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## Food Policies' Roles on Nutrition Goals and Outcomes: Connecting of Food and Public Health Systems

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### Abstract

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Nutrition exists when food security is combined with a sanitary environment, adequate health services, and proper care and feeding practices to ensure a healthy life for all household members. Despite increased attention to undernutrition, it remains a devastating multi-faceted problem for infants, young children, and women around the world, resulting in increased morbidity, mortality, and long-term disability. Undernutrition can also lead to poor health into adulthood, which affects social and economic development of nations. On the other end of the malnutrition spectrum, overweight and obesity are growing problems, linked to changing diets and activity patterns, which also lead to serious health problems and impact the economies of nations. This chapter attempts to unpack the importance of food and agriculture policies on nutrition outcomes and why engagement of food and public health systems remain critically important. External pressures, such as climate variability and population growth, that tax these systems are discussed, as well as the globalization of our food system and why that has shifted dietary patterns and nutrition and health status trends. The multi-sectoral integration of food and health systems and its importance to improve nutrition is demonstrated through three models. Three very brief case studies are presented that help exemplify some of the food and health system trends that influence policy and ultimately, nutrition outcomes.

### Introduction



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Historically, malnutrition is broadly thought of as a lack of sufficient food. However, in light of rapidly changing economic landscapes in and between nations, multiple “burdens of malnutrition” contribute to poor health and development. For example, children who do not consume adequate calories and micronutrients over long periods—beginning in utero—do not achieve full genetic potential in cognitive, reproductive and immune development. The latest series on nutrition in the renowned peer-reviewed journal, *Lancet*, emphasized chronic malnutrition over acute malnutrition in terms of the overall detrimental effect on society. Micronutrient deficiencies of essential vitamins and minerals, such as iron, zinc, folic acid, Vitamin A and other, are also gaining importance as the scientific community proves links to disease and inhibited growth. It is, therefore, important to understand to connect food and public health systems to the role of food policies on nutrition goals and outcomes.

### What Is the Triple Burden of Malnutrition?

Nutrition, by definition, exists when food security is combined with a sanitary environment, adequate health services, proper care and feeding practices to ensure a healthy life for all household members.<sup>1</sup> This definition may seem quite similar to the food security definition posed by the World Food Summit of 1996 that states: *Food security exists “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.”*<sup>2</sup> However, there are definitions, on the one hand, and then there are the implications on how these definitions are translated into policies and programmatic implementation, on the other hand. Nutrition is often forgotten in the food security mandate. Thus, food and agriculture policies are generally less attuned to ensuring nutrition is central in their ultimate outcomes.

Not getting the right amount of food and nutrients or the right types of nutrients can lead to undernutrition or overweight, which, in turn, has serious deleterious effects on health, development, and productivity. Despite increased attention to undernutrition, it remains a devastating multi-faceted problem for infants, young children, and women around the world, resulting in increased morbidity, mortality, and long-term disability. Undernutrition can also lead to poor health into adulthood, which affects social and economic development of countries on large scales. Overweight and obesity are also growing problems, linked to changing diets and activity patterns, which can lead to serious health problems including increased risk of non-communicable diseases such as diabetes, cardiovascular disease and strokes.

The global burden of malnutrition can be described as a “triple” burden<sup>3</sup> in which countries, communities and households may be burdened with three manifestations of malnutrition: undernutrition (often in the form of chronic or acute), overnutrition (overweight and obesity) and/or micronutrient deficiencies. In FAO’s State of Food and Agriculture 2013 report, countries were classified as having one, two or three of these burdens and in different combinations. There are very few countries that do not have at least one malnutrition insufficiency or a combination.<sup>4</sup>

Global prevalence of stunting, which reflects chronic undernutrition during the early stages of life causing children to fail to grow to their full genetic potential, both mentally and physically, has declined to 35 % in children under 5 years of age since 1990, which is a reduction of 2.1 % per year.<sup>5</sup> Yet, there are still an estimated 150 million children who remain moderately or severely stunted.<sup>6</sup> Wasting, which reflects acute malnutrition and is a strong predictor of mortal-

ity among children, impacts 50 million children under 5 years of age, with the highest burden in South Asia. There has been an 11 % decrease since 1990.<sup>7</sup> On the other end of the malnutrition spectrum, an estimated 43 million children under 5 years of age are overweight, and two-thirds of those children reside in low- and middle-income countries.<sup>8</sup> Prevalence of low body mass index (BMI) in adult women has decreased in Africa and Asia in the last 4 decades, but still exceeds 10 % in the two regions. At the same time, prevalence of overweight and obesity has increased in all regions.<sup>9</sup> According to the world's leading medical journal, the Lancet, “[d]eficiencies of essential vitamins and minerals continue to be widespread and have significant adverse effects on child survival and development, as well as maternal health.”<sup>10</sup> Thus, indicators of malnutrition have far-reaching effects world-wide.

## Why Food and Agriculture Policies Should Have Nutrition Goals and Outcomes

*Where policies exist that support nutrition-sensitive approaches and where active government processes stimulate joint agriculture nutrition approaches, there is a relatively high likelihood of success in implementing such programmes and projects with the theoretical implication of improved, nutrient-rich and balanced diets, and eventually, improved health status of consumers. However, the sustainability of such initiatives relies heavily on sustained political will.<sup>11</sup>*

The WHO maintains that “[a]griculture remains the largest employment sector in most developing countries and international agriculture agreements are crucial to a country’s food security.”<sup>12</sup> A recent report published by the UN Nutrition Sensitivity of Agriculture and Food Policies, however, concluded that the “complex role of how agricultural policies can effectively address nutrition is not yet well understood.”<sup>13</sup> Additionally, the UN Standing Committee on Nutrition found that “[t]here is considerable conceptual knowledge on this topic, but little understanding of how to carry concepts and policy objectives into effective implementation and delivery of food-based approaches that impact nutritional status of populations.”<sup>14</sup> By focusing on the entire human lifecycle, nutrition-sensitive agriculture and food policies should consider the nutrients and determinants that are important for development, growth, and maintenance of health at various stages of life. The approach should encompass the entire food system—a complete array of activities covering all stages of the food supply chain ranging from input distribution, on-farm production, marketing, processing, and storage. The goal should be to produce healthy and safe food containing essential micronutrients and to increase year-round, affordable access for both rural and urban communities, as the consumers.

Food policies and programs are relevant to ensure that food systems from production to processing to consumption are directed to ensuring improved dietary patterns and nutrition outcomes. Debate continues between those who argue that agricultural policy should play a large role in producing nutritious food and those who believe that it is more important for agricultural policy to focus on economic development and “feeding the planet” in the form of bulk calories.<sup>15</sup>

This chapter attempts to unpack the importance of food and agriculture policies on nutrition outcomes and why engagement of food and public health systems remain critically important. External pressures that tax these systems will be discussed, as well as the globalization of our food system and why that has shifted dietary patterns and nutrition and health status trends. The multi-sectoral integration of food and health systems and its importance to improve nutri-

tion will be demonstrated through three models. Finally, four case studies will be presented that help exemplify some of the agriculture, food and health system trends that influence policy and ultimately, nutrition outcomes.

## External Pressures on Food and Public Health Systems

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### How Climate Variability Impacts Food and Public Health Systems

There is clear and convincing evidence for anthropogenic climate change.<sup>16</sup> The warming of the earth will have devastating consequences including more extreme weather conditions, rising seas leading to salination of agriculture and drinking water sources, and acidification of oceans, in which many people rely on for their diets and livelihoods. These effects will impact food security, nutritional outcomes and public health. The increased climate variability will intensify the severity and frequency of natural disasters. Both floods and droughts are and will continue to occur more frequently.<sup>17</sup> Predicting weather patterns will become much more difficult as the variability related to climate change increases.<sup>18</sup>

Climate change is having, and will have, very different effects depending on where people live and which resources are available to them. The poor will be impacted the most and suffer the greatest repercussions. Risks of food insecurity and health will also impact the poorest nations—ironically, those who had made the least anthropogenic contribution to climate change.<sup>19</sup> These changes are also likely to have the greatest impact in many low resource regions' agricultural outputs, reducing yields of crops, soil fertility, and forest and animal productivity, which may lower income, resiliency and subsequently, reduced access to sufficient, nutrient dense foods and impaired nutritional status of communities.<sup>20</sup> Unstable agriculture output could increase global prices for food and their volatility,<sup>21</sup> while urban areas will be especially vulnerable in accessing food.<sup>22</sup>

The poorest communities, especially female headed-households, will feel the consequences of rising food prices most strongly.<sup>23</sup> Increases in food costs force people to reduce the quantity and nutrient-quality of food consumed, preferentially affecting those who are in need of nutrient dense foods like young children and pregnant or lactating women.<sup>24</sup> In addition, diminished biodiversity, which is an important source of diverse diets, may, “increase the risk of disease being transmitted to human beings, a phenomenon termed the dilution effect.”<sup>25</sup> Thus, it has been estimated that 80 % of the burden of disease related to climate change will affect children and that by 2050, with a potential projection of a 20 % increase in malnutrition.<sup>26</sup> Climate variability, according to the UN Office for the Coordination of Humanitarian Affairs, “could eliminate much of the improvement in child malnourishment levels that would occur with no climate change.”<sup>27</sup> In fact, some studies estimate an even greater impact with stunting increasing by as much as 30 % compared to a scenario in which climate is stable.<sup>28</sup>

Additionally, the disease burden will also be impacted with a warmer world, which will in turn, effect the public health system. As global temperature rises, health impacts will change. With increasing severity of heat waves, heat-related stress will increase short-term mortality from stroke, respiratory and cardiovascular incidents.<sup>29</sup> Rising temperatures will also increase the spread and transmission of vector and rodent-borne diseases as well as density, pathogen

maturation and replication within mosquitos resulting in increases in infections of malaria, dengue fever and other vector born diseases.<sup>30</sup> It is estimated that malaria, diarrhea and protein-energy malnutrition together cause more than 3 million deaths each year.<sup>31</sup>

## How Population Growth Will Impact Food and Public Health Systems

It is nearly certain that the world's population will continue to increase. Over the past decade, our global population has increased from 6 billion to 7 billion. Historically, most of the growth in population has occurred post industrial revolution following the boom in services and industry. It is estimated that by 2050, the world's population will continue to grow to 9 billion, which begs the question of how much our planet and humanity can sustain and what the boundaries are of our food and health systems? (see Chap. 10.1007/978-3-319-07542-6\_16).

The patterns of population growth are nuanced. Overall, fertility rates are declining and child survival is increasing. Explanations for these trends are analogous to the question of what came first, the chicken or the egg? Have declines in fertility resulted in increased child survival because families take care to invest in their few children, or has child survival, through improved primary care health systems led to declines in fertility because families are realizing that the children that they do have, not only survive, but also thrive? Although the trend is overall positive, the continued population growth and its resulting pressure will have impacts on our food and public health systems. Results will include pressures upon public health, sustainable food production, environmental conservation, and the prevention of climate change as a challenge of industrial food production.

As global populations expand, the health system will be increasingly strained. In high-income countries, the population is aging due to extended life expectancy. A UN Task Team, led by senior experts from over 50 UN entities and international organizations, the Department of Economic and Social Affairs, and the UN Development Programme, found that, “[t]he number and proportion of older persons aged 60 years or over are rising in all countries. Globally, the number of older persons aged 60 years or over is projected to increase from 810 million now to more than 2 billion in 2050.”<sup>32</sup> With this longevity, comes increasing prevalence of expenses to treat chronic diseases in which the health sector must be in consistent demand.

At the same time, rapid economic growth and an emerging middle class in low- and middle-income classes will increase the demand for health services. Some countries will struggle to meet this demand.

Demographic changes in the past decades have led to the largest generation of youth in the world today. Globally there were 1.2 billion young people aged 15–24 in 2010. High-fertility countries in sub-Saharan Africa are projected to experience a rapid increase in the population aged 15–24, from 173 million at present to 362 million by mid-century.<sup>33</sup>

Thus, more of the world's population lives in urban areas than rural, resulting in a new set of challenges for governments and the health and food systems. In many low-income countries situated in sub-Saharan Africa, Asia, Latin America and even parts of the high-income world, like America and England, urbanization has resulted in slums with little access to health services, decent food shopping areas, or sanitation services. Data suggests that “[a]s urban populations swell, so do the incidence of illness such as hypertension, heart disease, obesity, dia-

betes and asthma.”<sup>34</sup> As urban migration occurs, many cities are ill equipped to build a healthy, functional food system. Some researchers examined food insecurity amongst slum dwellers in Nairobi and found that “[o]nly one household in five is food-secure, and nearly half of all households are categorized as food-insecure with both adult and child hunger.”<sup>35</sup> Thus, current trends point toward increased food *insecurity*.

Food insecurity, however, is not only a conundrum of low-income countries. The effects of food insecurity are also felt in wealthy cities. In New York City, for example, one of the wealthiest cities in the world, more than 1.3 million residents, including one in five children and one in ten seniors (over the age of 60), live in households that lack sufficient food.<sup>36</sup> In the last 5 years, the number of city residents experiencing food insecurity has increased by more than 200,000 and the city’s food pantries and soup kitchens reported a 10 % increase in demand, while 63 % reported food shortages in 2013.<sup>37</sup> A recent study has also shown that food insecurity was significantly associated with increasing body mass index in women not receiving food assistance in New York City.<sup>38</sup> This study further demonstrates that, “in an urban population, overweight and obesity are very common as is food insecurity”<sup>39</sup> and there is often a correlation between the two.<sup>40</sup>

With population pressures in the future will also come the necessity to ensure that enough food is produced and that the food produced is not wasted. An estimated 30–50 % of the world’s food is never consumed, but, instead, wasted or disposed of somewhere along the value chain between the producer and the consumer.<sup>41</sup> In high-income countries, most of the food waste that occurs is with the consumer or the retailer, such as food markets, restaurants, convenience stores. In low-income countries, most of the food wasted is due to post harvest losses and a lack of infrastructure, transport and technology.

In order to ensure that enough food is available for the growing populations around the world and that food is not wasted, policy makers and consumers may need to better think about how food is grown, transported and distributed in an equitable and efficient way. In this process, nutrition is often forgotten or lost. Thus, changes in the types of food we eat, as well as shifts in our diet, will drive a new market of and demand for how food is grown, processed and consumed. While population is increasing, overall wealth amongst that growing population is also booming, particularly in places like India, China and Brazil. This diet will shift towards more meat, dairy products, oils and processed food consumption and away from the more sustainable plant-based diets. Consequently, despite the need to grow more crops in a sustainable way, there is also a need to ensure that the food is available and accessible in a more equitable way. It follows that the food that is grown, provided and sold should be of better nutritional quality while consumers demand more nutritious foods.<sup>42</sup>

## Potential Future Pandemics: Consequences for Food Supplies and Public Health

*A pandemic is a global disease outbreak that represents a top global catastrophic risk*<sup>43</sup>

Outbreaks are usually the result of rapidly transmitting pathogens. Many of these pathogens are still emerging and little is known about the potentiating implications, many of which originate from animals (termed zoonotic). Some concerning pathogens arose over the last decade—including severe acute respiratory syndrome (SARS), West Nile Virus and the H5N1 avian flu. According to the World Bank, “every year, 2.3 billion human infections occur in developing

countries by zoonotic diseases, and 2.2 million” <sup>44</sup> people die as a result.<sup>45</sup> The food supply and the risks that come along with it are intricately linked to health outcomes that are also connected to the consumption of animal products.

Those that suffer the most are the poor and fragile communities, often because of the lack of public health services and their proximity to animals and livestock. The pathogens causing zoonoses result in diseases that can have profound impacts on food security, nutrition outcomes and livelihoods of these poor households. The World Bank states that “[p]andemic prevention requires robust public health systems (veterinary and human) to detect contagion early, ensure correct diagnoses, and respond rapidly to defend against contagion.”<sup>46</sup> Prevention also requires oversight of the food system to do early screenings, oversight and governance of quality controls and assurances. To ensure better response systems, in 2008, the WHO, and the Food and Agriculture Organization (FAO), coordinated by the World Bank and UN System Influenza Coordinator, prepared a global strategy for using “One Health” approaches to reduce health risks at animal-human-environment interfaces.<sup>47</sup> This multi-sectoral and disciplinary coordination is crucial to both food and health system integration to reduce pathogen risk.

## Our Globalized Food System

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### The Impact of Food Policies on Diets and Nutrition Outcomes

*Nutrition-sensitive agriculture* involves the design and implementation of nutrition-based approaches within agriculture, sustainable farming, crop systems, value chains and market places.<sup>48</sup> Ultimately, nutrition-sensitive agriculture is aimed at improving the nutritional outcome of a population by maximizing the positive impact of food and agricultural systems and their value chains on nutrition while minimizing the potential for negative externalities on the sector’s economic and production-driven goals.<sup>49</sup> It is agriculture with a nutrition *lens* and should not detract from the sector or consumer goals.<sup>50</sup> What is clear is that changing agricultural systems should not only meet basic caloric needs, but also the micronutrient and dietary quality needs of communities.<sup>51</sup>

There are five crucial entry points to improve nutrition-sensitive agriculture approaches<sup>52</sup> with two entry points in particular: (a) enabling policies and government structures expressing the political will to fight malnutrition and micronutrient deficiencies, and (b) appropriate mechanisms for inter-sectoral and inter-organizational collaboration within the countries. Studies have shown that for nutrition-sensitive agriculture programmes to be successful, partners from different sectors must be considered as active players.

Policies and processes of global market integration can influence long-term dietary change, but there is a need to look beyond the health sector.<sup>53</sup> Policies also need to focus on the promotion of healthy, high-quality diets over the long-term among populations living in lower income countries. Some researchers noted that there were few comprehensive sets of policies addressing obesity and diet-related chronic diseases in the developing world.<sup>54</sup> This remains true today. There is also very little that existing policies do to address the forces and institutions of the global marketplace that can have more detrimental effects to the health of populations.<sup>55</sup>

Since the WHO adopted the Global Strategy in 2004, governments are increasingly beginning to implement food policies to encourage healthier eating. Although the main strategy has been to provide information for consumers, countries have made notable steps in reformulating food products, establishing school food standards, nutrition labeling, restricting food marketing to children, promoting fruits and vegetables, and more recently, implementation of food taxes. However, when it comes to national food and agricultural policies, the focus remains mainly on producers. The policies are also not designed with public health in mind. For example, the relationship between population nutrition and chronic disease risk is often ignored in most agriculture policies,<sup>56</sup> which was corroborated by other analyses. One particular supporting analysis points out that current food policies are largely incompatible with good public health, but interventions that include food producers, processors, and food providers can markedly improve a population's dietary health. Such an improvement would require cooperation between farming and commercial food producers in order to counter the current trends in food supplies and to reshape the nutrition transition.<sup>57</sup>

In the WHO nutrition policy review,<sup>58</sup> the most commonly reported policy activities in food security and agriculture were research (59 %) and supply of seeds (55 %), subsidized sales and construction of irrigation systems (48 %), construction of rural infrastructure (42 %), price control (41 %), international agreements to increase domestic food production (41 %), production credit from state-owned banks (39 %) and subsidized food for vulnerable groups (38 %).<sup>59</sup> The main policy goals of these programmes were to increase output and farm incomes, followed by improving the quality of the products. Few of the broad policy goals explicitly mentioned nutritional goals, such as combating undernutrition, reducing overweight or obesity, or promoting a healthy diet.

### The Importance of Linking Food Policy to Public Health: Dietary Health Guidelines and Nutrient Needs

Increasingly, countries are developing and adopting dietary guidelines to promote healthy diets for their populations. These guidelines are often structured into select food groups and the recommended relative amounts to consume in order to obtain essential nutrients or to reduce risk of non-communicable diseases. Most guides recommend a diet based on staples of cereals or starchy roots, combined with high vegetable and fruit consumption, moderate levels of animal and vegetable protein and small amounts of fat, salt and sugar. Many combine this dietary pattern type approach with physical activity recommendations.<sup>60</sup> Although many countries have developed their own set of guidelines, many countries have based their guidelines on those developed by the World Health Organization (WHO).

In the United States, dietary guidelines are updated every 5 years based on the latest science as well as some food policy. These guidelines are quite detailed and visual and, in their development, involve a public consultation. A study that compared the 2005 U.S. dietary guidelines to the food system supply that is available for the country, found that food supply does not, on average, equal the recommended dietary guidelines.<sup>61</sup> The volume supplied surpasses the volume required by some two-thirds in the case of grains, and by half for both fats and sugar, while the volume of protein supplied is more than twice as high as the amount required. Similarly, the amount of oil supplied is three times as high as the amount needed, while dairy supply exceeds requirements by one-fifth. Fruit supply stands at less than three quarters of the required amount. Only vegetables come close to the recommended levels. The authors of



this study also found that this imbalance between supply and demand, or better, need, is even worse for the least developed countries.<sup>62</sup> In addition, there is an issue with what dietary guidelines recommend to what is possible within the planetary boundaries. For example, increasing consumption of fish rich in omega three fatty acids may quickly deplete the natural marine resources that contain these essential nutrients. Thus, changing diets may have massive implications on our environment and planet. The IOM has recently recommended that U.S. dietary guidelines be more thoughtfully based on environmental as well as nutritional considerations and consider more sustainable diet options (see Chap. 10.1007/978-3-319-07542-6\_10).<sup>63</sup>

In middle- and high-income countries, attention and publicity is increasing to promote better quality of diets in terms of both nutrition and sustainability. However, it is clear that the cost of such diets is currently high<sup>64</sup> and even basic diets in much of the world remain costlier than daily wages due to increased food prices.<sup>65</sup> In South Africa, a middle-income country, a nutritious and healthy diet costs 69 % more than a typical South African diet.<sup>66</sup> Even in high-income countries, many people cannot meet the dietary guidelines because the cost is prohibitive or consumers do not know how to shift toward better diets. In particular, fresh fruit and vegetable recommendations are difficult to satisfy because fresh produce is more expensive across the globe. Conversely, the least expensive food alternatives are often also the least healthy and least sustainable—ultra-processed, high in sugar and fat, and high in energy cost for every dollar spent.<sup>67</sup> To some extent, this seemingly cheaper sticker price is due to the externalization of the food producers costs (see Chap. 10.1007/978-3-319-07542-6\_16). Thus, sustainable and plant-based diets geared toward public health must become less costly so that consumers can have realistic alternatives to fast and processed foods.

### Food Safety and Food Utilization

Food safety is of utmost concern as our global food system becomes more globalized, and the “movement” of foodstuffs is increasingly reaching most geographical pockets across the planet. Food pathogen outbreaks, for instance, that occur in one area can have devastating health impacts in another. Contaminated food is, therefore, a major cause of acute diarrhea, malnutrition and mortality in low- and middle-income settings, particularly among children who become vulnerable to diarrheal diseases when transitioning from breast milk to complementary foods.<sup>68</sup> Solving problems of contaminated food requires a multi-disciplinary approach involving experts in clean water resources, sanitation, public health, epidemiology, nutrition and of course, agriculture, as the major food source.

Some studies suggest that environmental enteropathy afflicts many children in the developing world.<sup>69</sup> Environmental enteropathy is a syndrome that causes changes in the small intestine of individuals who lack basic sanitary facilities and are chronically exposed to fecal contamination. This, in turn, decreases the ability of the intestinal tract to absorb critical nutrients necessary for optimum growth and development, leading to serious consequences in nutritional status. Environmental enteropathy is often seen in young children when complementary foods are introduced along with breastfeeding. Not only are children eating more solid foods, but they also have increased exposure to the outside environment itself, leading to an increased risk of consuming contaminated foods. The provision of toilets and community led sanitation,

hygiene programs, and improved systems can reduce the incidence of enteropathy.<sup>70</sup> Therefore, robust community public health programs are critically important to nutrition improvements and consuming food is not the only pathway to better nutrition.

Notably, food toxins can be process-induced or naturally occurring, which is considered poisonous and can cause disease. There are many types of toxins but one in particular, aflatoxin, is receiving a significant amount of attention because of its deleterious effects. Aflatoxins are fungal metabolites that contaminate staple food crops in many developing countries and have been loosely associated with growth impairments in children, i.e. stunting as a measure of chronic undernutrition. Foodborne aflatoxin exposure, for instance, in maize and groundnuts, is common in Africa and Asia.<sup>71</sup> More evidence is needed on how post-harvest storage and handling can control aflatoxin, which could indirectly have an impact on the nutritional status of households.<sup>72</sup> Thus, food toxins, whether process-induced or naturally occurring, should be addressed to improve nutrition outcomes as a whole.

This area of work is critically important in the infant and young child feeding interventions, and public health, education, and agriculture all play critical roles in ensuring food safety and nutrient availability. Most of the studies examine in this field, however, the contamination of foods with *Escherichia coli*. There are four major categories of diarrheagenic *Escherichia coli*: enterotoxigenic (a major cause of travelers' diarrhea and infant diarrhea in low-income countries), enteroinvasive (a cause of dysentery), enteropathogenic (an important cause of infant diarrhea), and enterohemorrhagic (a cause of hemorrhagic colitis and hemolytic uremic syndrome). Besides manifesting distinct clinical patterns, these categories of *E. coli* differ in their epidemiology and pathogenesis.<sup>73</sup> However, succinct outcomes need to be found as well as studies conducted to determine the effect of contaminated food directly on diarrhea incidence and indirectly on anthropometry measures. A lot of work still needs to be done in exploring connection, associations and correlations in young child feeding interventions, and public health, education, and agriculture but the evidence supports the need for overall improved food safety and nutrient availability.

## Bridging Sectors and Disciplines

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### Integration of Sectors Across Food and Health Systems for Nutrition

The interactions between health, nutrition and agriculture are mutual: agriculture affects health and health affects agriculture—both positively and negatively.<sup>74</sup> Consequently, multi-sectoral approaches are vital to ensure improvements in food security and nutrition for individuals, households and communities.<sup>75</sup> However, integration across diverse sectors and distinct systems is complex. There are, at a minimum, three key sectors that need to engage, collaborate and contribute to nutrition improvements: agriculture, health and environment sectors. These three sectors link nutrition with the functioning of and effectiveness of food, health, water and sanitation systems.<sup>76</sup>

A robust primary health care systems approach, complemented by improved water and sanitation, can improve nutritional status. The infectious disease burden, for example, impedes consumption and the body's ability to metabolize nutrients, resulting in poor nutrient absorption and nutritional deficiencies. Consequently, one of the most important premises to improve nutrition is to control and prevent the most common childhood infectious diseases by expanding

immunization programs, providing diarrhea and malaria control, treating infected patients, and decreasing parasitic burden. The backbone of some of these programs is a clean water supply, hygiene and sanitation improvements at the household and school levels.<sup>77</sup> The importance of clean water must not be understated and plays a role across a variety of food law and policy aspects.

Synergistically, if food production systems are inadequate, there can be negative effects on health. Thus, sound food production systems can improve the overall health of communities. After all, health is considered a primary goal and endpoint of food systems.<sup>78</sup> Similarly, poor health and dysfunctional health systems can limit agricultural productivity. Conversely, good or improved health and nutrition allow for improvements in agriculture outputs.<sup>79</sup> With improvements in agricultural production, in turn, household income can potentially increase and with that, more can be spent on household healthcare and other goods. Additional income can also be used to purchase higher-quality food toward a more diverse diet. Changes in agricultural production can also result in the introduction of new foods into diets.<sup>80</sup> Thus, the feedback loop between food and public health affects multiple sectors. A multi-sectoral approach, therefore, is the foremost method to address these concerns because it brings together a coherent range of strategies with the aim of enhancing food and nutrition security. These necessarily include interventions in agriculture and business development, healthcare, clean water, hygiene and sanitation, basic infrastructure, gender equality, and education.

To strengthen food and health systems and to achieve integrated synergies, there needs to be thoughtful integration between interventions or approaches, especially when an already existing collection of distinct vertical programs exists.<sup>81</sup> “Every intervention, from the simplest to the most complex, has an effect on the overall system, and the overall system has an effect on every intervention.”<sup>82</sup> Services, interventions and solutions that are bundled or packaged across food, health and environmental systems can be more effective and advantageous.<sup>83</sup>

Recent calls for greater attention to hunger and under-nutrition highlight the importance of integrating technical interventions with broader approaches to address underlying causes of food insecurity while incorporating perspectives from agriculture, health, water and sanitation, infrastructure, gender and education.<sup>84</sup> Such an approach would inherently build on the knowledge and on the capacities of local communities to transform and improve the quality of diets for better child health and nutrition, as well. Moreover, such approaches also highlight the interdependence and the bidirectional relationships that exist between hunger and nutrition and a host of other health development challenges.<sup>85</sup> Recent research, for instance, has documented potential synergies between health and economic interventions, suggesting multi-sectoral approaches which may generate a wider range of benefits than single sector approaches acting alone.<sup>86</sup> Even while addressing broader determinants, a political priority is to address primary causes of hunger and under-nutrition in an equitable manner.

Evidence also suggests that increasing economic growth alone, while necessary and important, is unlikely to be sufficient to address hunger and under-nutrition. Food and nutrition security are complex and require efforts across a spectrum that include enhancing food production while simultaneously increasing access and utilization with substantive political commitment to address the most vulnerable populations with an equitable, basic human rights lens approach.<sup>87</sup> Therefore, addressing food and nutrition insecurity are inextricably linked to the wider progress towards the new Sustainable Development Goals. Durable gains will hinge on concurrent steps to reduce poverty, improve access to education, empower women and girls,

and facilitate access to basic infrastructure including safe water and sanitation, energy, transport, and communication. Working on multiple fronts simultaneously has the potential to leverage synergies and catalyze gains that extend beyond those achieved through sector specific programs working in isolation.<sup>88</sup>

### Econutrition as an Integration Model

Ecologists, nutritionists and agronomists work in multi-dimensional systems, composed of organisms, energy, and the physical environment interacting at various spatial and temporal scales, which can be described in terms of composition, structure, functions, and resilience.<sup>89</sup> Though many ecologists have focused on the relationship between biodiversity and ecosystem functioning, there has been little focus on the role that ecosystems play in providing the essential elements of human diets. The same can be said for nutritionists and agronomists. Usually, experts stick to their own sectors without thinking of the role of their discipline on other sectors. More research is now in progress demonstrating how the combination of environment, communities, agriculture and human beings impact human nutrition and livelihoods.<sup>90</sup>

Econutrition is a discipline that integrates environmental health and human health, with a particular focus on the interactions among the fields of agriculture, ecology and human nutrition.

As humans modify their environment, they select and protect some species, crops and foods and exclude and eradicate others to achieve management goals and to maximize the provisioning of ecosystem services or optimize for nutrient diversity where increasing species richness increases the capacity of the agroecosystem to meet the entirety of human nutrition needs.<sup>91</sup>

The notion that nutrition, human and agricultural productivity, and environmental sustainability are interrelated has thus been coined as “econutrition.”<sup>92</sup> It is the goal of econutrition to tackle malnutrition, where much can be gained by linking agriculture and ecology to human nutrition and health. Integrated and mixed agriculture systems such as the rice-fish aquaculture systems, poultry-orchard systems, livestock-cover crop systems all provide benefits for food production, ecological, diet and nutrition.<sup>93</sup>

Econutrition type approaches are being piloted that integrate ecosystems services, with food production and nutrition. For example, ecological complementarity that also results in net nutritional benefit comes from the Mesoamerican “three sisters”—the combination of corn (a grass), beans (a nitrogen-fixing legume), and squash (a low-lying).<sup>94</sup> Integrated and mixed agriculture systems such as the rice-fish aquaculture systems, poultry-orchard systems, and livestock-cover crop systems also provide food production, ecological, diet and nutrition benefits.<sup>95</sup>

One such example of mixed farming systems was implemented in Northern Malawi. Legumes were promoted in a maize-dominated farming society to improve soil health (nitrogen fixing from legumes) while improving child nutrition (consumption of legumes rich in protein and micronutrients). The agriculture intervention was paired with consistent community and household education and the delivery mechanism was done through the local primary health care system, i.e. the local hospital. After 6 years of intensive interventions, child growth improved with underweight and stunting levels decreasing. This project demonstrated the impact

that using agriculture approaches, delivered through the health system, can impact nutritional outcomes.<sup>96</sup> Therefore, econutrition approaches have promising effects and great potential to reverse many of the food-related problems around the world.

## Ecological Public Health

Building on the econutrition approach, Rayner and Lang (2012) developed an “ecological public health” model. This model addresses the divisions that often happen with human health and the integrity of the natural environment. Moreover, this model links disciplinary boundaries and “champions a rebalancing of what is meant by health activity”<sup>97</sup> with preventative approaches being central. Four dimensions are stressed. These are:

- **The Material**—physical and energetic infrastructure
- **The Biological**—bio-physical processes and elements
- **The Cultural**—how people think and how collective consciousness applies
- **The Social**—interactions between people and their mutual engagement as collectives

Time, human action and institutions shape these dimensions. The outcomes, ultimately, that this model is geared toward are sustainable health futures. Nutrition fits squarely in this model because it plays a significant role in altering public health as well as the ecosystems that support nutrition. Nutrition “refers to massive changes not just in what people eat but in how food systems operate: turning precious food into cheaper calorie commodities which can be marketed and sold.” Nutrition is not just a health problem but also a larger systemic issue that demands action from many different sectors.<sup>98</sup>

## Sustainable Diets

In recent years, a number of initiatives and studies have focused more directly on the question of diets and their impacts on human health, the environment, and food systems. In 2010, the FAO led an effort to develop the following consensus definition for Sustainable Diets: those diets with low environmental impacts, which contribute to food and nutrition security and to [a] healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources.<sup>99</sup>

While elaborate, this definition reflects the important recognition that the health of human beings cannot be isolated from the health of ecosystems.<sup>100</sup> Thus, sustainable diets promote environmental and economic stability through low-impact and affordable, accessible foods, while supporting public health through adequate nutrition. Importantly, sustainable diets help promote sovereignty and preserve tradition involving culturally sensitive and acceptable foods.<sup>101</sup>

In order to advance commitments to sustainable diets as a central aspect to sustainable development, one must address the gaps in our understanding of what constitutes a sustainable diet for different populations and contexts. Additionally, it is important to understand how these diets can be assessed within the global food system and how environmental sustainability in global consumption patterns and dietary goals can be achieved. Finally, it is necessary to exam-

ine how (sustainable) diets can help transform the health of populations, while promoting economic development and the slowing of environmental degradation.<sup>102</sup> Although many of these processes are underway, they are not yet receiving due political attention or support. This lack of political attention is partly due to the complex web of interactions between food systems, manufacturers, the environment, public health, and consumer behavior and the challenges policy makers face in making appropriate choices whether they are in government, commerce or civil society.<sup>103</sup>

## Case Studies

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In this next section, four case studies are presented. In three studies, a political analysis was done in several middle- and low-income countries<sup>104</sup> in three major regions of the world, Africa, Asia and Latin America, to determine how nutrition is integrated into food and agriculture policies, with particular focus on “nutrition sensitive” agriculture policies. These case studies demonstrate the opportunities and challenges of countries undergoing a triple burden of malnutrition, and how difficult it can be to integrate nutrition, public health and agriculture in policy and in practice.

The last case study highlights a particular project, the Millennium Villages Project in integrating not only just nutrition into public health and agriculture, but also, nutrition into a wider development framework to achieve the Millennium Development Goals (MDGs). This case study illustrates how impactful integration of multiple sectors can be to achieve results in the most difficult of settings.

### Case Study Brazil: A Country in Transition

The major food commodities grown in Brazil include coffee, oranges, and soybeans. Notably, the Brazilian diet is shifting from traditional foods that are freshly prepared to ultra-processed foods.<sup>105</sup> Traditional foods include rice and beans as well as roots like cassava. These foods are being replaced with foods that are energy-dense and rich in salt, sugar, and fat. In fact, it has been observed that the reduction in consumption of traditional foods as well as fish, eggs, and vegetables has coincided with increased consumption of soft drinks, cookies, sausages, alcohol, and pre-made meals. Brazil has two agricultural models that define the food system. The agribusiness model focuses on large-scale monocultures grown primarily for export. Conversely, the family-farming model focuses on smallholders and domestic, diversified production. Although, the agribusiness model is the dominant model nationally, accounting for two thirds of agrarian production, the family-farm model is growing and is responsible for 70 % of the food consumed in Brazil.<sup>106</sup> Further and future-oriented support for family-farms is likely to be more beneficial for econutrition and food safety in Brazil than industrial agriculture.

Brazil is currently undergoing a nutrition transition. Within the past few decades, there has been a decrease in under-nutrition as well as large increases in overweight and obesity. Simultaneously, within Brazil’s policies and programs, there is a strong emphasis on increased food production focusing on better food storage, concerns for vulnerable groups, empowerment of women, and explicit nutrition objectives and indicators. Some of these policies contain elements of commitments towards the over-nutrition agenda, including nutrition education and focus on nutrient-rich foods, increase of access to markets, and promotion of dietary diversification. The resulting dichotomy between the two main agricultural models parallels the

nutrition challenges in Brazil. Logically, then, there is a dominance of the agribusiness model, which reduces the ability of policies to target the most undernourished populations. It also is linked to the consumption of highly processed foods, which lead to obesity. Essentially, the policies that focus on family farming have more nutrition-sensitive interventions, but face challenges in implementation and sustainability, especially in competition with agribusiness approaches.<sup>107</sup> As part of the nutrition transition in Brazil, a variety of challenges must, therefore, be overcome.

Brazil is an upper middle-income South American country with a population of 190 million and a rapidly growing economy. On average, per capita income increased by 22 % between 2004 and 2008 and roughly 30 million people have entered the middle class. Currently, Brazil is moving through the second stage of the nutrition transition. This means that most people have access to adequate calories, but not to adequate amounts of micronutrients. The typical diet in Brazil is unfortunately transitioning away from traditional and minimally processed foods—such as the combination of rice and beans—to energy-dense processed foods that are low in micronutrients.

Nevertheless, Brazil has made significant progress in combating chronic under-nutrition. Between 1989 and 2006, the prevalence of childhood stunting under 5 years of age fell from 19.6 to 6.7 %. Similarly, the prevalence of underweight among children under 5 years of age decreased from 5.4 to 1.8 %. However, the prevalence of under-nutrition is higher among low-income groups and among traditional peoples and communities.

As is typical for a country moving through the second stage of the nutrition transition, the decrease in the prevalence of under-nutrition has been accompanied by an increase in the prevalence of overweight and obesity. Between 1989 and 2006, the prevalence of overweight adults and adolescent males increased from 29.9 to 50.1 %. Correspondingly, the prevalence of obesity increased from 5.4 to 12.4 %. Over the same time period, the prevalence of overweight females increased from 41.4 to 48.0 % and the prevalence of obesity increased from 13.2 to 16.9 %.

An UNSCN analysis of the nutrition sensitivity of food and agriculture policies and programs in Brazil reviewed nine policies, plans, and programs in various administrative sectors, which provide helpful examples in support of the aforementioned policies and food-related concerns outlined in this chapter.

**Areas of Focus** There are two distinct and often contradictory models of agriculture in Brazil, namely the agribusiness model and the family-farm model. The agribusiness model accounts for 26.9 % of Brazil's GDP, and enjoys substantial political and financial support. The family farm model only accounts for 33 % of agrarian production, but it employs 74.4 % of rural workers and is responsible for 70 % of the food consumed in Brazil. In general, policies and programs focused on the agribusiness model are much less nutrition sensitive than policies and programs focused on the family farm model.

Except for the Agriculture and Livestock Plans, all of the policies analyzed for this case study are associated with the family-farm model.

*National Food and Nutrition Security Policy and Plan* The National Food and Nutrition Security Policy and the accompanying implementation plan take a comprehensive approach to improving food and nutrition Security in Brazil. The policy recognizes adequate food as a human right and seeks to sustainably improve access to food, especially among the most vulnerable members of society. Other policy objectives include: the creation of nutrition education processes, development and promotion of sustainable food systems, and increased integration of food and nutrition in all levels of health care. The plan also includes interventions targeting food production and supply, healthy eating education, and strengthening of family farming.

*The Harvest Plan for Family Farming* The Harvest Plan for Family Farming is the overarching plan for the implementation of agricultural policy through the Ministry of Agriculture and Development. Its goal is to increase production, income, and use of technology within the family farming model. There are a number of nutritionally sensitive programs within the Harvest Plan for Family Farming, including the National Program for Strengthening Family Farming (PRONAF) and the Food Purchase Programme (PAA).

While all of the above programs meet many of the nutrition-sensitive criteria, the PAA, in particular, is an innovative program that simultaneously achieves improved food security for family farmer food producers and food insecure individuals while also securing additional funding for further food sensitive interventions. The PAA facilitates government purchase of nutritious food from family farms outside of the administrative procurement protocol typical for government purchases. This creates a source of dependable income for small-scale family farmers and improves food security through poverty reduction. The purchased food is then distributed to food insecure households and individuals as well as government institutions including hospitals, health care centers, and schools, where the food is used in the National School Feeding Programme. Finally, the program also stipulates that any income generated from the sale of food purchased through the PAA must be used solely for programs that combat hunger and improve FNS.

*Successes, Challenges and the Way Forward in Brazil* Brazil has made great progress towards combating chronic malnutrition and promoting food and nutrition security. The right to adequate food is recognized in the Brazilian Constitution, and it is clear that there is substantial drive to see this right fulfilled both on the part of the government and that of civil society.

Nonetheless, the current policy in Brazil poses substantial challenges to the advancement of food and nutrition security and efforts to reduce the prevalence of overweight and obesity. Three such challenges are the apparent dichotomy between the agribusiness and family farming models, the struggle to achieve meaningful land reform, and the powerful lobby and legislative forces opposing some of the proposed food and nutrition initiatives. In the face of these challenges, however, the policies and programs analyzed are generally nutrition sensitive and provide a useful roadmap for improving nutrition in Brazil.

- ***Agribusiness versus Family Farming***

Stakeholders interviewed assert that the agribusiness model, which is dependent on monocultures and the extensive use of pesticides and genetically modified organism seeds, does not coexist harmoniously with the family-farm model. Agribusiness has had large positive



effects on Brazil's economic growth and is powerful and well funded. Many stakeholders see the decision to prioritize agribusiness as diametrically opposed to promoting food and nutrition security.

- ***Land Reform***

Many stakeholders identified land concentration as a major hurdle to guaranteeing food and nutrition security among the most vulnerable groups in Brazil. While traditional and indigenous groups have access to social support programs, the right to land is critical for them to ensure long-term, sustainable food security. There has been progress toward family farming and settling of landless families since 2003, but the agribusiness model favors land concentration and, in recent years, land reform has been removed from the government's agenda.

- ***Regulation and Legislative Challenges***

Civil society plays a very important role in Brazil, and is in part responsible for many of the food and nutrition security advancements in the country, such as through the National Food and Nutrition Security Council (CONSEA). However, agriculture laws, as well as food and nutrition policies and regulations sometimes face powerful opposition from pro-agribusiness lobbyists and politicians in addition to wealthy national and transnational corporations (BigAg and BigFood). This is evidenced by the successful derailment of a regulation that intended to set limits on the advertisement of foods with low nutritional values to children.

**Moving Toward Nutrition-Sensitive Agriculture in Brazil** All of the food and agriculture policies analyzed in this case study are nutrition sensitive to some degree. The plans that are related to promotion of the family farming model are especially nutrition sensitive. As a group, the policies and plans are strongest when it comes to taking a sustainable approach to improved food and nutrition security, increasing food production, targeting the most vulnerable, expanding access to markets, and improving food processing and storage. The current policies and plans, however, lack sufficient emphasis on increasing production of nutrient rich foods, improving processing to retain nutritional value, reducing post-harvest losses, and integrating nutrition education.

### **Case Study Nepal: A Landlocked, Post-Conflict Country with Great Momentum**

In Nepal, the major crops are paddy (unmilled rice), wheat, maize, millet, barley, and legumes. Cereal crops are predominant in agricultural production, with 72 % of all agricultural households cultivating paddy, 64 % cultivating maize, and 57 % cultivating wheat. The Nepali diet varies depending on the landscape—the Terai (fertile lowland plains) population consumes rice and wheat, the Hill population consumes maize and millet, and the Mountain diet consists largely of millet, maize, and barley. The main Nepali cash crops grown are sugarcane, oilseeds, potatoes and pulses. Thus, the agricultural sector has diversified into fruits, vegetables, spices and condiments.

Overall, while the food system still focuses on the production of cereal crops, the percentage of households with holdings of fruits and vegetables is increasing. This trend has supplemented and changed farmer income, as well as increased the nutrition content of domestically pro-

duced foods and diets. However, this trend would have greater effect with an increase in the share of land used to cultivate the aforementioned crops.<sup>108</sup>

The government of Nepal has also demonstrated a commitment to improving food and nutrition security, which is evident in the planning structure and policies across sectors that emphasize the need for improved nutrition. For instance, the country's programs and policies look toward diversification of production, increase of production of nutritious foods, improvements in post-harvest processes, and increases in women's income. These programs and policies could be further strengthened by focusing on additional nutrition education, managing natural resources, and empowering women through multiple channels, such as improving labor and time-saving technologies, access to extension services, and supporting their rights to land and employment.

However, there are also areas where nutrition-sensitive policies in Nepal are particularly weak. For example, there is little effort to assess the context and cause of malnutrition at the local level and to incorporate local insights and observations into sub-national planning. The Food and Nutrition Security Plan focuses on vulnerable groups, but there could be additional policy support to expand markets and market access to these groups. The plans could also elaborate on specific measures needed to increase equitable access, availability, and consumption of quality food, particularly in those areas that are geographically difficult to reach.<sup>109</sup>

In summary, Nepal is a low-income country with a population of about 27 million. It is located in southern Asia and is bordered by China on the north and India on the east, south, and west. Agriculture dominates Nepal's economy, accounting for 34 % of the GDP and employing 70 % of the workforce. Nepal is currently in the first stage of the nutrition transition, meaning that the typical diet is low in calories and micronutrients and under-nutrition is prevalent. Staple foods, such as grains including rice, wheat and maize, which are high in energy but low in micronutrients, account for 72 % of the caloric intake of the typical Nepalese diet.

Nepal has made significant strides in improving the nutrition situation over the past decade, reducing the prevalence of stunting for children under 5 years of age from 57 to 41 %. Moreover, the prevalence of underweight for children under 5 years of age fell from 43 to 29 %, and the prevalence of maternal anemia by 50–23 %. However, the Government of Nepal (GoN) recognizes that chronic malnutrition is still a serious problem. The major policies analyzed in the UNSCN case study seek to address this problem through a variety of nutrition-specific and nutrition-sensitive interventions.

A UNSCN analysis of the nutrition sensitivity of food and agriculture policies and programs in Nepal reviewed ten policies and programs in various administrative sectors. The main areas of focus are outlined in the following section.

**Areas of Focus** The National Planning Commission (NPC), which is the advisory body for formulating development plans in Nepal, is responsible for leading the coordination of the three main plans: (1) the Multi-sectoral Nutrition Plan for Nepal (MSNP), (2) the Agriculture Development Strategy (ADS), and (3) the Food and Nutrition Security Plan of Action (FNSP).

*Multi-Sectoral Nutrition Plan for Nepal (MSNP)* The MSNP sets specific reduction goals for the prevalence of stunting, underweight, and wasting among children under five and undernutrition among women ages 15–49. In essence, the plan intends to accomplish these goals through

interventions that focus on reducing diarrheal and other diseases that inhibit nutrition absorption, providing nutrition-focused maternal education, increasing the availability and consumption of nutrient-dense foods, and expanding capacity of national and local government to improve maternal and child nutrition among other factors. Under the MSNP, the Ministry of Agriculture and Development is responsible for increasing “consumption of diversified foods, especially animal source foods, particularly among pregnant women, adolescent girls, and young children”.<sup>110</sup> They intend to increase production of foods rich in micronutrients, promote ideal Infant and Young Child Feeding (IYCF) practices, expand the percentage of children receiving immunizations and micronutrient supplements, and improve the distribution systems to reach subsistence farmers in rural areas.

Upon critical examination, the MSNP could be stronger, from an agricultural perspective, if it focused more on consumption and utilization activities of food security, indigenous food’s role in improving nutrition, integration of food technology in improving IYCF practices through nutrient-dense complementary foods, and working toward food-based dietary guidelines and the introduction of a food labeling system.

*Agricultural Development Strategy (ADS)* The ADS is long-term strategy to increase agricultural sector growth over the next 20 years. It focuses on four strategic components: governance, productivity, profitable commercialization, and competitiveness. At the same time, ADS strives to promote inclusiveness, sustainability, multi-sectoral development, and market connectivity infrastructure. The ADS assessment report demonstrates a clear understanding of the difference between food sufficiency and food and nutrition security. Notably, nutrition remains 1 of the 12 thematic focuses of the ADS, while improving food and nutrition security are even included in the ADS vision statement. Thus, the four strategic components of the ADS are supposed to improve food and nutrition security both directly as well as indirectly through poverty reduction, agricultural trade surplus, and higher income for rural households. Nonetheless, the focus on profitable commercialization within the ADS remains cause for concern, as the commercialization of rice directly contradicts efforts within the FNSP to diversify diets. Additionally, the budget for agriculture in Nepal has historically been low and it is unclear if the plans can be accomplished without a significant increase in funding.

*Food and Nutrition Security Plan of Action (FNSP)* The FNSP was developed as a collaborative effort between the GoN and the Food and Agriculture Organization to ensure that food and nutrition security was a part of the ADS. The FNSP is a 10-year plan that is intended to be the government’s primary document for food security interventions. It will serve as a complement to the ADS and eventually become an entity of the ADS.

The FNSP seeks to reduce hunger and poverty by improving sustainable agriculture-based livelihoods, especially among Nepal’s poorest households. Thus, the nine components of the FNSP focus mainly on increasing food availability and are:

1. Agriculture Crops,
2. Fisheries,
3. Food Quality and Safety,
4. Forestry,
5. Gender Equity and Social Inclusion,
6. Horticulture,

7. Human Nutrition,
8. Legislation, and
9. Animal Health and Production.

The FNSP fills in gaps in the ADS by focusing on the most vulnerable and by promoting diversification of production systems. However, the FNSP would benefit from additional focus on access to and utilization of foods at the household level. It is the focus on production that ignores consumer-side factors that affect nutrition such as affordability, purchasing power, consumption and behavioral changes.

*Successes, Challenges and the Way Forward in Nepal* The GoN has aggressively pursued ambitious policies to address chronic malnutrition in the country. Political will to improve the nutrition situation is critical to success, and the GoN has showed the commitment necessary to make a positive impact on chronic malnutrition. One demonstration of this success was the recently drafted Multi-sectoral Nutrition Plan for Nepal that truly represents multiple sectors of the GoN.

All three major policies have explicit nutrition objectives, nutritional impact measurements within the monitoring and evaluation systems, and opportunities for multi-sectoral collaboration. These plans all include activities or interventions that increase food access by diversifying production and income, increasing production of nutritious foods (with a focus on local foods rich in micronutrients and protein), improving processing and reducing post-harvest losses, increasing market access, and improving storage and preservation of food. The plans could be strengthened by a greater focus on incorporating nutrition education into interventions, long-term management of natural resources, and empowering women through increasing income, improving labor technologies and supporting their right to land, education, and employment. Finally, the plans are also weak in assessing the causes and context of malnutrition at the local level to maximize the effectiveness of interventions within the heterogeneous localities in Nepal and increasing equitable access to resources.

While the three major policies and plans analyzed in this case study have nutrition-sensitive elements, Nepal faces implementation challenges including a lack of capacity and insufficient coordination between plans and ministries. There is a lack of nutrition-related human resources at all levels of government in Nepal, which is a major obstacle to effective implementation of nutrition-sensitive interventions. The Government of Nepal is aware of this scarcity and is working with NGOs and the donor community to build the necessary capacity at the local and central levels. Even the MSNP and the ADS have built-in capacity objectives to help address this gap.

There is a large potential for collaboration within the plans, but it is not immediately evident that this potential is being fulfilled. Many stakeholders are unaware of their role in the MSNP and the ADS. The plans also do not take advantage of many opportunities for multi-sectoral coordination. In fact, the ministries are seen as secondary and are underutilized. For example, the Ministry of Education is not engaged in the nutrition education initiatives of the FNSP.

*Toward Nutrition-Sensitive Agriculture in Nepal* All of the plans are ambitious with many outcome measures and target groups. To make substantive improvements, Nepal must focus on several key populations: children under two, pregnant and lactating women and the landless. If

nutrition actions focused on these three populations within Nepal, coordination and impact of the plans would be optimized.

High-level government officials play a decisive role in the successful implementation of these plans. These officials must coordinate all actions across ministries and government offices, channel donor and civil society efforts, and develop compelling narratives around nutrition as a poverty reduction priority. However, issues that repeatedly emerge include transient government and mandates which prove challenging for Nepal. Without a constitution, stable government and long-term positions in ministries, priorities shift. If Nepal can make a measurable impact in a short time with these new plans, it is in the best interest for Presidents to continue the work. It is also important for food and nutrition security to be embraced as a major objective of long-term national development strategies.

Finally, long lasting change takes time. Nepal's current food and agriculture plans are ambitious, and commendable. At the same time, Nepal is a young country, and faces a long path towards development and economic security. Under-nutrition reduction takes time. With that said, nutrition goals and targets should be aggressive, but also realistic and achievable in the appropriate time scales.

### Case Study Senegal: Improving Subsistence Agriculture Through Better Nutrition

As a largely rural country, Senegal relies predominantly on rain-fed, subsistence agriculture. Despite the fact that 75 % of the workforce is represented in the agricultural sector, Senegal remains a net food importer, particularly of rice. The main vegetable cash crops are green beans, tomatoes, melons, and mangoes. Other major commodities include peanuts, cotton, grains, and fish. In fact, fishing offers the biggest contribution to the Senegalese economy. Senegal has a traditionally diverse diet, including several forms of grains (millet, sorghum, rice), proteins (fish, goat, beef, ox), vegetables (carrots, lettuces, leaves), and starches (sweet and regular potatoes, cassava). Soil fertility and water issues are major barriers to agriculture in Senegal.

The Senegalese diet includes fruits, vegetables, meats, and grains. However, a primary constraint for Senegalese agriculture is water. The country depends on water as an agricultural input, but its proximity to the increasingly dry Sahel region makes the country subject to inconsistent rainfall and frequent droughts.<sup>111</sup> There are some approaches addressing the nutrition-vulnerable population and the use of agricultural programs as vehicles to deliver nutrition interventions but these are poorly developed in the agricultural sector.

Senegal's policies contain a number of objectives targeting vulnerable populations, empowering women, increasing production and diversification, improving the processing of agricultural products, and collaborating with other sectors. Policy commitments are nascent and clear nutrition objectives are absent in the national agricultural policy. Production of nutrient-rich foods, including nutrient value preservation, reduction in post-harvest losses, nutrition promotion and education, as well as market expansion and access carry the least focus in the analyzed policies. Coordinated action for nutrition has been high on the political agenda for the country for a long time, yet coordination is weak and delivery platforms are not used effectively.<sup>112</sup>

Thus, Senegal has followed many African neighbors by steadily improving life expectancy and health outcomes since 1995. Mortality for children under 5 years of age has decreased on average 6.4 % annually since 2000. Disparities exist particularly between rural and urban populations in Senegal. For instance, Senegalese children in rural areas face a 2.4-fold increased risk of dying compared to children who are living in an urban environment.

Malnutrition still underlies approximately one third of all child mortality. Overall, under-nutrition has decreased, from 28.5 % stunted and 16.4 % wasted in 1986 to 15.5 % stunted and 9.7 % wasted in 2012 in children under 5 years of age. Both wasting and stunting are much more prevalent in rural areas than near Dakar and other cities, where overweight and obesity is rising. In fact, a study from a rural, central region showed that 15 % of surveyed children were severely deficient in iodine, showing a lack in coverage or consumption of iodized salt. Vitamin A coverage is very high across Senegal, reaching 97 % of children under 5 years of age in 2009. Anemia was estimated to be higher than 40 % in 2005 with more than 80 % of children under 5 years of age, almost 60 % of women and more than 70 % of pregnant women being affected. Anemia rates improved to 34 % of women in reproductive age in 2012.

A UNSCN supported analysis of the nutrition sensitivity of food and agriculture policies in Senegal reviewed 13 policies in various administrative sectors.

**Areas of Focus** Senegalese agricultural policies and programs have a strong emphasis on food security. Nutrition objectives are largely absent in agricultural policies, even though there are several elements of the key recommendations on nutrition-sensitive agriculture built in to policy papers on food security. On average, the policies incorporated many of the key recommendations. The best covered item across policies is a sustainability approach, referring to the maintenance or improvement of the natural resource base, i.e. water, soil, air, climate and biodiversity. Conversely, the highest scoring policies are the Food Security Programs. For instance, the National Strategy and Priority Programmes for Food Security and the National Strategy for Food Security is rich in nutrition-sensitive approaches with a few exceptions, such as a focus on production of nutrient-rich foods and expanding markets, on the one hand, and access of nutrient rich foods, on the other hand.

**Senegal's Agricultural Pastoral Orientation Law** The main agricultural program in Senegal is the Agricultural Pastoral Orientation Law. This law is by far the most robust national policy paper on Agriculture in Senegal, but it does not include key nutrition components or objectives. The main objective of the current agricultural programs is to ensure availability of food, which also aims to diversify food production in the country. Key informants noted that the current agricultural programs in which they were involved had no explicit nutritional goals. The main objective of the current agricultural programs is to ensure availability of food, with a first level of post harvest transformation. In addition to this, the programs aim to diversify food production in the country. Thus, regulators generally perceived food security or dietary diversity as the finality of their work, but essentially looked at this from an angle of food production and food availability.

The present administrative organization of the government of Senegal is not conducive to joint nutrition and agriculture programming and policy implementation. Agriculture, in the large sense, falls under the Ministries of Agriculture and Rural Equipment, Livestock and Fisheries

and Maritime Affairs, while human nutrition is a matter for the Ministry of Health and Social Action. The current agricultural programs generally do not target the nutritional vulnerability or nutritional profile of communities.

A formal structure called the *Call Against Malnutrition (CLM)* was established in 2001 that reports directly to the Prime Minister's Office and was tasked with nutrition coordination at the national level. The CLM coordinates its activities with seven Ministries (Health, Education, Economy and Finance, Decentralization, Trade, Industry and Agriculture), National Association of Rural Advisors and the Civil Society. Senegal signed up to the *Scaling Up Nutrition Movement* in 2011 and aims to accelerate investment in nutrition, especially through the involvement of the Agricultural sectors. Senegal has begun to develop of a new national nutrition policy as of 2013.

In 2011, the government pledged to increase annual funding for nutrition to 2.8 billion FCFA per year in 2015. This direct investment will be strengthened to ensure full coverage of children and women in effective nutrition intervention programs. Following the *National Policy Paper on Nutrition* in 2001, the country is currently initiating the development of a multi-sectoral strategic plan for nutrition, called "*Lettre de Politique de Nutrition*" for 2013–2018. Some of the policies have specific monitoring and evaluation systems.

**Successes, Challenges and the Way Forward in Senegal** There is a clear recognition from the highest levels of government in Senegal that nutrition is important for the development of a healthy nation. Stakeholders understand that nutritional goals can be built into agricultural plans at a national level, and they are willing to fund proven interventions. Overall, the nutrition sensitivity of the agricultural policy documents integrated several key recommendations but missed out on others. Targeting the vulnerable population groups, empowerment of women, increases of the production, diversification and improvement of processing of agricultural products, collaboration between sectors and sustainability approaches were all present in the large majority of the policy documents. Current agricultural programs are also reported to engage and target women in terms of wellbeing, empowerment and livelihoods.

Current agricultural programs, however, do not have explicit nutritional goals and are not monitored using nutritional indicators. Technical agencies collaborate typically at the implementation level and there is little joint thinking to share experiences and inform policy development upstream. Stakeholder interviews showed a misunderstanding of what nutrition is within the agricultural sector. Most of the respondents stated that they incorporated nutrition in their programs, as they (1) worked with food scientists for primary transformation of agriculture produce, (2) simply produced the food that people eat, or (3) looked at food safety, Such as postharvest reduction of aflatoxins in peanuts. Most of the programs barely considered how agricultural production was used in dietary intake. Although interviewees reported that data was collected on these concerns, the compilations were information on national food consumption levels, not individual food consumption data. In terms of dietary quality, the concerns of the respondents were mainly focused on ensuring enough dietary protein intake, dietary diversification, or increasing food availability.

Senegalese agricultural policies lacked aspects of incorporating nutrient-rich foods, nutrient value preservation, and preservation of nutritional quality of produce. Areas that were also weak within policies were reduction of post-harvest losses, nutrition education and promotion,

food storage improvements, and market expansions and market access. All of these components were missing in more than half of the policies reviewed.

Various regions of the country suffer from persistent high rates of malnutrition despite a significant increase in agricultural productivity and income. Current agricultural programs insufficiently consider nutritional aspects and utilization of crops. Food availability at the macro level (regional—national level) has received the bulk of the attention of the agricultural sector but food availability at the individual level has received much less.

*Moving Towards Nutrition-Sensitive Agriculture in Senegal* There are a number of experiences with value chain approaches within the food system in Senegal, such as fruit and vegetable value chain or innovation platforms for the incorporation of local cereals in bread. The choice selection of seed varieties, for example, is conducted on the basis of commercial, i.e. yield, pest resistance and appearance indicators only. Consequently, promoting crop varieties on the basis of micronutrient composition is considered a promising strategy to address micronutrient deficiencies and promote local foods.

Finally, there is a general willingness and enthusiasm to incorporate nutrition objectives into the overarching agricultural framework for Senegal. Nutrition can be built into the Agricultural Pastoral Orientation Law as a formative direction towards nutrition-sensitive agriculture. The initiative to develop a Policy Letter on Nutrition and the upcoming revision of the Orientation Law are opportunities to institutionalize nutrition-agricultural linkages in Senegal. Building nutrition capacity among government leaders in various sectors, particularly in agriculture, will address the knowledge gap and confusion that exists around nutrition-sensitive agriculture. Currently, nutrition is too poorly understood by the various professionals at the agricultural ministries to enable proactive dialogue.

### Case Study Millennium Villages Project: Integration of Food and Health Systems for Nutrition

The Millennium Villages Project is attempting to address the root causes of extreme poverty by taking a holistic, community-led approach to sustainable development. In essence, the project focuses on the community level, through community-led development. With the help of new advances in science and technology, project personnel work with villages to create and facilitate sustainable, community-led action plans that are tailored to the villages' specific needs and designed to achieve the Millennium Development Goals (MDGs). The MDGs, in turn, reflect an understanding of the many interconnected factors that contribute to extreme poverty. Additionally, the MDGs include time-bound and measurable targets to address income poverty, hunger, disease, lack of adequate shelter and exclusion—while promoting gender equality, education and environmental sustainability.

The Millennium Villages (MVs) are demonstration and testing sites for the integrated delivery of science-based interventions in health, education, agriculture and infrastructure. By integrating these different sectors and interventions, it was originally thought that nutrition improvements would be seen. The aim of the Project is to accelerate progress towards the MDG targets, including MDG 1—to eradicate extreme poverty and hunger. The range of interventions adheres to a cost ceiling of \$110 per capita sustained over a 5–10 year period, reflecting the full value of contributions from government, external donors, local communities, and the Project itself.<sup>113</sup>



Solutions like providing high-yield seeds, fertilizers, medicines, drinking wells, and materials to build school rooms and clinics and improving food and nutrition security. Improved science and technology such as agroforestry, insecticide-treated malaria bed nets, antiretroviral drugs, the Internet, remote sensing, and geographic information systems is included to enrich this progress. Over a 10-year period, community committees and local governments build capacity to continue these initiatives and develop a solid foundation for sustainable growth. To date, the Millennium Villages project has reached over 500,000 people in 79 villages. Clustered into 12 groups across 10 African countries (Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Rwanda, Senegal, Tanzania, and Uganda), the villages are located in different agro-ecological zones that reflect the range of farming, water, and disease challenges facing the continent.

The MVs are situated in 'hunger hotspots', where at least 20 % of children are malnourished and where severe poverty is endemic. The MVs were chosen to reflect a diversity of agro-ecological zones, representing the farming systems found in over 90 % of sub-Saharan Africa. Sites range from slash-and-burn in rainforest margins to pastoralism in deserts, reflecting varied levels of population density, soil conditions, climate instability, water access, disease profiles, environmental degradation, nutritional deficiencies and food availability, market access, education levels, cultural traditions and religious norms.<sup>114</sup>

The MVP model employs a three-pronged food and nutrition security approach. First, *clinical interventions* focus on persistent macro and micronutrient deficiencies in children, including vitamin A supplementation, treatment of severe acute malnutrition and regular growth monitoring. For cases of moderate malnutrition, families receive nutrient-rich flour and other food commodities. In addition, basic maternal health interventions such as basic antenatal care and institutional delivery are supported by efforts to promote adequate weight gain and improve coverage with iron and folic acid supplementation. These interventions are "core" to most nutrition programs in the developing world and for the most part, sit in the public health sector's responsibilities. However the MVP three-pronged nutrition approach called for more integration of other sectors to address the root causes of undernutrition.

This integration of other sectors was found in the second and third prongs. Second, *education and behavior-based interventions* include homegrown school meals programs, gardens and nutrition activities after school, along with de-worming and environmental enteropathy reduction campaigns. Balanced school meals have been demonstrated both to increase school attendance as well as improve learning outcomes. Food and nutrition education and increased knowledge for women is also a critical intervention addressed. As previously shown, such interventions are important to food safety and food utilization for optimal nutrition outcomes.

Finally, *household, community and livelihood-based interventions* engage longer-term realities of food and livelihood security. These consist of subsidized seed and fertilizer interventions to increase agricultural productivity; the introduction of high-value crops, and; agro-processing initiatives and microfinance programs to stimulate small-business development. Taken together, these efforts are an attempt to enhance nutritional intake and diet diversity, while affording households the additional income required addressing nutritional needs in a sustainable fashion. A community health worker program to promote exclusive breastfeeding and locally appropriate complementary feeding, home-based fortification, and proper food storage techniques complemented this approach. Without integrating the "food and agriculture" element, nutrition and food security achievements in these communities would be sub-par.

Three years after the start of the program in 2005–2006, consistent improvements were observed by researchers at Columbia University in household food security and diet diversity, whereas coverage with child care and disease-control interventions improved for most outcomes. The prevalence of stunting, or chronic undernutrition in children <2 years old at year 3 of the program was 43 % lower (adjusted OR: 0.57; 95 % CI: 0.38, 0.83) than at baseline. These findings provide encouraging evidence that a package of multi-sectoral interventions has the potential to produce reductions in childhood undernutrition.<sup>115</sup> What these data show is that multi-sectoral approaches are vital to ensure improvements in food security and nutrition for individuals, households and communities. By integrating different sectors—such as livelihood and agriculture based interventions, public health and education—major and rapid reductions in undernutrition can be made, in poor settings.

The Millennium Villages and other project that integrate sectors to improve nutrition have been important in informing larger scale initiatives such as the Millennium Development Goals Achievement Fund. The Millennium Development Goals Achievement Fund (MDG-F) was established in 2007 as a comprehensive development cooperative mechanism to help achieve the Millennium Development Goals (MDGs). The program was large—with 130 joint programs in 50 countries with the highest burdens of undernutrition—working with different UN agencies, governmental institutions, the private sector, communities and civil society entities. The Children, Food Security and Nutrition thematic area was the largest of the MDG-F and received over US\$ 135 million to support 24 joint programs, implemented through the collaboration of several UN agencies.<sup>116</sup>

The joint programs of the MDG-F promoted multi-sectoral coordination to address food and nutrition security. Three case studies were analyzed for Peru, Brazil and Bangladesh by Levinson and Balarajan ([2013](#)). According to the authors, there were three major findings. First, convergence is important. Convergence that combines nutrition-specific and nutrition-sensitive interventions can be jointly targeted to vulnerable geographical areas and populations living in these areas. Second, the results-based incentives to sub-national governmental bodies and encouragement of more proactivity and accountability to demonstrate results related to reductions in undernutrition are critically important. Third, active and sustained civil society advocacy at the policy and programmatic levels is essential. At the policy level, this advocacy serves to ensure political and administrative commitment to nutrition and food security. At the programmatic level, advocacy helps to ensure adequate budgeting, well-designed and implemented programs that meet the needs of the population.<sup>117</sup>

## Conclusion

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The global community needs to better engage across the key sectors of agriculture, health and environment/ecology to improve nutrition. This engagement does not just need single, vertical interventions but bundled solutions that engage and revitalize food and health systems. More solutions are needed that ensure resilience of communities and sustainability of not only our food production and supplies, but also our diets, that take into account climate variability, food safety and population pressures.

New approaches and ways of thinking, that integrate sectors, such as the sustainable diets approach, econutrition and multi-sectoral integration could all be solutions to make nutrition improvements. The four case studies help illustrate how sectors can be integrated, albeit not

without challenges. In the case of Brazil, Nepal and Senegal, there is commitment to integrate nutrition into agriculture and food policies but more needs to be done.

We are rapidly approaching 2015 and the shift to a post-2015 agenda. The Millennium Development Goals (MDGs) have brought much-needed attention to a number of priority areas in sustainable development policy however nutrition must be more central to the post-2015 goals and the strategies put forward to achieve food security. This will require countries to position nutrition objectives explicitly within their broader public health and agriculture agendas.

The case studies demonstrated that there is some level of commitment to achieving positive nutrition outcomes, as well as an understanding, to varying degrees, that the agricultural public health sectors have pivotal roles in achieving nutrition objectives. As we move forward into the post-2015 era, good practices and transferable lessons can be drawn from each country case study. The studies collectively highlight the importance of a supportive policy environment, well-developed human resources, and effective systems for planning, implementation, and monitoring impact for creating successful, nutrition-sensitive agriculture policies and programs.

## Footnotes

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<sup>1</sup>World Bank ([2006](#)).

<sup>2</sup>FAO ([1996](#)).

<sup>3</sup>FAO ([2013](#)).

<sup>4</sup>FAO ([2013](#)).

<sup>5</sup>Black et al. ([2013a](#)) and UNICEF et al. ([2013](#)).

<sup>6</sup>Black et al. ([2013a](#)) and UNICEF et al. ([2013](#)).

<sup>7</sup>Black et al. ([2013a](#)).

<sup>8</sup>Black et al. ([2013a](#)) and UNICEF et al. ([2013](#)).

<sup>9</sup>Black et al. ([2013a](#)).

<sup>10</sup>Black et al. ([2013b](#)).

<sup>11</sup>Jaenicke and Virchow ([2013](#)).

<sup>12</sup>WHO, Trade, foreign policy, diplomacy and health: Food Security, available at <http://www.who.int/trade/glossary/story028/en/> (last accessed May 2014).