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SERIES L: ENVIRONMENT AND ICTS, CLIMATE
CHANGE, E-WASTE, ENERGY EFFICIENCY;
CONSTRUCTION, INSTALLATION AND PROTECTION
OF CABLES AND OTHER ELEMENTS OF OUTSIDE
PLANT

Information and communication technology and adaptation of the fisheries sector to the effects of climate change

Recommendation ITU-T L.1505

ITU-T L-SERIES RECOMMENDATIONS

**ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION,
INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT**

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Recommendation ITU-T L.1505

Information and communication technology and adaptation of the fisheries sector to the effects of climate change

Summary

Climate change will affect both fish stocks and their habitats. Rising or falling temperatures will influence the abundance, migratory patterns and mortality rates of wild fish stocks and determine what species can be farmed in specific regions. Climate change can lead to changes in the volume of water in rivers and lakes. The composition of water bodies can affect the species and quantities of fish stocks. These climatic effects on fish stocks will have social and economic consequences for people dependent on fisheries and aquaculture ranging from fisheries workers to coastal communities as well as to the consumers of fish.

Recommendation ITU-T L.1505 includes a review of the effects of climate change on fisheries and fishing communities. It recognizes the need for adaptation and for the use and dissemination of relevant innovative techniques. It explores adaptation plans and the potential role of information and communication technologies (ICTs) in supporting the adaptation of the fisheries sector to cope with the effects of climate change.

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Introduction

Climate change will affect both fish stocks and their habitats. Warmer or cooler temperatures will influence the abundance, migratory patterns and mortality rates of wild fish stocks and determine what species can be farmed in specific regions. Climate change can lead to changes in the volume of water in rivers and lakes. The composition of a body of water can affect the species and quantities of fish present. These climatic effects on fish will have social and economic consequences for people dependent on fisheries and aquaculture ranging from fisheries workers to coastal communities as well as to the consumers of fish [b-OECD].

The purpose of this Recommendation is to:

- Offer useful information to decision makers concerning areas of possible adaptive action using ICTs in both developing and developed countries in relation to climate change and the fisheries industry.
- Describe state-of-the-art ICT applications and systems, in addition to hybrid systems where traditional means of dealing with climate change adaptation effects are used hand-in-hand with new technologies in order to reach large and small-scale fishermen and other actors in the fisheries sector speedily and at minimum cost.
- Provide examples of success stories of the adoption of ICTs usage to adapt the fisheries sector to the events of climate change in order to bring general awareness for possible adoption by others.

Facilitate understanding of the role of ICTs in the fisheries sector for adaptation to climate change, paving the way for the adoption of ICTs to develop climate-smart fisheries, in particular achieving increased productivity and enhanced the resilience of small-scale fishermen despite the events of climate change.

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Recommendation ITU-T L.1505

Information and communication technology and adaptation of the fisheries sector to the effects of climate change

1 Scope

This Recommendation includes a review of the effects of climate change on fisheries and fisheries communities. It recognizes the need for adaptation and for the use and dissemination of relevant innovative techniques. It explores adaptation plans and the potential of ICTs in supporting the adaptation of the fisheries sector to cope with the effects of climate change with reference to [ITU-T L.1500] and [ITU-T L.1501]. Examples of best practices from different countries on the use of ICT systems and tools to adapt the fisheries sector are also provided in this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T L.1500] Recommendation ITU-T L.1500 (2014), *Framework for information and communication technologies and adaptation to the effects of climate change*.
- [ITU-T L.1501] Recommendation ITU-T L.1501 (2014), *Best practices on how countries can utilize ICTs to adapt to the effects of climate change*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 climate change [ITU-T L.1500]: Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity. The Intergovernmental Panel on Climate Change (IPCC) uses a relatively broad definition, referring to a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

The IPCC makes a distinction between climate change that is directly attributable to human activities, and climate variability that is attributable to natural causes. For the purposes of this report, either definition may be suitable depending on the context of the analysis.

3.1.2 climate change adaptation [ITU-T L.1500]: Adaptation to climate change can be defined as the adjustment in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects. It refers to changes in processes, practices and structures to moderate potential harm or benefit from opportunities associated with climate change.

3.1.3 food security [b-WHO 2001]: Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

3.1.4 vulnerability to climate change [b-IPCC]: Degree to which a system is susceptible to injury, damage, or harm (one part – the problematic or detrimental part – of sensitivity).

3.1.5 climate variability [b-WMO]: Variations in the mean state and other statistics of the climate on all temporal and spatial scales, beyond individual weather events.

NOTE – Variability is the range of climate compared to its average. The fluctuations comprising climate variability can influence patterns of rainfall, temperature and other variables on timescales anywhere from a few weeks to a few decades.

3.1.6 climate change mitigation [b-UNEP]: Efforts to reduce or prevent emission of greenhouse gases.

NOTE – Mitigation can mean using new technologies and renewable energies, making older equipment more energy efficient, or changing management practices or consumer behaviour.

3.1.7 aquaculture [b-Indian University]: Farming fish and other aquatic organisms.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

EWS	Early Warning System
FFMA	The Fisher Friend Mobile Application
FFP	The Fisher Friend Programme
GHG	Greenhouse Gas
GIS	Geographic Information Systems
ICT	Information and Communication Technology
PFZ	Potential Fishing Zone

5 Conventions

None.

6 Impacts of climate change on the fisheries sector

6.1 Ecosystem impacts

Climate change is having both physical and biological impact on ecosystems by modifying the distribution of marine and freshwater species. In general, warm-water species are being displaced towards the poles and are experiencing changes in the size and productivity of their habitats. In warmer parts of the world, ecosystem productivity is likely to be reduced in most tropical and subtropical oceans, seas and lakes and increased in high latitudes. Increased temperatures will also affect the physiological processes of fish, resulting in both positive and negative effects on fisheries and aquaculture systems depending on the region and latitude.

Climate change is already affecting the seasonality of particular biological processes, altering marine and freshwater food webs with unpredictable consequences for fish production. Increased risks of species invasions and the spreading of vector-borne diseases are additional concerns. Differential warming between land and oceans and between polar and tropical regions will affect the intensity, frequency and seasonality of climate patterns (e.g., El Niño) and extreme weather events (e.g., floods, droughts and storms).

These events will impact the stability of related marine and freshwater resources. Sea level rises, glacier melting, ocean acidification and changes in precipitation, groundwater and river flows will significantly affect coral reefs, wetlands, rivers, lakes and estuaries such as Chesapeake Bay in

Maryland. The bays surrounding the boroughs of New York City are also estuaries. San Francisco Bay in California and Lake Pontchartrain in Louisiana are other examples of large, developed estuaries requiring adaptive measures to exploit opportunities and minimize impacts on fisheries and aquaculture systems.

6.2 Impacts on livelihoods

Changes in distribution, the composition of species and habitats will require changes in fishing practices and aquaculture operations, as well as in the location of landing, farming and processing facilities.

Extreme events will also have an impact on the infrastructure, ranging from landing and farming sites to post-harvest facilities and transport routes. They will also affect safety at sea and settlements, with communities living in low-lying areas at particular risk. Water stress and competition for water resources will affect aquaculture operations and inland fisheries production and are likely to increase conflicts among water dependent activities.

Livelihood strategies will have to be modified, for example, with changes in fishers' migration patterns due to changes in the timing of fishing activities. Reduced livelihood options inside and outside the fisheries sector will force occupational changes and may increase social pressures. Livelihood diversification is an established means of risk transfer and reduction in the face of shocks, but reduced options for diversification will negatively affect the outcomes of livelihoods.

There are particular gender dimensions, including competition for resource access, risk from extreme events and occupational changes in areas such as markets, distribution and processing, in which women currently play a significant role. The implications of climate change affect the four dimensions of food security as follows:

- the availability of aquatic foods will vary through changes in habitats, stocks and species distribution;
- the stability of supply will be impacted by changes in seasonality, increased variance in ecosystem productivity and increased supply variability and risks;
- the access to aquatic foods will be affected by changes in livelihoods and catching or farming opportunities; and
- the utilization of aquatic products will also be impacted, for example, some societies and communities will need to adjust to species not traditionally consumed [b-FAO, 2009].

6.3 Economic impact on people

Countries in Central and Western Africa (e.g., Malawi, Guinea, Senegal and Uganda), North-Western South-America (Peru and Colombia) and four tropical Asian countries (Bangladesh, Cambodia, Pakistan, and Yemen) were identified as most vulnerable. This vulnerability is due to the combined effect of predicted warming, the relative importance of fisheries to national economies and diets and limited societal capacity to adapt to potential impacts and opportunities. Many vulnerable countries are also among the world's least developed countries whose inhabitants are among the world's poorest and who are twice as reliant on fish, which provides 27 per cent of dietary protein compared to 13 per cent in less vulnerable countries. These countries also produce 20 per cent of the world's fish exports and are in the greatest need of adaptation planning to maintain or enhance the contribution that fisheries can make to poverty reduction. [b-Wiley]

7 Climate change adaptation measures for the fisheries sector

Table 1, adapted from [b-FAO, 2014], shows climate change adaptation measures for the fisheries sector.

Table 1 – Climate change adaptation measures for the fisheries sector

Impact	Adaptation measure
Reduced yields	• Access higher-value markets • Increase fishing effort (risks overexploitation) • Shift aquaculture to non-carnivorous commodities • Selective breeding for increased resilience in aquaculture Moving/planning siting of cage aquaculture facilities • Change aquaculture feed management: fishmeal and fish oil replacement; find more • Appropriate feeds • Migration as fish distribution changes (risks overexploitation) • Research and investments into predicting where fish populations will move to (risks overexploitation) • Improve water-use efficiency and sharing efficacy (e.g., with rice paddy irrigators) in aquaculture • Aquaculture infrastructure investments (e.g., nylon netting and raised dykes in flood-prone pond systems)
Increased yield variability	• Diversify livelihood portfolio (e.g., algae cultivation for bio fuels or engage in non-fishery economic activity such as ecotourism) • Precautionary management • Ecosystem approach to fisheries/aquaculture and adaptive management • Shift to culture-based fisheries • Shift to propagated seed for previously wild-caught seed stocks (higher cost)
Reduced profitability	• Diversify livelihoods, markets and/or products • Exit fishery • Reduce costs to increase efficiency • Change aquaculture feed management • Shift to culture-based fisheries
Increased risk	• Adjustments in insurance markets • Insurance underwriting • Weather warning systems • Improved communication networks • Workshops to teach data gathering and interpretation • Monitoring of harmful algal blooms where molluscs farmed • Improved vessel stability/safety • Compensation for impacts
Increased vulnerability for those living near rivers and coasts	• Hard defences (e.g., sea walls) (risks affecting local ecosystem processes and/or local livelihoods) • Soft defences (e.g., wetland rehabilitation or managed retreat) (risks affecting local livelihoods) • Early warning systems and education • Rehabilitation and disaster response • Infrastructure provision (e.g., harbour and landing site protection, building aquaculture facilities to withstand increased storm damage) • Post-disaster recovery • Encourage native aquaculture species to reduce impacts if fish escape damaged facility