Comment Responses on:
Globalization of agricultural pollution due to international trade
By: C. O'Bannon el al.

**Review by HHG Savenije:**

*<u>Comment</u>: I only have problems with the incorrect use of units. Virtual water trade is a flux and as a result, the units should be in m3/a or if it is computed per capita in m3/(a.cap). Only Fig2 uses correct units for the rest all mention in the text and in the Figures is incorrect. To be acceptable for HESS correct use of units should be made.*

**<u>Response</u>: We have corrected the notation throughout the manuscript.**

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**Review by Anonymous Referee #2**

*<u>Comment 1</u>: While your study covers very long period (1986-2010), you have used the grey water footprint (m3/ton) from Mekonnen and Hoekstra (2010a, b) which is an average value for the period 1996-2005. How did you account for the change over time in the water footprint (m3/ton) due to changes in crop yield and fertilizer application rate? You have not said anything about the adjustment you made to the average values (m3/ton) in your paper. Will your final analysis and conclusion change if there is a change over the years in the grey WF (m3/ton)?*

**<u>Response 1:</u> We used a constant value equal to the average of the grey water footprint of each commodity in the 10-year study by Mekonnen and Hoekstra (2008) to estimate grey water transfers. We agree that there is temporal variability in crop water footprints (e.g. Sun et al. 2013 Water Resources Management 27:2447-2463). However, trends are minor and are overshadowed by the major changes in trade network structure (see Carr et al. 2012 Geophysical Research Letters 39:L06404 for a description of trade network changes). In the revised manuscript, we have clarified that we use a constant water footprint estimate in our analysis. We also now note that this approach is consistent with the methodologies of recently published analyses of virtual water transfer networks (e.g. D'Odorico et al. 2012 Environmental Research Letters 7:034007; Suweis et al. 2013 PNAS; Carr et al. 2013 PLoS ONE 8:e55825).**

*<u>Comment 2</u>: Your grey virtual water trade estimate seems to be quite large (1200 billion m3/yr in 2010) compared to the one estimated by Hoekstra and Mekonnen (2012) (433 billion m3/yr average over the period 1996-2005). Since you have used the same water footprint intensities (m3/ton), what could be the reason for this large difference? Have you considered more products compared to Hoekstra and Mekonnen (2012) or could there be other reasons?*

**<u>Response 2</u>: The grey water footprint estimated by Mekonnen and Hoekstra (2012) was 733 billion $m^3$/yr. This estimates is an average over a 10-year time period. Over the same time frame, our estimate (10-year average) was 1,010 Billion $m^3$/yr.**

**There are several potential explanations for the difference in estimates. First, in our calculations we convert live animals to 'carcass weight' and then convert to grey water, this may increase our estimates. Second, we use a different trade database than Mekonnen and Hoekstra (2012) use in their study. Even slight differences in the trade data could account for this inconsistency. Finally, there is a potential for double counting of grey water in products used for animal feed. Double counting of products inflate estimates of grey water footprint. Of these potential factors, differences in trade data are most likely to create the differences in overall estimates of grey water footprint. However, we now explicitly acknowledge both the difference in our estimate from the previously published estimate and each of these factors as potentially contributing to this difference.**

*<u>Comment 3</u>: Page 11229, line 23: You state that previous studies of grey WF are limited but have not indicated in what way. What was their limitation and how do you address them in your paper?*

**<u>Response 3</u>: Previous studies are important in developing the grey water concept and making initial estimates of the size of the global grey water footprint. However, previous studies of grey water are limited because they integrate long time spans, masking critical variability in grey water transfers. These previous analyses also do not evaluate factors that control grey water transfer networks. Our study is one of the first to make an attempt to describe the structure of the grey water trade network and to define the factors that control the network and its dynamics. We have clarified this point in the revised manuscript.**

*<u>Comment 4</u>: Page 11230, line 4: "The grey water footprint concept can be extended…" I am not sure if you can extend the grey WF concept by accounting for other pollutants. You will only improve its estimate. So please replace 'concept can be extended' by 'estimate can be improved'.*

**<u>Response 4</u>: We have removed this statement from the manuscript.**

*<u>Comment 5</u>: Page 11230, line 6-7: You stated that one of the serious shortcoming of the grey WF concept is its failure to explicitly account for the environmental effect of flow alteration. Flow alteration is related more to the blue WF than the grey WF. Therefore, I find your statement very strange. Please rephrase it or convince me.*

**<u>Response 5</u>: We have removed the confusing statement from the manuscript.**

*<u>Comment 6</u>: You missed one important recent study on virtual water trade which also include trade in grey water by Hoekstra and Mekonnen 2012, PNAS.*

**<u>Response 6</u>: We now cite this paper in the manuscript.**

*<u>Comment 7</u>: Page 11229, last line (line 27): replace 'off of' by 'only on'.*

**<u>Response 7</u>: Done.**

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**Review by Anonymous Referee #3**

*<u>Comment 1:</u> pg. 11225. I think that the words "clustering and dispersion" are a bit too vague and it is difficult to grasp the effect of the nonlinear relation in Eq. (2). The exponent of the power law indicates correlation between topology and weighted properties of the network (see Barrat et al, PNAS 2003). Correctly, an exponent greater than one, means that there is indeed non trivial correlation and that "not only would nodes with higher degrees have more export links but each link would also carry on average a higher volume of virtual water", i.e. the backbone of the networks is dominated by relatively few nodes (see Suweis et al., GRL 2011).*

**<u>Response 1</u>: We have clarified the use of the power law equation to describe the relationship between nodal strength and degree in the network. We no longer use the terms "clustering and dispersion." We now write "The value of the exponent is a measure of how concentrated the total strength of the network is relative to the varying degree of each node. Exponents greater than unity indicate a more concentrated network of grey water trade because, in this case, not only would nodes with higher degrees have more export links but each link would also carry on average a higher volume of virtual water."**

*<u>Comment 2</u>: pg. 11229 line 22. For future projection of virtual water transfers the correct references are Suweis et al, GRL 2011 and/or Dalin et al., GRL 2012. Possible hint: if from the analysis of the VW flows from 1986–2010 you find that the ratio of green + blue and gray virtual water growth is somehow constant, then you can use the mentioned future projections of VW to have a qualitative estimate of gray water transfer.*

**<u>Response 2</u>: We now cite the Suweis et al. 2011 and Dalin et al. 2012 papers.**

*<u>Comment 3</u>: In the conclusions you raise concerns related to the fact that consumers are not completely affected by the environmental impacts of their choices. However, at pg. 11228 line 26 you find that the Gini coefficient is slightly decreasing over the 25 years. Aren't these finding somehow indicating an improving in the responsible consumer behaviors? Moreover, same pg. 11228 line 28: "External grey water footprints were highly unequal, but only accounted for 14.1% of the inequality in the total grey water footprints because external water footprints are small compared internal water footprints and internal grey water footprints had lower inequality". Does it mean that up to now, globalization on water pollution due to agricultural production is not impacting so much national water pollution?*

**<u>Response 3</u>: We agree that the Gini coefficient decreases over time and now state this more explicitly in the text. We also note, however, that this change is very small relative to the overall magnitude of inequality.**

**We also agree that grey water transfers, while highly unequal (Table 1), account for a minority share of overall inequality in the grey water footprint. This is a reflection of grey water transfers being much smaller than the internal grey water footprint (e.g. Seekell et al. 2011 Environmental Research Letters 6:024017). However, we believe that grey water transfers are important for several reasons. First, the size grey water transfers are increasing. Second, the external grey water footprint is highly unequal. This is because socio-economic differences between countries create unequal abilities to externalize agricultural pollution (cf. Seekell et al 2011). This may result in a scenario where wealthy countries disproportionately pollute others. Understanding the dynamics of the grey water transfer network is critical to understanding potential fairness issues associated with this type of inequality. We have clarified these points in the revised manuscript.**

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**Review by Anonymous Referee #4**

*<u>Major Comment 1</u>: The grey water footprint here is a theoretical volume that must be applied to dilute the concentration of agricultural chemicals. This volume is not applied in practice, so there is nutrient leaching from agricultural fields. For this reason, this quantification is not an accurate representation of actual water pollution.*

**<u>Response 1</u>: We agree that the grey water footprint is a theoretical volume. However, assessing pollution associated with trade directly is difficult and the grey water footprint represents a previously validated approach (Liu et al. 2012 Ecological Indicators 18:42-49) by which we can attempt to evaluate the influence of trade on pollution (Hoekatra et al. 2011 The water footprint assessment manual. Earthscan). We clarify this reasoning the in revised manuscript.**

*<u>Major Comment 2</u>: It is misleading that "agricultural pollution" and "grey water" are the terms used throughout the paper, when only nitrogen runoff is considered. The title and terminology throughout the paper should be adjusted to be more precise and specifically represent nitrogen pollution only.*

**<u>Response 2</u>: We will provide additional clarification throughout the manuscript about the focus (coastal eutrophication due to nutrient inputs from rivers, Liu et al. 2012, Ecological Indicators) and limitations (nitrogen pollution only) of the grey water footprint.**

*<u>Major Comment 3</u>: A time invariant measure of nitrogen application was used, but the paper presents grey water trade over time, which is not even mentioned as a caveat.*

**<u>Response 3</u>: In the revised manuscript, we explicitly state that we use a time invariant grey water footprint to estimate grey water transfers. Our reasoning and changes relative to this our described in our response to Reviewer 2 (Response 1).**

*<u>Major Comment 4</u>: A set fraction of the applied nitrogen is assumed to run-off the agricultural lands, where a more sophisticated methodology could be used.*

**<u>Response 4</u>: We state this assumption of grey water footprint estimates explicitly in the revised manuscript.**

*<u>Comment 5</u>: It is problematic that nitrogen is the only nutrient considered in this study. Other papers have examined the implications of trade for phosphorous (see Schipanski et al 2012, Craswell et al 2010), so this nutrient should be included too, particularly to keep the terms "agricultural pollution" and "grey water". Until you include other pollutants, how can you claim that they will not change the trend? (i.e. please remove P11230 L9-11)*

**<u>Response</u> 5: The grey water footprint is an indicator of pollution associated with agricultural pollution (Hoekstra et al. 2011. The Water Footprint Assessment Manual. Earthscan). We will provide additional clarification in the revised manuscript that the grey water footprint is specifically based on nitrogen pollution. We will remove the sentence regarding other pollutants in the revised manuscript.**

*<u>Comment 6</u>: The methodology section is incomplete and many of the major assumptions are not clearly stated. The methodology on the grey water footprint calculations should be included in greater detail. The problematic assumptions, such as the time invariant data and assumption of a runoff threshold, should be explained and addressed. The commodities used should be included (rather than referring to Carr et al 2013). More information is needed on how Gini coefficients are calculated and what they mean (rather than referring to Seekell et al 2011).*

**<u>Response 6</u>: We now include a more detailed explanation of the calculation and interpretation the Gini coefficient.**

**We agree that the assumptions of the grey water footprint estimates should be more clearly stated. We now explicitly state that we use a temporally averaged grey water footprint to estimate grey water transfers (see reasoning in Review 2, Response 1). We now explicitly state the runoff threshold assumption (Review 4, Response 4).**

**We now include a table of the specific commodities used in our analysis. We have also included this table at the end of this document.**

*<u>Comment 7</u>: The USA was presented as the largest exporter of grey water (i.e. USA subjects itself to nitrogen runoff). However, the entire discussion focuses on the inequality of the trade system. The discussion focuses on how highly developed countries*

*off-shore their nitrogen pollution, which does not reconcile with the results of the USA as the major exporter. Please explain.*

**<u>Response 7</u>: We agree that the USA is the largest exporter of grey water, however we note that it also imports substantial amounts of grey water relative to other countries. Hence, the role of the United States is complicated, but it is still able to contribute to inequality in the external grey water footprint. We will clarify this point in the discussion. We will specifically discuss the case of the United States, which is wealthy enough to participate in international trade (off-shoring pollution) but is also a major center of agricultural production.**

*<u>Comment 8</u>: Similar to the above point, inequality in internal grey water networks was shown to dominate inequality (P11229 L3-6). However, the discussion focuses on external inequality (P11230 L12-15). Please explain. Also, if most inequality is driven by internal footprints, does that mean that food trade actually leads to off-shoring of pollution in some unfair way? Please explain how your findings on inequity relate to the paper by Craswell et al 2010, who indicate that lack of access to nutrients is the equity issue, rather than over-use of the nutrient, as indicated in this paper.*

**<u>Response 8</u>: We agree that most inequality is due to internal grey water footprints, but this is a reflection of the greater size of internal water footprints versus external water footprints (e.g. Seekell et al. 2011 Environmental Research Letters). We clarify this point in the revised manuscript. The external footprint is highly unequal. While our quantitative analyses are unable to resolve issues of fairness (see Seekell et al. 2011 Environmental Research Letters), there is a potential fairness issue with wealthy countries having more access to international trade and hence having a disproportionate ability to externalize their pollution (as represented by the grey water footprint). We clarify the limitation of the quantitative analysis and this potential fairness issue in the revised manuscript.**

**The Craswell et al. 2010 (Proceedings of the 19th World Congress of Soil Science Symposium, p. 27-30) perspective on inequality is different than ours, in part because the P imports they study are those in the crop itself. The pollution quantified in the grey water footprint is the pollution released in production process. In the revised manuscript, we describe this issue (citing Craswell et al.) and compare it to the perspective given in our paper. Overall we expect that the environmental sciences, including socio-hydrological (like our manuscript) and biogeochemical (like Craswell et al.) analyses stand to inform values-based judgments as policy makers increasingly recognize the need to manage across political boundaries.**

*<u>Comment 9</u>: There are several places in the paper where it is claimed that trade leads to increased water pollution. However, just because a correlation exists, this does not indicate causation. It is possible that there would be more water pollution without global trade. For example, the world without trade may lead to an agricultural system with increased nitrogen inputs. In other words, trade may be leading countries to become*

*more efficient in their internal grey water footprint (see Copeland and Taylor 2005, who causally show that trade reduces pollution in some cases). While it may be true that nitrogen inputs have increased over time, it is not clear that trade is driving this trend, so please remove all statements that trade is leading to more pollution unless you can identify a causal mechanism (i.e. P11231 L17-19; last sentence of abstract; others)*

**<u>Response 9</u>: The intended focus of our manuscript is not that trade leads to increased water pollution, but rather that trade allows for pollution to be externalized. We have clarified this point throughout the revised manuscript.**

*<u>Comment 10</u>: Externalize: In many places you use the term "externalize" in reference to trade. However, I think it would be better to use the term "off-shore" or "transboundary externality". This is because "externality" is commonly used to refer to a negative impact of production, such as pollution. In other words, the production of pollution is already an "externality" to growing food. Now, you want to talk about the production of this pollution externality specifically in the non-consuming country, so please use another term to avoid confusion due to dual meanings of "externality".*

**<u>Response 10</u>: Our usage of the term "externalize" is correct throughout the paper and is not related to the term "externality." In the revision we will make sure that there is no confusion between "externalize" and "externality".**

*<u>Comment 11</u>: P11224 L11 and P11229 L20-21 Please cite papers that actually present analysis of blue and green virtual water transfers. The papers that you cite here do not present work on blue or green flows.*

**<u>Response 11</u>: We have clarified that Carr et al., 2012a presents an analysis of virtual water transfers that are combined blue and green water transfers.**

*<u>Comment 12</u>: P11225 L25 and P11228 L17 Strength vs. degree does not indicate network clustering.*

**<u>Response 12</u>: The term "clustering" will be changed to "concentrated". Also see Review 3, Response 1.**

*<u>Comment 13</u>: P11228 L4 Here and in other places you state that the global grey water network is becoming more connected, when it is actually the food trade network globalizing. Whenever you are referring to the non-weighted properties of the network, it is best to refer to the actual commodity trade network, since this is what the trade links are based upon.*

**<u>Response 13:</u> We will adjust the paper so that in all references to non-weighted properties, we refer to the actual commodity trade network.**

*<u>Comment 14</u>: P11229 L17-18 What are you referring to here? Grey strength? Grey GWF? Please reference the appropriate graph (i.e. Fig 4A or 4C?)*

**Response 14: We are referring to the grey water strength, we will clarify statement and cite Figure 4A in the revised manuscript.**

*Comment 15: P11230 L19-20 It is not clear what causes the structure, please remove this statement.*

**Response 15: We have removed this statement in the revised manuscript.**

*Comment 16: P11230 L23 It appears that Mekonnen et al 2010 provide a constant grey water footprint across goods. Do they provide commodity specific grey water footprints? If not, please remove this sentence. If so, please include some data.*

**Response 16: Commodity specific grey water footprints are given in Mekonnen and Hoekstra (2011) and Mekonnen and Hoekstra (2012). We refer to these papers specifically in the revised manuscript.**

**Mekonnen, M.M. and Hoekstra, A.Y. (2011) The green, blue and grey water footprint of crops and derived crop products, *Hydrology and Earth System Sciences*, 15(5): 1577-1600**

**Mekonnen, M.M. and Hoekstra, A.Y. (2012) A global assessment of the water footprint of farm animal products, *Ecosystems*, 15(3): 401–415.**

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**Review by Anonymous Referee #5**

*Comment 1: First, the 'Data Section' should be as clear as possible. It is necessary to provide more detailed information of commodities and the trade data, not just mention the references. Mekonnen and Hoekstra (2010) calculate the grey water footprint with many years' average. How do you use such data to calculate the grey water footprint in different years? Or do you account for the change of the nitrogen fertilizer in different years? You should specify.*

**Response 1: In the revised manuscript, we have clarified that we use a constant water footprint estimate in our analysis. See our Response 1 to Reviewer 2. We will expand the "Data" section in the revised manuscript to provide increased clarity about our calculations.**

*Comment 2: Furthermore, in equation (1), it is not necessary to have GWNT, on the contrary, you should incorporate internal and external grey water footprint in it.*

**Response 2: Equation 1 shows that the grey water net trade is equal to the difference between the internal grey water and the external grey water values. We**

**will clarify in the revised manuscript that this equation incorporates both internal and external grey water footprints.**

*<u>Comment 3</u>: Second, The summary results should be expanded to provide more information. Specifically, how much grey water is externalized due to international trade? Which countries are the largest NET importers or exporters? Can you specify the large grey water flows between countries? I think readers should be more interested in such information more than just the largest importers or exporters of grey water footprint.*

**<u>Response 3</u>: We will expand the summary of results. We will include the quantity of grey water that is externalized due to trade in 2010, a list of countries who are both the largest net importers and net exporters in 2010, and identify a few of the largest grey water flows between countries in 2010.**

*<u>Comment 4</u>: Page 11223, Line 6. Allan has defined 'virtual water' not 'water footprint'.*

**<u>Response 4</u>: We agree that Allan did not define the water footprint and now cite Hoekstra et al. (2011).**

**Hoekstra, A.Y., Chapagain, A.K., Aldaya, M.M. and Mekonnen, M.M. (2011) The water footprint assessment manual: Setting the global standard, Earthscan, London, UK.**

*<u>Comment 5</u>: Page 3, Line 6-9: "…are transferred "virtually" from the exporter to the importer (Chapagain and Hoekstra, 2008; Hoekstra and Chapagain, 2008). Add the following references: (1) Liu J., Savenije H.H.G., 2008. Time to break the silence around virtual-water imports. Nature 453 (7195): 587. (2) Liu J., Zehnder A.J.B., Yang H., 2007. Historical trends in China's virtual water trade. Water International 32(1): 78-90.*

**<u>Response 5</u>: We agree that these references are relevant and have added them in the revised manuscript.**

*<u>Comment 6</u>: Page 11226, Line 20. What are 'within-class' and 'between-class'? please specify.*

**<u>Response 6</u>: Within-class inequality is a measure of the inequality in the grey water footprint that occurs between countries, but within their social development class (low, middle and high). Between-class inequality measures the inequality that exists between the aggregate social development classes. We clarify this point in the revised manuscript.**

*<u>Comment 7</u>: Page 11227, Line 8. "While the United States was…" This sentence is a repetition of previous description, and should be deleted.*

**<u>Response 7</u>: We will delete this sentence in the revised manuscript.**

*Comment 8: Page 11227, Line 12. "As such China generated…" This sentence is a repetition of previous description, and should be deleted.*

**Response 8: We will delete this sentence in the revised manuscript.**

*Comment 9: Page 11227, Line 15. I assume you want to talk about the net grey water importers/exporters, because Fig. 3 shows the map of the net importers/exporters. If so, another question is raised, is it true that large net grey water importers/exporters remained their identities statically? I can't tell such conclusion from Fig. 3.*

**Response 9: The majority of the large net grey water importers and exporters kept their identities static over the course of the time period studied. One of the only cases where this is not true is in the case of China, which switched to become a net-grey water importer as it developed. A list of some of the largest net-importers and exporters will be included in the revised manuscript as part of an exampled summary results section. See also Response 3.**

*Comment 10: Page 11230, Line 4. I don't think the concept of grey water footprint can be extended with incorporating other types of pollutants.*

**Response 10: We will remove this statement from the revised manuscript.**

*Comment 11: Page 11230, Line 9. Why you are sure that the results will not change much with other pollutants included?*

**Response 11: We will remove this statement from the revised manuscript. See also Review 4, Response 5.**

*Comment 12: Page 11231, Line 9. Again you should check the reference, I don't think Allan has mentioned the grey water in 1998.*

**Response 12: We agree that Allan does not mention grey water. We cited this reference to support Allan's proposition that "virtual water transfers are generally not an explicit consideration in trade decisions". We will rework the sentence and citation to ensure that we are properly representing Allan's work.**

*Comment 13*: *Page 11236, Fig. 1. Fig. 1 is neither clear nor necessary. It looks like importers transfer the pollution to exporter directly. However, the exporter actually generates the pollution by itself, but doing so due to the commodities demand from the importer. I recommend delete Fig. 1*

**Response 13: We agree that Figure 1 is not clear enough. We will redraw the figure in the revised manuscript to more clearly show that pollution is not traveling directly from the consumer to producer, but rather that the entire production process is externalized. We will also clarify this in the figure legend and in the main text.**

*Comment 14: Page 11238 Fig. 3 You mentioned that large net grey water importers/exporters remained their identities statically. However, I noticed from Fig. 3 that several countries have changed between net importer and net exporter. For example, China is a net grey water exporter in 1986, but a net grey water importer in 2010.*

**Response 14: Almost all of the net importers and exporters retained their identities statistically. Some countries, such as China, did change, but this is relatively a small number of countries. We clarify this statement in the revised manuscript. We specifically note that some countries, including China, change between being net-importing and net exporting.**

**To be included in the revised manuscript:**

Appendix A: Commodities used in the calculation of total GWF for each county

| **Commodity** |
|---|
| Wheat |
| Flour of Wheat |
| Macaroni |
| Bread |
| Rice, paddy |
| Rice Husked |
| Rice Milled |
| Rice Broken |
| Rice Flour |
| Barley |
| Barley Pearled |
| Barley Flour and Grits |
| Malt |
| Beer of Barley |
| Maize |
| Flour of Maize |
| Maize oil |
| Rye |
| Flour of Rye |
| Oats |
| Oats Rolled |
| Millet |
| Sorghum |
| Buckwheat |
| Quinoa |
| Fonio |
| Triticale |
| Canary seed |
| Mixed grain |
| Cereals, nes |
| Potatoes |
| Potatoes Flour |
| Frozen Potatoes |
| Potato Offals |

| |
|---|
| Tapioca of Potatoes |
| Sweet potatoes |
| Cassava |
| Flour of Cassava |
| Tapioca of Cassava |
| Cassava Dried |
| Cassava Starch |
| Yautia (cocoyam) |
| Taro (cocoyam) |
| Yams |
| Roots and Tubers, nes |
| Flour of Roots and Tubers |
| Sugar cane |
| Sugar beet |
| Maple Sugar and Syrups |
| Sugar crops, nes |
| Sugar Raw Centrifugal |
| Sugar Refined |
| Molasses |
| Other Fructose and Syrup |
| Sugar, nes |
| Sugar flavoured |
| Glucose and Dextrose |
| Beans, dry |
| Broad beans, horse beans, dry |
| Peas, dry |
| Chick peas |
| Cow peas, dry |
| Pigeon peas |
| Lentils |
| Bambara beans |
| Vetches |
| Lupins |
| Pulses, nes |
| Flour of Pulses |
| Brazil nuts, with shell |
| Cashew nuts, with shell |

| |
|---|
| Chestnuts |
| Almonds, with shell |
| Walnuts, with shell |
| Pistachios |
| Kolanuts |
| Hazelnuts, with shell |
| Arecanuts |
| Almonds Shelled |
| Walnuts Shelled |
| Hazelnuts Shelled |
| Nuts, nes |
| Prepared Nuts (Exc.Groundnuts) |
| Soybeans |
| Soybean oil |
| Cake of Soybeans |
| Soya Sauce |
| Soya Paste |
| Soya curd |
| Groundnuts, with shell |
| Groundnuts Shelled |
| Groundnut oil |
| Coconuts |
| Copra |
| Coconut (copra) oil |
| Palm kernels |
| Palm oil |
| Palm kernel oil |
| Cake of Palm Kernel |
| Olives |
| Olive oil, virgin |
| Olives Preserved |
| Karite Nuts (Sheanuts) |
| Butter of Karite Nuts |
| Castor oil seed |
| Oil of Castor Beans |
| Sunflower seed |
| Sunflower oil |

| |
|---|
| Sunflower Cake |
| Rapeseed |
| Rapeseed oil |
| Cake of Rapeseed |
| Olive Residues |
| Oil of Jojoba |
| Safflower seed |
| Sesame seed |
| Sesame oil |
| Mustard seed |
| Poppy seed |
| Melonseed |
| Cottonseed |
| Cottonseed oil |
| Cake of Cottonseed |
| Linseed |
| Linseed oil |
| Cake of Linseed |
| Hempseed |
| Oilseeds, Nes |
| Oil of vegetable origin, nes |
| Cabbages and other brassicas |
| Artichokes |
| Asparagus |
| Lettuce and chicory |
| Spinach |
| Tomatoes |
| Tomatojuice Concentrated |
| Juice of Tomatoes |
| Paste of Tomatoes |
| Tomato Peeled |
| Cauliflowers and broccoli |
| Pumpkins, squash and gourds |
| Cucumbers and gherkins |
| Eggplants (aubergines) |
| Chillies and peppers, green |

| |
|---|
| Onions (inc. shallots), green |
| Onions, dry |
| Garlic |
| Beans, green |
| Peas, green |
| String beans |
| Carrots and turnips |
| Okra |
| Maize, green |
| Sweet Corn Frozen |
| Veg.Prod.Fresh Or Dried |
| Carobs |
| Vegetables fresh nes |
| Juice of Vegetables Nes |
| Vegetables Dehydrated |
| Vegetables in Vinegar |
| Vegetables Preserved Nes |
| Vegetable Frozen |
| Bananas |
| plantains |
| Oranges |
| Orange juice, single strength |
| Tangerines, mandarins, clem. |
| Lemons and limes |
| Grapefruit (inc. pomelos) |
| Juice of Grapefruit |
| Citrus fruit, nes |
| Citrus juice, single strength |
| Apples |
| Cider Etc |
| Apple juice, single strength |
| Pears |
| Apricots |
| Dry Apricots |
| Sour cherries |

| |
|---|
| Cherries |
| Peaches and nectarines |
| Plums and sloes |
| Plums Dried (Prunes) |
| Stone fruit, nes |
| Strawberries |
| Raspberries |
| Gooseberries |
| Currants |
| Blueberries |
| Cranberries |
| Berries Nes |
| Grapes |
| Raisins |
| Grape Juice |
| Must of Grapes |
| Wine |
| Vermouths&Similar |
| Marc of Grapes |
| Watermelons |
| Other melons (inc.cantaloupes) |
| Figs |
| Mangoes, mangosteens, guavas |
| Avocados |
| Pineapples |
| Juice of Pineapples |
| Dates |
| Cashew apple |
| Kiwi fruit |
| Papayas |
| Fruit, tropical fresh nes |
| Fruit Tropical Dried Nes |
| Fruit Fresh Nes |
| Fruit Juice Nes |
| Coffee, green |
| Coffee Roasted |

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| Cocoa beans |
| Cocoa Paste |
| Cocoahusks;Shell |
| Cocoa Butter |
| Cocoapowder&Cake |
| Chocolate Prsnes |
| Tea |
| Hops |
| Pepper (Piper spp.) |
| Chillies and peppers, dry |
| Vanilla |
| Cinnamon (canella) |
| Cloves |
| Nutmeg, mace and cardamoms |
| Anise, badian, fennel, corian. |
| Ginger |
| Spices, nes |
| Peppermint |
| Cotton lint |
| Cotton Carded,Combed |
| Cotton Waste |
| Cotton Linter |
| Flax fibre and tow |
| Flax Tow Waste |
| Hemp Tow Waste |
| Jute |
| Other Bastfibres |
| Ramie |
| Sisal |
| Agave Fibres Nes |
| Manila Fibre (Abaca) |
| Fibre Crops Nes |
| Tobacco, unmanufactured |
| Natural rubber |
| Cattle |
| Cattle meat |

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| Offals of Cattle, Edible |
| Meat-CattleBoneless(Beef&Veal) |
| Meat of Beef,Drd, Sltd,Smkd |
| Sausage Beef&Veal |
| Cow milk, whole, fresh |
| Butter Cow Milk |
| Milk Skm of Cows |
| Milk Whole Cond |
| Whey Condensed |
| Yoghurt |
| Butterm.,Curdl,Acid.Milk |
| Milk Whole Dried |
| Milk Skimmed Dry |
| Cheese of Whole Cow Milk |
| Whey Cheese |
| Processed Cheese |
| Prod.of Nat.Milk Constit |
| Cattle hides |
| Hides Wet Salted Cattle |
| Hidesdry S.Cattle |
| Sheep |
| Sheep meat |
| Offals of Sheep,Edible |
| Cheese of Sheep Milk |
| Skins Nes Sheep |
| Skins With Wool Sheep |
| Goats |
| Goat meat |
| Offals of Goats, Edible |
| Cheese of Goat Mlk |
| Goatskins |
| Pigs |
| Pig meat |
| Offals of Pigs, Edible |
| Fat of Pigs |
| Bacon and Ham |

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| Sausages of Pig Meat |
| Prep of Pig Meat |
| Chickens |
| Hen eggs, in shell |
| Eggs Liquid |
| Eggs Dried |
| Duck meat |
| Goose and guinea fowl meat |
| Turkey meat |
| Other bird eggs,in shell |
| Horses |
| Horse meat |
| Hair of Horses |
| Hides Wet Salted Horses |
| Hides Dry Slt Horses |
| Hides Unsp Horse |
| Asses |
| Mules |
| Offals other camelids |
| Cocoon Unr.&Waste |
| Hair Coarse Nes |
| Food Prep Nes |