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**Actions to Adapt to and Mitigate Climate Change Impacts on Natural Resources: the Case of Fisheries and Aquaculture, Forestry, and Livestock in the Near East**

## TABLE OF CONTENTS

	Paragraphs
I. INTRODUCTION	1-5
II. CLIMATE CHANGE IMPACTS ON NATURAL RESOURCES	6-10
III. MEASURES TO ADAPT TO CLIMATE CHANGE IMPACTS	11-15
IV. ACTIONS TO ENHANCE NATURAL RESOURCE'S ROLE IN CLIMATE CHANGE MITIGATION	16-20
V. MEASURES ON ENABLING CONDITIONS FOR CLIMATE CHANGE ADAPTATION	21-23
VI. IMPLICATIONS OF CLIMATE CHANGE NEGOTIATIONS	24-31
VII. CONCLUSIONS AND RECOMMENDATIONS	32-35

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## I. INTRODUCTION

1. Climate change and climate variability have put the countries in the Near East region (RNE), where scarce natural resources are already under considerable pressure at significant risk. RNE, one of the driest regions in the world, is vulnerable to extreme climatic events such as droughts, floods, sea level rise, storms of dust, sand and snow. The Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup> predicts increases up to 4°C over the short term and to 9°C in the summer months in RNE by the end of the 21<sup>st</sup> century. A reduction in precipitation of 7-29% is predicted, for example, in Syria, Iraq and Arabian Peninsula; and the dry season is expected to increase by 2 months<sup>2</sup> hence reducing the length of time that the rangelands can support grazing animals. Sea levels rise would place coastal areas in Egypt, Kuwait, Libya, Qatar, Tunisia, and UAE at particular risk. Climate change is expected to exacerbate water stress and alter river flows. The region's vulnerability to climate change is aggravated by widespread poverty, particularly in the rural areas where 34% of the population lives below the poverty line<sup>3</sup>.

2. More than 500 million people globally depend on fisheries and aquaculture for their livelihoods. Fish provides essential nutrition for 3 billion people and at least 50 percent of animal protein and essential minerals for 400 million people in the poorest countries. Climate change is creating huge challenges for this sector; already facing serious threats from overfishing and poor management, and its implications for coastal and riparian communities are enormous. Although often overlooked amid broader development concerns, the fisheries and aquaculture sectors have unique issues and vulnerabilities with respect to climate change, which require specific and well-considered responses<sup>4</sup>.

3. Forest resources considered to be the most vulnerable to the combined impacts of climate change and socio-economic changes in RNE include<sup>5</sup>: 1) conifer and mixed relic forests in high mountain ranges – including in Lebanon, Syria, Iran and the southern part of the Arabian Peninsula; 2) threatened relic forests and tree and shrub species; 3) wetland forests – including freshwater forest ecosystems in North Africa; and 4) coastal forests including forests in coastal dune systems in the Mediterranean coast, and mangrove forests in Red Sea and Persian coasts.

4. The Near East is one of the centres of domestication for several livestock species, with a high genetic diversity remaining today. Livestock contributes to food security, poverty alleviation, employment and economic development and shares 30-50% of the agricultural output in the region. Given the aridity of the region, it is a prime component of rural livelihoods in the Near East. Dwindling water and feed resource base due to recurrent droughts, degradation of rangelands and desertification are major concerns.

5. The impacts of climate change on fisheries, forestry, crops and livestock, are eminent with varying degree of vulnerability among sectors and countries. In addition to their role as source of food, transport, fibre and other useful products, these natural resources have great potential for climate change mitigation. However, they contribute to substantial greenhouse gases (GHG) emissions which have to be dealt with. The aim of this paper is to enhance measures to adapt to and mitigate climate change in the region and addresses climate change impacts, past evidences, hotspots of climate change, projections and vulnerability of the sub-sectors, with a special focus on livestock, forestry, fisheries and aquaculture sectors.

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<sup>1</sup> IPCC. 2007. The Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

<sup>2</sup> Evans, J.P. 2009. 21<sup>st</sup> century climate change in the Middle East. *Climatic Change*. 92:417–432.

<sup>3</sup> IFAD. 2010. Climate change and sustainable water resources management: IFAD's experiences...IFAD, Rome.

<sup>4</sup> FAO. 2011. Strategy for fisheries, aquaculture and climate change. Framework and aims 2011-2016. FAO, Rome. 18 pp

<sup>5</sup> AFED. 2009. Arab environment: climate change. [www.sciencedev.net/Docs/arab\\_climate\\_report.pdf](http://www.sciencedev.net/Docs/arab_climate_report.pdf)

## II. CLIMATE CHANGE IMPACTS ON NATURAL RESOURCES

6. Changes in temperature have been well documented in RNE. Recent studies<sup>6</sup> using data from 75 weather stations of 15 countries in RNE disclosed significant increases in number of warm days and decreases in number of cold days, and revealed ample evidence of hotspots of impacts and vulnerability to climatic fluctuations in the Region<sup>7,8</sup>. The region also witnessed varying degree of extreme events such as droughts, floods, and sand and snow storms. In the north-eastern Syria, for example, herders lost almost 85% of their livestock due to repeated droughts since 2005<sup>9</sup>. In Mauritania and Morocco, these impacts included northern migration of sardinella and the collapse of sardine stock in 1997; in the Mediterranean a rise in sea surface temperature (SST) produced shifts in the distribution and abundance of species. Coral bleaching has been witnessed in the RECOFI<sup>10</sup> region and in 1998, PERSGA<sup>11</sup> reported that El-Nino induced coral bleaching and mangrove loss in parts of the Gulf of Aden and Red Sea.

7. Reduced precipitation and number of precipitation days in a year will add stress on already scarce water resources in many countries, and shift arable land into more arid rangelands, which would result in increased importation of water and feedstuffs or decreasing herd sizes. For example, a reduction in productivity of crops and shortage of water will be evident in Egypt and shortening of the length of growth period and number of freezing days would affect crops in Iran. It is expected that climate change will overall increase the interdependence of countries in respect to the access and use of genetic resources for food and agriculture<sup>12</sup>. Some of the projected changes in the region are summarised below.

8. Climate change will significantly impact the four dimensions of food security (availability, access, stability and utilization). The impact of climate change on the fisheries and aquaculture sectors will contribute to *availability* of aquatic foods through changes in habitats, stocks and species distribution and diversity; *stability* of supply by changes in seasonality, increased variance in ecosystem productivity and increased supply variability and risks; *access* to aquatic foods by changes in livelihoods and catching or farming opportunities, landing sites and fish prices; and *utilization* of aquatic products which will also be impacted. While the fisheries sector on the whole has historically been adaptable, increasingly over-exploited and poorly managed fisheries in the region may have reduced its adaptive capacity. Climate change can bring negative as well as positive impacts (potential increased flow of the Nile and increased primary productivity in the Arabian Sea<sup>13</sup>) on the fisheries and aquaculture sectors and the capacity to adapt to both of these will determine how they develop

9. Climate change and variability threaten the sustainability of agricultural systems and of forest and range resources in RNE and could result in further deforestation and forest and range degradation, thus undermining forest and range ecosystem services that are essential to livelihoods and food security. Climate change is also predicted to increase the risk of wildfires, cause shifts in species' ranges and increase the risk of genetic erosion and species extinctions, and, through sea level rise, affect negatively mangroves and other coastal ecosystems.

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<sup>6</sup> Zhang et al. 2005. Trends in Middle East climate extreme indices from 1950 to 2003, J. Geophys. Res., 110, D22104

<sup>7</sup> Celis et al. 2007. Hot spots of land cover change and drought vulnerability. Aleppo, Syria, ICARDA, 69 p.

<sup>8</sup> De Pauw, 2008. Hot Spots of Vulnerability to Climate Change. ICARDA Caravan, 25: 43-44.

<sup>9</sup> IRIN. 2011. <http://reliefweb.int/node/367335>

<sup>10</sup> RECOFI covers an area of water including the Gulf, Sea of Oman and north Arabian Sea. There are eight countries with coastal waters in RECOFI, including Bahrain, Iran (Islamic Republic of), Iraq, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates

<sup>11</sup> Regional Organization for the Conservation of the Environment in the Red Sea and Gulf of Aden, [www.persga.org](http://www.persga.org)

<sup>12</sup> Commission on Genetic Resources for Food and Agriculture. Background Study Paper N. 48. "The impact of Climate Change on Countries' Interdependence on Genetic Resources for Food and Agriculture".

<sup>13</sup> Goes, J. et al. 2005. Warming of the Eurasian Landmass is making the Arabian Sea more productive. Science 22 April 2005: Vol. 308 no. 5721 pp. 545-547 DOI: 10.1126/science.1106610

10. Climate change impacts livestock production and health through changes in the quantity and quality of available feeds, heat stress, available water, livestock diseases and disease vectors, and genetic diversity<sup>14</sup>. A reduction in precipitation will result in the loss of natural pastures leading to a loss of adapted animal genetic resources. Accelerated feed shortages are likely to worsen the rangeland degradation further. A predicted loss of 25% of animal production<sup>15</sup> relate to only reduced feeds and increased heat stress in the mixed crop-livestock system. Mapping and quantifying climatic data in combination with the spatial information on livestock production systems, livestock numbers and people was used to identify hotspots of change and vulnerability. Hotspots of vulnerability were identified where most people and livestock will be affected. Table 1 presents results grouped by livestock production systems, as adaption and mitigation options often will relate to these production systems.

Table 1. Projected changes in precipitation, temperature, vulnerable human and livestock population in the Near East<sup>16</sup>

Production system	Countries	Precipitation reduces by	Temperature increases	Vulnerable population	Rural	Vulnerable Livestock population
<b>agro-pastoral</b>	Morocco Tunisia Algeria	11 to 28%	2.2 to 3.3°C	15 to 23%		<i>Sheep &amp; goats:</i> 37% Algeria; 33% Tunisia
	Egypt Libya		2.2 to 2.8°C	Egypt 22%, Libya 88%		<i>Sheep &amp; goats:</i> 38% Egypt; 87% Libya <i>Cattle:</i> 13% Egypt; 79% Libya
	West Asia	By up to 20%	2.3 to 3.1°C	29% Iran 35% Iraq 22% Jordan 8% Syria		<i>Sheep &amp; goats:</i> 44% Iran; 24-38% Iraq, Jordan, Syria <i>Cattle:</i> 31% Iran & Iraq; 15% Jordan & Syria
	Arabian Peninsula	↑7% 24%	2.2 to 2.9°C			<i>Sheep &amp; goats:</i> 90% Yemen, Oman, Qatar; 50% Kuwait & UAE
<b>Mixed extensive (8% of the Near East)</b>	Morocco Tunisia Algeria	Algeria & Tunisia: 9 to 23% Morocco: 8-26% Mauritania: 15-29%	Algeria: 1.9-3.6°C Tunisia: 1.6-2.8°C Morocco: 1.6-3.3°C Mauritania: 2.3-3.2°C	Algeria: 71% Tunisia: 65% Morocco: 70% Mauritania: 16%		<i>Sheep &amp; goats:</i> 30-59% <i>Cattle:</i> 41-61%
	Egypt Libya		2.2 to 2.8°C	22% in Egypt 88% in Libya		<i>Sheep &amp; goats:</i> 38% Egypt; 87% Libya <i>Cattle:</i> 13% Egypt; 79% Libya
	West Asia	Syria: 18% Iran & Iraq: 14%	Syria: 1.7 to 2.3°C  Iran & Iraq: 2.5 to 3.3°C	43-47%		<i>Sheep &amp; goats:</i> Syria: ca 50% ; Iran: 35%; Iraq: 47% <i>Cattle:</i> Syria: ca. 50% Iran : 39% ; Iraq : 29%
<b>Landless</b>	Egypt	Data not available	Data not available	Data not available		<i>Sheep &amp; goats:</i> 30% <i>Cattle:</i> 35% <i>Buffaloes:</i> 50%

<sup>14</sup> Thornton et al. 2009. The impacts of climate change on livestock and livestock systems.... Agricultural Systems, 101: 113–127

<sup>15</sup> Sequin, 2008. In: Proceedings... Hammamet, Tunisia, 17-20 May 2008. Cambridge University Press.

<sup>16</sup> Van de Steeg, J. and Tibbo, M. 2012. Livestock and Climate Change in the Near East: Measures to adapt to and mitigate climate change. FAO-RNE (unpublished)

### III. MEASURES TO ADAPT TO CLIMATE IMPACTS

#### A. Fisheries and aquaculture

11. Actions to most effectively address the impact of climate change on **fisheries and aquaculture** in RNE were identified using the Ecosystem Approach to Fisheries (EAF) and Aquaculture (EAA), and examples of adaptation strategies are given Tables 2 and 3.

Table 2. Examples of adaptation strategies for capture fisheries

Marine Capture Fisheries								
Identification of adaptation and management strategies for priority impacts								
Ecological well-being			Human well-being			Governance and ability to achieve		
Priority Impact	Adaptation Strategy	Implementation Scale	Priority Impact	Adaptation Strategy	Implementation Scale	Priority Impact	Adaptation Strategy	Implementation Scale
Recruitment and life cycle	Life cycle assessment	Regional	Livelihood changes AND revenue changes	Develop and enhance aquaculture practices	National	Government instability	Capacity building inside the sector to increase the ability to achieve	Local and national
Changes in habitat structure	Responsible stock enhancement	Local		Explore and implement livelihoods diversification	Local and National		Explore and implement incentive mechanisms for increasing efficiency and increasing livelihood diversification	Local and national
	Coastal habitat restoration	Local		Optimizing the harvest sector	National	Changes in community level management (access rights)	Establish co-management systems within legal and policy framework	Local and national
				Adaptive post-harvest and marketing strategies	National and regional			

12. Adaptation strategies at all levels (community, national and regional) will require and benefit from stronger capacity building, through awareness raising on climate change impacts on fisheries and aquaculture, promotion of general education, and targeted initiatives in and outside the sector. In RNE there is a willingness to implement capacity building in the fisheries sector and the institutional capacity in the region is good. However, the operational capacity (finance and human) is moderate to low, posing an important challenge that must be considered when designing adaptation strategies. Adaptation actions in the aquaculture sector will need to rely on the availability of the most suitable genetic resources and of the specific knowledge for their use<sup>17</sup>.

<sup>17</sup> Commission on Genetic Resources for Food and Agriculture. Background Study Paper N. 55. "Climate Change and Aquatic Genetic Resources for Food and Agriculture: State of Knowledge, Risks and Opportunities"

Table 3. Examples of adaptation strategies for aquaculture

Aquaculture								
Identification of adaptation and management strategies for priority impacts								
Ecological well-being			Human well-being			Governance and ability to achieve		
Priority impact	Adaptation strategy	Implementation Scale	Priority impact	Adaptation strategy	Implementation Scale	Priority impact	Adaptation strategy	Implementation Scale
Water quality change	Monitoring system and early warning system	Farm, watershed and national level	Food security	Integrated agriculture aquaculture and development of (IMTA)	Farm	Climate-change proofing policies, planning and implementation for aquaculture	Investment in research to improve aquaculture adaptation and/or facilitate research and information to climate-change-proof aquaculture	National
	Set up a biosecurity framework	Watershed		Raise awareness about integrated aquaculture to improve food security	Watershed			
Extreme climate events	Preparedness of the farmers To improve farming systems	Watershed	Food security	Research and experimentation with new species	National	Farmers organized are better prepared. Enhance farmers associations	Watershed	
				Diversification incentives, new markets and new species	National			
	Set up a biosecurity framework	Watershed	BMPs, including training and incentives	Farm, watershed, country	Facilitate the production of local vulnerability maps and risk maps		National	
	Use local knowledge	Watershed	Food Safety	Standards setting	National		Government institutions improved to enhance cross-sectoral cooperation and coordination	National
	Ensure the provision and access of early warnings by farmers.	National	Toxics monitoring, classifying areas for different kinds of farming	Watershed (but facilitated by national governments)	Make efforts to develop a country aquaculture strategy and plan considering climate change		National	
	Facilitate education and readiness	National	Sharing information in the region	Watershed (but facilitated by national governments)				

## B. Forests and rangelands

13. Adapting **forest and range** management to climate change will entail making adjustments at every level, from local to national. It will require changes not only in management practices on the ground, but also in policies, institutions and other governance arrangements. Public awareness needs to be raised, new research will be required, climate change vulnerability assessments and cost-benefit analyses of mitigation and adaptation measures will be needed, and human and institutional capacities to deal with the emerging challenges will have to be strengthened.

14. Reversing unsustainable forest and range management practices (e.g. excessive livestock numbers, overgrazing, illegal logging, overharvesting of fuel wood and other products of rangelands) and applying best practices are fundamental for restoring ecosystem health and resilience. A review of the National Communications (NCs) and National Adaptation Programmes of Action (NAPAs) submitted to the United Nations Framework Convention on Climate Change (UNFCCC)<sup>18</sup> by the member countries of the Near East Regional Conference (NERC) provides a good indication of the types of adaptation measures the countries identify as most important. Actions identified in the forest and range sectors include restoration of degraded forests, afforestation and reforestation, use of drought tolerant species and varieties, watershed management, measures to reduce soil erosion and salinization, fire management, mangrove restoration and rangeland rehabilitation. Many of these actions will need to consider biodiversity issues, such as the use of adequate species and/or genetic

<sup>18</sup> [http://unfccc.int/national\\_reports/items/1408.php](http://unfccc.int/national_reports/items/1408.php)

resources, to ensure their sustainability in the long term<sup>19</sup>. Community-based management of natural resources and policy reform to increase peoples' access to natural resources were listed by some. Many countries listed improved forest/range monitoring, awareness raising, education, research, and institutional and policy reform as needed actions.

### C. Livestock

15. Livestock producers have long been **adapting** to environmental and climate changes using herds of mixed animal species and breeds, widespread and seasonal pastures, splitting animals into discrete herds and mobility, and involved in other economic activities<sup>20</sup>. However, increased urbanization, population growth, economic growth, consumption of animal source foods and commercialization made those existing coping mechanisms inadequate<sup>21</sup>. New approaches, technologies, and training to deal with climate change are now needed as well as better policies and stronger institutions to manage natural resources sustainably. Adaptation strategies include:

1. *Integrating crop-livestock* allows better use of crop residues as feed and animal manure as organic fertiliser and/or source of bioenergy for biogas, and reduces pressure on rangelands and water resources. *Supplementary feeding* of animals is also needed especially for animals reared for market as rangelands provide only a third or less of their feed needs. Introducing drought-tolerant crops and shrubs and use of appropriate tree forages<sup>22</sup> would also rehabilitate rangelands and increase productivity of livestock.
2. *Herd diversity*<sup>23</sup> by using multi-species and multi-breed and *herd splitting* into smaller manageable groups and moving them into different areas would buffer against climatic and economic adversities, prevent over-grazing and maintain the long-term productivity of rangelands<sup>24</sup>. *Mobility* has also been used for centuries by livestock keepers as a strategy to adapt to spatial and temporal variations in precipitation, though it can lead to problems of overgrazing, exposure to new diseases and parasites, resource use conflicts, etc.
3. *Production and marketing strategies* involve range of husbandry adjustments to counteract heat stress that may suppress feed intake, production, fertility, and survival rates<sup>25</sup>. Livestock *insurance* scheme based on index<sup>26</sup> which compensates clients for the loss of animals or reduced productivity because of drought should be introduced. The scheme is based on cumulative precipitation, cumulative temperature, area average yield, area livestock mortality and related indices. Unlike traditional insurance a payout is based on an external indicator which triggers a payment to all insured clients within a geographically defined space<sup>27</sup>.
4. *Adapted local livestock breeds* produce under conditions where other breeds cannot survive, resist or tolerate diseases, drought, water scarcity, stress from strong heat and solar radiation. They are also integral parts of their environment that help sustain biodiversity, as highlighted

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<sup>19</sup> Commission on Genetic Resources for Food and Agriculture. Background Study Paper N. 56. "Climate Change and Forest Genetic Resources - State of Knowledge, Risks and Opportunities"

<sup>20</sup> McIntire, 1991. Managing risk in African pastoralism. In: D. Holden et al. (eds). Risk in Agric. Proc. 10<sup>th</sup> Agric. Sector Symp. WorldBank.

<sup>21</sup> Sidahmed, A.E. et al. 2008. Livestock and climate change. In: P. Rowlinson et al (eds). Proceedings... Hammamet, Tunisia, Camb. Univ. Prs.

<sup>22</sup> Kitlyi, A. et al. 2008 Agro-forestry & livestock: adaptation... In: P. Rowlinson et al (eds). Proc... Hammamet, Tunisia, Camb. Univ. Prs.

<sup>23</sup> Hoffmann, I. 2010. Climate change & the characterization, breeding and conservation of anim. genet. resources. Anim. Genetics, 41: 32-46.

<sup>24</sup> Nyariki, D.M. & Ngugi, R.K. 2002. A review of African pastoralists' production system... Journal of Human Ecology, 13(3): 137-250.

<sup>25</sup> Pilling, P. & Hoffmann, I. 2011. CC and AnGR for food and agriculture: state of knowledge, risks & opportunities. B. Study Paper no. 53.

<sup>26</sup> Barrett C.B. et al. 2008. Codebook for data collected under the improving pastoral risk management on East African Rangelands.

<sup>27</sup> Ouma, R. et al. 2011. Review of pastoral development ... some innovations in risk management. Exp. Agric. 47 (2): 375-393.

in FAO's *Global Plan of Action for Animal Genetic Resources*<sup>28</sup>. Most of the adapted breeds, however, are largely uncharacterized and their loss as a result of droughts and floods, or disease epidemics related to climate change may increase. To secure against such disasters, it is necessary to characterize animal genetic resources and subsequently to build inventories, including information on the spatial distribution of breeds and valuable breeding stocks and countries should have a plan for conservation programmes. Countries need to introduce animal identification and traceability as an important livestock management tool.

5. *Modelling and forecasting emerging infectious animal disease and early warning systems* are crucial components for preparedness. Remote sensing satellite imagery is now being used to study a variety of environmental parameters in order to evaluate their potential to predict the emergence patterns of mosquito vectors of the *Rift Valley Fever*<sup>29</sup>. *Bluetongue* is another important viral disease whose distribution is affected by the changing climate. Climate and environmental changes might deeply alter the transmission pattern and disrupt the local epidemiological equilibrium, as is expected for malaria. The demographic growth of large cities and, more generally, the increase of human populations in northern Africa and the Middle East will result in more intense livestock aggregation around market areas, the merging of populations from different origins, and increased trade from sub-Saharan Africa to these regions. With periurban growth and climate change some devastating outbreaks could happen due to the fact that the vector *Culicoides* deposits their eggs in stagnant or slow moving waters with rich organic material or dung. *Old World Screwworm* risk prediction identified hotspots in southwest Iran, southwest Yemen, and along the south coast of Oman, and observed suitable condition areas in parts of Syria, Lebanon, Jordan, along the Nile Valley in Egypt, and in relatively large areas of Sudan. The FAO coordinated Global Information and Early Warning System (GIEWS) and the Famine Early Warning Systems Network (FEWS NET) of USAID were developed to manage risk of food insecurity through the provision of timely and analytical early warning and vulnerability information (<http://www.fews.net/>).
6. *Appropriate policies and institutions* for coping with climate change are needed for assisting livestock keepers, farmers and rural communities manage droughts in dry areas. Policies need to provide supportive conditions for smallholder farmers and pastoralists through guaranteeing access to grazing land and water, and facilitating the provision of appropriate services and infrastructure. Livestock keepers should be represented in national and international decision-making bodies, a voice in policy-making.

## IV. ACTIONS TO ENHANCE NATURAL RESOURCE'S ROLE IN CLIMATE CHANGE MITIGATION

### A. Fisheries and aquaculture

16. The primary mitigation route for the sector lies in its energy consumption, through fuel and raw material use. Fuel efficiency can be increased by improved fisheries management. Overfished stocks at lower densities and lower individual sizes require vessels to exert more effort, travel further and increase fuel use per tonne of landings. Climate change mitigation could be complementary to, and reinforce, existing efforts to improve fisheries and aquaculture sustainability<sup>30</sup>. These efforts can also play a role in decreasing costs and increasing profit per unit effort for fishing livelihoods. Energy consumption is important not just during production operations, but also for the transport, processing and storage of fish, so mitigation options by increasing energy efficiency must be considered

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<sup>28</sup> Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration  
<ftp://ftp.fao.org/docrep/fao/010/a1404e/a1404e00.pdf>

<sup>29</sup> Gould, E.A. & Higgs, S. 2009. Factors influencing emerging arbovirus diseases. *Trans. Royal Soc. Trop. Med. Hyg.* 103: 109-121.

<sup>30</sup> Reducing fishing effort and fleet capacity in order to reduce energy consumption and carbon emissions and reducing fishmeal reliance in aquaculture as well as increasing efficiency and reducing waste

throughout the fish supply chain. Another possibility would be to reduce the use of fuel through increasing use of renewable energy, and in particular bioenergy made from the residues of fish production and processing.

## B. Forests and rangelands

17. Mitigation actions in forestry include reducing GHG emissions due to loss of carbon stocks (through reducing deforestation and forest degradation and through conserving existing carbon stocks); enhancing carbon stocks (through afforestation, reforestation and forest restoration); and substituting non-renewable carbon rich materials with wood, which is a renewable resource. This contributes to the REDD+ programme goes beyond deforestation and forest degradation, and includes the role of conservation, sustainable management of forests and enhancement of forest carbon stocks.

18. Forest cover in RNE has been relatively stable over the past 20 years, so the region has less scope than other regions to reduce emissions from deforestation. The potential for significantly increasing forest cover through afforestation is limited in many countries by biophysical conditions, the availability of suitable land and relatively high cost/benefit ratio for planted forests. The region's main forestry and rangelands options for mitigation were to reduce degradation, for instance through measures to reduce and/or improve the use of fuelwood, and to enhance forest and rangelands restoration.

19. Rangelands' potential in carbon sequestration could be used to mitigate GHG emissions by avoiding land use changes that reduce soil carbon stocks and cautious management of pastures. Significant amounts of soil carbon could be stored in rangelands or in silvopastoral systems through a range of management practices suited to local conditions. Soil carbon sequestration is the mechanism responsible for most of the mitigation potential in the agriculture sector, with an estimated 89% contribution to the technical potential<sup>31</sup>. Carbon trading-related payments to farmers and pastoralists in semi-arid areas could provide an important incentive for those producers to adopt land management practices that build soil carbon pools. A well-managed grazing can increase carbon deposition through improved management in grasslands such as conversion of cropland to grassland, reduction in grazing intensity and biomass burning, improving degraded lands and reducing erosion, and changes in livestock species mix.

## C. Livestock

20. Mitigation strategies should focus on:

1. *Adjusting livestock numbers* to available resources, increasing individual animal resource use efficiency and optimization of feed rations and feed additives or other technologies may be primarily used to reduce methane excretion in ruminants. GHG from enteric fermentation change as production systems intensify and move toward higher feed use and increased productivity. Less GHG emissions are produced, for example, in beef cattle intensive feedlot systems and dairy farms. Emissions from extensive systems can be reduced through improved genetic potential of the animals, increased feed quality and manure management. Reducing livestock numbers is probably the only effective way to reduce GHG emissions in pastoral systems. Problems to be overcome in mitigation are incentive systems, institutional linkages, policy reforms, monitoring techniques for carbon stocks, and appropriate verification protocols.
2. *Animal waste management*: GHG emitted from manure are mainly methane and nitrous oxide<sup>32</sup>. Raising animals on pasture is an efficient way to reduce methane emission from manure. In addition to production of renewable energy, reducing storage duration of slurry, especially in

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<sup>31</sup> IPCC. 2007. Contribution of Working Groups I, II and III to the 4<sup>th</sup> Assessment Report of the IPCC. Geneva, Switzerland, IPCC.

<sup>32</sup> Steinfeld, H. et al. 2006. Livestock's Long Shadow: Environmental Issues and Options. LEAD. Rome, Italy, FAO.

hot conditions, the treatment of manure, and improved spreading techniques could reduce GHG emission<sup>33</sup>.

3. *Intensifying livestock production systems* reduce emissions through 1) improved feeding management through the use of biotechnologies and additives and high quality feeds and concentrates; 2) selective culling of unproductive animals, breed selection, improved herd health and minimising involuntary culling; 3) keeping browsing and grazing animals together, especially when feed is in short supply, to increase complementarities and make use of forage that cannot easily be used by other species; 4) improved feed conversion efficiency through appropriate practices including genetics, nutrition, reproduction or health improvement.
4. *Enhancing research into farming methods* to generate knowledge in search of better ways of managing farm inputs, characterising local livestock breeds in terms of their resistance and tolerance to specific diseases, adaptation to poor-quality feeds or to feeding in harsh conditions, and tolerance to climatic extremes.
5. *Improving policies* have the greatest chance of success in mitigation if they build on traditional pastoral institutions and knowledge, while providing pastoralists with food security benefits at the same time.

## V. MEASURES ON ENABLING CONDITIONS FOR CLIMATE CHANGE ADAPTATION

21. Adaptation measures for fisheries and aquaculture include increasing monitoring of fish resources, optimizing the supply chain, exploring different processing methods and marketing different fish species to the general population can assist to increase the resilience of the sector. Finally, disaster risk management should be promoted and implemented. Aquaculture systems that are less or non-reliant on fishmeal and fish oil inputs have a better scope for expansion than those systems dependent on capture fisheries commodities. Mariculture can offer an opportunity for fish production though is not well developed in RNE. One could also increase energy self sufficiency through the use of bioenergy from fish residues.

22. National politics and policies have a major effect on the livelihood of livestock keepers. Supportive policies stimulate, for example, the import of live animals in Jordan and Lebanon. Jordan relies on importing beef cattle for meat. Lebanon imports more than twice the amount of cattle and more than half the amount of sheep than that reared in the country. These import numbers are high, as local production is not supported by regulations and policies and witnessed that importing is cheaper than local production leading to further decline in local food production. The impact of climate change on the price of feeds will have direct effect on livestock production and import. In order to respond to the increasing demand for livestock products, enhancing local production should be stimulated by national policies. The import of live animals for local slaughtering ignores the GHG emission of livestock production elsewhere.

23. Gender disaggregation of roles in livestock production systems should be studied<sup>34</sup> to direct appropriate capacity building to improve adaptive responses to the impacts of climate change. Climate change is likely to intensify existing inequalities and have different effects on the capacity of women and of men to cope with additional stresses<sup>35</sup>. In view of their role as the most significant suppliers of family labour and efficient managers of household food security, more emphasis needs to be placed on ensuring that any adaptation and mitigation strategies developed take into account these differences and the increased needs of women for building community resilience to climate change.

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<sup>33</sup> Dourmad, J-Y. et al. 2008. Mission of greenhouse gas, developing management and animal farming systems to assist. In: P. Rowlinson et al (eds). Proceedings... Hammamet, Tunisia, Camb. Univ. Prs.

<sup>34</sup> Tibbo, M. et al 2009. [http://www.fao-ilo.org/fileadmin/user\\_upload/fao\\_ilo/pdf/Papers/17\\_March/Tibbo\\_final.pdf](http://www.fao-ilo.org/fileadmin/user_upload/fao_ilo/pdf/Papers/17_March/Tibbo_final.pdf)

<sup>35</sup> IFAD. 2009. Livestock and climate change. Rome. Italy, IFAD.

## **VI. IMPLICATIONS OF CLIMATE CHANGE NEGOTIATIONS & OPPORTUNITIES FOR REGIONAL COOPERATION**

24. All members of NERC are Parties to UNFCCC. Most have submitted at least one National Communication to UNFCCC and three countries: Mauritania, Sudan and Yemen have prepared and submitted a NAPA to UNFCCC. Over the past few years, UNFCCC has put increasing emphasis on climate change adaptation, recognizing that it must proceed at the same time as accelerated mitigation action. In the climate change meetings in Cancun in December 2010, UNFCCC adopted a decision<sup>36</sup> calling for enhanced action on adaptation by countries, including through international cooperation, and established the Cancun Adaptation Framework to guide action. UNFCCC also established a Green Climate Fund, through which a significant share of multilateral funding for adaptation is expected to flow and to supplement funds available through the Adaptation Fund (operational since 2007). The Cancun decision also invites Parties, in particular developing countries, to strengthen or establish regional centres and networks to facilitate and enhance national and regional adaptation actions and encourage intra-regional cooperation and coordination.

25. These decisions will pave the way for more support for adaptation actions and could lead to intensified regional cooperation in climate change. Developing countries with NAPAs or other well developed national or sectoral strategies for climate change adaptation will be better positioned than others to benefit from emerging sources of enhanced technical and financial support. Countries can also benefit from regional networks and support programmes that would facilitate the exchange of information and experience and promote regional collaboration in research and capacity strengthening.

26. In Cancun, UNFCCC also adopted important decisions on mitigation, including on NAMAs and REDD+. These provide potential incentives for the Near East countries to contribute to mitigation. The degree of impact of REDD+ on countries, in particularly on dry land and low forest cover countries but with extensive rangelands systems, remains to be seen. Key issues include what financial mechanism(s) for REDD+ including rangelands systems will be agreed upon by UNFCCC; if the financial benefits from REDD+ activities will outweigh the costs to the country and to forest owners/users engaging in REDD+; and the level of technical and managerial expertise that will be required in the country to implement a successful national REDD+ programme.

27. FAO has, over the past several years, intensified its work on climate change. Among other key initiatives, it has developed a climate change adaptation framework programme to assist member countries, is working to raise the profile of climate-smart agriculture and food security in UNFCCC, and is supporting early actions on REDD+ through the UN-REDD partnership (FAO, UNDP and UNEP) and mitigation actions in the Mitigation of Climate Change in Agriculture (MICCA) Programme. The Commission on Genetic Resources for Food and Agriculture, at its Twelfth Regular Session in 2011, recognized the need to address climate change in its Multi-Year Programme of Work. The Commission carried out studies on climate change and all the sectors of genetic resources relevant to food and agriculture and adopted a roadmap for its future work in this area.

28. The FAO Forestry Department is developing two tools for use and adaption, as appropriate, by countries to help them integrate climate change into the forestry sector. One is for use by policy makers – for incorporating climate change into national forest programmes, and the other is for use by forest managers to help them identify and undertake adaptation and mitigation actions. These will be available for use in 2012 by interested countries.

29. Due to the nature of the fisheries and aquaculture sector, which does not naturally fall within country boundaries, regional cooperation is particularly important. River basins and water bodies create possibilities for a more ecosystem-based approach to adaptation. Regional fishery bodies such

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<sup>36</sup> Decision 1/CP.16: See <http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2>

as RECOFI and GFCM<sup>37</sup> provide opportunities for this approach, and also provide a forum for countries with less institutional capacity and technological knowledge and experience to take advantage of those countries with the required capacity and resources to tackle challenges on the scale of climate change. Regional cooperation in the Red Sea and Gulf of Aden should be strengthened, and cooperation within trans-boundary Rivers should also be considered.

30. In 2010, FAO prepared two regional analyses on forests and climate change one for the Near East region and other for Eastern Europe and Central Asia which highlighted needs and opportunities for regional cooperation on forests and climate change. FAO intends to explore countries' interest in developing regional or sub-regional support mechanisms for forests and climate change, which, with donor support, could enhance regional cooperation and sharing of experiences, strengthen technical capacity, provide technical information and help develop or adapt technical tools appropriate for the region, assist countries in development of forest and climate change funding proposals and help raise public awareness. A workshop to explore needs and interest in developing sub-regional projects to support forests, rangelands and climate change actions in RNE was held from 20-22 September 2011 in Cairo. FAO has also sponsored: (i) Second Forum on Climate Change in the Near East: climate change, agriculture and food security held in June 27-29 2011 in Beirut, Lebanon; (ii) International Conference on adaptation to climate change and food security in the West Asia and North Africa region held 13-16 November 2011 in Kuwait.

31. Regional cooperation needs enhancement in areas of the implementation of Global Plan of Action for Animal Genetic Resources (GPA-AnGR), developing regional capacity in vulnerability assessment, monitoring and adaptation measures, drought insurance scheme, early warning systems for climate risk reduction, regional trust fund for climate change adaptation and mitigation, mapping breeds against environment for exchange and conservation of genetic resources for sustainable use in the region, etc.

## VII. CONCLUSIONS AND RECOMMENDATIONS

32. Climate change will have far-reaching effects on the already stressed natural resources in all Near East countries although the impacts will vary considerably from location to location. Reduction in rainfall by up to 29% and temperature increase by up to 4°C will significantly reduce water available for much needed increase in food production. Degradation of forests, rangelands and soil will negatively impact food and feed production and biodiversity conservation. Extreme climatic events will be evident such as droughts, floods, sea level rise, sand storm and occasionally snow. Better modelling of impacts is needed to better define (at local level) and assure investment in adaptation strategies. Increasing incidences of droughts, new animal diseases and parasites, and scarcity of feed supply are issues farmers have already experienced. Disappearance of palatable rangeland species following severe degradation of grazing lands, severe water shortage and shrinkage of annual rivers, repeated crop failures due to recurrent droughts are visible phenomena. Producers have been trying to adapt to these changes but with only short-term measures and need sustainable and coordinated adaptation and mitigation measures so that they continue to produce by increasing resilience of their production systems.

33. Fisheries and aquaculture industries in RNE must adopt adaptation strategies on a variety of levels in order to prepare adequately for the impacts of climate change, and must enhance capacities to effectively implement these strategies. Additionally, it is necessary to integrate the fisheries and aquaculture sector into the wider policy framework, as well as integration between sectors and across levels. Promoting the sector's involvement in climate change adaptation funding<sup>38</sup> at the regional and

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<sup>37</sup> General Fisheries Commission for the Mediterranean

<sup>38</sup> National Adaptation Programmes of Action (NAPAs), Least Developed Countries Fund for climate change adaptation and Special Climate Change Fund

national levels will also increase adaptation capacity. FAO has a well elaborated climate change strategy which can be referred to for further recommendations and action.<sup>39</sup>

34. The following key summary and recommendations are forwarded which also benefited from different forums<sup>40</sup>:

1. RNE is the most vulnerable region to climatic changes which would negatively affect food security and livelihoods of people who depend on natural resources.
2. Climate change impact assessment on livestock, aquaculture and fisheries, forestry and natural resources considering climate change model projections is one of the priorities
3. Adaptation to climate change is a top priority for crop, livestock, forest, rangelands, fisheries and aquaculture sub-sectors among others to achieve food security.
4. Adaptation and mitigation to climate change are very much linked in natural resources sectors, including biodiversity and genetic resources for food and agriculture, and therefore attention should be paid to both aspects in view of synergies and funding opportunities.
5. Full regional cooperation and exchange of successful experiences among countries using various networks and fora, funding for regional projects and programs should be strengthened.
6. Enhancing coordination among relevant institutions at the local, national and regional levels, including in understanding how farmers, fishermen, foresters and herders, are coping with climate change for improving sharing of best practices. Exchange of genetic resources for food and agriculture and of their related knowledge may also be taken into consideration.
7. Financing adaptation actions should be ensured through rural development funding mechanisms (official development assistance and other sources) as a primary funding source, with complementary specific climate change funding mechanisms Or integrating adaptation priorities into rural development programmes and funding mechanisms may be relevant
8. Member Countries of the Region, FAO and other organizations to launch a cooperative action in order to enhance national capacities in tackling the impacts of climate change on agriculture and food security in the Region through:
  - Enhancing involvement of policy and decision-makers and their recognition of climate change impacts;
  - Elaborating and implementing national policies and strategies for adaptation to climate change in agriculture and food security;
  - Considering the needs of proper management of genetic resources for food and agriculture in planning and implementing National Adaptation Programmes of Action and Nationally Appropriate Mitigation Actions.
  - Developing capacity in vulnerability assessment, monitoring and adaptation measures;
  - Supporting assessment of the impact of climate change on biodiversity in the region;
  - Improving data-collection and information-sharing on climate change impacts and adaptation options between relevant stakeholders;
  - Developing early warning systems against extreme climatic events;
  - Strengthening national coordination among the multiple stakeholders and expand involvement of stakeholders to include NGOs, civil society, universities, the private sector, etc;
  - Increasing public and private investment in climate change adaptation, improving capacity to access other available financial resources and considering the establishment of weather based index insurance;
  - Promoting the climate change agenda in the agricultural sector within national institutions systematically for fund raising;

<sup>39</sup> The following sites can be referred to

[ftp://ftp.fao.org/FI/brochure/stragegy\\_fi\\_aq\\_climate/2011/climate\\_change\\_2011.zip](ftp://ftp.fao.org/FI/brochure/stragegy_fi_aq_climate/2011/climate_change_2011.zip),  
<http://www.fao.org/docrep/012/i1323e/i1323e00.htm>, <http://www.fao.org/climatechange/27594-03ecd7bd225b93086e7dca3944de64307.pdf>

<sup>40</sup> Second Forum on Climate Change in the Near East under the theme Climate Change, Agriculture and Food Security” in Beirut, Lebanon, on 29 June 2011

- Enhancing integrated ecosystems approaches;
- Enhancing community-based management of natural resources;
- Implementing more flexible risk-management strategies through adjustments in stocking rates along with diversifying species of animals kept, and multiple production systems;
- Enhancing agricultural technologies such as the development of stress-tolerant varieties and the improvement of water resources development and management;

35. Development partners assisting the assessment of climate change impacts should consider the formulation of projects aiming at improving the sustainable management of the scarce natural resources and safety nets and support projects to enhance the livelihoods of vulnerable groups.