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Report of the

FAO EXPERT WORKSHOP ON STRATEGIES AND PRACTICAL OPTIONS FOR GREENHOUSE GAS REDUCTIONS IN FISHERIES AND AQUACULTURE FOOD PRODUCTION SYSTEMS

Bergen, Norway, 4–5 March 2013

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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PREPARATION OF THIS DOCUMENT

This is the report of the Expert Workshop on Strategies and Practical Options for Greenhouse Gas Reductions in Fisheries and Aquaculture Food Production Systems, held in Bergen, Norway, 4–5 March 2013.

Financial and in-kind support for the Expert Workshop was provided by the Government of Norway, the FAO Regular Programme, Seafish, and other contributing participants.

The opening statement is reproduced as submitted.

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ABSTRACT

This document contains the report of the Expert Workshop on Strategies and Practical Options for Greenhouse Gas Reductions in Fisheries and Aquaculture Food Production Systems, held in Bergen, Norway, 4–5 March 2013. The workshop was convened by the Director-General of the Food and Agriculture Organization of the United Nations, following a recommendation by the Twenty-ninth Session of the Committee on Fisheries that FAO should provide Members with information on possible fishing industry contributions to climate change, and on ways to reduce the sector's reliance on, and consumption of, fossil fuels, respecting the principles embodied within the United Nations Framework Convention on Climate Change.

CONTENTS

OPENING OF THE MEETING AND ARRANGEMENTS FOR THE SESSION

1. The Twenty-ninth Session of the Committee on Fisheries (COFI) recommended that FAO should provide Members with information on possible fishing industry contributions to climate change, and on ways to reduce the sector's reliance on, and consumption of, fossil fuels, respecting the principles embodied within the United Nations Framework Convention on Climate Change (UNFCCC). Following this recommendation, and the deliberations of industry practitioners and policy agents expressed at the International Symposium on Energy Use in Fisheries (Seattle, 2010) and the Seafood Summit (Vancouver, 2011), the Director-General of the Food and Agriculture Organization of the United Nations convened an Expert Workshop on Greenhouse Gas Emissions Strategies and Methods in Seafood. The Expert Workshop was held at FAO headquarters, Rome, Italy, 23–25 January 2012, with funding and in-kind support from the Government of Norway, the FAO Regular Programme, Seafish, Dalhousie University and other participants. The 2012 workshop highlighted options for the practical use of tools such as life-cycle assessment (LCA) but also emphasized gaps in information and practice, and noted the diverse aims/interests of key groups – researchers, industry players and policy-support agents. Although a full and seamless connection across these groups is not necessary, a sound industry-wide response to the demands of energy cost and climate change will require a basic level of common understanding and effective communication. As part of continuing the framework for concerted actions, this second Expert Workshop on greenhouse gas (GHG) mitigation was held in Bergen, Norway, 4–5 March 2013, with funding and in-kind support from the Government of Norway, the FAO Regular Programme, Seafish and other partners.

2. FAO staff members, government officers, researchers and academics, industry representatives, standards experts, civil society, fisheries and aquaculture consultants attended the Workshop. The attendance list is provided in Appendix 2. Background papers circulated to participants prior to the Workshop are listed in Appendix 3.

3. Mr Ari Gudmundsson of FAO's Fishing Operations and Technology Branch called the meeting to order. In the opening statement on behalf of the Director-General, he referred to the high dependence of the food system on fossil fuels, and the fact that, for the fisheries and aquaculture sector, the use of fossil fuels has significantly helped feed the world in recent decades, mainly through their contribution to increased mechanization of fishing vessels, processing and transport to markets. He highlighted that the FAO Code of Conduct for Responsible Fisheries (the Code) promotes the more efficient use of energy in harvesting and post-harvest activities. For the sector to become "energy smart" at both the small family and large corporate scales will require strong and long-term supporting policies and innovative multistakeholder institutional arrangements. He noted that at the Twenty-ninth Session of the Committee on Fisheries (COFI), FAO had reported that net GHG contributions of fisheries, aquaculture and related supply chain features were poorly studied and the paucity of data on GHG emissions across fisheries and aquaculture supply chains was a key factor constraining the development of strategies to address energy use. He observed that FAO also reported that the transition to energy-efficient and low-footprint aquatic food production systems would be facilitated through: the development of standardized methodologies throughout the food chain; collection of data; and the development of policy and technologies associated with energy use and GHG emission reductions. He thanked the experts at the Workshop for taking the time to consider these important issues. His statement is attached as Appendix 4.

4. Mr Yngve Torgersen, Deputy Director General, Department of Fisheries and Aquaculture, Norwegian Ministry of Fisheries and Coastal Affairs, welcomed workshop participants to Bergen. He underscored Norway's interest in addressing GHG emissions reduction in fisheries and aquaculture and indicated its intention to collaborate and partner with other countries and agencies, also including the private sector, to achieve measurable goals. Mr Torgersen wished for a successful workshop and looked forward to the follow-ups.

ELECTION OF THE CHAIRPERSON

5. Mr Ari Gudmundsson was nominated as the Chairperson of the Workshop. The workshop participants agreed with the Chairperson's proposal that discussions should be held in plenary only.

ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE WORKSHOP

6. The Agenda was adopted as given in Appendix 1. The Chairperson then outlined the timetable of work for the Workshop, the content of which had been divided into six sections, noting that a degree of flexibility would be required to make best use of the resources available to the meeting. Background papers and presentations of the Workshop are listed in Appendixes 3 and 5, respectively.

NOMINATION OF THE WORKSHOP FACILITATORS AND RAPPORTEURS

7. Ms Doris Soto, Mr John Ryder and Mr James Muir were nominated as workshop facilitators.

SECTION 1: OVERVIEW

8. Presentations under section 1 of the workshop focused on an overview, i.e. the significance of GHGs and their reduction in fisheries and aquaculture, across the whole supply chain – key themes, issues, practical aims and processes. Some key points highlighted were:

9. Mr James Muir, FAO Consultant, gave an overview of strategies and options for GHG reduction in fisheries and aquaculture. He informed the Workshop that a number of organizations with a mandate or history of engagement on seafood sustainability issues (FAO, Seafish, industry) were working within a framework for concerted action as a means of addressing and potentially resolving some of the issues around methodologies for GHG emissions and mitigating strategies. This framework for action, within which the workshop fits, aims to work towards common positions, where possible, on strategies and practical options for GHG reductions in fisheries and aquaculture food-production systems.

10. Mr Angus Garrett of Seafish described its work analysing seafood systems, which identified GHG emissions as an issue throughout the supply chains. The wider context of seafood (the open and international nature of the seafood sector in the United Kingdom of Great Britain and Northern Ireland, commitment to responsible practice, and importance of reputation management) was an important influence in driving and shaping the GHG emissions work within the framework of concerted action. The interests of multiple stakeholders, standardizing methods, risks of reinventing previous research work, and the costs associated with GHG emissions were identified as core challenges. Progress had been made in producing a standard method of assessing GHG emissions in aquatic food products, and completing a literature review of related research (energy in seafood over the last ten years).

11. Mr Yngve Torgersen, Deputy Director General, Department of Fisheries and Aquaculture, Norwegian Ministry of Fisheries and Coastal Affairs, presented the Norwegian policy of reducing GHG emissions in Norwegian fisheries and aquaculture. The implemented measures were focusing on

issues such as a new "NOx Fund", based on a structural quota system that would result in fewer vessels and cooling agents that would have to comply with the provisions of the Montreal Protocol. Other issues that are being planned include: a carbon dioxide (CO_2) tax; a national transport plan (NTP) that will promote sea transport rather than roads: and a carbon footprint label of seafood products, which is an indirect incentive to reduce emissions.

SECTION 2: POLICY

12. Presentations under section 2 of the workshop focused on policy areas for GHG mitigation, i.e. fisheries management options and possible impacts; fuel and energy use/subsidies – tradeoffs with other areas. Some key points highlighted were:

13. Prof. Ragnar Arnason described the three main options for reducing fuel and thereby GHG emissions in the fisheries sector, namely through: technological improvements; taxes and subsidies; and improved fisheries management and the role of sector in this regard. He underscored the point that fishers do not understand GHG emission but they understand fuel prices, so if they can reduce fuel costs, it is always good. His conclusion was that improved fisheries management is the most effective way to reduce fuel use in fisheries, because it is quick, it is not only costless but also profitable, it promotes sustainability, and it is much more promising than technological improvements alone.

14. Mr James Muir presented a paper, prepared by Prof. Trond Bjorndal, providing a review on current perspectives on fuel subsidies in the fisheries sector. At the outset of this analysis, the presentation set out four objectives that fishery subsidies are typically intended to achieve: (i) increase fishers incomes; (ii) Increase employment in the fishing sector; (iii) enhance food supply; and (iv) improve the competitiveness of the sector. The paper concluded that fuel subsidies are, in general, wasteful as these objectives are, in general, not being achieved. Resources are currently yielding no resource rent, owing to overfished stocks and excessive use of fishing effort (labour and capital). Therefore, other instruments than fuel subsidies need to be found in order to achieve relevant government objectives.

15. Mr James Muir presented another paper prepared by Prof. Trond Bjorndal, offering a review on management policy and energy use in the fisheries sector. Among the conclusions is that theoretical analysis suggests, and empirical case studies confirm, that catch-rights-based management (CRBM) could cause a reduction in, or possibly even elimination of, excess capacity in a fishery. Another consequence has also been improved profitability, at the fleet as well as vessel level. There exists scope for improvement in numerous fisheries worldwide; in many cases, there is still considerable concern about the transition to improved management, which must be handled with great care.

16. Ms Sara Hornborg, PhD student, gave a presentation titled "Energy demand and GHG emissions in the Swedish fishing sector". She concluded that there was a need for an integrated perspective on management decisions to reduce overcapacity and ensure the phasing out of harmful cooling agents. Furthermore, with increased selectivity there is a need to consider fuel demand carefully.

17. Mr James Muir presented a paper, prepared by Mr. William Barsley, an FAO intern, titled "Consumption-based carbon accounting". The paper argued that, if applied to the fisheries sector, and therefore to internationally traded fish, consumption-based accounting could have significant impacts, owing to the size and importance of the international fisheries market.

18. Mr James Muir presented another paper prepared by Mr. William Barsley, titled "The Carbon finance market: financial mechanisms and potential implications for greenhouse gas (GHG)

mitigation in the fishery and aquaculture sector". The presentation outlined the key components, mechanisms and trends within the carbon market in order to explore its potential for creating incentives for the fisheries and aquaculture sector. The production of credible standards and methods of measurement would be critical in order for the fisheries and aquaculture sector to engage in carbon markets, and while market confidence is low, options for new and untested sectors, whatever their potential for carbon reduction, may be limited.

19. The presentations were followed by a group discussion on the topic: **Can policy influence/change behaviour in the fisheries and aquaculture sector?**

20. The participants of the workshop mostly focused discussion on the need to improve fisheries management The need for better understanding by policy-makers, managers, the private sector and fishers on the role of fisheries management and fuel subsidies on GHG emission was underscored. It is also important to consider inland fisheries, as they also have a role, although more small-scale. It was agreed that policies could not change behaviours and that, therefore, better understanding and appropriate incentives could play a key role. Other interventions underscored the need to implement existing policies rather than going after new ones.

SECTIONS 3–4: BEHAVIOUR AND SYSTEMS

21. As section 3, on changing practice, and section 4, on changing systems, are closely linked, it was decided to consider those two sections together. The presentation focused on changing practice in fishing and other activities and changing systems, i.e. fishing vessels/gear, aquaculture and post-harvest. Some key points highlighted were:

22. Ms Doris Soto of FAO gave a presentation, prepared in collaboration with Mr James Muir and Mr Mohammad Hasan, which provided information on estimated GHG emissions and mitigation potential in aquaculture along with changing behaviours and systems. The presentation emphasized the role of feed and feeding as the main GHG emission factor in aquaculture, and she focused on the feed conversion ratio (FCR) as a main indicator of the carbon footprint and also production efficiency. However, it was shown that reduction in the FCR does not always result in reduced emissions because considerations of yield, economic benefits, origin of the feeds components (e.g. made on the farm vs commercial pellet feeds) and the different production and geographical scales also need to be taken into account. Nevertheless, while the complexity of trade-offs makes it difficult to fine-tune systems to meet specific goals (e.g. FCRs, GHGs, yields) – it may be possible to identify "sweet spots" – classes of better-performing systems / operating conditions. More and better information is needed across aquaculture systems to address this.

23. Mr James Muir presented further strategies for reducing GHGs in aquaculture, focusing on the factors contributing to GHGs that it may be feasible to manage and control. He provided an overview of options, possible priorities, and means of response through some schematic approaches. The presentation separated major and secondary sources and elements affecting emissions, and concluded by underscoring the need to focus on production and profitability models and applying scenarios of fuel and energy prices, to search potential for action. Technical innovation in developing improved systems and products was also considered important, as was the role of industry structure – which can be an obstacle but also an opportunity Communicating good practice and building capacity across specific aquaculture sectors were also seen as key actions to reduce emissions.

24. Mr John Ryder gave a presentation on GHGs in the post-harvest value chain. He explained that processing normally had a lot less impact than production (capture or farming), but that the contribution depended on the processing and product form. He provided examples on how GHG

emissions could be reduced from a technology point of view, and by changing consumption away from GHG-intensive products, and that the latter would require the provision of unambiguous information to enable informed decisions.

25. Ms Valeska Weymann from GLOBALG.A.P. Aquaculture gave a presentation titled "Market drivers and GHG reduction – recent experience and emerging practice". She introduced a new standard that has been designed for aquaculture producers, and provided examples of current criteria in approaching GHG reduction in aquaculture.

26. Mr Petri Suuronen of FAO gave a presentation on low-impact and fuel-efficient (LIFE) fishing. He highlighted that fishing practices vary widely in their environmental impacts and fuel efficiency. Towed gear generally has a higher fuel consumption than passive gear in terms of unit catch weight. However, a large number of factors, such as vessel design and age, fish abundance, weather, and the distance between fishing ground and fishing port, markedly affect fuel consumption. Environmental impacts and fuel consumption can be reduced through modifications and changes in operational techniques and gear. Successful transition to LIFE fishing depends on many factors, such as availability of acceptable technology, achievable and realistic objectives, adequate training and technical assistance, regulatory regimes, and fishers being part of the solution.

27. Mr John Willy Valdemarsen, Director at the Centre for Research-based Innovation in Sustainable fish capture and Processing technology (CRISP), gave a presentation on the Development focus on trawl to reduce environmental impact within CRISP. He gave examples how new instrumentation was capable of estimating quantity, species and fish sizes prior to the capture process, and monitoring gear performance and fish behaviour while fishing. He also informed the Workshop about plans to develop smarter trawl techniques that make use of fish behaviour and control of trawl performance while towing, and the need to improve the quality of trawl-captured fish by storage in live tanks until processing.

28. Mr Ari Gudmundsson of FAO gave a presentation on fuel savings for small fishing vessels in which he highlighted that the vessel speed is the most important factor in fuel consumption. He also provided a brief overview of Annex VI to the MARPOL Convention and the most recent developments being undertaken by the International Maritime Organization (IMO).

29. Mr Papa Gora Ndiaye from the Réseau sur les politiques de pêche en Afrique de l'Ouest (REPAO) gave a presentation on reducing GHG emissions in the artisanal fisheries in West Africa. He provided information on developing technologies in harvest and post-harvest activities, the protection of the mangrove, and a case study on GHG reduction in artisanal fisheries. Mechanisms that have been implemented in order to reduce the consumption of fossil fuels by artisanal fisheries include research to promote the use of more-efficient outboard motors, redirection of subsidies from harvest to post-harvest activities, and experiments with sailing canoes in mangroves and marine protected areas.

30. Ms Sandra Marin from Universidad Austral de Chile gave a presentation on the current status of Chilean aquaculture regarding GHG emissions. She informed the Workshop about GHG initiatives in Chilean aquaculture. She explained that improvements in feed processing were possible by reducing GHG emissions through renewable energy sources, and the decrease and/or recycling of waste.

31. Mr Angus Garrett of Seafish gave a presentation that focused on a specific element of concerted action work – standardizing and reducing the cost of GHG emissions assessments of aquatic foods through the BSI PAS2050-2 standard – and a wild-capture profiling tool. The development of the standard had been an international effort and addressed important questions in

making an assessment. Those questions included: “Where do we draw the boundary?”, “What is included within that boundary?”, “How do we allocate emissions across co-products?”, and “What functional unit (e.g. 1 tonne of cod, 1 kg of cod fillet) are we concerned with?” The presentation also briefly described a prototype wild-capture profiling tool that could be used by industry, and others, in profiling the GHG emissions of their products. The standard underpinned the design of the tool, and it was hoped the tool might prove a cost-effective means for industry to understand its GHG emissions impact.

32. Mr Erik Hognes of SINTEF described its work on LCA and GHG reducing measures in fisheries and aquaculture, which identified the LCA method in the broader picture. The presentation highlighted the climate aspects of seafood, i.e. where, how and why, and available GHG-reducing technologies.

33. Ms Amy White of Skretting gave a presentation titled “Practical strategies for GHG reduction through aquaculture feeds”. The presentation highlighted the fact that as the majority of LCA and carbon footprinting studies identify feeds as the major source of GHG in the life cycle of aquaculture, Skretting is aware of the need to do all it can to reduce emissions and recognize the need for the aquaculture industry to reduce dependence on forage fisheries. Geographic and temporal specificity of data from existing inventory GHG emission databases and methodologies reduces representativeness and accuracy of the results, and this is a problem for addressing GHG reduction in a comprehensive way. Nevertheless, the company has a strategy to reduce emissions, including focus work on FCRs, and additional parallel actions that contribute to mitigation and consumers fact sheets.

34. Mr Ulrik Jes Hansen gave a presentation titled “Best available technology makes drastic cuts in fuel expenses in trawl fisheries”. The presentation provided information on the best available technology for different types of fisheries and vessels but applying similar approaches. The results showed a reduced fuel consumption and increased profitability.

35. Mr Venkatesh Salagrama from the International Collective in Support of Fishworkers (ICSF) gave a presentation titled “Challenges and options for fuel saving and GHG reduction in South Asian small-scale fisheries”. He gave examples on why and how small-scale fisheries operations contribute to GHG emissions, as well as examples on adaptations that are already in place or are being considered. He concluded that increasing GHG emissions were an outcome of a range of factors – biological, environmental, social, economic and political – that influence the life and livelihoods of the fishers. Unless the wider spectrum of issues is also tackled, the ability of the sector to cope with the challenge of GHG emissions will remain limited.

36. The presentations were followed by a group discussion on the topic: **What are the drivers / barriers to uptake of new systems and practices?**

37. From the discussion, it was clear that fuel subsidies are an important barrier, while improved information and understanding of the mechanisms directly related to GHG emissions can be a mid- to long-term driver for mitigation. Climate change in the larger development perspective will become a relevant driver.

38. Solutions need to consider the different realities of the world – GHG emission reduction may be very different in the developing and less-developed world.

SECTION 5: ACTIONS

39. Mr Petri Suuronen gave a presentation, that he and Mr Francis Chopin of FAO had prepared on barriers, constraints and opportunities to successful transition to LIFE fishing. These barriers include factors such as: (i) lack of familiarity with cost-effective and practical alternatives; (ii) availability of adequate substitute technologies; (iii) incompatibility of vessels with alternative gear; (iv) risk of losing marketable catch; (v) additional work; (vi) concerns with safety at sea by using unfamiliar practices; and (vii) high investment costs. In addition, human behaviour barriers often play a marked role too. There are opportunities in a change, and these include: (i) cost reduction; (ii) waste elimination; (iii) product quality improvement; (iv) enhanced reputation and winning new markets; and (v) better motivation among the crew to innovate and further reduce environmental impacts. Fisheries management systems should give fishers a space in which to operate LIFE fishing as efficiently as possible, and facilitate the change. Public–private sector initiatives to commercialize economically viable and practical alternatives should be promoted.

40. Mr Bundit Chokesanguan gave a presentation titled "Energy optimization in fisheries in Southeast Asia and SEAFDEC initiatives on energy optimization in fisheries", in which he provided information on the status of the fisheries and aquaculture sector in the Southeast Asia region and an overview of initiatives taken by the Southeast Asian Fisheries Development Center (SEAFDEC) for energy optimization in the sector. He informed the Workshop about the plans of SEAFDEC to translate the FAO publication *Fuel savings for small fishing vessels – A manual*.[1]

41. Mr Angus Garrett gave a presentation on issues and experiences of engaging in seafood industry systems in addressing GHG emissions. Owing to severe economic conditions, addressing GHG emissions is inevitably pushed down the agenda, which undermines engagement with industry on this issue. Drawing upon lessons learned from previous work, the approach adopted has been to engage industry by responding to its current area of concern (costs) linking with previous work (energy costs and efficiency) that is also closely related to GHG emissions. The lessons from this experience include: a recognition that the issue of GHG emissions is one of multiple, interacting challenges; the importance of focussing on relevant industry problems (that need ongoing engagement); the need for dynamic modelling and collaborative solutions with industry; and the need to find solutions that are in context (finding "win–win" solutions).

42. The presentations were followed by a group discussion on the topic: **What is the effectiveness and rate of uptake by the sector and how are results monitored?**

43. Certification can have an important role across the fisheries and aquaculture industry regarding evaluating effectiveness, but it may be more difficult for small-scale holders. The workshop indicated and recommended that FAO should be leading aspects regarding quality information inventories on GHG emissions. FAO can coordinate and could further make the information available to users. There is a need for guidelines on how to approach mitigation, especially in the case of developing countries. However, countries will not make this a priority; therefore, it is important that FAO brings this into the agenda with the label of improved efficiency and lowering costs. Monitoring uptake of mitigation measures also needs coordinated actions.

[1] Gulbrandsen, O. 2012. *Fuel savings for small fishing vessels – a manual*. Rome, FAO. 57 pp. (also available at www.fao.org/docrep/017/i2461e/i2461e00.htm).

SECTION 6: FUTURE DIRECTIONS

44. Under this section, the group focused its discussion on the following topic: **What is the view of participants on priority setting for future actions?**

Generic summary / conclusions

45. Reducing GHGs across the fisheries sector is an important and positive area for development, potentially contributing to global and national climate mitigation goals and securing longer-term sustainable food supplies. There are definable and potentially beneficial opportunities for change in most parts of the supply chain, but these can be constrained by a number of factors the will need to be further addressed.

46. The primary areas of GHG-related concern/action at this stage are: fuel use in capture fisheries; the selection and use of refrigerants, particularly on board; and the sourcing and efficiency of use in aquaculture feeds. Process yields and wastes are also important in reducing GHG output per unit of product. Issues such as air pollution associated with fuel use are also potentially important but have yet to receive full attention.

47. There are three broad areas of incentive / driving action for GHG reduction:

- improved fisheries management, which typically reduces fishing effort and fleets and, consequently, reduces fossil-fuel use;
- national GHG reduction goals associated with the Kyoto Protocol requiring measurable change;
- consumer and market demand in wealthier markets, acquiring product globally and expecting relevant standards and certification.

A fourth and sometimes more immediate driving force is associated with rising fuel costs, which by acting to limit fuel use can directly or indirectly reduce GHGs. However, such impacts may be distorted by fuel subsidies, which can have a strong influence on sector capacity and activity, particularly in capture fishing.

48. There are definable ways in which GHGs can be reduced in most parts of the sector, with relatively functional measurement approaches. At industry level, these have recently been taken up in the development of a protocol (BSI PAS 2050 supplement, 2012), which now needs to be applied across a range of cases in the whitefish, pelagic and shellfish sectors.

49. In most cases, GHG reductions are at best achieved as a co-benefit from industry incentives for increased efficiency, such as improved fisheries management and aquaculture feeding efficiency. This approach to GHG reduction seems extremely promising, but the nature and quantities involved deserve to be highlighted effectively.

50. Greenhouse gas reduction in the fisheries and aquaculture sectors has a role in the broad strategies of GHG management in the food and natural resources sector, can assist relevant countries to meet Kyoto Protocol targets, and can offer options for those that are not currently committed. In theory, this could also be the basis for a carbon market, where GHG reduction or aquatic carbon sequestration in developing countries could be traded.

51. However, apart from the issue of fuel costs, and a market-based interest in affirming social/environmental responsibility in food sourcing, there are currently no sectoral incentive/investment mechanisms for reducing GHGs. Priorities for action may need to be pragmatic, through aiming to build the case for longer-term investment and community benefit.

52. Similarly, although a number of development programme activities are now taking up themes of energy efficiency (and GHG reduction), and a wider range of programmes is also touching on GHG

mitigation in the scope of climate change response, progress has been slow in engaging the aquatic sector in global carbon management strategies. This is potentially an important strategic area for change.

Specific workshop issues

53. The workshop reviewed a range of experiences, and analyses concerning the options to date for reducing GHGs in the sector are set out in the two sections below. Conclusions/recommendations related to these included:

- The relatively limited and dispersed measures and examples so far developed across the sector for GHG reduction, and the recognition of the need to improve data and build its coherence.
- The consequent need for further documentation of experiences concerning GHG reduction; including comparative assessments, definition of better practices, and the need to communicate results within and beyond sector.
- The potential to establish baselines and benchmarks for sector areas against which gains could be made; these could also link to better global system mapping for key subsectors, and for connecting with national accounting frameworks for food systems and other economic areas.
- Further work would be needed to explore incentives and constraints for GHG reduction (management processes, structural investments, subsidy reduction) and the practical means by which these may be put in place. A watching brief may also be required on the potential implications of consumption-based accounting.
- Recognition of the potential value of developing practical guidelines for GHG measurement and reduction. These could be connected into objectives related to the Code, and updated on a periodic basis as experience develops and sector criteria evolve.
- Further work would need to be done on aquaculture feed sourcing and impacts, together with the development of standard approaches and assessment frameworks. The model of the animal feeds industry forum currently being developed with FAO and others merits attention; aquatic feed producers have expressed a positive interest in principle, and would appreciate/benefit from clear criteria.
- More work is also required on methane (CH_4) and nitrous oxide (N_2O) interactions in aquaculture systems, to build up better understanding of implications and management options in a significant area of global aquaculture output.
- The role of refrigerants, fuel-based emissions and particulate carbon also needs to be clarified further across the sector, and, for fishing vessels in particular, more explicit linkages drawn with IMO marine pollution themes.
- Across all of these themes, there is a need to provide a specific focus on the small-scale sector in developing countries, and to identify specific initiatives for inclusion and support in global contexts, including sector resilience, trading access and generic climate change response.
- There is a need for further initiatives to bring the aquatic sector into global carbon financing frameworks, based on better-documented mitigation potential (e.g. for removing/sequestering carbon); also to explore ways in which community-based mitigation approaches can connect from adaptation funding to fuller financing in their own right.
- A related report may be developed within FAO to inform COFI, together with suggestions for follow-up decisions, including further field and demonstration work. These should also link with the Concerted Action Framework for GHG reductions, which provides valuable underpinning for industry linkages, and with emerging interest among a wider range of sector agents.

CLOSING OF THE WORKSHOP

54. Mr Árni M. Mathiesen, the Assistant Director-General of the Fisheries and Aquaculture Department of FAO, attended the closing ceremony of the Workshop. He expressed his appreciation that the Workshop had been able to exchange information and review concepts and practices to develop practical perspectives and recommendations for reducing GHGs in the fisheries and aquaculture sector as this would assist FAO and its partners in identifying and overcoming barriers to broad sectoral implementation of energy-smart technologies and practices.

55. The Chairperson, Mr Ari Gudmundsson, expressed his gratitude to the experts for their active participation in the Workshop, and formally declared the Workshop closed.

APPENDIX 1

AGENDA

	DAY 1 Monday Mar 4th	
Date/time	**Activity**	**Notes/people**
08.30-09.00	Welcome, Introductions, intended aims and processes of workshop, nomination of chair and other formalities	FAO/Seafish/local representatives
09.00-09.30	**Session 1: Overview** - the significance of GHG and its reduction in fisheries, across whole supply chain – key themes, issues, practical aims and processes	A. Gudmundsson/ J. Muir/others
09.30-10.00	Actions and strategies - the GHG/LCA concerted action programme – status and directions – PAS 2050 update	A. Garrett
10.00-10.30	Experience and expectations – inputs from participants - round table discussions	TBC/Workshop team
10.30-11.00	Break/coffee	
11.00-12.00*	Further inputs; lessons from the (1st) GHG/LCA workshop, key issues for this workshop – round table discussions	Moderated discussion
12.30-14.00*	Lunch	
14.00- 15.00	**Session 2: Policy areas for GHG mitigation** - fisheries management options and possible impacts; fuel and energy use/subsidies – tradeoffs with other areas	R. Arnason J. Muir S. Hornborg
15.00-15.30	Discussions on how/what circumstances these policy instruments could be taken forward – short and longer term	Moderated discussion
15.30-16.00	Break/coffee	
16.00-16.45	**Session 3: Changing practice** – in fishing and other activities; short introduction/overview of ideas; presentations on options and experiences	D. Soto J. Muir J. Ryder P. Suuronen A. Gudmundsson V. Weymann P.G. Ndiaye S. Marin
16.45-17.30	Discussions on what works, how to address constraints, what to move forward	Moderated discussion

	DAY 2 Tuesday Mar 5th	
Date/time	**Activity**	**Notes/people**
08.30-09.30	**Session 4: Changing systems** – short introduction/overview on options/constraints; followed by presentations for fishing vessels/gear, aquaculture, post-harvest	A. Garrett E. Hognes A. White U.J. Hansen J. Willy Valdemarsen V. Salagrama
09.30-10.30	Discussions on what works, how to address constraints, what to move forward	Moderated discussion
10.30-11.00	Break/coffee	
11.00- 12.00	**Session 5: Practical programmes of GHG mitigation** – short overview on options/potential constraints – followed by presentations on emerging experiences to date – SSF, EU fleets, retail initiatives	P. Suuronen B. Chokesanguan A. Garrett
12.00-12.30*	Initial discussions on potential effectiveness, costs, benefits of various options, measuring impacts, other consequences – problems and how to overcome them?	Moderated discussion
12.30-14.00*	Lunch	
14.00-15.00	Further discussions as above, break out groups to define priorities, actions, potential timelines	Moderated discussion
15.00-15.30	Break	
15.30 – 16.00	Summaries of discussion outcomes	Facilitated by team
16.00-17.00	**Session 6: Development strategies** – programmes, capacity building, investments, recommendations – ideas about how best to develop various concepts, strategy approaches, potential recommendations	Following from session 5, open discussions facilitated by workshop team
17.00-17.30	Final round-up, suggestions and conclusions	

* may need to adjust – local lunch times may be earlier

APPENDIX 2

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APPENDIX 3

BACKGROUND PAPERS

Author	Title of paper
J. Muir	Fuel and energy use in the fisheries sector - Approaches, inventories and strategic implications (draft)
T. Bjorndal	Review on current perspectives on fuel subsidies in the fisheries sector
T. Bjorndal	Review on management policy and energy use in the fisheries sector
W. Barsley	Consumption based carbon accounting: Will countries include imports in their national carbon accounting?
W. Barsley	The carbon finance market: financial mechanisms and potential implications for greenhouse gas (GHG) mitigation in the fishery and aquaculture sector
S. Hornborg, et al	Integrated environmental assessment of fisheries management: Swedish *Nephrops* trawl fisheries evaluated using a life cycle approach
J. Driscoll and P. Tyedmers	Fuel use and greenhouse gas emission implications of fisheries management: the case of the new england atlantic herring fishery
FAO	"Energy-smart" food for people and climate - issue paper
V. Salagrama	Challenges and options for fuel saving and ghg reduction in South Asian small-scale fisheries
B. Chokesanguan	Optimizing energy use in fisheries in Southeast Asia
P. G. Ndiaye	Reducing Greenhouse Gases Emissions in the artisanal fisheries in West Africa
IMO	Second IMO GHG Study 2009
J. Fitzpatrick	MARPOL ANNEX VI – outcome of the 64th session of the Marine Environment Protection Committee at the International Maritime Organization, held from 1 to 5 October 2012

APPENDIX 4

OPENING STATEMENT

Opening Statement

by
Ari Gudmundsson
Fishery Industry Officer
FAO Fisheries and Aquaculture Department

Distinguished delegates, friends and colleagues:

On behalf of the Director-General of FAO, Mr Graziano da Silva, it gives me much pleasure to welcome you to this Expert workshop on "Strategies and Practical Options for GHG reductions in Fisheries and Aquaculture Food Production Systems".

The FAO Code of Conduct for Responsible Fisheries, Article 8.6 on energy optimization, recommends States to promote the more efficient use of energy in harvesting and post-harvest activities. Furthermore, Article 8.8 of the Code on the protection of the atmosphere provides recommendations related to the reduction of dangerous substances in exhaust gas emissions and emissions of ozone depleting substances.

At the Twenty-ninth session of the Committee on Fisheries (COFI), FAO reported that Net greenhouse gas (GHG) contributions of fisheries, aquaculture and related supply chain features are poorly studied and the paucity of data on GHG emissions across fisheries and aquaculture supply chains is a key factor constraining the development of strategies to address energy use. FAO also reported that the transition to energy-efficient and low carbon footprint food production systems would be facilitated through the development of standardized methodologies throughout the food chain, collection of data and the development of policy and technologies associated with energy use and greenhouse gas emission reductions. The 29th session of COFI recommended that FAO should provide Members with information on possible fishing industry contributions to climate change, and on ways to reduce the sector's reliance on, and consumption of, fossil fuels, respecting the principles embodied within the United Nations Framework Convention on Climate Change (UNFCCC). And it is in this context that this expert workshop has been developed.

Following COFI's recommendation, and with support from FAO, the Government of Norway, Seafish and other key agents and researchers, FAO has been part of a series of concerted actions aimed at defining, measuring and quantifying GHG emissions and dependence on fossil fuel consumption. In 2012, FAO convened an Expert Workshop on Greenhouse Gas (GHG) Emissions Strategies & Methods in Seafood at its headquarters in Rome, Italy. The workshop highlighted options for the practical use of tools such as Life Cycle Assessment (LCA) but also emphasized gaps in information and practice and the need for a basic level of common understanding of the issues and the need for more effective communication among stakeholders.

As part of continuing the framework for concerted actions, this second workshop on GHG mitigation in Bergen, Norway will emphasize the practical needs of industry and national policy managers alike in developing and applying GHG mitigation measures in food production systems.

Turning specifically to the issues of energy use and food production, the global agricultural and food industry is dependent on energy inputs. For the fisheries and aquaculture sector, the use of fossil fuels has significantly helped feed the world over the last few decades, mainly through their contribution to increased mechanization of artisanal and highly-industrial production systems. However, many current production methods originated when resources were abundant, energy costs were dramatically

lower and less attention was paid to operating efficiency and ecosystem impacts. The new realities of high energy prices and greater environmental awareness present major challenges for the future viability of the sector. This may be especially true in developing countries where access to and promotion of energy efficient technologies has been limited. Future production is likely to be increasingly constrained by the cost of fuel and energy supplies. Accordingly, the fisheries and aquaculture sectors will need to use energy efficiently in production systems and become energy-smart along the entire food chain to cope with the volatility and rising trends of fuel and energy prices and to ensure food availability at accessible prices.

For the sector to become 'energy-smart' at both the small family and large corporate scales require strong and long-term supporting policies and innovative multi-stakeholder institutional arrangements. Examples exist of successful and cost-effective policy instruments and inclusive business schemes that have supported agri-business development throughout the sector. These instruments will need to be significantly scaled up if a cross-sectoral landscape approach is to be achieved at the international level. Enabling policies to ensure that full benefits are achieved will require investment in applied research development & deployment of technologies; introducing, sharing and adapting energy-smart technologies; fiscal support mechanisms; capacity building; support services; education and training. A policy environment without allocation of resources for implementation, up-scaling and facilitating the desired smart-energy changes may prove to be unsuccessful.

Distinguished delegates, friends and colleagues: by 2030 it is expected that as a result of continued population and economic growth the global demand for energy will rise by 40% and food demand by 50%. To add to the challenge, these increasing demands will have to be met in the context of climate change impacts, an already stressed set of natural resource assets and limited availability of productive sea and landscapes. The magnitude and complexity of the challenge, and the need for urgent action, explains the current importance now being given to seeking pragmatic solutions across food production systems.

The Assistant Director-General of the Fisheries and Aquaculture Department of FAO has followed closely the preparations for the meeting and he is delighted that FAO has been able to assemble such an impressive group. As you know each Expert here today, in his or her personal capacity, has been chosen because of the unique professional and geographical experience he or she brings to this workshop. I am pleased that this workshop has brought together an international cross-section of strategic industry stakeholders involved in fisheries and aquaculture to exchange information and review concepts and practices to develop practical perspectives and recommendations for reducing GHGs. Your contributions are intended to assist FAO and its partners in identifying and overcoming barriers to broad sectoral implementation of energy smart technologies and practices. To transition away from business-as-usual and to "do more with less" is a challenge but one which I am sure this workshop can effectively address.

Last but not least, I would like to acknowledge the financial support provided by the Government of Norway, FAO's regular programme, Seafish, and others for this workshop.

I wish you well for a fruitful and successful meeting and hope that your time in Bergen will provide you with an opportunity to see this beautiful coastal city.

Thank you very much.

APPENDIX 5

PRESENTATIONS MADE DURING THE WORKSHOP

The following presentations were made during the Workshop, and are provided in this appendix.

Presenter	Presentation title
James Muir	Strategies and options for GHG reduction in fisheries and aquaculture – a preliminary overview
Angus Garrett	Collective Action on GHG emissions in seafood systems
Yngve Torgersen	Norwegian policy of reducing greenhouse gas emissions in Norwegian fisheries and aquaculture
Ragnar Arnason	Reducing GHG Emissions: The Role of Fisheries
James Muir	A review on current perspectives on fuel subsidies in the fisheries sector
James Muir	A review on management policy and energy use in the fisheries sector
Sara Hornborg	Energy demand and GHG emissions in the Swedish fishing sector
James Muir	Consumption based carbon accounting
James Muir	Carbon finance market: financial mechanisms and potential implications for greenhouse gas (GHG) mitigation in the fishery and aquaculture sector
Doris Soto	Reducing GHG emissions in aquaculture; changing behaviors and systems
John Ryder	Greenhouse gases in the post harvest value chain
James Muir	Further strategies for reducing GHGs in aquaculture
Valeska Weymann	Market drivers and GHG reduction – recent experience and emerging practice
Petri Suuronen	Low Impact and Fuel Efficient (LIFE) Fishing
John Willy Valdemarsen	Development focus on trawl to reduce environmental impact within CRISP
Ari Gudmundsson	Fuel savings for small fishing vessels
Papa Gora Ndiaye	Reducing greenhouse gases emissions in the artisanal fisheries in West Africa
Sandra Marin	Current status of Chilean aquaculture regarding GHG emissions
Angus Garrett	GHG emissions in seafood systems – assessment and profiling tool
Erik Hognes	LCA and GHG reducing measures in fisheries and aquaculture
Amy White	Practical strategies for GHG reduction through aquaculture feeds – A commercial perspective
Ulrik Jes Hansen	Best Available Technology makes Drastic Cuts in Fuel Expenses in Trawl Fisheries

Venkatesh Salagrama	Challenges and options for fuel saving and GHG reduction in South Asian small-scale fisheries
Petri Suuronen	Barriers, constraints and opportunities to transition
Bundit Chokesanguan	Energy optimization in fisheries in Southeast Asia and SEAFDEC initiatives on energy optimization in fisheries
Angus Garrett	Engaging in seafood industry systems – issues and experiences

This document contains the report of the Expert Workshop on Strategies and Practical Options for Greenhouse Gas Reductions in Fisheries and Aquaculture Food Production Systems, held in Bergen, Norway, 4–5 March 2013.

Barcode