

An Agricultural Perspective on Global Food Security

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Abstract: Throughout history, food security has been a major concern for human societies. Concern over the effects of population increase and economic development/crisis on global food production and security has grown over the past few decades. This review's goals were to comprehensively summarise the definitions of food security, the idea of global food security, and, lastly, to emphasise the importance of agriculture for sustainability and ecosystem services on a global scale in addition to feeding the world. We looked for English-language publications from January 2000 to April 2013 in three scientific databases: Pub Med, Scopus, and Science Direct. Only 35 of the 1945 articles found in a review of the literature were chosen after being filtered by titles, abstracts, and complete papers. Numerous elements related to agriculture and food security were discovered in these publications. Nine billion people need to be fed, which is a huge problem that calls for changes in the global food security agenda for the coming decades as well as in agricultural productivity.

Keywords: Food security, agriculture sustainability, agriculture, nutrition

1. Introduction

Food security and the role of food in health security and in human security has always been very crucial issue to human civilizations through the ages (Andersen 2009, Wahlqvist 2009). In the last decades there is a growing concern about the impacts of economic development and population growth on global food security and food production. The growth of population size to nine billion people in the middle of the century means more demand for food production. And more food production means that mankind must change the use of land, water and soil resources (Godfray et al. 2010b; Schneider et al. 2011).

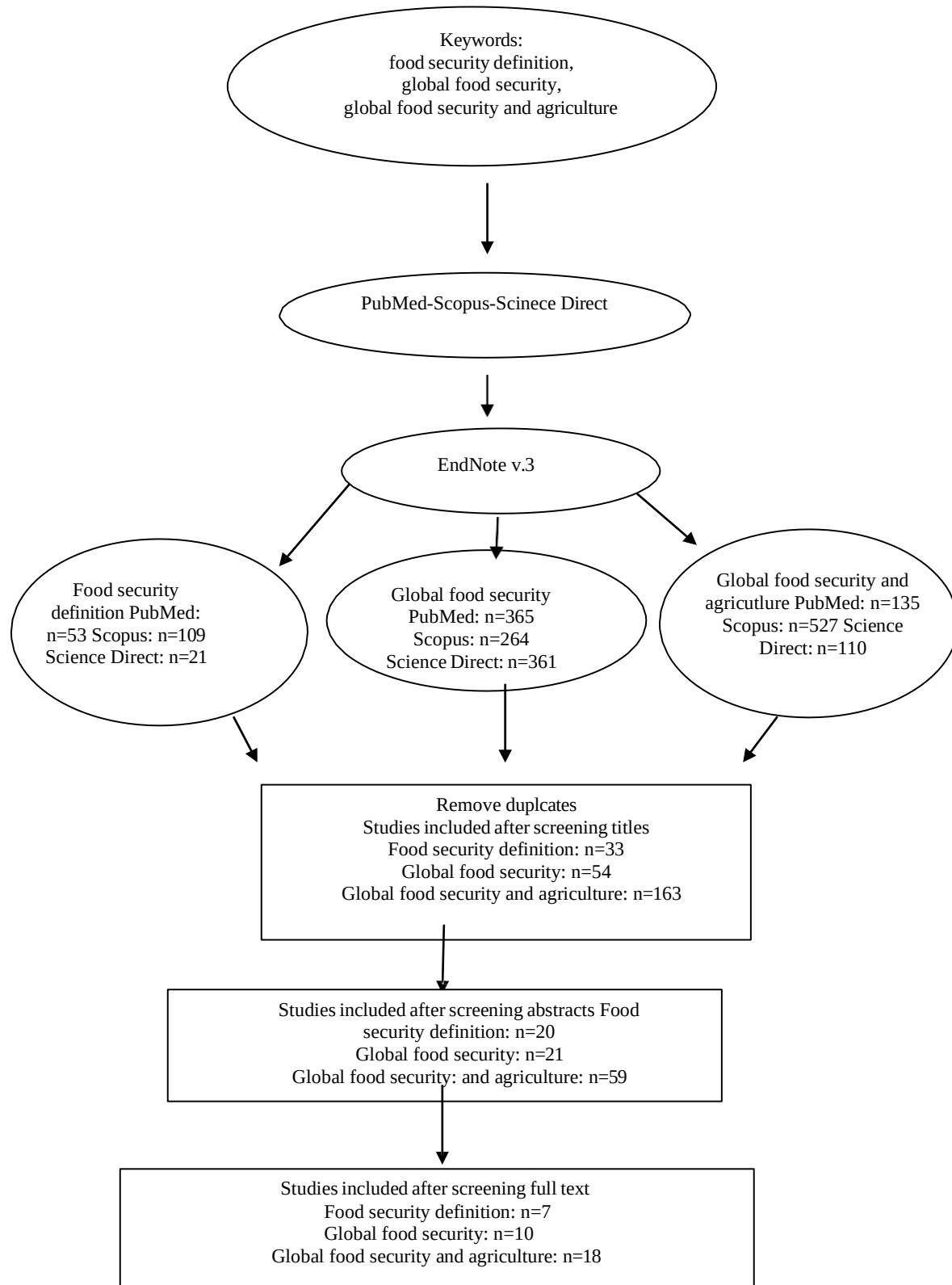
Nine billion people need to be fed, which is a huge problem that calls for changes in agricultural output in terms of high yields, cropping system adaptation to climate change, genetic enhancement of plant types, pest control, and innovative farm methods. This challenge reveals the significance of agriculture as well as more focused areas like food waste, biodiversity concerns, and landscape management, all of which have significant effects and are crucial to the development of new food security policies (Abumhadi et al. 2012). Furthermore, the demand for meat and dairy products has shifted due to dietary and lifestyle changes in developing nations (Godfray et al. 2010a). Animals receive over one-third of the world's cereal production (FAO 2006). As a result, the number of cattle, sheep, and goats has increased by around 1.5 times, while the numbers of pigs and chickens have increased by approximately 2.5 and 4.5 times, respectively (FAOSTAT 2009). Food security and availability to sufficient and healthy food will undoubtedly become major issues on the public agenda as competition for land increases due to the increasing demand for food (Erkan 2012).

2. Methods - Literature strategy, eligibility criteria and data collection

We examined three scientific databases (Pub Med, Scopus, and Science Direct) for English-language publications from January 2000 to April 2013 in order to find articles pertinent to our issue. —food security definition, global food security, global food security, and agriculture were the search terms utilised. Full-text articles, reviews, and editorials were the kinds of articles that were retrieved. Articles that addressed a different perspective on global food security and agriculture, which was outside the purview of this analysis, or those dealt

with climate change or case studies of particular nations or regions were not included. (Fig. 1)

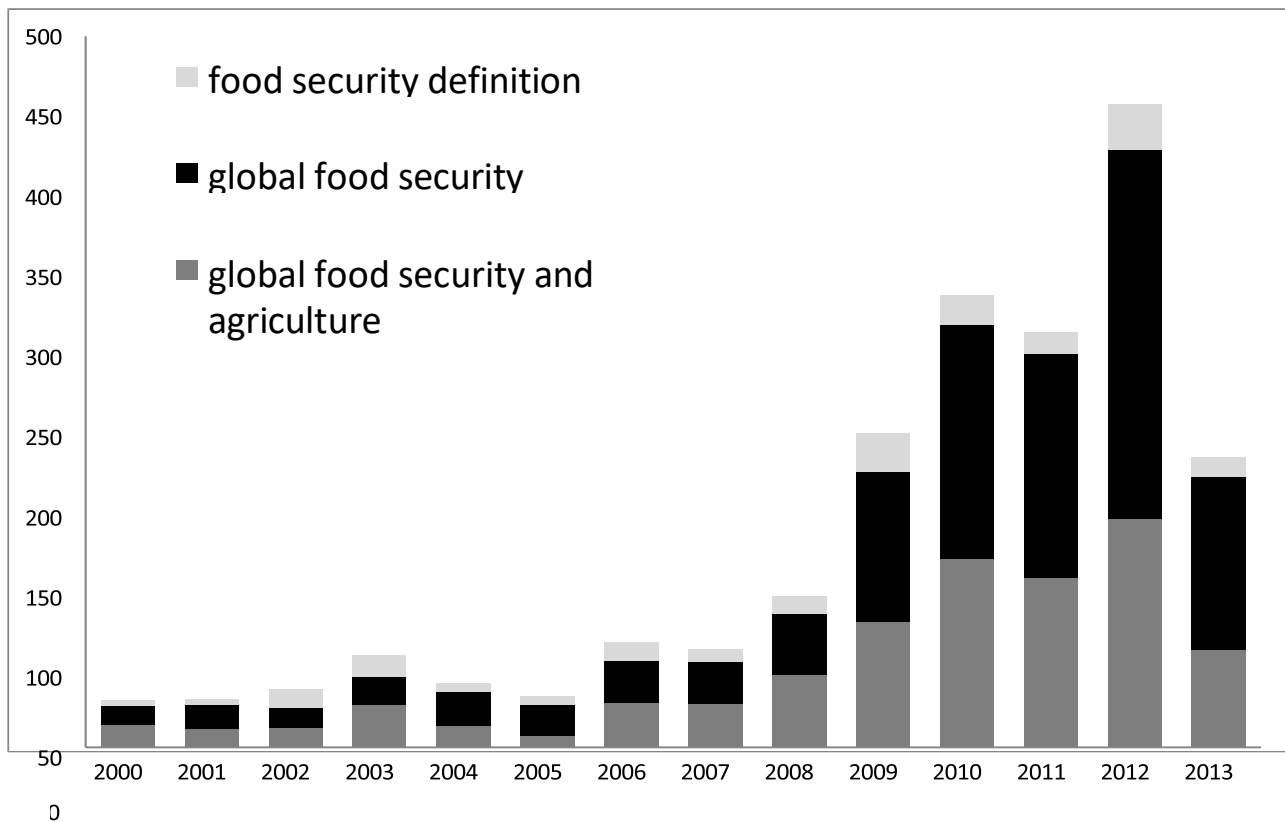
Fig 1. Flow diagram of study selection process in this review. 'n' represents the number of records identified through PubMed, Scopus and Science Direct searching



3. Results and Discussion

All articles were extracted into a bibliographic citation management software, EndNote library v.3, (Thomson Reuters. EndNote v.3, 2009), duplicates were discarded and exclusion criteria were applied by screening titles, abstracts and full papers. The search identified 1945 articles but after screening by title $n= 250$, abstract $n= 100$, full text $n= 35$ (Figure 2).

Fig 2 Number of articles in 3 databases by year (2013 contains Jan-Apr)



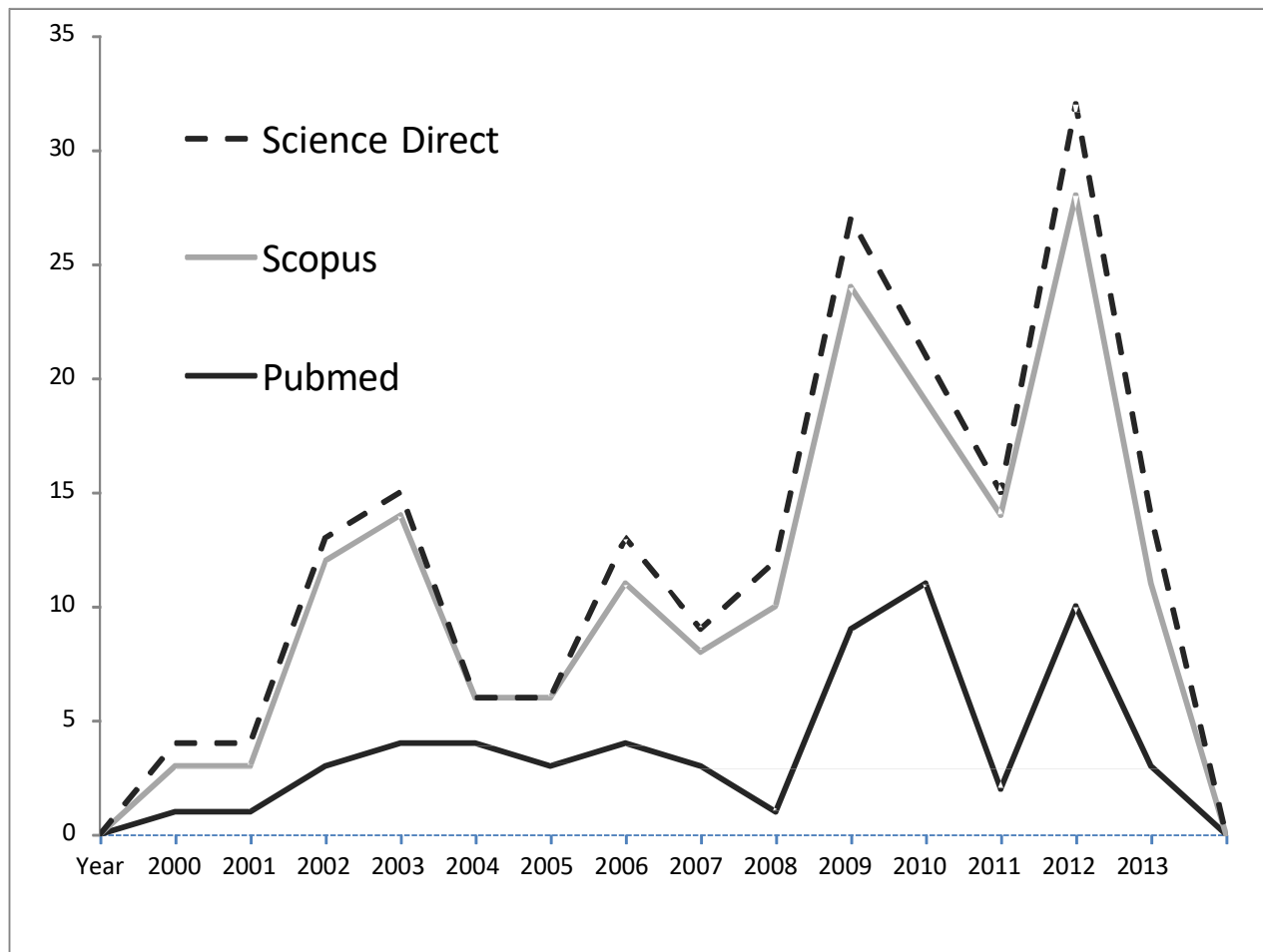
3.1 Food security definition

The definition of food security was assessed in seven articles. There were two reviews and five research articles. The increased trend in the number of articles that contained the term "food security definition" from 2000 to 2013 (till April) is depicted in Figure 3, and the lines indicate the consistent rise in the records that showed up as search results for "food security definition" at each database. Over the past 40 years, a number of definitions of food security have evolved. The databases yielded 191 articles. 33 papers are included after screening by title, 20 by abstract, and seven articles are ultimately selected.

"Availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices" was the initial definition provided by the World Food Summit in 1974 (UN 1975). This definition emphasises food availability and captures

the issues with food supply and production during the global food crisis in the middle of the 1970s (Hadley and Crooks 2012). Due to supply-side considerations, this crisis resulted in new policies that prioritise a steady global food supply. The World Food Program (WFP), the Consultative Group on International Agricultural Research (CGIAR), the International Fund for Agricultural Development (IFAD), and the Global Information and Early Warning Systems (GIEWS) were established to monitor the global food situation, according to the same authors (Hadley and Crooks 2012).

Fig 3 Search results (No of articles) in 3 databases for food security definition by year (2013 contains Jan-Apr).



However, not everyone has access to food just because it is readily available. Following the emergence of the supply and access issues, FAO broadened the definition in 1983 by adding the phrase "Ensuring that all people at all times have both physical and economic access to the basic food that they need" (FAO 1983). More than 194 definitions of food security existed between 1983 and 1996 (Renzaho and Mellor 2010). However, the World Food Summit added two new elements to the definition of food security in 1996: food safety and availability to the desired food (FAO 1996).

The terms "safe and nutrition" and "food preference," which are both included in the latter definition, were used by the Word Food Summit to draw attention to the problem of composition and access to sufficient food. They also identified other factors that emerged, such as utilisation and stability, which began to be included in

definitions of food security in the 1990s and exposed the opposite side of the same coin, food insecurity (Hadley and Crooks 2012, Andersen 2009). Additionally, the World Food Summit's definition of "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 1996) made it more clear that it was time to link food security and public health, particularly since the global agenda for food security would be re-established in the next ten years (Dowler et al. 2011, p. 405-406, Wahlqvist 2009). The notion of food security encompasses social, political, and economic aspects from 2000 to 2013 (till April) (Touzard and Templez 2012).

Different socioeconomic and political factors affect food availability, stability, utilisation, and access, even while food security has the same effects on people in both wealthy and developing nations (Hadley and Crooks 2012, pp. 73-74; FAO 2006). Furthermore, the idea of food security continued to be complicated and multifaceted, and it was debatable whether or not new components like food price spikes, energy crops, and financial crises reflected shifts in our knowledge of and ability to quantify food security (Renzaho and Mellor 2010, p.1).

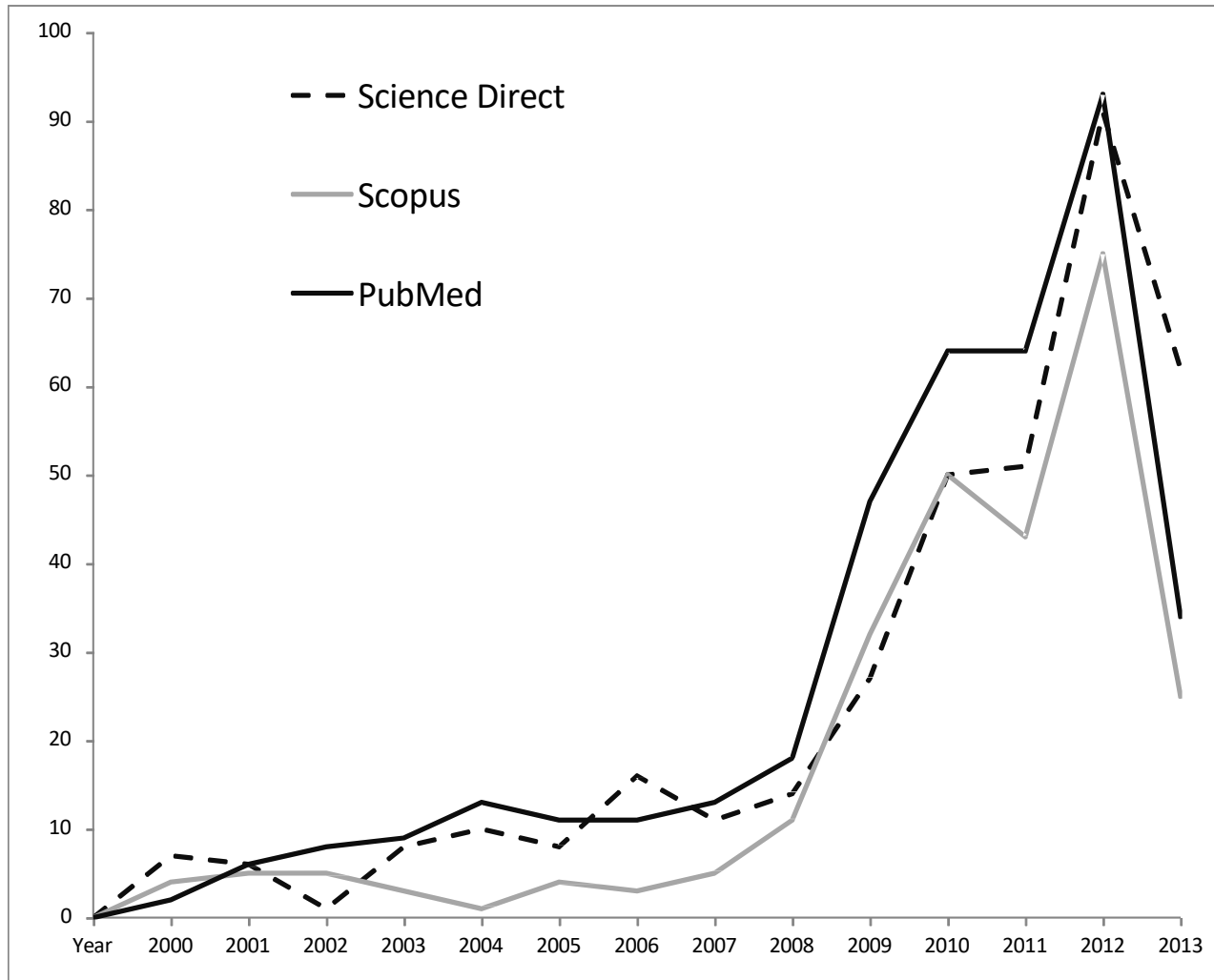
Lastly, the most widely used definitions of food security are as follows: "Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life." and "access by all people at all times to enough food for an active, healthy life and includes at least: a) the ready availability of nutritionally adequate and safe foods, and b) the assured ability to acquire acceptable foods in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, and other coping strategies)" (Vink).

Global food security

Ten publications were chosen to examine the idea of food security from a global perspective. There were two editorials, two reviews, and six research pieces. The lines in Figure 4 illustrate the abrupt rise in the number of records for global food security during the previous 13 years, as well as the rising trend in the number of articles that contained the phrase. It is evident that more articles using the term were published in 2013 than in 2008, even though 2013 just has four months.

When it comes to global food security, all of the writers start from the same place. Nearly one billion people are undernourished despite the fact that global food production exceeds world demand (Charles et al. 2010). Furthermore, the state of global food security may alter in a number of ways due to population increase, environmental changes, new laws aimed at reducing food waste in both rich and developing nations, and other socioeconomic problems. According to Charles et al. (2010), human capacity to produce food will be impacted by increased competition for land, water, and energy as well as overuse of Earth's natural resources.

Fig 4 Search results (No of articles) in 3 databases for global food security by year (2013 contains Jan-Apr).



Food security is a complicated topic with many political, economic, and environmental factors. Ingram (2011) emphasises that increasing food production won't meet society's demands, even though he examines several instances of how food systems methods connect with food security and global environmental change in his paper. Food access, affordability, and other aspects of the food system, such as production, storage, processing, and packaging, are also crucial.

Two researchers explore how globalisation affects food production and availability. McMichel (2001, pp. 216–217) criticises the rise in meat and animal protein consumption as well as the shift in social diets in the northern hemisphere. He highlights the "global epidemic of malnutrition," pointing out that the one billion undernourished people are balanced by the one billion overfed people. Lastly, he notes that globalisation of food markets may not provide a solution to the problem of malnutrition (McMichel 2001, p. 217). The other author attempted to provide a comprehensive strategy for future global food security. Important variables are examined, including population growth, food prices, urbanisation and globalisation, global food demands, and projected investments in agricultural research (Godfray et al. 2010b). Godfray et al. (2010b,

p. 2776) emphasise that in order to lower the risks of rising hunger, food security status necessitates a multidisciplinary approach integrating the social sciences and economics.

The relationship between global environmental change and food security is the subject of four research articles, one editorial, and three research articles. One facet of global environmental change and food security is how climate change affects land usage or agricultural productivity (Ericksen 2009, pp. 373-374).

The complexity and composite nature of global food security is highlighted, for instance, by the drought in Australia, the rising demand for meat in Asia, biofuel policies in the United States, Latin America, and Europe, and speculation on global food commodities (Ericksen 2009, pp. 373-374). Major environmental effects at every level of food production, distribution, retailing, and processing include biodiversity loss, water extraction, and greenhouse gas emissions (Garnett 2013). Furthermore, all four aspects of food security—food access, availability, stability of food supply, and food utilization—will be impacted by climate change. However, the severity of these effects will vary by region and will depend on a nation's overall socioeconomic standing as the effects of climate change take hold and unavoidably impact global food security (Schmidhuber and Tubiello 2007, p. 19708).

Global food security objectives and sustainable environmental management may clash as a result of numerous environmental pressures that have both direct and indirect effects on food production systems (Ericksen et al. 2009). In his study, Polly J. Ericksen (2008, p. 234) noted that "global environmental change, in the context of social, political, and economic changes, may bring unprecedented stresses to bear on food systems and food security."

Lastly, Cassman (2012) and Misselhorn et al. (2012) support the urgency of taking action to guarantee food security for everyone. The global food security agenda for the coming decades will be shaped, among other things, by high economic growth rates in developed nations, the decline in crop yields in major cereal production areas, urbanisation and competition between crops for food and energy (Cassman 2012), the use of frontier technologies in all areas of food systems, and restrictions on food access. (Misselhorn et al. 2012; Cassman 2012).

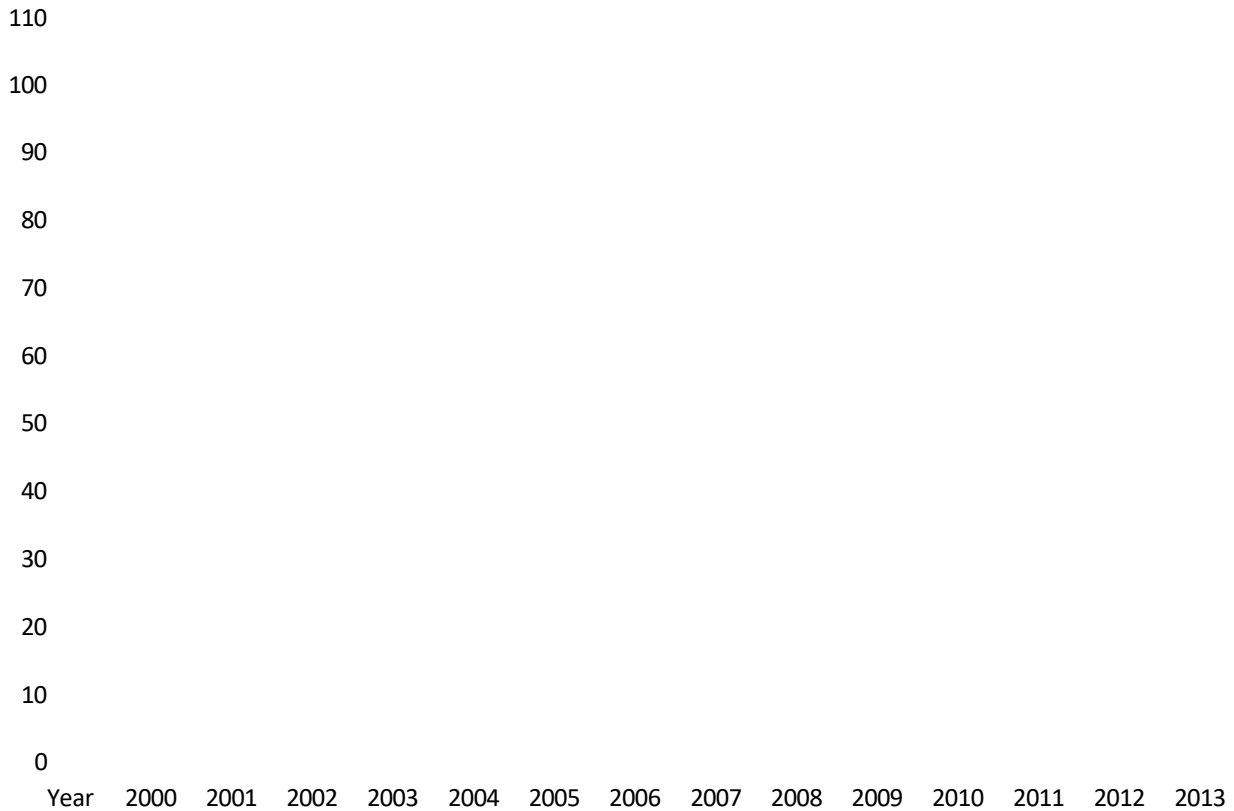
1.1 Global food security and agriculture

The upward trend in the number of articles containing the term "global food security and agriculture" is depicted once more in Figure 5. The lines indicate the progressive rise in electronic records for global food security and agriculture over the last 13 years in each database, particularly after the midpoint of the previous decade.

Agriculture has a vital and complex role in ensuring the world's food security. In order to ensure global food security, we shall concentrate on two major issues that agriculture must deal with in the coming decades. The first is how agricultural productivity innovation, biotechnology, and research can guarantee food security; the second is how agriculture can use natural resources sustainably to achieve food security on a global scale.

Fig 5 Search results (No of articles) in 3 databases for global food security and agriculture

by year (2013 contains Jan-Apr).



1) Research, biotechnology and innovation

New agricultural productivity research methods are required to boost crop yields in order to guarantee global food security. Public investments are essential for boosting agricultural productivity through environmentally friendly and yield-boosting production technologies, but they should also prioritise small farmers and the impoverished in developing nations (Andersen and Cohen 2000). The budget for economic development, food security, and poverty alleviation in any nation must clearly outline these investments and economic plans from the agriculture sector, and they must be cohesive and part of overall national plans (Adenle 2011, p. 92). According to Parry and Hawkesford (2010), advances in plant growth research that emphasise photosynthesis and a rise in water productivity could have a significant impact.

Ruanne and Sorino (2011, p. 359) emphasise the significance of agricultural biotechnology and the use of instruments for the diagnosis of bacterial and viral plant diseases, as well as immunodiagnostic and DNA-based procedures. Boggess et al. (2013) also discuss the application of "omics" to attain global food security. There are numerous ways that genomics, proteomics, and metabolomics will increase agricultural output. The identification of novel proteins and enzymes can, among other things, increase resistance to disease and pests, lessen the need for chemical pest and weed control, and ultimately lessen the demand for fertilisers and additional nutrients (Boggess et al. 2013, p. 16).

Two more publications highlight how agricultural biotechnology might increase crop yields. Transgenic crops, insect-resistant crops, herbicide-resistant crops, and viral-resistant crops are examples of plant genetic innovations that are essential to increasing global yields through responsible biotechnology management for sustainable agricultural production (Abah et al. 2010; Ronald 2011).

Furthermore, according to three other authors, we can improve food production and availability by moving crop production away from non-food uses such bioenergy crops (Foley et al. 2011, p. 340) and by tracking and monitoring crop losses before and after harvest (Flood 2010, pp. 218-220). Finally, in order to lessen food insecurity, employing pesticides in a more sophisticated manner that combines integrated pest management (biological pest control) with the best scientific applications of biotechnology to develop pest resistance in crops must be a top priority (Andersen 2002, p. 1208).

1) Sustainable and ecological agriculture

Eight articles were selected to discuss sustainable agriculture, food security and natural resource management. Ecological agriculture or agroecology can be defined as the utilization of ecological concepts and principles to the design, formulation and management of sustainable food systems. This definition is representative of a renovated approach to agriculture that aims at reconciling resource use and food production, in support of local, small-scale farming, while relying on modern ecological knowledge and theories to achieve sustainability in agriculture according to Borsari (2011).

Another four papers from the previous eight underline the "ecoagriculture approach". Eco-agriculture approaches may be relevant to some extent in all agricultural landscapes, in light of their focus on improving landscape performance vis-a'-vis three goals: agricultural production, biodiversity conservation and livelihoods (Scherr and McNeely 2008, p. 482). This approach assumes that biodiversity at the landscape level is pivotal to sustain both agricultural production and the provision of ecosystem services (Brussaard et al. 2010, p. 35).

Furthermore this approach must target to achieve food security, sustainability and ecosystem services at regional and global scale on a cost-effective way and guide the choice of crop species and cultivars to be grown in a target environments and regions (Spiertz 2012, p. 1, p. 7). The link between biodiversity, natural resources and hunger reduction requires well informed solutions and policies to provide the level and quality of ecosystem services necessary to support agriculture in the future (Hazell and Wood 2008, p. 513; Tschamntke et al. 2012, pp. 53-56).

Finally, two authors examine two different perspectives and relationships between food security, agriculture productivity and sustainability. Acevedo (2011, pp. 159-163) suggests that new research methods and new agricultural management and farming practices must be applied to increase water and food productivity. New monitor tools like GIS and remote sensing, biotechnological and precision agriculture technologies may contribute to increased productivity and properly linked with interdisciplinary models, will ultimately achieve sustainable food production increases that maintain environmental quality and conservation (Acevedo 2011, p. 165).

The relationship between food composition and analysis and nutrition and biodiversity is highlighted by Toledo A and Burlingam B (2006, p. 478). According to Toledo and Burlingam (2006), p. 478, p. 481, national information systems for food and agriculture can be strengthened and used as the foundation for priority setting and international policy-making if nutrient analysis and data dissemination of the various food species and intra-species diversity are undertaken systematically. They contend that biodiversity management plays a significant role in the development of sustainable agricultural development practices

and strategies against malnutrition.

1. Conclusions

This study concludes with definitions of food security, the idea of global food security, and the role that agriculture will play in ensuring global food security in the coming decades. In order to provide sustainable food production, ecosystem services, and biodiversity, plant biotechnology and innovation systems in agricultural practices, sustainable agriculture productivity, social sustainability, and, lastly, the ecological use of natural resources are essential (Beddington 2010). According to Schneider et al. (2011) and Pretty et al. (2012), the agricultural industry now has the issue of ensuring food availability, distribution, and social justice for all people in addition to maximising productivity and feeding nine billion people until 2050 without significantly raising food costs.

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