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**Article**

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## Conceptual paper

# An innovative approach to food security policy in developing countries



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### ABSTRACT

The article describes and analyzes the innovative concept of food security policy and presents theoretical microeconomic model of food security by Abdulai (2000) that explains individuals' demand for food ingredients. The literature review involves both direct and indirect policy measures that ensure food security in developing countries. These policies involve direct interventions involving structural changes in relative prices and targeted food subsidies, and indirect measures such as improving agricultural infrastructure, the general economic environment, and providing farmers with new farm technologies to increase food production. The manuscript shows the efforts several food security policy researchers have put to examine policy options and their impacts on food security.

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### Enfoque innovador a la política de seguridad alimentaria en los países en vías de desarrollo

#### R E S U M E N

El presente artículo describe y analiza el concepto innovador de política de seguridad alimentaria. Y también presenta un modelo teórico microeconómico de seguridad alimentaria creado por Abdulai (2000), que explica la demanda individual de ingredientes alimenticios. El estudio de la bibliografía incluye las medidas políticas tanto directas como indirectas, que garantizan la seguridad alimentaria de los países en desarrollo. Estas políticas incluyen intervenciones directas que conllevan cambios estructurales en precios relativos y

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subsidios alimentarios focalizados, así como medidas indirectas, tales como la mejora de la infraestructura agrícola, del entorno económico, y la entrega de nuevas tecnologías a los agricultores para aumentar la producción de alimentos. El artículo muestra el esfuerzo de numerosos científicos que se dedican a la política de seguridad alimentaria y se comprometen a explorar diferentes opciones de política y de influencia en la seguridad alimentaria.

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## Introduction

The twenty-first century is replete with uncertainty and complexity: game-changing trends are transforming the world. Indeed, uncertainty will be a key feature of the 21st century. Global trends affect regions, countries, industries, and even firms in heterogeneous ways. These trends entail both challenges and opportunities (Guillén & Ontiveros, 2012).

Food-borne disease remains a real and formidable problem in both developed and developing countries, causing great human suffering and significant economic losses. Dangerous pathogens and contaminants in food are on the increase as travel and tourism grow. Up to one-third of the population of developed countries may be affected by food-borne diseases each year, and the problem is likely to be even more widespread in developing countries. Pathogens have been the leading cause of food-borne poisoning or illness. Companies and governments lose in billions, if food-borne illness is widespread and food scams and scandals are exposed. This may also lead to bankruptcy and companies' liquidations.

Germany dominates the market and is the fastest growing European food safety testing market followed by United Kingdom. Recent food price hikes and the global economic crisis left their mark, as the number of hungry and malnourished people increases worldwide, particularly in developing countries. Evidence shows that about 902 million people in the developing world were malnourished in 2008, reflecting an increase of about 65 million since 2000–2002 (FAO, 2009). The latest estimates indicate that about 795 million people in the world – just over one in nine – were undernourished in 2014–16. Changes in large populous countries, notably China and India, play a large part in explaining the overall hunger reduction trends in the developing regions (FAO, 2015).

The impact of the declines in household income from the global economic downturn has been compounded by the relatively high food prices in many developing countries, resulting in further increases in the number of undernourished households in developing countries. This development makes it increasingly difficult to achieve the first millennium development goal (MDG) of halving the number of hungry people by 2015. Fanzo et al. (2010) identify lack of political will at both global and national levels as the major cause of the growing divergence from this important MDG. Although food insecurity had attracted little attention in the media and political agendas of developed countries during the last decades, the situation changed in 2008 as riots over higher food prices occurred throughout the developing world (Falcon & Naylor, 2005; Fanzo et al., 2010). The rising numbers

of food-insecure persons and global security contribute to renewing international interest in food security policies of developing countries.

Food security involves ensuring both an adequate supply of food and access of the population to that supply, mostly through generating adequate levels of effective demand via income growth or transfers. Both micro and macro factors include adoption of new technologies, fiscal and exchange rate policies that affect overall economic growth and income distribution influence on food security in developing countries. The policies associate with food security and usually involve structural changes in relative prices, the general economic environment, and other measures such as targeted food subsidies, improving technologies, and institutions available to farmers and consumers (Weber, Staatz, Holtzman, Crawford, & Bernsten, 1988). Policymakers often confront the dilemma of higher food prices to induce increase of food production and the food security of low-income consumers, as higher prices impose a heavy cost on this group of consumers. Governments use a variety of short and long term policy options to promote food security in the developing world. Some measures affect food availability on local markets, others the individuals entitlements to obtain food, while others tend to influence food utilization, i.e., how many nutrients an individual obtains from a given supply of food. Developing countries use the concept of food security and the various approaches to promote food security. A simple microeconomic model of food security develops and discusses the operational issues on food security strategies. Mellor (1978) maintains that an employment program, or an income transfer program for the poor or improve their food status, will be inefficient in assisting them unless provision is made for an enlarged supply of basic food commodities. Thus, policies geared at improving food security should include both income generation and food production measures. Modern food security policy comes into being at the turn of the twentieth century in response to scandals in the meat packing and food processing industries (Sinclair & Baldwin, 1996). Command and control forms of security regulation characterize the first generation of food security law. Early twentieth century industrial management practices such as continuous line inspection, visual product inspection, and detailed specification of approved hygiene practices influence on national food security policy. At the heart of this second generation of food security policy is an emerging global consensus on the need for a preventive, public-health-focused policy that fosters integrated management of food-borne hazards from farm to fork. This consensus calls for use of modern science-based risk management instruments that enhances efficiency

by more accurately targeting public actions and by allowing firms flexibility in how they achieve public health goals rather than relying on narrowly prescriptive command and control policies. While the board vision for this second generation of policy is clear, much of the detail is yet to be worked out. Economics have a significant role to play in this process.

## Aim and methods

### Microeconomic food security model

The aim of the article is to present how the growth of populations and changing lifestyles has brought great demand for more safe food. The manuscript presents, analyses and discusses the microeconomic food security model created by [Abdulai \(2000\)](#).

Food security exists when all people, at all times, have access to sufficient safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life ([FAO, 2003](#)). Thus, both quality and quantity of diet are important components of food security. Diet quality measures the ability of food to supply protein of high biological value and adequate supplies of micronutrients such as minerals, trace elements, and vitamins, whereas diet quantity refers to the availability and consumption of total food energy. In general, where the quantity of food is reduced, so is the intake of micronutrients ([Abdulai, 2000](#); [Aubert, 2004](#)). The broader definition of food security includes access to non-food inputs such as clean water, sanitation and health care ([FAO, 2009](#)). The most important elements of the model assume that individuals maximize utility derived from the consumption of goods and services ( $c$ ) and health status ( $h$ ). Total consumed product characteristics ( $x$ ) are obtained through the consumption of  $c$ . Product characteristics include ingested metabolizable ingredients ( $d$ ), which affect the individual's health status ( $h$ ), and characteristics that are directly valued by the individual ( $e$ ), such as taste, texture, and social acceptance. Individuals face a time constraint in producing goods and services within a production function. A health production function determines the health status of an individual. Given these assumptions, each individual assumes and maximizes a time-separable utility function of the following form (1):

$$U_t = E_t \sum_{\tau=t}^T \gamma^{\tau-t} U(e_\tau h_\tau m_\tau) \quad \gamma \in [0, 1] \quad (1)$$

where  $E_t$  is the expectations operator, given the information set at time  $t$ ,  $\gamma$  is the subjective discount factor,  $T$  is the number of periods, and  $m$  is leisure. Utility is non-negative and strictly increasing in the individual's health status ( $h$ ), which is a vector of non-negative health dimensions such as physical and cognitive capabilities. The consumption of product attributes that the individual values ( $e$ ), and by investing time in leisure, generates utility. [Abdulai \(2000\)](#) indicates that each individual faces the following constraints in maximizing the utility function:

$$x_t = A c_t \quad (2)$$

$$h_{t+1} = \Theta(h_t, d_t, l_t, z_t, \varphi^h) \quad (3)$$

$$p^c(c_t + s_t) = p_t^y y_t + b_t + g_t \quad (4)$$

$$b_t = \psi(a_t) \quad (5)$$

$$a_{t+1} = \delta a_t + s_t + \varphi^a \delta \quad (6)$$

$$\Omega(y_t, l_t, h_t, a_t | \varphi^p) = 0 \quad (7)$$

$$l_t + m_t = L \quad (8)$$

$$c_t, l_t, m_t, a_t \geq 0 \quad (9)$$

Overall consumed product characteristics ( $x$ ) are obtained through the consumption of commodities and services ( $c$ ) according to the linear consumption production technology denoted as matrix  $A$  in Eq. (2). Eq. (3) formulates a health production function, where the main determinants of health are chemical ingredients of ingested food, labor activity ( $l$ ), other variables influencing health ( $z$ ), and health shocks ( $\varphi^h$ ).

The budget constraint in Eq. (4) shows the relationship between the value of goods purchased for consumption and stocks and household total income, where  $s$  represents a vector of stockpiled goods,  $c$  is as defined earlier,  $p^c$  is a vector of prices of consumption goods;  $p^y$  represents the vector of prices for the household's own produce, including wage labor, and production inputs (vector  $y$  of netputs). This full-income relation ensures that the value of consumption does not exceed the sum of net income, the value of borrowings ( $b$ ), and the value of non-labor income ( $g$ ), such as rents and transfers received by the individual. Eq. (5) formulates a borrowing constraint and the amount of borrowed money  $b$  cannot exceed the willingness to lend that is captured by the function  $\psi(\cdot)$ , which increases in asset stocks ( $a$ ). Eq. (6) represents the law of motion for asset stocks, with  $\delta$  as the depreciation factor and current stock-building quantities and asset shocks ( $\varphi^a$ ) as explanatory variables. Netput quantities, labor activity, health status, asset stocks, and production shocks ( $\varphi^h$ ) determine the production technology captures as the function  $\Omega(\cdot)$  in Eq. (7). Eq. (8) expresses household human resources constraint, where the total time endowment  $L$  allocates between leisure  $m$  and hours of work for pay  $l$ . Eq. (9) formulates non-negativity constraints for labor activity, consumption quantities, and assets.

## Analyzing food security policies

The microeconomic model illustrates the various dimensions of food security as expressed by the three components of nutrition availability, nutrition access, and food utilization, and shows how government policies affect the food security status of individuals.

Nutrition availability may improve the supply of sufficient foodstuffs at the local markets to ensure that food meant for consumption and storage (i.e., food in  $c_t$  and  $s_t$ ) is not in limited supply. Besides ensuring higher productivity and output levels, major food security policies in this area generally

include improving market integration through infrastructure, private trade supportive policies, state trading, as well as public buffer stocks (Abdulai, 2000). Governments in developing countries therefore invest in research and development (R&D), farm infrastructure (irrigation and soil-conservation technologies) and extension services, and early warning systems, or subsidize farm inputs to shift the individual's production function  $\Omega(\cdot)$  for food upward or decrease food supply fluctuations ( $\varphi^p$ ). Public investment programs in storage facilities such as rat-proof granaries that reduce asset shocks ( $\varphi^a$ ) and depreciation ( $\delta$ ) are direct policies that tend to influence private assets. An indirect but significant policy for preventing negative asset shocks is the provision of institutions for a stable legal environment. This is particularly important because the occurrence of food insecurity itself may negatively affect regional security since food-insecure households are more likely to act against the law in order to improve their access to food (Falcon & Naylor, 2005). Privately stored food ( $a_t$ ), which supports to overcome food shortfalls, also contributes to the household's (future) nutrition availability.

Given that nutrient availability remains a chronic problem in developing countries and crisis-prone regions, the issue of improving food availability continues to attract attention in these countries. This is in contrast to the discussion of food security in the developed world, where food production and availability are generally at higher levels, markets are well integrated, and the institutions are stable over time, contributing to lower levels of food insecurity. Measures for improving farm productivity are not that relevant for achieving food security in developed countries, given that relatively small proportions of the populace are engaged in farming. Coates et al. (2006) indicate that food insecurity in developed countries mostly arises from shortcomings in food access, which partly explains why relatively more attention is given to examining and explaining this complex concept in research work related to the food sector.

Nutrition access is solely derived from Eq. (4), i.e., food buyers are dependent on food prices, food availability, and on any of elements that determine their purchasing power. Government policies help in lowering and/or stabilizing consumers' food prices ( $p^c$ ) and/or stabilizing producers' food prices ( $p^v$ ) and improve nutrition access in developing countries. In particular, improving the non-farm earnings of individuals is a way of enhancing their "entitlement" over an adequate amount of food (Sen, 1999). Policies generally address possibilities include education policies to enhance the human capital of individuals, promoting credit institutions to improve access to credit, as well as policies that foster market integration through trade incentives and better infrastructure, which provide both extended rural-urban linkages and spatial income diversification (Abdulai, 2000; Delgado, 1999).

Public work programs stabilize income shocks, while supplementary feeding programs normally target vulnerable groups (e.g., pregnant women, children) that need special diets (with the targeting criterion in  $z_t$ ). Market failures in financial markets enhance borrowing conditions ( $b_t$ ) and provide better insurance and hedging possibilities that help stabilize income ( $\varphi^p$ ). Commodity and cash transfers ( $g_t$ ) measure the framework of food safety nets, emergency food

aid, schooling services, input starter packs, and providing incentives for schooling or health services.

Food utilization incorporates the consumption technology  $A$  in Eq. (2) and through  $\varphi^h$  in Eq. (3), which includes health shocks that reduce the nutrient absorption capability of an individual's organism. The former influences policies altering the overall food quality, e.g., through micronutrient fortification and better access to clean water, or by individual nutrition education programs on food preparation. The latter commonly enhances sanitation conditions, health education programs, and better access to medical treatment (e.g., placement of and access to medical facilities, trade and distribution of medicine).

Innovations in food technologies have led to the use of many traditional technologies, such as fermentation, extraction, encapsulation, fat replacement, and enzyme technology, to produce new health food ingredients, reduce or remove undesirable food components, add specific nutrient or functional ingredients, modify food compositions, mask undesirable flavors or stabilize ingredients. Modern biotechnology revolutionizes food creation. In combination with biofermentation, desirable natural compounds produce in large amounts at a low cost and with little environmental impact. Nanotechnology is also beginning to find potential applications in the area of food and agriculture. Although the use of new technologies in the production of health foods is often a cause for concern, the possibility that innovative food technology will allow to produce a wide variety of food with enhanced flavor and texture, while at the same time conferring multiple health benefits on the consumer, is very important (Hsieh & Ofori, 2007).

In the area of agriculture and food processing there is now a paradigm shift toward providing foods with added health and nutritional benefits. A variety of foods provide specific nutrients or functional ingredients to improve nutrition, boost the immune system, increase stamina, prevent chronic diseases, and delay the aging process. Innovation in food technology plays a crucial role in translating nutrition information into consumer products. According to Soriano and Huarng (2013) innovation is a specific instrument of entrepreneurship. In a modern society, persons desire both good health and longevity and hence demand nutritious and functional food that promotes their well-being, enjoyment, and active life style (Deliza, Rosenthal, & Silva, 2003). Convenient health foods or foods that impart extra value in the form of health benefits are now the highest priority for product development in the food industry. Modern food technology provides an alternative health pathway for individuals who are unable to prepare their own healthy foods to conveniently obtain desired supplements or special nutrients from prepared foods and beverages of their choice.

#### Price and trade regulation policies

The rationale behind government-administered consumer prices for staple food (issue prices) is either to improve food access through lower market prices for consumers, or to stabilize consumption in times of upward price shocks by imposing price ceilings. The majority of developing countries historically maintain low food prices to help urban consumers

and foster industrialization through lower wages. In pursuing these objectives, two paths of food price subsidies matter. These include universal price subsidies that benefit net food buyers, and limited access subsidies, where concessional prices grant quantities. Universal price subsidies are inefficient since all individuals profit from general food subsidies. The politically vocal and well-organized groups, which include the urban population, government employees, and industrial workers, obtain the greater share of rationed food grains. While these beneficiaries normally support the cheap price policies, escalating fiscal expenditures for food subsidies and occasional political pressure from multinational donors compel most developing countries to liberalize food markets over time. Discrimination against the agricultural sector through non-compensated cheap food price policies has negative impact on farm households' welfare and farm investments, thus harming the current and future food security of most rural households (Schultz, 1964). To encourage domestic food supply and improve local food availability, some governments of developing countries offer producers higher than market prices, determine producer price floors, or subsidize farm inputs. Higher procurement prices have the ability to lift food-insecure farmers above the food security threshold, while price floors design to prevent farmers just above the food security threshold from falling into insecurity through declines in farm incomes. Asian countries with rice as the main staple food have effective price stabilization policy as a food security tool (Timmer & Dawe, 2007). An issue that usually accompanies procurement price increases is the extent to which these higher prices pass on to domestic consumers. If consumers give no sufficient compensation, rising food expenditures tend to impair the food security of net food buyers such as the urban population and rural workers not engaged in food production. This negative impact may be low in the case of foods that have small relevance to dietary requirements and contribute less to households' expenditure. While Kenyan consumers have had to face higher retail prices for sugar, price increases in staple foods, such as rice in Asia or wheat in northern Africa and the Middle East, have commonly not been fully passed on to consumers. Efficient price stabilization policies should normally incorporate factors that affect a country's specific price and production risks, e.g., if it is landlocked or prone to droughts and floods. Given that decision makers usually subject to rent-seeking activities of special-interest groups, it is not surprising that the procurement and issue prices tend to be suboptimal (Dixit & Josling, 1997; Rashid, Cummings, & Gulati, 2007). Trade restriction regimes concentrate on the form of quotas and tariffs. Import and export trade restrictions for the food sector reduce dependency on foreign imports. Import restrictions such as quotas and tariffs generally offer net-food-importing countries the opportunity to respond to world market price fluctuations. For example, developing countries recently had to deal with the sharp increases in world food prices, particularly for staple cereal foods. This price increases food crises in some regions, as the number of undernourished persons increases significantly. The trend of a declining proportion of undernourished people in the developing world has been reversed in the late 2000s. In Latin America and the Caribbean, where absolute numbers of undernourished

persons had previously been reduced, the number of malnourished people increased significantly.

Declining global food prices in 2009 could not prevent a further increase in the number of undernourished, which indicates massive income losses due to the global economic recession (FAO, 2009). These estimates only capture part of the food-insecure population since food insecurity also includes people who are not currently suffering from malnourishment but are at risk of falling below the healthy nutrient state thresholds (NS) in future periods (Barrett, 2002).

The food price increases in some countries re-examining their liberalized agricultural trade policies and intervening by imposing food price controls and trade restriction policies. For instance, Argentina, China, India, Russia, and Thailand restricted food exports in the wake of the price increases, while food-importing countries reduced their tariffs and taxes on food and agricultural imports to improve domestic food supply (Wodon & Zaman, 2008). Timmer and Dawe (2007) argue that such measures help in stabilizing domestic rice prices in Bangladesh and as such circumvented high levels of inefficient public procurement.

Some authors argue that tightening export restrictions tends to discourage local food production and also intensifies the burden on the food-importing countries. For example, von Braun (2008) points out that the elimination of export bans could reduce international grain price fluctuation and reduce price levels by 30 percent.

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## Conclusion and recommendations

Food security remains a major concern in the developing countries, and that national governments employ various policies to address food security concerns of their citizens. To the extent that ensuring food security also involves measures that stimulate adequate levels of effective demand through "entitlements", governments have also employed income diversification strategies and cash transfers to achieve food security goals. However, these income support measures for the poor are only efficient when making provision for an enlarged supply of basic food commodities. This underlines the significance of investing in the agricultural sector to boost food production.

The literature on food security in developing countries shows the efforts several policy analysts have put into research to examine policy options and their impacts on food security. However, a number of important questions still remain unaddressed. For example, in analyzing the effects of stabilization schemes on food prices, an important issue that crops up is that of determining the adjustments that do the least damage to economic growth and equitable distribution of income in the society. Timmer (1989) addresses that such issues normally require general equilibrium analyses, with dynamic investment functions linked to the impact on expectations of instability in food prices, in credit markets, and in the budgetary behavior of government. Most food security analyses remain partial and highly intuitive. Despite this limitation, our understanding of the food security policies of developing countries focuses on theoretical and empirical analyses over the last two decades.

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