Agriculture and health and nutrition have long occupied separate realms. Analyses of agricultural production seldom recognize that health status affects productivity, nor do they recognize that agricultural goods and processes have health consequences. At the policy and programmatic levels, agriculture and health operate in separate silos, seldom considering the consequences of their actions on sectors outside their own. This separation is strange given that agriculture and health and nutrition are tightly wedded. Agriculture is the primary source of calories and essential nutrients and is a major source of income for the world’s poor, while agriculture-related health losses are massive.

Strengthening the policy and programmatic links between agriculture and health and nutrition requires a means of seeing how their myriad links fit together. This chapter sketches a framework that elucidates the channels through which agriculture affects health and nutrition and vice versa. While this framework can be applied at the global or national level, here it is focused on households and individuals, given that improving individual welfare is the ultimate goal of public policy.

The Basic Framework
The framework has three components: settings, resources, and the processes associated with agricultural production and the determinants of health and nutrition status.

Settings
The physical, social, legal, governance, and economic settings in which individuals live and work influence their actions. The physical setting refers to phenomena that affect agricultural production, such as the level and variability of rainfall, soil

fertility, distances to markets, and quality of infrastructure. The physical environment also incorporates phenomena that directly affect human health—access to safe water and the presence of communicable human and zoonotic diseases being primary examples. The social setting captures such factors as the existence of trust, reciprocity, social cohesion, and strife. Norms of gender roles, “correct” behaviors, and folk wisdom—for example, what type of foods mothers “should” feed their children—are also part of the social setting.

The legal setting can be thought of as the rules that govern economic exchange. It affects agriculture through the restrictions it imposes on and the opportunities it creates for the production and sale of different foods, and through the regulation of labor and capital markets. The legal setting also affects health in terms of regulations applicable to the health sector in addition to those that govern food processing and safety. The governance setting captures how rules are developed, implemented, and enforced. It includes the political processes that create rules—for example, centralized or decentralized decisionmaking, dictatorial or democratic governance, and so on—and the implementation of these rules through bureaucracies, parastatals, and third-party organizations. Finally, the economic setting captures policies that affect the level, returns, and variability of returns on assets and, as such, influence choices regarding productive activities undertaken by individuals, firms, and households.

Resources
Households have resources—time and capital. Time refers to the availability of physical labor for work. Capital includes such assets as land, tools, livestock, social capital, financial resources, and human capital in the form of schooling and knowledge. It also includes human capital in the form of health and nutrition status. Some resources, such as health and schooling, are always held by individuals, while others, such as land, may be individually or collectively owned. These resources are allocated to different productive activities, including food production, cash-crop production, livestock raising, and nonagricultural income-generating activities, such as wage labor, handicrafts, and services.

Households may receive transfer income from other households or from the state. For smallholder households, agricultural production will be the predominant use of household resources. For landless or near-landless households, urban households, or households located in more advanced economies, wage labor or nonagricultural business activities will matter most. While differences in livelihoods do not change the basics of the framework presented in this brief, they imply that certain links among agriculture, health, and nutrition will be more important for some households than for others.
Agricultural Production

Agricultural production is affected by the settings within which the household resides, with the physical and economic settings being especially important. Both the natural physical setting—rainfall, temperature, soil quality, elevation, and so forth—and the man-made physical setting—roads, bridges, and other forms of infrastructure—influence what livestock can be raised, what crops can be grown and when, and the places where these products can be marketed. The economic setting—particularly the markets encountered by farmers—provides signals as to what activities are profitable and the types of inputs that can be profitably employed.

Within these settings, the household allocates its resources, capital, knowledge, and time. In some cases, allocations of all resources may be a collective decision. In other cases, individual men and women within the household may choose how to allocate the resources under their own control, independent of what other household members choose to do. In still other cases, some activities will be undertaken collectively or perhaps under the direction of one household member, while others are done individually.

In making these allocations, household members are also making choices about the technologies used in the generation of income. These technologies govern what crops will be produced, what livestock will be raised, how they will be produced, and when production will take place. Note that the health and nutrition status of individual members will affect the choice of activities, the timing of these activities, and the intensity with which productive activities will be undertaken. For example, individuals who are suffering from iron deficiencies or have a physical disability will encounter greater difficulty in using their physical labor to produce agricultural output. In populations where there are severe deficiencies in energy intake, or where economic activities are physically demanding, increased nutrient intake can raise labor productivity.

Savings and Consumption

Income can be saved or consumed. Savings create a feedback loop within this framework. Consumption decisions, in terms of the quantity and quality of goods consumed and the timing of this consumption, are affected by prices faced by households which in turn are a reflection of the structure, conduct, and performance of the markets with which households interact. Markets provide goods, such as medicine and clothing, that positively affect health status, as well as those that negatively affect health, such as tobacco. Food consumption—with its quantity, quality, and diversity dimensions—will account for a considerable fraction of the budgets of poor households.
**Determinants of Health Status**

The setting within which households and individuals live affects health. The physical setting—climate, access to water, the prevalence of communicable diseases, and health infrastructure—plays a major role in health status. So too does the social setting. Norms regarding what constitutes good health, the circumstances under which individuals should seek healthcare from modern or traditional sources, and how illnesses should be treated will all affect health status. Health is also affected by the allocation of individual and household resources. Assets in the form of the quality of housing and physical goods associated with water, sewerage, and waste disposal will affect health status. Knowledge of how health should be maintained, how illnesses can be identified, and how those illnesses can be treated will affect health. The allocation of time plays an important role in maintaining or improving health. Health status is also affected by the consumption of goods that directly improve or worsen health. Nutritional status affects health—for example, severe vitamin-A deficiencies lead to blindness.

The links between health status and agriculture are bidirectional. Choices made in agricultural production affect health through three channels. First, manual work in agriculture is physically demanding and can directly damage health. Second, agricultural work exposes individuals to harmful pathogens, such as those found in water-borne diseases or those that come from zoonotic sources. Third, where agricultural production involves the use of chemical pesticides, exposure to these can be another threat to health.

**Determinants of Nutritional Status**

Nutritional status results from the combination of time, physical assets, and knowledge of good nutritional practices, together with health status and the consumption of food. Food consumption, in terms of quantity, quality, and diversity, plays a major role in determining nutritional status and, as such, provides the most direct link between agriculture and nutrition. But it is not the only factor. There are physical assets involved such as cooking pots and utensils. The nutritional status of very young children will be affected by the frequency of feeding—this is an example of how allocation of time (here, time devoted to childcare) affects individuals’ nutritional status. Social norms regarding foods and who “should” consume them, and knowledge of what are the right foods to consume and in what quantities also affect nutritional status. Because nutritional status depends on the capacity of the body to absorb nutrients, it is affected by other dimensions of an individual’s health status, such as the presence of healthy intestinal mucosa. Finally, the nutritional status of an individual within a household depends on how the amount of food and other inputs into nutrition are allocated across members.
Leveraging Change to Agriculture to Affect Health and Nutrition

There are numerous locations within the framework where leverage can be applied to bring about changes. Levers are available to policymakers and other stakeholders, but they can also be operated by natural, market, or other forces.

Levers affecting agricultural production, emanating from either the public or private sector, operate at the level of settings, resources, production, and markets. For example, environmental programs that focus on soil and water conservation are levers that affect the physical setting. Infrastructure improvement affects both the level and type of agricultural production. Changes in the economic setting such as changes in exchange rates, tariffs, and openness to trade—which partly reflect globalization—will affect access to inputs and to new markets. Private and public actors can change value chains in ways that affect incomes received by farmers, the types of foods available to consumers, and prices faced by both producers and consumers.

Levers affecting agricultural production and markets will affect health and nutrition through six pathways.

1. *Changes to incomes:* When changes in agricultural production lead to increases in household income, the income can be used to purchase goods that affect health status. Better clothing and the ability of households to purchase improved healthcare are examples of this potential to improve health status, while the purchase of tobacco products will damage health. Higher incomes can be used to purchase more food, higher-quality food, and a more diverse diet. These will directly improve nutritional status. Higher incomes will affect health indirectly through their impact on nutritional status and directly where the food purchased has fewer pathogens and thereby reduces exposure to food- and water-borne diseases.

2. *Changes in crops, farm practices, and markets:* Changes in agricultural production can result in the introduction of new foods into diets. At the farm level, the introduction of new crops as a result of innovations in crop breeding (for example, biofortified foods) has the potential to improve both health and nutrition. At the level of local, regional, or national food markets, actions by the private sector, governments, or other actors can make existing foods produced within a country available to new markets. Reforming tariffs and reducing barriers to agricultural trade will permit the entry of foods only produced outside the country. Finally, changes in processing can also affect foods consumed. This can be beneficial, for example, where foods are fortified with micronutrients, or harmful, as in cases where processing introduces excessive levels of sodium.
3. Changes to crop varieties and production methods: Changes in the types of crops that are grown or changes in production processes may make agricultural work either more or less physically intensive. For example, mechanization will reduce the physical demands of agricultural labor, whereas crops that require greater manual weeding will increase it. They will also change exposure to pesticides, zoonoses, and work-related accidents.

4. Changes to the use of time: Where changes increase the returns to time spent in agriculture, households may increase the amount of labor they devote to agricultural production. If this labor does not come from outside the household and if it does not come from reduced leisure, then some other household activity will be affected. Households might reduce time spent on other income-generating activities, make greater use of child labor, or reduce time spent on the production of health or nutrition.

5. Changes to savings: Where changes in agricultural production result in higher incomes, individuals and households may choose to save some of these higher incomes in the form of assets that improve health.

6. Changes in intrahousehold resource allocation: Changes in agricultural production may result in changes in the allocation of resources within the household. If this change results in women earning greater income, it may affect how households spend money, how food is allocated, and what types of assets are accumulated.

It is not always clear whether a change in agricultural production will improve or worsen health and nutrition. Several factors are at play. First, how large are the income effects of this change? Are these gross or net (accounting for input costs) income changes? How does income derived from other, nonagricultural income sources change? How strong are the links between income changes and the dimension of health being considered, as mediated through changes in consumption of goods that affect health status? Does higher income cause households to purchase more food or foods of improved quality? Do households spend these higher incomes on goods that have no effect, or even a negative effect, on health and nutrition?

Second, how do these changes affect pathways through which agricultural production affects health directly? Are household members more exposed to zoonoses or to poisons such as those found in pesticides? Is more time spent in agriculture and less in the production of health or nutrition? Does the intensity of agricultural labor increase or decrease? To what extent does this offset or magnify the beneficial effects that these changes may have on household income?
Third, are the inputs into health and nutrition complements or substitutes? If a certain level of nutritional status can be maintained by reducing time spent preparing meals and purchasing prepared foods, then these purchased foods are a substitute for time spent cooking. But not all inputs are substitutable. If a child is suffering from diarrhea, trying to increase her food consumption without treating the illness will not improve nutritional status.

Finally, how are these changes—their benefits and costs—distributed within the household and across households? Are the people who benefit from these changes the same people who incur costs?

Implications for Policy
These myriad links—both beneficial and adverse—among agriculture, health, and nutrition pose challenges for policymakers. In an area of ongoing research such as nutrition, the key policy lever for poor countries—where a large proportion of the population relies on agriculture for their livelihoods—will be the changes in crops, farm practices, and markets. Technological improvements and value-chain enhancements, if distributed effectively, can affect the supply of healthy and nutritious foods while simultaneously boosting incomes. It is this potential that makes agricultural innovation a leverage point for policy and programmatic interventions.

Concluding Remarks
The links among agriculture, health, and nutrition are most complex when we consider smallholder households. However, the framework is equally applicable to other household types. For example, landless rural households and urban households are typically net food consumers, and so changes in agriculture affect health and nutrition largely through changes in the quality, variety, and prices of foods available to them. The framework can also be readily adapted to national or global levels.

Anything that affects agriculture has the potential to affect health and nutrition, and anything that affects health and nutrition has the potential to affect agriculture. While some of these pathways imply that changes in agriculture will have positive impacts on human health, this is not true of all pathways. Policymakers in all sectors need to be cognizant of these multiple pathways and their bidirectional effects. The importance of different links will often be context-specific and determined by characteristics of the population being considered. The policy challenge is to ensure that changes occurring in agriculture come about in a way that maximizes benefits to human health and nutrition while minimizing the risks. Many of the chapters in this book describe particular contexts and circumstances where this has been
achieved. Policy that uses the linkages among agriculture, health, and nutrition can produce good outcomes on all fronts.