ANALYSING SUFFICIENCY OF PRESENT GLOBAL FOOD PRODUCTION SCENARIO

Ms. Shilpa DilipVanire,
DY. Patil University's School of Hospitality and Tourism Studies,
Navi Mumbai, Maharashtra

ABSTRACT

When it comes to feeding a rapidly expanding global population, there is a pressing question: how can we do it without depleting natural resources? As the pace of global warming and the consequent rise in food demand continue to rise, most analyses on the future of global food security stop at 2050. There is enough food in the world to meet the needs of 9 billion people by 2050, even if many people's socioeconomic and nutritional conditions drastically change (ensuring access to the global food supply) (replacing most meat and dairy products with plant-based alternatives and increasing acceptance of currently fed-to-animals crops, particularly maize). In any situation, the window of opportunity for the production of biofuels is limited.

Keywords: Global scenario, food production, food demand, food self-sufficiency, GHG

INTRODUCTION

The worldwide agricultural system would have produced adequate food for the world's rising population throughout the twentieth century. It's been at least 50 years since real agricultural product prices have decreased despite rising food consumption, yet output has remained steady and supply has risen sufficiently to meet that need. Population increase and growing wages are to blame for this. There has been a rise in agricultural commodity prices since 2007, which supports the widely held assumption that the era of excess is over. [1] In the preceding half century, global food demand has more than doubled. As the global population grew from 3 billion to over 6 billion people, there was an increase in per-capita demand as a consequence of rising living standards. Food availability, long-term stability of that food supply, people's ability to acquire food, and how that food is utilised to ensure adequate and excellent nutrition are all components of food security. There has been an increase in the policy agenda for food self-reliance after the 2007–08 food price crisis and its ramifications. In nations throughout the world, from Senegal to India to the Philippines to Qatar, there is an increasing interest in food independence. An outcry arose over the policy's incorrect course, and it was quickly reversed. "Aiming for food self-sufficiency would be terrible worldwide," according to a 2009 Financial Times editorial. It is also possible to measure a country's food self-sufficiency by its dietary energy production (DEP) per capita. Nutritionists recommend a daily caloric intake of 2500 kcal (calories) or more for a balanced diet, hence countries with high per-person intakes are typically called self-sufficient. [4]

As the world's population grows, there is a pressing need to provide adequate food while lowering greenhouse gas emissions and other environmental consequences from farming. Some of the most prevalent options are to increase output by 70%, increase yields in less productive areas, eliminate waste, and reduce meat consumption. International accords such as the Paris Climate Agreement and Sustainable Development Goals may potentially benefit from these solutions (SDGs). [5]

LITERATURE REVIEW

M. Berners-Lee, C. Kennelly, R. Watson and C. N. Hewitt (2018) Analysis of global and regional food supply shows how calories, protein, and micronutrients like vitamin A and zinc are moved from production to human consumption quantitatively. Minimizing the amount of human-edible crops fed to cattle and, less critically, reducing waste are two ways we think we might boost food supply. In any situation, the window of opportunity for the production of biofuels is limited.Human-edible crops can't be fed to livestock, which limits calorie and protein availability, according to our findings. By 2050, a 119 percent increase in the amount of edible crops farmed will be necessary if civilization continues on its current 'business as usual' dietary trend. [6]

Le Mouël C., Forslund A. (2017) Twenty-five scenario studies have been reviewed and a summary of their principal replies on how to feed everyone in the world by 2050 has been synthesised in this study. Despite this, the analysis points out that there is a lot of uncertainty about how the many levers identified might help feed the globe sustainably up to 2050. As a result, we're able to pinpoint specific areas that still need improvement. [7]

“International Food Policy Research Institute” (IFPRI) (2017) Global and regional food policy concerns, events, and choices from 2016 are summarised in the IFPRI's flagship report, which also looks forward to 2017's challenges and prospects. It examines how fast urbanisation affects food security and nutrition, and discusses how food systems may be restructured to serve both urban and rural people. [8]

Michiel van Dijk, Marc Gramberger, Maryia Mandryk, et al. (2016) It's commonly accepted that scenario analysis is a good way to examine a broad range of complicated and unpredictable issues, including food security. New food security scenarios for the year 2050 are described in this study, including their creation process, narratives, and drivers. A participatory procedure is utilised to assure the scenarios' relevance, authenticity, and validity by including a wide range of stakeholders.[9]

Bruce M. Campbell, Sonja J. Vermeulen et al. (2016) Climate change will have a significant impact on the production of crops, animals, and fisheries, which will have a ripple effect throughout the food chain. Several of these consequences have already been seen and evaluated. Despite the limitations of climate-crop modelling, crop yields have dominated climate impact research, with little emphasis given to other components of food security. (a) Changing the culture of research; (b) building stakeholder-driven portfolios of options; (c) ensuring that adaptation activities are relevant to those most vulnerable; and (d) combining adaptation and mitigation are the four primary obstacles for research on climate change adaption [10]

THE FAO STUDY

FAO estimates that the world's population will rise to 9.15 billion by 2050, based on UN projections (medium variant projection). According to the authors, the GDP estimates are

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

sourced from the World Bank and represent one of the more cautious growth forecasts for various nations. Global GDP (GDP per capita) is forecast to be 2.5 (1.8) times higher in 2050 than it was in 2005/07, with emerging nations likely to increase at a quicker rate. Projections of food demand are then produced using Engel functions for various commodities and nations, which are then applied to the predicted per capita GDPs." Subsequent changes to the demand predictions are made, sometimes significantly, to ensure that they are in line with the "feasible" expected levels of production and trade for each item.

An rise in daily kilocalorie consumption from 2772 to 3070 is predicted by the Food and Agriculture Organization of the United Nations, according to a study (FAO). When it comes to consuming calories, developing countries have seen an increase of 2619 to 3000 calories a day, while rich countries have seen little change (from 3,360 to 3,908 calories a day in 2005/07 to 3,490 calories a day by 2050). S. Africa and South Asia would see significant increases in food consumption (SSA from 2238 kcal per person per day in 2005/07 to 2740 kcal per person per day in 2050; South Asia from 2293 kcal per day to 2820 kcal per person per day) reaching consumption levels comparable with those of the other three developing regions in 2005/07. At the present rate of calorie intake per person, just 1.9 billion (20 percent) of the world's population are expected to reside in countries where the daily average is more than 3000 kcal in 2050. About 35 percent of the world's population lived in countries that provided less than 2500 kcal per day in 2005/2007. This will be down to 240 million people by 2050. (2.6 percent).

The composition of the diet would change as consumption increased. Root crops and cereal grains are predicted to be replaced by animal products, vegetable oils, and fruits and vegetables as the primary source of food in every region. When it comes to developing countries, this would be more apparent. China and Brazil's rapid rise of meat consumption will impede the growth of meat consumption in developing countries. There will still be a large disparity between meat intake per capita in rich nations (91 kg/year, +14 percent) and that of developing countries (42 kg/person/year, +50 percent compared to 2005-2007).

The world's need for agricultural products is expected to change as a consequence of an increase in food consumption and a decrease in the quantities used as feedstock for non-food manufacturing. The FAO study on biofuel production is projected to be completed and met by all countries by 2020, with no further revisions. The FAO's research spans the years 2005/07 to 2020, using the OECD/forecasts FAO's for biofuel output and non-food demand for agricultural items.

There will be a 60 percent increase in global food and non-food demand by 2050, according to the FAO research. The FAO predicts a 60 percent increase between 2005/07 and 2050, compared to the annual growth rate of +2.2 percent witnessed from 1965 to 2005. This translates to an annual growth rate of +1.1 percent.

Theglobalflowofprotein

Like calories, protein travels across the planet in a similar fashion. At 44 grammes per day, the average daily protein consumption for the global population is 81 grammes more than the RDA (National Research Council, 1989) and RNI (British Nutrition Foundation, 16-gram) recommendations, according to this study (see S.I.). Rather than an 8% increase

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

in calorie consumption, this results in an 84% increase in calorie intake. It would be erroneous to assume that protein deficiency is less widespread than calorie deficiency in the world's population due to the fact that protein intake is not as strictly controlled by the health consequences of overconsumption.

On the other hand, around 14% of the calories in crops are utilised for uses other than food, but only 5% of the protein is. In terms of protein consumption, MD&F account for 38% of the total, but only 19% of total calories consumed (c.f. contributions of 37 percent and 18 percent respectively, estimated using a farm-based bottom-up inventory approach by Poore and Nemecek, 2018). Human-edible crops fed to animals have 43 percent more protein than MD&F, while MD&F's calories are 34 percent more. By feeding human food to livestock, the global protein supply is reduced by 51 grammes per person per day (or 116 percent of the global average RDA).

The global flows of vitamin A

For humans, the daily need for vitamin A is 878 g/p/d, which is 22% more than the global average of 721 g/p/d (see Methods) (Institute of Medicine Panel on Micronutrient, 2000). There is a 22 percent post-harvest loss, which is more than the energy losses (11 percent). A total of 686 g/p/d is available for future use. Compared to 14 percent of calories, just 1% of this is used for non-food purposes. Human-edible crops provide a 214 percent return on the vitamin A they offer to animals, which contributes 37% of the vitamin A consumed. There were previously recorded returns of 34% for calories and 43% for protein of this magnitude. 195 g/p/d are lost in processing, distribution, and consumption, leaving 639 g/p/d to be consumed. As a result, the worldwide intake of vitamin A would fall by 11 percent without fortification and supplementation. Fortification of food is a common solution to this problem in many countries (Saeterdal et al., 2012), although some people still go hungry.

The global flows of iron

The iron content of crops grown for human consumption is 74 milligrammes per kilogramme of food consumed each day. A daily recommended intake of 11 mg for the whole planet is a far cry from this (Institute of Medicine Panel on Micronutrient, 2000). Harvest, post-harvest losses, investment, and non-food uses all contribute to a loss of 11 mg/p/d, resulting in crops with 63 mg/d Only 7% of the iron in MD&F gets returned to the human food chain as MD&F iron (41 mg/p/d) by animals. As a result of an animal's metabolism, however, iron is more easily absorbed. In the end, humans may consume 21 mg/p/d after 18 mg/p/d are lost in processing and distribution. Other factors, including as age, gender, and whether or not a woman is breast-feeding, have an impact on micronutrient levels. There is no difference between the ARI of iron and that of other metals. For vegetarians, iron intake must be double that of carnivores since the bioavailability of non-haem iron is lower than that of haem iron (Institute of Medicine Panel on Micronutrient, 2000). The absorption efficiency may also be affected by other dietary components. The bioavailability of iron, on the other hand, is still a subject of debate. Even after allowing for a conservatively high factor of four differential in bioavailability, haem iron is more bioavailable than non-haem iron (Institute of Medicine Panel on Micronutrient, 2000). After distribution and processing losses and consumer waste, 35 mg/p/d of non-haem iron would be available for human consumption from the

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normal global diet's 3 mg/p/d of haem iron. To put it another way, this will raise the total non-haem iron intake to 53 mg/p/d.

The global flows of zinc

Crops planted with zinc have a ratio 2.8 times greater than that of crops cultivated with iron. Three times more efficiently than iron, but less efficiently than energy, protein, and vitamin A, animals get 21% of their zinc needs from crops grown for human use. Despite the fact that the daily recommended zinc consumption in the United States is just 9 milligrammes (mg), Americans consume an average of 15 milligrammes (mg/p/d) (see S.I.). Supplementing with iron and vitamin A is standard practise, especially in developed countries where many foods are fortified with zinc as part of the food manufacturing process.

Regional food calorie apportionment

Seven regions of the world are used as a starting point for a food waste research project conducted by FAO (Food and Agriculture Organisation of the United Nations, 2011). Net edible crops (that is, locally farmed + any net imports minus seeds invested) may be separated into numerous endpoints for each bar. Net animal losses are the difference between the amount of calories absorbed by animals and the amount of calories returned in MD&F. The ADERs offered in Our World in Data, 2017 are based on a particular geographic location (see S.I.).

Regional protein apportionment

Overall, protein consumption around the world is more than required for a healthy lifestyle, with the lowest amounts being seen in South and Southeast Asia (43 percent). Almost every region of the world imports protein in net terms, with the exception of the Americas. It is the highest in North Africa, Western Asia (202%) and Industrialized Asia (152%) where imports are required to prevent budget gaps. Exports in North America and Oceania and Latin America constitute 564 and 389 percent of their respective ARIs. Sub-Saharan Africa and South and Southeast Asia take 66 and 62 percent of the protein that is available to them, respectively, whereas North America and Oceania consume barely 25 percent (regionally grown plus net import). Animal husbandry causes a net loss of protein in every region. There's a good chance that North America and Oceania have the largest percentage of animal inputs dedicated to GP & S, whereas Sub-Saharan Africa has the lowest percentage.

RegionalvitaminAapportionment

There is just one place in the world that has a considerable excess in vitamin A intake over the ARI. Vitamin A deficiency exists in every other part of the globe, until fortification and/or supplements are implemented. This is in accordance with the high frequency of health problems associated with vitamin A deficiency (Muthayya et al., 2013). Industrialized Asia is the only area where animals are net consumers of vitamin A; everywhere, the supply of naturally generated vitamin A is mostly dependent on the production of animals..

Regionalironandzincapportionment

Every location above the ARI has an overabundance of iron and zinc. This does not, however, mean that everyone consumes an adequate amount of iron, and iron insufficiency is a major health issue across the world. Iron bioavailability varies across

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

various diets, individual needs (particularly for females), and the prevalence of imbalanced diets.

Thecurrentglobalfoodsupplycompatiblewitha healthydiet

Only in Industrialized Asia do people consume enough fruits and vegetables to meet the recommended daily intake of 38 percent. In every area except Industrialized Asia, global sugar and sweetener consumption is 26 percent over recommended levels. North America and Oceania are the most affected, followed by Latin America and Europe. 74 percent of the population in North America and Oceania consumes more vegetable oils than is considered safe, while Europe is just on the edge. Meat and dairy consumption throughout the world is 20 percent more than what is considered healthy, with the highest consumption in North America and Oceania and Europe.

Table 1 "Comparison of global and regional food consumption with requirements for a "healthy diet". The maximumrecommended intake of meat and dairy is 567 kcal/p/d; the intake of fish is kept at current consumption levels of 54kcal/p/d."

Food type	Healthy diet (kcal/p/ day)	Current (2013) global and regional consumption (kcal/p/day)							
		World	Industrial- ised Asia	North America & Oceania	Europ e inc. Russia	Latin America	South & South - east Asia	North Africa, West & Central Asia	Sub-Saharan Africa
Fruit and vegetables	255 (minimum)	159b	294	129b	142b	112b	82b	154b	193a
Sugar and sweeteners	150 (maximum)	189a	68	383b	264b	297b	195a	214b	153a
Vegetable oils	360 (maximum)	219	179	626b	359	296	116	304	173
Meat, dairy and fish	624 (maximum)	499	624	1059b	1035b	637a	257	404	170

a. Denotes a violation of a person's dietary guidelines (World Health Organisation& Food and Agriculture Organisation of the United Nations, 2003; Willett, 2001; American Heart Association, 2001).

b. Denotes a deviation from a healthy diet of more than 33% in food intake (World Health Organisation& Food and Agriculture Organisa- tion of the United Nations, 2003; Willett, 2001; American Heart Association, 2001).

Foodsupplyunderfuturehypotheticalscenarios

We provide nine ideas for how the globe may feed itself today and in the year 2050. If present growth rates continue, maize, rice, wheat and soybean yields will rise by about 67 per cent, 42 per cent, 38 per cent and 55 per cent by the year 2015 (Ray and co-authors 2013), but future yield increases are uncertain. This means that present food supplies must be assessed in terms of their ability to fulfil future food demands in the absence of yield improvements. To maintain 2013 levels of GP&S consumption in these scenarios,

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we leave crop production and consumption levels unchanged. Comparing present supply with anticipated future demand gives us a better idea of what social adjustments are needed to ensure that existing resources are enough (or not) for anticipated future demands. Consumption and investment of calories remain unchanged in the four 2013 scenarios (A2013–D2013), which are all based on 2013 data.

Global food calorie endpoints for 2013 (A2013) are shown in the "basic" scenario (A2013). By the year 2050, the world's population will have grown by 9.7 billion people, while food production will remain steady and per capita waste and investment will be reduced. The quantity of waste created per person in the United States has remained constant. There will be an increase in the consumption of plants in A2050, but this will be compensated by a decrease in the availability of MD&F. An energy shortfall of 40 kcal/p/d in 2050 means the existing food supply will not be enough to feed the estimated 9.7 billion people in 2050, even if all non-food uses are eliminated (which we take to be the lowest priority of all uses of crop calories, as they do not contribute to the human diet).

Under the "no animal feed" scenario for 2013, human-edible crops are not fed to livestock (B2013). Proportional losses are projected for all items in this scenario, including human-edible crops supplied to animals that end up in the food chain. There will be a comparable increase in human vegetable consumption to bring calorific intake to the current level, resulting in just a reduction in MD&F from 594 to 408 kcal/p/d. As the amount of food ingested increases, the amount of non-food calories consumed rises from 808 to 2359 per day, regardless of how much more food is consumed. A food system's capacity to provide other ecosystem services, such as carbon sequestration, biodiversity, or biofuel production, can be gauged by the availability of crops that can be used for non-food purposes. This capacity can be used to respond to food security threats such as reduced crop yields, market pressures diverting food to non-food uses, or a faster population growth. Assuming a 50% conversion efficiency, the quantity of human-edible agricultural inputs required to meet 2013 global aviation energy needs would be roughly 2100 kcal/p/d (Huang and Zhang. 2013).

Table2Descriptionofscenarios

Scenarios	2013 (population 7.2 billion)	2050 (population 9.7 billion)
Base – current global food production with losses and animal feed unchanged	A2013	A2050
No animal feed – current global crop production with no human-edible crops fed to animals	B2013	B2050
No waste and no excess consumption	C2013	C2050
50% less human edible crops fed to animals, waste and excess consumption (compared to Base)	D2013	D2050
Meat and dairy consumption per capita at 2013 levels	–	E2050
Meat and dairy consumption per capita at FAO 2050 prediction	–	F2050

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If the projected global population of 9 billion people in the year 2050 is to be fed without reducing waste or net surplus consumption, B2050 forecasts that the non-food usage of human-edible crops may be increased by 927 kcal/p/d. Due to this, there would be a decrease in MD&F availability to only 301 kcal per day per person.

These two "no waste and no excess consumption" scenarios, C2013 and C2050, show the implications of eliminating all waste and net excess consumption. Up to 2312 kcal/p/d will be available for non-food purposes in C2013. C2050 will be a time when the world's population will have enough food to go around. MD&F availability decreases to 439 kcal/p/d, but non-food use climbs to 1092 kcal/p/d as the population expands. These scenarios, in contrast to the "basic" ones (A), show the combined effects of a 50% decrease in human-edible crops fed to animals, total waste, and net excess consumption when compared to the "base" ones (A). If MD&F consumption is cut by 16 percent, non-food uses might rise from 501 kcal/p/d to 2385 kcal/p/d. MD&F availability reduces by 38% to 370 kcal/d in 2050, whereas non-food uses might rise to 1023 kcal/p/d.

MD&F consumption is expected to decline in all of the following 2050 scenarios, notwithstanding current FAO projections. An increase of 594 kcal/p/d in MD&F consumption is expected per FAO predictions by F2050, up from 594 kcal/p/d in 2013.Waste, non-food usage, and excessive energy use must be eliminated in order to make E2050 a reality. Even if this is done, an extra 5% agricultural output over 2013 levels is needed to meet the predicted population in 2050. Crop output will have to rise by 31% above 2013 levels by the year 2050 in order to meet demand. The estimated 9.7 billion people in 2050 will not be able to fulfil their meat and dairy demands because of present grain production. In order to feed 9.7 billion people, an additional global supply of 1.95 1012 kcal/d and 12.8 1012 kcal/d would be required if these crop productivity gains were not adopted.

As with calories, there will be no non-food applications for protein in A2050 because of a reduction in excess consumption from 36 to 18 grammes of protein per person per day. Even in the year 2050, the populations in scenarios B, C, and D will consume more protein than they do now. In E2050, per capita MD&F consumption may be maintained at 2013 levels by lowering non-food uses, waste, and excess energy consumption. Excess protein consumption decreases from 82% to 69% of the RDA. F2050 will need an increase in protein intake that is almost double the RDA to meet energy requirements (196 percent).Iron, zinc, or vitamin A do not need the same scenario analysis since their availability may be raised by fortification and/or supplements at a lower cost (Horton, 2006) without altering food production levels. As with energy and protein, a surplus supply does not guarantee that everyone will get enough of individual.

CONCLUSION

To be ecologically and human health-friendly, a global food system has to meet four criteria. In order to feed the world's population without creating severe environmental harm, the volume and quality of food must be enough. Distribution of food must be effective enough to guarantee that everyone has access to a diverse selection of healthy meals while also minimising the negative environmental effects.In order for everyone to be able to maintain a healthy diet, socioeconomic circumstances must be equally

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favourable. Food production must be increased on the supply side if a nutritious diet for the world's population is to be ensured. To reduce food waste, at all levels of the supply chain, and to reduce excess consumption beyond what is necessary for a healthy lifestyle is obvious.

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