

Linking SEEA-CF and SEEA-EEA: revitalising economic concepts for greater integration of Environmental-Economic Accounts.

(Authors: Peter Meadows, Australian Bureau of Statistics and Jonathon Khoo, Australian Bureau of Statistics.

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Abstract

This paper will examine the previous investigations on linking SEEA Central Framework and SEEA-Experimental Ecosystems Accounts. It proposes a reinvigoration of the economic framework to further integrate abiotic and biotic, through the development of a National Physical Balance Sheet. In summary, the paper raises the question as to what is an asset and what is a right to the asset contained within the environment. It outlines potential options to better link the experimental ecosystem (SEEA-EEA) accounts with the common framework in SEEA (SEEA-CF). By extension, linking SEEA-CF and SEEA-EEA also brings the SEEA-EEA closer to the SNA concepts. It will explore three approaches:

1. The use of summary tables as a way of drawing links between SEEA-CF and SEEA-EEA in a more analytical framework. The paper proposes a number of thematic cases and explore the use of key statistics from the two frameworks to inform the topic.
2. The paper proposes an initial approach to combining SEEA-CF and SEEA-EEA into a National Physical Balance Sheet through the extension of existing SEEA and SNA concepts.
3. The paper will explore the effect of introducing a quasi-environmental sector into a National Physical Balance sheet.

Stronger linkages allows for deeper macro analysis of issues such as the sustainable use of our ecosystems and other natural resources. This paper explores implications for the future development of SEEA and invite others to participate in the debate.

A) Methodological issue, (what needs to be clarified/changed)

Ecosystem accounts provide a framework for recording the extent, condition of ecosystems as well as the services and benefits that are derived from an Ecosystem. The international statistical framework for measuring ecosystems is the System of Environmental-Economic Accounts – Experimental Ecosystem Accounts (SEEA-EEA), which is an extension of the System of Environmental-Economic Accounts – Central Framework (SEEA-CF). However, currently SEEA-EEA and SEEA-CF are not well aligned, which means that the comprehensive measurement of all environmental assets is difficult. A closer alignment between the SEEA-CF and SEEA-EEA is a topic on the SEEA research agenda, and this paper seeks to progress this topic by presenting some potential alternatives to how SEEA-EEA and SEEA-CF could be more holistically linked. In considering alternatives it is important to reconsider the use of some treatments of non-produced, non-financial assets from System of National Accounts (SNA).

Some other interesting challenges to the SEEA family of accounts are being raised in the development of ocean accounts (Milligan, 2019); in the clarification of the monetary transactions in the general economic schedule (Fenmichel and Obst, 2019); and in conversations with policy agencies on the difference between natural resources, ecosystem assets and natural capital.

1. Natural resources and ecosystems are not linked well in the standards due to the reporting framework focus in SEEA on one asset. Abiotic (generally natural resources) and biotic (ecosystem) assets are not consolidated in the SEEA-CF accounts standards. One aim of a national set of environment accounts is to enable clearer links between the changes in one asset type impacting on other asset types.
2. Under SEEA-CF ownership of an environmental or natural resource asset is based on the physical value of the asset. Ownership of an environmental asset in the Central Framework is based on the natural resource asset being measured and not of the part of the environment (ecosystems) that supports or contains it. In SEEA-EEA there is a measurement of the asset, and ownership is based on the owner of the land rights where the ecosystem's basic spatial unit is located. Since ecosystems are difficult to trade, have services that have multiple users or sit outside of the production boundary, the ownership of ecosystem asset are not clear. There is no hierarchy of asset classes between ecosystems and natural resources, just a recognition that the environment asset can be co-located with the natural resource. The rights to access the asset (through ecosystem services or through asset depletion) can be owned.
3. SEEA-EEA goes a long way to reconciling 'discoveries', allocation or the appearance of ecosystem assets in the economy but doesn't currently link Central Framework with Experimental Ecosystem Accounts concepts. The current EEA update process is unlikely to fully address this linkage as it is not part of the revision process beyond the important links highlighted in the discussion on the linkage of ecosystem monetary accounts with the general structure of the accounts.
4. Under the SNA and SEEA-CF accounting standards, value added activities from the environment are predominately harvesting or exploitation events. In other words goods are either extracted from the asset for on selling, services are rendered for existing productive activities or goods and services are provided for final consumption. These uses are either from the ownership of the rights to the asset (for natural resources) or exploited as a free good from the environment (for ecosystem services). It is interesting to note that ecosystem services are considered to be one of final consumption, inputs into production or supporting (intermediate) services. Supporting/intermediate services are those considered to be used by the environment itself and not measured through SEEA.
5. SNA has considered the treatment of non-produced, non-financial assets where many of the challenges facing SEEA are the same, but SEEA has considered these assets to have fully entered the accounting framework. In practice the physical transaction of assets that takes place more closely resembles that of what occurs in SNA, which records the transaction as a right to access the non-produced, non-financial asset (or natural resource asset). However, these treatments do not address the interaction with the underpinning ecosystem asset.
6. There are still concerns about how to reflect the sustainability of the economy in regards to natural resources and ecosystems as the effect of the standards precludes any discussion about the remaining resource in the environment for future or sustained use. Much of the monetary consideration has been discussed previously and at the moment won't be considered here. Instead this paper considers physical environmental assets not represented in the SNA, but are measured in the SEEA.

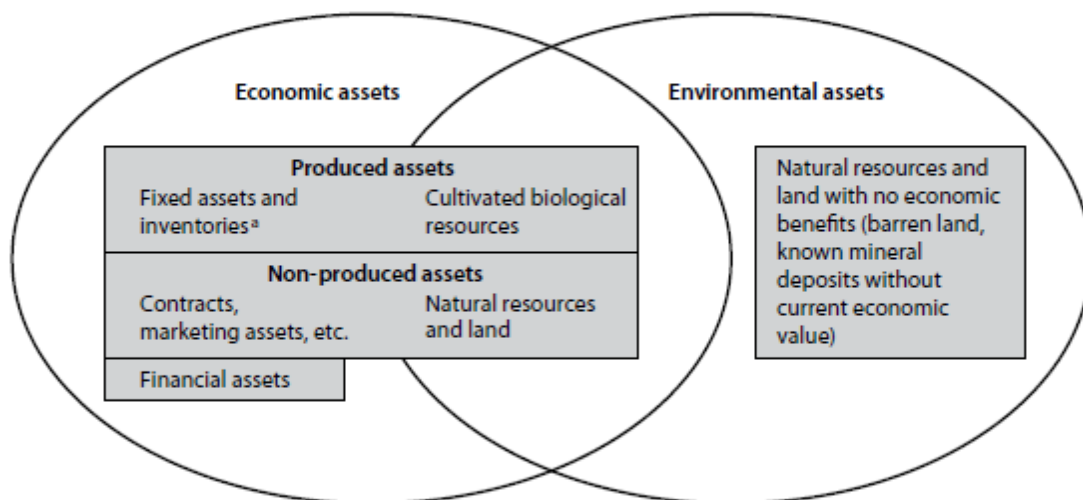
We propose three potential approaches for further linking the physical accounts from SEEA-CF, SEEA-EEA and SNA (to a lesser degree). The first approach is the extension of the combined presentation approaches as indicated in Chapter 6 of the SEEA-CF and Chapter 6 in SEEA-EEA. The second approach is an extension of the SEEA-CF asset schedule to include economic sectors and focus the additions and depletions terms to reflect the terms from the other change in assets concepts from SNA (i.e. use of economic appearance and economic disappearance). The third approach is an extension on the second, with the introduction of an environmental quasi sector and change of intent for SEEA-CF to be a focus on the rights to use the natural resources with a link to SEEA-EEA ecosystems being owned by the environment.

The London Group can help to discuss if the options for consolidating CF and EEA seem reasonable and pragmatic; if there is conceptual sense to approach 2 and 3 on reclassifying natural resources to the right to the resource; and the merits of approach 3 on the creation of a quasi-sector on the environment for physical accounts.

B) Status

Asset accounting in SEEA-CF follows SNA principles as set out in chapter 5. For monetary assets the value of the natural resource is recommended to be attributed to the economic owner. For physical assets there is a broad distinction between economic and non-economic assets. Figure 5.1 from the SEEA-CF broadly describes this.

Figure 5.1
Relationship between environmental and economic assets



^a Other than cultivated biological resources.

SEEA-EEA describes the ownership of ecosystem assets to be in accordance with SNA principles. Monetary valuation of the asset is again attributed to the economic owner or to a default owner where there is no clarity (though this is still being debated in the revision process). Physical assets are attributed to the land units in which ecosystems are located.

These basic principles for physical assets provides an interesting challenge if there is a desire to consolidate or link central framework and ecosystem accounts.

C) History (What has been discussed previously on the topic)

Over time the discussion has progressed how environmental assets should be treated in SEEA.

Physical environmental assets are considered to be defined by what is contained within a country's territories (para5.14 SEEA-CF, para1.25 SEEA-EEA) and extended to the relevant ecosystems services. Monetary environmental assets are defined as to what is in the SNA production boundary in the same sections of SEEA. This treatment limits information on the sustainability of environmental assets due to a lack of connection between the concept of in the SNA and physical assets recorded in SEEA which have *potential* economic use but are not valued on a monetary balance sheet. Many of the papers leading up to this London Group have focused on the important link between land and ecosystems, but not the link between ecosystems and the rights to use environmental assets.

Some of the papers on linking SEEA-CF and SEEA-EEA together in the past few London Group meetings:

- Land accounts – a link between SEEA CF and SEEA EEA, Statistics Sweden, 23rd London Group (Steinbach and Palm, 2017)
- Land accounts for biodiversity – A methodological study for the allocation of land with high nature values to owners and industries, Statistics Sweden, 20th London Group (Steinbach and Palm, 2017)
- Indirectly, AIR EMISSIONS, GHGs and Land Use/Land Cover: Relations between SEEA CF and the IPCC, FAO, 22nd London Group (Tubiello, 2016)
- Presenting SEEA CF and SEEA EEA statistics together: UK experience, ONS/DEFRA, 23rd London Group (Connors et al, 2017)

And a special note to ISTAT in highlighting the links between SNA and Environmental Accounts (20th London Group) (Femia, 2016).

More recently there has been a call for SEEA and SNA to better consider Oceans to include income and balance sheet estimates into SNA from oceans (Milligan, 2019, unpub).

Part of the problem linking environmental assets inside the production boundary with those considered outside of the production boundary are related to how we deal with ownership. There are some lessons from the treatment of non-produced, non-financial assets from SNA we can consider for the treatment of a broader view on environmental assets. .

We can consider what SNA08 says on the rights to a natural resource when considering how to establish a national physical balance sheet:

17.313 As noted above, in many countries permits to use natural resources are generally issued by government since government claims ownership of the resources on behalf of the community at large. However, the same treatments apply if the resources are privately owned.

17.314 There are basically three different sets of conditions that may apply to the use of a natural resource. The owner may permit the resource to be used to extinction. The owner may allow the resource to be used for an extended period of time in such a way that in effect the user controls the use of the resource during this time with little if any intervention from the legal owner. The third option is that the owner can extend or withhold permission to continued use of the asset from one year to the next.

17.315 The first option results in the sale (or possibly an expropriation) of the asset. The second option leads to the creation of an asset for the user, distinct from the resource itself but where the value of the resource and the asset allowing use of it are linked. The third option comes back to the treatment of the use as a resource lease. The difference in treatment between the second and third options was articulated in the context of the case of a mobile phone licence and that recommendation (see SNA News and Notes Volume 14, (United Nations, 2002)) is recapitulated before seeing how each of the three options relates to different types of natural resources.

The interesting note here is the three ways natural resources can be accounted for in SNA:

1. Permit by the owner to use the resource to extinction
2. Permit by the owner to use the resource for an extended period of time in which there is limited difference between the owner and the user of the asset
3. Permit by the owner to use the asset with rights to withdraw access to the asset from year to year.

Sharing assets

17.344 There are two ways in which assets may be shared. The asset may be wholly owned by two or more units, each at different points in time. Alternatively, the risks of and benefits from the asset may be shared by two or more units at a single point in time. The two cases require different treatments.

17.345 Within the SNA, even though the asset may be owned by different units at different times, when a balance sheet is drawn up, the whole of the value of the asset is attributed to one unit. For an asset subject to an operating lease, there is no ambiguity. The legal owner is also the economic owner and is the unit that shows the asset on its balance sheet. For an asset subject to a financial lease, the unit showing the asset on its balance sheet is the economic owner. The value of the asset is the present value of the future payments due to the legal owner plus the value of the asset at the end of the lease as specified in the lease agreement. This is consistent with the views that the value of the asset represents the stream of future benefits coming from the asset and the economic owner is the unit entitled to receive these benefits in return for accepting the risks associated with using the asset in production. For an asset subject to a resource lease, the value is shown on the balance sheet of the legal owner.

17.346 When licences to use natural resources such as radio spectra, land, timber and fish satisfy the “mobile phone” criteria, a separate asset, described as a permit to use a natural resource, is established. These assets are part of the subclass of contracts, leases and licences. They are then shown on the balance sheet of the licensee.

17.347 Sharing the risks and rewards of an asset between different units at a point in time is unusual. The most common occurrence is that a single unit undertakes the activity in which the asset is used and that unit shares the returns among the owners in the form of distributed property income. However, occasionally it is possible such a single unit does not exist and it is not meaningful to try to create it statistically. This is most common when the participating units are resident in different economies, as may be the case with an airline, or in the case of some unincorporated joint ventures (UJVs). The terms under which UJVs are established are diverse but one form allows that all members share the assets equally. In such cases, the SNA records the assets shared between the owners in proportion to their ownership shares.

17.348 In some joint ventures, one party may contribute an asset as its share of the costs. If this happens, an injection of capital equal to the value of the asset should be recorded followed by the purchase of the asset in question with the ownership of the asset then shared by all parties to the arrangement.

The interesting part to note here is that multiple owners of a single asset are plausible but rare and usually dealt with on a case by case basis. This has implications for the treatment of environmental asset where there are multiple uses.

From the OECD measuring capital manual (2009).

The scope of assets belonging to government is often large and includes produced and non-produced assets. For example, natural resources are often government-owned and can account for an important part in the total wealth of the public sector. Note, however, that when government owns a non-produced, non-financial asset such as land or a subsoil resource and leaves its exploitation to another unit, the act of renting is not itself considered production. Thus, the capital services provided by land and subsoil assets should be registered with the users of assets and there is no need to make an imputation for government. In other words, all assets that are used in production processes undertaken by governments should be considered as sources of capital services in government production and hence as candidates for a return on capital. For most practical purposes, this would limit the scope of government assets for which a net return is estimated, to produced assets (including inventories) plus land associated with structures used by government (16.3).

One of the more interesting insights from the measuring capital manual is the presumption that there is production for government units that own non-produced, non-financial assets is limited to property income. This points to the relationship around the rights to access natural resources and land with the economic activity taking place on the land. This further tells us that as we take into account capital services in the context of understanding productivity and the determinants of growth then multiple uses of an environmental asset will need to be measured. If we consider that ecosystems are providing services which are being consumed with no production process, then the owner of the rights is not clear, nor if the value should be attributed to any existing economic sector. For instance, if water purification processes are being used downstream by Agriculture and Households, there is no productive unit under existing economic sectors, though there is a consumption of these purification services regardless of ownership of the land where the ecosystem is located.

D) Proposal(s) for way forward

As previously mentioned, there are 3 possible approaches:

1. **Reporting change:** Combined table presentation can reflect the change in the asset as well as other economic and ecosystem changes, however these are theme based and run the risk on not being comprehensive or useful to determine the monetary transactions based on the activity.
2. **Extend the asset tables:** SEEA-CF tables should be extended in two ways:
 - a. Include the use of memorandum items to record related transactions in ecosystems, this will mean an increase in data needs as well as linking to the geographical location of natural resource harvesting sites (mines, farms, plantations etc). These assets should show stark changes over time as the economic activity or harvesting takes place. The extinguishing of the right to the asset should reduce double counting between ecosystems and natural resources.
 - b. Use of a Change in Asset table for SEEA-CF (SNA08 chapter 12). This should open up the possibility of tracing the economic appearance (discoveries) and disappearance (depletion, degradation) in a frame which can be compared to other changes. This could also open up the potential to record the extinguishment of rights to natural assets as a transfer to cash.
3. **Standards practice change:** Change some of the assumption around how SEEA-CF treats the transfer of assets from the environment to the economy
 - a. Assume there is a transfer of rights instead from the environment to the economy and the rights are then sold on for further economic activity
 - b. Harvesting is then considered to be an extinguishing of those rights in which the right to the asset is transferred from the environment to the economy for cash. The environment undergoes a change in asset for both the natural resource being harvested and for the ecosystems that are changed by harvesting the asset.
 - c. The extinguishing of that right to the asset needs to be accounted for on the balance sheet and any reduction in ecosystem services reflected in the relevant SU tables.
 - d. Introduce an environment quasi sector as the counter-party to these transactions. (see below).

Introduction of an environment quasi-sector

The environment quasi- sector would operate in a similar way to the 'rest of the world' sector in the SNA. Like the Rest of the world in SNA there would be specific rules for how this sector interacts with the other sectors. For example, introducing an environment sector has the effect

of moving the memorandum items on to the balance sheet with the ecosystems wholly incorporated into the environment quasi sector.

- a. The assumption of rights to a natural resource can be recorded as a capital transfer instead of an economic appearance
- b. The extinguishment of the rights to the asset can be reflected in the economic disappearance of the ecosystem asset in which it is located
- c. Any associated changes to ecosystem assets can be reflected in the accounts through treatment at the same time. And there is symmetrical treatment of asset in the economic and environmental sectors.
- d. Any changes in the delivery of other ecosystem services can be represented as changes in capacity of ecosystems in the balance sheet. Due to environment being classified as a sector, the remainder of ecosystem services not consumed are those that are available for intermediate services (own account use by the environment).

Examples

So we can demonstrate the different treatments with a scenario:

Scenario 1 – Timber harvesting

Government assumes the rights to a forest, sells this forest to a private corporation which harvests it to generate cash. The forest is also classified as a forest ecosystem which has various ecosystem services that are consumed by the local township and downstream. The harvested land is returned to government where it is left to regenerate over time.

Under current treatment, SEEA CF records an asset in the timber account and records depletion over time and then any regrowth. Land accounts will record a change from forest cover to probably grasslands and then potentially return to forest cover over time. Land use will record a change from unused to agriculture (forestry).

Independently, SEEA-EA records the provisioning of a timber provisioning service from the ecosystem, potentially a condition loss and a loss of ecosystem services based on the reduction of trees in the forest ecosystem. The condition of the ecosystem may be reduced to zero as it changes from a tree environment to a grassland. The condition may return over time, but it is likely that there will not be a return to its original condition.

Now if we apply approach 1 (combined tables reporting) to the scenario we should see something like this:

Economic variables							Environmental variables						
SELECTED PRODUCTS	Output/ Domestic production	Gross Value of Production (a)	Value added (b)	Exports (c)	Imports (c)	Employment	Land use		Use of	Net GHG emissi on	Carbon	Biodiversity	
				Quantity	Quantity		Opening stock 2014-15	Closing stock 2005-16	Soil water	2014- 15 (e)	Co2-e	# threatened species	
	t	\$m	\$m	t	t	no. persons	'000 ha	'000 ha	'000 ha	ML	Gg CO ₂ -e	t	no. '000
Forestry Products													
Timber provisioning	1,200	300	150	400	200	na	100	0	-100	500	60	-300	1

Step 3 – Timber is harvested; Land retained by government								
Opening stock			Other changes in assets			Closing stocks		
	NFC	GG		NFC	GG		NFC	GG
Timber	100		Economic disappearance	-100				
Land -Forest		100	Economic disappearance		-100			
Land - Grassland			Economic appearance		100			100
Memorandum item								
Forest Ecosystem		100	Economic disappearance		-100			
Grassland Ecosystems			Economic appearance		100			100

This aligns well with the notions of appearance (discoveries) and disappearance of non-produced, non-financial assets (depletion) that are produced in the SEEA tables, but have ownership identified as a physical asset and considered these a part of the forest ecosystem. As the right is taken to extinction, then the forest ecosystem resembles more of a grassland and its condition changes dramatically.

If we now introduce an environmental quasi-sector into the sector classifications. The treatment is similar to that of approach 3:

Step1											
Opening stock				Capital account				Closing stocks			
	NFC	GG	Env		NFC	GG	Env		NFC	GG	Env
Timber rights			100	Capital transfer		100	-100			100	
Land rights			100	Capital transfer		100	-100			100	
Forest Ecosystems			100								100
Grassland Ecosystems											

Step 2											
Opening stock				Capital account				Closing stocks			
	NFC	GG	Env		NFC	GG	Env		NFC	GG	Env
Timber rights		100		Acquisitions less disposals	100	-100			100		
Land rights		100								100	
Forest Ecosystems			100								100
Grassland Ecosystems											

Step 3											
Opening stock				Other changes in assets				Closing stocks			
	NFC	GG	Env		NFC	GG	Env		NFC	GG	Env
Timber rights	100			Economic disappearance	-100						
Land rights		100								100	
Forest Ecosystems			100	Economic disappearance			-100				
Grassland Ecosystems				Economic appearance			100				100

With the introduction of forest ecosystems onto the balance sheet but owned by the environment then the question of what is a natural asset in the economy can be recorded as a right. The rights to timber (and land, subsoil assets etc) are transferred to the relevant sector and then are traded or used in an economic process. If the asset is taken to extinction, then the asset is converted into cash, and the economic disappearance of the asset is recorded in the environment sector. As a corollary, any managed regrowth would be attributed to economic appearance of the asset.

The interesting part is the impact on the environmental sector. The forest ecosystem has been changed into another ecosystem, the final consumption and intermediate consumption characteristics have changed, leading to degradation of the ability of the ecosystem to provide its original ecosystem services. If there is a link to ecosystems services or capacity for ecosystem services, this could be recorded in context with the treatment of the right to the related asset.

This potentially improves the measurement of the value of environmental assets by highlighting the interactions of the environmental asset with its non-produced and natural counterparts (as highlighted in Fenmichael & Obst 2019 discussion paper on asset valuation).

One of the problems in developing the other changes in assets table with an environment quasi-sector is the question around if we need an asset-liability pairing. SNA doesn't need to handle this from an environmental perspective. Non-produced, non-financial asset occur as economic 'appearances' on the balance sheet without a corresponding liability. Ogilvy et al (2019) raises this question around if there should be some corporate accounting asset-liability relationship with the environment and considers implications for SNA. We haven't taken this discussion any further for the moment apart from highlighting that the use of an environmental quasi sector could aid to track the amount of environmental assets remaining. Some of the consequences of this would be worth discussing.

The comparable concepts from the SNA was resolved in the compilation of licences for radio spectra. The rights to natural resources (central framework concepts) are tradeable, whereas the ecosystems are impacted by the productive use of that right (as in the timber example above). The addition of an environmental sector and the application of some more SNA concepts can help to draw these assets closer together.

Next steps

We have started the creation of the "other changes in assets" accounts with environmental assets for discussion amongst national accountants and potential users of the changes. From the environment accounts perspective we feel that this will provide the link between environmental assets as a balance sheet and the use of those resources for income and production. So far we have constructed some of the balance sheet relationships for energy and mineral assets, with scope to fill in land cover or ecosystem extent when they become available in the next year or so.

The first use of an extended balance sheet will be useful to allocate the estimate of natural inputs to the economic disappearance of assets. The format will also enable to handle at least on the physical side, some of the dilemma faced when there is an appreciating stock (for example, from regrowth) in the environment compared to the economic (Fenmichel and Obst, 2019 - discussion paper 5.2).

E) Proposal of changes/additions in the SEEA CF

1. We suggest the construction of a national physical balance sheet, incorporating sectors into the calculation of environmental assets. This includes introducing some of the concepts from 'The other changes in asset' accounts from SNA 2008.

Incorporate where possible that the rights to the assets are recorded on the physical balance sheet (subsoil rights record the extent in which the minesite is located, timber rights with the forest ecosystems and so on) as the main attribution to the economy.

If an environmental quasi-sector is not palatable, establish ecosystems extent at least as a memorandum item to the accounts and focus the SEEA-CF asset tables as rights to use the part of the environmental asset.

2. Further discuss the introduction of an environmental quasi sector to bring ecosystems onto a physical balance sheet.

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Appendix 1 – Agricultural combined table

25.1 Combined Presentation, Australia, 2015-16

SELECTED PRODUCTS	Economic variables								Consumption Variables		Environmental variables						
	Output/Domestic production	Gross Value of Production (a)	Value added (b)	Exports (c)		Imports (c)		Employment	Food consumption/Nutrition		Land use	Use of Irrigated Water (d)	Net GHG emission 2014-15 (e)	Fertilizer - Nitrogen (f)	Livestock and Fruit Trees		
	t	\$m	\$m	Quantity	Value	Quantity	Value	no. persons	Food (raw product equivalent)	Consumption	Opening stock 2014-15 '000 ha	Closing stock 2005-16 '000 ha	Net Change	ML	Gg CO ₂ -e	t	no. '000
Agricultural Products																	
Cereal Crops																	
Wheat (for grain or seed)	22,274,514	6,170	na	38,184,868	11,802	32,320	40	na	na	na	12,214	11,282	-932	na	1,314	na	..
Barley (for grain or seed)	8,992,274	2,277	na	14,819,122	4,215	68	0	na	na	na	3,987	4,108	120	na	449	na	..
Maize (for grain or seed)	400,032	130	na	128,643	75	24,816	21	na	na	na	58	53	-5	na	14	na	..
Oats (for grain or seed)	1,299,680	398	na	213,208	183	2,328	3	na	na	na	806	822	15	na	73	na	..
Rice (for grain or seed)	273,942	115	na	376,100	474	159,962	200	np	na	na	68	27	-41	317,327	377	13,802	..
Sorghum (for grain or seed)	1,790,574	492	na	1,666,037	528	na	na	na	na	na	707	521	-187	na	116	na	..
Triticale (for grain or seed)	127,393	32	na	1,305	0	na	na	na	na	na	80	78	-2	na	9	na	..
All other cereals (for grain or seed)	54,686	15	na	494	1	na	na	na	na	na	189	65	-124	na	10	1,404,559	..

Source: (ABS 2017) From Nature to the Table: Environmental-Economic Accounts for Australia, 2015-16