



The State of Agricultural Commodity Markets *IN DEPTH*

Food self-sufficiency and international trade: a false dichotomy?¹

What are the issues?

In the wake of the 2007-08 food crisis that brought higher and more volatile food prices, many countries expressed increased interest in pursuing policies to bolster their levels of food self-sufficiency. At the same time, there has also been widespread critique of policies designed to support food self-sufficiency, on the grounds that they are inefficient and can disrupt trade. This debate has typically been cast as one in which political considerations clash with economic reasoning, resulting in costly outcomes. The dynamics of this debate are an important backdrop in the context of attempts to finalize the Doha Round Agreement on Agriculture at the World Trade Organization (WTO).

The aims of this Note are to clarify the terminology and definitions associated with the concept of food self-sufficiency, to provide some historical context regarding the application of policies that support this objective, and to outline the debates surrounding those policies. The analysis shows that debates over food self-sufficiency have been cast in black and white terms, with critics of the idea defining it in its most extreme form of complete rejection of all food trade.

In practice, self-sufficiency is more of a relative concept along a continuum. Conceptualizing food self-sufficiency along a continuum can help move the debate forward in more productive ways, and reveals that there are a number of instances when pursuing policies to increase a country's own food production for domestic consumption may be beneficial both economically and politically.

¹ This technical note was prepared for *The State of Agricultural Commodity Markets 2015-16* by Jennifer Clapp (Canada Research Chair in Global Food Security and Sustainability, Professor, Environment and Resource Studies Department, University of Waterloo, Canada).

What is food self-sufficiency and how is it measured?

There are multiple understandings of food self-sufficiency that can apply at different levels of analysis (O'Hagen, 1975). According to FAO, "The concept of food self-sufficiency is generally taken to mean the extent to which a country can satisfy its food needs from its own domestic production" (FAO, 1999). This most basic definition can apply at the level of individuals, countries, or regions. In the context of debates on trade and food security, self-sufficiency typically refers to countries that seek to produce all or most of their own food for domestic consumption.

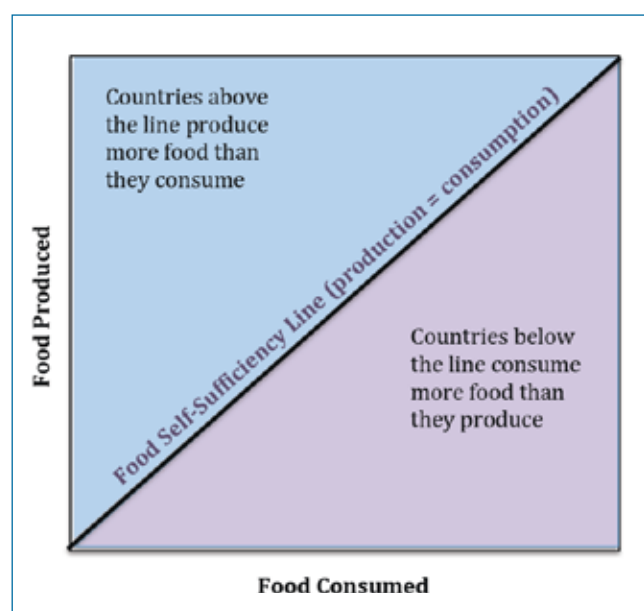
Figure 1 depicts this most basic understanding of food self-sufficiency, with the line representing where food production is equal to food consumption within a country. Individual countries can be plotted onto the diagram to show whether they fall above or below the self-sufficiency line (O'Hagen, 1975; Josling, 1975; Porkka *et al.*, 2013). In this figure, the axes could indicate total food production annually or per capita food production per day.

Although this basic definition is what most people think of when they hear the term food self-sufficiency,

there is a lack of clarity on details when the concept is applied in practice. For example, if a country claims to be self-sufficient in food, does this mean that it does not engage in *any* international trade in foodstuffs? The answer to this question depends on how one further clarifies the definition of food self-sufficiency and how that understanding guides government policy choices.

At one extreme, food self-sufficiency can be defined as a country closing its borders to all food trade – both imports and exports – and concentrating its resources on its agriculture sector so as to be able to produce all of its food requirements domestically. In other words, this definition refers to a state practicing complete autarky in its food sector. Such an extreme policy stance does not apply in practice today, just as there are no countries that practice completely free trade and rely on foreign markets for 100% of their food. All countries, even large food exporters that are fully self-sufficient, typically import at least some food. Even North Korea, the country with perhaps the most isolationist policies, still relies on some imports and food assistance for a portion of its domestic food needs (FAO, 2015).

Figure 1: Basic representation of food self-sufficiency



Source: Author.

A more practical application of the concept of food self-sufficiency is defined as a country producing a proportion of its own food needs that approaches or exceeds 100 percent of its food consumption. This definition does not exclude trade as a possibility, and instead expresses food self-sufficiency as a percentage, or ratio of consumption. This definition is less absolute with respect to where food is sourced, but still gives an idea of a country's self-capacity for food production. Countries that are self-sufficient may specialize their food production to some extent and import as well as export food. But in caloric terms, a self-sufficient country produces as much or more food than it consumes, even if some of the actual food items consumed by its population are different from those that it produces domestically.

This more pragmatic understanding of food self-sufficiency is captured by what the FAO terms the self-sufficiency ratio (SSR), which is defined as the percentage of food consumed that is produced

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domestically (FAO, 2012). The SSR is measured using the following equation with respect to food production and trade:

$$\text{Production} \times 100 / (\text{Production} + \text{Imports} - \text{Exports})$$

More precise measurements of the SSR also include changes in domestic stock levels (Puma *et al.*, 2015). The SSR is typically measured in calories or in volume of food produced, although it can also be expressed as a ratio of monetary value. The SSR can also be measured in terms of a specific commodity, such as wheat, maize, rice or dairy, to give an indication of a country's capacity to produce its own needs for these commodities.

Another measure that captures self-sufficiency levels of countries focuses on dietary energy production (DEP) per capita within a country. This measure considers those countries that produce over 2500 kcal per capita per day to be self-sufficient as it is over this threshold that caloric intake is deemed to be required for an adequate diet (Porkka *et al.*, 2013).²

Food self-sufficiency is related to, but not the same as, measures of net food importing and net food exporting countries, which indicate whether countries import more than they export or vice versa. However, most net food exporting countries are self-sufficient by the SSR and DEP measures, and most net food importing countries are not considered self-sufficient by those measures.³ Using the SSR and/or DEP measures of food self-sufficiency, a country can be considered self-sufficient while still engaging in food trade.

It is important to note that food self-sufficiency is not an expression of food security, although the two can interact in important ways. The concept of food security does not include a consideration of the origin of food or a country's capacity to produce it, so long as it is available, accessible, nutritious, and stable across the preceding three elements. Food self-sufficiency is mainly concerned with the availability (i.e. supply) pillar of food security, and focuses on origin of food, or at least the domestic capacity to produce it in sufficient quantities. As will be discussed below, some also argue that the pursuit of food self-sufficiency supports stability in the food supply, while others stress that it can cause instability.

Some countries that are considered self-sufficient on a national scale can still have a proportion of their population experience hunger and malnutrition. Such countries may produce sufficient amounts of certain crops, such as grain, but they may still need to import significant amounts of fruits and vegetables to achieve a healthy diet. Some self-sufficient countries may also have higher poverty levels that hinder adequate access across the entire population. Other countries that are self-sufficient may have no problem in ensuring adequate and nutritious diets for their population.

At the same time, some countries may have an SSR well below 100 percent, but face no difficulty in securing imports and distributing it equitably. These countries typically have high incomes and can easily cover the cost of food imports out of earnings from their overall exports. Yet other countries that have an SSR below 100 percent may not be able to afford adequate imports to ensure food security for all. Each country faces its own unique circumstances with respect to its own productive capacity and ability to purchase food on international markets, as well as its ability to ensure equitable distribution within its borders. Some of these different possibilities and some examples are outlined in Table 1.

² There are different interpretations of what constitutes an adequate diet in terms of caloric intake. Other factors besides calories also matter for adequate diets, including the nutritional content of the food. The caloric focus here merely captures the macronutrient needs for an adequate diet.

³ Some countries may import and re-export food items which may affect these measures.

Table 1: Countries face different circumstances with respect to levels of food self-sufficiency and food security

	Countries with SSR<80%	Countries with SSR>120%	Countries with SSR = 80-120%
Consumption at or above adequate nutritional intake	These countries are net food importers and easily meet their domestic dietary needs (hunger < 5%). Examples: Japan, United Kingdom, Republic of Korea, Iceland, Mexico	These countries typically meet their dietary needs (hunger < 5%) and export surplus food. Examples: United States of America, Australia, Argentina, Canada, Kazakhstan, Sweden	These countries roughly produce the same amount of food that they consume, meet dietary needs (hunger < 5%), and may export some food. Examples: South Africa, Brazil, Russian Federation, Germany
Consumption below adequate nutritional intake	These countries are net food importers but experience elevated levels of hunger (>15 % of the population). Examples: Liberia, Zimbabwe, Namibia, Yemen, Mongolia, Haiti	These countries experience mild (5-14.9%) or elevated (>15%) levels of hunger. Some of these countries still export food. Examples: Pakistan, Guyana, Thailand	These countries produce roughly the same amount that they consume, but experience mild (5-14.9%) or elevated (>15%) levels of hunger. Some of these countries still export food. Examples: India, Bolivia (Plurinational State of), United Republic of Tanzania, Chad, China

Examples of SSR by country based on information in Puma et al., 2015 (for the 2005-09 period), p. 10 (reproduced below in Figure 2) and compared with FAO 2015 Hunger Map.

Trends in food self-sufficiency

In the 1970s, most countries were largely food self-sufficient. According to O'Hagan, in reference to an FAO study on self-sufficiency measured by production of kilocalories per person per day, some 62 percent of the world's population lived in countries that were "approximately food self-sufficient", meaning that they had a ratio of self-sufficiency between 95 and 105 percent. The percentage of the global population living in countries that had under 95 percent self-sufficiency was 19 percent and the percentage living in countries with over 105 percent self-sufficiency was also 19 percent (O'Hagan 1975, p. 358).⁴

In a more recent estimate, Porkka et al. (2013) show that levels of self-sufficiency, measured in production per capita per day over 2500 kcal, has not changed markedly in the 1965-2005 period, with data showing that around 25 percent of the world's population produces over that caloric threshold, while 75 percent is under it. However, data from this study show that the percentage of the world's population producing

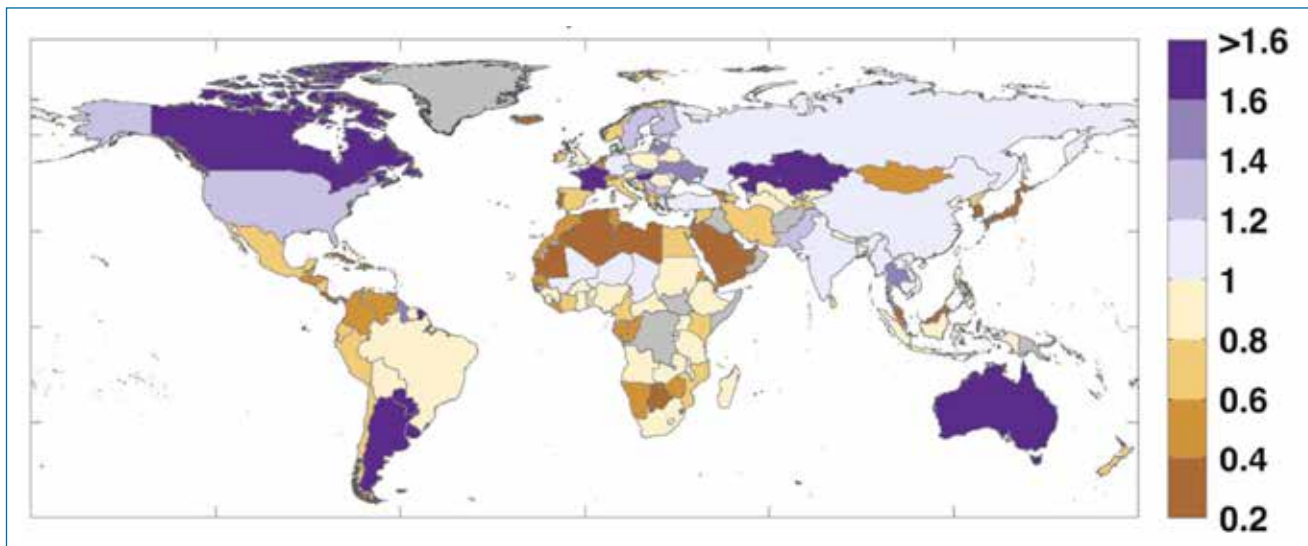
under 2 000 kcal/day has declined significantly since the 1965s. In other words, collectively, the countries producing under the 2500 kcal threshold have nonetheless still increased production since that time. Puma et al. conclude that 83 percent of countries either just met self-sufficiency (SSR close to 100) or had SSRs under 100 for the 2005–2009 period, which is similar to O'Hagan's findings over 30 years earlier (Puma et al., 2015). The lack of significant change in self-sufficiency rates overall is despite the fact that food production has increased globally by 50 percent since mid-1980s (D'Ororico et al., 2014).

Although the percentage of the world's population living in food self-sufficient countries has not changed a great deal on a global scale in the 1965-2005 time period, certain regions and countries have seen important changes over time. Luan et al. (2013) examined trends in self-sufficiency in Africa since the 1960s and found that the continent's overall SSR has declined from 1.0 in 1961 to 0.8 in 2007. The African figures by country over this period can be seen in Figure 3. Other countries also experienced declines in their self-sufficiency. Japan, for example, saw its SSR fall from approximately 80 percent in caloric terms in 1960 to around 40 percent today

⁴ This study does not specify how many kcal per person per day were considered to constitute a sufficient energy supply.

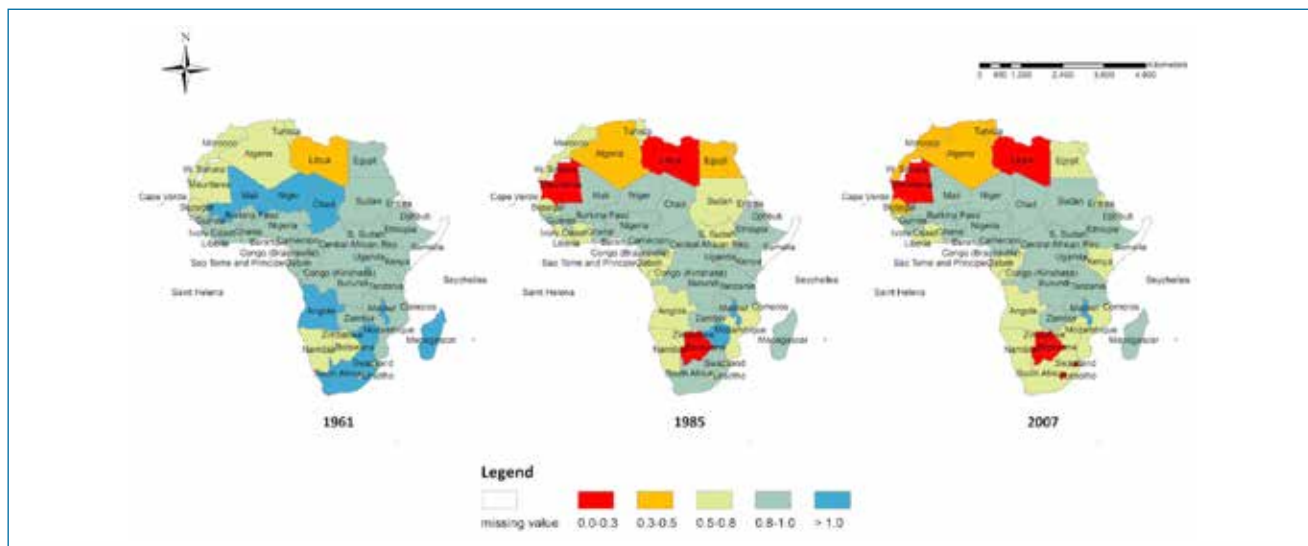
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Figure 2: World food self-sufficiency ratios by country, 2005-2009



Source: Reproduced from Puma *et al.*, 2015, based on FAO data. Licensed under Creative Commons: <http://creativecommons.org/licenses/by/3.0/>, and available open access at: <http://iopscience.iop.org/article/10.1088/1748-9326/10/2/024007/pdf>.

Figure 3: Changes in African countries' SSR over time



Source: Reproduced from Luan *et al.*, 2013, based on FAO data. Licensed under Creative Commons: <http://creativecommons.org/licenses/by/3.0/>, and available open access at: <http://link.springer.com/article/10.1007%2Fs12571-013-0260-1>.

(Kako, 2009). Other countries have seen increases in their levels of self-sufficiency over time. For example, Brazil, China and the Russian Federation have seen an increase in their SSR since the 1980s (Puma *et al.*, 2015; Porkka *et al.*, 2013).

A number of countries are unable to increase their level of self-sufficiency due to their natural

resource endowments. Fader *et al.* conclude that approximately 66 countries today are not able to be self-sufficient due to natural resource constraints, including limited amounts of available cropland, water, and fertile soil (Fader *et al.*, 2013). Imports have been important for these countries to meet their food needs. Indeed, international food trade has increased dramatically in recent decades.

D'Oroico *et al.* (2014) found that in the mid-1980s, around 15 percent of world food production was traded internationally, but by 2009 that figure had reached 23 percent. Fader *et al.* (2013) also estimate that 16 percent of the global population relies on international food trade to meet their food needs. Trade can thus provide an important backstop for those countries that cannot source all of their food domestically. It is also important to note, however, that there are also resource and environmental implications for those countries that export food crops to deficit regions (MacDonald *et al.*, 2015; Hertel *et al.*, 2014.).

Many developing countries, particularly those in Africa, have increasingly had to rely on imports for their food consumption needs, as shown by rising levels of food import dependence since the 1960s. This increase reflects declining levels of domestic food production as well as dietary shifts, demographic trends, and a

changing ability to purchase food on global markets with export earnings (Luan *et al.*, 2013; Rakotoarisoa *et al.*, 2011).

At the same time that food trade has increased, there has been a growing reliance on certain exporting countries as sources of staple food imports. There are relatively few exporters of rice and wheat, for example, on world markets, with just a handful of key exporting countries for each crop. A number of African countries, for instance, rely on Thailand for nearly all of their rice imports, while other developing countries rely on France for nearly all of their wheat imports (MacDonald, 2013; Puma *et al.*, 2015). Some studies show that this concentration of sources of food imports can contribute to heightened fragility in the global food system, which may make it more vulnerable to instability due to both natural and economic disturbances (Puma *et al.* 2015; MacDonald *et al.* 2015).

Policy debates over food self-sufficiency

Debates over the utility of food self-sufficiency as a national policy goal are longstanding. Governments have historically prioritized food self-sufficiency in their agricultural and economic policies as a national security measure. Ensuring a measure of self-sufficiency in food can provide governments with a contingency against supply disruptions that may arise in the context of war, a decline in availability of food on international markets, or volatile food prices on international markets (FAO, 1996). Countries have also historically seen self-sufficiency as a politically expedient policy stance, as dependence on others for its food supply can leave a country in a vulnerable position on the world political stage, especially if those countries that export food threaten to withhold it for political reasons (O'Hagan 1975, p. 359). Countries may also prioritize food self-sufficiency as a means to bolster their farm sectors and support overall economic growth and development, as well as to bolster economic activity and incomes in rural areas.

Some economists have long argued that food self-sufficiency policies are misguided, on the grounds that policies designed to support it are typically inefficient and trade-distorting (Naylor and Falcon, 2010, p. 710). The implementation of trade restrictions, tariffs, and

subsidies in the name of food self-sufficiency are seen to be dangerous and costly policies. Many argue that such policies undermine food security in the long run because they close off opportunities to capture efficiency gains, which can result in lower food production and higher food prices. As such, critics stress that there is a direct trade-off between efficiency and self-sufficiency. Along these lines, a number of empirical studies have sought to demonstrate that it is more efficient to grow cash crops, such as cotton, and import food crops, like wheat, in countries like Sudan (Hassan *et al.*, 2000). Others have stressed that a focus on achieving food self-sufficiency at the national level has diverted government attention from addressing household food security concerns (Von Braun and Paulino, 1990).

Despite these critiques, food self-sufficiency was widely accepted as an agricultural policy goal in 1970s. In the wake of the 1970s food crisis, when food prices climbed rapidly in the space of a few years, many countries adopted policies to bolster their food self-sufficiency. There was widespread support for this policy direction in international policy forums as shown by Resolution II of the 1974 World Food Conference. This Resolution explicitly called for increased food self-sufficiency: "...

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striving in accordance with each country's respective conditions for the maximum possible degree of self-sufficiency in basic foods is the fundamental approach to the solution of the food problem of developing countries" (O'Hagan, 1975, p. 360).

Food self-sufficiency as an agricultural policy goal fell out of favour with many countries in the 1980s up until the early 2000s. World commodity prices, including for food, were low and falling during most of this period. As such, economic policies that prioritized capturing market efficiencies gained political steam during this time. A number of countries became net importers of food after the 1980s, particularly in Africa where governments implementing programmes of structural adjustment were advised by the International Monetary Fund and the World Bank to focus their agricultural efforts on goods for which they had a comparative advantage, often including export crops (Clapp, 1997). Other countries that did not undertake adjustment programmes to the same extent and that had larger domestic markets – notably China, India, and the Republic of Korea – did not abandon their policies in support of food self-sufficiency, but were subject to criticism for what were perceived by economists as inefficiencies associated with those policies (Yang, 1989; Sen *et al.*, 2002; Martin and McDonald, 1986).

Recent years have seen a resurgence of interest in the idea of food self-sufficiency. The 2007-08 food crisis

ushered in a new era of uncertainty on world food markets characterized by higher and more volatile food prices than was the case in the previous 30 years. In this context, many countries announced policies to bolster their levels of food self-sufficiency. These government sentiments were complemented by a growing social movement in support of food sovereignty that emerged in the 1990s and warned of the problems associated with an excessive reliance on international markets. Promoters of food sovereignty have expressed strong support for greater food self-sufficiency based on agro-ecological farming methods as a means by which to increase the resilience of local food systems (Wittman *et al.*, 2010). A growing number of developing countries have explicitly endorsed the food sovereignty agenda in their national legislation, including Ecuador, Bolivia (Plurinational State of), Venezuela (Bolivarian Republic of), Nepal, Nicaragua, Mali and Senegal (Shattuck *et al.*, 2015).

This renewed interest in food self-sufficiency has roused further critique from economists. Their arguments have tended to focus on pointing out the flaws in the extreme, isolationist version of self-sufficiency, a policy few countries adhere to in practice, as outlined above. A top Cargill executive noted on the eve of the 2009 World Food Summit that the idea that countries "can be self-sufficient in every single food is a nonsense" (Blas, 2009). Similarly, the *Economist* magazine called the idea of food self-sufficiency for China "nonsensical" (*Economist*, 2013).

Towards a more balanced approach to evaluating food self-sufficiency policies

Conceptualizing food self-sufficiency as a continuum, rather than as an absolute state, more accurately reflects its actual policy application. In practice, countries often seek to achieve greater domestic food production as a proportion of their overall consumption, but they do so in a variety of ways, and rarely eschew all trade. Similarly, few countries disregard levels of domestic production and rely on international trade for all of their food needs. Understanding food self-sufficiency policies along a continuum, as illustrated in Figure 4, opens possibilities for a mix of policy choices and helps to move beyond the rigid, "either, or" nature of the debate.

Opening the conversation in this way also allows for a more objective assessment of the circumstances under which food self-sufficiency policies can be a sound policy choice for governments. Most countries adopt a mix of policy tools according to their own unique circumstances, taking a range of considerations into account including, but not limited to, economic costs and benefits.

Below is a list of some of the circumstances under which countries may want to promote greater food self-sufficiency due to the risks associated with excessive reliance on international trade:⁵

⁵ Many of these concerns are noted in FAO, 1996 and FAO, 1999.

Figure 4: Policy continuum between food self-sufficiency and free trade

Source: Author.

- Situations where a substantial portion of the country's main staple crops are commodities that are only thinly traded on international markets, for example, rice. In these cases, excessive reliance on imports and/or reliance on only a few suppliers can be risky because shortages and/or price spikes are more likely to occur in response to supply disturbances. Under these circumstances, greater domestic production can reduce price and supply risks.
 - Situations where countries have a large population and high demand for certain staple food commodities. In these cases, year-to-year fluctuations in the purchase of these food commodities on world markets by large countries can affect global food prices and have a negative impact both within that country as well as other countries. A self-sufficiency ratio close to 100 percent for such countries could contribute to more stable domestic as well as international food prices.
 - Situations where countries that depend on food imports face declining terms of trade for the goods that they export. In these cases, excessive reliance on imports can result in declining domestic food availability and greater risk of hunger. Greater reliance on domestically produced food can help to ensure that food supplies do not dwindle if export earnings decline.
 - Situations where countries face the threat of disrupted trade channels due to war or trade embargoes that may arise from political tensions. In these cases, greater reliance on self-production of food can provide an important supply contingency.
 - Situations where countries that depend on food imports face consistently volatile world food prices that they cannot adequately cover with export earnings. If these countries have suitable agricultural resources that are under-utilized, boosting domestic production can provide an important supply contingency that can help to stabilize domestic food prices.
 - Situations where agricultural specialization for export is linked to environmental degradation and the costs of such degradation erodes the real value of export earnings. In such cases, policies to support more diverse farming systems that include food production can improve ecological services associated with agriculture, as well as provide a greater variety of domestically produced foodstuffs.
 - Situations where countries rely excessively on cash crops or other non-food exports, especially when countries have little room for manoeuvre due to a large field of exporters of those same products. In such cases, diversifying domestic agriculture to include food crops can be beneficial for domestic food supply and provide more stable livelihoods for rural communities.
- Policies designed to boost domestic production as a percentage of consumption in these types of situations are justified not only on the grounds that they can contribute to domestic food security and foster more stable societies, but also because there are sound economic reasons to do so (FAO, 1999, Chapter 1).
- Which tools countries may choose to implement on this issue will depend on the resources available to them. Even if they may agree that boosting domestic production is advisable in some cases, many economists would reject the use of trade restrictive policies to achieve it. Not all countries, however, have equal access to the same policy tools to achieve their goals. Wealthier countries may be able to provide substantial investment to boost domestic production in support of greater levels of food self-sufficiency in ways that are considered to be non-trade distorting. Poorer countries

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with fewer resources at their disposal may find that they have access to a more limited range of policy tools, including trade-restrictive measures, in situations where they would benefit from greater self-sufficiency. In cases where more open trade policies exacerbate the risks outlined above, careful and balanced evaluation, based on detailed assessment of the unique constraints facing individual countries, can help to determine the most appropriate mix of policies.

Countries may also seek to follow different strategies along the policy continuum at different times in their development trajectory, depending on how their circumstances change over time. A country may wish to temporarily restrict some aspects of its food trade in order to foster a structural change in its agricultural

sector that boosts domestic food production, for example, and subsequently pursue more open trade once that adjustment has taken place. Indeed, often food self-sufficiency is not the main policy objective of countries that are aiming to increase domestic production and are justifying their trade policies on the basis of the need to promote diversification, employment creation, industrial upgrading, and overall economic transformation. Without adequate policy space and flexibility, countries in the situations outlined above are likely to find themselves facing the heightened risks associated with excessive reliance on international trade, which can have a direct impact on their food security, their economies, and their political stability.

Concluding remarks

In its broadest terms, food self-sufficiency refers to a country's capacity to meet its own food needs from domestic production. It is typically measured either by the proportion of a country's food consumption that is met by domestic production, or by per capita food production per day at the level of an adequate diet.

Food self-sufficiency is often presented as an extreme and isolationist concept by its critics, who see it as inefficient and trade distorting. In practice, however, many countries seeking to improve their food self-sufficiency do so in the context of international trade. The aim is not to produce 100 percent of their food on domestic soil, but rather to increase domestic capacity to produce food, even if the country engages in food

imports and exports. The narrow focus of the debate fosters an "either, or" approach that downplays the real concerns of many countries regarding their domestic food production and its implications for their food security, political stability, and economic development.

Conceptualizing food self-sufficiency as a continuum, rather than an absolute state, can help to open up the debate and provide a more open-ended assessment of the conditions under which excessive reliance on international trade poses risks, and policies in support of greater food self-sufficiency are warranted. The choice of tools to achieve this goal in these cases will require careful evaluation to weigh the costs and benefits.

References

Blas, J. 2009. Cargill warns on self-sufficiency. *Financial Times*. 10 November.

Clapp, J. 1997. *Adjustment and agriculture in Africa: farmers, the state and the World Bank in Guinea*. New York, USA, Palgrave Macmillan.

D’Odorico, P., Carr, J.A., Laio, F., Ridolfi, L. & Vandoni, S. 2014. Feeding humanity through global food trade. *Earth’s Future*, 2(9): 458–69.

Economist. 2013. As China globalises, some still think it should be self-sufficient in food. October 26. Available at: <http://www.economist.com/news/china/21588436-china-globalises-some-still-think-it-should-be-self-sufficient-food-daily-bread> (accessed 7 July 2015).

Fader, M., Gerten, D., Krause, M., Lucht, W. & Cramer, W. 2013. Spatial decoupling of agricultural production and consumption: quantifying dependences of countries on food imports due to domestic land and water constraints. *Environmental Research Letters*, 8(1): 014046.

FAO. 1996. *Food and international trade*. Technical background document. Available at: <http://www.fao.org/docrep/003/w2612e/w2612e12.htm> (accessed 7 July 2015).

FAO. 1999. *Implications of economic policy for food security: a training manual*. Available at: <http://www.fao.org/docrep/004/x3936e/x3936e03.htm> (accessed 7 July 2015).

FAO. 2003. *Trade reforms and food security: conceptualizing the linkages*. Rome: FAO. Available at <ftp://ftp.fao.org/docrep/fao/005/y4671e/y4671e00.pdf> (accessed 7 July 2015).

FAO. 2012. *FAO Statistical Pocketbook 2012*. Available at: <http://www.fao.org/docrep/016/i2493e/i2493e.pdf> (accessed 7 July 2015).

FAO. 2015a. *The Democratic People’s Republic of Korea: outlook for food supply and demand in 2014/15*. GIEWS Update. 3 February. Available at: <http://www.fao.org/giews/english/shortnews/20150203DPRK.pdf> (accessed 7 July 2015).

FAO. 2015b. *FAO 2015 Hunger Map*. Available at: <http://www.fao.org/hunger/en/> (accessed 7 July 2015).

H., Rashid M., Faki, H. & Byerlee, D. 2000. The trade-off between economic efficiency and food self-sufficiency in using Sudan’s irrigated land resources. *Food Policy*, 25(1): 35–54.

Hertel, T.W., Ramankutty, N. & Baldos, U.L.C.. 2014. Global market integration increases likelihood that a future African Green Revolution could increase crop land use and CO₂ emissions. *Proceedings of the National Academy of Sciences*, 111(38): 13799–804.

Josling, T. 1975. The world food problem. *Food Policy*, 1 (1): 3–14.

Kako, T. 2009. Sharp decline in the food self-sufficiency ratio in Japan and its future prospects. Paper presented at the International Association of Agricultural Economists Conference. Beijing, China. August. Available at: <http://ageconsearch.umn.edu/bitstream/51570/2/kako%20Sharp%20decline%20in%20food%20self-sufficiency1.pdf> (accessed 7 July 2015).

Luan, Y., Cui, X. & Ferrat, M. 2013. Historical trends of food self-sufficiency in Africa. *Food Security*, 5(3): 393–405.

MacDonald, G.K. 2013. Eating on an Interconnected Planet. *Environmental Research Letters*, 8(2): 021002.

MacDonald, G.K., Brauman, K.A., Sun, S., Kimberly, Carlson, M., Cassidy, E.S., Gerber, J.S. and West, P.C. 2015. Rethinking agricultural trade relationships in an era of globalization. *BioScience*, 65 (3): 275–89.

Martin, M.V. & McDonald, J.A., 1986. Food grain policy in the Republic of Korea: the economic costs of self-sufficiency. *Economic Development and Cultural Change*, 34(2).

Naylor, R.L. & Falcon, W.P., 2010. Food security in an era of economic volatility. *Population and Development Review*, 36(4): 693–723.

O’Hagan, J.P. 1975. National self-sufficiency in food. *Food Policy*, 1(5): 355–66.

Porkka, M., Kummu, M., Siebert, S. & Varis, O. 2013. From food insufficiency towards trade dependency: a historical analysis of global food availability. *PLoS ONE*, 8(12): e82714.

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- Puma, M.J., Bose, S., Chon, S.Y. & Cook, B.I. 2015. Assessing the evolving fragility of the global food system. *Environmental Research Letters*, 10(2): 024007.
- Rakotoarisoa, M.A., lafrate, M., Paschali, M. 2011. *Why has Africa become a net food importer?* Explaining Africa agricultural and food trade deficits. Rome, FAO.
- Sen, S., Russell, N. & Ozanne, A. 2002. Broad-based agricultural development versus food self-sufficiency: a general equilibrium analysis in India. *Journal of Agricultural Economics*, 53(3): 567–68.
- Shattuck, A., Schiavoni, C.M. & VanGelder, Z. 2015. Translating the politics of food sovereignty: digging into contradictions, uncovering new dimensions. *Globalizations*, 12(4): 421–33.
- Von Braun, J. & Paulino, L. 1990. Food in sub-Saharan Africa: trends and policy challenges for the 1990s. *Food Policy* 15(6): 505–17.
- Warr, P. 2014. Food insecurity and its determinants. *The Australian Journal of Agricultural & Resource Economics*, 58 (4): 519–37.
- Wittman, H., Desmaris, A.A. & Wiebe, N. 2010. *Food Sovereignty: reconnecting food, nature and community*, Halifax, USA, Fernwood Publishing.
- Yang, Y. 1989. The economic costs of food self-sufficiency in China. *World Development*, 17(2): 237–53.