activity itself, the sustainability without which any promotion initiative is doomed to fail. To get closer to sustainability is a matter of responsible management which is discussed under section 6.5.2.

6.5.1.1 Protection of aquatic life

It is inevitable to stop breaching fisheries laws and laws on protection of aquatic life or aquatic and wetlands environment. This is rather a matter of national sovereignty and supremacy of law than being an issue to discuss in technical papers. Essential is to realize that slackness in law enforcement, particularly when detering fishing, soon leads to serious environmental and biological consequences, that end up in the long run with a point of no return, i.e. desertification of resources.

Monitoring of fishing activities, checking on fishing gears upon vessels sailing and on catches upon landing, onshore and in water patrols are essential field measures. Imposing legal punishments for illegal behaviors are also essential legal measures to strictly follow. However, persistent social, conscientious and technical guidance aiming to promote self control and raise self commitment amongst fishers is more likely to minimize illegal fishing. Further motivations; such as fee exemptions or "Legion of Honor" for fishers with no antecedents, have proved and are expected to encourage further self respect and social prestige.

Fishers' associations and cooperatives should also have a responsibility for the protection of aquatic life. Fisheries associations and cooperatives should also be responsible for environmental and fish stock safety. Their role in self monitoring and securing the responsible behavior of their members is necessary for sustainability of their livelihood. The reduction of illegal fishing activities indirectly contribute to increasing fish harvest and consequently enhances livelihoods. This remains to be a common responsibility and a mutual target firstly of national educational authorities; fisheries, mass media and secondly local administration, police and legal authorities.

6.5.1.2 Fishery subsidies, tax incentives and funds

The income of traditional and small scale fishermen is of a day-by-day nature. The off-season always represents a period of hard living that can encourage illegal fishing behavior. Subsidies are, therefore, always welcomed in such critical seasons. Subsidies may be funded by the government as a reward for the contribution in protection of aquatic life and guaranteeing resource sustainability. This has proved to be economically and environmentally feasible in many fisheries worldwide. It is important to stress that the protection of nature, healthy fish stocks, sustainability of fishing harvest and self-supporting fishing communities are important and basic responsibilities of governments.

Sponsoring authorities can also promote environmental friendly behavior. Promotions could be offered in several ways, one of which is the environmentally friendly taxation system (EFTS). This implies proportional exemptions on licensing taxes or fees as a reward for a certain action of positive environmental impact.

Fishers also regularly need overall maintenance of vessels, replacement of fishing gears and/or other eventual or accidental needs. Seasonal or instant financial needs of fish farmers, as well, can be costly. Such expenditures often exceed the instant financial capabilities of fish producers. A fishery circulated revolving fund could be established with a given capital to cover the needs of fishermen and fish farmers in the shape of short-term or mid-term loans against a symbolic interest of, say, 1-3percent per year. The set interest should only be envisaged to cover the expenditure of running the fund itself plus a tiny profit margin to compensate for economic inflation. A special system for prioritizing applicants should be adopted and implemented. The fund may not necessarily be governmental but also vocational associations, cooperative or even joint fund. Fishing or fish farming associations and cooperatives are advised to furnish such services to their members.

A fishery pension fund could be established to disburse financial or in-kind monthly contribution to retired fishers. Such a fund could be established by an association or cooperative of fishers through which their catches are marketed. The fund could be financed by proportional shares of fish selling materialized by the members themselves. These deposits are to be exploited by the association or cooperative and later on be paid back on monthly basis.

6.5.2 Improving fisheries and aquaculture management

The inland capture fisheries, including fisheries in the STEU-Basin that has continuously ranked first in national catch size, seems to have reached its utmost production capacity or even exceeded it. Capture fisheries in the STEU-Basin usually contributes over 90% of the total national inland capture. Fisheries promotion initiatives can be rather foreseen in practicing integrated and responsible management of the resource than increasing fish production thereof. Rehabilitation of fishing environment, declaration of aquatic life sanctuaries, stock enhancement and rationalization of fishing are areas to be fortified in this respect. However, despite being highly qualified for expansion in various aquaculture systems, the STEU-Basin continues to be slightly exploited in aquaculture activities.

6.5.2.1 Integrated river basin management approach

River basins are spots of interest for several sectors; agriculture, industry, transport, construction, urbanization, tourism, sport, recreation, irrigation, power generation and fisheries. River basins are also dynamic over space and time, and any single management intervention has implications for the system as a whole. Aquatic environment and consequently fisheries, the most fragile sectors, can be seriously affected by activities of other sectors unless such activities were planned in a participatory manner and precautionary measures were taken. Similarly, efforts for sustaining or rehabilitating natural habitats and stocks might not bring about expected results if not coordinated with other stakeholders.

Integrated river basin management is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems (Kolars, 1994).

6.5.2.2 Rehabilitation of aquatic environment

The Euphrates River and its tributaries and dam lakes receive sewage water from surrounding urban areas. The river discharge is comparatively opulent and the lakes' storage capacities are massive that helps to minimize the resulting high biological oxygen demand. Nevertheless, pathogens, parasites, germs of contagious diseases, domestic disinfectants and detergents remain harmful to human health, aquatic environment and aquatic life. Drainage of fertilized agricultural lands, fossil fuel pipelines together with the small scale industrial activities add more environmental pressures in the STEU-Basin.

Eliminating harmful impacts of discharge of sewage and other pollutants needs to be given high priority by the government. Sources of high discharge levels and/or dangerous pollutants should be identified and treatment plants are advised to be set up or precautionary measures taken accordingly. Feasibility studies on investments for such installations are expected to take into considerations not only economic considerations but health, environmental, biological and most importantly sustainability of resources and socioeconomic values.

6.5.2.3 Re-establishing free fish movement

Damming processes have segmented the Euphrates River to create massive lakes that have brought about physical barriers to fish moving along the rivers. Created dam lakes have gradually developed into almost isolated stagnant water environments unsuitable for biological and environmental needs of riverine species. Euphrates fish species, reported to have totally or partially disappeared in catches, might have become unable to reach their spawning or nursery grounds. The remaining real riverbed with freely running water is currently restricted to the segment stretching between Ar-Raqqah City and the closest dam lake to the east of Syrian-Iraqi border. This river segment might be the last resort for riparian fish species to survive. Therefore, the Middle Euphrates needs further attention, environmentally and biologically, for mitigating the complicated consequences of huge water works.

Fish passes might be essential for connecting partitioned river segments and re-establishing previous upstream-downstream free fish movements. This is worth serious biological consideration and specialized technical designs based on sufficient investigations on peculiarities of constructions of dams in question.

6.5.2.4 Aquatic life sanctuaries

Economic fish species have been on a progressive decline over the past four decades. Detrimental fishing practices have had played a role in the diminishment of natural fish stocks (Krouma, 2006b). The exotic common carp, introduced in mid 1970s into Al-Assad Lake for cage culture, has gradually established itself and become one of major species both in the lake and the river itself. Three native barbels have almost disappeared in catches and may now be unable to reproduce (IFAP, 1999).

Sanctuaries or reserve areas are believed to help gradual re-establishment of endangered fish stocks and constant supply with juveniles. Reserve areas should be spacious enough and rich with spawning and nursery grounds for economic and endangered species. Site selection requires technical consulatations with aquatic biologists and environment experts.

6.5.2.5 Restocking with threatened species

Four barbel species, two of which are endeminc to the Basin, reported to have almost disappeared in catches, are advised to be studied as to the possibility of their artificial propagation. Infrastructure needed is basically available in the Governorate of Deir Ez-Zor. Restocking is expected to enhance threatened stocks, but only if the environmental pressures that caused thier decline are removed or circumvented through the stocking programme.

6.5.2.6 Introducing lacustrine fish species

All freshwater fish species in Syria are riparian, including those caught in the lakes, having been more or less successfully adapted to lacustrine ecological conditions. Firstly inundated in 1974 and classified in 1976 as oligotrophic, Al-Assad Lake, with its deep central water mass doesn't provide a living milieu suitable for riverine fish. Currently, its productive area is restricted to its peripheral zone of less than four metres depth lining its shallow banks. Now that almost four decades have passed following the formation of the lake, it might have gotten closer to become mesotrophic.

Introducing lacustrine fish species into Al-Assad Lake would make use of its huge central and deep, so far, unproductive water volume estimated to be round 11 billion m^3 out of a total of 14.1 billion m^3. The accidental introduction of the exotic common carp that escaped from cage culture aquaculture mayhelp to increase the fishable productivity of this lake. In 1975 in the context of Al-Assad Lake fishery project, carried out by GEF in collaboration with GTZ, few specimen of the Northern pike *Esox lucius* were introduced and stocked in the lake in an attempt to establish a lacustrine species capable consuming low valued riparian species such as the Silver bream *Acanthobrama marmid*. Unfortunately, the Northern pike could not naturally reproduce and within a couple of years, all specimen stocked were individually caught. Selection of environmentally and biologically suitable lacustrine species to be introduced is a delicate issue and needs to be deliberately done. The introduction process should be cautious enough and in line with the FAO Code of Conduct for Responsible Fisheries.

6.5.2.7 Fishing fiefs

Fishers used to overfish a certain resource and move up- or downstream in search for other productive areas. Limiting license spatial validity to home governorate was inefficient as the fishing field was still too spacious. Presumably, within smaller fishing fields, a group of associated fishers would care for the stocks, practice self control and identify and repel IUU activities. Establishing real fishers' associations and allocating a fishing fief to each is worth serious consideration. A socioeconomic study on fishing communities and a scientific survey on various fishing areas in the STEU-Basin would be the baseline for dividing the Euphrates River into well defined segments in which fishing

rights be assigned to residing fishers' association. The permanent underwater segment of Al-Khabour River together with small artificial lakes could also be considered for fiefs.

6.5.2.8 Fish quota principle

The spacious Al-Assad Lake, impractical to be clearly segmented, might qualify for application of fish quota principle. A deeper knowledge of stocks, their sizes, dynamics and MSYs would assist with the management of quota principle. However, using the precautionary approach, quota systems could be introduced and the information base built up in line with the management of the fisheries. This is also to be accompanied with a network of landing sites and a well designed monitoring on catches and data registry system.

6.5.2.9 Integrated aquaculture systems

The STEU-Basin, rich with inefficiently exploited land, water and human resources, all slightly employed in aquaculture activities, is highly qualified for IIA, IAA and FFP production systems. Field experiments on feasibility of integration of aquaculture with irrigation system; in irrigation and drainage canals, saline lands, barrage lakes and in family fish ponds were much promising.

6.5.2.10Participatory management approach

The participatory approach to fisheries management entitles fishers to hold responsible for healthy fisheries and better protection of nature, consequently for sustainability of their livelihood. Under the absence of effective associations or cooperatives, the single fisheries management authority could not eradicate IUU fishing. Even periodical meetings and discussions held by DOF with fishermen and fish farmers, on the backgrounds of management actions and needs for specific decisions, appeared to be inefficient in evoking their feeling of being part of decision making. Incorporating fisheries and aquaculture communities in fisheries management and field control would help to ensure a smooth application of any new management concepts.

6.5.2.11Aquaculture services

Services to aquaculture sector are expected to be upgraded and continue the following:

- Monitoring and evaluation of ongoing production systems and the aquatic environment.
- Continuous investigation on potentials of neglected, unconventional and underutilized resources.
- Securing sufficient and appropriate aquaculture inputs; stocking material, feeds and medicines.
- Developing simple fish farming techniques / concepts and lobbying for implementing feasible concepts.
- Diversification of cultured species by establishing specialized hatcheries and investigating on opportunities for introducing local fish species to aquaculture.
- Supporting new comers with fingerlings, knowledge and incentives.
- Intensifying and expansion of aquaculture extension activities.

6.5.2.12Fisheries and aquaculture research

There has been little to no research on fishing and aquaculture activities on this river system, or how other interventions (damming, agriculture, industry, urbanization) interact with these activities. An understanding of the type of fisheries and aquaculture activities taking place, of the challenges and constraints faced by fishers and of the potentials for development and cooperation on the national level would be extremely valuable for consolidated research. This is to support the sustainable use of the national and regional fishery and aquaculture resources. Fisheries and aquaculture authority is expected to coordinate with national research institutions for identifying key issues for potential research plans that would meet development needs.

6.5.3 Enhancing processing and marketing

Fish processing has never been a pressing issue in STEU-Basin or generally in Syria. National production volume does not justify any processing activity. One exception could be processing of unsold tilapias before cold spells in the Al-Ghab Valley in the Midwest of Syria, which is out of the area coverage of this review.

Generally speaking, fish marketing in the STEU-Basin is functions reasonably well. Lack of cooled transportation means is not an obstinate issue to overcome. Important is keeping catches in suitable storage conditions while waiting few hours on landing sites before transportation to wholesale markets. Marketing agents usually keep landings in boxes covered with moist cloth with or without ice in tents. DOF has established well designed constructions on major landing sites on principal fishing areas. Those are designed for washing, sorting, scaling, icing and storing in cooling rooms until transportation. Unfortunately, cooling rooms have not yet been equipped with cooling equipments.
The most workable approach to secure fresh and healthy fish in markets is edification of consumer on how to identify fresh fish and to abstain from buying suspicious or spoiled fish. This would indirectly force wholesalers and retailers to devote more attention to quality and presentation of marketed fish.

6.5.4 Opportunities for cooperation at a sub-regional level

The Basin is the largest and most important river system between the Nile and the Indus. Activities upstream impact activities downstream and the fisheries sector is no exception.
Countries sharing the Basin are expected to pay special attention to it, as international natural resource, and reach mutual concepts on its resource management in a sustainable and environmental friendly manner. Possible opportunities for such cooperation at a sub-regional level are given below.

6.5.4.1 Sub-regional research coordination

Research on fishing and aquaculture activities in the Basin have more or less been carried out by the Basin countries. However, coordination among research institutions or joint understanding of the type of fisheries and aquaculture activities that take place in the Basi*n* and its consequences in the three countries was mostly lacking. A trilateral scientific research committee is advised to be established on the sub-regional level.

Scientific Research Committee (SRC), which would take over the following responsibilities:

- Plan for a comprehensive study and assessment of the fisheries and aquaculture activities in the Basin.
- Advice on researches needed to acquire more knowledge on potential impacts of various development and/or exploitation activities.
- Coordinate with specialized research institutions in the Basin countries for the adoption and in follow ups of needed and ongoing researches.
- Exchange of research activities and results through a joint network to be established for this purpose.

The committee is supposed to comprise high level experts in fisheries, aquaculture and wetland environment, preferably representing national research institutions and/or fisheries authorities.

6.5.4.2 Sub-regional IRBM approach

IRBM approach is advised to be agreed upon and implemented on sub-regional level in Iraq, Syria and Turkey, not only on the national levels but on mutual transboundary level. Countries involved are expected to establish a trilateral supreme council for IRBM of the Basin. The council is expected to comprise two principal committees:

Technical Advisory Committee (TAC), which would take over the following responsibilities:

- Considering planned activities in the Basin and advice on needed modifications or amendments that safeguard the environment and holistic interests of upper and lower Basin or minimize expected harmful consequences.
- Considering ongoing activities and advice on how to mitigate their harmful impacts on the long run on the Basin.
- Set precautionary preparedness and intervention strategies for eventual mismanagement of the Basin.
- Reflect on and validate research programmes proposed by SRC.
- Propose a mechanism for regular trilateral coordination.

Political Backstopping Committee (PBC), which would take over the following responsibilities:

- Lobbying for technical advices and convincing high decision makers in the Basin countries to adopt and put to practice advices furnished by the TAC.
- Consolidate creative national initiatives on the high political and administrative level.
- Validate the coordination mechanism proposed by the TAC.
- Worth mentioning that the WWF organisation is committed to facilitating IRBM processes in major river basins around the world, with an emphasis on biodiverse and transboundary basins, where the challenges to integrated management are often greatest. The WWF's freshwater ecoregion sourcebook outlines a method for prioritizing actions needed to conserve biodiversity within each river basin. This is advised to be carefully studied, reflect on its guidelines and put to practice what seems to be of national and sub-regional interest.

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APPENDIX 7: FISHERIES AND AQUACULTURE IN THE EUPHRATES-TIGRIS BASIN: IRAQ

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7.1 Introduction to the area

The Euphrates-Tigris Basin is an important facto in shaping the geography of Iraq to the extent that the country as a whole is shaped like a basin, outlining the alluvial plain of the Euphrates and Tigris river basin. In fact, the total area of Iraq is 438 320 km^2, of which more than 50 percent is comprised of the Euphrates and Tigris river basin, including the Shatt Al-Arab.

7.1.1 Hydrology

Within Iraq, several tributaries flow into the river coming from the Zagros Mountains in the east, thus all on its eastern bank. From upstream to downstream these are listed in Table A7.1

Table A7.1 Tributaries flowing into the Euphrates and Tigris Rivers

Name of Tributary	Origin	Flow
Greater Zab	Turkey	13.18 km^3/year
Lesser Zab	Iran	7.17 km^3/year (5.07 km^3/year after Dokan Dam)
Al-Adhaim	Iraq	0.79 km^3/year
Diyala	Iran	5.74 km^3/year
Nar at Tib, Dewarege and Shehabi	Iran	1 km^3/year
Karkeh	Iran	6.3 km^3/year

The Shatt Al-Arab is the river formed by the confluence downstream of the Euphrates and the Tigris and it flows into the Persian Gulf after a course of only 190 km. The Karun River, originating in Iranian territory, has a mean annual flow of 24.7 km^3 and flows into the Shatt Al-Arab just before it reaches the sea, bringing a largeamount of freshwater (Frenken, 2008).

The Euphrates flows into northern Iraq from Syria to the point where it meets the Mesopotamian alluvial plain at Al-Ramādī in Iraq. The Tigris, in contrast, enters Iraq at the Syria-Turkey border and is then fed by four strong tributaries, the Great Zab, Little Zab, ʿUẓaym, and Diyālā rivers, all of which derive their water mainly from snowmelt in Turkish, Iranian, and Iraqi Kurdistan.

In Iraq, the present quality of water in the Tigris near the Syrian border is assumed to be good, including water originating in both Turkey and Iraq. Water quality degrades downstream, with major pollution inflows from urban areas such as Baghdad due to poor infrastructure of wastewater treatment. Water quality of the Euphrates entering Iraq is less than the Tigris, currently affected by return flow from irrigation projects in Turkey and the Syrian Arab Republic, and expected to get worse as more land comes under irrigation. The quality is further degraded at such times as flood flows are diverted into off-stream storage in Tharthar and later returned to the river system. Salts in Tharthar are absorbed by the water stored therein. The quality of the water in both the Euphrates and the Tigris is further degraded by return flows from land irrigated in Iraq as well as urban pollution. The amount and quality of water entering southern Iraq from the Iranian territory is largely unknown,

although it is clear that flows are impacted by irrigation return flow originating in the Islamic Republic of Iran (UNDG, 2005).

Some 90 percent of the water and silt that pass Baghdad and Al-Ramādī, however, never reaches the Persian Gulf. The water either evaporates or is absorbed in the extensive irrigated areas and marshes, and the silt settles upstream from the Shatt al-Arab. The water and sediments in the Shatt al-Arab derive mainly from the east-bank tributaries, the Karkheh River and Kārūn River, which both rise in Iran.

A summary of the annual flows from Iraq into the Tigris is shown in Table A7.2.

Table A7.2Annual flow of the Tigris tributaries in Iraq.

Rivers	Length km	Annual flow km^3	% inside of Iraq
Khabour	160	2.20	42
Greater Zab	392	14.32	58
Lesser Zab	400	7.07	64
Awa Spi (AL- Adhaim)	230	0.70	100
Sirwan(Dyala)	386	5.86	41
Total Amount of Water		30.15	59.8

7.1.2 Geography and topography

Iraq has a total area of approximately 437 072 km^2 of which 98.9 percent is land and 1.1 percent is water. Iraq can be divided to four areas:

Sedimentary Plains (alluvial)
This region covers about 132 000 km^2 and was named sedimentary because of the large depositions of salt, sand and mud. The area is rectangular in shape and around 650 km in length and 250 km in width and extends from the north between the city of Balad on the Tigris River and the city of Ramadi on the Euphrates River to the Persian Gulf in the south, and from the Iranian border in the east to the desert plateau in the west, and includes the marshes and lakes some of which permanent and others seasonally including Hammar and Huweza. Historically this area formed part of Mesopotania.

Western desert plateau
This region covers about 198 000 km^2 with an altitude of 100-1 000 m. It extends west of the Euphrates to the Syrian, Jordanian and Saudi Arabia desert. The area is very dry most of the year, however, the rainfall in the winter can be heavy and sometimes causes floods.

Mountainous region
The mountainous region covers almost 134 000 km^2 and starts from southern Kirkuk - Hamrin mountains and extends eastward to Iran and to the west to Syria, and to north to Turkey. This region located in the northern and north-eastern part of Iraq. This area covers the common borders with Syria in the west, and Turkey and Iran to the north and east.

Terrain region
The undulating terrain region is between the Tigris River north of Samarra city and Euphrates River north of Hit city and extended to Syria and Turkey. It is a transition zone between low lying plains in the south and high mountains of the mountainous region in the far north and north-east of Iraq. The terrain region covers about 67 000 km2, of which 63% is outside the mountain region and has an altitude of 100-200 m, and 37 percent is lower mountains with an altitude of 200-450 m.

7.1.3 Climate

The Tigris and Euphrates make habitable and productive areas from one of the world's harsher environments. The region has a continental subtropical climate, with average temperatures greater than

32 °C in summer and less than 10 °C in winter, that is accompanied by great diurnal variations. Precipitation is light in the lower reaches of the Tigris and Euphrates but increases considerably at higher elevations in the north towards their source areas. In the higher elevations, where the rivers have their upper courses, winter winds are light and variable. Much of the precipitation falls as snow, which can lie in some places for half the year. During winter, the mean temperature in the mountains is well below freezing, so that agriculture ceases and communications are restricted. With the melting of the snow in spring, the rivers' flow increases. The mountain flow is augmented in their middle courses by seasonal rainfall, which reaches its peak between March and May. In the lower courses of the rivers in the alluvial plain, rain can be torrential in winter but usually does not exceed 200 mm per year. Rain is a welcome supplement to irrigation, which since ancient times has made possible the region's legendary agricultural richness.

On the Mesopotamian plain, the most characteristic climatic feature is the extreme heat of the summer, with daytime temperatures rising to average highs of around 45°C that often go above 50°C. Often, temperatures change by 22°C from day to night. Humidity in most areas is as low as 15 percent. Dust storms, which occur throughout the year, are especially frequent in the summer. Most wind-borne dust consists of particles of clay and silt mixed with minute fragments of shell, which are from a remnant dune belt that has been formed from abandoned irrigated fields and dried-up marshes in the area between the two rivers. Only occasionally are there true sandstorms, bearing material from the western desert.

7.2 Demographics

7.2.1 Population

Iraq's population was estimated at 32.57 million in 2012 of which is 34 percent rural (WorldBank, 2014) . The population has increased by 360 percent since 1947. This growth has occurred primarily through natural increase. Distribution of the population is in central and southern Iraq near the rivers, since people depend on the availability of water for drinking and agriculture use. , For this reason it is unlikely that population centres will form near areas with salt water. Small villages near the Tigris and Euphrates rivers typically have approximately 100 people. The Arab marsh people occupy the marsh areas in the alluvial plains and live a traditional life with their homes distributed on land areas scattered within the marsh. Houses are often made of reeds and papyrus on the land and moved by using small handmade boats. The Arab marsh people depend on fishing to provide food for their families.

Iraq's population has rapidly increased over the last 100 or so years. It has increased from two million in 1900 to more than 16 million people in 1987 and then to 22 million in 1997, and is now over 32 million. The population has increased by about 2.5 percent per year since 1900 as a result of improved economic and social conditions and health. The average population growth was estimated at 3.6% during 1980-1990, but emigration of foreign workers and severe economic hardships have reduced this growth rate since 1990.

Iraq's population is concentrated along the banks of rivers and canals on the plains, but is more generally distributed in the villages and towns of the northeastern uplands and mountains. Average population density is estimated at 75 inhabitants per km^2, but ranges from five inhabitants per km^2 in the western desert part of the country, to more than 170 inhabitants per km^2 in the Babylon province in the centre of the country. Population density is expected to reach 97inhabitants km^2 by the year 2025.
The greatest single concentration of population, about 50% of the total, begins north and west of Baghdad, sprawls westward and southward across the mid-Iraq interfluve, and then follows the Euphrates and its various branches along the west side of the alluvial plain to the city of Samawah. Metropolitan Baghdad alone has one-third of Iraq's population. The middle Euphrates concentration has a well-balanced economy, based on agriculture, industry, trade, and tourism. Secondary concentrations of population are found in the south, normally along Shat Al-Arab, with Basra as its largest city; in the north around Mosul; and in the northeast piedmont, around the oil developments in

Kirkuk and the ancient city of Arbil. The remaining parts of the country are comparatively sparsely populated, with some 65 percent of the population living in urban areas. A summary of the population by administrative area is given in Table A7.3. The age distribution of the population, and the male:female ratio based on UN estimates from 2006 is given in Table A7.4.

There are emerging centres of population in desert areas where there is newly exploited mineral wealth or the territorial rehabilitated areas. These densely populated areas often form along with the main rivers and streams. This means that alluvial plain is suitable and stable for about 73 percent of the population so as to facilitate good land investment and irrigation water. The density of the population has increased in areas along the Shatt al-Arab to more than 500 inhabitants per km^2.

Table A7.3 Population in Iraq by administrative region

Administrative region	Population
Baghdad province	6 702 538
Diyala province	1 397 717
Anbar province	1 483 359
Kirkuk	1 325 853
Salahuddin province	1 337 786
Nineveh province	3 106 948
Sulaymaniyah	1 784 853
Erbil Governorate	1 532 081
Dohuk governorate	1 072 324
Wasit province	1 150 072
Babil province	1 729 666
Karbala	1 013 254
Najaf	1 221 228

Table A7.4 Age distribution of population in Iraq

Age in years	Percentage of population	male:female ratio
0-14	37.6%	1:0.97
15-64	59.3	1:0.97
65 years and over	3%	1:1.12

7.2.2 Important migration patterns

Rural people require good soils and irrigation for growing crops, as well as the availability of good and easy transportation routes to the large consumer markets, especially the markets of Baghdad. There has been a tendency for rural people to migrate to the cities where employment conditions are believed to be better. The Marsh Arabs (the Madan) of the south usually live in small clusters of two or three houses kept above water by rushes that are constantly being replenished. Such clusters often are close together, but access from one to another is possible only by small boats. Here and there a few natural islands permit slightly larger clusters. Some of these people are primarily water buffalo herders and lead a semi- nomadic life. In the winter, when the waters are at a low point, they build fairly large temporary villages. In the summer they move their herds out of the marshes to the river banks. Before the Marshes were drained, the lifestyle of the Madan centered around agriculture, particularly cultivating rice and dates, weaving read mats, raising water buffalo, and fishing. A form of local commerce had developed involving mostly local trade, supported by the use of small boats for transportation. During the last two decades, and especially in the 1990s, the Madan have either migrated to settled communities away from the marshes or have been forced by government decree to relocate within the marshes. Similarly, settlement patterns in the northern Kurdish areas have been affected during the last two decades; as a result, rural Kurds flocked into the regional centes of Arbil and Sulaymaniyah.

7.2.3 Governorates of Iraq

Iraq is composed of eighteen governorates. The governorates of Arbil, Duhok, Sulaymaniyah in Iraqi Kurdistan are the only legally defined region within Iraq, with its own government, the Kurdistan Regional Government.

7.3 Land use

7.3.1 General land use

It is estimated that 11.48 million hectares, or 26 percent of the total area of the country, is cultivable. The total area estimated to be used for agriculture is 8 million ha, which is almost 93 percent of the cultivable area. However, due to high soil salinities, fallow practices, and the unstable political situation, it is estimated that only 3-5 million ha are actually cultivated annually, which is about one-third of the potential.

In 1993, the area actually cultivated was estimated at about 3.73 million ha, of which 3.46 million ha consisted of annual crops and 0.27 million ha consisted of permanent crops. Historically the most significant types of land use and food production in Iraq have been irrigated agriculture and pastoralism. Irrigated agriculture requires substantial investment and is an intensive form of land use, where as pastoralism, which requires relatively little investment and is extensive. These have been combined with dry land farming in the semi-arid areas of northern Iraq. Although these basic types are technologically very different, they have been closely interrelated socially and economically for thousands of years. Historical evidence shows some significant declines in production from time to time during the last five thousand years, but the causes (which appear in most cases to have involved a combination of both human and natural factors) have not been reconstructed convincingly. The old Mesopotamian systems, as well as the new ones in present-day Iraq, have gone through several cycles of growth and decline, Environmental problems in development generally derive not from basic technologies such as types of irrigation or grazing, but from the scale of the productive activity in relation to the resource. Before the first attempt to develop irrigation in modern-day Iraq, irrigation (which probably developed in its most primitive form not long after the domestication of plants and animals some ten thousand years ago elsewhere in Mesopotamia) had already served as the basis of vast agricultural projects, and had had environmental effects which seriously reduced productivity. The best known example is from Mesopotamia; it was generally restricted to flood plains and was seasonal, depending on the annual flooding of the Tigris and Euphrates. Perennial irrigation in Iraq, which requires storage and gradual release of the water through the period of minimum flow, is largely the introduction of the 20th century. Such irrigation has allowed major increases in areas under cultivation and intensification of cropping but it also magnifies the adverse effects of irrigation: soil salinity and water logging develop faster and some of the adverse effects are more difficult to reverse.

7.3.2 Agricultural activities

Agricultural production, which, at one time employed about a third of the workforce, is not sufficient to meet the country's food requirements. Iraq's chief crops include wheat, barley, rice, vegetables, dates and cotton. Crop production accounted for about two-thirds of value added in the agricultural sector in the late 1980s. Planting of the winter crops, which normally starts in the second half of October, is occasionally delayed due to inadequate rainfall early in the season. Production is also likely to be constrained by the serious shortages of essential agricultural inputs. For example, in 2001, in addition to the shortage of agricultural inputs, a severe drought and the widespread incidence of pests and weeds adversely affected cereal crops. Most farming in Iraq entails planting and harvesting a single crop per year. In the rain fed areas the winter crops, primarily small grains, are planted in the fall and harvested in late spring or early summer. In the irrigated areas of central and southern Iraq, summer crops predominate. Even with some double or triple cropping, the intensity of cultivation is usually on the order of 50 percent because of the practice of leaving about half the arable land fallow each year. In the rain fed region, land is left fallow so that it can accumulate moisture. The fertility of

fallow land is also increased by plowing under weeds and other plant material that grow during the fallow period. On irrigated land, fallow periods also contribute some humus to the soil.

The irrigation potential in Iraq is estimated at over 5.55 million ha (FAO, 2008), of which 63 percent is in the Tigris Basin, 35 percent in the Euphrates Basin and 2 percent in the Shatt Al-Arab Basin. The actual areas irrigated by surface water is estimated at 3.3 million ha, of which approximately two-thirds is located in the Tigris Basin.

7.3.2.1 Small Grains

Small grains, primarily wheat and barley, are Iraq's most important crops. Cereal production increased almost 80 percent between 1975 and 1985, notwithstanding the wide variations in the harvest from year to year as the amount and the timing of rainfall strongly affected both the area planted and crop yields. Between 1980 and 1985, the area under wheat increased steadily at a cumulative growth of 30 percent, to about 1 566 500 hectares. Up until 1990, domestic grain production accounted for only about 30% of total consumption, with the balance covered by imports. The estimated cost of food imports ranged from US$ 2-3 billion. Total consumption of cereals dropped from 6.694 million tons in 1984/1985 to 3.646 million tons in 1995/1996, and then increased to 5.356 million tons in 1997/1998 after the implementation of the Oil- for-Food Program. Almost 50% of cereals (3.254 million tons) were imported during 1984/1985, resulting in a per capita cereal food use of 191 kg/year. In 1997/1998, however, the corresponding Per capita consumption of cereals dropped from 191 in 1985 to 121 in 1998.

Production of wheat in the three Northern Governorates (Iraqi Kurdistan) is reported to have increased as a result of the increase in the use of fertilizer and pesticides which were distributed under the oil-for-food program. However, overall prospects for the cereal output remain uncertain in the Central and Southern Regions; mainly due to below average and unevenly distributed rains as well as shortages of essential agricultural inputs and the widespread incidence of pests, and weeds. Barley requires less water than wheat does, and it is more tolerant of salinity in the soil. For these reasons, Iraq started to substitute barley production for wheat production in the 1970s, particularly in southern regions troubled by soil salinity. Between 1980 and 1985, the total area under barley grew by 44 percent, and by 1985, barley and wheat were virtually equal in terms of area cultivated and total yield. In 1991, there were 200 770 ha of irrigated barley, with an average yield of 1.8 tons/ha, while the rain fed barley area was estimated at 323 730 ha, with an average yield of 1.3 tons/ha. 47 Rice, grown in paddies, was Iraq's third most important crop as measured by cultivated area, which in 1985 amounted to 24 500 hectares. The area under cultivation, however, did not grow appreciably between 1980 and 1985; the 1985 production totaled almost 150 000 tons. Iraq also produced maize, millet, and oil seeds (e.g., sesame) in smaller quantities.

7.3.2.2 Legumes

Lentils, chickpeas, and to some extent, broad beans, are an important part of the Iraqi diet. However, production of these legumes declined dramatically in the 1990s. Originally almost self sufficient in lentils and chickpeas, Iraq now imports >40% of local requirements for lentils and >50% of local requirements for chickpeas. Farmers stopped producing lentils and chickpeas because of low yields and rising labor costs. Most lentil farmers use manual labor almost exclusively, and labor shortages during harvest result in crop losses. Dry land farmers are switching to other crops, mostly cereals, to increase profits, simply because cereal growing is almost fully mechanized and less expensive to grow. To increase the production of lentils and chickpeas, increase farmers' incomes, and reduce Iraq's protein food deficit, Iraqi Food legumes lag behind cereals in area and production 48 researchers, in cooperation with ICARDA, developed improved varieties of food legumes as part of a package of effective technologies and agricultural practices.

7.3.2.3 Industrial crops

A number of other crops are grown, but acreage and production were limited. With the exception of tobacco, of which Iraq produced 17 000 tons on 16 500 hectares in 1985, cash crop production declined steeply in the 1980s. Probably because of domestic competition from synthetic imports and a declining export market, production of cotton was only 7 200 tons in 1985, compared with 26 000 tons in 1977. Production of sugar beets was halted completely in 1983, and sugarcane production declined by more than half between 1980 and 1985. Iraq may have cut back on production of sugar beets and sugarcane because of an intention to produce sugar from dates.

7.3.2.4 Vegetables

Vegetable production also increased, particularly near urban centers, where a comparatively advanced marketing system had been developed. Vegetable gardening usually employed relatively modern techniques, including the use of chemical fertilizers and pesticides. Tomatoes were the most important crop, with production amounting to more than 600 000 tons in 1985. Other vegetables produced in significant quantity were beans, eggplant, okra, cucumbers, and onions. Overall vegetable production increased almost 90 percent between 1975 and 1985 The area devoted to vegetables has increased from about 8 per cent of the total cultivated area in 1989/90 to about 9 per cent in 1994/95. Potatoes are grown mainly in the northern uplands around Mosul and the central valley of the Tigris and Euphrates rivers near Baghdad. Some potatoes are also grown in the lower Tigris- Euphrates Valley, but production there is limited by soil salinity. There is no firm estimate of annual production of vegetables in Iraq. Estimates available through FAO Statistics indicate that it has varied between 3.2 and 3.5 million tons during 1991–1995.

7.3.2.5 Fruit trees

The estimated number of fruit orchards including citrus, date palm, and a variety of other fruits in 1989 was 84 000 (with average numbers of trees per orchard of about 832 in 1989) compared to 219 000 in 1978. The estimated productive number of orchards in 1995 is about the same as in 1989, but the annual production has since increased, ranging from 1.1 to 1.2 million tons during 1990–1994. The total production in 1995 was about 1.3 million tons. Farmers put in extra efforts to manage their orchards during the 1990–1995 periods, but to little or no avail. In the absence of necessary machinery and chemicals, farmers cannot do much against increasing weeds and infestation by insects and pests. In some areas also, orchards are suffering from water logging and salinity. No solid data is available on vegetable and fruit production in Iraq. Recently, international aid organizations are helping farmers develop tomato and potato production in central and northern Iraq.

7.3.2.6 Date palm

Dates, of which Iraq produces eight distinct varieties, have long been a staple in the local diet. The most abundant date groves are found along Shatt al-Arab. More than 30 million date palms existed in the early 1960s. In the mid-1970s, the Iraqi government estimated that the number of date palms had declined to about 22 million, at which time production of dates amounted to 578,000 tons. The devastation of the Shatt al-Arab area during the Iran-Iraq War hastened the destruction of date palm groves, and in 1985 the Government estimated the number of date palms at fewer than 13 million. Date production in 1987 dropped to 220 000 tons. Prior to 1990, about 400 000 tons of dates were exported annually. In addition, it is an important component in the food intake of the Iraqi people.

7.3.3 Industry

Traditionally, manufacturing activity in Iraq is closely linked to the oil industry. The main industries in this category include refining petroleum, chemical industry and fertilizers. Since 2003, security problems prevented efforts to create new institutions. The main problems which leads for this backward includes import bad and cheap product to Iraqi markets, as well as the factories became old causing frequent damages with the scarcity of rehabilitation and modernization for these machines , which negatively impacted the national industry. There are plants and factories still operating, but

produced much less industrial product, and this leads to high production costs at a time the competition with import product is difficult due to uncontrolled openness for foreign goods, which makes the national product in a situation where it cannot compete with those imported. The construction industry is an exception, in 2000 it was only major industrial cement product does not rely on oil and gas. Now many steps have been taken to rebuild the infrastructure of this sector. But due to security issues and shortage of the electric power still this sector inactive as required. Now Iraq has a few industry products such as car assembling, electrical cables, motors, refrigerators, air coolers, and fans.

7.3.3.1 Oil and Energy

Despite what Iraq have by huge oil reserves, but has failed so far, to reach operational productivity to a level equivalent to the possibility of reserves. Now we can see Iraq starting to import petroleum products and has a disastrous deficit in those derivatives. Result of the terrorist operations and security turmoil that occurred after the American occupation in April 2003, oil refineries stopped working at full capacity, or half of their capacities sometimes, and lead to a situation of almost total deficit of supplies of oil derivatives, forcing the government to rely on the import of those products from the neighbouring countries.

7.3.3.2 Other industries

Other industries include the Iraqi Pipes Company, Rubber Company, Pharmaceutical industry, Cement factories, and glass factories.

Farmers were faced with a multitude of problems including disease, the lack of electricity, poor feed quality, lack of water and several economic hardships, such as high operations costs, low prices and transportation issues.

The fish industry had always been a staple for the nation's economy, but has floundered over the past decade and needs reviving. The hatcheries had been operating at less than 20 percent of capacity due to conflict, sanctions and the shortage of water. The hatcheries produced less than 2 million carp fingerling, which is far below minimum for a country like Iraq, In order to revive the Iraqi aquaculture industry; five constraints to fish production and productivity: water aeration, genetic quality of fish stock, appropriate quality fish feed, live haul transport and training. The Ministry of Agriculture, as well as other organizations, brought improved carp fingerlings from Hungary to Iraq for cross breeding with the native carp species. One of the main benefits was that cross-breeding helped improve the overall health of the fingerlings. Future production of the carp species will be dependent on the cross breeding program with Hungarian brood stock, which are quickly adapting to the Iraqi waters, Furthermore, repaired and upgraded the infrastructure of both farms and continues to improve linkages in the fish market value chain, the hatcheries produced approximately 180 million fingerlings in 2011 compared to the 12 million in 2008 from the local non-cross bred variety.

7.4 Fisheries

Production from inland fisheries appears to have declined over the past decade. The Tigris and Euphrates Rivers and their branches and lakes are the main sources of inland fresh water in Iraq, although flows in these major river systems have been reducing in recent years as a result of extensive damming in their upper reaches. The mean production from these water bodies for 1981-1997 was 18 800 tonnes per year, compared to an estimated 8 000 tonnes in 2001. Previous estimates of annual sustainable production from inland waters have been put at 30 000 tonnes although this is unlikely to be achievable given the environmental changes that have taken place. The inland fisheries are based in great part on *Cyprinus* spp., while the most important Many of the fish caught in Iraq are the indigenous fish belong to the genus *Barbus* (FAO, 2004).

7.4.1 Fish species in the Euphrates and Tigris River basins

The following types of fish are caught in capture fisheries (**Error! Reference source not found.**).

Table A7. 5 Some species of fish caught in capture fisheries in Iraq

Governorate and Location	Name body of water	Fish species
Baghdad	Hill Al Bshat	*Cyprinus carpio, Aspius vorax, Barbus sharpeyi, Silurus triostegus*
Al-Qādisiyyah	Salt marsh	*Cyprinus carpio, Aspius vorax, Barbus sharpeyi, Silurus triostegus*
Babil	Aldelmj marsh	*Barbus luteus, Cyprinus carpio, Aspius vorax, Barbus sharpeyi*
DhiQar	Salt marsh	*Barbus sharpeyi, Cyprinus carpio, Liza abu, Liza subviridis*
Maysan	Al Hawizah marsh	*Barbus xanthopterus, Cyprinus carpio, Barbus sharpeyi, Barbus luteus, Aspius vorax, Silurus triostegus*
DhiQar	DhiQar marsh	*Cyprinus carpio, Aspius vorax, Barbus sharpeyi, Barbus xanthopterus, Liza abu, Liza subviridis, Barbus luteus, Barbus grypus*
Al Anbar	Al-Tharthar Lake	*Barbus xanthopterus, Barbus sharpeyi, Barbus grypus, Cyprinus carpio*
Al Anbar	Al-Habbaniyah Lake	*Cyprinus carpio, Barbus sharpeyi, Barbus grypus*
Diyala	Hamrin dam	*Barbus xanthopterus, Barbus grypus, Cyprinus carpio*
Nineveh	Mosul dam	*Cyprinus carpio, Barbus sharpeyi, Barbus grypus, Barbus xanthopterus, Barbus esocinus, Silurus triostegus*

A brief description of them appears below, including geographical distribution, diagnostic features, and biological aspects:

7.4.1.1 Mesopotamichthys (=Barbus) sharpeyi

The number one species, the *Mesopotamichthys sharpeyi,* its local name is Bunni, is spread in Tigris and Euphrates rivers, and in most local water bodies especially in the south and middle regions, reduced in number in the north regions. It is an economical species, and has become wide spread in stagnant or slow current water, attempts are being carried out to breed such type of fish in earthen ponds, the governmental sector works to propagate such species and release their fries to the water bodies to compensate their diminishing numbers, herbivorous feeders feeding on algae, aquatic plants and detritus, reach sexual maturity in 3-4 years with 40cm in length and 750 g in weight, spawn in May, females deposit their eggs as batch on the vegetation in depth about 0.75m, absolute fecundity ranged from 16 068 to 358 343 egg with average of 200 000 egg per season, while the absolute fecundity ranged between 85 to 145 egg/g body weight, diameter of mature egg is about 2 mm, sex ratio is 1:1.

7.4.1.2 Luciobarbus (=Barbus) xanthopterus

The *Luciobarbus xanthopterus,* local name Gattan is endemic in the Tigris and Euphrates Basin, and their tributaries, and all local lakes and reservoirs, reduced in number in local marshes and south regions. It is a commercial fish with desirable taste, become wide spread in moderate-enriched oxygenated water, and can tolerate salinity up to 8g/1. Attempts are being carried out to breed such type of fish in earthen ponds, the governmental sector works to propagate such species and release their fries to the water bodies to compensate for their diminishing numbers, omnivorous feeders with dominant of animal components, such as molluscs, crustaceans and aquatic insects, reach sexual maturity in 4 years with a length of 50 cm and a weight of 1 500 g, spawn starts from April to late May on gravel beds and digs small nests in the gravel, deposit their eggs on the nest, water depth is ?-1 meter, absolute fecundity ranges from 100 000-260 000 egg per season, sex ratio is 1:0.67.

7.4.1.3 Barbus grypus

The *Barbus grypus* with the common name of Shabbout are spread in most Iraqi water bodies, they represent almost 20 percent of the total catch that has declined in the last few years in spite of being dominant in Heditha and Dokan dam lakes. It is an economical species, with desirable taste, liable to spread in high current within the mid-column of water and move down searching for food. The governmental sector works to propagate this species and release their fries to the local water bodies to compensate for their diminishing numbers. Omnivorous feeders, feeding on animals and plant components with equal ratio, reach sexual maturity in 4 years at 42 cm in total length and 2 kg in weight, the mature fish migrates to the upper rivers during the period of April and May to spawn. The regions between Balad and Tikrit river and between Heet and Haditha on Euphrates river, Himrin dam Darbendekan dam Tharthar lakes are natural spawning regions. Spawning continues about one month, and females deposit their eggs on gravel beds. Absolute fecundity reaches 35 000 egg per season. Sex ratio is 1:0.87.

7.4.1.4 Aspius vorax

The *Aspius vorax* with the local name Shilik is spread in most Iraqi water bodies, dominant in Habbaniyah and Tharthar lakes and reducing in Haditha dam lake and the main rivers. It is an important species, prefering to live in mid water columns, carnivorous feeders, feeding on fish fry, crustacean and aquatic insects. The governmental sector works to propagate such species, reach sexual maturity in 4 years with 40 cm in total length and 1 kg in weight. They spawn twice a year, first in early spring with a high fecundity and second in autumn with a lower fecundity. Tubercles on the head in spawning period. Females deposit their eggs on shallow regions near coast. Absolute fecundity ranges between 68 000-280 000 egg per season, mature egg diameter is about 2 mm. Sex ratio is 1:0.69.

7.4.1.5 Cyprinus carpio

The *Cyprinus carpio* with the local name of common carp was introduced into Iraq in the 1950s as a brood stock species then released into some local water bodies such as Habbaniyah lake, Abu-Dibis marsh and Darbandikhan dam lake and then diffused in all Iraqi water bodies. This species now represents 50 percent of the total catch. It is an economical species, which prefer to spread in marshes and stagnant lakes and capable of living in under different conditions. Tolerates salinity to 12g/1. oAn omnivorous feeder mainly on molluscs, crustaceans and algae. Reaches sexual maturity in less than 1 year at 15 cm in length and about 40 g in weight. Spawning takes place twice a year, first in spring with a high fecundity and second in autumn with a lower fecundity. Females deposit their egg on vegetation. Absolute fecundity ranges between 14 151-1 492 504 eggs. The diameter of the mature egg ranges between 0.9-1.02 mm.

7.4.1.6 Liza abu

The *Liza abu* with the local names of Khishni or Abu Khraiza is spread in high densities in all Iraqi water bodies and in earthen ponds as an exotic species. They feed on detritus and phytoplankton, reach sexual maturity in 2 years with 12 cm in length. They spawn twice a year, first in April and May and second in early Autumn, females deposit their egg within shallow water, relative fecundity ranges between 1000-1500 egg/g body weight while the absolute fecundity ranges between 12 000-63 000 egg, mature egg diameter is about 0.9 mm, sex ratio is 1:0.93.

7.4.1.7 Carasobarbus (=Barbus) luteus

The *Caraoobarbus luteus* has the local name of Himri and can widely be found in Tigris and Euphrates rivers and their tributaries, and in all Iraqi water bodies. It is dominant in the middle and south regions such as the marshes, Haditha dam lake and the main drain. It is liable to spread within the mid-column of water and move down to the bottom surface searching for food. It is an omnivorous feeder, feeding mainly on molluscs, aquatic plants, aquatic insects. Reaches sexual maturity in 2.5 years and 15 cm in length and about 45 g in weight, spawn twice a year, first in April and May of

higher fecundity and second in October of less fecundity. Female deposits their egg on vegetation; mature egg diameter which is poisons for human health reaches 1.2 mm, sex ratio is 1:1.5 for the benefit of female.

7.4.1.8 Silurus triostegus

The *Silurus triostegus* with the local name Asian Djirri is spread in all Iraqi water bodies especially in the middle and south regions, such as Tigris and Euphrates rivers, and Shatt Al-Arab rivers, lakes, reservoirs and marshes ,can also be found in Dokan dam lake. It is liable to spread within slow current water. A carnivorous feeder, feeding on fish fry, frogs fry and aquatic insects. The governmental sector works to propagate such species. Reaches sexual maturity in 3 year at 5 cm in total length and 1 kg in weight. Spawn in May and continues few months, females deposit their eggs on vegetation. The mature egg diameter ranges between 3.9-4.2 mm, and the sex ratio is 1:1.1.

7.4.1.9 Luciobarbus esocinus

The *Luciobarbus esocinus* with the local name Bizz is spread in the middle and north regions, from Ali Al-Gharbi in the south to the Iraqi-Turkish border in the north at Tigris river, and from Kufa in the east to the Iraqi-Syria borders in the west at Euphrates river, also spread in the upper of Tigris, Lower Zab and Upper Zab. Has declined in number during the last few years. It is an important economic species. Liable to spread in fresh enriched oxygenated water. It is a carnivorous feeder, feeding on fish fry, crustacean, aquatic insects and zooplankton. It reaches sexual maturity in 10 years and 70 cm in standard length and 17 kg in weight. It spawns once a year during April and May, migrate to the upper regions of Tigris and in Tharthar Lake. Females deposits their eggs on gravel beds with depth up to one meter with moderate water currents. Absolute fecundity is about 600 000 egg, and the sex ratio is 1:3.

7.4.2 Gear used

Fishing gears and methods, there are three main types of means and methods of fishing

Entangling:

- Gillnets
- Tangle nets
- Trammel nets

Luring:

- Hook lining
- Trolling
- Traps

Pursuit:

- Wounding gears: e.g. lances, spears, clamps, rakes, tongs, missiles, harpoons, rifles.
- Stupefying aids: e.g. striking gears, clubs, insecticides, explosives, hand grenades, dynamite, electro fishing
- Sweeping gears or seining: eg shore or beach seine, Danish seine, surrounding nets, falling nets, ring nets, purse nets.

Mesh size regulations are in place for inland fisheries and for marine gill net fisheries. For both inland and marine waters, the minimum mesh size was 50 mm stretched mesh.

There are a total of 6 330 motor boats using Johnson, Yamaha, Mercury, Mariner, Tohatsu,- Suzuki, Ivan Rod, and Hayevonk engines with power ranges of 8-55 hp. There are a total of 4 817 non-

motorised boats. The total number of fishing boats is 11 147 mostly distributed along the Euphrates and Tigris Rivers (Table A7.6 and Table A7.7).

Table A7.6 Number and types of fishing boats in Iraqi Governorates

Governorates	Motorboats	Non-motorized boats	Total
Baghdad	102	12	114
Basrah	622	460	1082
DhiQar	492	1162	1654
Maysan	69	237	306
Muthanna	96	18	114
Najaf	2	26	28
Karbala	170	122	292
Wasit	323	11	334
Diwaniyah	2	215	217
Babylon	58	22	80
Mosul	378	-	378
Anbar	193	-	193
Saladin	335	-	335
Kirkuk	10	-	10
Diyala	3	3	3
Grand Totals	2855	2285	5140

Table A7.7 Number and types of fishing boats in Iraqi Kurdistan

Governorates	Motorboats	Non-motorized boats	Total
Erbil	150	60	210
Sulaimania	235	78	313
Dohuk	70	23	93
Garmian Administration	165	80	245
Grand Totals	620	241	861

7.4.3 Fishing seasons

Law no. 48 for 1976 regulates the whole activities of fisheries in Iraq. The Ministry of Agriculture issues regulations under this Law, according to the need. The Ministry of Agriculture in Kurdistan Region sets the regulations for that region. Closed seasons have been implemented for inland fishing for various areas in Iraq. These periods are as follows:

- In Southern areas: 15 February to 1 May
- In Central areas: 1 March to 15 May
- In Kurdistan Region: 1 April to 15 June

7.4.4 Locations

The fishing locations are distributed along of the Euphrates and Tigris rivers, mostly in rural areas. Fishing activities are especially important in the southern governorates, particularly in the marshes. Table A7.8 and Table A7.9 show the fishing locations, water area or river length, and the fish species caught where known.

Table A7.8 Fishing locations and production details

Governorate	Name body of water	Water area (ha)[1]	Production kg/ha/year
Baghdad	Hill Al Bshat Tigris River	49 -	0.15 -
Saladin	AL-Habbaniyah Lake AL-Tharthar Lake		
Al Anbar	Al-Tharthar Lake	37 500 73 000 78 000 42 500	0.35 0.35 0.4 0.35
	Al-Habbaniyah Lake	35 500	0.3
	Qadisiyah dam	3 500 7 000 12 000	-
	Hadetha dam	200 000	-
Karbala	Al-Razaza Lake	125 000	
Najaf	Abu Najm marsh		
Babylon	al-Hilla river		
Wasit	Aldelmj marsh	6 250	0.4
Muthanna	Alsalibat		
Diwaniyah	Salt marsh	2 000 1 250 3 000 250 -	0.4
Maysan	Al Hawizah marsh	88 850	0.5-0.7
DhiQar	Salt marsh	4 750	0.2-0.3
	Chabaish marsh Alhamar marsh Suq Alshyok		
	DhiQar marsh	45 000 75 000 73 000 7 500 7 500 3 500 1 125 325	0.5 0.4 0.6 0.3 1.0 0.4 0.5 0.3
Mosul	Mosul dam Tigris River	40 000	0.4
Basrah	AL Basrah marsh		
Diyala	Hamrin dam	2 400	0.2

[1] The area has been converted from donum assuming that 1 donum=2 500m^2.

Table A7.9 Fishing locations in Kurdistan region

Name body of water	Governorate and Location	Water area (ha) or river length (km)
Dokan dam Lake	Sulaimania	7 600 ha
Darbandikhan dam Lake	Garmian Administration	3 600 ha
Mosul dam Lake	Dohuk	13 500 ha
Khabour	Dohuk	160 km
Greater Zab	Erbil	392 km
Lesser Zab	Erbil	400 km
Awa Spi	Garmian Administration	230 km
Sirwan	Garmian Administration	384 km

7.4.5 People involved

The estimated number of people involved in fisheries in the Central and South region is 10 629 with 2 461 in the Basra governorate. Table A7.10 lists the number of fishermen who have official licenses in each province in 2009. The number of licensed fishermen recorded in 2005 in the Gulf was 542. Most fishermen are illiterate and aged from 19 - 40 years old and sometimes up to 50 years.

The role of men and women in the employment sector in Iraq seems to vary according to the region. In the southern and some central Governorates, in general, men assume a dominant role and are responsible for almost all activities. However, women are still have a role in employment especially in the farming sector, where women have a larger role in agriculture and harvest. In central Iraq we can find more civility and women participate more in government offices and can occupy good positions. Women also work in private companies in order to raise their standard of living. Many women also attend and graduated from universities and colleges with good results to obtain work as doctors, engineers, teachers, and university professors. In north and west part there are fewer women with higher education, and they do more farm work or staying at home after marriage. Women in Iraq are not working in fishing, but they are involved in the sale of fish, especially in the southern regions.

Table A7.10 Number of licensed fishes and their geographical distribution in 2009

Governorate	Number of fishers
Baghdad	44
Saladin	169
Anbar	93
Karbala	214
Najaf	411
Babylon	39
Wasit	13
Muthanna	141
Diwaniyah	145
Maysan	481
DhiQar	818
Mosul	4
Basrah	1034
Total	3606

There are an estimated 930 fisherman in the northern governorates (Table A7. 11). Most of the fishers in the northern Kurdish regions are between 15-20 years of age, are illiterate, and are not normally registered with official licenses. Women do not work in the profession of fishing. Fishing is not considered an important profession in the northern region because of the nature and style of this region where fish are not an important component of the diet.

Table A7. 11 Number of fishers in Kurdistan

Governorate	Number of fishermen
Erbil	220
Sulaimania	335
Dohuk	104
Garmian Administration	271
Total	930

7.4.6 Processing and marketing

There is no special processing equipment because the Iraqi consumer wants fresh fish. The transport of fish from the capture location to the markets and on to the consumers invariably leaves the fish in poor condition. Only a few people use refrigerated trucks to transport fish between Iraqi governorates, but there are no accurate statistics on this subject. Manpower employed in the fishery pertains to private sectors. Those employed in the private sector are mostly fishing in inland water bodies.

There are no private markets in the Kurdistan region to fish sell as it exists in the central and southern governorates. The fish are sold in small shops within the vegetables markets. There are no statistics on the quantities marketed, but according to estimates by the Ministry of Agriculture in Kurdistan of inland production of 1 500 tonnes of fish annually.

7.4.7 Market locations

Fish is one of the main meals in the Iraqi dining table particularly central and southern regions is also known that most of Iraq's provinces are scattered along of the Tigris and Euphrates rivers, so we find in each province the big private market to sell the fish wholesale and retail, but the largest of these markets are located in the province of Baghdad and Basrah. The number of markets are the same as the number of governorates will be clarified in later tables and chart, with regard to the small markets selling fish retail there is no accurate statistics as well as for number of traders or people working in the marketing, as we said earlier that the women in the provinces of the south contribute to the sale of fish in the markets. in Iraq there is no surplus of fish to be exported out of the country, in spite of having coastal waters in the gulf is estimated at 900 km 2 well as internal waters represented by the Tigris and Euphrates rivers and tributary as well as the Shatt al-Arab, where the total lengths 3425 km and the total surface area convergence 68.5 thousand hectares, although the existence of these different sources of water we notes the fish production does not meet the needs of the Iraqi citizen.

Table A7.12 shows the quantities of fish marketed fish between them and the types of fish from 2003 to 2011. It should be noted that the production quantities of fish are for inland waterways including the production from fish farms, and also fish being imported from outside of Iran especially the common carp.

Table A7.12 Fish species marketed in 2003-2011

Year	*Barbus sharpey*	*Barbus xanthopt*	*Barbus luteus*	*Barbus gryus*	*Aspius vorax*	Carp	*Liza abu*	*Siluris triostegus*	other species
2003	998	2415	676	1153	305	1985	4251	870	2136
2004	1783	1606	355	1256	381	2247	1751	530	2422
2005	3134	2176	1400	1712	1328	4805	5071	4830	1278
2006	2931	2128	2578	1480	2446	11175	5192	3958	1679
2007	2750	2270	1026	1070	1994	14286	4725	1064	680
2008	2219	1874	2046	1338	2070	14363	4883	1096	1188
2009	1960	1496	2709	1141	2448	15232	5781	1174	1330
2010	2410	2089	2425	990	1581	17738	5731	871	951
2011	3499	3804	1848	1561	1685	16051	3597	1094	1752
Avg	2409	2206	1674	1300	1582	10876	4554	1721	1491

There is a clear gap between the current supply and market demand for fish. In the main Baghdad fish markets the daily supply are sold well before closing time. Fish production falls short of demand because of low productivity and poor transportation facilities to make product available at the right place at the right time, the current average consumption of fish in Iraq stands at only 0.8/kg per capita, compared to 2.5/kg in 1990, before the international embargo. It is fair to assume that consumption has been hampered not only by a decrease in purchasing power – as occurred with poultry and red meat – but also by poor supply in terms of both quantity and quality. Historically and under normal conditions, there is a clear gap between the consumer price of fish and the price of poultry and red meat in Iraq. A more efficient model for aquaculture in Iraq could enable the marketing of fish at a retail price of $2.1/kg, considerably lower than poultry, sold in normal condition at 2.5/kg (USAID, 2006).

7.4.8 Transport used

There are two ways of transporting fish according to the type of fish and if they are dead or alive. There are no specialized vehicles for the transport of live fish in Iraq except for two cars that were brought to the northern region by the Food and Agriculture Organization in 2001, one in Erbil and the second in the governorate of Sulaymaniyah. Most fish are transported dead to markets and especially when the distance is long, for example, between Basra and Baghdad which is estimated at about 450 km where the movement of marine fish to Baghdad.

Live fish are transported through the use of vehicles that can carry small 1-2 tons of cargo. The back of the vehicle is filled with water and pumps recycle the water and provide aeration.

Dead fish are transported using refrigerated cargo of 3 - 5 tons and are put fish in plastic boxes and covering with ice and carrying in the car. However, often not enough consideration is given to the health aspects in the process of transport and fish can spoil. The number of people employed in the fish transfer is 2 200 workers for loading and unloading and 1 100 support workers. The number of cars and number of drivers unknown.

7.4.9 Institutions

7.4.9.1 Government Departments

The General Board for Fish Resource Development is the main authority responsible for developing and upgrading the fishery and aquaculture sectors, encouraging investment, developing procedures through better management, stocking and enhancement of species diversification through an effective regulatory framework for both the inland and marine fisheries, as well as, aquaculture. At present, there is a potential to optimize research and studies into different local species which are currently under the acclimation process. The General Board comprises many technical or administrative departments and divisions. The technical departments are responsible for fish reproduction and rearing, providing fingerlings and good quality fish seed for the farmers. The internal Fishery Department is responsible for supervising fishermen, fishing licenses, fishing boats and the wholesale fish trade. The studies and investment department deals with the implementation of new project proposals. The General Board, together with other scientific institutions, is responsible for research and studies of the different technical aspects to serve the development of the fishery and aquaculture sectors in order to increase production.

The General Board is the main executive power with authority to apply the rules and regulations issued by Government in collaboration with the Ministry of the Interior to apply the relevant Law No. 48, issued in 1976, and its codes which regulate fisheries and aquaculture to better manage aquatic living resources. This institution does not have enough staff to adequately monitor the control and enforcement of the laws due to the extent of the water bodies.

7.4.9.2 Fishing cooperatives, organizational structures

The fishery associations cooperates with the General Board to support and facilitate fishing communities through the releasing of legal licenses to the fishermen and boats, as well as, encouraging the members by providing easy loans and the requirements to improve their work. The following communities are related to fisheries:

- Two non-governmental organization (NGOs) in Basrah for marine fishes.
- The fisheries cooperative at Al Kut for fishing in the Al-damlag marshes (NGO) total members 80.
- The fisheries cooperative at Al-Najaf for fishing in the Eben-najem marshes.
- The fisheries cooperative at Karbala for fishing in Lake Al-Razaza.

7.4.10 Changes in past decade

Surveys showed in some Iraqi water bodies undertaken two decades ago, such as Tharthar Lake , Habbaniyah Lake and Razzaza Lake, the productivity reached their likely potential of 7 to 8 kg/ha but has now declined to 4 kg/ha due to neglect and overfishing. The negative effects that have occurred in the living environment for the fish are due to water scarcity, pollutants and climate change. Some species may be threatened with extinction, for example *Barbus xanthopterus*, *Barbus esocinus*, *Barbus sharpey*, with the spreading of the introduced carp that has become dominant in many water bodies and constitute between 50-70% of the catch.

7.4.11 Main constraints to production and livelihood development

The decline in fish production in Iraq over the past decades was due to difficulties in fisheries technical issues, regulatory obstacles and marketing. Many of these still continue today and can summarized as follows:

- The cancelling of scientific institutions supervising the fisheries sector and the exclusion of scientific and technical staff that were working in the rearing and fish biology, and fisheries technicians and engineers from specialized institutes and academies.
- The Draining of the marshes that once contributed in supplying the Iraqi market with more than 50% of fish annually.
- Ineffective fish stairs on dams or lack thereof, or exploited by the beneficiaries.
- Uncontrolled exploitation of water bodies and rents by investors.
- An acute shortage of transport-related infrastructure, storage and refrigeration, which encouraged the use of primitive methods in the marketing of fish
- Lack of health control has led to the impeding the growth of this industry.
- Regulation of fishing activities to maintain the fishery in terms of determining the quality and specifications of fishing vessels, quality nets and specifications, periods year-round fishing lack of data and statistics related to territorial waters and water bodies in terms of environmental conditions and growth rates fish populations where and reproduction and migration and estimate fish stocks are all required.
- Lack of efficiency with traditional fishing and the poor management of smaller water bodies.
- Non-compliance with laws and legislation on the use of poison, pesticides and electrofishing in fishing operations.
- Shortage of raw materials for the feed industry and the high price and poor quality of feed.
- Scarcity of technical information about the Iraqi fisheries.

7.4.12 Policies and legislation affecting activities

1- Instructions relative to the Maritime Consultations Bureau (No. 60 of 1993).

Abstract: The Maritime Consultations Bureau shall be established in the Centre of Maritime Sciences and be attached to the President of the Basrah University. The Bureau shall, inter alia, provide consultations and specialized experience for the development of fish resources and the protection of the marine environment. The institute shall be guided by a supervisory body consisting of a Director-General, a Director, Heads of Sections, and a specialist of maritime law (art. 3). Decisions of this body require approval by the President of the University. The University Council may dissolve the Consultative Bureau (art. 10).

2- Agreement between Iraq and Yemen concerning fishing in the territorial waters of Yemen.

Abstract: This Agreement is composed of 11 articles. The Yemeni General Authority grants to the Iraqi General Board the right to fish in the Territorial Waters of Yemen from the date of signature of the Agreement (art. 1). The two Parties shall establish an Operation Joint Committee (art. 2). The Iraqi General Board, according to this Agreement, shall give to Yemen 35 percent of their fish or fish products in exchange of the permission to fish in their waters (art. 3). The Iraqi General Board shall not throw any poisonous small fish in the Yemeni Territorial Waters (art. 4). The Iraqi General Board shall employ at least 40 percent of Yemeni employees on their vessels (art. 5). The Iraqi Board shall pay compensation for damage of local angler's equipment (art. 8). The Iraqi Board shall present fishing programmers to the Joint Committee to be approved before starting any fishing operations (art. 9). Dispute settlement (art. 10).

3- Law regulating the exploitation and protection of aquatic life (Law No. 48 of 1976).

Abstract: Basic Law regulating fishing and aquaculture in seven Chapters and 36 articles: Breeding and protection of aquatic life and waste disposal (Chapt. 1); General rules for fishing activities (2); Fishing gear (3); Marketing and industrialization of aquatic products (4); Dues and licenses (5); Penalties (6); General provisions (7). Article 1 prohibits the use of mass destruction methods such as chemicals, explosives, or electrical energy, the use of gear which may harm eggs or fry, the pollution of waters in such way as to harm aquatic life, and the use of fixed gear which blocks the flow of water entirely. Various fish conservation measures may be proclaimed by the State Fisheries Company (art. 2). This Company shall also undertake fish breeding in public waters (art. 4) and the import and distribution of breeding fish and other aquatic species (art. 7). Fishing in the territorial waters of the Arab Gulf shall be governed by a special regulation to be promulgated within one year from the date of promulgation of the present Law (art. 9). Article 11 provides for fishing licences to be issued to vessels. Article 12 provides for personal fishing licences for professional fishermen. The Company shall supervise trading in aquatic life (art. 16).

4- Official Proclamation regarding exploitation of the maritime zone contiguous to the territorial sea of 23 November 1957.

Abstract: This Proclamation asserts the right of Iraq property of "exclusive general jurisdiction" over natural resources existing on the sea bed and in the subsoil underneath it of the maritime zone contiguous to the territorial sea of Iraq. Iraq shall likewise have the exclusive right to explore and exploit such resources.

5-Bahrain; Iran, Islamic Republic of; Iraq; Kuwait; Oman; Qatar; Saudi Arabia; United Arab Emirates: Agreement for the establishment of the Regional Commission for Fisheries.

The purpose of the Regional Commission for Fisheries (RECOFI) is to promote the development, conservation, rational management and best utilization of living marine resources, as well as the sustainable development of aquaculture within its area of Agreement.

7.4.13 Management initiatives, enforcement, implementing body

The responsible authority for the implementation and application of these laws and conventions and instructions are the General Authority for Fish Resources, under the Ministry of Agriculture, in cooperation with the Ministry of the Interior. However, due to the absence of administrative structure, this sector that has been marginalized for more than 15 years and there are no effective development of policies and investment. There has been limited investment in technical and material potential by the private sector. Individual investments are very limited in the traditional fishery though there is some fish farming by individuals creating ponds in arable land. There are some private companies the field of fish farming.

7.5 Aquaculture

7.5.1 History and general overview

In the 1950s, carp species were introduced for the first time in Iraq, but only for scientific research purposes. The main aim was to acclimatize these species in the Iraqi inland waters and to establish whether they would be suitable for rearing in the Iraqi environment without interference and without a negative impact on endemic species. However, at that time, this experience was not channelled into commercial activities; later, significant attention was given to the aquaculture sector, initially with the establishment of hatcheries and the construction of fish farms, the first artificial reproduction was started recently in Iraq, by following up on the experimental phase. However, the reproduction and rearing of local fish species was not carried out sufficiently, due to a lack of knowledge of the biology of the species, the aquaculture sector developed after 1954, but was not given any importance or particular attention. It was limited by laws, codes and regulations which protected, organized and utilized the existing fishing techniques in inland waters. In 1985, hatcheries, as well as, farms for fish reproduction and rearing were built, but these farms were too small, and not suitable for commercial purposes.

In 1989, the General Board for Fish Resource Development was disbanded and became a branch under the Animal Resource Services Company, in 2004, the General Board for Fish Resource Development restarted as an independent state institute to assume responsibility as a scientific authority to improve fish production in Iraq, by applying fisheries and aquaculture science methodologies, a number of developmental projects, assisting directly and indirectly the development of aquaculture and the inland fishery industry in Iraq have been carried out, for example, upgrading the central fish hatchery and laboratory at Wasit, rehabilitating fish farming sites in several areas in the country, building a functional hatchery for local fish species production and the building of operational closed recirculating systems and pilot cages, there have also been several initiatives to restore the Mesopotamian marshes, which have offered opportunities for intervention to increase fish production by releasing fingerlings of local species, as well as, carp species. Farmers and fishermen have also been supported by means of easy loans or through the establishment of natural protectorates in the Mesopotamian marshes, marine aquaculture has not been developed at all due to a lack of competencies in this sub-sector as there is no know-how on reproducing or culturing fish in marine waters.

Aquaculture activities in Kurdistan Region

Aquaculture activity in the Kurdistan region started in 1960 with common carp on Dokan dam and Darbandikhan. However, it was not until 1999 that any economically important success was realised when the Food and Agriculture Organization established two projects for fish. One was in Erbil and the other in Sulaimaniya, and the development of a hatchery for the artificial reproduction of common carp, silver carp and grass carp. The capacity of each hatchery is about 20 million larvae per season, and there are two small feed-mills of a capacity of 4-5 ton per hour. The project has a number of model fish pond for demonstration and training. In addition, FAO established six model fish ponds in the Agriculture College in Dohuk Governorate for demonstration and training. FAO has also distributed hand-size fish to farmerswith small ponds established for storing water and irrigation. This is the first step to teach farmers in the Kurdistan region to raise fish, which is a new profession in the region. From 2000, grown fish projects we note that the following tables.

Farming systems distribution and characteristics

Iraq has diverse water resources which are thought to be suitable for enhancing its fishery resources, especially in inland water bodies which cover around 600 000 to 700 000 hectares, comprising natural lakes (39 percent) dams and reservoirs (13.3 percent) rivers and their branches (3.7 percent) and marshes (44 percent),the farming system rely mainly on fish farms which are widespread within the middle and southern part of Iraq and are mainly based on extensive and semi-intensive fish ponds culture.

Practices and systems of culture

Pond culture is the practice currently applied. Due to the international economic and scientific embargo during 1990-2004, Iraqi scientists and experts experienced great difficulties in communicating with scientists outside the country. As a consequence, this isolation contributed to creating a gap and decline in all aspects, especially in the field of scientific research. As a result of this, fishery and aquaculture studies and research declined. Research and studies are currently being carried out in the area of acclimation and artificial reproduction of the native *Barbus* sp. at the Sewera central hatchery. Successful results have previously been achieved from the acclimation of Acanthus purges lotus at al-Razaza Lake, which is an enclosed salty lake. With the collaboration of various scientific authorities, the General Board for Fish Resource Development is carrying out research and studies on these desirable species in order to reproduce this build up hatchery, especially near al-Razaza Lake.

7.5.2 Species farmed

Freshwater fish production consists of pond culture of the common carp (*Cyprinus carpio*), as well as the grass carp (*Ctenopharyngodon idellus*) and the silver carp (*Hypophthalmichthys molitrix*). There have been no initiatives to provide opportunities for the development of native fish production due to a limited supply of good quality fish seed, a lack of scientific knowledge and because native species are economically worthless to be produced or cultured in ponds. Such species require 4–5 years to reach marketable size.

Species farmed in Kurdistan

The following species are farmed in Kurdistan: *Cyprinus carpio*, *Ctenopharyngodon idellus*, *Hypophthalmichthys molitrix*, and Salmon. Most fish projects depend on well water and there is both a high establishment cost and a high production cost. The use of well water means that the filling of ponds requires energy which doubles the production cost. Only about 50% of these projects are successful for many causes. The lack of interest by government authorities in this subject and limited of support for farmers and the high cost of production because of the mountainous nature hinder success.

7.5.2.1 Inputs required

Feed is the main input and important in aquaculture and livestock, especially protein, which is the basic material in the feed industry. There is no plant protein in Iraq despite the presence of many fodder plants grown in most provinces, particularly in Baghdad. There is also a difficult in acquiring suitable land and there are administrative obstacles to get official approval for the establishment of fish farms owing to the text of the law No. 48 of 1976. This states that fish farms can not be created on arable land. There are higher cost of construction on lower grade lands, and taking into account the constraints in the management of fish farms because of a few experience in this sector.

7.5.2.2 Land ownership

Water bodies are state-owned, but land for fish farms can be either purchased or rented from the Ministry of Agriculture, which owns all of the agricultural land. There are a number of private companies undertaking cage projects that have been established recently, the materials are owned by the farmer and the water bodies are owned by the state but given to farmers to invest only. Table A7.13, Table A7.14 and Table A7. 15 show statistics associated with private companies, cage culture fish farms in Iraq.

Table A7.13 Active fish producing companies

Company name	Area (ha)[1]	Location
Al-Furat	375.0	Babil
Al-msayab	71.0	Babil
Al-sharq al-awsad	375.0	Babil
Al-gharnata	200.0	Babil
Al-esam	3.3	Babil
Nazer Majeed	90.3	Wasit
Al-Manahel	62.5	Wasit
Al-Ahleya	50.0	Wasit
Al-Bozogh	12.5	Wasit
Al-Wataneya	421.3	Wasit
Al-Rafedayen	90.0	Wasit
Al-Sewera	23.0	Wasit
Al-Jobayel	52.5	Wasit
Al-Janaeen	12.5	Wasit
Al-Bohayrat	40.5	Wasit
Al-Waha-Al-Khadrah	42.5	Wasit
Al-Asreya	25.0	Al-Anbar
Al-Azhar	6.0	Baghdad
Total	1952.8	18 companies

[1] The area has been converted from donum assuming that 1 donum=2 500m^2.

Table A7.14 Fish cage farms culturing common carp in Iraq

Location	Waterbody	No. of licences	No.of cages	Total area (m2)
Wasit	Tigris River	6	67	1 032
Babil	Euphrates River	15	391	6 316
Wasit	Tigris	32	362	6 456
Basra	Tigris, Euphrates, Shall Al-Arab	205	602	7 373
Dhi-Qare	Euphrates, garaf branch	20	99	1 410
Karbala	Euphrates River	2	55	660
Najaf	Euphrates River	2	21	514
Diyala	Tigris River	1	24	576
Salah-Al-deen	Tigris River	2	6	216

Al-Anbar	Euphrates River	7	150	2 125
Naynava	Tigris River	2	2	15
Al-Muthana	Euphrates River	2	8	256
Al-Kadessya	Euphrates River	10	235	3 235
Maysan	Tigris River	35	753	11 733
Total		332	2 775	41 914

(General Board for Fish Resource Development, 2012)

Table A7. 15 Fish farms in Iraq

Location	No. of farms	Total area (ha)[1]	No. of cultured fish	Estimated production (ton)	No. of non-productive (not active) farms
Baghdad	130	358.8	1 423 150	1 421	350
Wasit	96	1 251.3	3 441 360	3 329	64
Babil	61	1 401.0	5 095 420	2 172	88
Al-Anbar	2	-		25	
Salah-Al-deen					
Diyala					
Karbala					5
Najaf	11	50.5	192 000	190	61
Kirkuk	12	31.5	142 050	105	31
Naynava	2	6.8	18 000	15	10
Al-Muthana	3	192.3	465 000	315	19
Dhi-Qare	21	51.0	194 500	194	20
Diwaniyah	6	4.3	17 500	15	10
Maysan	37	93.8	363 000	200	39
Basra	31	131.3	218 160	200	21
Total	412	3 572.3	11 570 140	8 181	804 (area = 2 927 ha)

(General Board for Fish Resource Development, 2012)

[1] The area has been converted from donum assuming that 1 donum=2 500m^2.

7.5.3 People involved

Manpower employed in the fishery and aquaculture pertains to public and private sectors. Those employed in the private sector are mostly fishing in inland water bodies rather than working in aquaculture, but a few are involved in the basic work on the fish farms. The better educated and more skilled in this field, work with various public organizations. There are about 300 highly educated experts, such as diploma holders or with bachelor degrees and only 15 percent has a master's degree or PhD which currently work in research centers and universities. Women do not work in the private sector for fish farming, but there are a lot of women that hold bachelor and master Degree's work as experts and supervisors on this sector, mostly within the government sector. The number of people working in the aquaculture sector by FAO statistics is 5 000 people (FAO, 2004).

7.5.4 Water quality

Downstream riparian countries complain about the quality of the water. Turkey's use of water has so far been limited mainly to hydropower generation and irrigation. While the former use is considered non-consumptive and not directly linked to water quality, the return flow from irrigation causes water pollution, which in turn affects potential downstream uses. Equally important are natural causes of environmental concern in the sense that some residual characteristics common to both rivers exacerbate the damaging effects of human pollution. Notable natural causes are the high rate of

evaporation, sharp climatic variations, the accumulation of salts and sediments, poor drainage and low soil quality in the lower reaches of the Tigris and Euphrates.

In Iraq, the present quality of water in the Tigris near the Syrian border is assumed to be good, including water originating in both Turkey and Iraq. Water quality degrades downstream, with major pollution inflows from urban areas such as Baghdad due to poor infrastructure of wastewater treatment. Water quality of the Euphrates entering Iraq is less than the Tigris, currently affected by return flow from irrigation projects in Turkey and the Syrian Arab Republic, and expected to get worse as more land comes under irrigation. The quality is further degraded at such times as flood flows are diverted into off-stream storage in Tharthar and later returned to the river system. Salts in Tharthar are absorbed by the water stored therein. The quality of the water in both the Euphrates and the Tigris is further degraded by return flows from land irrigated in Iraq as well as urban pollution. The amount and quality of water entering southern Iraq from the Iranian territory is largely unknown, although it is clear that flows are impacted by irrigation return flow originating in the Islamic Republic of Iran.

The deterioration of water quality and the heavy pollution from many sources are becoming serious threats to the Euphrates–Tigris River Basin. A problem is that there is no effective water monitoring network, making it difficult to address water quality and pollution, as the sources of pollution cannot be precisely identified. Hence, the rehabilitation and reconstruction of the water monitoring network is urgently needed for water security.

7.5.5 Types of processing

The fisheries sector in Iraq is of no significant value to the national economy due to absence of export and import activities at present. The Fishery industry (catches, production, fish farms and marketing) is exclusively a private sector activity and it is difficult to estimate the total investment. There is no processing industry for fish products, the gross domestic product of aquaculture not enough to the consumer so we do not find any fish processing plant, because the product consumed fresh by the Iraqi consumer.

7.5.6 Institutions and organizations

There are no special cooperatives for fish breeders, despite the having some cooperatives and fishers associations, which have been noted earlier, has not been given this sector of interest by the state.

Role of public and private sectors

The previous Government in Iraq subsidized the fishing and aquaculture industries through State-funded initiatives such as supplying fingerlings for aquaculture production, providing and repairing boat engines and net material and supplying limited operational supplies such as fish feed. In addition, the public sector (through the General Authority for Animal Resources Development, Fisheries Department) was responsible for fisheries and aquaculture development and management policy and worked through their various offices in each Governorate. Catches, production and marketing of fisheries products are exclusively done by the private sector, the private sector (companies and individuals, fish farms are owned by private sector as well.

Financial services
Financial services are available through the Agricultural Bank, which gives loans to the owners of simple fish projects that cover nearly half the cost of building a small project does not exceed several donums of water, Interaction with other sectors: In Iraq there is no mixed system such as fish farming mixed with rice or fish farming with ducks breeding and do not use drainage water for irrigation.

7.5.7 Management initiatives, enforcement, implementing body

In the previous Government, the principal responsibility for fisheries was with the Ministry of Agriculture, through the General Authority for Animal Resources Development, Fisheries Department. This general Authority was established in 1989. Before that the General Authority for Fish Resources Development was responsible for this activity. In the 18 provinces of Iraq there are sections (divisions) for fish resources that are part of the Ministry of Agriculture and these operate through the local agriculture authority in each province. As described in the above section the General Board for Fish Resource Development is the main authority responsible for developing and upgrading the fishery and aquaculture sectors, encouraging investment, developing procedures through better management, stocking and enhancement of species diversification through an effective regulatory framework for both the inland and marine fisheries, as well as, aquaculture.

In collaboration with FAO, the General Board has designed a scientific training programme to rehabilitate and restore fish resources in Iraq, in order to develop and build up the capacity of the staff. At the same time, there is scientific research collaboration between the General Board and the universities, as well as, all institutional research centres to assess the status of the fisheries resources in Iraq. The following scientific institutes are involved in this research:

- Marine science centre (Basrah).
- College of education/Iben-ALHytham/Biology Department.
- Ministry of science and Technology/Fisheries department.
- College of sciences/Basrah university/Biology Department.
- Technical college technique/Babil.
- Technical Institute/Babil.
- Veterinary college.

7.6 Recommendations

7.6.1 Enhancing livelihoods

Sustained development of aquaculture brings social and biological resilience and strengthening farmers' capacity to positively adapt to changes beyond their control; and the usefulness of risk management as a tool to reduce, mitigate and cope with the threats to farmers' livelihoods, Economically viable and responsible aquaculture systems are resilient systems, better management practices enhance productivity and social and environmental responsibility, their net impact is to strengthen the ability of the aquaculture sector to successfully face the uncertainties and risks wrought by economic crisis and climate change.

7.6.2 Improving fisheries management

Management objectives for capture fisheries (both inland and marine) in Iraq are unclear at the time of writing because of the transitional nature of the present Government. As noted above, a major objective is likely to be the rehabilitation of the marshes of southern Iraq, which will have beneficial impacts on both the freshwater and marine commercial fish stocks of the immediate area and the northern Gulf. The management objectives of the previous Government were orientated towards the development of aquaculture and were:

- Supporting private sector activities in field of marine fisheries (catch) and encouraging investment in marine aquaculture.
- Intensification of fish culture in earth ponds by exploiting the entire existing pond area of farms of about 7500 Hectares. It is estimated that only 25% of this area is exploited in 2003. With the lifting of economic sanctions on Iraq, the availability of equipment and materials for re-habilitation of these farm ponds should improve.

- Introducing fish culture technologies such as floating cages to exploit inland water bodies (lakes and reservoirs) is the best technology for this purpose.
- Developing fish culture in high salinity lakes of high salinity such as Razzaza lake by introducing suitable species of fish.
- Production of fish seed of common carp, grass crap and silver carp in quantities required to cover the needs of fish farms when utilized by full potentials using polyculture techniques.
- Production of Iraqi indigenous fishes (Cyprinidae) such as Bunni, Shabbot and Gattan by artificial reproduction for restocking purpose.

7.6.3 Enhancing processing and marketing

Local markets in the region absorb most of the production from fish farming. Aggregated exports of fish and fishery products from both aquaculture and capture fisheries are thus, minimal. Generally speaking, aquaculture products are insignificant in the exports of the countries of the region. Even some exportable farmed fish species are not likely to be exported because they enjoy higher prices in local markets, especially when considering the additional preparation and shipping costs. Unfortunately, national statistics systems do not provide a breakdown of their fish exports by origin (culture or capture); therefore, no or little information is available. Contribution of aquaculture products to regional exports of fish and fishery products it's very little, Fish marketing – Aquaculture products are traditionally consumed fresh. Governmental fish farms tend to auction their production ahead of the harvesting season. Private producers are free to sell their products either through wholesalers or directly to retailers, or restaurants through special arrangements or even directly to local consumers, with prices usually reflecting supply and demand in a free-market system. Wholesale markets, whether official, free or cooperative, play a key role in fish marketing chains, particularly in big cities, but mainly for fishermen and to a lesser extent for farmers who bring their products to be auctioned daily.

To improve and strengthen aquaculture governance consideration should be given to the following recommendations:

- National aquaculture development policies and plans should be discussed, agreed upon and established through a strong consultation process with all major stakeholders which include governmental authorities; research, training and extension institutions; producers and service providers; aquaculture associations; and other relevant civil organizations. Strategies and implementation plans are more likely to succeed when designed through such a participatory approach.
- Regional aquaculture development strategies need to be projected onto planning matrixes for comprehensive, synchronized and timely implementation. Such matrixes should clearly define major goals, objectives and activities; detailed action plans should be prepared and timely executed; establish monitoring and periodical evaluation systems; and clearly identify performance indicators.
- Applying existing export incentives on quality and safety of farmed products destined to the local markets may significantly encourage the application of BMPs at all farming levels.
- Better performance monitoring of the aquaculture sector along with a regular evaluation of trends and management efficiency is still required in the region and particularly, Special attention should be given to the collection of accurate statistical data. In this respect, farmer associations could play a key role through self management and development.
- Aquaculture product labeling, certification and quality assurance are pressing issues particularly for major export markets and certainly require further attention in the region.
- A thorough review of aquaculture legislation is important, as it will ensure that the sector is developing within a healthy legislative environment. Water and land use, lease terms and conditions, and taxation are key issues in promoting the development of the sector.
- There is a need to further strengthen human capacity and reorganization of services provided to the sector in order to ensure the timely acquisition of new knowledge and technologies

7.7 Opportunities for cooperation at a sub-regional level

Improving the image of the aquaculture industry and environmental performance requires a multifold approach which may be accomplished through the following:

- Limiting aquaculture to locations where environmentally friendly practices can be ensured.
- Adopting good farming practices as those developed by the General Authority for Fish.
- Encouraging the establishment of farming associations that can play an effective role in self-monitoring
- of aquaculture practices and their impacts on the environment.
- Disseminating information on aquaculture practices to the public via different media channels (e.g. press, television, radio and the Web) and through awareness campaigns.
- Enforcing national and international environmental measures and norms.
- Adopting a transparent approach in cases of environmental violations to build confidence among stakeholders.
- Conducting adequate EIAs for all aquaculture projects, in the near future, agricultural, environmental and aquaculture water management will need, inter alia, to take into consideration the following aspects:
- Upgrading of existing treatment plants and monitoring facilities so that they fully comply with standards for effluent water quality.
- Controlling the extraction of groundwater in order to reduce overexploitation.
- Improving water quality in open water bodies through pre-treatment of inflows.
- Increasing water use efficiency by adopting an integrated agriculture-aquaculture where possible, an integrated irrigation-aquaculture and a fish pond.
- Increasing the net benefit per unit of land and water through aquaculture-agriculture rotation systems, whenever and wherever possible.
- Concentrating, as far as possible, on the use of native species for aquaculture development thus, reducing or eliminating the introduction of exotic species.
- Strictly regulating the use of chemicals in fish farming and minimizing excessive feeding;
- Generally improving the management of the aquaculture sector Conduct for Responsible Fisheries and the ecosystem approach to aquaculture.

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This report, in its main body and appendixes, provides an overview of the state of fisheries and aquaculture in the Euphrates–Tigris Basin, including country-level overviews for Iraq, the Syrian Arab Republic and Turkey, as well as the summary record of an expert meeting held in Erbil, Iraq, in 2012, and the outcomes. A list of species for the Euphrates–Tigris Basin is also included. The expert meeting on the review of fisheries and aquaculture activities in the Euphrates–Tigris Basin was the first to purposely address, at the regional level, the sustainable management and development of capture fisheries and aquaculture in the Euphrates–Tigris Basin. A regional cooperation framework was agreed upon. This framework focuses on: resource sustainability; a comprehensive management plan, as well participatory co-management involving resource users and stakeholders; and the promotion and establishment of regional technical cooperation and dialogue with the purpose of establishing regionally harmonized fisheries and aquaculture management plans and actions.

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