Food and Agriculture Organization of the United Nations

United Nations

System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries

(SEEA AFF)

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Published by
the Food and Agriculture Organization of the United Nations
and
United Nations Statistical Division
Rome, 2020

Required citation:

FAO and UN. 2020. *System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF)*.

Rome. https://doi.org/10.4060/ca7735en

ISBN 978-92-5-132207-9 [FAO]

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Foreword

The System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF) is a statistical system for organizing data to enable the description and analysis of the relationship between the environment and the economic activities related to agriculture, forestry and fisheries. These primary activities depend directly and have an impacton the environment and its resources. The SEEA AFF provides an integrated framework that supports the computation, monitoring and reporting of agri-environmental indicators, including those relevant to international processes, such as the 2030 Agenda for Sustainable Development and the Convention on Climate Convention.

The SEEA AFF is a subsystem of the SEEA Central Framework (SEEA CF), the first international statistical standard for environmental-economic accounting, endorsed in 2012 by the United Nations Statistical Commission. It applies and expands the SEEA CF concepts and methods related to agriculture, forestry and fisheries. Its accounting tables provide the statistical basis for the measurement and reporting of information on physical and monetary assets and flows relevant to production, trade, and the consumption of food and other agricultural, forestry and fisheries products and the use of natural resources.

This final document of the SEEA AFF was developed by Statistics Division of the Food and Agriculture Organization of the United Nations (FAO), in coordination with the United Nations Statistics Division (UNSD) under the auspices of the United Nations Committee of Experts on Environmental Accounting. It is the outcome of an inclusive process, involving member countries and the international statistical community. Initial work started in 2013, drafts of the document underwent two rounds of global consultations, in 2013 and 2015, which enabled the gathering of significant inputs from international and national experts.

The United Nations Security Council has recognized the importance of developing dedicated environmental-economic accounts for agriculture, forestry and fisheries, especially as a tool to support countries in implementing the 2030 Agenda. As mandated by the Statistical Commission at its forty-seventh session, held from 8 to 11 March 2016, the Committee of Experts endorsed the SEEA AFF as the internationally agreed methodological document for energy accounts in support of the SEEA Central Framework.[1]

The compilation of the SEEA AFF produces comparable and reliable data on agriculture, forestry and fisheries, which are essential in building the evidence base required to better understand the linkages between food security, sustainable development, environment and climate change issues, to inform effective national policies and response actions.

Rome, December 2019

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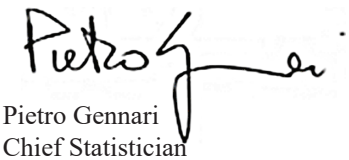

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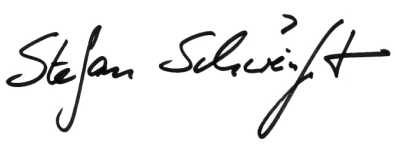

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Director
United Nations Statistics Division

[1] *Official Records of the Economic and Social Council, 2016, Supplement No. 4* (E/2016/24), chap. 1, sect. B, decision 47/106.

Preface

The scope of the System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF)

1. The SEEA AFF applies the environmental-economic structures and principles described in the System of Environmental-Economic Accounting 2012 Central Framework (SEEA Central Framework) to activities related to agriculture, forestry and fisheries. The SEEA Central Framework, an extension of the conceptual framework of the 2008 System of National Accounts (SNA) (European Commission and EUROSTAT, 2009), was adopted in 2012 as an international statistical standard by the United Nations Statistical Commission (UNSC). It was jointly published in 2014 by the United Nations, the European Commission, FAO, the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD) and the World Bank (United Nations *et al*., 2014). The SEEA AFF was endorsed in 2016 by the United Nations Committee on Economic Environmental Accounting (UNCEEA) on behalf of UNSC, as an "internationally approved methodological document in support of the SEEA Central Framework".

2. The focus of the EEA AFF is on the integration of data required for describing how biophysical and management information relevant to agriculture, forestry and fisheries production can be integrated into the statistical framework established under the SEEA Central Framework. Its data coverage is, therefore, broad, including data in monetary and biophysical terms across ten primary data domains.

3. Although agriculture, forestry and fisheries production represent a notable example of ecosystem services, the accounting approach described in the SEEA Experimental Ecosystem Accounting (SEEA EEA) is not currently incorporated in the SEEA AFF. This is because the data needed to underpin ecosystem accounting, including measurement of ecosystem services and ecosystem conditions, are not sufficiently advanced for the systematic implementation of the accounting approach at the country level at this point in time. There are, however, key linkages between the two systems and the need for closer integration of them is recognized as an important area of future SEEA research, by, for example, the London City Group Research Agenda and the SEEA EEA Technical Committee.

4. An important step towards developing ecosystem accounting is the estimation of information at the subnational level. The development of geospatially enabled datasets for agriculture, forestry and fisheries is, therefore, of critical importance, in particular when considering broader links with processes for achieving sustainable development processes.

Background to the development of the SEEA AFF

5. The relevance of extended accounting frameworks for analysis of agriculture, forestry and fisheries activities is well recognized. Examples of important work in that area are the following:

(a) The System of Economic Accounts for Food and Agriculture (FAO, 1996) and the Economic Accounts for Agriculture (EEA) build on the 1974 Handbook for Economic Accounts for Agriculture.

(b) The Integrated Environmental and Economic Accounting for Fisheries (United Nations and FAO, 2004).

(c) The European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF),(European Commission and EUROSTAT, 2002). While there are differences in the scope and coverage of those documents relative to the SEEA AFF, they collectively point to the potential to adopt accounting techniques in this area.

6. Following the adoption of the SEEA Central Framework in March 2012, UNCEEA endorsed the FAO-led plan to develop a SEEA for agriculture, forestry and fisheries in June 2012. Work on the SEEA AFF commenced in June 2013 with resourcing from the Global Strategy to Improve Agricultural and Rural Statistics (the Global Strategy) (FAO, United Nations, and World Bank, 2010) led by FAO. A draft version of the SEEA AFF was tested in 2014 through four country pilots, in Australia, Canada, Guatemala and Indonesia, followed by two global consultations, in 2014 and 2015. In 2016, as per the request of UNSC, the SEEA AFF was finalized as an internationally approved methodological document in support of the SEEA Central Framework by UNCEEA.

7. The critical role of FAO in support of the development of the SEEA AFF included its longstanding collection, analysis and dissemination of national statistics covering agricultural, forestry and fisheries activities and related themes, such as land, soil and water resources. In addition, FAO leads critical international work on the development of new data products and indicators within FAOSTAT, FishStat and other relevant corporate FAO data repositories. The work on the integration and further development of those statistics, as well as their relevance for and integration with national data, is a central motivation underpinning the development of the SEEA AFF.

8. By highlighting and identifying the functional connections among a wide range of data domains, the SEEA AFF is intended to provide a useful framework that facilitates analysis of statistics and indicators in support of several ongoing international efforts, including the following:

(a) The 2030 Agenda for Sustainable Development and the Sustainable Development Goals;

(b) The 2015 UN Climate Change Conference in Paris, held from 30 November to 11 in December 2015 (COP 21);

(c) Global Strategy to Improve Agricultural and Rural Statistics.

Acknowledgements

1. The SEEA Agriculture Forestry and Fisheries (SEEA AFF) is the outcome of a transparent process with extensive involvement of member countries and the international statistical community. After initial work started in 2013, the SEEA AFF final draft underwent two global consultations, respectively in 2013 and 2015, with the involvement national statistical offices, ministries of agriculture and ministries of Environment, and main international organizations, including EUROSTAT, OECD and the World Bank. The final SEEA AFF draft was submitted to the forty-seventh session of the United Nations Statistical Commission (UNSC) in March 2016.

2. The United Nations Statistical Commission, at its forty-seventh session, recognized the importance of developing dedicated environmental-economic accounts for agriculture, forestry and fisheries, especially as a tool to support countries in implementing the 2030 Agenda for Sustainable Development, and requested the United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) to support its finalization. The SEEA AFF was endorsed by UNCEEA at its eleventh meeting in June 2016, on behalf of UNSC, as an Internationally agreed methodological document in support of the SEEA AFF. This final version includes the comments and guidance received through the Technical Committee of UNCEEA, serving through 2017 as the Editorial Board of the SEEA AFF.

3. The SEEA Agriculture, Forestry and Fisheries is the result of the work and dedication of many professionals in a number of international organizations and member countries, under the coordination of the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Statistical Division (UNSD). FAO wishes to thank Carl Obst, who served as senior consultant on the project from its inception and functioned as the overall SEEA AFF Technical Editor, under the coordination of Robert Mayo and Francesco N. Tubiello, FAO Senior Statisticians, respectively former and current Team Leader of the Environmental Statistics Team of the FAO Statistics Division. Alessandra Alfieri and Ivo Havinga and their staff at the Environmental Economic Accounts Section of UNSD; in particular Sokol Vako, provided significant coordination and support throughout the project, assisting operationally through the implementation of global consultations and technically through the provision of technical feedback and overall direction.

4. Many FAO professionals in relevant divisions at Headquarters and in decentralized Offices contributed knowledge and time towards the successful completion of the SEEA AFF over many years. We are thankful for their contribution and enthusiasm in supporting this work. It is not possible to mention all by name. Among those who actively participated in the SEEA AFF process, we wish to thank Caterina Batello, Riccardo Biancalani, Veronica Boero, Jairo Castano, Giorgia De Santis, Antonio Di Gregorio, Sangita Dubey, Carola Fabi, Alessandro Ferrara, Alessandro Flammini, Karen Franken, Neli Georgeva, Irene Hoffman, Lars Gunnar Marklund, Arvydas Lebedys, John Latham, Thais Linhares Juvenal, Kenneth Mac Dicken, Javier Montero-Serrano, Simona Mosco, Eloi Ouedraogo, Daniela Ottaviani, Valentina Ramaschiello, Mirella Salvatore, Nadia Scialabba, Salar Tayyibb, Sachiko Tsuji and Ronald Vargas.

5. We wish to thank the Global Strategy to Improve Rural and Agricultural Statistics, its Coordinator, Christophe Duhamel, and the Chair of the Global Strategy Action Committee at the time, Fred Vogel, for supporting the critical early part of this work, including the contribution of knowledge and funding for publishing an interim version of the SEEA AFF in 2014.

6. Pietro Gennari and Josef Schmidhuber, Director and Deputy Director of the FAO Statistics Division until 2016, understood the strategic value of the SEEA AFF and provided their support to its implementation. We are also grateful to the current Director and Deputy Director of the FAO Statistics Division, Jose' Rosero Moncayo and Iswadi Mawabagja, who continued to support this project through its completion.

7. We wish to specifically acknowledge the contributions of the FAO Environmental Statistics Team, who led the coordination of this project from its inception within FAO and across agencies and member countries. The staff included Robert Mayo, former Team Leader, Bianca Papi, Silvia Cerilli, Dominique Ballayan, Simona Mosco, Giorgia De Santis, Giulia Conchedda, Aldo Femia (ISTAT), Carl Obst and Francesco N. Tubiello, current Team Leader.

8. The lead authors of this SEEA AFF publication were Francesco N. Tubiello, Carl Obst, Robert Mayo, and Silvia Cerilli. They also served as the main editors under the guidance of the SEEA Technical Committee of UNCEEA, functioning as the Editorial Board during the period 2016−2017, towards the completion of this report.

The United Nations Committee of Experts on Environmental-Economic Accounting (UNCEEA) and its Bureau.

9. The process of revision of the SEEA AFF involved the United Nations Committee of Experts on Environmental-Economic Accounting; other international, regional and non-governmental organizations; project staff; agencies responsible for compiling official statistics in many countries; city groups; other expert groups; and individual experts in environmental economic accounting and related fields from all regions of the world.

10. The Statistical Commission established the Committee of Experts at its thirty-sixth session, held in March 2005, with the mandate to mainstream environmental accounts and related statistics, and oversee and manage the revision of the SEEA AFF. The Bureau was established in 2007 to assist in carrying out specific activities between meetings. Members of the Bureau are elected from a pool of senior officials from national statistical offices and international organizations.

11. The following have served as members of the Bureau of the Committee of Experts: Bert Kroese (Chair); Lisa Wardlaw-Kelly and Mark Lound (Australia Bureau of Statistics); Andre Loranger (Statistics Canada); Arturo de la Fuente (Eurostat); Francisco Guillen and Raul Figueroa (INEGI, Mexico); Gerard Eding and Sjoerd Schenau (Statistics Netherlands); Francesco Tubiello (FAO); Peter van der Ven, Myriam Linster and Pierre-Alain Pionnier (OECD); Ivo Havinga and Alessandra Alfieri (United Nations Statistics Division); Glenn-Marie Lange (World Bank); Romeo Recide (Philippines Statistics Authority); and Joe de Beer (Statistics South Africa).

12. The staff of the Economic Statistics Branch of the United Nations Statistics Division, under the overall responsibility of Ivo Havinga and Alessandra Alfieri, provided secretariat services to the Committee of Experts and its Bureau. The following country representatives have served as members of the Committee of Experts: Peter Harper and Gemma van Halderen (Australia); Luiz Paulo Souto Fortes, Wadih Joao Scandar Neto and Eduardo Nunes (Brazil); Martin Lemire, Art Ridgeway and Robert Smith

(Canada); Huaju Li and Yixuan Wang (China); Luz Amparo Castro, Monica Rodriguez Diaz, Carlos Eduarte Sepulveda Rico and Luz Dary Yepes Rubiano (Colombia); Ole Gravgård Pedersen, Bent Thage and Kirsten Wismer (Denmark); Miguel Jimenez Cornielle, Roberto Blondet Hernandez, Olga Luciano Lopez and Olga Diaz Mora (Dominican Republic); Leo Kolttola (Finland); Walter Radermacher, Michael Kuhn and Karl Schoer (Germany); Ramesh Chand Aggarwal, Jogeswar Dash and Shri V. Parameswaran (India); Slamet Sutomo (Indonesia); Corrado Carmelo Abbate and Cesare Costantino (Italy); Hida Fumikazu (Japan); Mark de Haan and Peter van de Ven (Netherlands); Torstein Bye and Olav Ljones (Norway); Khalaf Al-Sulaimani (Oman); Estrella Domingo and Raymundo Talento (Philippines); Sergey Egorenko, Igor Kharito and Andrey Tatarinov (Russian Federation); Joe de Beer and Anemé Malan (South Africa); Inger Eklund and Viveka Palm (Sweden), Rocky Harris (United Kingdom of Great Britain and Northern Ireland); and Dennis Fixler and Dylan Rassier (United States of America).

13. The following representatives of international organizations served as members of the Committee of Experts: Lidia Bratanova (ECE); Salvador Marconi and Kristina Taboulchanas (ECLAC); Joel Jere (ESCAP); Wafa Aboul Hosn (ESCWA); Jean-Louis Weber (European Environment Agency); Pedro Díaz Muñoz and Pieter Everaers (Eurostat); Pietro Gennari (FAO); Manik Shrestha (IMF); Myriam Linster (OECD); Linda Ghanimé, Maria Netto and Veerle van de Weerd (UNDP); Kathleen Abdalla, Tariq Banuri, Matthias Bruckner, Jean-Michel Chéné, Manuel Dengo, Liisa-Maija Harju and Mary Pat Silveira (UNDSD); Hussein Abaza, Derek Eaton, Maaike Jansen, Fulai Sheng, Guido Sonnemann and Jaap van Woerden (UNEP); Alessandra Alfieri, Ivo Havinga and Eszter Horvath (UNSD); and Kirk Hamilton, Barbro Elise Hexeberg, Glenn-Marie Lange and Marian S. de los Angeles (World Bank).

14. The following participants served as observers to the Committee: Brad Ewing and Pablo Muñoz (Global Footprint Network); Arnold Tukker (Organization for Applied Scientific Research); Yamil Bonduki (UNDP); Frederik Pischke and Friedrich Soltau (UNDSD); Molly Hellmuth (consultant to UNESCO); Haripriya Gundimeda (UNEP); Rolf Luyendijk (UNICEF); Francois Guerquin and Koen Overkamp (United Nations Secretary-General's Advisory Board on Water and Sanitation); Martin O'Connor (l'Université de Versailles Saint-Quentin-en-Yvelines); and Peter Cosier (Wentworth Group of Concerned Scientists, Australia).

15. The following experts in environmental-economic accounting from international organizations regularly provided substantive contributions: Brian Newson and Anton Steurer (Eurostat); Manik Shrestha and Kimberly Dale Zieschang (IMF); Paul Schreyer (OECD); Alessandra Alfieri and Ivo Havinga (UNSD); and Glenn-Marie Lange (World Bank).

16. Other staff members of international organizations who contributed substantively to the project were the following: Jean-Louis Weber (European Environmental Agency); Stephan Moll, Julio Cabeca and Marina Anda Georgescu (Eurostat); Antonio Di Gregorio, Greg Gong, John Latham, Valentina Ramaschiello, Sachiko Tsuji and Adrian Whiteman (FAO); Odd Andersen, Annette Becker, Ralf Becker, Daniel Clarke, Magdolna Csizmadia, Ilaria DiMatteo, Bram Edens, Robert Edwards, Vladimir Markhonko, Ricardo Martinez-Lagunes, Gulab Singh, Herman Smith, Sokol Vako, Michael Vardon and Jeremy Webb (UNSD).

London Group on Environmental Accounting

17. The London Group on Environmental Accounting met five times to discuss issues related to the SEEA AFF, among other items. The London Group was chaired throughout the preparation of the SEEA AFF, during the period2013−2015 by Joe St Lawrence (Statistics Canada) and in 2016, by Nancy Steinbach (Statistics Sweden). The meetings were held in November 2013 in London, hosted by the Office for National Statistics UK and Department for Environment, Food and Rural Affairs; in October 2014 in New Delhi, hosted by Central Statistics Office of India; in November 2015 in the Hague, hosted by Statistics Netherlands; in September 2016 in Oslo, hosted by Statistics Norway (SSB); in October 2017 in San José, hosted by the Central Bank of Costa Rica (BCCR).

18. The following individuals have participated in one or more meetings of the London Group since 2013: Sofia Ahlroth; Alessandra Alfieri; Irene Alvarado; Anna Andriianets; Iulie Aslaksen; Giles Atkinson; Ida Björk; Gerhardt Bouwer; Trine Braathu; Gerry Brady; Salim Buhroon; Sven C. Kaumann; Juan-Pablo Castaneda; Silvia Cerilli; Kyusoong Chung; Emily Connor; Mark de Haan; Jane Harkness; Rixt de Jong; Arturo de la Fuent; Derek Eaton; Daniel Desaulty; Gary Dunnet; Mark Eigenraam; Beyhan Ekincil; James Evans; Shi Faqi; Aldo Femia; Raul Figueroa Diaz; Brendan Freeman; Gabriel Gagnon; Alessandro Galli; Per Arild Garnåsjordet; Cor Gravelan; Ole Gravgård; Mads Greaker; McGrevy Ryan Greenaway; Rocky Harris; Roderich Harris; Sami Hautakangas; Takashi Hayashi; Bayron de Jesús; Jawed Khan; Eunyoung Kang; Steven King; Tonje Køber; Kristine Kolshus; Pushpam Kumar; Julie L. Hass; Alessandra La Notte; Cindy Lecavalier; Dongsoo Lee; Gang Liu; Mark Lound; Kristine M. Grimsrud; John M. Matuszak; Live M. Rognerud; Monica Magaua; Zarinah Mahari; Duong Manh Hung; James Mathew; Helmut Mayer; Robert Mayo; Taha Zaitun Mohd; David Montero Dias; Ole Moss; Chris N. Mukiza; Jukka Muukkonen; David N. Barton; Michael Nagy; Frederic Nauroy; Yvonne Newland; Carl Obs; Julio Oleas; Thomas Olsen; Kaia Oras; Viveka Palm; Gravgard Pedersen Ole; Jan-Erik Petersen; Pierre-Alain Pionnier; Elsa Varela Redondo; Kevin Roberts; Etjih Tasriah; Leila Rohd-Thomsen; Kyung Sam Min; Neto Wadih João Scandar; Sjoerd Schenau Ingrid; Semb Weyer; José Antônio Sena do Nascimento; Joe St. Lawrence; Nancy Steinbach; Celine Steinfeld; Anton Steurer; Joachim Thomas; Qin Tian; Sachiko Tsuji; Arnold Tukker; Jørn Kristian Undelstvedt; Sokol Vako; Stefan van der Esch; Michael Vardon; Henry Vargas; Scott Wentland; Monika Wozowczyk; and Žiga Žarnić.

19. The London Group constitutes a substantial body of research. The authors of papers prepared for the Group that contributed substantially to the SEEA AFF are the following: Silvia Cerilli; Giulia Conchedda; Rixt de Jong; Arturo de la Fuente; Aldo Femia; Cor Graveland; Lars Hein; Julie L. Hass; Cindy Lecavalier; Mark Lound; Francesco N. Tubiello; Carl Obst; Roy Remme; and Sjoerd Schenau.

Country contributions

20. National statistical offices, ministries of agriculture and environment and other relevant national agencies made significant in-kind contributions to the revision of the SEEA AFF through the provision of papers for discussion at various meetings and the transmission of comments during the global consultation processes. We wish to thank government experts from Australia, Canada, Guatemala and Indonesia, who contributed to an early piloting of the SEEA AFF in 2014 by providing highly valuable contributions to this final version. They are the following: Airlanga Buyung (BPS Statistics, Indonesia); Augustan (BPPT Centre for Natural Resource Accounting, Indonesia); Cindy Lecavalier and Joe St Lawrence (Statistics Canada); Mark Lound (Australian Bureau of Statistics); and Renato Vargas (SEGEPLAN, Department of Planning, Guatemala). Julien Hardelin (OECD, Ivo Havinga (UNSD) and Johan Selenius (EUROSTAT) provided support on behalf of their respective international organizations to the SEEA AFF country pilot testing.

21. In 2016 and 2017, Australia and Netherlands began testing a preliminary version of the SEEA AFF, for application within their national accounting system. Their findings and suggestions were incorporated into this final SEEA AFF version. We are thankful to Lisa Wardlaw-Kelly, Lisa Green, Andew Hunt, Steven May and Mike Booth (Australian Bureau of Statistics), Sjoerd Schenau (Central Bureau of Statistics, Netherlands) for their inputs.

22. Several pilot countries of the World Bank Wealth Accounting and Valuation of Ecosystems Services Programme (WAVE) have been using a preliminary version of the SEEA AFF as a basis for testing applicability within their national accounting systems. We are thankful to Juan Pablo Castaneda, WAVE Manager, for the adoption of the SEEA AFF in his work. Specifically for Uruguay, Vicente Plata, Uruguay FAO Representative, coordinated the participation of government experts to a specific WAVES SEEA workshop in Feb 2017 (MVOTMA, MGAP, SNAACC, OSE, INIA), which resulted in valuable feedback towards the finalization of the SEEA AFF.

23. Government experts from Uganda contributed additional feedback to the SEEA AFF through a capacity development workshop, held in April 2016. We are thankful to Patrick Otello and Emmanuel Menyha (UBOS), Percy Mucunguzi (NEMA), John Diisa (NFA) and Agens Nagayi (MAAIF), among others, for their valuable contributions. The workshop was organized and funded by the World Bank, for which we are thankful to Ademola Braimoh.

24. We are thankful to the contribution of government experts of the Badan Pusat Statistik (Indonesia Statistics), in particular Etjih Tasriah, who worked with FAO in 2018 and 2019, providing valuable insight for the final testing and data compilation of the accounting tables that are published in this final report.

25. We are thankful to UNSD for giving FAO the opportunity to present its agri-environmental statistics, including the SEEA AFF accounting principles, to several countries in regional workshops. The comments received by country participants contributed towards improving this final draft. In particular, the SEEA AFF was presented to government experts and specialists from China, the Philippines and Mongolia, among others (Regional Training Workshop on the System of Environmental-Economic Accounting; Shanghai, China, 2015); and from Burundi, Kenya, Malawi, Rwanda, Uganda the United Republic of Tanzania and South Sudan (Workshop on Environment Statistics for the East African Community Region; Arusha, United Republic of Tanzania, 2017).

26. Finally, the SEEA AFF was presented to statistical experts of most FAO member countries in several regional commissions on agricultural statistics, receiving encouragement for the methodological work and endorsement of the activities undertaken. Various versions of the SEEA AFF were presented to and received feedback from more than 100 member countries over the period 2012−2016, by region: for Asia and the Pacific (APCAS 24 and 25, 2012−2014); Africa (AFCAS 23 and 25; 2013−2015); and Latin American and Caribbean (IICA 26 and 27, 2013−2015).

Abbreviations and acronyms

AFOLU	Agriculture, Forestry and Other Land Use
CBD	Convention on Biological Diversity
CO2	carbon dioxide
CPC	Central Product Classification
CPUE	catch per unit effort
ECE	Economic Commission for Europe
ECLA	Economic Commission for Latin America and the Caribbean
EEA	Experimental Ecosystem Accounting
EPEA	environmental protection expenditure account
ESCAP	Economic and Social Commission for Asia and the Pacific
EUROSTAT	Statistical Office of the European Union
FAO	Food and Agriculture Organization of the United Nations
FAOSTAT	FAO Statistical database
GDP	gross domestic product
GIS	geospatial information system
IEEAF	European Framework for Integrated Environmental and Economic Accounting for Forests
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification of all Economic Activities
ISTAT	Italian National Institute of Statistics
ISSCFC	International Standard Statistical Classification of Fishery Commodities
IUU	illegal, unreported and unregulated (fishing activity)
LKAU	local kind of activity unit
LNG	liquefied natural gas
LPG	liquefied petroleum gas
OECD	Organisation for Economic Co-operation and Development
SE4ALL	Sustainable Energy for All
SEEA	System of Environmental-Economic Accounting
SIEC	Standard International Energy Product Classification
SNA	System of National Accounts
SUT	supply and use table
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
UNCBD	United Nations Convention on Biodiversity and Aichi biodiversity targets
UNCCD	United Nations Convention to Combat Desertification
UNCEEA	United Nations Committee of Experts on Environmental-Economic Accounting
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1 Introduction to the System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries

1.1 Overview of the System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries

1.1. The System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries (SEEA AFF) is a statistical system for organizing data to enable the description and analysis of the relationship between the environment and economic activities related to agriculture, forestry and fisheries. These primary activities depend directly and have an impact on the environment and its resources.

1.2. Understanding the complex relationship between these primary activities and the natural environment is critical for the analysis of sustainable food and agriculture, which is dependent on the interlinkages between food security, natural resource use and the sustainability of food, fibre, material and bioenergy production, rural incomes, and employment.

1.3. Integrating economic and environmental information about agriculture, forestry and fisheries involves consideration of the connections and trade-offs between the objectives of each activity and the related environmental factors. To that end, the SEEA AFF supports the growing dialogue on the water–climate–food–energy nexus, in particular, in the context of the 2015 Agenda for Sustainable Development (United Nations, 2012).

1.4. The SEEA AFF is designed to be applicable to and by all countries, regardless of their economic or statistical development status, economic structure or environment. Recognizing significant variations among countries in agriculture, forestry and fisheries activities, the structure of the SEEA AFF accounts easily allows for the inclusion of nationally important activities and products.

1.5. The accounting framework described in the SEEA AFF covers monetary and physical data. In doing so, the SEEA AFF is an application of the accounting principles and structures contained in the System of National Accounts (SNA) and the SEEA Central Framework (SEEA CF), with a focus on the integration of data relevant to agriculture, forestry and fisheries into national accounting frameworks. As such, the SEEA AFF is endorsed by UNCEEA on behalf of UNSC as an "internationally approved methodological document in support of the SEEA Central Framework".

1.6. The basic organization of the SEEA AFF can be extended in a variety of ways. It is hoped that extensions and refinements to it will be carried out based on country needs and experience to enhance the system described herein. In that sense, the SEEA AFF constitutes a platform for an accounting framework aimed at facilitating the integration and use of data relating to agriculture, forestry and fisheries activities within the domains of economics and the environment.

1.2 Motivation for the development of the SEEA AFF

1.7. The main purpose of the SEEA AFF is to foster the integration of environmental and economic data with a view to supporting the mainstreaming of environmental information into economic planning, development policy, and analysis and monitoring. The SEEA Central Framework to Agriculture, Forestry and Fisheries activities is applied, which makes it possible to conduct a joint analysis of environment and economy for those sectors in support of a more complete analytical framework than otherwise possible when performing analysis in each field separately. As a complement and in addition to the SEEA CF, in the SEEA AFF, eleven new physical flow and asset accounting tables are introduced, including for crops and livestock production, fish and aquatic products, fertilizers, pesticides, and agriculture-specific economic data, which are needed to record and analyse relevant agricultural statistics in an integrated, holistic manner. These SEEA AFF specific tables are highlighted in the text in relevant sections of the present document.

1.8. This issue is important in relation to agriculture, forestry and fisheries because there are fundamental connections between economic units – businesses – and the environments and ecosystems in which they are located and operate. By way of example, farmers rely directly on the quality of soil and the availability of water to grow crops and raise livestock; foresters must balance the extraction of timber against the condition of the forest in terms of such factors as soil stability, biodiversity, the management of pests and disease and fire risks; and fishermen need to understand how their activity affects fish stocks and how the local freshwater or marine environment supports healthy populations.

1.9. At the same time, the exclusive focus on environmental and ecological factors ignores the reality that those engaged in agricultural, forestry and fisheries activities do so to derive an income. Consequently, they must take into account the costs of inputs, delivery and storage, and consider consumer demand and other economic factors that drive economic decisions with respect to use of the environment. Such decision-making is challenging, requiring the balancing of economic and environmental factors.

1.10. The SEEA AFF provides information relevant to the analysis of production functions for individual products and activities, but it goes beyond standard economic production functions to include environmental inputs, status and impact. Accordingly, it brings together information to extend and improve the data available for analysis of, for example, the cultivation of rice, the raising of livestock, and the management of forests and fish stocks. A SEEA AFF-based dataset can directly assist in the coordination of information to measure those and other production functions, in support of improved evidence-based decision-making.

1.11. The larger analytical potential of SEEA AFF stems from its application of a common framework in which concepts, definitions and classifications are consistently applied across different products and activities. The production of wheat, for example, can in this manner be described and more meaningfully compared with the production of forest products or fish. Furthermore, by applying the concepts of the SEEA Central Framework and thus of national accounts, SEEA AFF allows for a more consistent and meaningful comparison of agricultural, forestry and fisheries products and activities with the products of the manufacturing, retail and services industries.

1.12. In addition to direct structural comparisons between, for example, yield per hectare or energy use per tonne harvested, data that are in a common framework can be used to assess trade-offs between alternative scenarios using various modelling techniques.

1.13. Furthermore, because the starting scope of the SEEA AFF is a national-level activity, the data in the SEEA AFF framework are not case studies of specific production functions, Instead, the observed relationships between inputs and outputs are embedded in aggregate measures of production, supply and demand. Hence, the SEEA AFF may help in scaling up to more detailed studies, enabling mainstreaming of detailed technical data into macro-level discussions. The logic of this micro–macro connection is an important aspect of standard economic accounts. The adoption of them can facilitate the integration of survey data on input-output relationships for particular industries (including specifically agriculture, forestry and fisheries), with macroeconomic indicators of international trade, consumer demand, government expenditure, and business production and investment.

1.14. By facilitating the integration of relevant information, the SEEA AFF is a very useful framework for assessing the sustainability of agriculture, forestry and fisheries activities. It may, nonetheless, exhibit a number of possible limitations to this end. First, it can make connections with social data, such as employment and household incomes, but it does not incorporate other social aspects, such as social capital or education.

1.15. Second, its role as a data integration framework may be too general in specific circumstances for capturing critical differences in production practices, in particular locations and for specific products.

1.16. Third, its focus on integration of data in biophysical terms – tonnes and cubic metres, for example – and in monetary terms may hinder analysis of some potential environmental impacts. The relative toxicity of pesticides, for example, will not be recognized if pesticides are accounted for only in terms of tonnes of active ingredients or in terms of their monetary values.

1.17. Fourth, the environmental data that are integrated in the SEEA AFF largely concern those stocks and flows that support and provide input to agriculture, forestry and fisheries activities. At this stage, there is no explicit coverage of changes in environmental quality that arise as a result of these activities, although the information relevant to these impacts may be found in accounting for changes in land, soil and water resources. A more complete accounting for environmental quality could be further developed through the incorporation of the SEEA Experimental Ecosystem Accounting, as envisaged in the SEEA AFF research agenda.

1.18. Notwithstanding the above-mentioned limitations, the integration of environmental and economic data is a major step towards mainstreaming environmental factors into economic policy development and analysis. Information in itself is no guarantee of a particular outcome with respect to policy or decisions, but availability of it may encourage a more informed approach to decision-making.

1.3 Potential beneficiaries

1.19. Many possible users and beneficiaries of the SEEA AFF are described below. It should be noted that they may be users of information or compilers of information.

1.20. Information agencies, including national statistics offices. These agencies can benefit from the approach taken by SEEA AFF to place multiple data sources in a unique framework that is compliant with international standards. The SEEA AFF encourages the use of consistent and non-overlapping concepts, data-item definitions and classifications of activity and products, which can assist in streamlining data collection and facilitating comparisons and quality assessments.

1.21. Compilers of national accounts. Agricultural, forestry and fisheries activities are major contributors to economic activities in many countries, in particular with regard to their effects related to short-term movements in aggregate gross domestic product (GDP). The collection of data on those activities is challenged by the large number of widely separated producers, their seasonal nature and the possible prevalence of home and subsistence production. SEEA AFF-based accounts will be directly relevant to the compilation of estimates for the core national accounts, contributing to the compilation of more accurate estimates of GDP.

1.22. Government departments. Most countries and many administrative regions have departments dedicated specifically to agriculture, forestry, fisheries and the environment, and departments that cover both economic and environmental issues, such as macroeconomic development and planning institutions. Because those departments' core datasets are many and varied, they may not be conducive to the joint consideration of environmental and economic factors. Data compiled following the SEEA AFF can facilitate departmental understanding of macro-level and micro-level linkages and trade-offs between those factors.

1.23. Natural resource managers. The compilation of the SEEA AFF requires input from natural resource managers, such as foresters, fisheries experts, soil experts and hydrologists. The SEEA AFF is unlikely to provide additional information to support improved management of individual natural resources, but the common framework will highlight linkages among different natural resources and between natural resources use and economic drivers.

1.24. Industry associations and individual economic units, including multinational corporations. Discussion on the use of the SEEA often focuses on its relevance for government and administrative decision-making. In addition, a broad-based information set on agricultural, forestry and fisheries activities is likely to be of interest to private-sector economic actors, industry associations, agriculture, forestry and fisheries businesses, supporting industries and the finance sector. A SEEA AFF database would serve as a useful source of business intelligence, provide a reference for the collection and organization of data by those agencies, and support the assessment of risks through the supply chain.

1.25. Academic and research institutions. The increasing focus on environmental-economic and other interdisciplinary linkages suggests that the availability of better integrated datasets would support research and independent monitoring in those areas. To overcome, the challenges involved in bringing together environmental data expressed in physical terms in an economic accounting framework, further investigation is needed, which would result in opportunities for researchers.

1.26. International agencies. The SEEA AFF framework may be very beneficial for international agencies. From a statistical point of view, the SEEA AFF can support work to improve the quality of statistics. From a development policy perspective, increased understanding of environmental linkages is desirable based on the view that agricultural, forestry and fisheries activities are significant in terms of employment and development, as is the capacity to make comparisons among countries on the basis of consistent metrics, such as agri-environmental indicators.

1.27. Among the many global policy initiatives with links to agricultural, forestry and fisheries activities are the following:

(a) 2030 Agenda for Sustainable Development and its Sustainable Development Goals;

(b) Poverty-Environment Initiative of the United Nations Development Programme and the United Nations Environment Programme

(c) United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD);

(d) Convention on Biodiversity (CBD) and its Aichi Biodiversity Targets;

(e) United Nations Convention to Combat Desertification (UNCCD);

(f) United Nations Sustainable Energy for All (SE4ALL);

(g) United Nations Framework Convention on Climate Change (UNFCCC).

1.28. Each of these initiatives has established or will establish specific targets and benchmarks. Benefits, however, can also be derived in providing an integrated dataset that supports all programmes using the SEEA AFF approach as environmental-economic standards for evidence-based policy decision making.

1.4 Implementation: expectations and data requirements

1.29. The SEEA AFF supports the organization and integration of information from multiple domains based on the accounting principles of the SEEA Central Framework. As a result, it provides a structure in which compilation exercises may be carried out. Importantly, the implementation of it should be seen as part of a broader national statistical architecture and within the context of each country's national statistical system. The implementation of the SEEA AFF is ongoing in Morocco (Haut Commissariat au plan, Haut Commissariat aux Eaux et Forêts et à la lutte Contre la Déforestation), Cameroun (Institut National de la Statistique – INS) and Senegal (Agence nationale de la Statistique et de la Démographie).

1.30. As with all areas of environmental-economic accounting, a combination of agencies and disciplines is required for implementation of the SEEA AFF, with integrated planning and full coordination as fundamental principles. Implementation should not be seen as a purely technical or statistical exercise. To ensure appropriate targeting, producers and owners of information and users of information must be involved from the outset.

1.31. The SEEA AFF has a broad coverage and requires a large amount of data for complete implementation. At the same time, it combines, in a single context, ten domains and underlying datasets that, individually, are either well established or otherwise often available at the national level. Much of the data required by the SEEA AFF are collected through well-established international statistical questionnaires developed in the various domains. In that sense, the SEEA AFF as accounts are not experimental.

1.32. Similar to the implementation of the SEEA Central Framework, countries are not expected to implement all aspects of the SEEA AFF in a single step. A flexible and modular approach is envisaged, whereby countries implement components incrementally, taking into consideration national priorities, existing data, available resources and national policy requirements.

1.33. To help provide structure for implementation and facilitate implementation by countries at any level of statistical capacity, the SEEA AFF builds on the three-tiered approach used in the Intergovernmental Panel on Climate Change (IPCC). Guidelines for national greenhouse inventories for reporting to UNFCCC. The objective is to provide a relatively standard entry point to the SEEA AFF framework for countries, especially those that have relatively less developed statistical systems. Simplified accounts compiled at low tiers can be used as a starting reference point for compilation, quality assessment and quality control, and to facilitate international comparison. Over time, as experience with the SEEA AFF grows, countries will progressively move towards more complete and more detailed accounts and hence higher tiers, enabling a broader range of policy discussion and analysis.

1.34. In brief, three tiers of implementation are envisaged. The first tier involves the compilation of accounts using as default data those available in international databases, including FAOSTAT; the second tier uses those data and additional national data that are available or might be sourced following discussions with relevant national agencies; the third tier involves introducing new or expanded data collections to provide accounts that have additional detail, facilitating incorporation of subnational-level data, including the use of geospatial data and models. The three tiers are explained further in annex I.

1.35. Initial development of SEEA AFF does not require new questionnaires, though it may require increased harmonization among existing data-collection efforts across different data domains. In that context, SEEA AFF is a single tool for harmonizing and aligning the data from various agencies within a national statistical system. The data are to include information drawn from surveys and censuses, administrative sources and, increasingly, geospatial information systems (GIS).

1.36. Other than official statistical collections and processes, data collected in other national and international processes should be utilized: the use of data on greenhouse gas emissions from UNFCCC processes is an example. There may be differences in measurement scope and definition, but such datasets will provide useful support for the development of the integrated accounts envisaged in the SEEA AFF.

1.37. Given that the approach of the SEEA AFF is to use data from multiple sources, it does not provide guidance on compiling data for specific domains; the focus is on describing a structure and rationale for the integration of data.

1.38. The process of integration described in the SEEA AFF requires the collection of additional detail in some areas to support its cross-cutting approach. Such additional detail, in particular at the product level, should be seen as part of the dataset that might be developed using the SEEA AFF. The collection of additional detail should be in response to policy and analytical need rather than being viewed as a requirement.

1.39. It is understood that although some of the detail described in the SEEA AFF is not the focus of current activity by statisticians at the country level; such detail is commonly used in agricultural, forestry and fisheries modelling and analysis. Hence the SEEA AFF may provide greater transparency in the development of models that integrate and allocate data from a variety of sources.

1.40. Consistent use of the SEEA AFF provides the basis for international comparability. Decisions regarding the country-level data that may be collected for international reporting purposes, and the appropriate mechanisms for collection and coordination, will be made through the relevant international statistical processes.

1.5 Summary of uses and applications of the SEEA AFF framework

1.5.1 Primary uses of SEEA AFF data

1.41. The SEEA AFF provides a structure for the organization of environmental and economic data that are useful for policymaking and analysis. Accordingly, it must be informed by and responsive to the needs of data users. In the present chapter, ways in which SEEA AFF data might respond to those needs and encourage discussion between data compilers and data users are outlined. Also, some potential applications are highlighted; more examples are expected as development and testing proceed.

Statistical data coordination

1.42. With its strong connections to the SEEA Central Framework, the SEEA AFF includes many approaches of national accounts for organizing information and statistics, as outlined in the following paragraphs.

1.43. Framework for organizing data. By using consistent classifications, for example for "product" (CPC) and "activity" (ISIC), and information structures, such as supply-and-use tables and asset accounts, the SEEA AFF provides a system for bringing together economic and environmental information coherently within a single setting.

1.44. Data gap analysis and gap filling. The SEEA AFF is designed on the basis of the relevance of information rather than its availability. As it is broad based, the SEEA AFF framework can be used to identify and assess data gaps or data of poor quality and to support the allocation of resources to fill significant data gaps. In addition, because the accounting that underpins the SEEA AFF reflects accepted relationships between stocks and flows, the relationships can be used as a basis for filling data gaps through modelling or analogous approaches.

1.45. Data collection and reporting. The SEEA AFF can support and encourage the use of consistent data-item definitions in different collections and the use of consistent classifications across collections, such as for product classifications. Those practices can facilitate the exchange of data among agencies.

1.46. Uses in defining indicators. One motivation for the SEEA AFF is the need to facilitate the derivation of indicators that reflect cross-domain comparisons, such as between yield per hectare and water use per tonne of crop produced. For these indicators to be meaningful, the definition of information from the relevant datasets must be consistent. Different datasets often have their own scope, definitions and classifications, and, as a result, the quality of the resulting indicators may be compromised.

1.47. The SEEA AFF meets this challenge by providing consistent scope and classification for agriculture, forestry and fisheries products and activities for all datasets, thereby constituting a basis for adjusting primary data to derive sound cross-domain indicators and for developing the primary datasets themselves.

1.48. The types of indicators that can emerge from the SEEA AFF framework are described in chapter 6 of the SEEA Central Framework, and in chapter 2 of the SEEA applications and extensions. In addition, there is a more specific discussion on types of agriculture, forestry and fisheries indicators in section 2.6 of this document. The types of indicators are the following:

- Descriptive and structural statistics;
- Environmental asset aggregates
- Environmental ratio indicators
- Decoupling indicators
- Polluter-pays indicators

1.49. The SEEA AFF provides a framework in which the data used to derive indicators through participatory processes are readily available and organized coherently.

1.50. Examples of indicator sets include those being developed for the Sustainable Development Goals, the agri-environmental indicators collected by OECD, EUROSTAT and FAO,[1] and the indicators in the Sustainable Energy for All Global Tracking Framework. Many of the indicators in those indicator sets can be derived from a SEEA AFF-based dataset and, conversely, it would be relevant when selecting indicators to consider the potential for deriving indicators based on the SEEA AFF.

1.51. The SEEA AFF does not define a concept of sustainability, nor does it suggest that direct measures of sustainable development can be derived from a SEEA AFF dataset. It does, however, provide information relevant to the assessment of the environmental sustainability of an agricultural, forestry or fisheries activity. The distinction between organizing the relevant information and the direct measurement of sustainability must be taken into account when considering the potential role of the SEEA AFF.

Uses for detailed analysis and modelling

1.52. The information in the SEEA AFF can be used to compile environmentally extended input-output tables, which are introduced in chapter 3 of the SEEA applications and extensions. The basis behind these tables is that standard input-output tables focused on flows of products in an economy measured in monetary units are extended to incorporate environmental flows measured in physical units, such as greenhouse gas emissions and use of water and energy. The mathematics of input-output analysis has been adapted to suit that extension. The essential point is that the organization of information about the additional environmental flows is based on the same product and industry classifications as the standard input-output table.

1.53. Because standard input-output tables are structurally aligned with the SNA, environmental information organized following the SEEA – including agricultural, forestry and fisheries data – can be readily incorporated into an environmentally extended input-output table.

1.54. Environmentally extended input-output tables have been developed for individual countries, and are increasingly being developed to cover several countries; they are referred to as multiregional input-output tables, which also incorporate connections between countries through international trade in goods and services.

1.55. After the environmentally extended input-output tables are established, different types of analysis may be supported. The following examples are introduced in more detail in the SEEA applications and extensions.

- Multiplier analysis
- Demand based accounts and indicators, including footprint indicators
- Structural decomposition analysis
- Extended productivity analysis
- Modelling of international trade
- General and partial equilibrium analysis
- Life-cycle analysis

1.5.2 Primary policy themes

1.56. This section provides a description of the various policy areas that may be supported by a well-populated SEEA AFF dataset, bearing in mind that the intention of the SEEA AFF and the SEEA generally is to facilitate consideration of connections between environmental and economic factors relevant to economic, planning and development decisions. Statistical information is unlikely to be the sole basis for such decisions, so the approach adopted by the SEEA AFF to integrate data in meaningful ways is just as important as the clarification of definitions and treatments.

[1]FAO, OECD and Eurostat share a coherent set of indicators.

1.57. The term "policy" is used generically, covering the use of information to (a) support consideration of alternative options and scenarios in the policy development process; (b) analyse policy outcomes; and (c) monitor progress in a policy, for example through indicators or benchmarks. In addition to government policy, the term is also applied here to refer to the decision-making frameworks of non-governmental organizations, corporations and small businesses.

1.58. The SEEA AFF framework supports the discussion of the five themes described below with potential links to particular policies. The themes are a basis for the SEEA AFF combined presentations described in section 2.5.

Theme 1: Activity-specific and product-specific inputs

1.59. This theme focuses on analysis of economic and environmental information about a country's most important products, and the associated trends in the use of environmental inputs and the generation of residual flows. Determination of the "most important" products depends on the criteria applied, which may include the most traded internationally, the most significant for nutrition, contribute the most to production or use the most land for agricultural purposes.

1.60. The policy connections relate to understanding the intensity of use of environmental flows: they are of direct relevance in assessing the impact of changes in policies and incentives with regard to green growth and related objectives.

Theme 2: Food product consumption, losses and waste

1.61. Here, the focus is on the production and consumption of food products, in particular tracking sources of supply – domestic production or imports – and destinations of use – final consumption, intermediate consumption, changes in inventories and exports. In balancing supply and use, there is always an element of waste and loss of food that must be correctly recorded and attributed.

1.62. Two policy connections are (a) the links between food production, and household final consumption – at home and in restaurants; and (b) the potential to improve food security outcomes by reducing food waste in the supply chain; the latter is a focus of work of OECD, the World Food Programme and FAO. The SEEA AFF provides some essential information that can be linked to other physical flow and/or input-output data to map the full supply chain.

1.63. A critical theme is the link between food consumption and health, nutrition and undernourishment. Using the common unit of calories or other nutrients, the production and consumption of food products can be considered differently. These relationships are traditionally measured through food balance sheets. In addition, the SEEA AFF allows for consideration of the additional links to water use, land use, greenhouse gas emissions and other environmental flows.

Theme 3: Bioenergy

1.64. The requirement to consider sources of energy other than fossil fuels has led to rapid increases in the production of energy from agricultural and forestry products. International initiatives, SE4ALL the FAO-led programmes on bioenergy and food security and the Global Bioenergy Partnership reflect the importance of this aspect of agricultural and forestry activity. The information in the SEEA AFF will support an integrated assessment of the factors affecting the production and consumption of bioenergy.

Theme 4: Use of environmental assets – timber, fisheries, water and soil

1.65. The focus of this theme is on the extent to which the extraction and use of environmental assets to carry out agricultural, forestry and fisheries activities is depleting available resources below sustainable levels, and hence reducing the capacity to sustain these activities in the long term.

1.66. The policy connections involve supporting the management of natural resources and understanding potential environmental constraints for particular activities.

Theme 5: Cross-industry and activity perspectives

1.67. The focus of this theme is on bringing together information that can be compared across agricultural, forestry and fisheries activities, in particular information on production and value added, international trade, employment, land use, water and energy use, and greenhouse gas or other air emissions.

1.68. The policy connections are numerous. Issues, such as land-use planning and the food-water-energy-climate nexus, are of particular interest because of the need to understand trade-offs between different activities. This level of analysis is also likely to be useful for international comparisons and benchmarking.

1.5.3 Other relevant policy connections

1.69. The design of the SEEA AFF may be extended to encompass more policy themes, as set out in chapters 3 and 4 in relation to specific data domains.

1.70. One additional theme concerns rural incomes as distinct from total incomes from agricultural, forestry and fisheries production activities. A rural-income focus may be supported by integrating information on farm size, income distribution and demographic data, such as age and gender, in relation to farm ownership and employment. The challenge in incorporating that view into the SEEA AFF framework is to attribute relevant environmental information, for example, about the use of water or fertilizer. It may be possible if, for example, the differences in production techniques between smallholders and large-scale farmers can be documented and measured.

1.71. Another policy theme is to consider in more detail the connections among agricultural, forestry and fisheries activities at the domestic level with international trade and food manufacturing, wholesale and retailing activities – the global supply chains. Various international trade models exist, such as the Global Trade Analysis Project, in which the SEEA AFF supports improved data quality. The capacity to track flows relating to specific products and types of corporation would be needed, involving challenges required for restructuring the standard input-output tables.

1.72. Other themes that may be considered concern different types of production processes, such as organic agriculture and the role of genetically modified crops. Additional disaggregation of data must be carried out to support these analyses.

1.5.4 Applications at the subnational level

1.73. Although the SEEA AFF is designed to provide national-level information and accordingly work with national datasets, information on the connections between environmental and economic factors at the subnational level is also required. This is because environmental pressures and scarcities are often location-specific: one example is water scarcity in a particular river basin.

1.74. In principle, the SEEA AFF framework may be applied at the subnational level provided that appropriate subnational boundaries can be determined for which a suitable range of data is available. The boundaries may be administrative – which suits the organization of socioeconomic data – or environmental, for example, by river basin or landscape type. Selecting the subnational level requires compromises that take into consideration the type of information available, its capacity to be scaled up or down and the question of interest.

1.75. Geospatial assessments of the capacity of the environment to sustain agricultural production and the impacts of that production are critical to understating environmental-economic interactions; an example of this is the FAO global agro-ecological zones model. The SEEA AFF framework supports the development of such datasets and models by providing coherent national-level information on relevant environmental and economic factors. This, in turn, enables appropriate benchmarking of subnational models.

1.76. The development of subnational datasets must allow for cross national boundaries analysis: the Mekong delta, the Nile and Lake Victoria are notable examples that highlight this requirement. SEEA AFF accounts can provide each country with a baseline of comparable national data, ensuring that the relevant subnational estimates would be more comparable than might otherwise be the case.

1.77. An ongoing challenge in developing subnational datasets is determining the scale and related geographical classifications. Socioeconomic data, from a census, for example, are organized according to one classification, while environmental data are organized according to another – for example by water catchment area. Both classifications may be appropriate for the individual datasets, but in the SEEA context, the integration of data requires that selections on scale and classification be made. One option is to downsize all information to the relevant geospatial scale and then aggregate the detailed information at higher scales, as required.

1.78. Notwithstanding the statistical challenges, subnational information is especially relevant, at least for individual datasets, and the accessible technology and techniques can be used to generate subnational data at several scales. Account users must be able to define the questions to be answered and hence identify the data to be integrated. To support that process, it would be useful to map the information from individual datasets, for example on wheat production and water use, and compare the outcomes: particular locations and issues of interest may be highlighted far more effectively through this procedure than by interpreting information from accounts and tables. It should be noted that the description of approaches for the organization of data at subnational scales, including the choice of appropriate spatial units, is a particular feature of the SEEA Experimental Ecosystem Accounting.

1.6 Structure of this document

1.79. This document consists of four chapters. Chapter 1 "Introduction" contains a discussion on the overall motivation and intent, the potential beneficiaries and the expectations concerning implementation, and a summary of the main uses, applications and policy themes.

1.80. Chapter 2 "Conceptual framework" provides an overview of the structure and logic of the approach to integrating economic and environmental data pertaining to agricultural, forestry and fisheries activities. In particular, the relevant national accounting principles are described, an overview of the base accounts of the SEEA AFF are given, some key accounting issues and challenges are highlighted, and combined presentations and indicators that can be derived from the base accounts are described.

1.81. Chapter 3 is focused on physical flows and asset accounts for agricultural, forestry and fisheries production and the associated biological resources, such as livestock, forests and fish stocks. In this chapter, accounting in both physical and monetary terms are considered.

1.82. The focus of chapter 4 is on accounts for other relevant environmental assets, including water, land and soil, and physical flows of natural inputs and residuals of high relevance to these three activities, including water, energy, fertilizers and air emissions. The accounting described in this chapter is largely in physical terms.

1.83. For each of the base accounts, chapters 3 and 4 further provide information on the scope and purpose of measurement, the accounting entries and the possible extensions for each of the base accounts in the framework.

1.84. Throughout the document considerable referencing to the SEEA Central Framework and the SNA are provided to give the user useful information, while avoiding duplication of information from those two United Nations standards.

Chapter 2 Conceptual framework

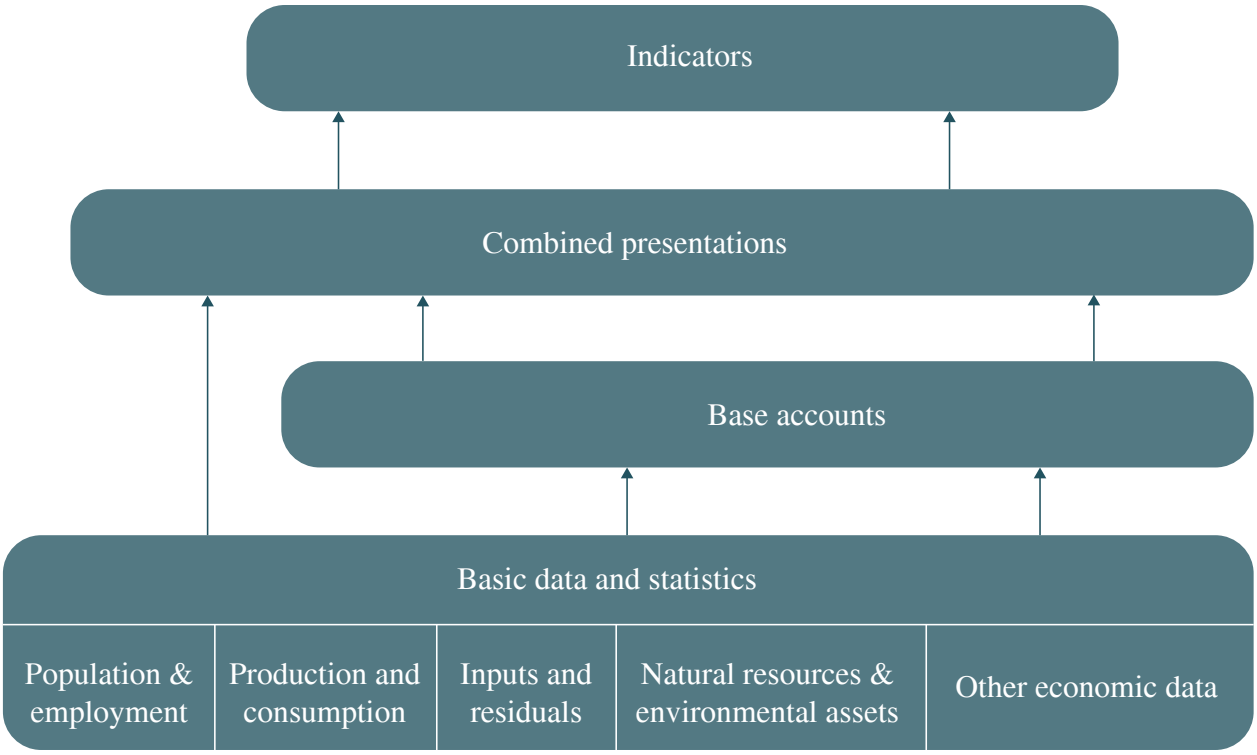
2.1. Overview of the SEEA AFF conceptual framework

2.1. The SEEA AFF is based on the SEEA central framework and the SNA, which together provide a foundation for integrating environmental and economic data in monetary and physical terms. This chapter contains a summary of the relevant accounting structures and principles from these standards, and a description of the main components of the SEEA AFF framework

2.2. Figure 1 shows the links between the four main components: basic data and statistics; base accounts; combined presentations; and indicators. It is important to recognize that the nature of the connections between the components should not be subject to strict rules. Hence, not all possible basic data are used to compile base accounts, and the data to be used depends on the methods used in the base accounts and their level of detail.

Figure 1

SEEA AFF information flows



2.3. The combined presentations are to include select information from the base accounts, relevant to a specific thematic analysis of interest. They may incorporate additional information not in the base accounts, such as population data. The content of combined presentations may change over time to reflect changing analytical and policy priorities, but the structure of the base accounts will be relatively stable. To derive indicators, information may also be taken from the combined presentations.

2.4. The SEEA AFF provides a starting point for the integration of information and support for analysis and discussion. It is not a one-size-fits-all approach: compilers and analysts should adapt the framework to respond to the information needs of users, but they should also adhere to basic national accounting principles.

2.1.1 Main areas of focus and key features

2.5. In accordance with the objective of examining the connection between economic activity and the environment, the SEEA AFF covers agricultural, forestry and fisheries activities, as defined in the International Standard Industrial Classification (ISIC) section A, divisions 01, 02 and 03 (United Nations, 2008). The purpose of covering three different types of activity is to facilitate an analysis of the trade-offs and dependencies among the activities that should be considered in national-level and local-level planning. The available information sets for each of those activities are often developed independently, which may hinder comparison of the activities and management of the relevant resources, and also discourage consideration of alternatives.

Data domains

2.6. Within the SEEAA AFF, accounts in ten primary data domains are described. Each domain relates to a general data area that may include data on stocks and flows, and for which data are generally available from a limited number of sources. The objective of the base accounts is to organize the available information in accordance a basis for integrating information across domains.

2.7. The ten primary data domains and their associated base accounts are shown in table 2.1. Because the SEEA AFF focuses on activities, rather than a particular type of asset or flow, there is no immediate restriction on the range of analysis or the number of data domains that can be incorporated.

2.8. The ten data domains were selected on the basis of the following:

- The products supplied by the three ISIC divisions covering agricultural, forestry and fisheries activities;
- The individual environmental assets of direct relevance to agricultural, forestry and fisheries activities based on the classification of environmental assets in the SEEA Central Framework;
- The main physical flows associated with agricultural, forestry and fisheries activities that have been the focus of measurement and analysis – water, energy, greenhouse gas emissions, fertilizers, nutrient flows and pesticides;
- Data related to the production and investment activity of agricultural, forestry and fisheries activities within the SNA.

2.9. The domains and the associated accounts are structured in a manner that supports communication of the SEEA AFF to users and which reflects the common way in which data are organized. In effect, the structuring is based on themes. An alternative structuring of the various accounts could be adopted, for example, into physical flow accounts on the one hand and asset accounts on the other.

2.10. The selected domains and the associated accounts are most relevant in terms of understanding (a) the nature of production processes in physical and monetary terms, and (b) the policy issues relating to agriculture, forestry and fisheries. If additional data domains are identified as relevant during the development and implementation of the SEEA AFF at the country level, an extension of the set of SEEA AFF base accounts may be appropriate.

2.11. In each data domain, some data sources are common to many countries. For example, regular agricultural surveys and censuses are conducted at the country level. In practice, during the preparation of base accounts, a range of sources and methods are to be used to estimate the relevant concepts and variables.

Table 2.1

Data domains and base accounts

Data domains	Base accounts
Agricultural products and related environmental assets	Physical flow account for crops* Physical flow account for livestock products* Asset account for livestock* Asset account for plantations*
Forestry products and related environmental assets	Physical flow account for forestry products* Asset account for forestry Asset account for timber resources
Fisheries products and related environmental assets	Physical flow account for fish and aquatic products* Asset account for fish and other aquatic resources*
Water resources	Asset account for water resources Physical flow account for water abstraction Physical flow account for water distribution and use
Energy	Physical flow account for energy use
Air emissions	Physical flow account for air emissions
Fertilizers, nutrient flows and pesticides	Physical flow account for fertilizers* Physical flow account for pesticides*
Land	Asset account for land use Asset account for land cover
Soil resources	Asset account for soil resources
Other economic data	Monetary supply and use table for agricultural, forestry and fisheries products* Extended production and income account for agricultural, forestry and fisheries activities*

* New accounting tables with respect to the SEEA Central Framework.

Accounting design

2.12. The design logic of the SEEA AFF entails three stages. First, the SEEA AFF base accounts are designed: in those accounts, data from the ten primary data domains are recorded into accounting structures in which the accounts are set up using the SEEA Central Framework and SNA accounting approaches. At this stage, the basic accounting identities (see SEEA Central Framework, section 3.2) are applied, with benefits in terms of ensuring data coherence and consistency. The various SEEA AFF base accounts in each data domain are described in chapters 3 and 4.

2.13. Second, data for selected variables within the base accounts are brought together in combined presentations. The presentations may take many forms because they do not need to conform with accounting identities. In the combined presentations, information relevant to the discussion of a particular question or policy theme is organized, but they should aim to integrate as much information as possible across the three economic activities and across all data domains, as described in section 2.5.

2.14. Third, indicators can be derived from the data in the combined presentations to show trends in the relationship between agricultural, forestry and fisheries activities and the environment. A particular focus of those indicators should be on the intensity of the use of environmental assets and environmental flows relative to production. It should be possible, for example, to develop indicators that describe the changing intensity of such products as rice, maize and livestock in terms of their use of land, water, energy and fertilizers and their generation of greenhouse gas emissions.

Key products

2.15. A particular feature of the SEEA AFF approach is the focus on recording information about the most important products. Consequently, in addition to grouping information according to generic activities, such as cropping or livestock rearing, a comprehensive set of economic and environmental inputs is articulated for the production of individual products, such as wheat, rice, beef, timber and species of fish.

2.16. To define the most important products, various factors must be considered. The list of relevant products is likely to vary according to the criteria chosen. At the country level, relevant considerations may be the contribution of product output to agricultural, forestry and fisheries value added, the contribution of a product to calorie intake or the share of land used to generate a product. At the international level, it may be relevant to record information about products that are commonly traded.

2.17. There are three motivations for focusing on key products in the SEEA AFF. First, complete information is likely to be available for the most important products, so developing the accounts to support integration of data at the product level should facilitate the use of as many data as are available. There is, however, a risk that data in some domains may not be available at the key product level or are only generated through detailed modelling or assumptions: in such cases, decisions related to the priority of generating the information in relation to the quality of the data are needed.

2.18. Second, policies that are aimed at improving environmental sustainability in agriculture, forestry and fisheries will target major products, such as rice, palm oil, livestock and tuna. It is, therefore, reasonable to extend the national accounting approach to the key product level to support analysis and policy development. Because national accounts also track total production and other economic activity, the SEEA AFF framework supports an ongoing assessment of changes in the relative importance of different products, which is an essential part of monitoring.

2.19. Third, by using the key-product approach, the SEEA AFF supports analysis by agricultural economists, ecologists and others, which will, at the country level, focus on individual products that are significant in terms of their contribution to agricultural production, exports and food supply or in relation to environmental constraints, such as land or water. The structure of production functions for individual products – that is functions describing the relationships between inputs and outputs – are likely to vary considerably by product type, particularly in relation to environmental inputs, such as water.

2.20. It is also necessary to maintain a connection with broader aggregations, for example, at the level of cropping activity, as there are likely to be linkages between product types and general pressures and constraints, such as the availability of water and land that need to be assessed.

Other features of the SEEA approach

2.21. The structure of the SEEA AFF can, in principle, be extended to describe specific agricultural products within a given production function, for example, distinguishing organic production of crops. This type of extension is not described in the SEEA AFF base accounts and in combined presentations, with the exception of the distinction between capture fisheries and aquaculture.

2.22. Although the SEEA AFF works in fine detail, the approach ensures a connection with the organization of information at the industry and national economy levels. The objective of the approach is largely to organize macro-level data from the standard national accounts and other national datasets with a view to integrate micro-level perspectives. It would be applied, for example, by using aggregate measures of the supply and use of fertilizers, including measures of production, imports and exports, and deriving measures of fertilizer use for major products, such as rice or wheat.

2.23. At the micro-level, the approach should also allow for important relationships to be appropriately scaled up from the subnational to national level. The SEEA AFF is intended, in fact, to mainstream detailed economic and scientific research on agricultural, forestry and fisheries production.

2.24. The SEEA AFF is designed for national-level analysis of agricultural, forestry and fisheries activities and products to enable the mainstreaming of environmental information into standard economic assessments of the activities and provide information on a broad scale. Through the SEEA AFF, it is also possible to develop extensions at the subnational level across the various data domains, which may be relevant for specific policy issues, such as water use, in particular catchment areas.

2.25. An important logic associated with the SEEA AFF is that by starting from a national and broad activity perspective across the data domains, it is possible to partition the information using various data and indicators in such a way that product-level information is seen in a broad context; this approach is known as multilevel analysis. The integration of fertilizer data from the national accounts and for key products is a relevant example in that context.

2.26. By placing product-level information in a wider context, the SEEA AFF moves beyond measurement of the environmental-economic relationship in studies of such issues as wheat production in temperate agricultural zones. Such studies that are focused on economics or ecology are likely to be useful, but challenging in terms of scaling up to enable integrated analysis in the context of other economic activities.

2.1.2 Potential areas of extensions

2.27. The design of the SEEA AFF shows the potential of organizing information that can support analysis of the relationship between the environment and the economy in agricultural activities. There are various directions in which it may be extended.

2.28. First, in line with the above-mention discussion on the SEEA Experimental Ecosystem Accounting, the production functions for individual agricultural products can be extended (a) to include inputs of ecosystem services; and (b) to consider the supply of ecosystem services from agricultural areas, forests and fisheries ecosystems to other economic units and to society, in general. In the context of agricultural, forestry and fisheries production, ecosystem services are the contributions made by the ecosystem to production. Examples of ecosystem services are pollination, soil retention, water provisioning and nutrient flows. The relevant set of ecosystem services vary for different agricultural, forestry and fisheries products and for different production processes.

2.29. Such an extension into ecosystem accounting would consider the range of ecosystem services, the capacity of agricultural and surrounding ecosystems to provide services sustainably and the potential for substitution and trade-offs among ecosystem services and produced goods and services; an example of this is the use of cultivated bees rather than natural pollinators. Also captured in this extension are cultural services provided by relevant ecosystems, such as areas of agricultural landscapes.

2.30. In assessing the capacity of ecosystems to supply ecosystem services, it is important to consider the measurement of the condition of an ecosystem and how it changes over time. Techniques for measuring the condition of ecosystems at the national level are still being developed, but the general approach is to assess various characteristics because direct measurement of an overall ecosystem condition is not possible. Relevant characteristics are water resources, soil type, climate and biodiversity. Information on some of these characteristics is already recorded in the accounts of the SEEA AFF.

2.31. An important aspect of ecosystem accounting is its use of a spatially explicit approach for measurements and hence its integration of geospatial and other remote-sensing data, which are becoming increasingly available.

2.32. The development of ecosystem accounting has also been closely linked to the development of national-scale carbon accounting wherein the various stocks and flows of carbon, including emissions of carbon dioxide, are tracked over time. Given that the ecosystems and biomass associated with agriculture, forestry and fisheries activities are important stores of carbon, carbon accounting can potentially be focused on these areas. The SEEA AFF can provide much relevant information for this.

2.33. An extension of the SEEA AFF to incorporate ecosystem accounting is possible in concept, but further research and testing are needed before a definitive ecosystem accounting approach can be established. Significant advances are expected in the short term and the medium term and can build directly on the type of information collected in the SEEA AFF, as described.

2.34. The SEEA AFF can be extended to incorporate accounting for economic transactions related to agricultural, forestry and fisheries activities that are considered to be "environmentally related". Some examples of this are (a) environmental protection and resource management expenditure by economic units involved in agriculture, forestry and fisheries activities; (b) environmental taxes and subsidies payable and receivable by those units; and (c) rents payable by those units, including payments for the use of land, access to forest reserves and payments in relation to fishing quotas. The first type of data may be organized into environmental protection expenditure accounts or resource management expenditure accounts.

2.35. Because these are standard economic transactions, treatment of them is set out in the 2008 SNA. The SEEA Central Framework provides additional guidance on identifying environmentally related transactions and in the design of environmental protection expenditure accounts and resource management expenditure accounts. There is little additional guidance provided in the SEEA AFF, apart from recognizing the potential to identify transactions relevant to agricultural, forestry and fisheries activities. This information may be drawn into combined presentations as appropriate, but this is not set out in the SEEA AFF.

2.36. Third, a range of standard, industry-level national accounting data may be included in the tenth data domain – other economic data. The variables in the relevant base account are output, intermediate consumption, gross value-added, compensation of employees, gross operating surplus and mixed income, gross fixed capital formation, consumption of fixed capital (depreciation) and employment. Depending on the focus of interest, information on such variables as expenditure on research and development and on environmental protection and resource management may be included, in accordance with the SEEA Central Framework guidelines. If the data are available, information on innovation activity, interest payments and financial liabilities may also be incorporated.

2.37. This extension can also incorporate the description of supply chain, tracing the movements of agricultural, forestry and fisheries products through the economy. The use of standard national accounts classifications facilitates the connection of data from the SEEA AFF to datasets and models that are used for this analysis.

2.38. Fourth, the SEEA AFF can be extended to integrate additional social statistics and indicators. Relevant information is already incorporated in the SEEA AFF, such as employment, food consumption and nutrition. Extensions may be made to include data on rural incomes and poverty, access to water and energy in rural areas and age and gender, which are of interest in terms of policy pertaining to sustainable development. These extensions would require further discussion and coordination with related projects, in particular relating to the integration of economic, environmental and social data at the subnational level, taking advantage of increasingly available data from GIS.

2.39. Fifth, with regard to physical flows, additional data may be incorporated on residual flows from agricultural, forestry and fisheries activities in which these residual flows represent measures of environmental pressures. Some examples are data on flows of solid waste, ozone depleting substances and emissions to water.

2.40. Finally, with respect to environmental assets, the domains of the SEEA AFF do not directly cover changes in the quality or condition of these assets. Instead, the focus is on changes in the quantity or volume of such assets as land, water and soil. Accordingly, while the SEEA AFF accounts provide a strong starting point for framing this work, in an extension, therefore, additional information on changes in the quality of those assets, either as a result of an agricultural, forestry and fisheries activity, or because of other factors, must be included. Measurement of changes in the quality and condition of assets is a challenging area, but it is only one aspect of the work on ecosystem accounting, as described above. It is anticipated that this extension would be covered in applying ecosystem accounting to those areas in addition to capturing the impacts that agriculture, forestry and fisheries activities might have on other environmental assets and characteristics, such as biodiversity.

2.2 Basic national accounting principles

2.2.1 Introduction

2.41. This report contains detailed descriptions of national accounting principles in the 2008 SNA, in particular in chapters 2 to 4 and a summary of relevant aspects for environmental-economic accounting in the SEEA Central Framework, which is in chapter 2. In this section, the relevant principles are highlighted and the reader is directed to the SNA and the SEEA Central Framework.

2.42. The measurement of stocks and flows is central to establishing accounting approaches to convey comprehensive and consistent information about stocks of assets, changes in those stocks over time, and flows of production, income, consumption and other transactions associated with the use of the assets. Internal consistency is ensured by the application of accounting identities. The degree of comprehensiveness is determined by the choice of accounting boundaries for the definition of assets, the definition of income and production and the geographical coverage.

2.43. With appropriate accounting boundaries and identities in place, consistent classifications can be adopted. The data used for accounting are generally sourced from a range of agencies and data collections, which are probably collected and organized for purposes other than integration and accounting. Core macroeconomic statistics are increasingly being collected according to standardized classifications of industries and products. This standardization, however, has not yet been extended to environmental information or the specific activity and product-level details used in the SEEA AFF. In compiling actual accounts, data from various sources must be converted to a common classification to enable the application of accounting principles.

2.44. The SEEA AFF applies the accounting boundaries and principles described in the SEEA Central Framework. Any differences are primarily related to the structuring of the selected base accounts, because this is the area in which the SEEA AFF focus on agricultural, forestry and fisheries activities is most apparent.

2.2.2 Types of accounts

2.45. The two types of SEEA AFF base accounts are physical flow accounts, or physical supply and use tables; and asset accounts. They are described in section 2.3 of the SEEA Central Framework. A short summary of them is also provided below.

Physical flow accounts

2.46. Physical flow accounts or physical supply and use tables (see table 2.2 and chapter 3 of the SEEA Central Framework) are a central feature of the SEEA Central Framework. Their structure is derived from monetary supply and use tables (see table 2.3, and chapter 14 of the 2008 SNA), which are used to record the flows of products in an economy between different economic units. They are structured to record the total supply of products against the total use of products; the required balance between them, i.e. total supply for each product must always equal total use of each product, is the accounting identity.

Table 2.2

Basic form of a monetary supply and use table

	Industries	Households	Government	Accumulation	Rest of the world	Total
Supply table						
Products	Output				Imports	Total supply
Use table						
Products	Intermediate comsumption	Household final comsumption expenditure	Government final consumption expenditure	Gross capital formation (incl. changes in inventories)	Exports	Total use
	Value added					

Source: SEEA Central Framework, table 2.1 (United Nations, *et al*. 2014).

[*] *Notes:* The measure of household final consumption expenditure on non-profit institutions serving household (see SNA 2008, chapter 9); dark grey cells are null entries in conceptual terms.

2.47. Extensions are required to the structure of the monetary supply and use table to enable the recording of flows to and from the environment. The extensions involve the addition of an "environment" column and two rows for "natural inputs" and "residuals". The equality between total supply and total use – applied to each product, natural input and residual flow – remains in physical terms, supported by the law of the conservation of matter.

Table 2.3

Basic form of a physical flow account

	Industries	Households	Accumulation	Rest of the world	Environment	Total
Supply table						
Natural inputs					Flows from the environment	Total supply of natural inputs
Products	Output			Imports		Total supply of products
Residuals	Residuals generated by industry	Residuals generated by final household consumption	Residuals from scrapping and demolition of produced assets			Total supply of resuduals
Use table						
Natural inputs	Extraction of natural inputs					Total use of natural inputs
Products	Intermediate comsumption	Household final comsumption expenditure	Gross capital formation (incl. changes in inventories)	Exports		Total use of products
Residuals	Collection & treatment of waste and other residuals		Accumulation of waste in controlled landfill sites		Residual flows direct to environment	Total use of residuals

Source: SEEA Central Framework, table 2.2 (United Nations et al. (2014).
Note : Dark grey cells are null entries in conceptual terms.

2.48. The extensions make it possible to fully account for flows of materials and energy in cases in which the flows are recorded in a common unit of measure. For example, flows of water from the environment, within the economy and back to the environment can be recorded in a physical flow account with a single measurement unit of cubic metres of water. Similarly, energy flows can be recorded in joules, irrespective of whether the energy is carried in coal, timber, electricity, heat or food.

2.49. For the purposes of the SEEA AFF, the application of the monetary supply and use tables and physical flow accounts will usually be at the level of individual products – for example, to trace the total supply and use of wheat. This application of supply and use principles is not described in detail in the SNA or the SEEA Central Framework, but it is appropriate and can be completed in line with the general accounting principles and boundaries.

Asset accounts

2.50. Asset accounts (see table 2.4) facilitate the recording of information on stocks of assets at the beginning and end of an accounting period, and changes in them during the accounting period. Monetary and physical asset accounts follow the same structure; the only difference is the inclusion of a row to record revaluations of assets in the monetary asset accounts.

Table 2.4

Asset account

Opening stock of environmental assets
Additions to stock
Growth in stock
Discoveries of new stock
Upward reappraisals
Reclassifications
Total additions of stock
Reductions of stock
Extractions
Normal loss of stock
Catastrophic losses
Downward reappraisals
Reclassifications
Total reductions in stock
Revaluation of the stock*
Closing stock of environmental assets

Source: SEEA Central Framework, table 2.3 (United Nations *et al*, 2014).
Note: Only applicable for asset accounts expressed in monetary terms.

2.51. The internal consistency of asset accounts is determined by the identity that the opening stock plus additions to stock less reductions in stock must equal the closing stock. This identity enables various data on stocks and changes in stock to be reconciled, and data gaps to be filled.

2.52. If the use of an asset involves a physical input to the production process – timber extraction, for example, is an input to the production of wood products, the relevant reduction in stock recorded in the asset account is conceptually equivalent to the flow of natural inputs recorded in the physical flow accounts. Accordingly, there are important connections between accounts, which must be taken into

consideration in the compilation process. This aspect of accounting may be useful when the objective is to improve the measurement of agricultural, forestry and fisheries activities. For example, in cases in which data on flows of natural inputs are available, the data quality may be assessed in terms of consistency with changes in the stock of relevant environmental assets.

2.53. Although asset accounts may be used to record stocks and changes in stocks of any type of asset, the SEEA Central Framework and the SEEA AFF focus on recording information on environmental assets: "Environmental assets are the naturally occurring living and non-living components of the Earth, together comprising the biophysical environment, which may provide benefits to humanity" (SEEA Central Framework, paragraph 2.17).

2.54. As explained in chapter 5 of the SEEA Central Framework, this definition of environmental assets encompasses two perspectives on the measurement of these assets. The first perspective, which is adopted in the SEEA AFF, is to consider individual components of the environment, such as resources of timber, soil, water, minerals and energy.

2.55. The second perspective is to consider environmental assets in terms of ecosystems, in cases in which ecosystems are defined in relation to areas in which individual resources and other environmental features interact through ecological processes. Ecosystem accounting involves measurement of the changing extent and condition of the ecosystem assets in a country, and the ecosystem services that each asset supplies. An approach to accounting for ecosystems in line with standard national accounting was developed in the SEEA Experimental Ecosystem Accounting, but it has not yet been developed with respect to agriculture, forestry and fisheries. In most cases, the measurement of individual environmental assets will be significant in the measurement of the extent and condition of an ecosystem. The approach described in the SEEA AFF should, therefore, be seen as a key building block for the development of ecosystem accounting.

2.56. In the SEEA, environmental assets include both natural and cultivated biological resources; consequently, the asset boundary is not limited to only biological resources subject to human management. Given that boundary, the SEEA AFF asset accounts include measurement of livestock, plantation timber and stocks of farmed fish and aquatic resources, as well as non-cultivated timber resources, non-wood forest products and wild fish for capture. This broad concept of environmental assets is useful in understanding the changing structure of production. Following the 2008 SNA, cultivated biological resources may be classified as fixed assets or as work in progress. The non-cultivated biological resources are not treated as such, however they are recorded in the SEEA AFF. Treatment as fixed assets occurs for biological resources that are used for breeding or provide outputs on an ongoing basis over time, such as dairy cows for milk, sheep for wool and vineyards for grapes. Treatment as work in progress occurs when the biological resources are cultivated for future harvest. This includes plantation timber resources, crops, livestock raised for their meat and aquaculture.

2.2.3 Main accounting rules and principles

2.57. The recording of accounts requires a consistent set of accounting rules and principles. Without them, related transactions and flows may be recorded on different bases, at different times and with different values, thereby making accounting and reconciliation difficult and the information less useful.

2.58. The SEEA AFF follows the same accounting rules and principles as the SEEA Central Framework and the 2008 SNA, which are explained at length in those documents. To reduce the risk of alternative or unintended interpretations, they are not described in detail in this document. In this section, the main rules and principles that the SEEA AFF compilers should be aware of are delineated, with supporting references to the SEEA Central Framework and the 2008 SNA, as required.

Production boundary

2.59. The definition of production and the production boundary is a fundamental element of the SNA. The production boundary determines which activities should be included in the measurement of value added, and hence defines the range of products that should be the focus of measurement. The definition of production also affects the scope of consumption and income that is measured in the national accounts framework (see 2008 SNA, chapter 6).

2.60. In general terms, the production boundary is defined as activities "carried out under the control and responsibility of an institutional unit that uses inputs of labour, capital, and goods and services to produce outputs of goods or services." (2008 SNA, section 6.24). The SNA then goes on to determine some specific treatments related to own-account production and other matters.

2.61. Consistent with the SNA, the production boundary applied in the SEEA AFF includes illegal production and informal, non-observed activities. Approaches to the measurement of these activities, which may be significant in some countries, were developed for the improvement of national accounts measures (see *Measuring the Non-Observed Economy: A Handbook* (OECD, 2002). Importantly, for an agriculture, forestry and fisheries activity, this part of production includes subsistence activity. This type of activity is commonly assumed to be excluded from the scope of the national accounts and GDP, as it is not the subject of market transactions. At least in concept, however, it is within the measurement scope.

2.62. There are issues concerning the application of the production boundary that do not arise in the SNA, but are included in the SEEA Central Framework and the SEEA AFF when recording physical flows. They largely concern flows internal to a single economic unit – often referred to as "own-account" production and consumption (see SEEA Central Framework chapter 3 and section 3.4 of the SEEA AFF for a discussion of the treatment of these flows for SEEA purposes).

Economic units

2.63. Accounting in the SNA and the SEEA Central Framework centres on recording the economic activities – production, consumption and accumulation – of economic or institutional units, which are defined and classified in various ways depending in part on the purpose of the analysis (see 2008 SNA, chapters 4 and 5 and section 2.6 of the SEEA Central Framework for the logic behind defining institutional units). Institutional units are generally the focus of statistical collections, as they are considered to be the entities with decision-making autonomy and hence have the capacity (and often are requried) to record information on their activities.

2.64. Of particular relevance for SEEA AFF, is that, in principle, it will be appropriate to record information at a fine level of detail to provide specific information about the products and processes used by a given economic unit in a particular location. Accordingly, estimates should be compiled based on the level of the "local kind of activity unit" (LKAU). This may be applied through direct collection at that level of detail, including through surveys of sampled units at the farm level or equivalent. Alternatively, it may be necessary to adopt a more aggregated, top-down, measurement, but the intent should remain to cover only relevant LKAU.

2.65. In cases in which a single institutional unit engages in a single economic activity, the concepts of an institutional unit and LKAU will align. It is common, however, for a single institutional unit to carry out a number of different activities (as classified within ISIC). For example, a farmer may grow livestock fodder for sale and also raise cattle using some of the fodder.

2.66. Ideally, in this case, a separate LKAU will be formed relating to each activity, with each LKAU classified to a different industry and separate sets of information collected in relation to each activity. In practice, however, it may not be feasible to make this separation and consequently, units will be recorded as producing multiple outputs – i.e. there will be secondary activities within a single unit.

2.67. To support analysis, especially for environmental-economic accounting, it is recommended that the process of defining LKAU be carried out consistently across all types of collections whether it be for the collection of data in monetary terms or in physical terms. Consistent treatment of units, preferably completed in the context of a complete business register, is of great benefit in facilitating the integration of data. Further discussion of secondary production is presented in section 3.4.

Geographic boundary

2.68. To determine which economic units are within the scope of a set of national accounts, there are rules and conventions for enabling the attribution of each economic unit to a particular country on the basis of the concept of residence (see the 2008 SNA, chapter 4). A country's geographic boundary delineates its "economic territory", which may differ from the territory specified by its customs boundary.

2.69. The scope of the SEEA AFF is consistent with a country's economic territory as applied in its national accounts. The application of this boundary for SEEA AFF purposes is generally straightforward, but challenges can arise with regard to fisheries activities in a country's exclusive economic zone and on the high seas (see the SEEA Central Framework, section 5.9).

Asset boundary

2.70. The scope of assets is an important measurement boundary in the SNA and the SEEA Central Framework. Chapter 10 of the 2008 SNA contains the definition and scope of assets, with a focus on the measurement of economic assets in monetary terms. The SEEA Central Framework applies the same asset boundary as the SNA for environmental assets measured in monetary terms, but it applies a broader boundary in physical terms (see SEEA Central Framework, chapters 2 and 5). Asset boundaries for environmental assets are described in detail in the SEEA Central Framework; the same boundaries are applied in the SEEA AFF.

Valuation concepts

2.71. Consistent valuation of stocks and flows is a central element of the SNA: without it accounting is not be possible, especially among multiple economic units. In this context, the SNA applies a concept of "exchange values". Exchange values reflect the actual or observed price paid by a buyer to a seller, or the price that would have been observed had a transaction taken place (see the 2008 SNA, chapter 3 and the SEEA Experimental Ecosystem Accounting, chapter 5).

2.72. Other elements of valuation in national accounts are the treatment of taxes, subsidies and margins underlying price differentials experienced by buyers and sellers. Concepts, such as basic prices, producer prices and purchasers' prices, are explained in chapter 6 of the 2008 SNA and section 2.7 of the SEEA Central Framework.

Recording principles

2.73. To ensure that data from a variety of sources can be integrated and reconciled, various recording principles must be applied. They are double-entry and quadruple-entry accounting, the length of the accounting period, the time of recording, and accounting identities, such as the supply and use identity (see chapter 3 of the 2008 SNA and chapters 2 and 3 of the SEEA Central Framework).

Use of standard classifications

2.74. The use of standard classifications in different parts of the accounting system enables the integration of data from various sources, and allows for easier and more valid comparisons. Three classifications are fundamental to the accounting in the SNA and the SEEA: (a) classification of institutional sectors (see chapter 4 of the 2008 SNA); (b) classification of economic activities/industries (see ISIC, Rev. 4); and (c) classification of products (see Central Product Classification (CPC), Rev 2.1). Countries and regions often develop versions of ISIC or CPC with detailed classes, reflecting particular features of their economies, but all countries apply the high-level classifications for industries and products described in ISIC and CPC. Additional classifications relating to exported and imported products, and correspondences between them and CPC have been developed.

2.75. The SEEA AFF data domains and base accounts are also consistent with the classifications and classification principles discussed for physical flows in the SEEA Central Framework, as they cover items that are well identified in those classifications. Besides products, those classifications cover natural resource inputs, natural resource residuals (i.e. natural resource inputs that do not subsequently become incorporated into production processes and, instead, immediately return to the environment), and other residual flows (i.e. flows of solid, liquid and gaseous materials, and energy that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation).

2.76. These are the main elements of the accounting rules and principles relevant to the compilation of the SEEA AFF accounts. It is possible that additional accounting issues will be encountered in the compilation of SEEA AFF base accounts. To resolve these issues, further consideration and interpretation among relevant experts will be needed.

2.3 SEEA AFF base accounts

2.3.1 SEEA AFF physical flow accounts

2.77. The ten physical flow accounts in the set of the SEEA AFF base accounts are intended to ensure that data in each relevant domain – crop production, for example – are accounted for consistently across the various elements of supply and use. For each base account, the total supply of a product – output plus imports – must be equal to the total use of that product in terms of intermediate consumption, final consumption, gross fixed capital formation (if available) and changes in inventories or exports.

2.78. In addition to ensuring data consistency in a domain, the use of physical flow accounts connects the supply and demand sides of agricultural, forestry and fisheries activity. This facilitates the analysis of demand factors, such as increasing population or increasing standards of living that may drive changes in production.

2.79. There are two types of SEEA AFF physical flow accounts. In the first type, in which emphasis is placed on agricultural, forestry or fisheries products or on non-natural inputs to production, such as inorganic fertilizers and pesticides, the focus is on recording the supply and use of individual products, such as wheat, timber and fertilizer. This type of account mirrors the structure of monetary supply and use tables (SUT) because no flows of natural inputs or residuals are recorded, and no column to record flows to and from the environment is required.

2.80. The second type of physical flow account concerns flows related to water, energy and emissions. In this case, the structure of the base accounts resembles the physical flow accounts described in the SEEA Central Framework.

2.81. With regard to the product-specific physical flow accounts, it is reasonable to conclude – given the link between the structure of these accounts and monetary supply-and-use tables – that data in the physical flow accounts should be aligned with the corresponding data recorded in monetary terms in standard national accounts. For example, the output of wheat recorded in tonnes and the output of wheat recorded in monetary terms should be aligned. The extent of alignment will be reflected in the prices received by wheat producers for their output.

2.82. Although some physical data are used in compiling the monetary estimates of national accounts, there is usually no regular balancing of supply and use in physical terms for particular products. Such balancing, as proposed in the context of the SEEA AFF, will probably lead to improvements in the compilation of national accounts estimates in monetary terms and in the physical flow accounts themselves.

2.83. One situation in which physical flows of certain products are balanced is through the compilation of food balance sheets. The accounts are intended to determine overall human consumption of all food items in tonnage and calorie terms to enable assessment of nutrition levels in different countries. The conventions applied by FAO in compiling food balance sheets are different from those used in standard national accounts and the SEEA, but they are similar in the sense that they reconcile the total

supply of food with its use. Reconciliation of food balance sheet estimates with related work in monetary terms for national accounts does not usually take place.

2.3.2 SEEA AFF asset accounts

2.84. The SEEA AFF consists of ten asset accounts, which are mainly used to organize data on stocks of environmental assets in a specific data domain. The structure of the asset accounts follows the SEEA Central Framework.

2.85. The asset accounts in the SEEA AFF may be compiled in monetary and physical terms. The focus of the discussion in chapters 3 and 4 is on asset accounts in physical terms – e.g. in terms of hectares of land, cubic metres of timber and head of livestock. It is recommended that SEEA AFF compilers focus initially on organizing relevant physical data because those data are usually a prerequisite for valuing environmental assets, many of which have no observed market prices as they are not traded in markets; and much is to be gained from consideration of physical stocks in assessing the sustainability of production and related productivity-type relationships. At the same time, important benefits can be reaped by generating valuations of these assets. Relevant references to the 2008 SNA and the SEEA Central Framework are noted in the related sections.

2.86. Similar to the SEEA Central Framework, the SEEA AFF asset accounts cover natural and cultivated environmental assets. The distinction, which originates in SNA, involves distinguishing between assets created in a process of production and assets that occur naturally. Examples of cultivated assets in agricultural, forestry and fisheries activities are livestock, orchards, vineyards, oil palm plantations, aquaculture and plantation forests. All of them have a high level of economic activity associated with the establishment, growth, production and eventual use of the assets. Examples of natural assets are land and soil, marine fish stocks, natural forests and wild animals that are hunted for meat or other products.

2.87. Section 5.2 of the SEEA Central Framework provides various considerations to assist in making the often difficult distinction between cultivated and natural assets. However, because the asset accounts comprise both types of environmental asset, the exact distinction is less important than the primary intention of tracking changes in the way environmental assets are managed over time, for example from natural to plantation timber or from capture fisheries to aquaculture.

2.3.3 SEEA AFF other economic data

2.88. The term "other economic data" refers, in this document, to data that would generally be reported in monetary terms in standard national accounting datasets. For the purposes of the SEEA AFF, two particular aspects of national accounting are considered.

2.89. First – economic data describing the supply and use of agricultural, forestry and fisheries products in monetary terms. For a given product, such as wheat, the base account covers data on output, imports and exports, intermediate consumption, final consumption, gross fixed capital formation and changes in inventories. Those data may be available in national input-output or supply and use tables, though generally only for major products or groups of products. In conjunction with the physical flow accounts for agricultural, forestry and fisheries products, the data support a fairly full assessment of the links between production and demand because they can be used to examine the effect of prices.

2.90. Second – extended production and income accounts for agricultural, forestry and fisheries activities and products are described, initially at a broad activity level. This kind of account brings together information on output, intermediate production costs in terms of inputs, such as fuel, seed, fertilizer or water, and compensation of employees and hence reflects a production function. From those items, the gross value added can be derived as the difference between total output at basic prices and intermediate

consumption at purchasers' prices. Gross value added can be further broken down into gross operating surplus and gross mixed income – profits –compensation of employees and taxes less subsidies on production and imports.

2.91. Other economic data can be incorporated, including, for example, estimates of employment and hours worked (recognizing that in these activities, the contributions of self-employed and non-salaried workers may be significant), gross fixed capital formation and consumption of fixed capital – that is, investment and depreciation – and payments of interest and rent. Those data can be used in the derivation of indicators of profitability and productivity.

2.92. In theory, production functions can be defined at the levels of (a) activities, such as cropping, fisheries and forestry; (b) individual products, such as rice, tuna or beef; and (c) production processes for specific products, such as paddy rice, extensive grazing or organic farming. In practice, however, the level of detail will be limited by the ability to attribute production costs to individual products and processes, for example employment and management costs. For the SEEA AFF, the proposals in chapter 4 constitute a basic level of information; decisions as to the level of detail at the national level should be based on data availability, policy and analytical relevance.

2.93. In some countries, the role of taxes and subsidies relating to agricultural, forestry and fisheries activities may be important. The national accounts framework provides for the recording of information on those flows.

2.4 Accounting issues

2.4.1 Introduction

2.94. Among the accounting challenges in developing the range of base accounts, five are of cross-cutting relevance: (a) scoping the products of agriculture, forestry and fisheries; (b) treatment of own-account production and use; (c) treatment of secondary production; (d) treatment of natural and cultivated assets; and (e) treatment of changes in inventories, losses and waste. This section includes a discussion of these issues in line with the general accounting principles and treatments in section 3.2.

2.4.2 Scoping of products

2.95. The outputs from agricultural, forestry and fisheries activities are a common starting point for many supply chains in an economy – food, raw materials and energy, for example. It is, therefore, important that the SEEA AFF determine the scope of products for inclusion in the accounting framework.

2.96. The starting point in defining the scope of the SEEA AFF is the set of products that are the primary outputs of economic units classified in ISIC, Rev. 4, section A – agriculture, forestry and fisheries – and reflected in section 0 of the Central Product Classification, Version 2.1. The following ISIC groups (table 2.5) are within the scope of SEEA AFF. For groups 016 and 024 – support activities to agriculture and forestry, there is generally no production of goods that would be reported in physical supply and use tables, but the activity of these groups is included in the monetary accounts.

Table 2.5

Scope of the SEEA AFF activities by ISIC division and group

ISIC division	ISIC group
01 Crop and animal production, hunting and related service activities	
	011 Growing of non-perennial crops
	012 Growing of perennial crops
	013 Plant propagation
	014 Animal production
	015 Mixed farming (of crops and animals)
	016 Support activities to agriculture and post-harvest crop activities
	017 Hunting, trapping and related service activities
02 Forestry and logging	
	021 Silviculture and other forestry activities (forestry)
	022 Logging
	023 Gathering of non-wood forest products
	024 Support services to forestry
03 Fishing and aquaculture	
	031 Fishing
	032 Aguaculture

2.97. Based on this scope, there are some important implications regarding the structure of the physical flow accounts described in chapters 3 and 4. In the case of crops, the product scope reflects harvested outputs, such as wheat, rice, apples or palm oil.

2.98. Regarding livestock rearing, a distinction is made between the managed raising of animals and the products obtained. The output of raising and breeding animals is part of agricultural production. Generally, products obtained from the killing of animals, such as meat and hides, are considered to be outputs from manufacturing processes rather than the output of agriculture. Other products obtained from livestock, such as milk, eggs, honey and wool, are considered to be the output of agriculture. To support analysis, all of those types of output are included in the SEEA AFF physical flow accounts although it is recognized that the production of meat is a specific exception (for details see chapter 3).

2.99. The capture of animals from the wild through hunting and trapping is a distinct product. It includes, for example, animals hunted for bush meat. While conceptually in the scope of the SEEA AFF, these products are included in the physical flow accounts in chapter 3, but extensions can be made, as appropriate.

2.100. A distinction is made between forestry, in which the output is the growing of trees, and logging, in which the output is felled timber in the form of roundwood. The outputs from both forestry and logging are included in the relevant physical flow accounts. Products made from timber are considered outputs of the manufacturing industry and are excluded from the scope of the SEEA AFF.

2.101. The gathering of non-wood forest products, including mushrooms, berries, rubber, cork and other products (including for medicinal purposes) is a distinct activity within forestry and logging. While conceptually in the scope of the SEEA AFF, these products are not included in the physical flow accounts in chapter 3, but extensions can be made, as appropriate.

2.102. The products from plant propagation (ISIC group 013) and from forest nurseries (part ISIC group 021) are not included in physical flow accounts.

2.103. For fisheries activities, the output in the scope of the SEEA AFF is equal to the harvest of fish and aquatic products, whether from capture fishing or from aquaculture.

2.104. For analytical purposes, it may be of particular interest to understand a more complete supply chain from the outputs of agriculture, forestry and fisheries through the manufacturing, transportation, wholesale and retail industries. The SEEA AFF does not attempt to cover that broad scope, although some initial steps in that direction are included in relation to crops and livestock products to support the recording of information relevant to the assessment of nutrition.

2.4.3 Recording of intra-unit flows

2.105. Associated with determining the scope of products is deciding which flows of products should be recorded in the accounts. This question arises because not all flows of products involve transactions between separate economic units, as not all units constitute a single activity. For example, one unit may manage the growth of a forest and also log the timber, or a unit may use milk produced on the farm to raise calves. The treatment of so-called intra-unit flows was discussed at length in the development of the European Economic Accounts for Agriculture; the SEEA AFF has adopted the conventions that have been determined.

2.106. In relation to physical flows, the conceptual starting point is that the recording should be "exhaustive". Ideally, all physical flows of all products, between economic units and within economic units, should be recorded. It means that if a product is retained for use within the same activity, in the same unit, then the relevant physical flows should be recorded in gross terms. A good example is the retention of seeds (for example, from rice or wheat) for use in future crop growing. The application of that treatment means that, in physical terms, the total production is recorded, not only the amount used in other activities, such as feeding livestock, exchanged with other units or otherwise used.

2.107. In relation to monetary flows, the intra-unit, intra-activity flows just described are not recorded. This is because it is generally not possible to place observed values on flows within an economic unit and the recording of intra-unit flows representing, simultaneously, an output and an input, adds no information content in the estimation of value-added. The boundary between intra- and inter- activity is defined at the ISIC group level, as per table 2.5

2.108. In practice, the ability to collect data at these levels of detail will vary, depending on the nature of the production processes that exist within a country and the resources available for data collection. A key factor will be the capacity to separately distinguish different types of activity that take place within a given economic unit. Ideally, each different activity (when different activities are determined at the ISIC group level) are considered as a separate LKAU (see section 2.2). In cases in which this is not possible, the treatment relevant in the context of recording secondary production needs to be taken into account (see section 2.4.6).

2.4.4 Treatment of own-account production and use

2.109. Own-account production and use, a feature of most economic activities, occurs when a single economic unit produces a particular good or service that is used within the same unit rather than sold to another unit. In physical terms, in line with the discussion above, all flows of own-account production should be recorded. However, in monetary terms, if a single economic unit is responsible for several stages of production or transformation in the same activity, the usual national accounting treatment is to omit flows within that economic unit because they amount to internal buying and selling with no net addition to value added.

2.110. There are two major exceptions to this in the standard national accounts. One exception is when the output is used by the same economic unit as part of its final consumption. This is relevant for the SEEA AFF for subsistence agriculture and fisheries activities. If, for example, a farmer grows food or fibre and uses that output in the household, the production and associated consumption should be recorded

to ensure that estimates of production and consumption are not limited to products bought and sold or otherwise exchanged among economic units. This treatment also includes the products obtained from hunting, trapping and the collection of non-wood forest products. In many countries, the estimates of own-account production in agriculture, forestry and fisheries may be substantial and should be appropriately recorded.

2.111. The other major exception is when own-account production forms part of an investment made by the economic unit in produced assets – gross fixed capital formation. This can occur in two distinct ways. When a farmer breeds dairy cattle or sheep for wool, those livestock are treated in the national accounts as produced assets that deliver other outputs, such as milk and wool, over time. Breeding stock of farmers and in aquaculture are treated in a similar manner. Such "own-account capital formation" may be important in some situations, but if there are balanced patterns in the number of livestock, the recording of the activity will be less important.

2.112. Separately, there may be situations in which producers in these activities may, for example, build their own storage or processing facilities or invest in the construction of fences and holding facilities. In addition, there may be cases in which a landholder engages in land improvements, which satisfy the definition of capital formation in the SNA, e.g. the construction of retaining walls and dams. In these cases, this activity should be recorded as own-account capital formation.

2.113. In some instances, this activity will be an investment that underpins the primary activity of the producer, while, in other cases, it may be that the investment is used within a separate activity. For example, some logging activities also include the operating sawmills. Following the principle of recording according to LKAU, the investment related to secondary activity should be recorded separately.

2.4.5 Treatment of joint products

2.114. Consideration of the outputs of agricultural, forestry and fisheries activities has to this point focused on the production of individual outputs for individual plant and animal types. The growing of sugar cane, for example, is associated with the production of sugar, and the growing of fruit trees is associated with apples.

2.115. However, the growing of individual crops and rearing specific types of animals is increasingly leading to the production of more than one type of output. Growing sugar cane, for example, leads to the production of sugar, but the crop may be used to generate energy products. Generating multiple outputs from a single production process is known as the production of "joint products".

2.116. It is not the intention here to describe all the variations of mixed and joint production technologies of agriculture, forestry and fisheries activities. New technologies, economic drivers and environmental constraints will continue to shift the production mix over time. From an accounting point of view, however, two key points emerge.

2.117. First, all joint products should be recorded as output from the producing unit. Using the sugar cane example, both the quantity of cane used to produce sugar and the quantity of cane used to produce energy products should be included in the total production volume. Especially in cases in which the mix of uses is changing over time, it is important to track the additional flows to understand the supply chains between those activities and other economic activities. Also, from an environmental asset perspective, any additional removal of biomass may reduce the availability of crop residues that can help to maintain the productivity of the soil.

2.118. Second, when processed quantities are converted into a raw material or live-weight equivalent, as is necessary to enable a balanced assessment of supply and use, it is necessary to ensure adjustments are made to the conversion factors to account for joint production. Thus, in cases in which there is a change in the mix of outputs and some sugar cane is used to produce energy, the conversion factor for refining must be amended.

2.4.6 Treatment of secondary production

2.119. Secondary activity is recorded when a distinct LKAU is not created to recognize that a single institutional unit is carrying out two different activities. In these cases, the institutional unit will be considered to conduct both a primary and a secondary activity and be classified to the ISIC group or class of the primary activity.

2.120. The type of situation envisaged in section 2.2 in the discussion on economic units is when a single unit in involved in two activities both within the same ISIC division – e.g. involved in the growing of fodder and the raising of livestock. In this situation, the primary and secondary activities are within the scope of the SEEA AFF. The treatment described in section 2.4.3 should be followed to record physical and monetary flows in those instances.

2.121. Another dimension of secondary production from a national accounting perspective concerns cases in which an agricultural, forestry or fisheries unit creates other products, such as those relating to agro-tourism or an economic unit that is not principally involved in agriculture, forestry or fisheries activities produces outputs associated with those activities – e.g. a government research farm produces wool. In both cases, there is lack of homogeneity in the production within the unit.

2.122. For the purposes of the SEEA AFF, the physical flow accounts should focus on the specific products, irrespective of the classification of the unit carrying out the production. Accordingly, in the physical flow accounts, non-agricultural, forestry and fisheries products should be excluded and production of agricultural, forestry or fisheries products by units classified to non-agriculture, forestry and fisheries activities should be included. The only exceptions to non-agricultural, forestry and fisheries products concern the recording of some manufactured products from crop and livestock products that are included to support analysis of nutritional flows.

2.123. For the accounting in monetary terms, the recording of the supply and use of products should be focused only on agricultural, forestry and fisheries products. However, for the purposes of compiling the extended production and income accounts (table 3.4), if the secondary activity cannot be separately distinguished, i.e. through the formation of a distinct LKAU, then the estimates of the value of output, intermediate consumption and other variables should be recorded and include both primary and secondary activities. This ensures that the table reflects the total production and income attributable to those units classified to ISIC divisions 01, 02 and 03 and hence aligns with the recording of other industry divisions in the broader national accounts.

2.124. The concept of secondary production discussed in this document is a national accounting concept and should be distinguished from the recording of other flows associated with agricultural, forestry and fisheries activities. Other flows may include the following:

- The generation of ecosystem services from land managed by agricultural units – carbon sequestration, water regulation or landscape amenity, for example;
- Income earned from managing or restoring the land and ecosystems for environmental protection and conservation;
- Income earned from selling hunting or fishing rights;
- Income earned from providing areas of land for generating renewable energy, for example by wind turbines, or for access to mineral and energy resources, such as coal or gas.

2.125. These flows are outside the production boundary of the national accounts and treatment of them varies according to the flow and nature of the transactions. In general terms, for the SEEA AFF, (a) the value of ecosystem services may not be fully accounted; (b) income earned for restoring land is treated as a subsidy or a current transfer; and (c) income earned from access rights is treated as rent. Further details are given in chapter 4 of the SEEA Central Framework.

2.126. Finally, the concept of secondary production should be distinguished from concepts of externalities and welfare effects that may be associated with agricultural, forestry and fisheries activities with regard to economic analysis. The information in the SEEA AFF should support the measurement of those effects, but it does not report on them directly.

2.4.7 Treatment of natural and cultivated biological resources

2.127. Perhaps the most important measurement boundary in national accounts is the production boundary. The definition of production helps to determine GDP and provides a basis for the related concepts of income and consumption. A significant aspect of the definition of production in the SNA is the exclusion of natural processes that occur without human intervention, which is significant in the treatment of the numerous stocks and flows associated with agricultural, forestry and fisheries activities.

2.128. In the SNA, natural processes are distinguished from cultivated processes. Cultivated processes are those involving significant human input – labour and produced assets – in the growing of plants or raising of animals. There is no definitive rule as to what constitutes a natural or a cultivated process for national accounting purposes. The important related issue is the extent to which human activity influences the raising of the animals or growing of plants.

2.129. The effect on the SEEA AFF base accounts is that distinctions should be made between products resulting from cultivation and management and those sourced from natural environments. This distinction has different effects in the various activities (see chapter 4).

2.4.8 Treatment of changes in inventories, losses and waste

2.130. A feature of agricultural, forestry and fisheries production is the various stages and time lags involved in growing, harvesting, distributing and storing the products produced. A number of economic units will be involved in the supply chain – primary producers, transport companies, manufacturers, wholesalers, retailers and finally households. For each unit, changing of quantities will be recorded. Given the nature of the products, a proportion of each one will be lost through damage, spoiling or other causes, and changes in the quantities held will vary because of changes in production and demand over time.

2.131. In the SNA, changes in quantities held are recorded as part of "change in inventories" when the quantities involved are considered recurrent or expected. Significant or large one-off changes, e.g. because of a catastrophic storm, should be treated as "other changes in volume". The discussion in this section is focused on the treatment of recurrent losses.

2.132. A single entry in monetary terms to cover all possible reasons for change in inventories is satisfactory for the purposes of macroeconomic statistics. However, a breakdown into different components is required for accounting in physical terms to provide a more complete set of information for analysis. The focus in the SEEA AFF is the quantities of a product that are lost or otherwise not finally consumed through the supply chain.

2.133. The SEEA Central Framework (section 3.2.4) provides a framework for the accounting for losses. In it, four types of losses: losses during extraction; losses during distribution; losses during storage; and losses during transformation (which applies only to flows of energy) are noted. The principles for recording losses described in the SEEA Central Framework are also applicable in the SEEA AFF

2.134. For the SEEA AFF, losses at three stages in the supply chain are identified. First, losses that take place during primary production, such as felling residues in forestry,[2] discarded catch in fisheries and pre-harvest losses in agriculture, for example when crops are not harvested because of low prices or adverse weather are recorded. These losses are not measured regularly as a rule, and most estimates of output are made on a net production basis – that is, the quantities sold or otherwise supplied by the producing unit to other units. They should ideally be recorded because they may indicate levels of efficiency in the use of land, water, forests and fish stocks. At the same time, some level of loss during production is to be expected.

[2] Note that felling residues are different from natural losses of timber resources that occur through, for example, disease, fire and windfall. These changes are accounted for in the asset account for timber resources.

2.135. Second, there are losses between the point of the product leaving the producing unit – "the farm gate" – and the point of final consumption or the point of processing into other products. Such "post-harvest losses" of agricultural, forestry and fisheries products are important considerations in countries where transport, distribution and storage infrastructure is less developed. With regard to products that are ultimately sold "fresh", such as fruits, vegetables, meat and fish, post-harvest losses should include the losses incurred by retailers who do not sell the products or must discard them. Note that the separate identification of post-harvest losses is limited to cases in which there is minimal transformation of the originally harvested product – i.e. it primarily applies to crops and fish products. Losses that arise during the manufacturing and other transformation processes are not accounted for in this item.

2.136. Third, there is "food waste". In the SEEA AFF, this refers to losses within households when products are discarded. Household consumption in national accounting terms is equal to the quantity of commodities purchased or otherwise acquired, not the quantity ultimately consumed. It is, therefore, relevant to partition estimates of household consumption in physical terms into food waste and quantities consumed.

2.137. While losses at three stages are identified, those three types of losses are not considered to represent an exhaustive coverage of losses related to agricultural, forestry and fisheries activities and the associated supply chain. Consistent recording of these losses can provide information for determining policy to reduce losses and increase the effectiveness and productivity of agricultural, forestry and fisheries activities.

2.138. In addition to recording losses relating to agricultural, forestry and fisheries products, there may also be interest in accounting for losses of various inputs, such as water and energy associated with agricultural, forestry and fisheries activities. Accounting for these losses is not discussed in the SEEA AFF, but relevant explanations are given in the System of Environmental-Economic Accounting for Water (SEEA-Water) and the System of Environmental-Economic Accounting for Energy (SEEA-Energy).

2.139. There are important links between the treatment and recording of losses and the treatment of joint production as economic units find ways to use materials that might previously have been discarded. More generally, an important area of research is a more complete and consistent articulation of losses, unused biomass, residues, waste, reuse and recycling in relation to biomass.

2.4.9 Issues concerning measurement units and aggregation

2.140. The aim of national accounting approaches, such as the SEEA AFF, is to provide country-level descriptions of relevant trends. Because the descriptions are not usually obtained from direct measurement, information must be aggregated from different sources and breakdowns of data. In national accounting, aggregation is usually a matter of converting stocks and flows into monetary terms and aggregating on the basis of relative prices. When markets exist, the relevant values of stocks and flows can be observed directly or estimated on the basis of observed transactions.

2.141. The use of monetary aggregates is particularly useful, as it gives insight into the relative value that different economic units place on various stocks and flows. Such assessments are viable because the use of a single currency enables comparisons across many variables that may not be comparable in physical terms. As a result, it allows production, incomes, wealth and its distribution, and various other economic concepts to be assessed in a meaningful manner. Regarding agriculture, forestry and fisheries, comprehension of stocks and flows in monetary terms and the associated prices makes it possible to attain a better understanding of the effect that changes in supply and demand for products has on incomes and production. It also facilitates the analysis of them from a broader, economy-wide perspective.

2.142. At the same time, some analytical questions may be best measured in physical units. For example, to understand requirements for transportation and storage, measurement in physical, units, such as tonnes or cubic metres, is appropriate. Also, in the management of production processes, the volume of water or area of land will represent the key factor in producing a quantity of wheat. For that reason, there is much analytical value in understanding the physical flows involved in production.

2.143. The aggregation of physical flows needs to be carried out with caution. It is inappropriate to aggregate estimates measured using different measurement units. In that respect, accounting identities (for example, the balance between supply and use) only hold when a single measurement unit is used. However, even when using the same measurement unit, the meaningfulness of the aggregate should be considered carefully. Accordingly, understanding the total tonnes of food produced may not have any specific correlation to the available nutrition from that food. Particular care is needed in relation to flows of pesticides. Measuring and aggregating the active ingredients of pesticides in tonnage or monetary terms does not give an indication of the toxicity of the pesticide.

2.144. The important point for the SEEA AFF is that the use of an accounting framework supports the use of alternative measurement units and that the framework is a platform for discussion of alternative aggregation approaches.

2.145. Another common type of macro-level comparison is one that is carried out among countries. For national accounts data in monetary terms, the best approach for such a comparison is to use purchasing power parities, which take into account the different mixes of production and consumption in a country, instead of using exchange rates or similar methods.

2.146. For comparisons among countries in physical terms, per capita measures or per hectare measures is usually required in order to take into account differences in population and area between countries. As with aggregation and comparison among stocks and flows within a country, the appropriate analytical question must be defined, and the appropriate measurement basis must be selected.

2.5 SEEA AFF combined presentations

2.5.1 Introduction

2.147. In chapter 6 of the SEEA Central Framework, ways in which environmental and economic data may be integrated are described. An approach described in the SEEA Central Framework section 6.3 involves the compilation of combined presentations that integrate monetary and physical information. They are not strictly accounts in that the information they contain does not need to be in the same measurement units, and not all entries in a physical flow or asset account need to be translated into a combined presentation.

2.148. Combined presentations are valuable mechanisms, whereby various data on a particular theme or topic can be presented together, and not scattered through different accounts. In section 6.5 of the SEEA Central Framework, examples of combined presentations for energy, water, forest products and air emissions are given.

2.149. In the context of the SEEA AFF, the cross-cutting nature of a set of economic activities and the range of environmental and economic information constitute a powerful rationale for developing combined presentations. A number of alternative structures exist: this section presents five SEEA AFF combined presentations. The first four presentations are linked to individual policy themes, as described in this chapter. The selection of themes and variables does not reflect a standard presentation, but instead should encourage compilers and users to imagine alternative uses and applications of accounting data.

2.150. The reference combined presentation is designed to support implementation of SEEA AFF. It is considered a standardized, tier 1 type, combined presentation and is intended to provide an indication of the type of detail and coverage relevant when commencing a programme of work on the SEEA AFF. This combined presentation is described in section 2.5.3 along with a discussion on the tiered approach to implementation.

2.5.2 SEEA AFF thematic combined presentations

2.151. Tables 2.6 to 2.9 show combined presentations relevant to four policy and analytical themes: (a) activity-specific and product-specific inputs; (b) food product consumption and waste; (c) sustainable use of environmental assets; and (d) cross-industry and cross-activity perspectives. These presen-

tations are designed to indicate the potential of combined presentations to bring together data for analysis and support the derivation of indicators. They also show that a range of issues may be considered once a sound underlying database of accounts is compiled. In that sense, the SEEA AFF base accounts should not be considered policy-specific. Depending on the issue, different information from the same base account may be relevant.

2.152. In the combined presentations, the rows show selected agricultural, forestry and fisheries products or activities. The structure and coverage of those activities and products depend on the issues under consideration. The SEEA AFF is focused on providing information for specific products rather than product groupings: maize, wheat and rice, for example, are shown instead of a "cereals" product group.

2.153. The combined presentations that follow are not standard reporting tables. The choice of products is provided as an example. In practice, countries should incorporate the variables and products most relevant to the issue under consideration, using those examples as a starting point.

2.154. If required, additional rows within a product group may be added to distinguish different production processes, such as capture fisheries and aquaculture, or organic farming and irrigated agriculture. The design of combined presentations is flexible enough to take into account different views, but the implications for the design of the underlying base accounts and the availability of data must be noted.

2.155. The combined presentations do not conform to accounting identities. Accordingly, it will be possible to aggregate different rows and columns in some parts, but not in others. In practice, this is reflected in that the measurement units applied will vary through the table.

2.156. The information in the combined presentations can be drawn in a large part from the underlying SEEA AFF base accounts. The definitions of the data items are, therefore, consistent with the data items defined for the base accounts. For the combined presentations shown in tables 2.6 to 2.9, data item definitions are provided in chapters 3 and 4.

Table 2.6

SEEA AFF combined presentation: activity and product specific inputs

Selected key products only	Economic variables					Environmental variables							
	Ouput		Exports	Imports	Employment	Land use		Use of Irrigated Water	Energy use in agriculture	Greenhouse gas emission (CO_2 eq.)	Use of inorganic fertilizer (tonnes)			Use of pesticides
	(tonnes)	(currency units)	(tonnes)	(tonnes)	(000 people)	Opening stock (ha)	Net Change (ha)	(cubic metres)	(terajoule)	(gigagrams)	N	P	K	(tonnes)
Agricultural products														
Crop products														
Maize														
Rice														
Wheat														
Palm oil														
Sugar														
Potatoes														
Fodder														
Other food crops														
Other non-food crops														
Total														
Livestock products														
Livestock raising														
Eggs														
Raw milk														
Honey														
Other livestock products														
Total														
Other agricultural products														
Total Agriculture														
Forestry products														
Forestry														
Logging														
Other forestry products														
Total Forestry														
Fisheries products														
Aquaculture														
Capture fisheries														
Total Fisheries														

Table 2.7

SEEA AFF combined presentation: food production and consumption

Food products	Household consumption variables			Supply and use variables						Environmental variables (inputs to production)			
	Food consumption/nutrition			Ouput	Exports	Imports	Intermediate use	Changes in inventories		Land use		Use of irrigated water	Greeenhouse gas emissions (CO2 eq.)
	Household final consumption (tonnes)	of which: food waste (000 tonnes)	Kcal/per capita/per day	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	of which: post-harvest losses (tonnes)	Opening stock (ha)	Net Change (ha)	(cubic metres)	(gigagrams)
Agricultural products													
Food crops													
Maize													
Rice													
Wheat													
Palm oil													
Sugar													
Potatoes													
Other food crops													
Total													
Meat products													
Catlle and buffalo meat													
Sheep and goat meat													
Pig meat													
Chicken meat													
Other meat													
Total meat													
Other livestock products													
Honey													
Milk													
Eggs													
Total livestock products													
Fisheries													
Aquaculture (by type of fish)													
Capture fisheries (by type of fish)													
Total Fish and aquatic products													

Table 2.8

SEEA AF combined presentation: use of environmental assets

ACTIVITY	Ouput (tonnes)	Environmental asset variables							
		Land use		Soil resources	Water resources		Forest and timber resources	Fish and aquatic resources	Livestock numbers
		Opening stock (ha)	of which: used for organic production (ha)	Indicator of soil quality (e.g. measure of soil organic carbon)	Use of irrigated water (cubic metres)	Water abstracted as a share of renewable water resources (%)	(e.g. change in forest area)	(e.g. change in catch per unit effort indicator)	(head)
Agriculture									
Cropping									
Livestock raising									
Other agricultural activity									
Total agriculture									
Forestry									
Forestry									
Logging									
Other forestry activity									
Total forestry									
Fisheries									
Aquaculture - inland									
Aquaculture - marine									
Capture fisheries - inland									
Capture fisheries - marine									
Total fisheries									

Note: CPUE, catch per unit effort

Table 2.9

SEEA AFF combined presentation: cross industry and activity perspectives

	Economic variables								Environmental variables				
	Output	Intermediate consumption	Subsidies	Value added	Exports	Imports	Gross fixed capital formation	Employment	Land use		Use of irrigated water	Energy use in agriculture	Greenhouse gas emission (CO2 eq.)
ACTIVITY	(currency units)	(currency units)	(currency units)	(currency units)	**(currency units)**	(currency units)	(currency units)	(000 people)	Opening stock (ha)	Net Change (ha)	(cubic metres)	(terajoule)	(gigagrams)
Agriculture													
Cropping													
Livestock raising													
Other agricultural activity													
TotalaAgriculture													
Forestry													
Forestry													
Logging													
Other forestry activity													
Total forestry													
Fisheries													
Aquaculture - inland													
Aquaculture - marine													
Capture fisheries - inland													
Capture fisheries - marine													
Total fisheries													
Total agriculture, forestry and fisheries													
Total economy													

2.157. In the columns of the combined presentations, broad groupings of information are suggested – economic variables, consumption variables and environmental variables, with each one being sourced from different base accounts. This is an attribute of the SEEA AFF framework in that the use of common classifications and structures facilitates flexible integration of the information, whose coherence and consistency is assured because it is compiled through the base accounts.

2.158. The terms "economic" and "environmental" applied to general groupings are used only to give a sense of the type of information that might be included. The economic variables are those commonly measured in the SNA in monetary or physical terms, and the environmental variables are those primarily measured in physical terms relating to environmental assets and related physical flows.

2.159. Although, in the combined presentations, information on a large number of variables is organized, the presentations shown here provide data for a single time period, and possibly for an average over a number of years. In addition to structural information, time-series data are required to create a three-dimensional dataset: this is best managed in a database setting. In that sense, the combined presentations will be helpful in suggesting the most useful content of an output database and the way in which it might be structured.

2.160. Combined presentations should enable the extraction of variables relevant to the derivation of indicators. Indeed, discussion of a combined presentation should assist in the design and selection of indicators of the environmental sustainability of agricultural, forestry and fisheries activities. To derive indicators, additional information, such as population data or GDP, may need to be incorporated without being recorded in the combined presentation. In practice, that does not pertain to any particular field in the combined presentation, but it is nonetheless relevant.

2.161. The combined presentations are structured to feature a single level of spatial aggregation at the national, subnational or multinational levels. The facility for looking at several spatial areas, such as the different regions of a country, may be relevant, particularly in relation to the sustainability of environmental assets. To compare spatial areas, additional layers of information will of course be needed.

2.5.3 SEEA AFF reference combined presentation

2.162. In addition to the thematic combined presentations, a SEEA AFF "reference combined presentation" has been designed to provide a focal point for discussion on the description and implementation of the SEEA AFF. This combined presentation is based on consideration of the types of information that are considered to be available to form tier 1 accounts, as described in annex I.

2.163. The structure of the reference combined presentation is shown in table 2.10, which provides a cross-cutting perspective on a set of environmental and economic variables, such as land, biological resources, outputs, intermediate and natural inputs, trade flows and residual flows.

Table 2.10 **SEEA AFF reference combined presentation**

	Assets					Inputs									Outputs				
						Water withdrawal	Energy use	Synthentic fertilizer			Organic fertilizer			Pesticides	Actual production		Gross production value	Value added	Total gross domestic product
	Land area (000 ha)	Harvested area (000 ha)	Biomass stock (million tonnes)	Number of heads (stock) (000 heads)	Producing animals (000 heads)	(m3)	(terajoules)	N (000 tonnes)	P_2O_5 (000 tonnes)	K_2O (000 tones)	N content (000 tonnes)	P_2O_5 (000 tonnes)	K_2O (000 tones)	(000 tonnes)	(000 tonnes)	(m3)	USD million dollars (current)	USD million dollars (current)	USD million dollars (current)
TOTAL																			
Agriculture																			
Arable land																			
Permanent crop																			
Permanent meadows and pastures																			
Crops Primary																			
Cereals																			
Roots and tubers																			
Pulses																			
Nuts																			
Oil-bearing crops																			
Vegetables																			
Fruits																			
Fibres																			
FoddercCrops																			
Sugar Crops																			
Stimulants																			
Spices																			
Other crops																			
Cattle and buffaloes																			
Beef and buffalos meat																			
Milk																			
Sheep and goats																			
Sheep and goat meat																			
Milk																			
Pigs																			
Meat, pigs																			
Poultry Birds																			
Eggs primary																			
Meat, poultry																			
Other livestock																			
Meat, other livestock																			
Forest																			
Planted forest																			
Primary forest																			
Other naturally generated forests																			
Game meat and edible forest products																			
Wood fuel																			
Industrial roundwood																			
Sawlogs and veneer logs																			
Pulpwood, round and split																			
Other industrial roundwood																			
Other forest products																			
Water																			
Inland water																			
Coastal water (exclusive economic zone)																			
Aquaculture products																			
Fisheries products																			

Note: CO2, carbon dioxide; N, nitrogen; GHG, greenhouse gas; P2O5, phosphorus pentoxide; K2O, potassium oxide; USD, United States dollars; kcal, kilocalories; capita, calorie supply per capita.

Table 2.10 **SEEA AFF reference combined presentation**

	Assets					Trade flows								Population	Food availability		Environmental Impacts
						Exports				Imports							
	Land area (000 ha)	Harvested area (000 ha)	Biomass stock (million tonnes)	Number of heads (stock) (000 heads)	Producing animals (000 heads)	(m3)	(000 heads)	(000 tonnes)	USD million dollars (current)	(m3)	(000 heads)	(000 tonnes)	USD million dollars (current)	(000)	Food (000 tonnes)	Food supply (Kcal/capita / day)	GHG Emission (CO2 eq) from Agriculture (gigagrams)
TOTAL																	
Agriculture																	
Arable land																	
Permanent crop																	
Permanent meadows and pastures																	
Crops Primary																	
Cereals																	
Roots and tubers																	
Pulses																	
Nuts																	
Oil-bearing crops																	
Vegetables																	
Fruits																	
Fibres																	
FoddercCrops																	
Sugar Crops																	
Stimulants																	
Spices																	
Other crops																	
Cattle and buffaloes																	
Beef and buffalos meat																	
Milk																	
Sheep and goats																	
Sheep and goat meat																	
Milk																	
Pigs																	
Meat, pigs																	
Poultry Birds																	
Eggs primary																	
Meat, poultry																	
Other livestock																	
Meat, other livestock																	
Forest																	
Planted forest																	
Primary forest																	
Other naturally generated forests																	
Game meat and edible forest products																	
Wood fuel																	
Industrial roundwood																	
Sawlogs and veneer logs																	
Pulpwood, round and split																	
Other industrial roundwood																	
Other forest products																	
Water																	
Inland water																	
Coastal water (exclusive economic zone)																	
Aquaculture products																	
Fisheries products																	

Note: CO2, carbon dioxide; N, nitrogen; GHG, greenhouse gas; P2O5, phosphorus pentoxide; K2O, potassium oxide; USD, United States dollars; kcal, kilocalories; capita, calorie supply per capita.

2.6 Aggregates and agri-environmental indicators

2.6.1 Types of indicators

2.164. Aggregates and indicators are the summary measures that emerge from an accounting framework. They provide indications of status, trends and structural changes. These indicators can be compared to externally given reference levels, defined in the same way, such as policy-given targets, and also to benchmark values derived from within the system itself, such as averages of larger classes to which the units being evaluated belong. Given their comprehensive and internally consistent nature, accounting tables are designed to provide aggregates, such as total water use or total wheat production, that conform to the selected accounting boundaries.

2.165. Because accounting frameworks have embedded relationships between variables – for example, between production and intermediate inputs or between income and assets, it is possible derive indicators directly from the accounting tables: some examples are GDP and net saving.

2.166. These aggregates and accounting indicators can be compiled and presented at various levels of classification, depending on the data available, for example, by industry or institutional sector. Where data are organized in a table reflecting a structured classification – production data classified by product or industry for example – descriptive statistics can be developed that highlight the structure of an economy or set of economic activities. One example of this would be statistics showing the proportion of total agricultural output attributable to rice production.

2.167. These types of aggregates and indicators can be derived directly from base accounts. Because those accounts pertain to specific data domains, the indicators are limited to those domains. For example, the share of water use by agriculture, net greenhouse gas emissions attributable to agriculture, or the agricultural shares of GDP and employment. In that context, the use of base accounts to organize information in a given data domain may seem to provide limited additional value in that the trends and relationships shown by in-domain indicators are unlikely to be significantly affected if the underlying data and statistics are placed in a supply and use table or asset account.

2.168. In line with the SEEA Central Framework, the SEEA AFF recognizes three broad groupings of indicators, descriptive statistics; environmental asset aggregates and indicators; and environmental ratio indicators, of which there are three specific types. Those different types of indicators are described in detail in annex II.

2.169. The additional value of the SEEA approach generally, and the SEEA AFF approach, in particular, arises when data are compared across domains. One of the main rationales for the SEEA is to facilitate the comparison of data across domains, particularly in comparing environmental stocks and flows with economic data, such as production. Without common measurement boundaries and classifications, reasonable comparisons could often be misleading or flawed.

2.170. Those cross-domain indicators are referred to in the SEEA as "environmental ratio indicators", including productivity and intensity ratios, decoupling ratios and polluter-pays indicators (see annex II for details). Environmental ratio indicators are particularly relevant to the SEEA AFF because, in terms of policy development, often the intensity of use of environmental inputs, such as water, energy or pesticides, relative to production is of more interest than the total amounts used.

2.6.2 Role of SEEA AFF in supporting the development and monitoring of indicator frameworks

2.171. An objective of the SEEA AFF is to provide the basis for an integrated, multi-domain dataset pertaining to agricultural, forestry and fisheries activities that ensures that accurate environmental indicators can be derived, data gaps are filled and any resulting additional indicators are identified in a coherent manner.

2.172. Although a set of SEEA AFF indicators is not proposed, it is clear from the structures of the combined presentations that the derivation of intensity indicators linking water use, fertilizer use, energy use, greenhouse emissions and land use in production, ideally at the product level, is envisaged in the design of a combined presentation. Furthermore, by using the link between supply and demand for each product, the intensity indicators may be linked to consumption and calorie intake. Analysis of these types of ratios may provide insights for the development of policies on food production and distribution.

2.173. The discussion above assumes the cross-domain dataset is comprised of economic and environmental variables, such as production, trade, consumption, land use, water and energy. However, as the SEEA AFF list of data domains makes clear, comparing stocks and flows across the agriculture, forestry and fisheries domains is not an easy task. This is because the compilation of data in these activity domains does not usually follow similar methods and classifications, making it difficult to conduct an analysis of the trade-offs between them. The SEEA AFF applies the same accounting concepts and principles to the three activities to facilitate investigation of cross-cutting issues, such as land use, water use and relative contributions to the provision of food, fibre and materials.

2.174. One reason for not providing a set of SEEA AFF indicators is to emphasize the principle that the SEEA AFF is a multi-purpose dataset that can be used to support multiple indicator sets and a variety of analyses. The SEEA AFF may be suited for supporting a generic set of agri-environmental indicators, but it should also be acceptable for the provision of information for a set of sustainable development indicators, for example, in relation to food security, environmental pressure and production efficiencies, based on a coherent compilation of the underlying relevant economic and environmental data. Below is a discussion of sources of indicators that may be derived, or are fully aligned with the SEEA AFF

2.175. First, FAOSTAT questionnaires, core statistics and derived agri-environmental indicators, the latter co-developed with EUROSTAT and OECD, are already fully aligned with the SEEA AFF (for example, see annex III).

2.176. Second, the FAO Global Strategy to improve agricultural and rural statistics core minimum dataset covering economic, social and environmental domains, can be derived in part using the SEEA AFF data framework.

2.177. Finally, considering the many links between the 2030 Agenda with agriculture, forestry and fisheries themes, many of the Sustainable Development Goals indicators can, in principle, be sourced from SEEA AFF-based datasets.

Chapter 3 Accounting for agricultural, forestry and fisheries production, and associated biological resources

3.1 Introduction

3.1. This chapter provides a description of the SEEA AFF base accounts pertaining to production by agricultural, forestry and fisheries activities and the associated biological resources. For each base account, the following is set out in the chapter: (a) its purpose and scope and its links to other components; (b) the definition of accounting entries, accounting treatments and relevant classifications; and (c) areas of possible extension.

3.2. The accounting principles and treatments of the SNA and the SEEA Central Framework apply throughout. Any interpretation of accounting matters should refer to them. The national accounting treatments in the European Economic Accounts for Agriculture and Forestry (EUROSTAT, 2000) should also be useful in determining the treatment of individual products and practices in agriculture and forestry.

3.3. The SEEA Central Framework offers a flexible and modular design in responding to the resources available in a country and its policy requirements. Regarding the SEEA Central Framework, the interpretation of "modular" concerns the prioritization of accounts and themes – that is, whether priority should be given to, for example, energy accounts, environmental protection expenditure accounts or land use accounts. Because the perspective of the SEEA AFF is cross-cutting, the implementation of it cannot be modular in this way and, ideally, the relevant base accounts are to be compiled in parallel.

3.4. Compiling such an extensive range of base accounts – even where the focus is on agricultural, forestry and fisheries activities rather than an entire economy – is a major endeavour. It should involve a planning exercise to match expectations with available resources and an initial focus on a limited number of data domains that are most relevant to policy and for which data are readily available. This limited initial scope should enable the development of appropriate skills and accounting processes. The main lesson from the development of environmental-economic accounts over the past 20 years is that the optimum approach is to "learn by doing".

3.5. This chapter, and chapter 4 provide a starting point for those seeking to use an accounting approach to organize information for the analysis of agricultural, forestry and fisheries activities. As more experience is gained regarding country work, further guidance and supporting material will be developed.

3.6. There is no expectation that each country will take the same steps in implementing the SEEA AFF or will structure particular base accounts in exactly the same way. Differences will emerge, reflecting economic and environmental circumstances, data availability and policy priorities. Accordingly, the descriptions in this chapter, as reflected in the design of the tables, are not based on templates or questionnaires for the purposes of international reporting. In due course, reporting mechanisms may emerge and so will a core set of the SEEA AFF

3.7. An important aspect in the development of SEEA AFF ad hoc reporting mechanisms is coordination with the existing reporting on agriculture, forestry, fisheries to international agencies and on related data domains, for example on water, greenhouse gas emissions and fertilizers.

3.8. This flexibility in the table structure was designed to facilitate comparability. Using the SEEA AFF to focus on key products should ensure that different countries can use comparable approaches to their measurements. Furthermore, comparability among countries is practicable because aggregate information is sought at the activity level and through the use of International Standard Classifications of Industries and Products, respectively ISIC and CPC. Fundamentally, as with national accounting generally, the consistent use of the concepts and principles of the SNA and the SEEA Central Framework provides the basis for international comparability.

3.9. This chapter is structured to provide a description of physical flow accounts for the outputs of agriculture, forestry and fisheries activities and asset accounts for the biological resources that underpin these outputs, i.e. plantations, livestock, forest and timber resources and fish and other aquatic resources. The focus of the account descriptions is on accounting in physical terms.

3.10. Accounting for those activities in monetary terms is described in section 2.2. Two tables are presented, a monetary supply and use table, and an extended production and income account. Descriptions of those two accounts are relatively short, as the accounting entries are equivalent to those described in the SNA. Accordingly, there is little advantage in repeating or synthesising the accounting text. These short descriptions are not intended to imply that monetary information is not relevant, but instead, their purpose is to indicate that from an accounting perspective. the key challenge will be the integration of physical data to suit national accounting measurement principles.

3.11. The description of asset accounts in this chapter also focuses on accounts in physical terms, as the physical measure of the various biological resources determines the scope for monetary valuation. At the same time, the sections with descriptions of asset accounts also provide references to relevant sections of the SNA and the SEEA Central Framework in which the accounting for biological resources in monetary terms is described.

3.2 Physical flow account for crop products

3.2.1 Measurement purpose and scope

3.12. The physical flow account for crops records the supply and use of food and non-food crop products in physical terms, usually tonnes. For each product, the following is recorded on the table: (a) total supply of the raw product from the agriculture industry and from the rest of the world; (b) total use of the raw product, for example, intermediate consumption to the manufacturing sector or to export; (c) total supply of the processed product; and (d) total use of the processed product, including household consumption.

3.13. The recording of supply-and-use flows of crops in raw and processed forms opens up a link with household consumption of food products. This information is useful for assessments of food security and nutrition. The supply-and-use approach ensures internal consistency and coherence of data that are often collected from several sources. Confrontation and reconciliation of data from different sources is an important function of accounting frameworks.

3.14. The scope of the physical flow account is on crops. In most countries, however, the number of crop products often exceeds 100. Compiling a physical flow account covering more than 100 products in raw and processed forms is a considerable task, especially because many of them will be insignificant in the assessment of the overall production and environmental impact at the national level.

3.15. For the SEEA AFF, countries may consider developing physical flow accounts for crops that focus on the eight to ten most important crops. The selection of the crops is not straightforward. Products may be important in terms of their share in total food production, their contribution to nutrition, their emerging contribution to bioenergy production, their share of imports and exports, or their use of environmental inputs, such as land and water.

3.16. Focusing on selected products is preferable at the national level because it is the basis for drawing together a range of data and promoting discussion on differences among products. An alternative approach – organizing data by major product groups, such as cereals roots and tubers – may provide data that are more comparable across countries, but they would be less useful for individual countries.

3.17. Some crops, particularly maize, are increasingly cultivated for energy rather than food; certain species are in fact grown for specific fuels. Where data allow, it may be relevant to distinguish between crop types used for food and non-food production. If only total production data can be obtained, it is probably more useful to record production for all purposes and show allocations to different uses separately.

3.18. Totals for all crops should also be compiled for variables, such as output, imports, exports and household consumption. Those estimates are relevant to the compilation of combined presentations. They facilitate the monitoring of changing patterns in the supply and use of crops. If, for example, the difference between the total output of all crops and the output of the selected crops increases over time, it may be necessary to change the initial list of key products.

3.19. Physical flow accounts for crops used primarily for food can be compared with information in food balance sheets, which are used in some countries and by FAO to determine the composition of food consumed. The principles on which they are based are similar to the physical flow accounts described in this document, but different definitions of supply and use are applied. In the SEEA AFF, supply and use are defined to be consistent with the standard economic accounts, making it possible to do straightforward comparisons with economic data, including data in input-output tables. Although total supply and use may be defined differently, in general, the components of supply and use from food balance sheets can be used with little adaptation to compile SEEA AFF physical flow accounts.

3.20. The physical flow accounts described in this document are aligned with the accounts known as material flow accounts and physical input-output tables in which all flows in an economy in physical terms are recorded. Information from such accounts may be useful in compiling physical flow accounts for crops.

3.21. Physical flow accounts for individual products or groups of products are not provided in the SEEA Central Framework. In section 3.6.2, the possibility of physical flow accounts is set out, but no tables or measurement advice are provided apart from noting the benefit of applying standard boundaries and definitions for natural inputs, products and residuals (see SEEA Central Framework, section 3.232).

3.22. The recording of flows in monetary terms should be compiled consistently with the requirements of the SNA.

3.2.2 Accounting entries

3.23. The physical flow account for crops products, shown in table 3.1, records the flows in physical terms for a selected crop; it is divided into the supply table and the use table. For each crop and in each row, the total supply must be equal to total use. The selection of products in the supply and use table is indicative, and does not represent a standard set of crop products. As discussed above, selection of the most important products is a matter for consideration at the country level, such as the top five or ten most important crops for national production could be chosen.

3.24. An objective of the SEEA AFF is to distinguish between an agricultural activity and other types of economic activities, in particular manufacturing, in such a way that clear connections can be made between the outputs and inputs related to agricultural activity and information in standard economic datasets. This is reflected in the physical flow account for crops in which production of the agricultural industry (ISIC A) and the manufacturing industry (ISIC C) are shown separately and a distinction is made between raw and processed products.

3.25. Making this distinction is important, especially with food crops, because a function of the SEEA AFF is to make the connection between the production of food crops and household consumption. Raw and processed products are recognized in the SEEA AFF because most crops are processed before household consumption and there are often alternative uses for crops, such as using maize to produce fodder and to generate energy.

3.26. In practice, understanding the relationships between raw and processed commodities can be challenging. Commodity "paths" or "trees" may be established to map linkages between different commodities, but this can also be challenging initially and because the commodity paths will change over time.

Table 3.1

Physical flow account for crops (tonnes of raw commodity equivalent)

Physical supply table for crops

	Output							
	Gross production	Harvest losses	Agricultural industry		Manufacturing industry	Total Output	Imports	Total supply
			Total	of which Household production				
Selected products*								
Cocoa, beans (raw)	670 318	10 518	659 800			659 800	226 613	886 413
Cocoa, beans (processed)					414 007	414 007	78 700	492 707
Coffee, green (raw)	675 970	7 270	683 240			683 240	11 892	695 132
Coffee, green (processed)					258 106	258 106	1 770	259 876
Maize (raw)	29 272 387	348 372	28 924 015			28 924 015	514 000	29 438 015
Maize (processed)					16 174 345	16 174 345		16 174 345
Palm oil (raw)	38 958 436	1 145 836	40 104 272			40 104 272		40 104 272
Palm oil (processed)					27 205 209	27 205 209		27 205 209
Potatoes (raw)	1 225 424	60 686	1 164 738			1 164 738	66 174	1 230 912
Potatoes (processed)					143 812	143 812		143 812
Rice (raw)	86 770 167	5 621 573	81 148 594	8 114 859		81 148 594		81 148 594
Rice (processed)					72 111 394	72 111 394	481 475	72 592 869
Soybeans (row)	538 728	-	538 728			538 728	2 671 914	3 210 642
Soybeans (processed)					2 540 380	2 540 380	16 426	2 556 806
Sugar (raw)	2 125 984	4 684	2 121 300			2 121 300	74 578	2 195 878
Sugar (processed)					1 808 551	1 808 551	23 738	1 832 289
Tea (raw)	149 380	9 980	139 400			139 400	2 664	142 064
Tea (processed)					127 450	127 450	5 193	132 643
Wheat (raw)							10 534 672	10 534 672
Wheat (processed)							148 160	148 160

Physical supply table for crops

	Intermediate consumption					Household final consumption		Changes in inventories		Flows from the rest of the world	
	Agricul. Ind. (Feed)	Agricul. Ind.(Seed)	Generation of energy products	Food Processing	Non-food processing	Food consumption	of which: food waste	Post-harvest losses	Other changes in inventories	Exports	Total use
Selected products*											
Cocoa, beans (raw)		37 500		401 488	12 519	9 084			390 101	35 721	886 413
Cocoa, beans (processed)						368 362			- 154 879	258 424	492 707
Coffee, green (raw)		23 596		258 104		17 000			- 82 270	464 162	680 592
Coffee, green (processed)						234 934		2 628	15 499	2 985	259 876
Maize (raw)	114 753	110 607		16 103 810	70 620	10 331 557		1 363 843	1 341 042	1 768	29 438 000
Maize (processed)						14 999 000		300 600	499 045	700	15 799 345
Palm oil (raw)		818 000		26 136 431	3 360 427				9 758 460	30 954	40 104 272
Palm oil (processed)						12 155 584			5 454 000	7 402 509	25 012 093
Potatoes (raw)		14 391		143 464		1 034 008		61 401	- 41 938	3 923	1 230 912
Potatoes (processed)						134 222		752	8 833		143 807
Rice (raw)	46 621	770 000		71 575 644	535 749	8 686		4 381 963	3 806 000	3 531	81 128 194
Rice (processed)						71 528 520		486 250	39 490		72 592 869
Soybeans (row)		27 000		2 540 380		446 756		158 153	36 706	1 647	3 210 642
Soybeans (processed)						2 509 036		28 067	14 940	2 558	2 554 601
Sugar (raw)	79 232	186 504		1 808 600		54 925			15 434	654	2 145 349
Sugar (processed)						1 537 961		122 593	22 264	1 920	1 684 738
Tea (raw)		4 178		127 410		10 168			- 3 267	3 575	142 064
Tea (processed)						118 260			1 110	13 273	132 643
Wheat (raw)	200 000			9 000 000	1 000				714 596	19 076	9 934 672
Wheat (processed)						148 160					148 160

Not Applicable

* Selection of products is indicative to illustrate the logic of the accounting structure; countries will determine the actual key products for inclusion.

3.27. To record the raw and processed versions of each crop, a common basis for recording must be established. The proposed approach is to determine the "raw commodity equivalent" weight for each processed product. In the case of wheat, for example, the relevant weight of the processed product – bread – is not the total weight of the bread but the weight of the unprocessed wheat required to produce it. This basis of recording enables a direct connection between production and food consumption.

3.28. Determination of raw commodity equivalent weights requires consideration of the actual proportion of raw commodity used as an input into the processing stage. In cases in which harvested raw commodities are used for different purposes – sugar cane, for example, is used to produce energy and sugar – allocations to the different uses must be made in terms of the total weight of the raw commodity produced.

Supply table entries

3.29. To separate agricultural activities from other activities, the supply table distinguishes between total supplies of raw and processed products: the supply of raw products relates to production by the agricultural industry, whereas the supply of processed products relates to production by the manufacturing industry. The allocation of production to different industries is based on the relationships between products and industry set out in ISIC. The aim of this is to show that when alignments with standard measures of economic activity are made, there must be a clear separation of products and industries, reflecting a value-added chain from primary producers, to secondary and subsequent activities and finally to consumers.

3.30. The SEEA AFF is not intended to articulate the full value added or supply chain associated with agricultural production; instead, it is meant to identify the boundary around the first step in the chain from the agricultural industry to other producers. The second step in the chain will usually be the manufacturing industry, though, in practice, there will be many other players, such as the transport, wholesale and retail industries, that might be added to obtain a complete supply and use table for each product.

3.31. In the SEEA AFF, those additional steps are not recorded, and consequently, the physical flow account for crops shows a stylized link between primary production and final consumption. The account, nonetheless, provides a basis for integration with economy-wide supply and use tables and input-output tables, which may be relevant in analysis of the agro-food industry, for example, or in tracking the chain of prices through the production-based and margin-based industries.

3.32. A particular link in the supply chain relevant to food consumption is the role of restaurant and related food services. In line with the paragraph above, the intermediate consumption of food products by the restaurant industry is not separately identified in the table and the measure of household final consumption includes the consumption of food products in restaurants in addition to those consumed at home.

3.33. Total supply is then given in two equations:

(a) Total supply of raw product = agricultural industry output + imports;
(b) Total supply of processed product = manufacturing industry output + imports.

3.34. The entry for "output – agriculture industry" relates to total output and includes commercial and non-commercial production and production from kitchen gardens. Output estimates should be reported at the farm level and include output for sale and barter and output consumed on own-account by the producing unit – subsistence agricultural production, for example.

3.35. Output excludes harvesting and threshing losses and the part of the mature crop not harvested for any reason. However, for analytical purposes, such as studies of productivity and efficiency, it may be relevant to include measures of gross output before such losses occur; in that case, columns are included in the physical flow account for crops to record gross output and harvest losses. Agricultural industry output is defined as net output (farm gate) = gross output – harvest losses.

3.36. The entry for "output – manufacturing industry" in the physical flow account for crops is assumed to relate to economic units involved in the manufacture of food, beverages and tobacco products and relevant non-food products, such as clothing.

3.37. In the physical flow account for crops, estimates of output by the manufacturing industry are based on assumptions regarding the source of products used in final consumption. Three final uses are considered as being supplied by the domestic manufacturing industry, and accordingly are assumed to reflect the quantities of the raw product that are subsequently consumed as (a) household final consumption – food; (b) household final consumption – other uses; and (c) changes in inventories. These are defined below under use table entries.

3.38. The estimate of output for the manufacturing industry is matched by entries reflecting the intermediate use of the raw product by the manufacturing industry (see below: use table entries). The estimate for intermediate consumption for food and non-food processing also includes amounts used in the manufacture of products that are not attributed to the processed product.

3.39. Imports of crops consist of the purchase, barter or receipt of crop products by residents from non-residents. In principle, it includes commercial trade, donated quantities, and illegal or other unrecorded trade. Imports should be recorded in terms of raw commodity equivalent.

Use table entries

3.40. The entry for "intermediate consumption – agricultural industry feed" refers to the quantity of product used for feeding livestock and poultry during the reference period, either domestically produced or imported. The quantities are assumed to be raw.

3.41. The entry for "intermediate consumption – agriculture industry seed" refers to the quantity of product used for sowing or planting, either domestically produced or imported. The entry also includes quantities used for sowing or planting crops harvested for fodder. The quantities are assumed to be raw.

3.42. The entry for "intermediate consumption – generation of energy products" refers to the use of raw products by economic units for the generation by economic units of energy products, such as fuel, heat and or electricity. A distinction may be required between those crops grown solely for the purpose of the production of biogas and related energy products. In some cases, they may be considered output of the electricity supply industry (ISIC division 35) rather than outputs of the agriculture industry.

3.43. The entry for "intermediate consumption – food processing" refers to the use of raw products by economic units involved in the physical or chemical transformation of raw commodities into food and beverage products.

3.44. The entry for "intermediate consumption – non-food processing" refers to the use of raw products in the processing of non-food products.

3.45. The entry for "household final consumption – food" refers to the total quantity of a product consumed as food. It includes the product and any product derived from it through further processing. Food from maize, for example, comprises the quantity of maize, maize meal and any other maize product available for human consumption. All food for human consumption is assumed to be consumed directly from the agricultural or manufacturing industry. Consequently, the movement of quantities of food products through supporting industries, such as wholesale and retail networks or restaurants, is, therefore, not recorded.

3.46. The aggregate for "household final consumption – food" includes amounts purchased or otherwise obtained by households. For some policy and analytical purposes, it may be relevant to make a separate measurement of the amount of household food waste.

3.47. The entry for "household final consumption – other uses" is a catch-all for non-food uses of crop products.

3.48. The entry for "changes in inventories – post-harvest losses" refers to quantities of product lost through wastage during the year at all stages between the recording of agricultural output and final consumption, such as losses during storage and transport. Losses occurring before and during harvest should be recorded in "harvest losses"; waste generated from final consumption in households is excluded, but it is recorded in "household consumption". Quantities lost during the transformation of raw products into processed products are accounted for in the assessment of extraction and conversion rates. Distribution waste can be considerable in countries where the climate is hot and humid or where transport, storage or processing facilities are inadequate, particularly in the case of perishable goods.

3.49. The "changes in inventories – other" entry reflects changes in holdings of crop products during the reference period at all stages between output and final sale of processed products. It comprises changes in government stocks and the inventories of manufacturers, importers, exporters, wholesalers, retailers, transport and storage enterprises, and farms. It excludes changes in inventories resulting from post-harvest losses.

3.50. Exports of crops consist of the sale, barter or transfer of crop products by residents to non-residents. Processed commodity exports should be recorded in terms of raw commodity equivalent.

3.2.3 *Measurement issues and possible extensions*

3.51. Some points concerning issues related to the measurement of physical flows of crops should be noted. First, the production of food for consumption by a farm household – subsistence agriculture – should be included in the accounts. Depending on the product or in-country circumstances, it may be relevant to provide an estimate of subsistence production separately from other production.

3.52. Second, in cases in which production or harvesting of crops is carried out in forest areas, the output should be recorded in the physical account for crops or in other relevant tables, such as meat production, depending on the product. This type of production is not included in the accounts for forestry, which is limited to the production of timber. For analytical purposes it may be relevant in some countries to make a distinction between food and non-wood forest products.

3.53. Third, many crops are produced from plantations, vineyards and orchards. Information on plantations in terms of area or number of plants may be organized in the form of asset accounts (see section 4.5). Information about the area of plantations may also be included as rows in the land use account (see section 4.15).

3.54. Fourth, measuring the production of fodder for livestock may be challenging. In cases in which fodder crops are harvested for sale to other economic units, the production should be included under non-food crops. In cases in which fodder is harvested, but retained on the producing farm to feed livestock, it should be included under production of non-food crops and intermediate consumption by the agricultural industry. In cases in which pastures are improved or fodder crops grown for grazing, the growth of plant material should not be considered as additional production, but the costs of inputs, such as fertilizers, seed and water, should be included in other accounts as appropriate.

3.55. The physical flow accounts for crops may be extended in various ways, depending on data availability and analytical requirements, for example, incorporating information on the type of production process used to grow specific crops, such as the use of irrigated and non-irrigated rice production or the use of organic farming practices.

3.3 Asset account for plantations

3.3.1 Measurement scope and purpose

3.56. The physical asset account for temporary and permanent crops shows the total harvested area, by crop type, and changes over an accounting period. The corresponding SEEA land use classification is "land under permanent crops". This information may help to clarify the mix of plantations and their share of land use. Because plantation-based agriculture may involve different production processes and generally operate over a long period of time, the information is relevant in understanding the potential environmental impacts of plantations.

3.57. The scope of the asset account is permanent or temporary crops cultivated area, excluding area for timber, namely the accounts that are focused on plants managed for a process of crop production by economic units. Forest plantations are, instead, included in the asset accounts for forests and timber resources. Plantations usually provide most of the associated crop products of economic interest as being distinct from the same products harvested from the wild, and will usually be most relevant in assessing environmental impacts.

3.58. Temporary and permanent crop plants of each type are included, regardless of age. The asset account should, accordingly, show the area of plantations, increases resulting from planting and decreases caused by removal, natural death and losses from such causes as storm damage or disease.

3.59. For the monetary asset account for plantations, the same scope for the physical account is adopted. Plantations are considered cultivated biological resources in the SNA and the SEEA Central Framework and the accounting entries concerning these resources are discussed specifically in the 2008 SNA paragraphs 10.88 to 10.96. Most commonly, plantations are treated in the SEEA AFF as fixed assets, following the 2008 SNA, as they will be managed for their production of various crops harvested on a regular basis over time.

3.3.2 Accounting entries

3.60. The physical asset account for plantations is shown in table 3.2. In the table, the opening and closing area of selected types of plantations and additions and reductions in stock over an accounting period are recorded For each plantation type, the opening area plus additions less reductions must equal the closing area.

3.61. The information in the plantation physical asset account should be consistent with the information in the land use account.

Table 3.2

Physical asset account for temporary and permanent crops (hectares)

	Opening stock	Additions to stock			Reductions in stock				Net change in Stock	Closing stock
		Increases due to planting	Other additions to stock	Total additions	Reductions due to removal of plants	Catastropic losses (storm, fire, disease)	Other reductions in stock	Total reductions		
Selected plantation types										
Cocoa, beans	1 701 351	30 000	5 000	35 000	6 000	300	49	6 349	28 651	1 730 002
Coffee, green	1 228 512	39 568	3 000	42 568	- 570 188	- 929 628	- 1 289 068	- 1 648 508		- 2 007 948
Maize	4 444 000	1 000 000	100	1 000 100	50 000	19 000	100	69 100	931 000	5 375 000
Palm oil	9 168 220	220 000	10 000	230 000	120 000	500	20	120 520	109 480	9 277 700
Potatoes	124 000	2 000	8 000	10 000	800	20 000	200	21 000	- 11 000	113 000
Rice	15 156 000	700 000	100 000	800 000	80 000	87 500	500	168 000	632 000	15 788 000
Soybeans	577 000	400 000	10 000	410 000	600 000	25 000	5 000	630 000	- 220 000	357 000
Sugar	458 255	5 000	8 000	13 000	1 000	40 000	143	41 143	- 28 143	430 112
Tea	117 268	1 650	16	1 666	4 000	600	642	5 242	- 3 576	113 692
Total	32 850 606	2 398 218	144 116	2 542 334	291 612	- 736 728	- 1 282 414	- 587 154	1 463 696	31 176 558

3.62. The entry for "opening stock" records the total area held at the beginning of the accounting period.

3.63. The entries for "additions and reductions in stock" are to show reasons for changes in the total area of plantations over an accounting period. The main changes will result from additional planting, removal of plants because of age or economic circumstances, for example, or catastrophic losses. If it is not possible to identify additions and reductions separately, an entry for "net change in stock" may be recorded.

3.64. The entry for "closing stock" entry shows the area of plantations at the end of the accounting period. The closing stock of one accounting period constitutes the opening stock of the following period.

3.65. The monetary asset account for plantations follows the same structure as the account for the physical account except that an additional column is incorporated to record revaluations of assets – i.e. those changes in the value of the stock of plantations over the accounting period that are due solely to changes in the prices of the assets. The generic asset account in monetary terms, including revaluations, is presented in the SEEA Central Framework table 5.3.

3.3.3 Measurement issues and possible extensions

3.66. Information about the area of plantations may be usefully supported by data giving the number of trees or plants. In fact, the asset account for a particular plantation type can be compiled using the number of plants rather than the area. With data for the number of plants and the area, indicators of the density of plantations can be derived that may useful in assessing environmental impacts.

3.4 Physical flow accounts for livestock products

3.4.1 Measurement purpose and scope

3.67. For these physical flow accounts, the supply and use of livestock products are recorded in physical terms, generally tonnes. For each product, the total supply from the agricultural industry and from the rest of the world, and the total use of this supply in the domestic economy and by the rest of the world are recorded.

3.68. The scope of these physical flow accounts is the rearing of livestock and the supply of all livestock products. Initial consideration may limit the scope to animals raised for meat or dairy items, but a wider range of products may be incorporated, such as eggs, honey, hides, skin, fur and silk. Most of those products are the result of managed rearing of livestock, but they may also be obtained by harvesting wild animals or their outputs.

3.69. In theory, a physical flow account for livestock products can be extended to cover any or all of those outputs, but it should focus on the managed rearing of livestock and the products derived in line with the approach taken in relation to the physical flow account for crops.

3.70. Following the ISIC and the SNA, a distinction is made between the product of raising and breeding livestock and the products derived from them. The product of raising and breeding livestock should always be considered an agricultural activity, whereas the treatment of the products derived from livestock varies according to the product. In general, livestock products that require the killing of an animal – for meat or hides, for example – are considered to be outputs of the manufacturing industry, whereas products obtained from animals on an ongoing basis, such as eggs, milk, wool and honey, are considered outputs of the agricultural industry. To ensure alignment with the SNA, this distinction is maintained in the SEEA AFF. Notably, guidance on specific products can be attained in ISIC Rev. 4 and CPC Rev. 2.0. extends guidance.

3.71. The SNA recognizes that the raising and breeding of some livestock is a form of gross fixed capital formation in which the animals are used to produce outputs over an extended period of time; examples of this are dairy cattle for milk and sheep for wool. The SNA recommends that this part of the raising of livestock be capitalized rather than treated as a work-in-progress, which would be the treatment if the animals were raised for slaughter.

3.72. As with crop products, the focus should be on recording a country's most important livestock products, with particular emphasis on covering the use of livestock products for nutrition to permit the most detailed possible description of the composition of the national diet by type of agricultural product.

3.73. As noted with regard to crop products, the SEEA AFF focuses on identifying the boundary around the first step in the value chain from the agricultural industry to other producers. It does not, however, fully articulate the full value added or supply chain associated with agricultural production. The second step in the chain is usually the manufacturing industry, but, in practice, there tends to be other players, such as the transport, wholesale and retail industries, that may also be added to create a full supply and use table for each commodity.

3.74. In the SEEA AFF, these additional steps are not considered, so the physical flow account for livestock products shows a stylized link between primary production and final consumption and other uses. It does provide, nonetheless, a basis for integration with economy-wide supply and use tables and input-output tables, which could be relevant in the analysis of the agro-food industry, for example, or in tracking the chain of prices through the production and margin-based industries.

3.75. A particular link in the supply chain relevant to food consumption is the place of restaurant and related food services. In line with the paragraph above, the intermediate consumption of food products by the restaurant industry is not separately identified in the table, this can be done using standard expansions aligned with input-output and supply use tables. The measure of household final consumption should, however, include the consumption of food products in restaurants in addition to those consumed at home**.**

3.76. The production boundary of the SNA and hence the SEEA includes illegal production, so poaching or illegal acquisition of products, such as ivory, are conceptually within the scope of the SEEA AFF and may form important parts of output in a particular country, depending on their scale and importance for policy formulation.

3.77. The recording of flows in monetary terms should be compiled consistently in line with the requirements of the SNA. Discussion and references are provided in section 2.2.

3.4.2 Accounting entries

3.78. The physical flow account for livestock products is shown in table 3.3. It records the flows in physical terms of major livestock products in the supply table and the use table. For each livestock product, total supply must be equal to total use.

Supply table entries

3.79. The entry for "output – agricultural industry" has two main components: total additions to livestock numbers over an accounting period and production of eggs, honey, raw milk and raw wool.

3.80. The entry for "output – manufacturing industry" includes total meat production from commercial slaughter and farm slaughter. The data are in terms of dressed carcass weight excluding offal and fat. Production of beef and buffalo meat includes veal; pig meat includes bacon and ham in terms of fresh equivalent. Poultry meat includes meat from all domestic birds and refers when possible to ready-to-cook weight. Production of skins and hides is also included when they are a by-product of animals slaughtered for meat.

Table 3.3

Physical flow account for livestock products

Physical supply table for livestock products

	Output			Flows from the rest of the world	Total supply
	Agricultural industry		Manufacturing industry		
	Total	of which: household production		Imports	
Selected products*					
Livestock raising and breeding (head)					
Cattle and buffalo	3 684 461	736 892		468 064	4 152 525
Sheep and goats	12 449 728	1 867 459			12 449 728
Pigs	4 953 900	743 085			4 953 900
Chickens	2 175 612 000	435 122 400		5 662 000	2 181 274 000
Other poultry					
Other animals					-
Duck	17 600 478	2 112 057			17 600 478
Meat (tonnes)					
Cattle and buffalo meat			516 700	80 792	597 492
Sheep and goat meat			124 842		124 842
Pig meat			743 000	3 000	746 000
Chicken meat			2 258 239		2 258 239
Other meat					
Duck			43 156		43 156
Rabbit and hare			3 000		3 000
Eggs (number)	33 940 407 000	6 788 081 400		285	33 940 407 285
Honey (tonnes)				1 636	1 636
Raw milk (tonnes)	1 694 220	254 133		6 055	1 700 275
Processed milk products (tonnes)			99 885		99 885

Physical use table for livestock products

	Intermediate consumption	Household final consumption			Changes in inventories	Exports	Total use
		Food consumption	of which: food waste	Other uses			
Selected products*							
Livestock raising and breeding (head)							
Cattle and buffalo	2 879 525			614 000	659 000		4 152 525
Sheep and goats	7 492 776			209	4 956 743		12 449 728
Pigs	3 847 272			28 000	817 628	261 000	4 953 900
Chickens	2 000 000 000			181 000 000	268 000	6 000	2 181 274 000
Other poultry							
Other animals							
Duck	17 600 478						17 600 478
Meat (tonnes)							
Cattle and buffalo meat	26 000	545 492	3 000	22 000	4 000		597 492
Sheep and goat meat	4 000	120 000	5 000		842		124 842
Pig meat	5 000	741 000	1 000				746 000
Chicken meat	33 000	2 225 000	2 000		239		2 258 239
Other meat							
Duck	156	42 000				1 000	43 156
Rabbit and hare		2 500				500	3 000
Eggs (number)	5 000	33 940 398 509	1 000	503	782	503	33 940 405 297
Honey (tonnes)		1 400		44		192	1 636
Raw milk (tonnes)	692 103	1 000 000				8 172	1 700 275
Processed milk products (tonnes)		85 000		196		13 789	98 985

3.81. The "imports" entry covers the total quantity of meat by type of animal and the total quantity of other livestock products imported from the rest of the world. In principle, it includes commercial trade, donated quantities, and illegal or other unrecorded trade. Quantity is expressed as net weight in tonnes, excluding any container. Imports of livestock are included, and are measured as the number of animals.

Use table entries

3.82. The entry for "intermediate consumption" covers the use of livestock products by other industries as inputs to other products, including meat.

3.83. The entry for "household final consumption – food" includes the quantity of all livestock products consumed by households as food. The aggregate for household food consumption includes quantities purchased or otherwise obtained. For specific policy and analytical purposes, it may be relevant to measure separately the quantities of household food wasted or discarded.

3.84. The entry for "household final consumption – other uses" includes all non-food uses of livestock products.

3.85. The entry for "changes in inventories" comprises changes in inventories during the reference period at all stages between agricultural production and retail, including post-harvest losses. It covers changes in the inventories of manufacturers, importers, exporters, wholesale and retail merchants, transport and storage enterprises, and farms**.** It also includes the gross fixed capital formation, from which the number of livestock considered to be an addition to the stock of animals used for breeding or to produce items, such as milk or wool, is recorded.

3.86. The entry for "exports" gives the total quantity of meat by type of animal and other livestock products exported. Quantity is given as net weight in tonnes, excluding any container. Exports of livestock are included, and are measured as the number of animals.

3.4.3 Measurement issues and possible extensions

3.87. A challenge encountered in accounting for the output of livestock products is the choice of measurement units. Different units will be used at different stages of the production cycle, such as numbers of livestock before slaughter, for example, and carcass weight after slaughter, which makes it difficult to balance the supply and use of meat products. There are also variations in weights – boned and boneless, for example, or warm and cold – and the units may vary by type of livestock. In general, the physical flow account for meat products should focus on the carcass weight of the animal at slaughter.

3.88. Some livestock products may be obtained from forest areas – bush meat, for example – or from wild animals; this includes illegal activity. Because the physical flow account for livestock products focuses on managed raising of livestock, the harvesting of meat from natural sources is not included, but it can be included when relevant by adding additional rows. The activity and its outputs would come under the hunting and trapping elements of the agriculture industry, including cases in which animals are hunted professionally for fur or skin, which should be included in the production of livestock products. In cases in which animals are hunted for other reasons, for example, on a safari, the activity should be considered a recreational activity in the economic context of supply and use.

3.89. In terms of extensions to the livestock product accounts, a distinction can be made between extensive and intensive livestock production in a country if both production types are significant for a particular livestock type.

3.5 Asset account for livestock

3.5.1 Measurement scope and purpose

3.90. The asset account for livestock shows the total number of livestock, by type of animal, and changes in the number of livestock over an accounting period. The information can be used to better understand the carrying capacity of agricultural areas with respect to livestock, for example, the number of cattle per hectare, and to estimate the potential output of livestock products and the associated environmental impacts.

3.91. The scope of the asset account is cultivated livestock – animals bred and managed as a process of production by economic units. Cultivated livestock will usually provide most of the livestock products of economic interest, and will tend to be most relevant in assessing environmental impacts.

3.92. All animals of each type are included, regardless of age, sex or use. The asset account should, therefore, provide a complete report of livestock increases from breeding and imports, and decreases resulting from slaughter, natural deaths and exports.

3.93. For the monetary asset account for livestock, the scope for the physical account has been adopted. Livestock are considered cultivated biological resources in the SNA and the SEEA Central Framework. The accounting entries concerning those resources are discussed specifically in the 2008 SNA, paragraphs 10.88 to 10.96. These treatments are adopted in the in SEEA AFF. Livestock may be treated as either fixed assets or work in progress, depending on their use in production. Livestock as fixed assets are those used as breeding stock and those used to produce outputs over a period of time, such as milk from dairy cows, wool from sheep. Livestock as work in progress includes animals raised for slaughter.

3.5.2 Accounting entries

3.94. The asset account for livestock is shown in table 3.4. The opening and closing stock of each type of livestock and additions and reductions over an accounting period are recorded in the account. In all cases, the opening stock plus additions less reductions must equal the closing stock.

Table 3.4

Asset account for livestock (number of livestock)

	Opening stock	Additions to stock				Reductions in stock				Net change in Stock	Closing stock
		Growth in livestock	Imports of stock	Other additions to stock	Total additions	Livestock processed / slaughtered	Exports of stock	Other reductions in stock	Total reductions		
Type of livestock											
Cattle and buffalo	17 164 914	3 426 766	469 000		3 895 766	2 079 000		477 650	2 556 650	1 339 116	18 504 030
Sheep	15 717 000	5 903 305	5 903 305		11 806 610	976 000		1 340 660	2 316 660	9 489 950	25 206 950
Goats	17 862 000	17 862 000	6 546 423		24 408 423	1 897 000		1 716 538	3 613 538	20 794 885	38 656 885
Total Sheep and goats	33 579 000	23 765 305	12 449 728		36 215 033	2 873 000		3 057 198	5 930 198	30 284 835	63 863 835
Pigs	7 904 000	4 953 437			4 953 437	1 948 000	261 000	1 107 350	3 316 350	1 637 087	9 541 087
Chickens	2 088 498 000	248 917 418	69 000		248 986 418	236 871 000			236 871 000	12 115 418	2 100 613 418
Ducks	55 593 000	17 600 000			17 600 000	41 942 000		6 575 935	48 517 935	- 30 917 935	24 675 065
Geese										24 675 065	24 675 065
Turkeys										-	
Pigeon and other birds	16 564 000										16 564 000
Total poultry and birds	2 160 655 000	266 517 418	69 000		266 586 418	278 813 000		6 575 935	285 388 935	- 18 802 517	2 166 527 548

3.95. The "opening stock" entry is the total number of live animals held at the beginning of the accounting period. Live animals are divided by type; many animal types may be included, depending on their significance for a country. Some examples are horses, camels, bees and silk worms..

3.96. The following are details of the "additions to stock" entry in the SEEA AFF:

- "Growth in livestock numbers" reflects births less normal losses of stock that do not reach maturity (e.g. calves that die shortly after birth). Normal losses of stock that reach maturity (e.g. mature livestock that die because of disease) are assumed to be slaughtered and processed, and are included in reductions in stock (see below). Normal losses are those that might reasonably be expected based on past experience. Normal losses do not include one-off, large-scale losses because of, for example, extended drought or widespread disease. Such large-scale losses should be included under "other reductions in stock".
- Growth in livestock = closing stock + exports of stock + livestock processed + other reductions in stock – opening stock – imports of stock – other additions to stock.
- Imports of stock includes all live animals imported into national boundaries during the year.
- Other additions to stock records all other additions to stock, such as through the domestication of wild animals and upward reappraisals in stock estimates.

3.97. The following are details of the "reductions in stock" entry, in the SEEA AFF:

- "Livestock processed/slaughtered" are all animals of indigenous and foreign origin slaughtered in-country; all data are expressed in number of animals.
- "Livestock to the rest of the world" includes all live animals exported from a country during the stock year.
- "Other reductions in stock" are all other reductions such as losses caused by drought or disease and downward reappraisals in stock estimates.

3.98. In the "net change in stock" entry, net change is the difference between the closing stock and opening stock.

3.99. The "closing stock" entry shows the number of livestock available at the end of the accounting period. The closing stock of one accounting period constitutes the opening stock of the following period.

3.100. The monetary asset account for livestock has the same structure as for the physical account except for an additional column, which is incorporated to record revaluations of assets – i.e. changes in the value of the stock of livestock over the accounting period that are due solely to changes in the prices of the assets. The generic asset account in monetary terms, including revaluations is presented in SEEA Central Framework table 5.3.

3.5.3 Measurement issues and possible extensions

3.101. Ideally, a distinction is made between livestock raised for different purposes – cattle for meat or milk, for example, or sheep for meat or wool – to clarify the link between various livestock products and the underlying asset base. This purpose-based approach to measuring livestock numbers is also relevant in distinguishing between the national accounts variables of gross fixed capital formation of livestock and work-in-progress. It may be necessary to adopt conventions for showing the purposes for which particular types of livestock are used.

3.102. A related extension is to identify the numbers of livestock used for breeding, which constitute another type of livestock asset. Information on the age distribution of livestock types may also be relevant, especially if it is not stable over time, as this may be an indicator of risks relating to future livestock production.

3.103. To align with possible extensions to the set of livestock products, it may be relevant to incorporate information on the stock of animals supporting illegal activity and changes in the stock of wild animals. A distinction between the numbers of livestock in an intensive and extensive farming system may also be useful.

3.6 Physical flow account for wood forestry products

3.6.1 Measurement scope and purpose

3.104. In the physical flow account for wood forestry products, the supply and use of forestry products in physical terms are recorded, with a view to distinguishing the activities of harvesting timber from the activity of processing raw timber and manufacturing wood products (FAO, 1982). In line with the general scope of the SEEA AFF accounts, the coverage of this account should include all production of forestry products, including non-wood forest products (Sorrenti, 2017), irrespective of the industry classification of the economic unit carrying out the activity.

3.105. Conceptually, under the SEEA AFF, the analysis is expanded to cover forestry products other than wood that are derived from economic activities classified under ISIC A023, "Gathering of non-wood forest products", such as resins and gums, mushrooms, honey and edible insects. However, the current structure of this table is not readily applicable to the recording of non-wood forestry products. In particular, this is because wood and non-food forest products are commonly reported in different measurement units (i.e. volumes versus weights). In that regard, a monetary flow account for forestry products would represent a more meaningful development of the accounting framework.

3.106. The physical flow account for wood forestry products applies specific focus to ISIC division 02, forestry and logging, group 021 (forestry) and group 022 (logging). In line with the SEEA CF in which timber resources are not managed or cultivated – for example if growth is the result of a natural process outside the production boundary – no output is recorded against ISIC group 021 and the only physical flows recorded relate to the logging and removal of roundwood.

3.107. In cases in which timber resources are not managed or cultivated – for example, if growth is the result of a natural process outside the production boundary – no output is recorded against ISIC group 021 and the only physical flows recorded relate to the logging and removal of roundwood.

3.108. The physical flow accounts should cover all production of roundwood in a country, including the output by households for their own final consumption. This can include the output sourced, all relevant land use, not only land used for forest but also land for small-scale farms, crop plantations, such as orchards, and urban tree management. Where possible, this output should be included in the accounts, especially to recognize the increasing use of this wood as a source of bioenergy. In practice, the initial accounting can focus on timber and other forestry products sourced from land used for forestry, i.e. a country's forest land or other wooded land, and included as the primary output of a logging activity (ISIC groups 021 and 022).

3.109. The SEEA AFF physical flow account does not track the flows involved in the manufacture and distribution of wood products, such as furniture, paper and pulp, nor timber used in construction. Such connections could be made by extending the product and industry scope of the physical flow account. However, because the SEEA AFF is intended to focus on the activities of the agriculture, forestry and fisheries industries and the connection to the environment of those activities, such extensions along the supply chain are not considered.

3.110. The recording of flows in monetary terms should be compiled consistently with the requirements of the SNA. Discussion and references are provided in section 2.2.

3.6.2 Accounting entries

3.111. A physical flow account for wood forestry products is shown in table 3.5. In it, the flows in physical terms of the products – net annual increment (relating to the output of ISIC group 021), and roundwood, including industrial roundwood and wood fuel –corresponding to the outputs of ISIC group 022, are recorded. For each product, total supply equals total use.

Table 3.5

Physical flow account for wood forestry products (cubic metres)

	Output			Total output	Imports	Total supply
	Forestry activity (ISIC 021)	Logging activity (ISIC 022)	Other industries (ISIC 023, 024)			
		Total				
Product						
Net annual increment	51 317 336			51 317 336		51 317 336
Gross fellings		50 809 243				
Felling residues (not removed)		5 443 000				
Removals (over bark)		45 366 243	5 443 000			
Bark		2 160 297	2 595 564	4 755 861		21 883 812
Removals (under bark)		43 205 946	2 847 436			
Roundwood (under bark)		43 205 946	2 847 436	46 053 382	1 320 725	47 374 107
of which Industrial roundwood						
-Sawlogs and veneer logs			3 759 542	3 759 542	344 250	4 103 792
-Pulpwood, round andsplit		35 362 000		35 362 000		35 362 000
-Other industrial roundwood		5 565 000		5 565 000		5 565 000
wood fuel		44 210 621		44 210 621		44 210 621
Other goods (non-wood forest products)						

Physical use table for timber products

	Intermediate consumption			Household final consumption		Changes in inventories	Exports	Total use
	Logging industry	Manufacturing industry	Generation of energy products (including charcoal)	Energy	Other uses			
Product								
Net annual increment	45 366 243					5 441		45 371 684
Bark		21 883 812						21 883 812
Roundwood (under bark)		42 252 359	158 814	294 580	1 820 917	2 847 437		47 374 107
of which: industrial roundwood								
-Sawlogs and veneer logs		3 899 454					204 338	4 103 792
-Pulpwood, round and split		35 362 000						35 362 000
-Other industrial roundwood		3 000 000	664 000	300 000	900 000	701 000		5 565 000
wood fuel			43 000 000	508 621			702 000	44 210 621
Other goods (non-wood forest prducts)								

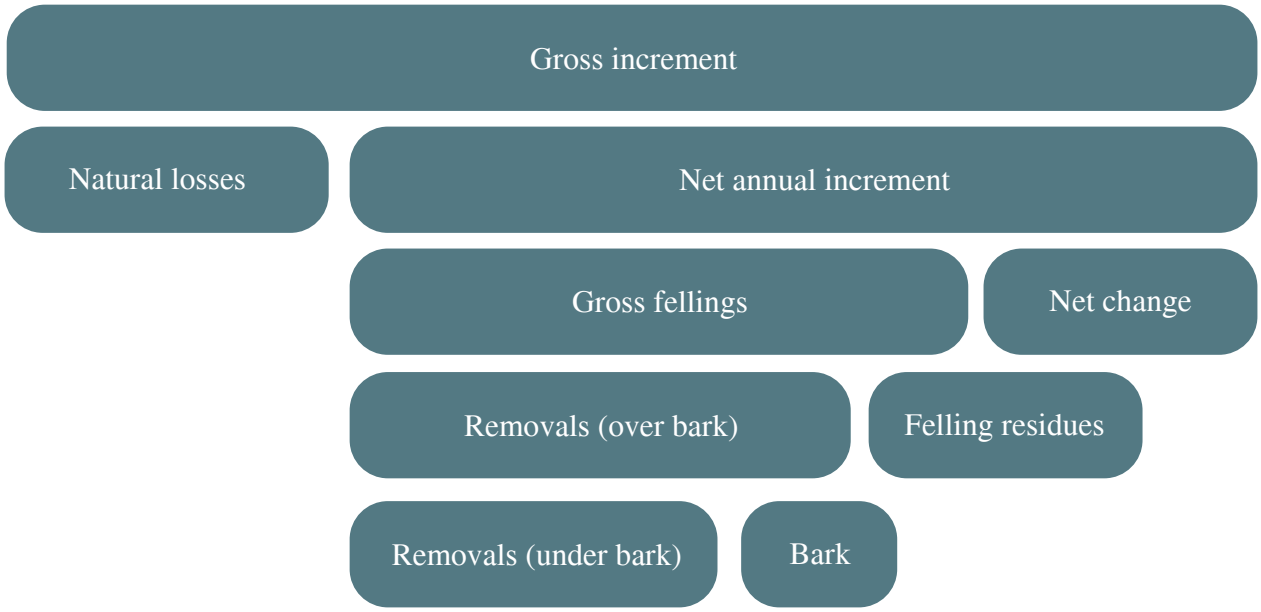
Supply table entries

3.112. The explanation of the scope of the physical flow accounts in the previous sections highlights the intricacies of describing the supply side for forestry activity. Figure 3 illustrates the sequence of flows that are the focus of the SEEA AFF. Using the terminology in that figure, the output of forestry activity (ISIC group 021), the net annual increment is equal to the gross annual increment less natural losses.

3.113. Importantly, the scope of this output measure only applies in cases in which timber resources are actively managed and hence the estimated output will exclude the net increment associated with natural timber resources and the net increment of those timber resources managed by economic units whose primary activity is not ISIC group 021. The total net annual increment of a country's timber resources is recorded in the asset account for timber resources (table 3.6).

Figure 2

Forestry concepts



Source: Adapted from Päivinen*, et al* (1999).

3.114. Gross fellings is comprised of the total volumes of trees, living or dead, that are felled. It includes the output of the logging activity (i.e the production of roundwood) and felling residues (harvesting waste).

3.115. The output of logging activity (ISIC group 022) is measured in terms of removals, equal to the volume of timber removed from forest land, other wooded land and other land during the accounting period. Felling residues reflect the difference between removals and gross fellings, which is generally comprised of the volume of timber found to be rotten, damaged or undersized at the time of felling. The volume of gross fellings and removals may also be different because of the time of recording. For example, timber is felled in one accounting period, but is not removed until a later accounting period.

3.116. Standard practice for international reporting[3] is to record removals excluding, or "under", bark, and hence the volume of removals is estimated by deducting an estimate of the volume of bark. However, for supply and use recording purposes, a complete accounting for the total volume of timber required, basically the table, includes rows for removals both over and under bark and a row for the

[3]Following the FAO/Eurostat/OECD/ITTO Joint Forest Sector Questionnaire

bark itself (as bark that is removed can be used for various purposes, including, for, among others, fuel or mulch. It is noted that removals also include removals of felling residues, roots, stumps and burls.

3.117. Roundwood measured under bark is a key production statistic and can be separated into two primary products – industrial roundwood and wood fuel (including wood for charcoal). It is possible to continue to incorporate additional wood products, such as logs and pulpwood. This extension to the supply chain is currently not included in the SEEA AFF.

3.118. Imports of roundwood include products imported for domestic consumption or processing, including imports for re-export. Excluded from the entry are in-transit shipments, which are recorded in cubic metres of solid volume. When estimates of imports are recorded in tonnes of dry matter, the volumes should be converted to cubic metres of timber using appropriate conversion factors.

Use table entries

3.119. The entry for "intermediate consumption – logging industry" relates to the use of the net annual increment from forestry activity as an input to logging activity.

3.120. The entry for "intermediate consumption – manufacturing industry" relates to use of the output of roundwood by timber-related manufacturing industries (primarily ISIC division 16, manufacture of wood and of products of wood and cork, expect furniture; and division 17, manufacture of paper and paper products), which encompasses the manufacture of wood and wood products, pulp and paper and paper products. The measure of intermediate consumption is equal to the volume of roundwood removed by the logging industry adjusted for imports and exports of roundwood.

3.121. Under intermediate consumption, in the "generation of energy products", the use of wood fuel or roundwood is recorded as a source of energy, including the production of wood for charcoal. The use of roundwood for the generation of wood pellets and other agglomerates used by households for energy is, however, excluded from this entry and recorded directly under "households final consumption – energy". Some production of energy from wood fuel will be ultimately used as an input to the activities of the forestry and forest-related manufacturing industries. Bark may also be a common input to the generation of energy by those industries. Own-account use of timber products to generate energy should be included in the physical flow account.

3.122. The entry for "household final consumption – energy" covers roundwood used for cooking, heating or power production. It includes (a) wood harvested from main stems and branches if harvested for fuel; (b) wood for charcoal production – in pit kilns and portable ovens for example; and (c) wood chips for fuel that are made directly – that is, in the forest. Those entries are reported in cubic metres of solid volume excluding bark. "Household final consumption –energy" includes raw timber used by households for energy and as primary wood products, such as wood pellets and other agglomerates, ultimately used by households for energy. Although those primary wood products are not a direct use of roundwood, it is considered to be a sufficiently direct flow to the household for it to be recorded as a final use of wood rather than of derived products, which remain excluded from the scope of the account. Quantities of primarily wood products directly consumed by households for energy should be recorded in the "wood fuel" row. Not included in this entry is non-wood energy products ultimately consumed by households that may be generated by other industries that use roundwood or wood fuel as energy sources, such as electricity, biogas and heat.

3.123. The entry for "household final consumption – other uses" includes all household non-energy uses of roundwood.

3.124. The entry for "changes in inventories" reflects the balance between net annual increment in timber resources and fellings resulting from logging activity. No change in inventory is recorded for roundwood because all timber removed is allocated to intermediate consumption, household consumption, gross fixed capital formation or exports.

3.125. The entry for "exports" covers exports of roundwood, including re-exports. It excludes in-transit shipments and is reported in cubic metres of solid volume. In cases in which estimates of exports are recorded in tonnes, those volumes should be converted to cubic metres of timber using appropriate conversion factors.

3.126. Note that not all entries in the supply table have a corresponding entry in the use table. In particular, the entries for gross fellings and removals are intended to support the recording of information on logging activity and place this information in an accounting context. The supply and use related to the output of logging activity is recorded in relation to roundwood and associated products.

3.6.3 Measurement issues and possible extensions

3.127. Depending on analytical requirements and the availability of data, the estimate of total output of roundwood can be broken down into production by species of tree, such as coniferous or broadleaf, or by forest type, such as plantation forest. An additional breakdown can separate plantation forests cultivated in short rotations for biofuel. In cases in which the purpose of cultivation is clear, outputs can be allocated to the relevant class of use. Breakdowns in production by forest type may be developed in alignment with asset accounts for forests and timber resources, as described in section 3.7.

3.128. A general challenge in measurement is the alignment of information on the source of the timber (e.g. from cultivated or natural forests, or agricultural land) with the total removals and production of roundwood. Not all roundwood may come from forests, although forests are the most significant source. To obtain a better understanding of the connections between forestry and logging activity and the underlying timber resources, it is, therefore, recommended that close attention be paid to the scope of the accounts compiled about timber products and the scope of the associated land use accounts for "forestry" and those for timber resources (section 3.7). Where significant quantities of timber products are sourced from land use areas other than forestry, the different sources of timber must be recorded to ensure consistency of measurement between data on the supply and use of timber products and the data on the stock of timber resources.

3.129. The focus in accounting for timber products is not intended to ignore the potential contribution of the activity of gathering non-wood forest products, which is part of the forestry industry, and is in the scope of SEEA AFF. When those products are significant or of policy interest, a separate physical flow account should be established.

3.7 Asset accounts for forestry and asset accounts for timber resources

3.7.1 Measurement scope and purpose

3.130. The assessment and analysis of forests and timber resources involves two complementary perspectives: the "asset account for forestry" records the area and changes in land used for forestry; and the "timber resources asset account" records the volume of marketable standing timber in terms of stock and changes in stock resulting, for example, from harvesting or natural growth.

3.131. As already noted for the physical flow accounts for forestry products (3.109), the scope of the timber resources asset account covers trees in all relevant land uses. Countries should, therefore, determine the scope of their timber resources accounts based on the relative importance of the types of areas that provide timber resources. In practice, initial accounting efforts could focus on trees in land used for forestry, i.e. trees in a country's forest land and other wooded land.

3.132. The relationship between the perspectives of the two accounts will vary over time and from country to country, depending on national land use definitions, relevance of timber resources outside of land used for forestry, the type of forest, the type of timber, planning and harvesting methods, and economic conditions.

3.133.

3.138. The entry for "opening stock" is the total area of land used for forestry, expressed in thousands of hectares, available at the beginning of the accounting period. The area is divided by forest type, as shown in the table; the definition of each type is consistent with the land use classification of the SEEA Central Framework (see annex I, section B "Classification of Land Use")

3.139. Regarding the entry for "additions and reductions in stock", there are various reasons for changes in the area used for forestry over an accounting period, particularly between different types of land use. The SEEA Central Framework distinguishes between managed and unmanaged expansion or reduction: "managed" refers to increases or decreases in the area resulting from human activity, whereas "unmanaged" refers to increases or decreases resulting from natural processes. An important change may also be the result of a reclassification in an area, for example between different types of forest (e.g., relative to land use change from primary forest to planted forest). Those changes should be recorded separately when information is available.

3.140. Where possible, the distinctions between additions and reductions in stock and between managed and unmanaged changes should be recorded. However, if the relevant data are not available, it may be necessary to record "net change in stock" only. In the absence of information on additions and reductions, "net change in stock" is the difference between closing stock and opening stock.

3.141. The entry for "closing stock" is the total area used for forestry expressed in thousands of hectares, available at the end of the accounting period. The closing stock of a given year constitutes the opening stock of the following year.

3.142. The physical asset account for timber resources is shown in table 3.7. The opening and closing stock of standing timber and changes in the stock caused, for example, by natural growth, removals, natural losses and catastrophic losses, are recorded. The timber resources asset account, shown below, includes timber resources available for wood supply and those not available for wood supply. In section 5.8.3 of the SEEA Central Framework, those different entries are explained in detail.

3.143. The stock of standing timber is defined as the volume of trees, living or dead, that can be used for timber or fuel. There are precise measurement conventions for estimating those volumes, but various assumptions are usually required when estimating timber volumes, for example the use of factors to convert forest land to timber volume.

3.144. The monetary asset account for timber resources follows the same structure as the physical accountm except an additional column is incorporated to record revaluations of assets, i.e. those changes in the value of the stock of timber resources over the accounting period that can only be attributed to changes in the prices of the assets. The generic asset account in monetary terms, including revaluations, is presented in the SEEA Central Framework, table 5.3.

Table 3.7

Physical asset account for timber resources (000 m3)

		Additions to stock			Reductions in stock							Closing stock
	Opening stock	Natural growth	Reclassi-fications	Total additions	Removals	Felling residues	Natural and catastrophic losses, and reclassifications	Natural losses	Catastrophic losses	Reclassi-fications	Total reductions	Net changes in stock	
Type of timber resource													
Java teak	118	4		4			1				1	3	121
Java jungle	506	11		11			1				1	10	516
Rimba Luar Jawa	4 009	21	36	58	47		297				344	- 286	3 723
Total	4 634	37	37	74	47		299				347	- 273	4 361

Note: Depending on data availability, it may be preferable to record natural growth net of natural losses. In such cases, the entry for natural losses is moved from a reduction in stock to a negative addition to stock.

3.7.3 Measurement issues and possible extensions

3.145. The measurement of the area of land used for forestry can be complicated because various concepts and definitions are used in different situations. In the SEEA AFF, the area of land used for forestry is defined in accordance with the SEEA Central Framework, annex I, which is a basis for measurement of the area of land use, not land cover. By applying the concept of land use, estimates of the area used for forestry can be integrated with estimates of land used for other purposes, particularly agriculture.

3.146. Focus needs to be placed on the possible differences in data collection between forestry, agriculture and other land uses to ensure consistency of the definitions across data sources. The relationship between land-use data and land-cover data for forests is an important area that needs to be investigated and reconciled.

3.147. In the physical asset account for timber resources, the distinction made between cultivated and natural timber resources the same way as what is done under the SNA and the SEEA Central Framework. For national accounting purposes, this distinction is important because it affects the recording of timber resources. As growth of natural timber resources is considered to be outside of the production boundary, those resources are classified as non-produced assets on the balance sheet. On the other hand, growth of cultivated timber resources is inside the production boundary, so the timber resources are classified as inventories or work-in-progress. Given the different asset types and the difference in the timing of recording of production, maintaining the distinction between those types of timber resources is useful.

3.148. Distinguishing between cultivated and natural timber resources is not a straightforward exercise, as the compiler must assess the degree of human management involved in growing the timber resources. The SEEA AFF is aligned with the SEEA Central Framework in not prescribing how to distinguish between these two categories (e.g. see SEEA CF paragraphs 5.353–5.357). In practice, in some cases, it may be useful to use the distinction between the SEEA land use subcategories of forest land, specifically between primary regenerated forest and planted forest, as a proxy to distinguish between natural and cultivated timber resources.

3.149. Regarding the physical flow accounts for forestry products, various alternative presentations may be relevant in the design of asset accounts for forests and timber resources. For forests, it may be useful to distinguish farm forests, industrial forests, public forests and protected areas within forests. In accounting for timber resources, it may be useful to distinguish between natural timber available for wood supply and not available for wood supply, as spelled out in the SEEA Central Framework. In addition, both asset accounts can be extended by integrating information by tree species or resources, in particular locations.

3.150. Another alternative presentation is to consider timber resources as a source of energy. In paragraph 5.372 of the SEEA Central Framework, it is noted that for analytical purposes, asset accounts for timber resources with a focus on use for energy, in particular as renewable sources of energy, can be constructed, based on the availability of data. In that regard, a particular focus may be on identifying short rotation forestry for bioenergy production.

3.151. Data on timber resources and forest areas are usually major components in national estimates of carbon stocks, and are important in the measurement of greenhouse gas emissions and emissions resulting from logging and deforestation. Factors reflecting the quantity of carbon per tonne or cubic metre of timber can be used to generate such estimates.

3.152. Consistent with the SEEA Central Framework, the physical asset accounts for forests and timber resources include all forests and timber regardless of whether those resources hold economic value, following the principles set out in the SNA. For many countries, this treatment raises no particular issues. However, for countries that have extensive forest areas with timber resources considered to be non-economic because they are, for example inaccessible, there may be a significant difference between the measured scope of the physical asset account and the scope that is relevant

for compilation of the national balance sheet in monetary terms. Consistent with the recommendation of the SEEA Central Framework in paragraph 5.347, the physical measures of forests and timber resources that do not have economic value should be clearly distinguished to support alignment and reconciliation in measurement with the SNA.

3.8 Physical flow account for fish and other aquatic products

3.8.1 Measurement scope and purpose

3.153. In the physical flow account for fish and other aquatic products, the total supply and use of all fish and aquatic products, including production from capture fisheries and aquaculture, is recorded. Total supply consists of domestic production and imports; total use covers intermediate use of fish products, final consumption by households, changes in inventories and exports.

3.154. The information is organized to support the integration of information with standard economic data and the comparison of information with other activities, such as those associated with agriculture and forestry. The supply-and-use structure facilitates comparisons of data on the production, trade and consumption of fish products.

3.155. The analysis of the consumption of fish products in the physical flow table can be extended to calorie and nutritional intake corresponding to household fish consumption. Linking that information, which is also available in food balance sheets, with economic and environmental variables can help to improve assessments of food security and sustainability issues.

3.156. The scope of the physical flow account is all fish and other aquatic products, as in the International Standard Statistical Classification of Fishery Commodities. (ISSCFC). To support the aggregated perspective of the SEEA AFF, groupings of fish products based on ISSCFC were created. There are 12 major groups listed below. These groupings of fish products may also be categorized by production process, i.e., aquaculture or capture fisheries, as follows.

- Freshwater fish
- Diadromous fish
- Demersal fish
- Tuna, bonito, billfish
- Other pelagic fish
- Other marine fish
- Crustaceans
- Cephalopods
- Other molluscs
- Aquatic mammals
- Other aquatic animals
- Aquatic plants, algae

3.157. The recording of flows in monetary terms should be compiled consistently with the requirements of the SNA.

3.8.2 Accounting entries

3.158. The physical flow account for fish and aquatic products is shown in table 3.8. It is divided into the supply table and the use table, with fish products grouped according to the categories listed above. For each product, total supply must equal total use.

3.159. Fish and aquatic products are measured in tonnes. Estimates of nominal catch – the core measure of production – should be in terms of live weight equivalent. For the purposes of balancing supply and use, all categories of use should also be recorded in live weight equivalent. It is important when deriving relevant conversion factors that the complete range of uses in accounted for. In particular, conversions should take into account the existence of post-harvest and post-catch losses. In some cases, losses and other waste may be converted into other products, such as dry fish meal. These are considered derivative products and are not included in the supply and use table.

3.160. For some aquatic products – marine mammals, for example – measurement in tonnes is not appropriate: data relating to them are collected using other measurement units, such as the number of individuals. When the products of such species are significant for a country, an appropriate measurement unit must be determined to balance estimates of supply and use.

3.161. No aggregates across products are proposed in table 3.8, even though some products can be aggregated to obtain total tonnages for groups of fish products. In view of the diversity of products in the table, no meaningful aggregate can be derived in tonnes. In some cases, aggregation involving different products may be possible in terms of nutritional values (e.g. calories, protein content).

Supply table entries

3.162. The "gross catch" entry includes the total live weight of fish caught. It should in theory include the weight of fish caught in illegal, unreported and unregulated (IUU) fishing activity, but in practice, this is difficult.

3.163. The "discarded catch" entry is the difference between the gross catch and the live weight of fish retained and landed by the fisheries unit – the nominal catch. In practice, the measurement of discarded catch is difficult and open to considerable error.

3.164. In recording output for "output – fisheries", a distinction is made between capture fisheries (ISIC group 031) and aquaculture (ISIC group 032). Capture fisheries can be defined as an activity leading to the harvesting of fish in a defined area, a broad concept covering all aspects of human fisheries activity, including economic, managerial, biological, environmental and technological viewpoints.

3.165. In the physical flow account for fishery, the nominal catch – fish landed converted to a live weight equivalent – is equal to the gross catch less discarded catch. The output measure should, in principle, include the retained catch from IUU activity.

Table 3.8

Physical flow account for fish and aquatic products (000 t)

Physical use table for for fish and aquatic products

		Output							
		Capture fisheries			Aquaculture			Other catch (incluidng household production)	Total output
		Gross catch	Discarded catch	Nominal catch	Harvest	Harvest loss	Nominal harvest		
Fish and other aquatic products									
Fish	Freshwater fish	3 062	43	3 019	4 036	57	3 979		6 998
	Diadromous fish								
	Demersal fish	1 152	16	1 135	71	1	70		1 205
	Pelagic fish, includingTunas, bonitos, billfishes	1 590	22	1 568	9		9		1 577
	Other pelagic fish	164	2	162					162
	Marine fish, other				599	8	591		591
Crustaceans		401		401	921	1	920		1 321
Molluscs	Cephalopods	188		188					188
	Other molluscs excl cephalopods								
Aquatic animals, other	Marine mammals								
	Reptiles								
	Other aquatic animals								
	Pearls, sponges and corals								
Aquatic plants, algae	Algae				10 748	200	10 548		10 548
	Macro plants								

Physical use table for for fish and aquatic products

		Intermediate consumption		Household final consumption			Changes in inventories		Exports			Total use
		Feed	Other uses	Food consumption	of which: food waste	Other uses	Post-harvest/catch losses	Other changes	Food use	Non-food use	Total Exports	
Fish and other aquatic products												
Fish	Freshwater fish	29	1 431	3 591	50	405	20	115			1 407	6 999
	Diadromous fish											
	Demersal fish	4	434	676		63		17			11	1 205
	Pelagic fish, including Tunas, bonitos, billfishes	5	428	668	0	62		4			411	1 577
	Other pelagic fish	1	58	90		11					2	162
	Marine fish, other	2	188	293		27		8			73	591
Crustaceans			267	687		45					322	1 321
Molluscs	Cephalopods			188							0	188
	Other molluscs excl cephalopods											
Aquatic animals, other	Marine mammals											
	Reptiles											
	Other aquatic animals											
	Pearls, sponges and corals											
Aquatic plants, algae	Algae		8 086	139				105			2 218	10 548
	Macro plants											

3.166. Regarding the "output – aquaculture" entry, in 1988, FAO introduced the following definition:

> "Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated. For statistical purposes, aquatic organisms which are harvested by an individual or corporate body which has owned them throughout their rearing period contribute to aquaculture, while aquatic organisms which are exploitable by the public as a common property resources, with or without appropriate licenses, are the harvest of fisheries. (FAO, 2008)"

This entry is the nominal harvest of fish from aquaculture facilities.

3.167. The entry for "output – other catch, (incl. household catch)" includes other fish production except for capture fisheries and aquaculture, for example household catch or recreational fishing.

3.168. The entry for "imports" reports total imports of fisheries commodities in live weight equivalent. A distinction is made between imports for food, which includes the categories whole-meat fish, filleted fish and processed fish and imports for non-food. The non-food categories are fodder, industrial use and other uses.

Use table entries

3.169. The entry for "intermediate consumption – feed" refers to the use of fish products as input to manufactured feeds, an important element of modern commercial aquaculture: in granule or pellet form, fish products provide nutrition in a stable and concentrated form, which enables the fish to feed efficiently and grow to their full potential. Many of the intensively farmed fish are carnivorous, including, among others. Atlantic salmon, trout, sea bass and turbot. In line with the emergence of modern aquaculture in the 1970s, fish meal and fish oil have become major components of feed for those species.

3.170. The entry for "intermediate consumption – other purposes" refers to all uses other than export, household final consumption and changes in inventories.

3.171. The entry for "household final consumption – food" refers to the total amount of fish and aquatic products consumed by households as food, whether purchased or otherwise obtained for a particular policy and analytical purposes, it may be relevant to measure household food waste – the amount of food discarded – separately.

3.172. The entry for "household final consumption – other uses" refers to the total amount of fish and aquatic products consumed by households for purposes other than food.

3.173. The entry for "changes in inventories – post-harvest losses" relates to losses in terms of the quantity of fish and fish products lost between the point of capture or harvest and the point of use.

3.174. The entry for "exports" covers the total exports of fisheries commodities in live weight equivalent, with a distinction between exports for food, which includes the categories of whole-meat fish, filleted fish and processed fish; and exports for non-food, which includes the categories of fodder, industrial use and other uses.

3.8.3 Measurement issues and possible extensions

3.175. Depending on analytical and policy requirements, information on the production of fish can be considered by individual fishery rather than by species. Focusing on individual species may miss the connections between species, which underpin the health of individual fisheries. A related extension can be made to distinguish supply and use data between fisheries in inland waters and marine fisheries.

3.176. A frequent measurement issue with capture fisheries is the treatment of fish caught in a country's exclusive economic zone by foreign vessels. Following standard national accounting conventions, such fish products are considered the production of the country in which the fishing vessel is resident (see SEEA Central Framework, paragraph 3.132). This is conceptually consistent with the treatment of production in the SNA as well as in measures of GDP and the balance of payments.

3.177. However, determining residence for fishing vessels may not be straightforward. A working assumption could be to assign residence to the country of the flag flown by the fishing vessel. This treatment underpins the collection of fish catch statistics data by FAO (Garibaldi, 2012). However, the country of the flag flown may not correspond to the country in which the operator of the fishing vessel is considered an economic resident. For accounting purposes, it is important to ensure that there is an alignment in treatment between the physical accounts and the monetary accounts and also between entries related to production and international trade. Where different treatments in determining residence are evident, appropriate adjustments to ensure alignment should be adopted.

3.178. Another production boundary issue concerns recreational and sport fishing. Fish caught and consumed by recreational anglers are considered as production, and are within the scope of fisheries activity, akin to the treatment of subsistence fishery activity. A distinction is made, however, if households pay companies for sport fishing: such activities are recorded as recreational activities, and the catch is excluded from the scope of production used in the SEEA AFF. Nonetheless, in the asset account for fish and other aquatic resources (see section 4.9), the catch of fish by all means and for all purposes should be regarded as a reduction in stock.

3.9 Asset account for fish and other aquatic resources

3.9.1 Measurement purpose and scope

3.179. The decline in global fish stocks in recent decades and the corresponding rise in aquaculture facilities is well documented (see, for example, FAO, 2016). Measuring fish stocks and changes in stocks is challenging, but it should be a priority in view of the importance of understanding issues of sustainability.

3.180. The SEEA AFF follows the guidance provided in section 5.9 of the SEEA Central Framework that an asset account for a country's fish and other aquatic resources should cover stocks of aquaculture facilities and all resources in coastal and inland fisheries in its exclusive economic zone throughout their life cycles. Migrating fish and those that straddle the border of a country's exclusive economic zone are considered to belong to that country while inhabiting the zone.

3.181. Fish stocks on the high seas and fish stocks subject to international agreements on exploitation should be included in a country's estimate in accordance with the portion of access rights to the resources that belong to it. Estimates of fish and other aquatic resources should be compiled in line with legal frameworks for international fisheries management established under the United Nations Convention on the Law of the Sea.

3.182. A physical asset account for fish and other aquatic resources shows the total biomass of all species subject to harvesting or cultivation activity within a national boundary. The scope of harvesting includes commercial sea and freshwater operations and aquaculture, and subsistence and recreational harvesting of aquatic resources.

3.183. Asset accounts for fish and other aquatic resources can be compiled in monetary terms. A full discussion on the accounting entries and associated measurement options is presented in the SEEA Central Framework, section 5.9. From the perspective of the SNA, fish and other aquatic resources comprise both cultivated and non-cultivated biological resources. Relevant text concerning accounting entries is provided in the 2008 SNA, paragraphs 10.88–10.96; 10.182–10.183 and 13.51. Fish and other aquatic resources that are considered cultivated resources may be either fixed assets if they are considered breeding stock or as work in progress if they are being raised for harvest. The treatments of the SEEA Central Framework and the 2008 SNA are adopted in the SEEA AFF.

3.9.2 Accounting entries

3.184. A basic physical asset account for fish and other aquatic resources is presented in table 3.9, which shows the opening and closing stock of aquatic resources, and additions and reductions in stock resulting from natural growth, catches and other factors.

3.185. Section 5.9 of the SEEA Central Framework contains a discussion on the measurement of those stocks and flows. For cultivated aquatic resources – stocks as defined in section 3.9 – measurement of the opening and closing stocks and changes in stock should be relatively straightforward given that the stocks are managed and controlled. Challenges may arise when recording reclassifications of cultivated and natural fish stocks, for example when wild fish are introduced as breeding stock or when cultured seeds are released into the wild; escapes by fish from aquaculture facilities in river and marine environments can also occur. Unexpected large losses from disease or natural disasters should be recorded as catastrophic losses.

3.186. For natural fish and other aquatic resources, direct measurement of opening and closing stocks and elements of change in stocks usually cannot be observed or measured directly; an exception to this is the measurement of the harvest or gross catch. Accordingly, biological models and assumptions must be used to make estimates, but such estimates may not be fully robust (see section 5.9 of the SEEA Central Framework).

3.187. The monetary asset account for fish and aquatic resources has the same structure as for the physical account, with the exception that an additional column is incorporated to record revaluations of assets – i.e. changes in the value of the stock of fish and aquatic resources over the accounting period that can only be attributed to changes in the prices of the assets. The generic asset account in monetary terms, including revaluations, is presented in the SEEA Central Framework, table 5.3.

Table 3.9

Physical asset account for fish and aquatic resources (000 tonnes)

	Opening stock	Additions to stock			Reductions in stock					Net changes in stock	Closing stock
		Natural growth	Other additions	Total additions	Gross catch/harvest	Natural losses	Catastrophic losses	Other reductions	Total reductions		
Type of fish and aquatic resource											
Cultivated aquatic resources											
Breeding stock											
Inventories											
Small pelagics*	3 523	1 359		1 359	1 000				1 000	359	3 881
Big pelagics*	2 490	744		744	500				500	244	2 733
Demersal fish	2 317	1 000		1 000	300				300	700	3 017
Reef fish	977	500		500	600				600	- 100	877
Penaeif shrimp	327	200		200	180	40			220	- 20	307
Lobster	9		5	5	3				3	2	11
Blue swimming crab	44				1				1	- 1	43
3-spot swimming crab	49	15	2	17	6				6	11	60
Squid	197	200	26	226	139				139	87	284
Natural (wild) aquatic resources											

3.9.3 Measurement issues and possible extensions

3.188. In the view of the measurement challenges, compilation of a complete physical asset account for fish and other aquatic resources is most likely not possible under current circumstances. However, it may be possible to provide a more qualitative assessment of fish stocks by considering various biological and bioeconomic models and catch statistics to show whether species and fisheries are being underfished, fully fished or overfished.

3.189. In this vein, a common approach is to consider changes in the gross catch relative to fishing "effort" – labour, days at sea, size of vessel and fishing gear, for example. The catch per unit effort may be a good indicator of the change in stock size, assuming that population density and population size are correlated and that the catch per unit effort increases as population densities increase.

3.190. Another approach is to consider indicators of the condition of marine and inland water ecosystems with a view to understanding the state of fish and other aquatic resources. For inland waters, useful information about the surface area of lakes and wetlands may be obtained from land-cover accounts. For marine environments, indicators, such as the mean trophic index and the Ocean Health Index, may be used.

3.191. More research and development is needed to establish practical methods for deriving internationally comparable estimates to populate a physical asset account for fish and other aquatic resources.

3.192. Finally, the assessment of the conditions to support fishing activity would be supported by taking into account information on water resources. Ideally, measures of the changing stock and quality of water resources would provide important information. This may include, for example, indicators of changes in river flow. At this stage, such measures are likely to be available only on an ad hoc basis for specific locations.

3.193. More generally available may be measures of the area of inland waters, including rivers and wetlands. In principle, such measures are included within the scope of the land use and land cover accounts of the SEEA Central Framework, which are also incorporated in SEEA AFF. Countries are encouraged to develop the inland waters components of those land accounts. Of particular relevance may be an assessment of changing seasonal patterns of the area of rivers and wetlands that can provide important habitats for the breeding cycle of certain fish stocks.

3.10 Base accounts for economic data for the SEEA AFF

3.10.1 Measurement purpose and scope

3.194. In section 2.3, the types of economic data relevant to SEEA AFF are introduced. Two considerations are relevant: recording the supply and use of agricultural products in monetary terms and recording extended production and income accounts for agriculture, forestry and fisheries activities and, potentially, products. In this section, those two base accounts and the common data sources and methods are described.

3.195. Table 3.10 shows a monetary supply and use account for agriculture, forestry and fisheries products. It follows the general structure of the SNA monetary supply and use account, with agriculture, forestry and fisheries products in the rows and standard components of total supply and total use in the columns. For each row, total supply – output plus imports – must equal total use in terms of intermediate consumption, final consumption, gross fixed capital formation, changes in inventories and exports. Note that a column for government final consumption is not included, as the purchase of agricultural products by general government units will form part of their intermediate consumption as inputs to the production of government services.

3.196. As the data are in monetary terms, a basis for valuing or pricing the products must be considered. The treatment of taxes and subsidies is relevant in this document. In line with the SNA concepts, total output of the producer is measured in basic prices, including the value of subsidies received on a product. Total use and its components are measured at purchasers' prices in which taxes and margins are added to the basic price and subsidies are deducted. Subsidies on products are included in the output valued at basic prices as received by the producing economic unit, but are not paid by the economic unit purchasing the product; instead, subsidies on products are transfers from the government to the producer. In table 3.10**,** other subsidies on products are recorded as a component of output valued at basic prices; and subsidies on imports are recorded as a component of imports valued at basic prices. As a whole, total supply is valued at basic prices. Additional columns compared to the physical flow accounts are included in table 3.10. to record those entries.

3.197. Another aspect of subsidies in agriculture, forestry and fisheries is that they are often provided in relation to outputs and inputs of the activities. Subsidies on fuel costs, for example, reduces the price of the input for the producer and consequently affect economic decisions. Subsidy arrangements and similar schemes are discussed in, for example, the OECD Agricultural Policy Monitoring and Evaluation (OECD, 2014). They are not considered any further in this document. The organization of information in the SEEA AFF may support analysis of those issues, and the base accounts can be extended to incorporate additional data.

3.198. The scope of products considered in table 3.10 are all output of a given product whether produced by units whose principal activity is agriculture, forestry and fisheries or the output is the secondary production from other units. This scope is intended to ensure alignment between the monetary supply and use account and the scope of the physical flow accounts for agriculture, forestry and fisheries products.

3.199. An alternative scoping of table 3.10 entails including only products produced by units classified to agriculture, forestry and fisheries, i.e. covering their non-agricultural, forestry and fisheries products. This may include cases of vertical integration where units produce raw products and also manufactured outputs (e.g. raw milk and cheese; grapes and wine); and also unrelated products, such as agritourism-related outputs. In the SEEA AFF, this perspective is presented in table 3.11 in which the total output and associated income for all agriculture, forestry and fisheries units is included in the scope, albeit not at the level of individual products. If a more complete product description is required, then analysts should consider using input-output tables and related data sources.

3.200. A description of the relevant accounting entries in monetary terms is not provided in the SEEA AFF. Compilers, instead, are referred to the relevant sections of the SNA and chapter 2 of the SEEA Central Framework. Of particular relevance are the sections on valuation concepts and prices (the 2008 SNA, paragraphs 6.49–6.69 and the SEEA Central Framework, section 2.7.3); and the discussion of the measurement of output of agriculture, forestry and fisheries in the 2008 SNA, sections 6.136–6.138 on recording output; and sections 10.88–10.96 on recording capital formation on cultivated biological resources.

3.201. Table 3.10 provides information to link production to measures of final demand and, in conjunction with physical flow account information for the same products, offers insights into the effects of price changes. In theory, those data should be available from standard national input-output or supply-and-use tables, but the information in those tables may be more aggregated than in table 3.11. Additional information is, needed for compilation. The information compiled for an account, such as in table 3.11**,** will also be relevant to input-output tables and supply-and-use tables. Accordingly, cooperation between the compilers is recommended. The compilation of physical flow accounts concurrently with monetary information is also likely to be useful.

3.202. Table 3.11 shows an extended production and income account for agricultural, forestry and fisheries activities. It is based on the standard SNA production account and extended to incorporate other information, to give a complete production function. A number of options exist for the level of presentation in table 3.11, including, among them, a product perspective, an activity perspective

and a process perspective. In theory, a production function exists at the finest level of detail of product and process, but there may be challenges in compiling such a view because inputs related to, for example, management and financing, may only be relevant at the overall business level. Where a single business produces more than one product or uses more than one process, the allocation of inputs may be difficult.

3.203. Given these considerations and the aim of the SEEA AFF to support comparison across agriculture, forestry and fisheries, an activity perspective based on ISIC classes is used to construct table 3.11. Depending on the data available and the types of data allocation – for example using micro-level information – a detailed account describing product and process levels can be constructed, at least for some variables. To ensure alignment with the total output and incomes for all units considered as part of those activities, a range of support and service activities classified in ISIC section A must also be included.

Table 3.10

Monetary supply and use table for agricultural, forestry and fisheries products (currency units)

	Monetary supply table for agricultural, forestry and fisheries products							Monetary use table for agricultural, forestry and fisheries products					
	Output		Imports	Trade and transport margins	Taxes on products	Less subsidies on products	Total supply at purchasers prices	Intermediate consumption	Household final consumption	Gross fixed capital formation	Changes in inventories	Exports	Total use at purchasers prices
	Agriculture, forestry andFisheries units	Non-Agriculture, Forestry and Fisheries units											
Agricultural products													
Crop products													
Maize	6 266		157	594	940	113	7 844	3 704	2 998	808	333	1	7 844
Rice	54 359		154	5 153	8 154	978	66 842	32 128	24 990	6 944	2 777	3	66 842
Wheat			3 628				3 628		3 265		363		3 628
Palm oil	17 775		2	1 685	2 666	320	21 808	10 836		2 324	- 9 864	18 512	21 808
Sugar	1 157		801	110	174	21	2 220	677		148	- 1 372	2 767	2 220
Potatoes	923		32	88	138	17	1 164	625 086		118	- 624 043	3	1 164
Fodder													
Other crops	34 111		5 053	3 234	5 116	613	46 901	26 523	11 784	4 432	1 309	2 853	46 901
Total	114 591		9 827	10 863	17 188	2 062	150 407	698 954	43 037	14 774	- 630 497	24 139	150 407
Livestock products													
Livestock raising	14 285		56	1 354	2 143	257	17 581	8 444	6 566	1 841	730		17 581
Eggs	7 076		13	671	1 061	127	8 694	4 182	3 239	912	360		8 694
Raw milk	742		16	70	111	13	926	439	349	95	39	4	926
Honey	1		4				5	135			- 132	2	5
Other livestock products	784		1	74	118	14	963	464	356	101	40	2	963
Total	22 888		91	2 169	3 433	412	28 169	13 664	10 510	2 950	1 037	8	28 169
Other agricultural products													
Total agriculture	137 479		9 918	13 032	20 621	2 474	178 576	712 618	53 547	17 724	- 629 460	24 147	178 576
Forestry products													
Forestry													
Logging	28 104		124	2 664	4 216	505	34 603	16 609	12 826	3 624	1 425	119	34 603
Other forestry products													
Total forestry	28 104		124	2 664	4 216	505	34 603	16 609	12 826	3 624	1 425	119	34 603
Fisheries products													
Aquaculture	11 913			1 129	1 786	214	14 615	7 039	5 436	1 535	604		14 615
Capture fisheries	15 159			1 437	2 274	273	18 597	8 960	6 915	1 954	768		18 597
Total fisheries	27 072		10	2 556	4 061	487	33 212	15 999	12 350	3 489	1 372	2	33 212

Table 3.11

Extended production and income account for agricultural, forestry and fisheries activities (currency units)

	Output	Intermediate consumption					Gross value added	Compensation of employees	Gross operating surplus and gross mixed income	Gross fixed capital formation	Changes in inventories	Consumption of fixed capital (depreciation)	Employment (000 people)
		Water	Energy	Fertilizer	Other	Total							
Agriculture	(1)			(-2)			(3) = (1) - (2)	(4)	(5) = (3) - (4)	(6)		(7)	(8)
Cropping	114 591	20 317	10 158	13 545	23 703	67 723	46 868	3 281	43 587	14 772	4 377	13 401	31 377
Animal produciton	22 887	4 058	2 029		7 439	13 526	9 361	655	8 706	2 951	1 168	2 726	6 049
Mixed farming													
Support activities to agriculture													
Hunting and trapping													
Total agriculture	137 478	24 375	12 187	13 545	31 143	81 249	56 229	3 936	52 293	17 723	5 545	16 127	37 426
Forestry and logging													
Forestry													
Logging	28 104	4 983	2 491		9 135	16 609	11 494	805	10 690	3 624	1 425	3 407	57
Gathering non-wood forest products													
Support services to forestry													
Total Forestry and Logging	28 104	4 983	2 491		9 135	16 609	11 494	805	10 690	3 624	1 425	3 407	57
Fisheries													
Fishing - marine	3 032	538	269		985	1 792	1 240	87	1 153	390	168	363	654
Fishing - freshwater	12 127	2 150	1 075		3 942	7 167	4 960	347	4 613	1 562	600	1 363	2 676
Aquaculture - brackish*	7 848	2 087	696		1 855	4 638	3 210	225	2 985	1 011	400	909	1 724
Aquaculture - marine	15	3	1		5	9	6		6	2	4	23	
Aquaculture - freshwater	4 050	1 077	479		838	2 394	1 657	116	1 541	522	200	477	892
Total fisheries	27 072	5 855	2 520		179	8 553	11 073	775	10 298	3 487	992	11 449	5 946
Total agriculture, forestry and fisheries	192 654	34 158	17 079	13 545	49 078	113 859	78 796	5 516	73 280	24 836	7 962	22 714	43 429
Total economy	2 477 915	438 713	219 356	14 544	789 763	1 462 376	1 015 539	71 088	944 451	320 093	39 811	292 143	119 256

3.204. The starting point for populating this account is the standard input-output and supply and use tables, which provide core information on production and incomes for types of agricultural activities, such as cropping, livestock, forestry and fisheries. Data from that source must be reconciled with economy-wide information on industry that relates directly to macroeconomic measures of economic activity to put the data in context and indicate relative importance.

3.205. If a finer level of detail is required, other relevant information sources must include agricultural, forestry and fisheries surveys, and physical data on inputs to industrial and agricultural production. Among those sources, cost-of-production surveys that collect details of input structures for products and processes are of particular interest.

3.206. Apart from ensuring alignment between the scope of the cost information and the definitions of costs relevant for national accounts purposes, the main challenge in using those data is to establish a method for scaling cost-of-production data to the national level, rather than reflecting case studies of particular farms. This is where the accounting framework and the "outside – in" approach can be most useful in compiling information for policy analysis at the country level.

3.10.2 Measurement issues and possible extensions

3.207. The structures proposed above bring together a basic level of monetary data, which can be linked to the data in other parts of the SEEA AFF framework. Many possible extensions can be made, depending on the focus for analysis.

3.208. One extension could be to focus on capital formation and investment. In the category of gross fixed capital formation, for example, identification of expenditure on machinery, equipment, research and development might be relevant insofar as it pertains to agricultural, forestry and fisheries activities. An extension to consider the stock and changes in stock of supporting infrastructure, such as roads, rail and port facilities, may also be of interest.

3.209. Given the dependence of agriculture, forestry and fisheries activities on resources including land, soil, timber fish and water, data might be gathered on payments for access to these resources, for example in terms of payments for licences, permits quotas and, rights. The relevant information varies, depending on the resource and the management arrangements in place. An introduction to the relevant accounting entries is provided in the SEEA Central Framework, section 4.4.5 and specifically in relation to timber and fish resources in sections 5.8 and 5.9.

3.210. Building further on the dependence on natural resources, information on expenditure concerning landscape restoration, environmental protection and resource management may be relevant for analysis. Such types of investment are relevant in the consideration of linkages between the environment and the economy, and the relevant accounts can be extended accordingly where data are available, building on the economy-wide discussion of the recording of these expenditures described in the SEEA Central Framework, chapter 4.

3.211. Considerably more detail regarding the cost of production may be compiled to expand the "intermediate consumption" entry. For example, an extension can highlight the relative significance of inputs, such as energy, materials, fertilizers, pesticides and labour.

3.212. The level of detail may also be expanded by incorporating information on the size and characteristics of economic units involved in agriculture, forestry and fisheries. Information on income by type of activity, for example, can be cross-classified by size of economic unit in terms of employment or production, or by the proportion of output exported. Incorporating such information would assist in understanding differences between economic units, and hence the effect of policies. In that regard, understanding subsidies paid by type of economic unit is of particular interest.

3.213. Given that the information in the tables above is sourced from input-output tables, it is possible to relate the information to the input-output tables themselves and hence make connections between agriculture, forestry and fisheries activities and the supply chains they support in food, textiles and materials. Those upstream activities are not the focus of the SEEA AFF, but clear portrayal of the links between primary industries and the environment they depend on may help secondary and tertiary industries to understand more clearly the risks associated with their supply chains.

3.214. A final area of extension noted here is the potential to develop a more complete sequence of accounts going beyond the extended production and income account presented in table 3.11. Additional accounts may include distribution and use of income accounts, capital accounts, financial accounts and balance sheets. The full sequence of accounts is described in the SNA and in the SEEA Central Framework, chapter 6, which has a particular focus on the recording of depletion. This type of extension has some commonality with the intentions of the Economic accounts for agriculture (FAO, 1996). A difficulty with this extension is that the compilation perspective must shift from a production or industry-based perspective to an economic ownership/institutional sector perspective. Such a shift is possible, but relevant assumptions concerning the relationship between these two perspectives need to be further explained in order to correctly identify the appropriate sequence of accounts required.

Chapter 4 Accounting for environmental assets, primary natural inputs and residual flows

4.1 Introduction

4.1. This chapter contains a description of the SEEA AFF base accounts, setting out for each one: (a) its purpose and scope and links to other components; (b) the definition of accounting entries, accounting treatments and relevant classifications; and (c) areas of possible extension.

4.2. The accounting principles and treatments of the SNA and the SEEA Central Framework apply throughout. They should be referred to for any interpretation of accounting matters. The national accounting treatments in the European Economic Accounts for Agriculture and Forestry (EUROSTAT, 2000) should also help in determining the treatment of individual products and practices in agriculture and forestry.

4.2 Physical flow and asset accounts for water resources

4.2.1 Measurement purpose and scope

4.3. All agricultural, forestry and fisheries activities depend on water quantity and quality. At the national level, in particular for large countries, differences in the availability of water between regions may not be apparent. Accordingly, it is highly relevant to compile information on water in relation to individual water catchments. In addition, seasonal variations in water availability may be a constraining factor as such subannual data on water availability are useful. Activities at the start of a water catchment can have regional and international repercussions because they are likely to affect activities downstream. There may be associated competition for water, for example, for economic activities, including the production of energy, manufacturing and human consumption. Water also plays an important role in ensuring the delivery of environmental services (e.g. wildlife habitat) and support different in situ activities, such as recreational fishing and transportation.

4.4. Maintaining a coherent set of national data on water resources and their links to economic activities and environmental outcomes is critical to address the challenges highlighted above, especially in the light of increasing pressures on water availability in many areas. It is recognized that data may not be currently available in all countries to cover all the relevant dimensions on the supply and use of water resources.

4.5. One approach to developing such a set of information is the accounting framework in the SEEA-Water in which information on water is organized according to the guidelines in the SEEA Central Framework. The accounts for stocks and flows of water resources in SEEA AFF include extensions of those documents, together with the 2012 International Recommendations for Water Statistics. In addition, in the SEEA AFF, there is a specific focus on rainfed and irrigated crop production.

4.6. There are two types of SEEA-Water accounts – physical flow accounts for water and water asset accounts. In physical flow accounts, the following are recorded: water flows into the economy from the environment; flows between economic units in the economy, including waste water; and returns to the environment (including both surface water and groundwater). In water asset accounts, the stocks of water resources, primarily surface water and groundwater, and changes in the stocks from flows, such as abstraction, precipitation and evaporation, are recorded. Both of these accounts are adapted for the purposes of the SEEA AFF.

4.7. The aim of the SEEA AFF is to assess the use of water in the production of such items as rice and wheat, and the sustainability of use given the available water resources. The use of water should include the effects of different approaches to the production of agricultural, forestry and fisheries products: for example, the information on water in the SEEA AFF relates to irrigation and to attempts to place irrigated agriculture in a broader context.

4.8. Focusing solely on water use in agriculture, forestry and fisheries is insufficient because such use must be considered in reporting the use and availability of water in general. The SEEA AFF tables, therefore, cover the entirety of water resources and water use in a country, while providing additional details pertaining to agricultural, forestry and fisheries activities.

4.9. The SEEA AFF accounts for water resources support the assessment of water yield and the availability of water, aspects of water stress and water efficiency and productivity. As noted above, often it will be necessary to compile information at a river basin level, to more effectively inform policy and analysis. Also, as far as possible, seasonal effects should be considered – possibly through the measurement of some variables on a monthly basis – e.g. precipitation and abstraction.

4.10. In line with the SEEA Central Framework and the SEEA-Water, the SEEA AFF water accounts cover stocks and flows of water without regard to water quality. Work on environmental-economic accounting for water quality, for example in chapter VII of SEEA-Water, is not sufficiently advanced to be incorporated into the SEEA AFF at this stage.

4.11. The valuation of water resources is considered an ongoing item on the research agenda for SEEA. The flows of water into and from the economy described in the accounts below are recorded in physical terms, generally cubic metres. Transactions in water within the economy, such as the purchase of water from water supply companies, are recorded in the standard national accounts. Relevant transactions can be included in the monetary accounts of SEEA AFF. For the valuation of stocks of water resources, the relevant measurement issues are described in the SEEA Central Framework, Section 5.11.4. To date, no asset account in monetary terms has been described in the SEEA Central Framework.

4.2.2 Accounting entries – physical flow account

4.12. Table 4.1 mirrors the physical flow account for water presented in the SEEA Central Framework. The differences relate only to the reduction of industry level detail for non-agricultural, forestry and fisheries industries and the inclusion of additional detail on crops and livestock. Although not shown in the table, the columns for crops and livestock can be further disaggregated to highlight key products within those categories. The extent of disaggregation carried out should be based on the relative importance of different activities and products within a country and the needs of users.

4.13. Given the strong parallels to the recording of the physical flow accounts in the SEEA Central Framework and the SEEA-Water, no additional explanation of the general definitions of the accounting entries are provided in this document. However, there are some specific issues on the recording of flows of water for agriculture, forestry and fisheries that are highlighted in the following paragraphs.

Table 4.1

Physical flow account for water (cubic metres)

Physical supply table for water

	Abstraction of water; production of water; generation of return flows							Flows from the rest of the world		
	Agriculture, forestry and fishing	Mining and quarring, manufacturing and construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Other industries	Households	Imports	Flows from the environment	Total supply
(I)Sources of abstracted water										
Inland water resources										
Surface water									440.6	440.6
Groundwater									476.3	476.3
Soil water									50	50
Total									966.9	966.9
Other water sources										
Precipitation									101	101
Sea water									101.1	101.1
Total									202.1	202.1
Total supply abstracted water									1 169.0	1 169.0
(II) Abstracted water										
For distribution				378.2						378.2
For own use	108.4	114.6	404.2	13.9	100.1	2.3				743.5
(III) Wastewater and reused water										
Wastewater										
Wastewater to treatment	17.9	117.6	5.6	1.4		49.1	235.5			427.1
Own treatment										
Reused water produced										
For distribution					42.7					42.7
For own use		10								10
Total	17.9	127.6	5.6	1.4	42.7	49.1	235.5			479.8

	Abstraction of water; production of water; generation of return flows							Flows from the rest of the world		
	Agriculture, forestry and fishing	Mining and quarring, manufacturing and construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Other industries	Households	Imports	Flows from the environment	Total supply
(IV) Return flows of water										
To inland water resources										
Surface water			300		52.5	0.2	0.5			353.2
Groundwater	65	23.5		47.3	175	0.5	4.1			315.4
Soil water										
Total	65	23.5	300	47.3	227.5	0.7	4.6			668.6
To other sources		5.9	100		256.3		0.2			362.4
To return flows	65	29.4	400	47.3	483.8	0.7	4.8			1031
of which: losses in distribution				47.3						47.3
(V) Evaporation of abstracted water, transpiration and water incorporated into products										
Evaporation of abstracted water	29.5	38.3	2.5	1.8	0.7	3.6	10			86.4
Traspiration	40.2	1.2								41.4
Water incorporated into products	6.5	3.7								10.2
Total supply	267.5	314.8	812.3	442.6	627.3	55.7	250.3		1169	3 940

Physical use table for water

	Abstraction of water; intermediate consumption; return flows						Final consumption	Flows to the rest of the world			Total use
	Agriculture, forestry and fishing	Mining and quarring, manufacturing and construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Other industries	Households	Accumulation	Exports	Flows to the environment	
(I) Sources of abstracted water											
Inland water resources											
Surface water	55.3	79.7	301	4.5	0.1						440.6
Groundwater	3.1	34.8	3.2	432.9		2.3					476.3
Soil water	50										50
Total	108.4	114.6	304.2	437.4	0.1	2.3					966.9
Other water sources											
Precipitation				1	100						101
Sea water			100	1.1							101.1
Total	0	0	100	2.1	100						202.1
Total use abstracted water	108.4	114.6	404.2	439.5	100.1	2.3					1169
(II) Abstracted water											
Distributed water	38.7	45	3.9			51.1	239.5		0		378.2
Own use	108.4	114.6	404.2	3.1	100.1	2.3	10.8				743.5
(III) Wastewater and reused water											
Wastewater											
Wastewater received from other units					427.1						427.1
Own treatment											
Reused water											
Distributed reuse	2	40.7									42.7
Own use	10										10
Total	12	40.7			427.1						479.8

	Abstraction of water; intermediate consumption; return flows						Final consumption		Flows to the rest of the world		
	Agriculture, forestry and fishing	Mining and quarring, manufacturing and construction	Electricity, gas, steam and air conditioning supply	Water collection, treatment and supply	Sewerage	Other industries	Households	Accumulation	Exports	Flows to the environment	Total use
(IV) Return flows of water											
Return flows of water to the environment											
To inland water										668.6	668.6
To other sources										362.4	362.4
To return flows										1031	1031
of which: losses in distribution											
(V) Evaporation of abstracted water, transpiration and water incorporated into products											
Evaporation of abstracted Water										86.4	86.4
Transpiration										41.4	41.4
Water incorporated into products								10.2			10.2
Total use	267.5	314.8	812.3	442.6	627.3	55.7	250.3	10.2		1158.8	3 940

4.14. The physical flow account is separated into two tables, a supply table and a use table. Both tables have five main sections of data to enable tracking of the relevant flows of water from the environment to the economy (section I), within the economy (sections II, III and IV) and from the economy to the environment (section V).

4.15. In the first section (I) total supply and use of water from the environment by type of source are recorded. The entries relating to abstraction of water from inland water resources, namely surface water, groundwater and soil water. The initial focus should be on recording information on abstraction from surface water and groundwater resources, for example for irrigation, for livestock or for aquaculture, and on abstraction of soil water by crops. Water is also abstracted from the environment through direct collection of it from precipitation into storage tanks, and through desalination of seawater. Those, and other sources of water are included to provide a full picture of water entering the economy.

4.16. The entries in the second section (II) indicate whether the water abstracted from the environment is distributed to other economic units or retained for own-use. Abstraction for own-use is a common situation for agriculture, forestry and fisheries activities.

4.17. The last three sections (III, IV and V) of the table concern flows of water that follow the initial use of abstracted water. There are three possibilities: (a) the water is collected as wastewater before either being reused or returned to the environment, usually following treatment – recorded in section III; (b) the water is returned directly to the environment – return flows, which are recorded in section IV; or (c) the water evaporates, transpires through plants or is embodied in products, recorded in section V. A detailed explanation of each of the flows is provided in the SEEA Central Framework and the SEEA-Water.

4.18. In some countries, the reuse of water, with or without treatment, may be an important part of agricultural processes. The physical flow account provides for the reuse of water to be recorded, in terms of its generation and its use. It is noted that in cases in which water is returned to surface water after use, e.g. to a river, and then further downstream the "same" water is abstracted for use, the flows should be recorded in gross terms to enable appropriate understanding of the total volume of water abstracted for agricultural purposes. The analytical aggregate of final water use (commonly known as water consumption) can be determined after recording all of the relevant accounting entries.

4.19. Abstraction of soil water refers to the uptake of water by plants and is equal to the amount of water transpired by plants plus the amount of water that is embodied in the harvested product (SEEA Central Framework, paragraph 3.198). In the SEEA AFF, soil water is included in principle within scope, as its inclusion supports an assessment of the changing dynamic between rainfed and irrigated agriculture and allows for a more complete picture on the use and availability of water resources.

4.20. In practice, measuring the physical flows and stocks of soil water are difficult to do, as they can exhibit high variability over time and space within an accounting period and within the accounting boundary. One solution to overcome such problems is to use hydrology models, which are widely used in agricultural and ecological research, through consultation and engagement with experts in those fields.

4.21. As a simplification and alternative to the measurement of soul water, the compiler of the SEEA AFF may choose to focus on recording the main inputs and outputs affecting soil moisture over an accounting period (i.e. precipitation and irrigation water as input, and actual evapotranspiration and runoff as output). Such an approach may be relevant, in particular in relation to recording water flows and stocks associated with rainfed and irrigated agriculture. While such input and output variables may still require some modelling, they are far easier to estimate than soil water variables.

4.22. In fact, in terms of assessing consumptive water use by agricultural crops (defined as the balance between actual evapotranspiration and precipitation minus runoff), neither accounting for soil water dynamics nor actual evapotranspiration may be relevant. Specifically, for rainfed agriculture, consumptive water use is by definition zero over one or more accounting periods. For irrigated agriculture, consumptive water use is equal to irrigation water.

4.2.3 Accounting entries – asset accounts

4.23. In the asset account for water resources, the opening and closing stocks of assets and changes in stocks over an accounting period are recorded. This structure may be difficult to apply for water resources, because water is in constant motion and assessment of the functioning of the water cycle is usually of primary interest. Ideally, therefore, stocks of water resources should be measured at the river basin level to provide the most useful information to understand the availability of water and such issues as water stress. The asset account for water resources is shown in table 4.2.

Table 4.2
Asset account for water resources (cubic metres)

	Surface water				Groundwater	TOTAL
	Lakes	Rivers and streams	Artificial reservoirs	Glaciers, snow and ice		
Opening stock of inland water resources	2 700	5 000	1 500	0	100 000	109 200
Additions to stock from the environment						
Precipitation	246	50	124			420
Inflow from other territories		17 650				17 650
Inflows from other inland water resources	339	2 487	1 054		437	4 317
Other addtions to stock						
Return flows from economy		53	300		315	668
Total	585	20 240	1 478	0	752	23 055
Reductions in stock from the environment						
Evapotranspiration	215	54	80			349
Outflows to other territories		9 430			87	9 517
Outflows to the sea		10 000				10 000
Outflows to other inland water resources	100	1 343	1 000			2 443
Other reductions in stock						
Abstraction by economic units						1 169
Total	315	20 827	1 080	0	87	23 478
Net change in stock of water resources	270	- 587	398		665	- 423
Closing stock of inland water resources	2 970	4 413	1 898		100 665	108 777

4.24. Regarding the opening and closing stocks, the scope of the asset account for water resources is limited to inland water resources – artificial reservoirs, lakes, rivers and groundwater.

4.25. The entries for additions and reductions to the stock of inland water resources reflect all flows of water that add to the opening stock of water resources. These entries are detailed in the SEEA Central Framework, section 5.11.

4.26. Where opening and closing stocks cannot be measured reliably, the measurement of the net change in the stock of water over an accounting period may be derived, provided each component series can be measured directly. The net change in stock can be interpreted as a measure of the water yield. Furthermore, following the previous discussions on physical water flows in paragraphs 4.22 and 4.23, in practice, and as a first approximation, soil water stocks can be assumed to be unchanged over one or more accounting periods.

4.2.4 Measurement issues and potential extensions

4.27. Various measurement issues should be considered in accounting for water resources. This section includes a review of some of them; in documents, such as the SEEA-Water and the International Recommendations for Water Statistics, these issues are discussed in greater depth.

4.28. First, although the accounts described above are applicable at the national level, ideally, information should be recorded, and accounts should be compiled at the catchment or river basin level. The aim of working at this level of detail is to focus on water resources that are most used in terms of water abstraction relative to the resources available. Compilation at the national level can mask significant variations between water catchments.

4.29. Second, water accounts should be compiled on a regular basis, ideally at least annually, in particular in catchments where pressure on water resources is high. Depending on rates of change in abstraction for industry or domestic consumption, water resources may become stressed more quickly than would be indicated based on long-term averages. In many cases, subannual measurement of some variables can be considered with a view to accounting for seasonal variations in water availability.

4.30. The information in this document does not directly deal with the question of the overall sustainability of water resources in terms of the extent to which water is available to support economic and human activity. The following factors may help to organize information relevant to this issue.

4.31. First, assessment of sustainability for a given basin or country requires consideration of abstraction and other water-related activities of all industries and sectors, not only agriculture, forestry and fisheries. Focus on a narrow set of water users may misrepresent the pressures on water use. This is why the water accounts in the SEEA AFF are economy-wide in scope. At the same time, because agriculture is a significant user of water in many areas, consideration of use for agricultural activities is an important point.

4.32. Second, understanding how water is used in different activities is likely to be important. In line with the SEEA Central Framework, water abstraction includes quantities of water used for particular activities and immediately returned to the environment. Some examples of this are hydropower generation, in which the final water use – abstractions less returns, commonly called water consumption – is small, but a large stock of water is required, and aquaculture in which water requirements vary depending on the species of fish and the intensity of production.

4.33. A number of indicators are relevant for assessing water resources, depending on the question to be answered. In some cases the focus will be the total quantity of water abstracted; in others, it will be on final water use.

4.34. Third, the water accounts in this section relate to quantities of water only. A complete assessment of water resources requires consideration of water quality and changes in water quality, especially quality may change, for example within a river catchment, and may be closely related to the sustainability of the water resources and their potential use.

4.35. Of particular relevance to agricultural, forestry and fisheries activities is the effects they may have on water quality, for example through residual flows of fertilizers and pesticides. Those flows can have serious consequences, for example in the creation of "dead zones" in coastal areas near river mouths. The negative consequences of reductions in water quality for other economic activities, such as fisheries, may also be of interest.

4.36. The SEEA AFF does not cover accounting for and measurement of water quality. Readers can refer to chapter VII of the SEEA Water for more detail, and to section 4.51 of the SEEA AFF for a discussion on flows of fertilizers and pesticides to the environment.

4.37. The SEEA AFF does not include a detailed discussion on the treatment and definition of wastewater and reuse of water, but in some situations, it may help in establishing the pattern of water use by agricultural, forestry and fisheries activities. Water abstracted by a landholder and returned to a river before reabstraction by another user is not considered as reuse. Instead, it is classified as a return of the water to the environment. Many water-harvesting schemes and techniques exist in which multiple uses of water occur before final return to the environment. In such cases, recording and understanding the reuse of water may be relevant. The definition and appropriate recording of wastewater and reused water can be found in the SEEA Central Framework and the SEEA-Water.

4.38. In assessing the overall use of water resources by agricultural activities, the allocation of water use by type of agricultural product may not be required. Where the availability of water is constrained, however, information as to which products – usually crops – are using the largest amounts of water may be relevant in determining responses. In the SEEA AFF Central Framework, it is also possible to link detailed water-use data with related production information, and hence to assess the relative importance of water for particular crops and production approaches.

4.3 Physical flow account for energy use

4.3.1 Measurement purpose and scope

4.39. In the physical flow account for energy use, the direct use of energy is recorded, expressed in joules, by agricultural, forestry and fisheries activities and selected agricultural, forestry and fisheries products. Energy may be used in the form of coal, electricity, petrol and diesel fuels, biofuels, heat, solar power and wind power. Although all of those energy products may be used directly, often they are converted to electricity before being used by economic units. The focus of the physical flow accounts is recording energy products in the form used directly by the agricultural, forestry or fisheries unit.

4.40. In their complete form, energy flows in physical units are recorded in physical flow accounts for energy from the environment into the economy – energy from natural inputs; within the economy – energy products back to the environment – energy residuals. Details are given in section 3.4 of the SEEA Central Framework.

4.41. The physical flow accounts for energy are currently restricted to flows of energy used in agriculture, forestry and fisheries. Ideally, those data would be complemented by figures for the production of energy by the agriculture, forestry and fisheries sector, sources of energy used by those activities and other users,

4.42. In line with the SEEA Central Framework, the measure of energy use includes the consumption of energy produced on own-account by an agricultural, forestry or fisheries unit. Production of this energy directly competes with energy purchased from outside sources. Accordingly, they must be included to support a complete understanding of energy use and the changing structure of supply.

4.3.2 Accounting entries

4.43. The physical flow account for energy use is shown in table 4.3. In the first column, the total supply of energy products will be recorded by type, which are described below. The "transformation of energy products" row relates to the use of energy products, such as coal, to produce other energy products, such as electricity. Because the table focus is on the use of energy by agricultural, forestry and fisheries activities and the transformation of energy products is not a primary activity of those units, there is no expansion of this aspect of energy use.

4.44. Most of the columns relate to the use of energy as an input to agriculture, forestry and fisheries activities, where possible by type of product. Various data sources are required to compile data at that level of detail. Energy use by other industry groups, such as manufacturing and electricity, households, and exports of energy products, are recorded in order to establish an economy-wide context for energy use.

4.45. The tracking of energy flows into and through the economy must reflect the fact that the original source – coal or hydropower for electricity, for example – may be transformed before final use in the economy. In the use table for energy products, there must be a distinction between, energy products used directly by final consumers and energy products used by transforming industries to generate new energy products that are then consumed. Not all energy products are used for energy purposes – oil-based products are used to produce plastic, for example. Consequently, it is relevant to distinguish different types of end use for products that are primarily considered to be for energy purposes.

4.46. The energy products in the use table are classified according to the Standard International Energy Product Classification (SIEC), which was developed in the preparation of the International Recommendations for Energy Statistics (United Nations, 2011) adopted by the United Nations Statistical Commission at its forty-second session, held in February 2011. SIEC is expected to guide the collection and compilation of energy statistics at national and international levels to enhance international comparability and the integration of energy statistics with other statistical domains.

- Coal (SIEC code 0) includes hard coal (SIEC code 01).
- Peat and peat products (SIEC code 1) include peat (SIEC code 11), peat and peat products (SIEC code 12) and other peat products (SIEC code 129).
- Gas (SIEC code 3) includes natural gas, liquid natural gas and biogas.
- Oil (SIEC code 4) includes gasoline, liquefied petroleum gas, gas-diesel and residual fuel oil in fisheries.
- Biofuel (SIEC code 5) includes modern biofuel, which is generated with modern technology and is highly efficient, and traditional biofuel, which is generated using traditional technology and has low efficiency.
- Waste energy (SIEC code 6) is energy produced by converting solid waste into an energy product.
- Electricity (SIEC code 7) describes the amount of electricity, expressed in terajoules, used in agriculture.
- Heat (SIEC code 8) is energy diffused among the particles in a substance or system by means of the kinetic energy of the particles.
- Nuclear fuels and other fuel (SIEC code 9) provide energy through the splitting of the nucleus of an atom – fission – or combining two atoms into a single atom – fusion.

Table 4.3

Physical flow account for energy use (terajoule)

	TOTAL SUPPLY	Agriculture, forestry, fisheries												Other industries	Households	Changes in invetories	Exports	TOTAL USE
		Agriculture									Total agriculture	Total forestry	Total fisheries					
		Coconut	Coffe	Rice	Maize	Palm oil	Soybean	Other crops	Total crops	Livestock								
USE OF ENERGY	22 319 270	1	6	163	304	1 754	1	3 988	6 216	317	6 533	3 056	9 048	9 477 547		1 350 723	11 472 362	22 319 269
Tranformation of energy products	5 844 241													5 844 241				5 844 241
End-use of energy products	16 475 029	1	6	163	304	1 754	1	3 988	6 216	317	6 535	3 056	9 048	3 633 306		1 350 721	11 472 362	16 475 028
Coal	10 280 742													325 021		66 415	9 889 305	10 280 741
Hard coal	10 220 514													320 885		10 325	9 889 304	10 220 514
Peat and peat products	60 228													4 136		56 091	1	60 228
Gas	1 320 881													536 389		2 576	781 916	1 320 881
Natural Gas (including liquefied natural gas)	1 320 881													536 389		2 576	781 916	1 320 881
Biogas																		
Oil	3 398 117	1	6	163	240	1 459	1	3 661	5 530	135	5 666	2 619	8 367	1 841 508		802 969	736 988	3 398 117
Liquefied petroleum gas	342 029					7		14	21		21	1		36 021		301 716	4 270	342 029
Gas-diesel oil	546 563													441		- 30 271	576 393	546 563
Gasoline	49 795		1	10	3	1		30	46		46	2		28 779		- 4 253	25 221	49 795
Residual fuel oil	2 459 729	1	5	153	237	1 451	1	3 616	5 463	135	5 599	2 616	8 367	1 776 267		535 777	131 103	2 459 729
Biofuel	543 755													344 157		135 444	64 153	543 755
Waste																		
Electricity	931 534				64	295		327	686	182	869	437	681	586 230		343 318		931 534
Heat																		

bottom row of the table – and the mix of energy products at the level of all agriculture, forestry and fisheries and other industries. For this reason, the area of the table showing the use of individual energy products in agricultural products is shaded. It may be possible to develop such estimates using various assumptions and modelling techniques.

4.3.3 Measurement issues and possible extensions

4.48. The main issue concerning the measurement of energy in the SEEA AFF is the lack of articulation of stocks and flows related to the supply of energy. Two potential extensions are considered here.

4.49. First, it is likely to be relevant to organize information on the production of biomass that is subsequently used for the production of biofuels and other energy products, such as biogas. For example, certain types of maize can be grown specifically to produce biofuels. In other cases, the generation of energy products represents joint production: for example, the generation of energy from sugar cane. The production of biofuel is not necessarily an input to agricultural, forestry and fisheries activities, but information on the land and water used and emissions generated will be relevant in understanding the food-water-energy-climate nexus.

4.50. One solution to accommodate that demand could be an extension of the physical flow account for energy use described above. The SEEA AFF may in the future be extended in that way. At this stage, in cases in which there is interest in understanding the physical flows of biomass associated with the production of energy products, it is noted that relevant information is recorded in the physical flow accounts for crops and forestry products. In these accounts, the volume of biomass used in the generation of energy products is recorded. By using appropriate conversion factors, the estimates of volume may be converted to joules to support extended analysis.

4.51. Second, it may be of interest to understand the direct production of energy products by agriculture, forestry and fisheries units and the extent to which these energy products are sold to other units or used on own-account. For example, energy can be captured directly by solar panels or wind turbines located on agricultural properties. This may be an important source of income (for example, if electricity is sold to a national grid) but it can also be used in, for example, the abstraction of groundwater (e.g. using windmills). The production of energy products can also be in the form of fuels (e.g. wood fuel) to run machinery or generate electricity.

4.52. The inclusion of "of which" columns next to the columns for total energy use for each activity to record the quantity of energy sourced from own account production facilitates the analysis of the use of energy produced and used on own account. As a further step, income earned from the sale of energy products should be included in tables 3.10 and 3.11, as appropriate.

4.53. At the aggregate economic level, the SEEA-Energy and the SEEA Central Framework physical flow accounts for energy can be used to map the full range of energy sources with the uses of energy by different activities. Additional information may be required, however, to assess the extent to which the electricity consumed by agriculture, forestry and fisheries could be recorded by the original source – coal, nuclear, wind or solar; it should be noted that there would be no need for this extension to connect to energy use at the product level. If such mapping were carried out, the sustainability of energy supply in terms of the mix of renewable and non-renewable sources needs to be considered. It is not, however, the intention of SEEA AFF to develop extensions of this type because this area of work is covered by the SEEA-Energy.

4.54. Given the links between the measurement of energy use and estimates of greenhouse gas emissions by agriculture, forestry and fisheries, estimates of greenhouse gas emissions will depend on estimates of energy use.

4.4 Physical flow account for air emissions

4.4.1 Measurement purpose and scope

4.55. The measurement of anthropogenic greenhouse gas emissions has emerged in recent years as an important issue for agricultural, forestry and fisheries statistics. On the one hand, countries already report their emissions from agriculture, forestry and other land use through their national greenhouse gas emission inventories, following the guidelines of IPCC, to the United Nations Convention on Climate Change (UNFCCC). On the other, emissions from agriculture, forestry and fisheries may represent a significant proportion of total national emissions, especially in developing countries, making planning in those sectors critical for meeting national mitigation goals as set in nationally determined contributions under the Paris Agreement.

4.56. The physical flow account described in the SEEA AFF includes the air emissions account of the SEEA Central Framework by focusing on the greenhouse gas emissions from agriculture, forestry and fishing. Emissions are recorded across the three relevant subgroups of ISIC section A: crop and animal production, hunting and related service activities (ISIC A division 01); forestry and logging (ISIC A division 02); and fishing and aquaculture (ISIC A division 03).

4.57. Accordingly, the SEEA AFF account facilitates the analysis of mitigation actions associated with the national economy, for example, through the computation and use of relevant indicators. Specifically, national greenhouse gas emissions at the national level are linked to the production and flows of goods and services from ISIC A and other industries. The account makes it possible to derive consistent indicators for policy analysis, such as greenhouse gas emissions per unit of value added and per unit of output.

4.4.2 Accounting entries

4.58. The SEEA AFF physical flow account for air emissions is shown in table 4.4. The account structures information on the air emissions from agriculture, forestry and fisheries activities from the perspective on the diverse activities within agriculture and from a perspective of (b) selected agricultural, forestry and fishery products. The perspective on agricultural activities enables a correspondence mapping with the measurement and reporting processes of UNFCCC, following IPCC guidelines, as detailed in the section below. The perspective on products enables a link with production, trade, consumption and other environmental flows in the SEEA AFF Central Framework, with a view to facilitate the creation of useful indicators.

4.59. The initial focus should be on estimating total greenhouse gas emissions from agricultural, forestry and fisheries activities using the activity perspective, while considering a subset of selected products of national interest, namely the total across the columns for a single product. There is no requirement to collect data on the mix of products and activities directly, but it may be relevant to consider the link between activities and products when preparing aggregate estimates.

4.4.3 Correspondence to IPCC: system boundaries and classifications

4.60. The SEEA AFF account provides a mapping of the SEEA AFF to IPCC categories, in particular ISIC A to the Agriculture, Forestry and Other Land Use (AFOLU) sector of IPCC (table 4.4). This mapping is intended to facilitate the use of SEEA analyses in support of the UNFCCC process. It provides guidance to SEEA AFF compilers towards the estimation of greenhouse gas emissions from ISIC A activities by using the internationally established IPCC methodologies.

4.61. To that end, SEEA AFF compilers can use IPCC categories (IPCC, 2006) AFOLU to estimate ISIC A emissions, as follows:

4.62. ISIC A01 emissions can be estimated using IPCC categories agriculture —including synthetic fertilizers, rice cultivation, drainage of organic soils, crop residues, burning crop residues, enteric fermentation, manure management, manure applied to soils, or manure left on pasture; land Use—cropland, grassland; and Energy—for instance, fuel use for farm machinery.

4.63. ISIC A02 emissions can be estimated using IPCC categories land use: forest land; energy—for example, fuel used for logging machinery; and others. ISIC A03 emissions that are covered by the SEEA AFF but are not covered within IPCC AFOLU categories, can be estimated by linking to relevant IPCC categories in energy, for example, fuel use in fishing vessels or to operate refrigeration.

4.64. When using the mapping to IPCC and related national inventory data, compilers should keep in mind critical differences between the two accounting frameworks, as described below.

4.65. The SEEA AFF follows the residence principle, i.e., reports emissions from national economic activities regardless of where these activities occur. The IPCC follows the territorial principle, i.e. recording of emissions that are generated within the national territory, regardless of who is causing the emissions. In practice, these differences may result in significant accounting differences in emissions accounting for international shipping and transport activities. This may be relevant in small island States with significant fishing activities.

4.66. While the SEEA AFF account links the greenhouse gas emissions to relevant economic activities, the IPCC categories are focused on the underlying biophysical processes and on the type of greenhouse gas emissions. For example, emissions from the same ISIC A activity of crop cultivation may be recorded under IPCC in at least two categories, distinguishing between its carbon dioxide (CO2) and non-CO2 emissions.

4.67. In its Manual on Air Emission Accounts, EUROSTAT provides a comprehensive list of specific cases that facilitate understanding of the distinctions between the recording of emissions under the IPCC and the SEEA AFF. It should be noted however, that several IPCC AFOLU categories are excluded from the scope of EUROSTAT accounts, mostly on the basis of difficulties in estimation, rather than on conceptual grounds.

Table 4.4

Physical flow account for air emissions (gigagrams of carbon dioxide equivalent)

	ISIC A AGRICULTURE FORESTRY AND FISHING																	All Other ISIC	TOTAL
	ISIC A01 Crop and animal production, hunting and related service activities												ISIC A02 Forestry and logging			ISIC A03 Fishing and aquaculture		Total supply and use	Total Supply & Use	Total supply and use
	Correspondence mapping to IPCC/UNFCCC												Correspondence mapping to IPCC/UNFCCC			Correspondence mapping to IPCC/UNFCCC				
	Syntetic fertilizers	Rice cutivation	Drainange of organic soils	Crop residues	Burning crop residues	Enteric fermentation	Manure management	Manure applied to soil	Manure left on pasture	Cropland	Grassland	Energy	Other	Forest land	Energy	Other	Energy	Other			
Type of substance																					
Greenhouse gases																					
Carbon dioxide										291 910	11 923	4 000		300 000					607 833	566 083	1 173 91
Methane		70 098			812	22 234	2 826					9							95 979	179 431	275 41
Nitrous oxide	19 054		36 096	7 025	311		5 117	5 284	11 878			543							85 308	14 939	100 24
Total greenhouse gas in CO2eq	19 054	70 098	36 096	7 025	1 123	22 234	7 943	5 284	11 878	291 910	11 923	4 552		300 000					789 120	760 453	1 549 57
Other air pollutants																					
Dinitrogen oxide																					
Hydrofluorocarbons																					
Perfluorocarbons																					
Sulphur hexafluoride																					
Carbon monoxide																					
Non-methane volatile organic compounds																					
Sulphur dioxide																					
Ammonia																					
Heavy metals																					
Persistent organic pollutants																					
Particulates (including PM10 and dust)																					
Greenhouse gases: CO2eq by product																					
Crops primary																					
Cereals					2 204																
Pulses					70																
Fodder crops																					
Other crops					17																
Livestock																					
Cattle and buffaloes						16 623	649	1 415	3 920												
Sheep and goats						3 661	141	328	2 955												
Pigs						171	1 025	187													
Other livestock							934	3 071	4 501												
Gross fixed capital formation in land																					
Land transformation																					
Land conversion																					

4.4.4 Measurement issues and possible extensions

4.68. The following clarification pertains to the scope of greenhouse gas emissions in the SEEA AFF account. Both emissions and removals by ISIC A activities should be compiled in table 4.4, in line with the SEEA Central Framework, paragraph 3.243. The SEEA AFF includes the emissions and removals directly linked to an ISIC A activity, such as emissions from soil cultivation and land clearance or carbon sequestration in biomass and soils resulting from specific land management choices.

4.69. Following the generic implementation approach of the SEEA AFF discussed earlier in this document, i.e. in terms of adopting tiers of successive data complexity to aid compilation, it should be noted that the SEEA AFF air emissions accounts can be compiled at tier 1 using the IPCC default, or tier 1, methodology and coefficients. At that initial level of complexity, most land-based emissions can be reported on a net basis, namely, the net of emissions minus removals. Reporting using higher tiers may allow further separation of gross fluxes. In an economy-wide setting, however, net flux reporting is sufficient. Nonetheless, from a national accounts perspective, a gross basis permits more appropriate attribution of flows to specific activities of interest. As a practical step, the SEEA AFF compilers may consider indicating the tier level used for compiling.

4.70. Relevant data for compiling SEEA AFF accounts may be available from UNFCCC inventories and national reports. Reference tier 1 data consistent with table. 4.4 of the SEEA AFF are available from FAOSTAT, for all countries starting and 196.[4]

4.5 Physical flow accounts for fertilizers, nutrient flows and pesticides

4.5.1 Measurement purpose and scope: fertilizers and pesticides

4.71. Fertilizers and pesticides are frequently used to carry out agriculture, forestry and fisheries activities. It is important to quantify the flows of fertilizer and pesticide use because of the following: their relative cost in production; their potential effects on surrounding ecosystems; and it is not possible to accurately assess the merits of alternative production practices, such as organic farming system, without good measures of the intensity of chemical usage.

4.72. The use of an accounting approach for recording these flows facilitates comparisons of data on the use of fertilizers and pesticides with data on other measures of agriculture, forestry and fisheries activities, such as production, consumption and trade.

4.73. Data on inorganic fertilizers can be recorded in terms of product weight (in tonnes) or nutrient content, such as tonnes of active nutrients –- nitrogen, phosphate and potassium/potash, as defined by FAO. For consistency, data used in the physical flow account should be converted to a common nutrient basis in line with the FAO standard practice "nutrient principles". This will facilitate comparisons between countries and over time, and support coherence in measuring such variables as production, consumption, imports and exports.

4.74. It is widely recognized that organic fertilizers are important sources of nutrients and are needed to maintain long-term soil health. Organic fertilizers may also represent an important part of the overall functioning of rural systems as it is a source of energy for households and an input to agriculture. In theory, designing a supply and use table for the output of organic fertilizers, including own-account production, and their use in agriculture, forestry and fisheries is straightforward. The elements for various categories of organic fertilizer are shown in table 4.5. Internationally agreed methods for the estimation of the supply and use of organic fertilizers, such as manure, compost and crop residues, are well developed with respect to flows of nitrogen but are still under discussion with respect to phosphate and potassium/potash. Estimates of the relevant flows may emerge from the derivation of nutrient

[4] FAOSTAT emissions database, at http://www.fao.org/faostat/en/#data/GT and http://www.fao.org/faostat/en/#data/GL

budgets and also as part of the estimation of greenhouse emissions in section 4.4. Global data with country detail is available from FAOSTAT.[5]

4.75. Data on pesticides are available in terms of product weight and active ingredient content. Although there is no universal standard measurement for measuring the intensity of pesticide use, in SEEA, it is suggested to measure use in terms of active ingredients. One concern with this approach is that it does not account for the differing potencies of active ingredients or their differing environmental impacts.

4.76. The System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries measures the supply and use of fertilizers and pesticides by focusing on the balance of flows within the economy. This, however, ignores the effects on local and neighbouring environments in terms of soil, water and air quality. One approach for assessing these effects is to measure nutrient cycles; another is to develop measures of water quality and soil quality and monitor them over time. This area of measurement is still being developed from an accounting perspective and is connected to developments in ecosystem accounting.

4.5.2 Measurement purpose and scope: nutrient flows

4.77. To obtain a general picture of flows of nutrients and fertilizers, flows of nitrogen and phosphorous may be traced from extraction to the movement in and subsequent return to the environment. This is done to understand the factors affecting the relationship between agriculture and the environment, such as the sustainability of extracting nitrogen and phosphorus from the environment, in particular, nutrient levels in the soil relative to the application of nitrogen and phosphorus and flows of excess nitrogen and phosphorus to the environment, including to inland and coastal water systems and ammonia emissions to the atmosphere. A more complete assessment also requires an understanding of the method and timing of the application of nutrients and fertilizers, as this can have a substantial bearing on the potential environmental impacts.

4.78. An international programme of work on the measurement of nutrient budgets and balances led by the European Commission and OECD has measurement guidance on nutrient budgets (Kremer, 2013), setting out the concepts, sources and methods relevant to the measurement of nutrient flows. For the SEEA AFF, only a brief introduction to this guidance is required. Nutrient budgets cover flows of nitrogen and phosphorous in and across a defined boundary, such as a country, in a given time frame, typically a year. They also track stocks and changes in stocks of nitrogen and phosphorous within the boundary. The data cover the relevant media – water, air and soil – and relevant economic sectors.

4.79. The basis for measuring nutrient budgets is tracking the nitrogen and phosphorous cycles, including the processes of nitrogen fixation, mineralization and ammonification and the transformation of phosphorous in soils. Through consistent measurement of each part of those cycles, an overall indication of change can be obtained along with measures of surpluses or deficits of nitrogen and phosphorus.

4.80. Given the established framework for the measurement of nutrient budgets, no tables or additional advice is provided in the SEEA AFF. In that respect, nutrient budgets are a good example of physical flow accounting, as envisaged in the SEEA Central Framework. Countries should implement the methods described in the European Commission and OECD guidance: organizing data in the SEEA AFF base accounts will support the measurement process and may improve the coherence of estimates.

4.81. Where nutrient budgets are estimated, various measures of interest (e.g. gross nitrogen surplus, phosphorous surplus and ammonia emissions) can be incorporated into the SEEA AFF outputs, including into combined presentations.

[5] See FAOSTAT Fertilizers by Nutrient http://www.fao.org/faostat/en/#data/RFN and FAOSTAT Livestock Manure http://www.fao.org/faostat/en/#data/EMN.

4.5.3 Accounting entries for fertilizers

4.82. The physical flow account for fertilizers is shown in table 4.5. The supply and use of inorganic and organic fertilizers in terms of active nutrients are recorded for this account, which is divided into a supply table and a use table; total supply must equal total use.

Supply table entries

4.83. For inorganic fertilizers, the entry for "output" refers to the total quantity of synthetic fertilizer produced at the national level, expressed in tonnes of nutrient equivalent.

4.84. For organic fertilizers, flows related to nitrogen, phosphate and potassium/potash are recorded. Two types of supply are recognized. The first concerns the situation where nitrogen, phosphate and potassium/potash are effectively applied in situ as a result of agricultural and land management activity. Three cases are included in the table – urine and dung from grazing animals (nitrogen, phosphate and potassium/potash), crop residues (nitrogen only) and cases in which there is mineralization of nitrogen when carbon is lost as a result of land use change, such as through clearing forest land for grazing or cropping.

4.85. The second type of supply is organic fertilizer collected or manufactured (potentially as a by-product of other processes). The scope for this includes manure, compost, sewerage sludge and other organic sources, such as guano and rendering and brewery waste. The nitrogen, phosphate and potassium/potash content for collected manure is recorded in the output column. For the other sources, only the supply of nitrogen is shown in the table, but coverage could be extended to phosphate and potassium/potash, as required.

4.86. The entry for "imports" refers to the quantity of imported inorganic and organic fertilizers in tonnes of nutrient equivalent.

Table 4.5

Physical flow account for fertilizers (tonnes of nutrient equivalent)

				Intermediate consumption																Changes in inventories			
	Output	Imports	TOTAL SUPPLY	Maize	Rice	Wheat	Palm oil	Sugar	Potatoes	Other food crops	Non-food crops	Livestock grazing	Other agriculture	Total agriculture	Forestry	Fisheries	Other industries	Total	Household final consumption	Losses	Other changes	Exports	TOTAL USE
Inorganic fertilizers																							
Nitrogen fertilizers (N total nutrients)	3 838 526	359 593	4 198 120											2 977 967			494 117	3 472 084	232 341		138 858	354 837	4 198 120
Phostate fertilizers ($P_2 0_5$ total nutrients)	304 660	174 517	479 176											316 478	43 609		48	360 135	95 099		21 349	2 593	479 176
Potash fertilizers ($K_2 0$ total nutrients)	442 385	80 606	522 990											345 269	56 088		20	401 377	89 767		22 439	9 407	522 990
Organic fertilizers (N, P2O5, K2O)																							
In situ sources																							
Urine/dung from grazing animals																							
Nitrogen (N)																							
Phostate (P205)																							
Potash (K2O)																							
Crop residues (N)	1 177 262		1 177 262	230 950	931 812					14 500				1 177 262				1 177 262					1 177 262
Mineralization of N with loss of C during land use change (N)																							
Application of organic fertilizers																							
Collected manure																							
Nitrogen (N)	761 308		761 308											761 308				761 308					761 308
Phostate (P205)																							
Potash (K2O)																							
Compost (N)	909 423		909 423											909 423				909 423					909 423
Sewerage sludge (N)																							
Other (N)																							

Use table entries

4.87. The entry for "intermediate consumption" refers to "consumption in nutrients" – the total amount of organic and inorganic fertilizers, expressed in tonnes of nutrients, applied to soil to increase crop yield, or the total quantity of fertilizer consumed by a country for agriculture production. Information on the intermediate use of fertilizers should be allocated to key agricultural products, primarily crops, to show the intensity of fertilizer use by crop type. Consumption by other industries covers use by, for example, municipal parks and golf courses.

4.88. The entry for "household final consumption" refers to the total quantity of fertilizer products, expressed in nutrient equivalent, consumed by households for non-productive purposes. For inorganic fertilizers, this includes such activities as fertilizing gardens and lawns. For organic fertilizers, this covers garden use and also, in some countries, the use of manure as an energy source.

4.89. The entry for "changes in inventories – losses" refers to the quantity of fertilizer products, expressed in nutrient equivalent, lost during the year in storage and transport between production and final use. It does not include quantities applied to the soil that are not taken up by plants or residual flows to the environment.

4.90. The entry for "changes in inventories – other changes" comprises changes in inventories occurring during the reference period at all stages between production and retail – changes in stocks held by the government, manufacturers, farms, importers, exporters, wholesale and retail merchants and transport and storage enterprises. It excludes losses in inventories.

4.91. The entry for "exports" refers to the quantity of fertilizers in nutrient equivalent tonnes exported.

4.5.4 Accounting entries for pesticides

4.92. The physical flow account for pesticides is shown in table 4.6. The supply and use of pesticides in terms of active ingredients in eight pesticide groups, as defined by FAO, are recorded (see below). The account is divided into a supply table and a use table; total supply must equal total use.

Table 4.6

Physical flow account for pesticides (tonnes of active ingredients)

			Intermediate consumption													Household final consumption	Changes in inventories			
	Output	Imports	TOTAL SUPPLY	Maize	Rice	Wheat	Palm oil	Sugar	Potatoes	Other food crops	Non-food crops	Other agriculture	Total agriculture	Forestry	Fisheries	Other uses	Total		Losses	Other changes	Exports	TOTAL USE
Product																						
Insecticides																						
Mineral oils																						
Herbicides																						
Fungicides and bactericides																						
Seed Treatments, fungicides																						
Seed Treatment, insecticides																						
Plant growth regulators																						
Rododentices																						
Total																						

The eight FAO pesticide groups used to structure information for the supply and use table are outlined below. Other classifications of pesticides may also be appropriate.

i. Insecticides (FAO code 1309) – chlorinated hydrocarbons, organophosphates, carbamates-in secticides, pyrethroids, botanical and biological products and others (not classified elsewhere).

ii. Mineral oils (FAO code 1354).

iii. Herbicides (FAO code 1320) – phenoxy hormone products, triazines, amides, carbamates-herbicides, dinitroanilines, urea derivatives, sulfonyl ureas, bipiridils, uracil and others (not classified elsewhere).

iv. Fungicides and bactericides (FAO code 1331) – inorganics, dithiocarbamates, benzimidaz oles, triazoles, diazoles, diazines, morpholines and others (not classified elsewhere).

v. Seed treatments, fungicides (FAO code 1331) – dithiocarbamates, benzimidazoles, triazoles, diazoles, botanical and biological products and others (not classified elsewhere).

vi. Seed treatments, insecticides (FAO code 1353) – organo-phosphates, carbamates-insecticides, pyrethroids and others (not classified elsewhere).

vii. Plant growth regulators (FAO code 1356).

viii. Rodenticides (FAO code 1345) – anti-coagulants, cyanide generators, hypercalcaemics, narcotics and others (not classified elsewhere).

Supply table entries

4.93. The entry for "output" refers to the total quantity of pesticides produced at the national level expressed in tonnes of active ingredients.

4.94. The entry for "imports" refers to the quantity of pesticides products imported, in tonnes of active ingredients.

Use table entries

4.95. The entry for "intermediate consumption – agriculture industry" refers to the quantity of pesticide products, expressed in tonnes of active ingredients, consumed as inputs in agricultural production. Information on the intermediate use of pesticides should be allocated to key agricultural products, primarily crops to show the intensity of pesticide use by crop type.

4.96. The entry for "intermediate consumption – forestry" refers to quantities of pesticide products used in forestry, expressed in tonnes of active ingredients.

4.97. The entry for "intermediate consumption – fisheries" refers to quantities of pesticide products used in fisheries, expressed in tonnes of active ingredients.

4.98. The entry for "intermediate consumption – other uses" refers to quantities of pesticide products used in industries other than agriculture, forestry and fisheries, expressed in tonnes of active ingredients.

4.99. The entry for "household final consumption" refers to the total quantity of pesticide products, in tonnes of active ingredients, consumed by households during the reference period for non-productive purposes, such as treating garden plants.

4.100. The entry for "changes in inventories – losses" refers to the quantity of pesticide products, in tonnes of active ingredients, lost in storage and transport during the year from the point of production to final use. It excludes residual flows of pesticides to the environment after application.

4.101. The entry for "changes in inventories – other changes" comprises changes in inventories during the reference period from production to retail – changes in stocks held by the government, manufacturers, farms, importers, exporters, wholesalers, retailers and transport and storage enterprises. It excludes losses in inventories.

4.102. The entry for "exports refers to quantities of pesticides products, in tonnes of active ingredients, exported.

4.103. It must be noted that the current accounting structure for pesticides are reflected under fertilizer. However, data availability of these two agricultural inputs may be different. Regarding pesticides, their use in agriculture, imports and exports are available in FAOSTAT and may support a tier 1 compilation of the account.

4.5.5 Measurement issues and possible extensions

4.104. Most of the issues related to accounting for fertilizers and pesticides are discussed in previous sections. A few additional points are made in this one. Some important sources of organic fertilizers have been included in the base account for fertilizers. Additional sources that may be of interest are, among others, lime and biochar. There may also be interest in recording flows of other elements in addition to nitrogen, phosphate and potassium/potash. In theory, all elements contained in organic fertilizers can be accounted for in the supply and use tables, but the adjustment to do this this has not yet been developed. A number of factors should be noted. First, many flows related to organic fertilizers will be captured in the measurement of nitrogen and phosphorus cycles.

4.105. Second, the measurement of pesticides in terms of tonnes of active ingredients is a starting point for assessing the extent of pesticide supply and use. Measurement in tonnes, however, may mask the potential impact of certain pesticides with high levels of toxicity relative to their mass. Adjusting for toxicity and, therefore, factors is beyond the accounting framework, but is important from the perspectives of decision-making and policy.

4.106. Third, there may be interest in distinguishing the use of fertilizers and pesticides between conventional agriculture and organic farming. To the extent that output can also be distinctly recorded for these two farming practices, single factor measures of productivity may be derived.

4.107. Fourth, work on the measurement of fertilizer and pesticide flows will link to other areas of the SEEA AFF Central Framework, particularly the condition of soil resources. Accounting frameworks for soil resources need to be developed further (see section 4.7).

4.108. Fifth, there are links to the measurement of greenhouse gas emissions and the quality of water resources. Measures of water quality, for example, that take into account eutrophication, are likely to be important in understanding the sustainability of fisheries activities.

4.6 Asset accounts for land

4.6.1 Measurement purpose and scope

4.109. In the SEEA Central Framework, section 5.6, the various aspects of accounting for land, in particular, the distinction between land use and land cover, is described based on the definitions in the SEEA Central Framework, the following can be ascertained:

(a) Land use reflects (i) the activities undertaken and (ii) the institutional arrangements put in place in a given area for the purposes of economic production or the maintenance and restoration of environmental functions (SEEA Central Framework, paragraph 5.246).

(b) Land cover refers to the observed physical and biological land cover of the Earth's surface. It includes natural vegetation and abiotic (non-living) surfaces (SEEA Central Framework, paragraph 5.257).

4.110. For SEEA AFF purposes, land use and land cover are relevant. Land use information is valuable in studies of agricultural, forestry and fisheries production, food security and cropping intensity. Using the SEEA CF Land Use classification, the SEEA AFF applies a special focus to facilitate analysis of ISIC A activities. Specifically, it proposes a simplified grouping of SEEA CF categories into agriculture,

forestry and other land use. The latter grouping is aligned with current FAO land use classes.[6] Land cover information is relevant for understanding the changing composition and condition of a country's ecosystems, including its agricultural and forest landscape. Land use and cover information can be used together for the purposed of understand a country's agricultural sector deriving environmental indicators, such as those related to land conservation or clearance, such as afforestation and deforestation.

4.111. Apparent mismatches between land use and land cover information are frequent. The area of land used or set aside for forestry, for example, may include recently logged and cleared areas that do not satisfy the criteria for forests (i.e. areas covered with trees) from a land-cover perspective. For that reason, it is relevant from the SEEA perspective to distinguish between land use and land cover and account for each concept separately.

4.112. Given the focus on economic activity in the SEEA AFF, areas in a country used for agriculture, forestry or fisheries, including coastal waters, should be identified first. Changes in those areas – for example, in terms of increasing areas of land being used for agriculture compared with forestry, or decreasing areas of agriculture resulting from urban expansion – can be monitored using the data to show the changing mix of land use. Consideration should be given to economy-wide programmes of work on land accounting because integration of data among large-scale projects is likely to bring significant advantages.

4.113. For land use and land cover accounts, the starting point is a country's land territory, including land area and the area of inland water resources, such as rivers and lakes. If marine areas are a significant asset, they should be included, particularly for assessments of coastal and marine fisheries activities. The SEEA AFF categories, accordingly, include coastal waters and exclusive economic zones.

4.114. A major purpose of accounting is to track change over time. The SEEA Central Framework and the SEEA AFF have recommend that accounts be compiled annually to more effectively link with the SNA. For land accounting, however, in particular at large or national scales, the rate of change in land use or land cover may be incremental, and accounting at five-to-ten-year intervals may be more appropriate.

4.115. Where there are clear, ongoing changes in land cover and land use, for example through consistent patterns of deforestation or urbanization, it is recommended that annual accounts be compiled to ensure that regular monitoring is established; this also applies where the mix of cropping types, for example from temporary to permanent crops, is changing on a consistent basis.

4.116. The land asset accounts in the SEEA Central Framework incorporate information on the composition of land in terms of area only; they do not take into consideration changes in the quality of land, such as changes in soil or ecosystem condition. Those qualitative aspects may be included in accounting for individual environmental assets, such as soil and timber resources, or in ecosystem accounting.

4.117. Asset accounts in monetary terms for land used for agriculture, forestry and fisheries may be of interest. Such accounts are described in the SEEA Central Framework, section 5.6.5. In the SEEA Central Framework, the possibility to compile asset accounts for land in terms of land ownership is also noted. Some particular measurement challenges are involved in valuing land for specific activities, which are explained further in section 4.6.3. Consequently, a monetary asset account for land has not yet been articulated in the SEEA AFF.

4.6.2 Accounting entries

4.118. The physical asset account for land use (table 4.7) facilitates land accounting for crop, livestock, and fisheries production. Based on other types of land the SEEA CF account, specific aggregates, following FAO land use classes, such as agricultural land, cropland, arable land, and other land are introduced. Additional entries are provided to account for both capture fisheries and aquaculture activities taking place in inland waters coastal waters and at the exclusive economic zones (see annex III).

[6]FAO Land Use, Irrigation and Agricultural Practices Questionnaire (available at www.fao.org/economic/ess/ess-home/questionnaires/en/).

Table 4.7

Physical asset account for land use (hectares)

	Opening stock	Additions to stock	Reductions in stock	Net changes in stock	Closing stock
Land use classes					
(i) Land					
Land used for agriculture	60 200			2 100	62 300
Cropland	49 200			2 100	51 300
Arable land	25 200			1 100	26 300
Temporary crops					
Temporary meadows and pastures					
Land temporarily fallow					
Permanent crops	24 000			1 000	25 000
Permanent meadows and pastures	11 000			0	11 000
Land used for forestry	91 010			0	91 010
Land used for aquaculture					
Use of built up areas					
Land used for maintenance and restoration of environmental functions					
Other uses of land not elsewhere classified	36 541				34 441
Land not in use					
Land area (total)	187 751			36 541	187 751
(ii) Inland waters					
Inland waters used for aquaculture or holding facilities					
Inland waters used for maintenance and restoration of environmental functions					
Other uses of inland waters nec					
Inland waters not in use					
Inland water (total)	10 201				10 201

4.119. In general, the physical asset accounts for land records the opening and closing stock of land area, in hectares (ha), classified by type of land use and also supports the recording of changes in land use over an accounting period through additions to stock and reductions in stock. At this stage, it is recommended that focus be placed on measurement of the opening and closing stocks and the net change in stock, so where there are gaps in data on additions and reductions in stock, the asset account can still be compiled.

4.120. For SEEA AFF purposes, information on land use should also be allocated by key agricultural product. This entails collating different sources of information and allowances for variations in cropping practices. Ideally, it would be possible for the classes of land use, in particular, arable land, permanent crops and permanent meadows and pastures, to be directly attributed to individual crop and product types. However, two factors make this not possible in most circumstances. First, there are cases in which within one land area, multiple crops may be grown at the same time – for example, in intercropping and alley cropping systems. Second, there are cases in which more than one crop is grown through the course of a year – for example, two (and sometimes three) crops of rice may be harvested from one area.

4.121. In both cases, data on the total area harvested by crop type are often available. However, because of multiple cropping, the sum of the area harvested will be greater than the total area of land. This is a problem from an accounting perspective, as there is no initial constraint or boundary on the total area that can be harvested. Conceptually, it is possible to make adjustments such that the sum of the area harvested by crop type would correspond to the total available area of land according to the land use classes in table 4.8. This requires making adjustments to the area harvested on the basis of cropping intensity factors.

4.122. Countries are, nonetheless, encouraged to maintain data on the area harvested by crop type and changes in that area over time to support this type of analysis. These variables are routinely collected by FAO through its crop production questionnaires. In addition, a general indicator of total area harvested to total arable land and permanent crops may be useful in understanding the changing intensity of agricultural production over time.

4.123. The area of forestry is defined in accordance with the area of land supporting the forest asset accounts in section 3.6, so the area of land used for forestry covers forest land and other wooded land.

4.124. Beyond the measurement challenges concerning multiple cropping described above, challenges also arise when there are multiple land uses, perhaps on a seasonal basis, for example, grazing in land used for forestry or seasonal use of inland water areas for cropping and grazing during dry seasons. Regarding, multiple cropping, adjustments may be made to ensure aggregation is constrained to the total land area.

4.125. The main accounting entries for the asset account for land use are summarized in the following paragraphs.

4.126. The entry for “opening stock” is the total amount of land area and area of inland waters, in hectares and by land use type, available at the beginning of the reference period – arable land, permanent crops, permanent meadows and pastures, forestry, land used for aquaculture, built up areas, and land used for maintenance and restoration of environmental functions.

4.127. Regarding the entry for “additions and reductions in stock”, there are various reasons for changes in the stock of land over an accounting period, in particular between different types of land use. The SEEA Central Framework distinguishes between managed and natural expansion or reduction: the former is an increase or decrease in the area resulting from human activity, while the latter is an increase or decrease in area resulting from a natural process. The SEEA AFF does not give detailed specifications for those entries, but the asset account for land use in the SEEA Central Framework should be used if the data are available.

4.128. In the entry for "net change in stock", net change is simply the difference between closing stock and opening stock if information on additions and reductions in stock is not available.

4.129. The entry for "closing stock" is equal to the total area of land or inland waters, in hectares, available at the end of the reference period. The closing stock of a given year constitutes the opening stock of the following year.

4.130. The physical asset account for land cover is shown in table 4.8. The opening and closing stock of land, in hectares, is recorded, classified by type of land cover and the changes in land cover over an accounting period through additions to stock and reductions in stock. At this stage, the focus of accounting in SEEA AFF should be on the opening and closing stock and the net change in stock, so that in cases in which data on additions and reductions in stock are not available, the asset account can still be compiled.

Table 4.8
Physical asset account for land cover (000 ha)

	Opening stock	Additions to stock	Reductions in stock	Net changes in stock	Closing stock
Land cover classes					
Artificial surfaces	2 610	1 105	345	761	3 371
Herbaceaous crops	46 377	9 390	11 993	- 2 604	43 774
Woody crops	15 199	4 576	4 447	129	15 328
Multiple or layered crops	4 485	2 007	2 001	6	4 492
Grassland	3 421	517	1 062	- 545	2 876
Tree covered areas	99 169	9 975	6 849	3 126	102 296
Mangroves	1 402	100	98	2	1 404
Shrub covered areas	6 416	212	836	- 623	5 793
Shrubs regularly flooded					
Sparsely vegetated areas	8 433	1 537	1 932	- 395	8 038
Terrestrial barren land	582	253	135	117	699
Permanent snow and glaciers					
Inland water bodies	3 760	100	75	25	3 785
Coastal water bodies					
Total area	191 856	29 773	29 773	0	191 856

4.131. In the following paragraphs, the main accounting entries for the asset account for land cover are described.

4.132. The entry for "opening stock" is the total area of land, in hectares, by type of land cover at the beginning of the accounting period.

4.133. Regarding "additions and reductions in stock", there are various reasons for changes in the stock of land cover during an accounting period, in particular between different types of land cover. The SEEA Central Framework distinguishes between managed and natural expansion or reduction: the former is an increase or decrease in area resulting from human activity, while the latter is an increase or decrease in area resulting from a natural process. The SEEA AFF does not give detailed specifications for those entries, but the asset account for land cover in the SEEA Central Framework should be used where data are available.

4.134. The entry for "net change in stock" is the difference between closing stock and opening stock, by land cover type.

4.135. The entry for "closing stock" is the area of land, by land cover type, at the end of the accounting period. The closing stock of one accounting period constitutes the opening stock of the next.

4.136. Section 5.6 and annex 1 of the SEEA Central Framework gives a classification of land cover type on the basis of the FAO Land Cover Classification System, version 3 (FAO and Global Land Cover Network, 2009):[7]

- Artificial surfaces – areas with a predominantly artificial surface, such as industrial areas, waste dumps and parks.
- Cropland – herbaceous crops, woody crops and multiple or layered crops.
- Grassland – areas, such as a steppe or savannah dominated by natural herbaceous plants.
- Tree-covered areas – any area dominated by naturally growing trees.
- Mangroves – any area dominated by woody vegetation permanently or regularly flooded by fresh or brackish water.
- Shrub-covered areas – any area dominated by natural shrubs.
- Shrubs and/or herbaceous vegetation, aquatic or regularly flooded – any area dominated by natural herbaceous vegetation permanently or regularly flooded by fresh or brackish water.
- Sparsely natural vegetated areas – any area where natural vegetation cover is between 2 and 10 percent.
- Terrestrial barren land – any area where natural vegetation is absent or almost absent; may include bare soil.
- Permanent snow and glaciers – any area covered by snow or glaciers permanently or for more than ten months per year.
- Water bodies – inland waters and coastal waters.

4.6.3 Measurement issues and possible extensions

4.137. There are several challenges in determining areas of land use, especially in terms of use for particular product types. For example, the ways of handling multiple cropping through the year, multiple crops in the same area of land, and various land uses on the same area of land must be considered. Seasonal changes in land use and land cover between wet and dry seasons also pose a challenge.

4.138. Estimates of land use and land cover at the country level may be made, but the data sources are usually different. It is important to reconcile different estimates of land use and land cover to convey a useful picture of the two concepts. In that regard, consistency with other indicators of land use, such as production statistics, should be sought. Land cover and land use change matrixes in which changes between the opening and closing stock are categorized by type of change is a useful analytical tool.

4.139. The links between land accounting and other areas of the SEEA AFF Central Framework

[7] A complete SEEA land cover domain (http://www.fao.org/faostat/en/#data/LC) has been recently developed by FAO. The FAOSTAT domain land cover contains land cover information organized by the land cover classes of the SEEA Central Framework. The land cover information is compiled from publicly available global land cover maps. In particular it draws information from the two following global land cover products:
(a) SEEA-MODIS, which contains land cover area values for the years 2001 to 2012 derived from the International Geosphere-Biosphere Programme product of the MODIS land cover types dataset (MCD12Q1);
(2) SEEA-CCI-LC, which contains land cover information for the period 1992–2015 derived from the annual land cover maps produced by the Catholic University of Louvain Geomatics under the European Spatial Agency Climate Change Initiative;Those three different sources have been geoprocessed, normalized and mapped to the SEEA land cover for a 1992–2015 time series.

include accounting for soil resources and accounting for fisheries activities through the measurement of the surface area of inland waters and marine areas. In addition, an understanding of agricultural practice may be enhanced through the recording the area of land subject to irrigation. Measures of irrigated land can inform discussions on requirements for abstracted water and the potential for improvements in production if investments in irrigation are to be carried out. Similar extensions relating to different farming practices can also be developed, for example, to accounting for areas of organic farming and areas subject to specific cultivation practices.

4.140. There are also links between land accounting and the emerging field of ecosystem accounting, which considers the areas of land that form ecosystem assets, the quality or condition of these assets and the ecosystem services generated from the assets. Measures of the condition of land may vary and include measures of biodiversity. In some agri-environmental indicator sets, estimates of the number of farmland bird species are a proxy for biodiversity. Extended accounting to consider those aspects is discussed in the SEEA Experimental Ecosystem Accounting.

4.141. Land use and land cover information is the starting point for the development and integration of subnational data. The various characteristics of different land cover and land use are important in the allocation of production and other economic activities at the national level, and can also be used to upscale and downscale information.

4.142. In general, it should be recognized that there are a range of measurement initiatives that use measures of changes in the composition of land. At the international level, examples include the work on measurement of greenhouse gas emissions through IPCC, work on the measurement of changes in land use in the context of the United Nations Convention to Combat Desertification, work on the measurement of changes in ecosystems as part of the Convention of Biological Diversity and the Intergovernmental Platform on Biodiversity and Ecosystem Services, and the long-standing collection of land use data pertaining to agriculture and forestry by FAO.

4.143. In each of those cases, the classification of land could benefit from increased international coordination. An important part of the research agenda for the SEEA Central Framework and SEEA AFF is to advance the discussion on internationally agreed land use and land cover classes. To that end, useful mapping linking IPCC, SEEA land use categories and ISIC A activities is also part of the research being conducted by the London City Group[8].

4.144. With regard to the development of monetary values for land used for agriculture, forestry and fisheries, many measurement issues need to be considered. In the first instance, the development of those monetary asset accounts requires a clear delineation of the relevant areas of land to be valued. In concept, this will align with the physical asset accounts for land described above. However, information on the monetary value of land may not be available in relation to the same land areas, and alignment of areas and values may be challenging. This same challenge does not arise when seeking to obtain an economy wide valuation of land.

4.145. More broadly, it may be possible to identify the value of land based on relevant market transactions or through administrative data sources, such as taxation authorities or land evaluators. The valuations of land commonly encompass a range of factors, which may be difficult to disentangle. Three different factors are relevant here. First, the value of land may incorporate the value of associated soil resources, water resources or timber resources. Following the SEEA Central Framework, ideally, the value of the individual resources should be distinguished. In addition, the value of agricultural land may need to be adjusted to exclude the value of relevant buildings and other produced infrastructure that are located on the land. A related consideration is the valuation of land improvements (for example the formation of dams and drainage systems) that require a specific treatment following the SNA.

4.146. Second, depending on the location of agricultural, forestry or fisheries land, there may an option in particular areas to use the land for alternative purposes – for example, for housing development in the case of agricultural land or for agriculture in the case of forest land. Distinguishing these option values may be important for analytical purposes and understanding the sustainability of agricultural and forestry activity.

[8] https://unstats.un.org/unsd/envaccounting/londongroup/meeting22/D_14.pdf.

4.147. Third, it is likely that areas of land used for agricultural, forestry and fisheries also supply a range of ecosystem services that (a) may be of value to economic units other than the land owner or manager (for example, the role of forests in watershed management) or (b) may be of value to individuals and society more broadly (for example, the amenity value of agricultural landscapes or the carbon sequestration value of forests). In those instances, the market value of land will likely understate the full value of land. Considering the valuation of those ecosystem services is increasingly being considered with regard to the SEEA Experimental Ecosystem Accounting.

4.148. The valuation of land is a multifaceted exercise that remains a subject of development and research for the SNA and the SEEA. In the context of the SEEA AFF, it is relevant to monitor developments on that topic and to also clarify the types of valuation scope most relevant for analysis of agricultural, forestry and fisheries issues.

4.7 Accounting for soil resources

4.149. Soil resources are a fundamental environmental asset for agricultural and forestry production. Monitoring the state and change in the state of a country's stock of soil resources must, therefore, be a priority in research and measurement with regard to sustainable agricultural production.

4.150. As an indication of what may be possible, the SEEA Central Framework introduces a general approach to accounting for soil resources with a focus on the area and changes in area of different types of soil resources in a country and the volume and changes in volume of soil resources, for example from erosion. Section 5.7 of the SEEA Central Framework provides a context for work on accounting for soil resources in terms of descriptions of soil resources and ways in which their characteristics might be considered.

4.151. Table 4.9 shows a physical asset account for national soil resources with a focus on recording the composition of soil resources within a country. Types of soil resources may be classified in different ways at the country level. The recommended approach for the SEEA AFF is to use the classification system of the world reference base for soil resources 2014 (FAO, 2015). Generally, the composition of a country's soil resources, in terms of soil types, does not change significantly over time and hence no detail on additions or reductions in stock is proposed in this asset account. In addition, rather than focusing on measuring change, at least initially, it is considered appropriate to focus on mapping different soil types and understanding where certain soil types are located relative to agricultural and forestry activity. Establishing linkages between soil accounts and land accounts may, therefore, be of interest.

Table 4.9

Asset account for the composition of soil resources (hectares)

	Type of soil resource	Total area
Opening stock of soil resources		
Additions to stock		
Reductions in stock		
Closing stock of soil resources		

4.152. While the composition of soil resources is important information, there is perhaps greater interest in understanding the changing quality of soil over time. This is relevant in understanding issues, such as land degradation and agricultural productivity. Relevant measures are indicators of carbon content, measures of erosion rates, measures of texture and percentages of positively charged ions.

4.153. Work is under way to apply natural capital accounting approaches to soil resources and use the developments in the measurement of soil health (see for example, Dominati, 2010), but further work is needed to apply them to the design and compilation of SEEA-type accounts. Related information on soil conservation practices, such as areas subject to conservation tillage, rotational grazing or cover crop adoption, may also be relevant.

4.154. In some cases, it may be possible to use accounting approaches to organize the information needed to derive soil health indicators. For example, measures of soil carbon content, could be integrated into a carbon stock account, as described in the SEEA Experimental Ecosystem Accounting.

4.155. Data sources developed in recent years regarding soil include the Harmonized World Soil Database, v 1.2[9] and the GlobalSoilMap (International Union of Soil Sciences, 2009). Along with the work on natural capital accounting for soils noted above, they should constitute a basis for further progress in this area.

[9]Available at http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/.

Annex I

Tiered approaches to implementation of the System of Environmental-Economic Accounting for Agriculture, Forestry and Fisheries

A critical concept of the SEEA AFF is the phased, tiered approach to implementation. It is recommended that users proceed in successive phases, starting with the use of national-level default data, including from international organizations, which can be used as a reference to gauge progress towards inclusion of data at higher tiers, including providing support for data gap-filling and quality assurance and quality control functions.

Tier 1: Global datasets

The compilation of SEEA AFF accounts at the tier 1 level can be an entry level point for both compilers of accounts and users of accounting-based information. For compilers, it is envisaged that a country would be able to source a majority of information from existing FAO and similar global datasets and compile a basic set of SEEA AFF accounts.

Using these data has a range of benefits, including reducing the search and collection costs for data, getting an initial sense of the nature of the accounting approach and enabling the derivation of some key variables and indicators of relevance for policy and for international reporting – for example, for implementation of the 2030 Agenda for Sustainable Development. As the FAO datasets also provide a time series of information, the use of these data during the initial efforts can immediately support the description of trends in agriculture, forestry and fisheries, which are central to analysis and policy monitoring.

Experience in the compilation of various SEEA accounts suggests that the largest challenge is often simply starting the first set of accounts. Using tier 1 data is, therefore, one way to lower barriers to entry and it should provide a sound base for future and ongoing work.

Tier 2: National datasets

At tier 2, a more engaged and broader based compilation of accounts is required. Generally, the provision of data to the FAO and other global datasets involve the sourcing of data from various government agencies. The task for tier 2 accounting is to examine the potential for coordination of existing data within the structure of the SEEA AFF accounts, to assess data gaps, including gaps in time series, and to establish mechanisms for integrating existing data at the national level across the SEEA AFF domains.

Based on discussions among relevant agencies, it is expected that a broader range of data would be able to be integrated, but this may require additional resources to align data with common definitions and classifications. In particular, any investigation should consider the development of the intended key product focus of the SEEA AFF across the various data domains. To obtain a coherent picture for different products, it may be necessary to engage a variety of national experts in agriculture, forestry and fisheries.

An important outcome from discussions on data coordination should be an increased understanding of the key national policy issues for agriculture, forestry and fisheries, the associated information gaps and, ultimately, the development of a plan for the development of the relevant information set.

The compilation at tier 2 is expected to result in a complete set of the SEEA AFF accounts. Importantly, at tier 2, coordination of existing data is expected, instead of a collection of additional data. Given the costs of an additional data collection, all avenues for the use of existing data should be explored provided the right connections can be found. It is often surprising how much data are available that can be used to complete sections of accounts. From the perspective of users, the coverage and detail of accounts at the tier 2 level should provide a very comprehensive set of information for policy and analysis.

Tier 3: additional data collection

At tier 3, a very complete and full implementation of the SEEA AFF accounts is expected to take place. Tier 3 accounts are not expected to be developed in the short term. They will be developed progressively over time, with the likely focus to be on the most relevant domains at the national level.

The compilation at tier 3 accounts will likely require the collection of additional information, for example through the addition of questions to relevant surveys and censuses. In the view of the resources that would be required for the collection of information, one approach to tier 3 accounts is to apply benchmarking approaches in which detailed data are collected at three or five-year intervals and, in the intervening years, indicator series are used to interpolate and extrapolate the relevant series. This is a form of modelling that is commonly applied in national accounting.

More generally, tier 3 accounts may require the use of various models and relationships between different stocks and flows, especially for the development of product-level data. Such modelling can be effectively supported in an accounting context, as the modelled estimates would be developed based on broader estimates of stocks and flows from already developed data sources.

One dimension of tier 3 accounts is the development of subnational detail, potentially using GIS techniques. Most likely, it would make sense to pursue such fine levels of detail for only a subset of the SEEA AFF accounts, perhaps for specific variables. Nonetheless, it is likely that the availability of subnational data that can be placed in accordance with broader, national estimates will be of high value for policy and analysis.

Annex II

Types of environmental indicators

Descriptive statistics cover measures of aggregates, such as total fertilizer use by agriculture and total production of livestock products, where the totals are derived from aggregations within the accounting structure. Descriptive statistics also include structural statistics, such as the proportion of irrigated water use attributable to food crops or the share of land used for timber production. In the SEEA AFF, descriptive statistics tend to be based on information from a single base account or in relation to a single variable, such as value added or employment.

Environmental asset aggregates and indicators cover measures of the stocks and changes in stocks of environmental assets in physical and monetary terms; measures of depletion and estimates of asset or resource life. In physical terms, environmental asset indicators are derived in a single asset account. In monetary terms, the derivation of indicators, such as the share of national wealth[10] attributable to individual environmental assets, can also be considered.

Environmental ratio indicators are of three types:

Productivity and intensity indicators where the use of a resource or input is related to a measure of economic activity. Examples of these indicators include land used for forestry relative to forestry value added, or water use per unit of crop output. A productivity indicator uses the resource or input measure as the denominator, whereas an intensity indicator uses the resource or input measure as the numerator. The derivation of meaningful productivity and intensity indicators is perhaps the most significant application of the SEEA AFF framework. The intention is to develop these types of indicators across different environmental variables, such as land use, water use and energy use, and across individual products and activities.

Decoupling indicators. These indicators are similar in form to productivity indicators but they are focused on residual flows, such as emissions or flows considered potentially unsustainable, such as energy use at the aggregate level. An example of a decoupling indicator is the ratio of greenhouse gas emissions to GDP, where a decrease in the ratio reflects a decoupling of GDP growth from greenhouse gas emissions. A similar ratio may be developed specifically for agricultural, forestry and fisheries activities.

Polluter-pays indicators. These indicators link estimates of physical flows of residuals, such as greenhouse gas emissions or flows of waste with the associated costs to business such as taxes or expenditure to mitigate pollution. To develop these indicators, the set of SEEA AFF accounts need to be extended to incorporate information on environmentally related taxes and other payments. The use of SEEA AFF in that way could help to quantify the costs of pollution.

[10] The sum of all national economic assets less liabilities to the rest of the world.

Annex III

The SEEA Central Framework land use classes in the SEEA AFF

The SEEA AFF uses the SEEA CF land use classification, with specific aggregations to facilitate analysis of ISIC A activities. From that perspective, land area is divided into agriculture, forestry and other land. The latter is an aggregation of all remaining SEEA Central Framework classes considered of lesser relevance to SEEA AFF accounting. Within agriculture, new aggregations are introduced, including agricultural area, cropland, arable land and permanent crops, using FAO terminology.[11] Both capture fisheries and aquaculture are included as activities in inland eaters, coastal eaters and the exclusive economic zones.

The SEEA AFF also considers country area, defined as the area under national sovereignty, and consisting of the sum of: land area, inland waters, and coastal waters. Areas under exclusive economic zones are not part of country area, but can be used for accounting within the SEEA AFF.

The table below provides detailed information on the usage of the SEEA Central Framework land use classes for the purpose of SEEA AFF accounting.

[11] FAO Land Use, Irrigation and Agricultural Practices Questionnaire (available at : www.fao.org/economic/ess/ess-home/questionnaires/en/).

Land use class	Definition	SEEA CF Code
Country area	Area under national sovereignty. It is the sum of land area, inland waters and coastal waters. It excludes exclusive economic zones.	
Country area		
Land area	Country area excluding area under inland waters and coastal waters. It corresponds to the sum of agriculture, forestry, and other land use.	**1**
Inland waters	Inland waters are areas corresponding to natural or artificial water courses, serving to drain natural or artificial bodies of water, including lakes, reservoirs, rivers, brooks, streams, ponds, inland canals, dams, and other landlocked waters. The banks constitute limits whether the water is present.	**2**
Coastal waters	Waters located in between the land territory and the outer limit of the territorial sea. They comprise "internal waters" (UNCLOS 1982, Art. 8) and "territorial sea," (UNCLOS 1982, Art. 3) and where applicable, "archipelagic waters," (UNCLOS 1982, part V)	**3**
Exclusive economic zone	Waters beyond and adjacent to the territorial sea, not extending beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured (UNCLOS 1982, part V).	**4**
Land area		
Agriculture	The total of areas under “agricultural land” and “land under protective cover”. Scattered land under farm buildings, yards and their annexes, and permanently uncultivated land, such as uncultivated patches, banks, footpaths, ditches, headlands and shoulders, are traditionally included	**1.1**
Forestry	Land used for forestry. Excludes land that is predominantly under agricultural or urban use.	**1.2**
Other land	Land area not classified as "agriculture” and" "forestry". It includes SEEA categories “"land used for aquaculture," "built-up and related areas, "land Use for maintenance and restoration of environmental functions", "other uses of land not elsewhere classified”,' and "land not in use”.'	**1.3-1.7**

Agriculture		
Agricultural land	Land used for cultivation of crops and animal husbandry. The total of areas under "cropland" and "permanent meadows and pastures." This category includes tilled and fallow land, naturally grown and cultivated permanent meadows and pastures used for grazing, animal feeding or agricultural purpose.	**1.1.1-1.1.6**
Land under protective cover	Land used for agriculture occupied by dwellings on farms, such as dwellings and operating buildings, such as hangars, barns, cellars, greenhouses and silos, buildings for animal production, such as stables, cowsheds, pig sheds, sheep pens and poultry yards, family gardens and farmyards. Excludes buildings for agro-food manufacture and buildings in rural areas for exclusive residential purpose.	**1.1.7**
Agricultural; and		
Cropland	Land used for cultivation of crops. The total of areas under "arable land" and "permanent crops".	**1.1.1-1.1.4**
Permanent meadows and pastures	Land used permanently (five years or more) to grow herbaceous forage crops through cultivation or naturally (wild prairie or grazing land). Permanent meadows and pastures on which trees and shrubs are grown should be recorded under this heading only if the growing of forage crops is the most important use of the area. Measures may be taken to keep or increase productivity of the land (i.e., use of fertilizers, mowing or systematic grazing by domestic animals). This class includes:	**1.1.5**
	• Grazing in wooded areas (agroforestry areas, for example);	**1.1.5.1-1.1.5.2**
	• Grazing in shrubby zones (heath, maquis, garigue);	
	• Grassland in the plain or low mountain areas used for grazing: land crossed during transhumance where the animals spend a part of the year (approximately 100 days) without returning to the holding in the evening: mountain and subalpine meadows and similar; and steppes and dry meadows used for pasture.	

Cropland		
Arable land	The total of areas under temporary crops, temporary meadows and pastures, and land with temporary fallow. Arable land does not include land that is potentially cultivable, but is not normally cultivated.	**1.1.1-1.1.3**
Permanent crops	Land used for crops with a less-than-one-year growing cycle, which must be newly sown or planted for further production after the harvest. Some crops that remain in the field for more than one year may also be considered as temporary crops, such as asparagus, strawberries, pineapples, bananas and sugar cane. Multiple-cropped areas are counted only once.	**1.1.4**
Arable Land		
Temporary crops	Land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. This land may be in the form sown for the exclusive production of green manure. Land remaining fallow for too long may acquire characteristics requiring it to be reclassified, as for instance "permanent meadows and pastures" if used for grazing or haying.	**1.1.1**
Temporary meadows and pastures	Land temporarily cultivated with herbaceous forage crops for mowing or pastures. A period of less than five years is used to differentiate between temporary and permanent meadows and pastures.	**1.1.2**
Temporary fallow	Land that is not seeded for one or more growing seasons. The maximum idle period is usually less than five years. This land may be in the form sown for the exclusive production of green manure. Land remaining fallow for too long may acquire characteristics requiring it to be reclassified, as for instance "permanent meadows and pastures" if used for grazing or haying.	**1.1.3**
Forestry		
Forest land	Land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ* . Excludes land that is predominantly under agricultural or urban land use, and land that is predominantly used for maintenance and restoration of an environmental function.	**1.2.1**

Forest land	Explanatory notes:	**1.2.1**
	• Forest land is determined both by the presence of trees and by the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 metres *in situ* ;	
	• Includes areas with young trees that have not yet reached but that are expected to reach a canopy cover of 10 percent and tree height of five metres. It also includes areas that are temporarily unstocked, owing to clear-cutting as part of a forest management practice or natural disasters, and that are expected to be regenerated within five years. Local conditions may, in exceptional cases, justify the use of a longer time frame;	
	• Includes forest roads, firebreaks and other small open areas;	
	• May include forest land in national parks, nature reserves and other protected areas, such as those of specific environmental, scientific, historical, cultural or spiritual interest;	
	• Includes windbreaks, shelter belts and corridors of trees with an area of more than 0.5 hectares and width of more than 20 metres;	
	• Includes abandoned shifting cultivation land with a regeneration of trees that have, or is expected to reach, a canopy cover of 10 percent and tree height of 5 metres;	
	• Includes areas with mangroves in tidal zones, regardless of whether this area is classified as land area or not	
	• Includes areas with bamboo and palms provided that land use, height and canopy cover criteria are met;	
	• Some agroforestry systems, such as the taungya system, where crops are grown only during the first years of the forest rotation should be classified as forest;	
	• Excludes: tree stands in agricultural production systems, such as fruit-tree plantations (permanent crops), oil palm plantations, rubber and Christmas trees (permanent crops) and agroforestry systems when crops are grown under tree cover;	

Other wooded land	Land not classified as “forest land”, spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of 5 to10 percent, or trees able to reach those thresholds *in sit* u; or with a combined cover of shrubs, bushes and trees above 10 percent.	**1.2.2**
	The definition above encompasses two options:	
	(a) The canopy cover of trees is between 5 and 10 percent; and trees should be higher than 5 metres or able to reach 5 metres *in situ* ;	
	(b) The canopy cover of trees is less than 5 percent but the combined cover of shrubs, bushes and trees is more than 10 percent. Includes areas of shrubs and bushes where no trees are present.	
	Includes:	
	• Areas with trees that will not reach a height of 5 metres *in situ* and with a canopy cover of 10 percent or more, such as some alpine tree vegetation types and arid zone mangroves.	
	• Areas with bamboo and palms provided that land use, height and canopy-cover criteria are met.	
	• Excludes land that is predominantly under agricultural or urban land use, and land that is predominantly used for maintenance and restoration of environmental function.	
Other land, of which:		
Land used for aquaculture	Land used for aquaculture facilities and fish-farming activities. Includes housing facilities for breeding, nursing and rearing seed of fish, invertebrates or aquatic plants to fry, fingerling or juvenile stages.	**1.3**

Inland waters, of which:		
Inland waters used for aquaculture or holding facilities	Inland water areas that are used for aquaculture facilities including supporting facilities. Aquaculture facilities include enclosures and pens (water areas confined by net, mesh and other barriers that allow uncontrolled water interchange), cages (open or covered enclosed structure constructed with net, mesh or any porous materials that allow natural water interchange), barrages (semi-permanent or seasonal enclosures formed by impervious man-made barriers and appropriate natural features) and rafts, ropes and stakes (raft, long lines or stakes used to culture shellfish and seaweeds).	**2.1**
Inland waters used for capture fisheries	Area of inland waters that is used for catching aquatic animals or gathering aquatic plants in the wild.	**2.3 (subset of)**
Coastal Waters, of which:		
Coastal waters used for aquaculture or holding facilities	Area of Coastal waters used for marine aquaculture facilities, including supporting facilities. Aquaculture facilities include enclosures and pens (water areas confined by net, mesh and other barriers that allow uncontrolled water interchange), cages (open or covered enclosed structure constructed with net, mesh or any porous materials that allow natural water interchange), barrages (semi-permanent or seasonal enclosures formed by impervious man-made barriers and appropriate natural features) and rafts, ropes and stakes (raft, long lines or stakes used to culture shellfish and seaweeds). This category includes oyster beds and other types of shellfish (mussels, clams, abalones and scallops); bodies of water used for seaweed production; and bodies of water used for fish rearing.	**3.1**

Coastal waters used for capture fisheries	Area of coastal waters that is used for catching aquatic animals or gathering aquatic plants in the wild.	**3.3 (subset of)**
Exclusive economic zone, of which:		
Exclusive economic zone used for aquaculture or holding facilities	Area of exclusive economic zone used for marine aquaculture facilities, including supporting facilities.	**4.1**
Exclusive economic zone used for capture fisheries	Area of exclusive economic zone used for catching aquatic animals or gathering aquatic plants in the wild.	**4.3 (subset of)**

References

Dominati, E., Patterson, M. & Mackay, A. 2010. A framework for classifying and quantifying the natural capital and ecosystem services of soils. *Ecological Economics* 69(9): 1,858–1,868.

European Commission, IMF, OECD, United Nations & World Bank. 2003. *Handbook of National Accounting: Integrated Environmental and Economic Accounting 2003.* Studies in methods, Series F. No 61, rev 1. New York.

European Commission, IMF, OECD, United Nations & World Bank. 2009. *System of National Accounts 2008*. Sales No. E.08.XVII.29 (available at http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf).

European Commission & EUROSTAT. 2002. *The European Framework for Integrated Environmental and Economic Accounting for Forests.* Luxembourg, Office for Official Publications of the European Communities (available at https://ec.europa.eu/eurostat/documents/3859598/5859829/KS-BE-02-003-EN.PDF/5d0687cc-d770-4183-80b5-b684a62a8917).

European Commission & EUROSTAT. 2009. *Manual for Air Emission Accounts*. *Eurostat Methoologies and Working Papers.* Luxembourg, Office for Official Publications of the European Communities (available at http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-09-004/EN/KS-RA-09-004-EN.pdf).

EUROSTAT. 2000. *Manual on the Economic Accounts for Agriculture and Forestry,* rev 1.1. Luxembourg,Office for Official Publications of the European Communities (available at https://ec.europa.eu/eurostat/documents/3859598/5859829/KS-BE-02-003-EN.PDF/5d0687cc-d770-4183-80b5-b684a62a8917).

FAO. 1982. Classification and definition of forest products. Rome (available at. http://www.fao.org/3/a-ap410m.pdf).

FAO. 1995. Code of Conduct for Responsible Fisheries. Rome (available at. www.fao.org/docrep/005/v9878e/v9878e00.htm).

FAO. 1996. *A system of Economic Accounts for food and agriculture*. Rome (available at. www.fao.org/3/contents/b56bc3dc-89a7-52f0-b692-b2e08ccad3e3/W0010E00.htm.).

FAO. 2000. *International Standard Classification of Aquatic Animals and Plants*. Rome.

FAO. 2008. Glossary of aquaculture. Rome (available at http://www.fao.org/fi/glossary/aquaculture/pdf/glossary.pdf).

FAO, 2015. World reference base for soil resources 2014 – International soil classification system for naming soils and creating legends for soil maps – Update 2015. World Soil Resources Reports 106. Rome (also available at www.fao.org/3/a-i3794e.pdf.

FAO. 2016. *Global Forest Resources Assessment, 2015: How are the World's Forests Changing?* Rome. (also available at www.fao.org/3/a-i4793e.pdf).

FAO & Global Land Cover Network. 2009. *Land Cover Classification System*, v.3. Rome.

FAO, International Institute for Applied Systems Analysis, International Soil Reference and Information Centre, Institute of Soil Science-Chinese Academy of Sciences & Joint Research Centre of the European Commission. 2009. *Harmonized World Soil Database*, v. 1.2 (available at. www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/harmonized-world-soil-database-v12/en/).

FAO, United Nations & World Bank. 2010. *Global Strategy to Improve Agricultural and Rural Statistics*. Washington, DC. International Bank for Reconstruction/World Bank (also available at www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/ICAS5/Ag_Statistics_Strategy_Final.pdf).

Garibaldi, L. 2012. The FAO global capture production database: a six-decade effort to catch the trend. *Marine Policy*, 36(3): 760–768.

IPCC. 1996. *Revised 1996 Guidelines for National Greenhouse Gas Inventories* (available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs4.html).

IPCC. 2003. *Good Practice Guidance on Land Use, Land-Use Change and Forestry.* Penman, J., Gytarsky, M., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. & Wagner, F., eds. Hayama, Japan, Institute for Global Environmental Strategies for the IPCC (available at www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.html).

IPCC. 2006. *IPCC Guidelines for National Greenhous Inventories*. Hayama, Japan, IPCC (also available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/).

International Union of Soil Sciences. 2009. GlobalSoilMap (available at http://www.globalsoilmap.net/).

Kremer, A. 2013. *Nutrient budgets: EUROSTAT/OECD methodology and handbook* (available at https://ec.europa.eu/eurostat/documents/2393397/2518760/Nutrient_Budgets_Handbook_%28CPSA_AE_109%29_corrected3.pdf).

OECD. 2002. *Measuring the Non-observed Economy – A Handbook*. Paris (also available at http://www.oecd.org/sdd/na/1963116.pdf).

OECD. 2008. Measuring material flows and resource productivity: OECD guidance manual. Vol. II: A theoretical framework for material flow accounts and their applications at national level. Draft. Paris. LG/11/6 (available at http://unstats.un.org/unsd/envaccounting/londongroup/meeting11/LG11_9a.pdf).

OECD. 2014. *Agricultural Policy Monitoring and Evaluation*. Paris.

OECD & Joint Research Council of the European Commission. 2008. *Handbook on Constructing Composite Indicators: Methodology and User Guide.* OECD, Paris.

Päivinen, R., Lehikoinen, M., Schuck, A. & Moiseyev, A. l. 1999. Global overview of European forests. In P. Pelkonen, A. Pitkanen, P. Schmidt, G. Oesten, P. Piussi, & E. Rojas (eds), Forestry in changing societies in Europe – Information for teaching module, SILVA Network, part I, pp 5-14.

PARIS21. 2011. Statistics for transparency, accountability and results: a Busan action plan for statistics (available at www.paris21.org/sites/default/files/Busanactionplan_nov2011.pdf).

Sorrenti, S. 2017. Non-wood forest products in international statistical systems. Non-wood Forest Product Series no. 22. Rome, FAO (also available at www.fao.org/3/a-i6731e.pdf).

United Nations. 2008. *International Standard Industrial Classification of All Economic Activities*, rev.4. Statistical Papers, Series M, No. 4/rev.4. Sales No. E.08.XVII.25 (also available at https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf).

United Nations. 2011. International recommendations for energy statistics. Draft version (available at https://unstats.un.org/unsd/statcom/doc11/BG-IRES.pdf).

United Nations. 2012. *Report of the United Nations Conference on Sustainable Development*, Rio de Janeiro, Brazil 20-22 June 2012 (A/CONF.216/16).

United Nations. 2013. *Framework for the Development of Environment Statistics*. New York.

United Nations. Forthcoming. System of Environmental-Economic Accounting for Energy.

United Nations & FAO. 2004. Handbook of national accounting: integrated environmental and economic accounting for fisheries. Final draft (available at http://unstats.un.org/unsd/envaccounting/Fish_final_whitecover.pdf).

United Nations, European Commission, FAO, IMF, OECD & World Bank. 2014. *System of Environmental-Economic Accounting 2012 Central Framework*. Sales No. E.12.XVII.12 (also available at https://unstats.un.org/unsd/envaccounting/seearev/seea_cf_final_en.pdf).

ISBN 978-92-5-132207-9

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CA7735EN/1/03.20