



# Investments for Healthy Food Systems

## A Framework Analysis and Review of Evidence on Food System Investments for Improving Nutrition

### Implementing the Framework for Action of the Second International Conference on Nutrition



**UNSCN**

United Nations System Standing Committee on Nutrition

September 2016

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## Foreword

### Implementing the framework for action of the Second International Conference on Nutrition

In November 2014, governments from around the world committed themselves to developing “coherent public policies” to advance nutrition. The occasion was the FAO/WHO jointly organized Second International Conference on Nutrition (ICN2). One year later, governments also called for “policy coherence” – when policies in different sectors support common objectives – in the implementation of the new Agenda 2030 and achievement of the Sustainable Development Goals.

As with International Trade Policy – the topic of an earlier paper in this series – investment policies are generally far divorced from nutrition policies and programmes. Macroeconomic investment policies are intended to improve future economic growth rates – generally by sacrificing current consumption for future gains. Similarly, agricultural and food investment policies aim to increase economic rates of return in the sectors, rather than specifically the quality of what is produced in those sectors. This disconnect should be corrected. There is no necessary conflict between agriculture and healthy food systems and a strong rate of return for investors in the sector. In fact, as consumers increasingly demand quality, diversity, taste and safety in the foods they eat, those mutual goals can be met through investments that meet those demands.



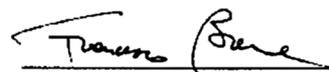
Many choices are presented in this paper that can achieve mutual benefit for agriculture and food system investors – both private and public – and nutrition and health of the population. In just one example, private investors are increasingly finding opportunity in value chains for fresh, local horticulture to be made more available in supermarkets around the world. Through farmer training and technical support, they invest in the capacity of smallholder farmers to reach commercial markets. In addition, the public sector is responsible for important investments, such as infrastructure for water and roads, which create the enabling environment for the private sector to be efficient. It also can deploy its investment decisions to encourage – through co-investing, taxing, subsidizing, or regulating – private sector investments in healthy food systems.

With this paper, we offer a framework for understanding food systems and their investment needs, along with evidence for interventions and investments that promote nutrition and health. It is intended to encourage dialogue and further investigation of the most promising investments for healthy food systems, across many varied country and local contexts. It also highlights important knowledge gaps that should be further explored in order to help countries implement the recommendations of the ICN2 regarding their public and private investments.



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## Key messages

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**Investments to support healthier food systems are at hand for countries that wish to implement the ICN2 Framework for Action.** Investments to improve nutrition and health range from large-scale infrastructure improvements to small-scale technical and marketing support, and should be complemented by regulatory and voluntary measures, consumer education and incentives.
- 

**Every food system has the capacity to produce the healthy food that is needed for good nutrition and human health.**
- 

**Food system investments need to be tailored to specific contexts.** Investment decisions should take into account food system variation and learn from other experiences.
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**Investments have a higher pay-off when enabling conditions are present, and when interventions reinforce one another** by creating multiple types of capital (human, financial, physical).
- 

While most investing for the food system is made by the private sector, **the public sector holds primary responsibility for providing public goods and enhancing social values** by filling gaps not addressed by the private market. The public sector should test new ways to leverage its investments and regulatory power to incentivize the private sector to include improved nutrition among its goals.
- 

**Public investments in food systems should be aligned with other social goals.** Too often, agricultural and industrial policies ignore the social and health implications of their expenditures. Government has a responsibility to increase social well-being and should align investment policies toward that end.
- 

**Significant gaps remain and need to be closed in the knowledge** available to countries and investors about how to select among the investment choices and which to prioritize for a given food system and nutrition context.
- 

**Development banks and other financial institutions should provide contextualized financial information to better identify promising investments that improve nutrition and health.**



# 1 Introduction

The Second International Conference on Nutrition (ICN2) which took place on 21 November 2014 was a milestone in advancing the linkages between agriculture and nutrition. The Conference produced the Rome Declaration on Nutrition,<sup>1</sup> a political document that includes commitments to reduce malnutrition in all its forms, and the Framework for Action, a policy document that provides policy options and strategies to countries to achieve those commitments.<sup>2</sup> Recommendation 17 of the ICN2 Framework for Action encourages governments, UN agencies, programs and funds, and other actors to use investment policies to identify opportunities to achieve the agreed global food and nutrition targets.



<sup>1</sup> <http://www.fao.org/resources/infographics/infographics-details/en/c/266118/>

<sup>2</sup> <http://www.fao.org/3/a-mm215e.pdf>

Public sector investment policies refer to government expenditures intended to enhance future societal benefits. In the agriculture and food sectors, such investments aim to increase production, productivity, affordability, access, and consumption of healthy foods. They can also include government efforts to attract private sector investment in healthy food systems. Examples of investment policies include creating nutrition-enhancing value chains, supporting smallholder and family farmers, and improving infrastructure.

*According to FAO (2013), Food systems influence the availability and accessibility of diverse, nutritious foods and thus the ability of consumers to choose healthy diets. But the linkages from the food system to nutritional outcomes are often indirect – mediated through incomes, prices, knowledge and other factors. What is more, food system policies and interventions are rarely designed with nutrition as their primary objective, so impacts can be difficult to trace and researchers sometimes conclude that food system interventions are ineffective in reducing malnutrition.*

While not the conclusion of this paper, it is certainly the case that strong evidence of the link between food systems and nutrition outcomes is elusive. According to the Global Panel on Agriculture and Food Systems for Nutrition, *Policy interventions in the market and trade domain have been sparsely studied in relation to food systems in low and middle income countries. There is a need for more critical emphasis on this “missing middle” of the policy space between agricultural policies and consumer policies* (GloPan, 2015).

Government policies play a role in influencing whether agriculture and food systems contribute to healthy diets and improved nutrition (FAO, 2015). They are neither the only influence nor the strongest, but if formulated strategically, they can provide public goods, catalyze support from the private sector to make positive contributions, and create incentives that guide consumers to make good choices. This paper describes government policies and investment opportunities which can improve nutrition and health outcomes. It also highlights strategies for government to encourage private sector investment in healthier outcomes from agriculture. The private sector is a key partner: Private interests are the largest investors in agriculture (FAO, 2012), but will continue to under-invest in healthy outcomes unless government can create incentives for social and environmental benefit, namely an enabling environment in terms of risk and profitability.

Recognizing that policy needs, feasibility and outcomes are context- specific, this paper proposes a typology of food systems, from “rural” to “industrial”, and provides guidance about which investments are most appropriate to fit the needs of each.<sup>3</sup>

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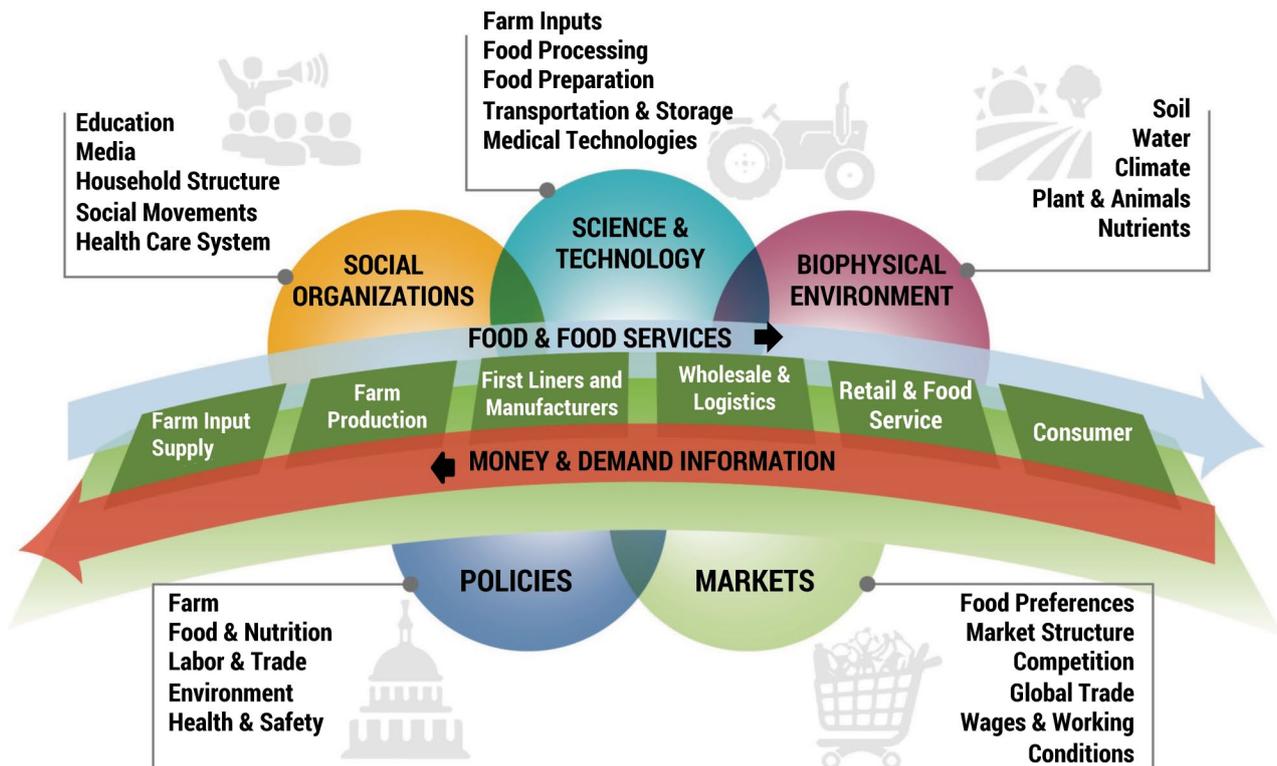
<sup>3</sup> Annex A provides a review of evidence for improving nutrition through five different channels within food systems: 1) enhancing nutrition sensitivity of value chains; 2) implementing specific agricultural practices; 3) enhancing governance and institutions; 4) improving infrastructure; and 5) promoting new technologies and R&D.

# 2 What is a healthy food system?

## 2.1. Components of a food system

Food systems encompass the many stages of converting natural resources and human effort into food to sustain human life. These stages – from “farm to flush” – include growing, harvesting, processing, packaging, distributing, marketing, trading, consuming, and disposing of waste. Most of those steps are called the “supply side” of the food system and often involve complex and sophisticated supply chains, although short and simple food supply chains can and still do provide healthy options in many communities. The “demand side” is similarly varied, affected by price, location, consumer preferences, knowledge, tastes, cultural habits, and perceptions. Selecting the right public and private investments can make each of these steps more efficient in producing multiple outcomes, including improved nutrition.

**Figure 1.**  
**Framework for assessing effects of the food system**



Source: Nesheim, M.C., et al., 2015. *A Framework for Assessing Effects of the Food System*. U.S. Institute of Medicine.

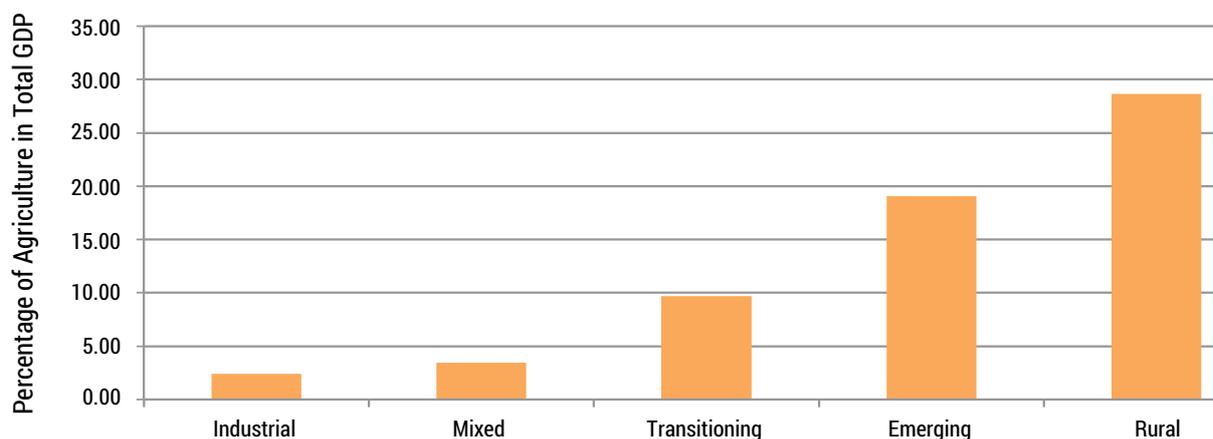
Figure 1 shows a very high level depiction of the many influences on what food gets produced and consumed in a country, exposing multiple possible investment opportunities to improve nutrition. However, no food system is alike; investments need to be tailored to specific contexts and require supportive elements to be in place. For instance, increasing production capacity of fresh, perishable products for urban markets is a viable nutrition strategy only if

transport, distribution and refrigeration capacity is adequate and reliable. Thus, investments should be suited to the level of development in the agriculture Investments for Healthy Food Systems 9 sector, with gradual “scaffolding” of more complex investments. This paper does not attempt to comprehensively assess all investment possibilities to improve nutritional outcomes; rather it assesses current evidence for a range of investments- affecting production, consumption, and other food system aspects - to improve nutrition, and suggests where additional evidence is needed. A serious challenge to this objective is that data on investments in agriculture are very limited (FAO, 2013). One of the most apparent needs is financial or economic information about which investments provide the best return over time.

## 2.2. Understanding differences in food systems

Recent analyses<sup>4,5</sup> use five important features to define food system types: demographics, agricultural productivity, environmental sustainability, food availability and diversity and food accessibility. Demographics captures the degree of urbanization in a country and hence the rural-urban transition and the concomitant changes in lifestyles and diet but also changes in food value-chains.<sup>6</sup> Consumption characteristics are captured, in part, by food availability and diversity. Lack of data precluded a more precise categorization of food systems. Nevertheless, the five domains represent key features of food systems.<sup>7</sup> The purpose of the food system typology is to move from a categorization of countries solely along productivity indices (e.g. GDP) towards a more nuanced conceptualization of food systems. The typology suggests multiple indicators can be used to measure the ways a food system affects nutritional outcomes in a country. This multidimensional definition reflects the approach used to understand health systems starting in 2002 and carried forward since then (WHO, 2000).

**Figure 2.**  
**Agriculture’s share of GDP, by food system type**



4 The food system typology was prepared for the Global Nutrition Report 2015. See chapter 7 for further methodological details and application of the typology to nutrition and health outcomes.

5 Borrowing from the method used in Reyter et al (2014) to produce indicators of sustainable agriculture.

6 High urbanization is correlated with the structural transformation of food systems, which entails more highly processed foods and less diversity in primary production (see World Bank 2008; Nugent 2011).

7 Reardon et al. 2012; Hawkes et al. 2012). Domains not included here, and some sources for them, are: eg, resiliency (CIMSANS), socio-economic sustainability (CIMSANS), agricultural stewardship (San Diego Foodshed Assessment), governance (ATNI), and social (IOM).

Table 1 shows five types of food systems, along with indicative countries in each system. Figure 2 shows that agriculture's share of GDP is strongly correlated with food system type, with higher-income countries having a lower share of agriculture in GDP and lower-income countries having a higher share. This suggests that, while countries in each food system category have many investment opportunities to choose from that will improve their food and nutrition outcomes, those in Food Systems 4 and 5 have the strongest economic reasons to invest in agriculture and food chains (World Bank, 2008). Understanding the major features of each different food system helps to align those investments to desired outcomes.

**Table 1.**  
**Features of the five food systems**

Food system 1	Food system 2	Food system 3	Food system 4	Food system 5
<ul style="list-style-type: none"> <li>• <b>Industrial:</b> Broad range of agricultural productivity and CO2 equivalent emissions,<sup>9</sup> high urbanization, low dependence on staples (supply of staples)<sup>9</sup></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Mixed:</b> Moderate agricultural productivity, low emissions, lower urbanization, low dependence on staples<sup>9</sup></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Transitioning:</b> Urbanization same as System 2 but far lower agricultural productivity, more reliance on staples and higher food budget share<sup>10</sup></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Emerging:</b> Lower urbanization and agricultural productivity than Systems 1-3, low CO2 equivalent emissions, more reliance on staples<sup>9</sup></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Rural:</b> Lowest urbanization and agricultural productivity, low CO2 equivalent emissions, most reliance on staple foods<sup>9</sup> and highest food budget shares<sup>10</sup></li> </ul>
<ul style="list-style-type: none"> <li>• United States, Denmark, Korea, Canada, Lebanon, Sweden, Australia</li> </ul>	<ul style="list-style-type: none"> <li>• Switzerland, Bulgaria, Italy, Estonia, <b>Germany</b>, Hungary, Barbados</li> </ul>	<ul style="list-style-type: none"> <li>• Ukraine, Ecuador, <b>Brazil</b>, Malaysia, Mauritius, Guyana</li> </ul>	<ul style="list-style-type: none"> <li>• Honduras, Namibia, Thailand, Uzbekistan, China, Cameroons</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Senegal</b>, Nepal, <b>Indonesia</b>, Ethiopia, Bangladesh</li> </ul>

## 2.3. Nutrition and health outcomes by food system category

Food systems are not themselves good or bad, healthy or unhealthy. However, they can contribute to more or less desirable outcomes for nutrition (e.g. healthy child growth versus stunting), health (e.g. normal blood sugar levels versus diabetes), and the environment (e.g. healthy versus contaminated soils). Table 2 provides a general description of outcomes seen along the food system spectrum from Rural (Food System 5) to Industrial (Food System 1). When considering this table, it is important to note that many outcomes are produced in a given food system; even when countries fall into the same typology, there are important differences across countries in those outcomes. In addition, food systems defined at the country level are still highly aggregated and omit important intercountry variations which are better captured by commodity supply chain analysis.

In general, as countries move from rural to industrial, diets become more diverse, including more packaged processed foods and more protein of all types, especially animal protein. There is less reliance on staple foods and typically less food price volatility. The proportion of household budgets spent on food declines from a high of 50% or more in countries with rural food systems, to less than 20% in countries with industrial food systems.

<sup>8</sup> Total emissions (CO2eq) from agriculture per capita (FAO, 2011 and WB population data, 2011).

<sup>9</sup> Supply (i.e. production) of energy provided by cereals, roots, and tubers as percentage of total Dietary Energy Supply (FAO, Food Security Indicators, 2011).

<sup>10</sup> As proportion of consumer expenditure per capita spent on food and non-alcoholic beverages, derived from Euromonitor share of "Consumer Expenditure on Food and Non-Alcoholic Beverages" out of total "Consumer Expenditure" (Euromonitor, 2014).

Undernutrition and obesity (double burden of malnutrition) coexist in all countries to some degree, but are especially pronounced in Food systems 3-5, and especially intractable in some Type 5 countries. Box 1 provides country examples of the producer and consumer experiences in three types of food systems, encompassing high-income, upper-middle, and low-income countries.

**Table 2.**  
**Outcomes by type of food system**

Food system Outcome	Food system 1 <b>Industrial</b> (High productivity & urbanization)	Food system 2 <b>Mixed</b> (High productivity & lower urbanization + emissions)	Food system 3 <b>Transitioning</b> (Urbanization same as system 2 but lower productivity)	Food system 4 <b>Emerging</b> (Lower urbanization & productivity than systems 1-3)	Food system 5 <b>Rural</b> (Lowest urbanization & productivity)
<b>Food diversity<sup>11</sup> and reliable availability</b>	<ul style="list-style-type: none"> <li>Diverse diets, high packaged processed foods and animal protein.</li> </ul>	<ul style="list-style-type: none"> <li>Diverse diets, balanced in protein sources.</li> </ul>	<ul style="list-style-type: none"> <li>Diverse diets with high fresh food and protein intake.</li> </ul>	<ul style="list-style-type: none"> <li>Less diverse, range of processed foods, high fresh foods.</li> </ul>	<ul style="list-style-type: none"> <li>Least diverse, low animal and other protein.</li> </ul>
<b>Food accessibility</b>	<ul style="list-style-type: none"> <li>Low budget share spent on food; stable prices.</li> </ul>	<ul style="list-style-type: none"> <li>Low budget share spent on food; stable prices.</li> </ul>	<ul style="list-style-type: none"> <li>Moderate budget share spent on food; higher price volatility.</li> </ul>	<ul style="list-style-type: none"> <li>High budget share spent on food; highest price volatility.</li> </ul>	<ul style="list-style-type: none"> <li>High budget share spent on food; high price volatility.</li> </ul>
<b>Health and nutrition<sup>12</sup></b>	<ul style="list-style-type: none"> <li>Mostly overweight/diabetes.</li> </ul>	<ul style="list-style-type: none"> <li>Mostly overweight/diabetes.</li> </ul>	<ul style="list-style-type: none"> <li>Less overweight, some stunting.</li> </ul>	<ul style="list-style-type: none"> <li>High stunting, low child overweight, high adult overweight.</li> </ul>	<ul style="list-style-type: none"> <li>High stunting, double burden, emerging child overweight.</li> </ul>

Based on IFPRI (2015). High, moderate, and low are relative. For rough cut-off points, see IFPRI (2015). Sources include: Food price volatility index (FAO, 2011), Packaged and fresh food retail volume, kg per capita (Euromonitor, 2014), Avg protein supply in grams/cap/day 3-year average (FAO, 2011), Budget share spent on food (Euromonitor, 2014 – see footnote 9), Child stunting and overweight (UNICEF, years vary), Adult overweight (WHO, 2014), Diabetes prevalence (IDF, 2014).

The broad descriptions above suggest a wide range of investment needs for each of the five types of food systems. Ideally, investment choices should be based on assessment of relative rates of return in the specific setting, with resources allocated to those with the highest returns, subject to equity goals. Unfortunately, very little public information is available about the economic or even financial returns of different investments in agriculture vis a vis health and nutrition outcomes.

<sup>11</sup> A diverse diet is defined here as a diet sufficient in calories and protein, as well as low in reliance on staples.

<sup>12</sup> There are certainly other diet-related NCDs, particularly cardio-vascular diseases, that vary across food system types. However, the authors examined a select number of adverse health outcomes that are easily attributable to diet (IFPRI, 2015).

**Box 1.****Country food system outcomes: Germany, Brazil, Indonesia, Sénégal****Germany food system type 2 - Mixed**

Germany in many ways resembles its wealthy country peers, but as a food system Type 2 country, it has marginally lower food diversity and availability and slightly lower child overweight than Food System Type 1 countries. At the same time, Germany faces a high burden of obese and overweight people, and is searching for ways to increase healthiness of its food supply. These include reformulation of products to reduce salt, sugar and unhealthy fats, as well as incentives to increase healthy eating and standards for school feeding programs. On the supply side, Germany intends to improve the diversification of its food supply by supporting farmers and agricultural supply chains in ways that encourage consumers to broaden dietary diversity. Germany is carefully examining food and agriculture links to find ways to improve the sustainable production and quality of food. Food waste is one issue that has received global attention and is being addressed in Germany as part of a strong focus on the consumer's eating behaviors. Germany established the INFORM program in 2009 to incentivize healthy eating and physical activity.

**Brazil food system type 3 - Transitional**

About 85 percent of Brazil's population lives in urban areas and the share of energy diversity supplied by cereals, roots, and tubers (i.e. staples) is relatively low. Nonetheless, Brazilians consume about a third less than the recommended daily allowances of six servings of fruits and vegetables, and sugars and saturated fats constitute about 12 and 10 percent of their diets, respectively. While undernourishment in Brazil has declined since the 1970s, six percent of all Brazilians are still undernourished (Graziano Da Silva, 2011). Meanwhile, obesity has replaced undernutrition as the leading form of malnutrition among adults: more than 53 percent of Brazilians aged 25 and older were either overweight or obese in 2008 (WHO). Brazil has demonstrated the ability to implement strong supply -side interventions in order to address issues of adult overweight and poor diets. In 2014, vegetable supply centers (CEASAs) in Brazil initiated a campaign "Encouraging Intake of Fruits and Vegetables in the Central Food Supply". The first phase, which is underway, aims at increasing the availability of fruits and vegetables by focusing on dealers, licensees, and producers. The second phase will focus on increasing demand for fruits and vegetables by disseminating consumer information and promoting healthy diets (Hawkes, 2015).

### Indonesia food system type 5 - Rural

Indonesia, a lower middle-income country, has experienced tremendous economic growth in the last four decades, increasing its average per capita income to \$3,475 in 2013 with an average life expectancy of 71 years. Despite economic growth and improved health, poverty and the double burden of malnutrition are problems and of concern to national policy makers. Many dual burden households are in urban areas, where there is a greater selection of processed convenience items and fast food meals, and where jobs and lifestyles are less physically demanding (Roemling et al., 2013). Diabetes is on the rise, but is still lower than in neighboring countries (Martiniuk et al., 2011). In rural areas, low dietary diversity makes people vulnerable to food price shocks and micronutrient deficiencies. A strong political mandate to achieve national food security based on domestic availability has helped perpetuate an enduring rice economy, along with steadfast tastes and preferences for a rice-based diet. Indonesia has a history of promoting nutrition, but action has focused on nutrition specific interventions to improve maternal and child health (breastfeeding and complementary feeding, micronutrient supplementation, and family planning). Food policy has focused on stabilizing rice prices, with little attention paid to food crop diversification. Addressing the dual burden of malnutrition will require new approaches for promoting increased production and consumption of a variety of foods, improved hygiene, and a more active lifestyle including regular exercise and monitoring body weight (Soekirman, 2011).



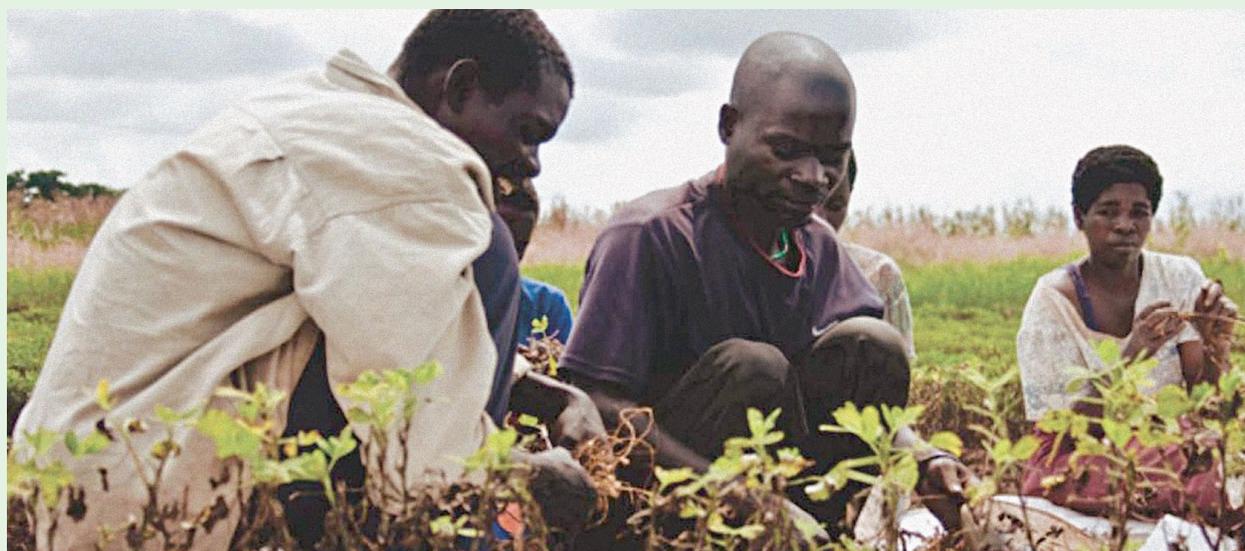
### Senegal food system type 5 - Rural

Senegal is a lower-middle income country on the Western Coast of Africa. Its population is young, with 44 percent of the 14 million total under 15 years of age (World Bank, 2014). Almost 20 percent of the population is food insecure, with a large disparity between rural (25.1 percent) and urban (12.2 percent) communities (Wuehler et al, 2011). Undernutrition is the primary nutrition challenge, for example prevalence of iron deficiency anemia is very high, afflicting 71 percent of children under five, 61 percent of pregnant women, and 54 percent of women of reproductive age (USAID, 2014). This has dire consequences for the health and development of these demographics.

Senegal has made substantial progress against malnutrition in the past couple of decades, including reducing rates of stunting in children under 5 and contributing to an almost 40% decline in child mortality within the past 5 years alone (Wuehler et al, 2011). This progress is likely attributable to: widespread vitamin A supplementation; a national nutrition program; upscaling of child survival activities (via the Basic Support for Institutionalizing Child Survival platform, 1994-2006); and the improvement of communications to increase “harmonized behavior change” (Wuehler et al, 2011). Gains in economic growth and overall welfare have been more moderate. While the average growth for sub-Saharan countries in recent years has been about 6%, Senegal saw growth of just 4% between 2000 and 2010 and only 3.3% since 2006 (USAID, 2014). In addition, expansion of the agriculture sector has made up only a small portion of this economic growth. While agriculture employs 68% of the labor force, it accounts for just 14% of the country’s GDP (Wuhler et al, 2011).

Agricultural development has been hindered by weak governance, a poor investment climate, and heightened international competitiveness. Additional constraints include repeated energy shortages, droughts, and flooding, all of which make entry into the agricultural sector difficult. Poverty rates have declined only slightly, from 48.3% in 2005 to 46.7% in 2011, while the poverty gap between rural (57.1%) and the urban capital Dakar (26.1%) has actually widened (USAID, 2014).

Senegal’s agriculture sector has significant potential to grow and to create greater economic stimulus for the country. According to Feed the Future, Senegal’s government has increased its investment in agriculture by over 10% per year (Feed the Future, 2015). Further, Millennial Challenge Corporation (MCC) funded investments in the northwest, where rice is the predominant crop, are expected to increase the irrigation efficiency of 7,800 hectares and to increase the production capacity of 32,500 hectares; these improvements are projected to benefit approximately 260,000 smallholder farmers (MCC, 2015). With access to international markets through a major port, an abundance of arable land, and motivated entrepreneurs, agriculture-led economic growth is quite attainable. Both for export and domestic markets, horticultural production should be an area of expansion.



## 3

## Investments to improve nutrition in different food systems

Public sector investment goals are broad. They include reducing poverty and hunger, providing public goods that complement private investment, and creating social and environmental benefits (FAO, 2012). Nutrition is rarely an explicit primary goal of agriculture, but increasingly agriculture and food systems are being turned to for improving nutrition outcomes through “nutrition-sensitive” investments. Different food systems present different opportunities and constraints for achieving improved nutrition. The main features of the defined food systems, along with opportunities and constraints for improving nutrition outcomes in each, are explored below. For simplicity, the five food system types defined above are placed into three categories: Industrial/Mixed, Transitional, and Emerging/Rural.

### 3.1. Industrial and mixed (systems 1 & 2)

Industrial and mixed food systems are characterized by complex supply and value-chains and often high levels of food processing.<sup>13</sup> Powerful large scale retailers and processors can have considerable influence over the nutritional value in the foods produced (Gereffi et al., 2009). Complex supply chains may enhance the availability and affordability of food products through improvements in productivity and efficiency of supply. However, these gains may be offset by reductions in variety and increased access to processed foods (e.g. Gereffi et al., 2009).

Indeed, complex, and vertically-integrated supply and value chains may deprive consumers of choice (World Bank, 2008). Farm output is often shaped by the needs and preferences of processors, wholesalers, and transporters whose output is shaped by the demands of manufacturers. These in turn cater to the needs of major retailers: low cost, long shelf-lives, and uniform quality. Nowhere in current supply-chains does nutrition factor in as a primary concern. Enhancement of the retail sector is needed in order to maintain diversity of food outlets for consumers. It is also needed to increase access to fresh foods, especially in urban areas where bulk distribution and large retail outlets combine to reduce food options for the poorest consumers.

Solutions may be found by focusing not only on agricultural production alone, but rather on changing the ways in which primary ingredients are substituted, transformed, distributed and marketed (Hawkes, 2012). Indeed, in industrial and mixed type food systems, next to consumer education, regulation and incentives that shape supply may be among the most efficient and effective actions to improve nutrition outcomes.

Value-chain approaches concentrating on the actions of large processors and retailers may have a significant impact on nutritional outcomes. For example, creating incentives for large firms to substitute healthier ingredients in their product formulations, and creating and enforcing regulations to provide consumer information (e.g. mandatory nutritional labeling can induce companies to change the formulation of their products (Hawkes, 2015). One way to

<sup>13</sup> Food systems that have undergone structural transformation have longer supply chains, more highly processed foods, and less diversity in primary production (see World Bank 2008; Nugent 2011; Reardon et al. 2012; Hawkes et al. 2012).

improve the nutritional and environmental health of communities is to promote local sourcing by linking producers with nearby vendors such as restaurants, markets, and public institutions.

Downstream solutions notwithstanding, agricultural production and the policies that influence it remain significant concerns for the healthiness of industrial and mixed food systems. A major obstacle to healthier food formulations and marketing are the agricultural subsidy regimes in place in many industrial and some mixed food systems. In countries with these regimes, food and agricultural policies have had the long-term deleterious effect of concentrating support on a few commodities – grains, dairy, livestock, sugar – which are now pervasive in the food supply (Anand et al, 2015). These unhealthy commodity subsidies are not confined to rich countries. Anderson et al (2013) document how agricultural subsidies in some developing countries are creating perverse incentives such that government policies are working against the creation and maintenance of healthy food supply chains. While subsidies could also be directed toward healthy agricultural products, this is less common and far smaller in magnitude. Substantial political and economic effort is required to revamp these outdated and harmful agricultural support systems, and to chart a path toward better alignment of agriculture and health goals.

### Constraints

- Long, complex supply chains shaped by powerful agribusiness (e.g. large producers, processors and retailers, often with all three functions vertically integrated in the same multinational).
- Limited consumer awareness of health benefits of nutritious foods and of costs of unhealthy foods.

### Investments

- Align commodity priorities toward quality and diversity, and away from a small number of grains and animal-source products.
- Provision of, and standards for, healthier foods in specific settings (e.g. schools, health care).
- Shorten supply chains (e.g. promote local supply chains).
- Promote consumer choice through nutritional labeling, social marketing and nutrition education.
- Regulations: safety and nutrition standards, restricted marketing of unhealthy foods, standards for nutrient information and claims on food labels, limits on salt and removal of trans fats.
- Health-related food taxes and government subsidy schemes for healthy foods for lower-income groups.
- Voluntary and mandatory food reformulation.



### 3.2. Transitional food systems (system 3)

Countries with transitional food systems (system 3) have higher agricultural productivity than rural and emerging food systems (systems 4 and 5), and are undergoing structural changes already experienced in industrial and mixed food systems. As urbanization increases, food commodities are increasingly sourced from complex supply and value chains driven by large retailers and processors. While productivity enhancement is still a priority in these countries, governments should target investments that shape the transforming food system and the way food commodities are handled and processed in the post-harvest stages of food value chains.



Regulation and private-sector partnerships can provide incentives for emerging retailers and processors to develop nutrition-sensitive value chains by, for instance, creating incentives for the production and consumption of fortified and nutritionally-dense foods. Actions to ensure sustainability over the long term of value-chains that are nutrition-oriented include strengthening producer organizations, supporting small-scale technologies, and improving post-harvest handling through investments in storage and transport improvements.

#### Constraints

- Increasingly complex supply chains limited by gaps in post-harvest technology (e.g. cold chains).
- Increased supply and consumption of processed foods.
- Limited consumer awareness of health benefits of nutritious foods and of costs of unhealthy foods.

#### Investments

- Connect smallholder to high-value emerging supply chains driven by growth of large urban centers.
- Incorporate nutrition into value chains by improving post-harvest handling, implementing safety standards, and incorporating more nutritious crops including fortified foods.
- Promote demand for nutritious foods through packaging, branding and product differentiation.
- Provision of, and standards for, healthier foods in specific settings (e.g. schools, health care).
- Promote consumer choice through nutritional labeling, social marketing and nutrition education.
- Regulations: safety and nutrition standards, restricted marketing of unhealthy foods, standards for nutrient information and claims on food labels, limits on salt and removal of trans fats.
- Government-led programs for voluntary food reformulation.
- Support smallholders in addressing constraints to production (e.g. producer organization and meeting safety and quality standards).

### 3.3. Emerging and rural food systems (systems 4 & 5)

In many regions of countries with emerging and rural food systems, markets may be poorly developed and difficult to reach, leading households to be partially or fully self-sufficient in terms of food supply (Muller, 2009). In this context, household decisions on what food to produce is informed by consumption needs, thereby linking food production directly with household nutrition outcomes. Investments that target household production may thus be most cost effective in regions with less developed food chains.

The production-for-own-consumption pathway to improved nutrition is illustrated in a study of the effects of cow ownership on child dairy consumption and reduced stunting in India (Hoddinott et al., 2013). The authors observed positive effects of cow ownership on both outcomes, but only for households located in villages without market access; those with market access did not benefit. This suggests that, in areas with limited market access, promising agricultural interventions include those that directly increase household access to nutrient dense foods.

In a related example, also from India, a smallholder dairy production initiative was successful in leveraging a value-chain approach to improve and build on existing market linkages. The initiative worked at multiple levels of the value-chain: the farmer level to introduce productivity-enhancing technologies and establish cooperatives; the policy-level to shape the policy environment; and the commercial level to improve the procurement, processing, and marketing of milk in part by linking India's urban and rural areas by infrastructural improvements (Cunningham, 2009). The initiative grew to include 13 million members and through targeted investments, India transitioned from a dairy importing country to becoming the top goat and buffalo milk producer, as well as the sixth largest producer of cow milk worldwide.

Where markets make it possible for traders and retailers to reach producers, interventions to improve market-linkages may be more effective given scarce resources. Here, value-chain approaches can be effective in overcoming supply and demand constraints of nutritious commodities and products. Either public or private agricultural extension services can be highly instrumental in building market linkages. Hawkes et al. (2011) suggest a framework for utilizing value-chain approaches in subsistence farming contexts.

These interventions cut across the entire supply chain, starting with targeted support to producers and ending with marketing, consumer outreach and nutrition education.

Besides investments that increase household production diversity and improve market-linkages, countries and regions with rural food systems require public investments in infrastructure. Nearly sixty percent of rural citizens in Nigeria walk more than two kilometers to access the nearest all-season road and 65 percent do not have access to electricity (World Bank, 2008). While the evidence on whether investments in infrastructure contribute directly to positive nutrition and health outcomes is weak (Headey, 2012), investments in rural road systems can bring about positive synergies with other sectors and spillovers into health and nutrition outcomes. Improved infrastructure grants farmers access to additional markets and reduces post-harvest losses, providing rural populations additional income and enhanced food security. Investments in irrigation and other productivity enhancing technology and infrastructure may also yield substantial nutritional benefit where agricultural productivity is low and irrigation mechanisms are weak or non-existent.

In countries where rural agriculture predominates, government capacity may not suffice to deliver the interventions and investments listed below. Some of these may be most effectively implemented through decentralized approaches by utilizing nongovernmental organizations (Headey, 2012), or public-private partnerships (PPPs). Many new PPPs have been formed in recent years, but very little work has been done to evaluate their possible impact on nutrition outcomes. One clear exception is the HarvestPlus Challenge Program, which promotes the biofortification of staple foods and includes explicit nutrition goals (Meenakshi et al 2010, FAO 2012).

Finally, transnational food companies are increasingly investing in foreign affiliates to increase sales in developing countries (Hawkes, 2005). Therefore, system 4 and 5 countries could also benefit from encouraging nutritionally-responsible foreign direct investment (FDI), in tandem with public health and safety regulations of the food industry.

### Constraints

- Undeveloped markets: weak market linkages, supply chain gaps, market failures, high transaction costs.
- Low agricultural productivity among smallholder households, who are often engaging in subsistence agriculture.
- Limited access of producers to inputs and capital.
- Often rudimentary infrastructure.
- Lack of production diversity, few nutrition-dense options for consumption.



### Investments

- Increased public expenditure on healthy agriculture.
- Infrastructure investments such as farm to market roads, irrigation, and improved access to water.
- Increase access to and demand for high-value nutritious commodities.
- Revision of land property rights.
- Agricultural interventions both at the producer and the household level.
- Public-private, decentralized, nutrition-sensitive extension including micro-finance, technology, and other inputs (e.g. Mobile technology for market information, time and labor saving tools and technologies, pest control, improved crop varieties).
- Connect smallholders to emerging supply chains through value-chain approaches.
- Incorporate nutrition into value chains by reducing postharvest handling, improving safety standards, and promoting nutritious foods, including fortified products.
- Regulations: safety and nutrition standards, restricted marketing of unhealthy foods, standards for nutrient information and claims on food labels, limits on salt and removal of trans fats.

## 4

## Applying the food system typology to investment choices

A food system typology elucidates the different needs and investment opportunities facing countries as they implement the ICN2 Framework for Action. Countries with “rural” food systems which remain heavily reliant on agriculture for economic growth face a particular dilemma as they attempt to meet the current consumption needs of their populations, while simultaneously investing in the future to improve both economic and nutrition outcomes. Countries with “industrial” food systems face a very different set of challenges, most of which concern assuring an affordable supply of fresh, local foods despite a highly efficient, mechanized, vertically integrated agrifood industry which favors low cost, long shelf-lives, and uniform quality over nutrition. Careful investing in agriculture, food systems, and institutions can put people to work today in ways that will produce healthier food systems tomorrow – whether the starting point is a rural or an industrial food system.

Table 3 lists categories of investment policies for which there is some evidence of being able to improve nutrition outcomes, either via producer-oriented investments or consumer-oriented ones. Farmers are also consumers and, in many cases, support for production can increase own-consumption in farming households. Thus, some investments address needs on both sides of the below ledger. Because the quality of evidence is variable and many of the categories in question are not supported by evidence of direct impact on nutrition, Appendix A provides a partial review of the evidence for using these types of policies to achieve healthy food systems. It is noted that some of these policies are particularly relevant for certain food systems – for instance, research and development (R&D) for product reformulation is especially needed in industrial/mixed food systems where consumers are heavily dependent on processed food.

**Table 3.**  
**Categories of investments for healthy food systems**

Investment affecting nutrition through production	Investment affecting nutrition through consumption
<ul style="list-style-type: none"> <li>• Producer contracts, cooperatives, and other collective organizations</li> <li>• Marketing through supermarkets</li> <li>• Post-harvest handling management and loss reduction</li> <li>• Home gardening</li> <li>• Crop diversity</li> <li>• Livestock production</li> <li>• Dairy, poultry, and aquaculture production</li> <li>• Infrastructure: irrigation, roads, electricity, water supply</li> <li>• Land tenure reform</li> <li>• Communication</li> <li>• Biofortification and fortification</li> </ul>	<ul style="list-style-type: none"> <li>• Creating demand and improving access to local produced food</li> <li>• Home gardening</li> <li>• Crop diversity</li> <li>• Livestock production</li> <li>• Dairy, poultry, and aquaculture production</li> <li>• Social safety nets and cash transfer programs</li> </ul>

Analysis of the evidence shows that there are well proven interventions that can improve nutrition, increase food and production diversity, and enhance farmer livelihoods (IFPRI 2014, Berti 2004, Malapit et al 2013, Behrman et al 2012). It shows that there are policy objectives – such as increasing the nutrition sensitivity of social safety nets and increasing access to nutritious foods at the household or institutional level– that are beneficial in all settings, regardless of food system type. Actions in support of these objectives are likely to directly improve consumer choices and access to healthy foods, and there is strong evidence of their effectiveness, such as Oportunidades in Mexico and “Buy Fresh, Buy Local” in Iowa, USA.

However, the food system typology also reveals how different investment interventions address different nutrition needs, and therefore the priorities to recommend to different countries. Perhaps not surprisingly, among the most needed investments in rural and emerging food systems (food systems 4 and 5) are production and post-harvest infrastructure investments, which are costly and require sustained investment. But smaller investments in home gardening and household livestock and improving market access also pay off well in those contexts.



Institutional changes are called for in all food system contexts, though not necessarily the same ones. In rural and emerging food systems, non-governmental organizations (NGOs) play an important role where government capacity is weak. This implies that investments directed to strengthening and utilizing NGOs to support household awareness of and capacity to produce and access nutritious food may be an efficient path to improved nutrition. In transitioning food system countries (Food System Type 3), institutional arrangements to strengthen producer organizations' capacity to negotiate with supermarkets and to increase the value-added aspects of products are wise investments. Finally, legal and regulatory actions in industrial and mixed food systems may be needed to enable public institutions (schools, hospitals, etc.) to purchase from local farmers, enhancing freshness and diversity of food supplies to their clients.

The analysis presented here has significant limitations. First, and perhaps foremost, there is virtually no available financial or economic information about most of the investments described above, save in a few instances, and particularly for infrastructure (FAO 2012, Hoddinott et al 2013). The lack of financial information severely limits the ability to compare across investment categories and discern a financial rate of return, or even a cost-effectiveness ratio. It is thus not possible to say with certainty that any of these strategies – even those for which there is evidence of positive results – are a “good” investment, in the standard sense of the term. This is not unusual as public sector investments are generally not expected to demonstrate the kind of financial returns that the private sector requires. Nevertheless it would be preferable to use rate of return calculations to compare and potentially rank alternative investments, given that public resources for nutrition investments are limited, and because such measures are a pro forma step for development banks in decisions about public sector lending. Further, as happened with nutrition specific investments through the 2008 and 2013 Lancet series on maternal and child nutrition (Bhutta et al., 2008 & 2013), academically vetted cost-benefit measures could catalyze and harmonize donor investments by creating consensus as to which investments should be prioritized.

Second, this work provides a qualitative assessment of the research evidence supporting specific agricultural, nutrition, and other investments to improve food system outcomes (Appendix A). This partial review illustrates that different investment approaches are more suitable to some food system contexts than others. However, this review of evidence is based on results of a limited number of heterogeneous studies in a limited number of contexts.

Finally, the scope of this work derives ambiguity from the Framework for Action (FFA) Recommendation 17 to use investment policies to achieve food and nutrition policies. As described above, investment is generally used to refer to expenditures aimed at increasing benefits in the future. Many such interventions and policies were discussed at the ICN2 and elsewhere by health and nutrition officials and advocates, and are included in this report. However, other interventions to improve health and nutrition outcomes of food systems are more appropriately called consumption measures (procuring healthy food for school feeding programs), regulation (taxing unhealthy food and beverages), or transfers (using social safety nets to encourage healthy eating). Because these offer proven health and nutrition benefits, they are important to the ICN2 FFA and the most favored among these are included in this report even though they are not expected to pay future returns.

## 5 Conclusion and recommendations

This report reviews current evidence on investments to promote healthy food systems, in furtherance of the ICN2 Framework for Action, Recommendation 17. It uses a food system typology from the Global Nutrition Report 2015 that allows for differentiation among countries with respect to food system outcomes. It finds that there are significant differences among food systems that call for countries to make different investments to meet their food and nutrition needs. It further suggests that many types of investments and investors can be involved in improving the nutrition and health outcomes of a food system: public, private, and households.

Countries with rural and emerging food systems are, according to the typology, primarily low-income countries. Undernutrition remains a challenge in these countries, although some are also experiencing increased prevalence of overweight and obesity, implying a rapid change in food systems and nutrition conditions. These countries can benefit from a wide range of investments, particularly infrastructure and productivity enhancements in agriculture, and also strategies to enable the provision of more diverse food choices to their populations, either through commodity value chains or household production. Many of these investments will improve agricultural and economic returns in the future. And many are costly, relative to income levels in those countries as well as relative to some of the investments that are needed in more developed countries.





In contrast, countries with transitional food systems already have more diverse diets with reasonable intake of fresh foods and protein. There is growing consumption of packaged foods, and remaining pockets of undernutrition, especially stunting. Food system investments in these countries would prioritize value chains for non-staples, especially strengthening cold chain technology and addressing other post-harvest challenges that improve overall sector productivity, as well as improving access and awareness of healthy foods for consumers. Some of these investments may be costly, but on average they cost less than the infrastructure investments so urgently needed in rural and emerging food system countries. In short, transitional food systems generally deliver good diversity and availability of food, but can improve their economic and health returns with the right investments.

For industrial and mixed food systems, emphasis in investment choices should be on better alignment of public policy with health and nutrition objectives, particularly to support fresh and specialized production rather than a small number of grains. Policy and governance changes that incentivize healthy consumer behavior and restrict certain industrial practices and powers are needed. These changes do not cost much in terms of financial outlays, but are politically difficult.

A wide range of investment options to support healthier food systems are available for countries that wish to implement the ICN2 Framework for Action. They range from large-scale infrastructure improvements, to small-scale technical assistance and marketing support, to consumer education and incentives. Some require costly financial expenditures which will pay back over multiple years in more productive and nutrition-sensitive agriculture, while others require no financial outlays but only regulatory action.

Significant gaps remain in the knowledge available to countries and investors about how to select among these investment choices, and which to prioritize for a given food system and nutrition context. It is hoped that development banks and other financial institutions will work with the nutrition community to provide contextualized financial information about the promising interventions that are discussed in this report, so that informed choices among investment alternatives can be made by countries with any type of food system.

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## Appendix

# Review of the evidence for creating healthy food systems through nutrition-sensitive investments

### Agricultural interventions for improved nutrition

In spite of very weak and mixed evidence, agricultural strategies seem to hold promise for improving nutrition status. Even less evidence is available about food system strategies to improve nutrition; in fact, there is really no literature on that topic as distinct from agriculture and a few population-based policies that affect industry. This brief and partial review focuses on agriculture where there are several key contributions to the literature. Some of the investment categories highlighted below affect nutrition through production, some through consumption, and some through other channels.

Agriculture can influence nutrition through several pathways and the literature acknowledges four of them as key factors (Ruel & Alderman, 2013): (i) food prices, (ii) income from agriculture, (iii) consumption of own production due primarily to market imperfections, and (iv) factors linked to gender. If household-level effects of agriculture on nutrition exist, they are most likely the result of one or a combination of these factors. A review of 23 studies on five types of interventions (biofortification, home vegetable gardens, dairy development, fisheries, and animal husbandry) found that households increased the production and consumption of the food items targeted in the intervention. Evidence is mixed on the effect of agricultural interventions on other measures, including micronutrient and nutritional status as well as income. The authors attribute this to the studies lack of statistical power and data collection, rather than the lack of program efficacy (Masset et al., 2011).

An earlier review of 30 studies on agricultural interventions including home gardening, livestock, mixed garden and livestock, cash cropping, and irrigation found that most interventions increased food production, and 19 out of 30 improved nutrition at the household level. Of the 19 interventions that improved nutrition, 14 invested in multiple types of capital (human, financial, physical, and social capital) (Berti, 2004). Both of the reviews stress that lack of rigour and highly heterogeneous methods across studies limit analysis and generalizability of results (Berti, 2004; Masset et al., 2011). This concern is echoed by a separate review of 27 agricultural projects that concludes evidence of agricultural production strategies in improving the nutrition of women and children is limited in large part due to methodological limitations of the studies reviewed by the authors (Girard et al., 2012).

Girard et al. (2012) report that agricultural strategies consistently and significantly improved dietary patterns and vitamin A intakes for women and children, though this did not translate into positive effects on vitamin A status, anaemia or morbidity. Some studies in their review report significant effects on stunting and wasting while the authors' summary estimates do not.

### **Production contracts and producer organizations**

Production contracts between farmers and the private sector have been successful in providing farmers with necessary inputs, credit, and extension services (WB, 2008; Asian Development Bank, 2012). In addition, contracts provide smallholders assured markets and prices and firms share production and marketing risks with the producers. In order for smallholders to benefit from contract farming, however, there are many prerequisites. Smallholders need access to roads and information services, and they may need to organize since suppliers and wholesalers often prefer to contract with producer organizations which can help assure quality and timely delivery of products (Taren & Alaofè, 2013).

### **Supermarket channels**

Developing countries have experienced the rapid growth of supermarkets due to transformations in supply and demand side factors. Supermarkets can be local or international in ownership, and typically offer a wide range of Investments for Healthy Food Systems 27 food and other products from one location. Through vertical and horizontal integration (Reardon et al, 2012), they often concentrate ownership, distribution and other food system functions. In spite of these risks, studies have mostly found positive impacts of new supermarket channels on farm productivity, sales prices, and income. Chege et al. (2015) found that farmers in Kenya participating in supermarket channels have higher incomes and produce more vegetables. The authors show that these two pathways – income and crop production choices - had positive effects on nutrition: farm households that supply supermarkets consume about 15-20% more calories, iron, and zinc and 30% more vitamin A. A caveat is that commercialization favors specialization, reducing production diversity of individual farmers.

### **Post harvest handling management and loss reduction**

Agriculture value chain or market development projects can also improve post harvest handling with positive effects on nutritional status. By improving techniques for handling, storage, and preservation, improved post harvest handling leads to consumption smoothing and increases year-round availability of fresh and nutritious foods. In particular, careful preservation methods can maintain nutrient content and reduce the use of sugar, salt, and other added ingredients. Improved post harvest handling increases the quality and quantity of harvests translating into increased incomes (Copenhagen Consensus Center, 2015).

### **Creating demand for and improving access to locally grown food**

A program in Iowa, United States, was able to substantially increased sales of local farm production to restaurants, cooperatives, and other institutions (Ranum & Wiemerslage, 2011). It linked local producers with previously untapped markets (e.g. schools) by coordinating price points and focusing on second-grade products. Further, producers were given training, and grants to help finance greenhouses, diversification, and improvement of storage facilities. Under the already existent marketing brand “Buy Fresh, Buy Local”, the program targeted consumers through education and outreach components which included food tastings and farm-to-school tours. The program piloted six programs in schools in which nutrition education was built into the curriculum, teachers were given training, and distribution channels were set up to provide local produce to the school lunch program. Finally, the program had to lobby for changes in state policy in order to allow for public institutions to source locally. As a result of the program, farmers reported better quality and quantity of their products, and local food purchases from restaurants, food cooperatives, and local institutions increased by over half a million US dollars.

## Home-gardening

The positive impacts of home-gardening interventions on nutritional status, income, and dietary patterns are well documented (Taren & Alaofè, 2013). While some home-gardening systems focus on production of foods, legumes and tubers, production of fruits, vegetables, herbs and condiments are most common (Taren & Alaofè, 2013). For example, a home kitchen gardening intervention in Nepal combined with nutrition education increased the nutrition knowledge and dietary diversity of participants. Also, participants were more likely to feed infants complementary foods and to preserve foods (Jones et al., 2005).

In a review of agricultural interventions, all nine home-gardening interventions reviewed reported moderate to high positive effects on diets. All three of the interventions which measured anthropometry reported reduced underweight, wasting, and or stunting in children. This compares favorably to the other types of interventions reviewed, but the authors note that most gardening interventions included an explicit nutrition objective and entailed human capital investment components, whereas most non-home gardening interventions did not. This makes it difficult to compare home-gardening with other interventions and to isolate the reasons behind homegarden success. It does suggest however, that interventions including broad investments in different types of capital such as nutritional education and gender consideration are more successful than those that do not (Berti, 2004).

## Crop diversity

In a review of agricultural strategies to improve nutrition, Carletto et al. (2015) reviewed three studies exploring the linkages between crop diversity and nutrition. In Nepal, evidence from a multisectoral nutrition program reveals that dietary diversity for mothers and children as well as weight-for-age-scores in children was strongly associated with production diversity<sup>14</sup> at the household level (Malapit et al., 2013). Interestingly, the study finds that women's empowerment mitigates negative effects of low production diversity on dietary diversity and height-for-age-scores (HAZ) in mothers and children. Using panel data, econometric analysis estimates that in Nigeria, a 10% increase in crop diversity leads to a 2.4% increase in dietary diversity (Dillon et al., 2014). In Zambia, production diversity as measured by total number of different number of crops and food groups produced as well as agricultural activities engaged in (e.g. animal husbandry, fruit and vegetable production, production of field crops) in subsistence households was positively associated with HAZ scores and inversely associated with stunting in children older than 24 months (Kumar et al., 2015). This implies that production diversity at the household level can have positive effects on dietary diversity and anthropometric measures in children and mothers.

## Livestock production

Household-level interventions targeting livestock and or aquaculture have mostly focused on income generation rather than consumption. While there is little available evidence on the impact of these types of investments on nutrition and diets, animal-source foods are nutrient dense and there is some evidence to support positive impacts on nutrition outcomes. A review of eight studies examining the links between agricultural production of both crops and livestock, household dietary diversity, and child nutrition outcomes concludes that livestock is linked to positive nutrition outcomes (Carletto et al., 2015).

<sup>14</sup> Using a nine-food item production diversity index. Included food groups: starchy staples; beans, legumes, and nuts; dark green leafy vegetables; vitamin A-rich fruits, vegetables, and tubers; other fruits and vegetables; milk and milk products; eggs; fish; and meat.

### **Dairy, poultry, and aquaculture**

Different studies have found that dairy interventions may increase dairy and overall nutrient intake, and may decrease prevalence of stunting, wasting, and underweight (Taren & Alaofè, 2013). The Milk Matters project (Sadler et al., 2012) compared two intervention groups to a control group. One intervention group was provided with milking animals (either a cow or four goats) and fodder, for the other group, household milking animals received vaccinations and de-worming in addition to fodder. Interventions were implemented in the Somali region of Ethiopia where pastoralists consume between 20-50 percent of their energy requirement as milk and animal products. Annual drought exacerbates malnutrition, in part, through reduced milk production during the dry season. Compared to controls, the Milk Matters interventions increased dairy intake and stabilized nutritional status of pastoralist children during the hunger season. Further, it is estimated that interventions were highly cost-efficient – costs were estimated to be 45-75% of therapeutic feeding programs implemented through community-based management of acute malnutrition. Finally, women reported having more free time, which may have positive effects on childfeeding practices (Sadler et al., 2012).

### **Land tenure**

A review of twenty studies (Lawry et al, 2014), found that land tenure interventions which formalize ownership rights such as freehold titling, registration through land redistribution, and formal registration of customary rights are associated with gains in productivity and welfare. De jure recognition of tenure was found to increase the monetary value of land productivity by 40% on average, though the heterogeneity of results limits the ability to draw conclusive results. Title recipients' welfare as measured by consumption or income increased by 15 percent on average. The authors note that the quality of evidence does not provide a firm basis for generalization of results and that qualitative measures fail to take into account social consequences of land tenure policies such as displacement and gender equality. Gains were significantly greater in Asia and Latin America than in Africa and varied by income level; smaller effects in sub-Saharan Africa may be explained by already wide-spread and established customary tenure. While it appears that tenure recognition contributes to welfare, effects are highly variable and context specific (Lawry et al, 2014).

### **Social Safety Nets and Conditional Cash Transfer Programs (CCT)**

Evidence from CCT programs suggests that these programs have significant impacts on child anthropometry and some studies show effects on younger children who receive welfare for longer durations (Ruel and Alderman, 2013). In addition, these programs have positive effects on other outcomes that affect nutritional status, including increased household expenditure, food security, and improved diet (Leroy et al., 2009). Social protection played a large role in reducing undernutrition in Colombia, the only country currently on target to meet four World Health Assembly targets (IFPRI, 2014a). Further, making social protection more nutrition-sensitive is promising since public expenditure on social protection is increasing across the world (IFPRI, 2014a).

## Public-Private Partnerships

Food consumption in any given country is determined by the food production, processing, distribution, and retail sectors. Therefore, the private sector has an enormous impact on dietary patterns and nutrition outcomes. In addition, sectors such as the mobile phone, media, and health sectors shape consumer preferences and consumption. Public-private partnerships (PPPs) could help connect farmers to supply-chains by providing investments in public goods and in policies that facilitate trade and market development, as well as in education and training to develop farmers' technical capacity and meet sorting, packing, and growing standards (Narrod et al., 2008).

Further, the public sector can encourage the private sector to adopt pro-nutrition policies. It can do this through direct regulation, voluntary commitments, or through PPPs whereby both sectors leverage the other's resources and create shared value. PPPs may allow the public sector to scale interventions and leverage investments through the private sector's established development and delivery capacity. The private sector, in turn, may benefit through risk sharing and shared value through improved public perception. Evidence on PPPs targeting nutrition is sparse and it is not clear whether PPPs are more effective than alternative engagements with the private sector (Hoddinott et al, 2015).



## Infrastructure investments and nutrition

### Irrigation

While the impact of irrigation on poverty alleviation is well documented, nutrition impacts of improved irrigation are not (Hussain & Hanjra, 2004). Nevertheless, there are indications that irrigation can help alleviate chronic and seasonal malnutrition by improving the intake of staples and animal-source foods as a result of higher incomes and improved livestock productivity (Taren & Alaofè, 2013). Moreover, by enabling year-round cultivation of high value crops, irrigation can improve consumption of certain foods. In Benin, solar-powered drip irrigation systems increased the consumption of vegetables to the Recommended Daily Allowance, and income from vegetable production allowed farmers to purchase staples, pulses, and protein during the dry season. In a survey, beneficiaries of the irrigation project were 17 percent less likely to identify themselves as food insecure (Burney et al., 2010).

In Ghana, low-cost shallow groundwater irrigation technology increased profitability and created jobs during the dry season. Dietary diversity did not increase among farmers who irrigated, however, and decreased for farmers owning a specific type of shallow well. The authors suggest that this may be due to adverse nutritional impact of mono-cropping which irrigation may have promoted in some instances (Namara et al., 2011). Indeed, for this reason it is important to consider potential negative impacts of irrigation programs such as increased dependency on mono-cropping and water-borne diseases. Further research is needed on how irrigation technologies may lead to positive nutritional outcomes and on how to mitigate risks such as contaminated water affecting health through irrigation systems (Taren & Alaofè, 2013). Effects of irrigation vary considerably depending on factors including the ecology and the epidemiologic setting of the area (Taren & Alaofè, 2013).

It is important to acknowledge that irrigation infrastructure often requires extension services and technical support to ensure the sustainability of irrigation technology. Investments should be made depending on resources and regional ecological profiles – where markets are relatively undeveloped and where groundwater is easily accessible, less resource intensive technologies may be implemented such as the shallow wells in Ghana mentioned above. Uptake of more advanced irrigation technologies may require regional manufacturing, market linkages, and financial inputs. In both cases, governments can partner with project implementers including the private sector and NGOs to facilitate the widespread adoption of irrigation technologies.

### Road networks, electricity, and improved water quality

Limited evidence suggests that investments in road networks generate positive impacts on agricultural productivity, rural GDP growth, and poverty reduction (Knox et al., 2013). Electricity investments have larger impacts where farming systems are more modern and where electricity requirements are greater. Finally, improved water quality may have positive effects on linear growth in children under five years of age, though studies to-date are of low quality (Dangour et al., 2013).

## Investments in technology and research and development for nutrition

### Communications

Investments that increase the availability of information and improve market efficiency may increase social welfare. Internet and mobile technology allow for the rapid transmission of agriculture and nutrition information to rural populations though high levels of illiteracy, inadequate infrastructure, and costs of information services impede the growth of rural information systems. Information communication technology (ICT) can promote nutrition directly through social marketing campaigns and indirectly by supporting small-holder productivity. Telecenters in Tanzania for example have provided small-holder farmers access to information on credit, markets, and weather (Mtega & Ronald, 2013).

Behrman et al (2012) calculate the positive benefit-cost ratios of improving market information through SMS messaging in two south Asian and four African countries. Investments in literacy programs and partnerships with the private sector to reduce costs and ownership of information services could promote the expansion of ICT into rural areas. Information on nutrition should be provided.

### Biofortification

Biofortification can be a highly cost-effective investment: after initial outlays to develop biofortified varieties, conduct in-country trials, and create demand and local markets, micro-nutrient supplementation through biofortification can be self-sustaining with little recurring costs (Meenakshi, 2008). Scaling up value chains for biofortified and fortified foods holds promise for improving dietary intake of micro-nutrients and for improving overall nutritional status of consumers. Marketing campaigns that add nutrition education increase consumer acceptance and willingness to pay for these types of foods (Meenakashi et al., 2012).

The evidence base regarding the effectiveness of biofortification in increasing levels of micro-nutrient stores is strong and growing. For example a well known study (Low et al., 2007) assessed a two-year program in Mozambique which targeted 741 farm households. The program provided access to orange fleshed sweet potato (OFS P) vines (bred to be high in beta carotene), and extension services. The extension services covered topics from nutrition knowledge to production methods and commercialization. Children of beneficiary households increased vitamin A intake and mean serum retinol levels increased significantly while prevalence of low serum retinol decreased from 60 to 38 percent. No changes were observed in controls, although all children in the community had access to vitamin A supplements. The authors point out that their findings underscore the need for multiple interventions, including supplementation, as well as food-based approaches (Low et al., 2007). More recent evidence from larger scale, randomized and controlled studies have also reported positive effects of OFS P introduction among 12 and 10 thousand households in Mozambique and Uganda respectively (Hotz et al., 2011; Hotz et al., 2012).

Other crops besides OFS P can be biofortified, for example zinc-biofortified wheat, high-iron rice, and improved protein maize; each of these have demonstrated potential to increase stores of the targeted micro or macro-nutrient (Taren & Alaofè, 2013). Evidence supporting the nutritional efficacy of biofortification is strong, but further research is required to determine how biofortified crops affect yields and farmer profits and how to create local markets and demand in varying climatic and socio-economic conditions. Evidence from rural Ghana suggests that consumers are willing to pay a premium for biofortified crops, provided consumers receive information on the nutritional benefits (Banerji et al., 2013).

## List of abbreviations

<b>ATNI</b>	Access to Nutrition Index
<b>CCT</b>	Conditional Cash Transfer Programs
<b>CIMSANS</b>	Center for Integrated Modeling of Sustainable Agriculture & Nutrition Security
<b>CO2eq</b>	Carbon Dioxide Equivalents
<b>FAO</b>	Food and Agriculture Organization
<b>FDI</b>	Foreign Direct Investment
<b>GDP</b>	Gross Domestic Product
<b>GNR</b>	Global Nutrition Report
<b>HAZ</b>	Height-for-age-scores
<b>ICN2</b>	Second International Conference on Nutrition
<b>ICN2 FFA</b>	Second International Conference on Nutrition, Framework for Action
<b>ICT</b>	Internet and Communication Technology
<b>IDF</b>	International Diabetes Federation
<b>IFPRI</b>	International Food Policy Research Institute
<b>IOM</b>	Institute of Medicine
<b>MCC</b>	Millennial Challenge Corporation
<b>NGO</b>	Non-Governmental Organization
<b>NCD</b>	Non-Communicable Diseases
<b>OFSP</b>	Orange Flesh Sweet Potato
<b>PPP</b>	Public-Private Partnerships
<b>R&amp;D</b>	Research and Development
<b>UNICEF</b>	United Nations International Children's Emergency Fund
<b>WB</b>	World Bank
<b>WHO</b>	World Health Organization

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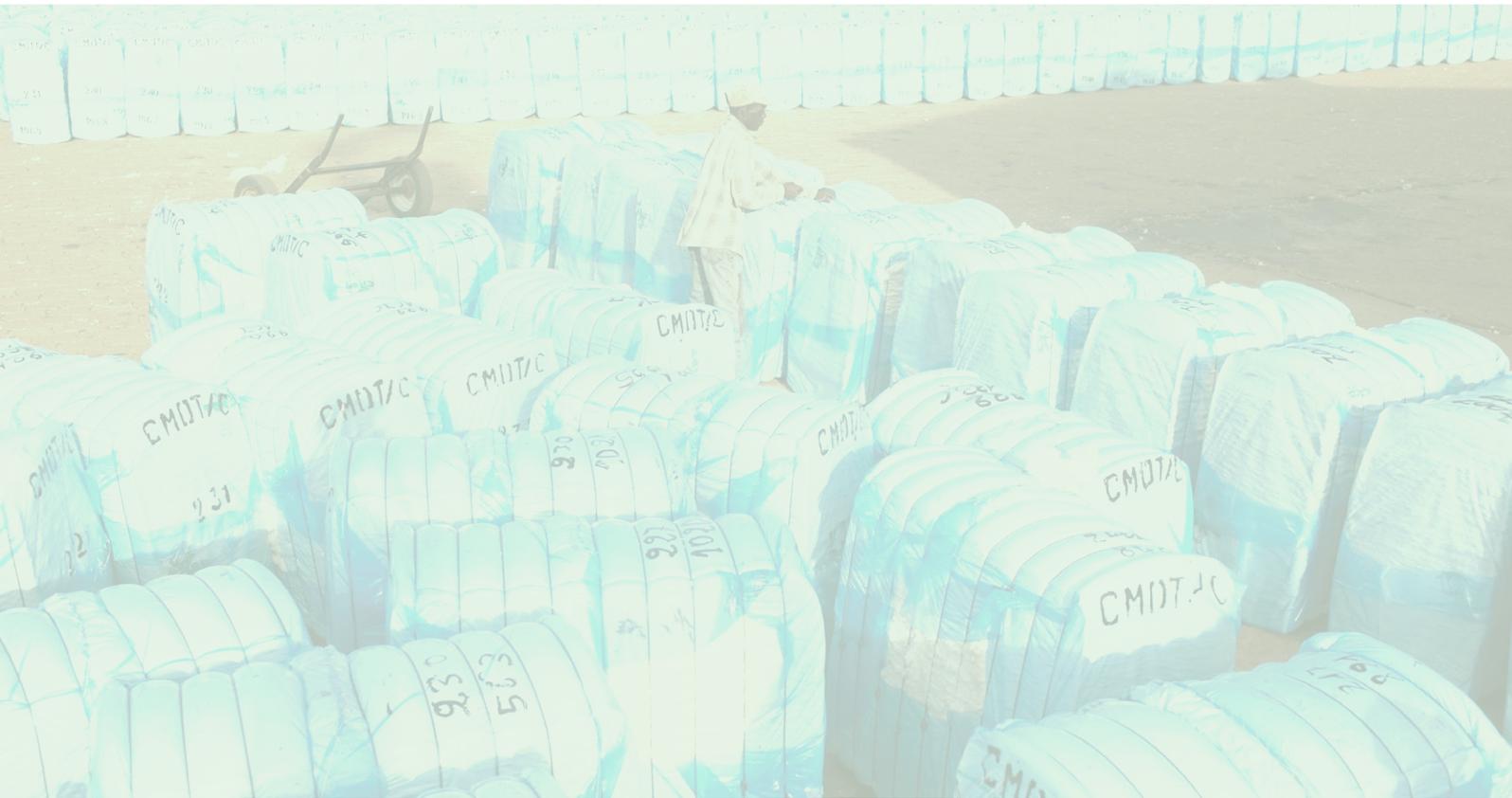
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A world free from hunger and all forms of malnutrition is attainable in this generation

UNSCN Secretariat

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