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AGRICULTURE, HEALTH, AND NUTRITION: TOWARD CONCEPTUALIZING THE LINKAGES

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Abstract

This paper outlines a conceptual framework that links agriculture, health, and nutrition. Three components make up this framework: settings, resources, and production processes. Policy levers, programs, and interventions designed to affect agriculture will affect health and nutrition by changing the quantity and type of goods consumed by household members; work intensity; exposure to zoonoses, pesticides, and work-related accidents; the allocation of time devoted to agriculture, health, and nutrition; asset accumulation; and the rules governing intrahousehold resource allocation. The presence of feedback loops within the framework illustrates the possibility that anything that affects agriculture can affect health and nutrition, and anything that affects health and nutrition can affect agriculture. Because there can be no presumption that these effects will be, on balance, beneficial or harmful, policymakers and program planners need to be cognizant of the multiple pathways through which agriculture can affect health and nutrition.

Agriculture, Health, and Nutrition: Toward Conceptualizing the Linkages

JOHN HODDINOTT

I. Introduction

AGRICULTURE, HEALTH, AND NUTRITION HAVE LONG OPERATED OCCUPIED separate realms. Analyses of agricultural production seldom recognize that health status can affect productivity, nor do they recognize that the production and use of agricultural goods can 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 of 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 80 percent of the world's poor (IFPRI and ILRI 2010). Agriculture-related health losses are massive, accounting for up to 25 percent of all disability-adjusted life years lost and 10 percent of deaths in low-income countries (Gilbert et al. 2010 cited in IFPRI and ILRI 2010).

Strengthening the policy and programmatic links between agriculture and health and nutrition requires a means of seeing how their myriad links fit together. This paper presents a framework that elucidates the channels through which agriculture affects health and nutrition and, in turn, how health and nutrition affect agriculture.¹ The framework can be applied at the global, regional, or national level. In this paper, however, the focus is on applying it to households and individuals, given that given that improving individual welfare is the ultimate goal of public policy.

Three components make up the framework: settings, resources, and processes. The framework shows how policy levers, programs and interventions designed to affect agriculture will, in turn, affect health and nutrition through changing the quantity and type of goods consumed by household members, work intensity, exposure to zoonoses, pesticides and work-related accidents, the allocation of time between agriculture, health and nutrition, asset accumulation and the rules governing intra-household resource allocation. Anything that affects agriculture has the potential to affect health and nutrition and anything that affects health and nutrition may have implications for agriculture. As discussed below, because there can be no presumption that these effects will be, on balance, beneficial or harmful, policymakers and program planners need to be cognizant of the multiple pathways through which agriculture can affect health and nutrition.

2. 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.

¹ Agriculture is defined as “The science and practice of cultivating the soil, producing crops, and raising livestock, and the preparation and marketing of the resulting products” (Merriam-Webster 2010). Health is “A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (WHO 1948). Nutritional status is a dimension of health relating to the macro and micro nutrient adequacy of an individual's diet.

Settings

The actions of individuals are influenced by the settings in which they live and work—physical, social, legal, governance, and economic. The physical setting refers to phenomena that affect agricultural production, such as the level and variability of rainfall, elevation, soil fertility, distances to markets, and quality of infrastructure. The physical environment also incorporates phenomena that affect human health—temperature, rainfall, access to safe water, and the presence of communicable human and zoonotic diseases all being examples. The social setting captures such factors as the existence of trust, reciprocity, social cohesion, and strife. Norms of gender roles, of “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 of the game” under which economic exchange takes place. It affects agriculture through the restrictions it imposes on and 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 (for example, rules regarding licensing, the approval of drugs, and so on) as well as those applicable to food processing and safety. The legal setting is linked to but is distinct from the governance setting. The governance setting captures *how* rules are developed, implemented, and enforced. This includes the political processes that create rules—for example, centralized or decentralized decisionmaking, dictatorial or democratic processes, 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. These can be divided into two broad categories: time (or labor power) and capital. Time refers to the availability of physical labor for work. Capital can be divided into three categories. First are assets such as land, tools for agricultural and nonagricultural production, livestock, social capital, and financial resources that, when combined with labor, produce income. Second is human capital in the form of formal schooling and knowledge. For an agricultural household, this knowledge is obtained both from formal schooling and training in agricultural production. It also includes informal knowledge obtained via trial and error, indigenous knowledge, past farming experiences, discussions with friends and relatives, observations made about practices on neighbors’ farms, and so on. Knowledge includes how to recognize and treat illness and how to maintain good health. It also includes knowledge of good nutrition practices, such as appropriate complementary foods and the frequency of feeding of young children. The third and final resource is human capital in the form of health and nutrition status—specifically, the physical capacity to do work. Some household resources, such as health and schooling, are always held by individuals while others, such as land and financial capital, may be individually or collectively owned.

Conditional on the settings in which a household operates, these resources are allocated to different productive activities. These include food production, cash crop production, livestock, and nonagricultural income-generating activities (such as wage labor, handicrafts, food processing, services, and so on) in response to the returns each activity generates. In addition, households may receive transfer income from other households or from the state. For purposes of this paper, these sources of income are divided into two categories: agricultural production and other income. For smallholder households, agricultural production will be the predominate use of household resources. But not all households are smallholders. Landless or near-landless households, urban households, or households located in more advanced economies typically rely more heavily on wage labor or nonagricultural business activities. While differences in livelihoods do not affect the presentation of this framework, they do imply that certain links between agriculture, health and nutrition will be more important for some households than for others.

Agricultural production processes

Given the focus on the links among agriculture, health and nutrition, it is helpful to expand on processes of agricultural production. It is affected by all 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 of roads, bridges and other forms of infrastructure strongly influence what livestock can be raised, what crops can be grown, when they can be grown, and the places where these products can be marketed. To the extent that this setting creates variability in production, it will also influence the portfolio of agricultural activities and their distribution over time and

space. The economic setting—particularly the markets encountered by farmers—provides signals as to what activities are profitable to undertake and the types of inputs that can be profitably employed.

Within these settings, the household allocates its resources of capital, knowledge, and time. Because some resources are held individually while others are held collectively, one needs to be cautious in using the phrase “the household allocates.” 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 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 will be produced, how it will be produced (for example, whether fertilizer, pesticides, and/or hired labor will be used), and when production will take place. Finally, 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 have greater difficulty in using their physical labor to produce agricultural output. Particularly 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

Once households have generated income, they can choose to save or consume it. Savings create a feedback loop within the framework, as foregoing current consumption allows household members to accumulate assets in a variety of forms: financial, social, and physical assets such as land, livestock, durables, and jewelry. 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 markets – and their structure, conduct, and performance.²

In the context of the links among agriculture, health, and nutrition, the consumption goods can be divided into three categories. First, there are goods that directly affect health status. These can be such things as food, medicine, and clothing, which improve health, but can also include goods that negatively affect health, such as tobacco. Second, food consumption – with its quantity, quality and diversity dimensions – will account for a considerable fraction of the budgets of poor households. For completeness, a third category, “all other goods,” includes good that fall outside of the first two categories.

DETERMINANTS OF HEALTH STATUS

As with agricultural production, an examination of health status determinants begins by emphasizing that the setting in which households and individuals live will affect health. The physical setting—climate, access to water, the prevalence of communicable diseases, and health infrastructure—plays a major role in affecting health status. So too does the social setting. Norms (which may be gender-differentiated) regarding what constitutes good health, the circumstances under which individuals should seek health care 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 they can be treated will affect health. The allocation of time—for example, time spent washing or caring for individuals who are sick—also plays an important role in maintaining or improving health. Health status is affected by the consumption of goods (described above) that directly improve or worsen health.

It has already been noted that health status affects agricultural production. The links between these are bidirectional. The choices made in the context of agricultural production affect health through three channels. First, manual work in agriculture is physically demanding and as such, it may directly damage health: for example, the physical toll exacted by long hours spent tilling soil or bending over to transplant rice places on the body. Second, agricultural work exposes individuals to harmful pathogens such as those found in water-borne

² There will be some foods that households both produce and choose to consume. These items will not pass through markets though the presence and functioning of markets will affect the decision whether to consume these at home or sell them.

diseases or from zoonotic sources. Third, where agricultural production involves the use of chemical pesticides, exposure to these can be a threat to health.

The final factor that affects health is nutritional status. There are many examples of these links. Two good examples are severe Vitamin A deficiencies that lead to blindness and the importance of a balanced diet in sustaining treatments for HIV.

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, both in terms of quantity and quality, plays a major role in determining nutritional status and, as such, provides the most direct link between agriculture and nutrition. It is, however, not the only factor. There are physical assets involved, such as clean cooking pots and utensils. Nutritional status of very young children will be affected by the frequency of feeding, and thus the amount of time devoted to this aspect of child care will affect their 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 affects 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, nutritional status of an individual within a household depends on how the amount of food and other inputs into nutrition are allocated across members.

Two features of this framework are worth noting. First, there are many pathways through which agriculture affects health and nutrition. Food production and consumption is an important factor, but there are other pathways too. Second, the relationship between agriculture and health and nutrition is bidirectional. Each affects and is affected by the other.

3. Placing Levers that Affect Agriculture into the Framework

Policy levers, programs, and interventions designed to affect agriculture will, in turn, affect health and nutrition. These levers operate in two stages. This section discusses how levers designed to affect agricultural production, emanating from the public or private sector, operate at the level of settings, resources, agricultural production, and agricultural markets through the use of selective and non-exhaustive examples. The following section examines the pathways through which these changes will affect health and nutrition.

Environmental programs that focus on soil and water conservation are actions that affect the physical setting. So too are efforts to improve water control, prevent insect infestations, or eliminate cattle diseases. Infrastructure improvement, by opening new markets and by reducing transaction costs, can affect both the level and type of agricultural production. Changes in economic policy affect agriculture in many ways. Changes in exchange rates, tariffs, and openness to trade — some of which are responses to globalization—will affect access to inputs and to new markets. Domestic price policy will affect agricultural production as will changes in domestic marketing and trade structures. Legal changes surrounding the marketing of foods and food safety regulations affect agricultural production and marketing. Changes that improve the security of property rights will also affect agricultural production.

Household resources can be affected in several ways. Public and private support to micro-finance can improve access to financial services while land redistribution improves access to land. Efforts by private or public actors to improve women's knowledge of farming practices increase stocks of knowledge. Research and development that leads to new crops or new production processes, again by either the public or private sector, can lead to higher yields, lower costs, or new and possibly healthier products. Last, private and public actors can change value chains in ways that affect both incomes received by farmers, the types of foods available to consumers, and prices faced by both producers and consumers. The expansion of Western-style supermarkets into developing countries is an example of this.

4. Pathways through Which Changes in Agriculture Affect Health and Nutrition

There are a number of pathways through which changes to agricultural production and markets will affect health and nutrition. These include the following:

1. Where these changes lead to increases in household income, this income can be used to purchase goods that affect health status. Improved clothing and the ability of households to purchase improved health care are examples where this has the 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, or a more diverse diet. This will directly improve nutritional status. It will affect health indirectly through its 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 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 (biofortified foods being an excellent example) 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. Reforms to tariff and removal of barriers to agricultural trade will permit the entry of foods produced the country. Finally, changes in processing can also affect foods consumed. This can be beneficial, for example, where foods are fortified with micro-nutrients, or harmful, as in cases where processing introduces excessive levels of sodium that increase the prevalence of hypertension.
3. 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. These changes will also change exposure to pesticides, zoonoses, and work-related accidents.
4. 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 (for example, through hiring workers) and if it does not come from reduced leisure, then some other household activity will be affected. It could be that households reduce time spent on other income-generating activities, that they make greater use of child labor, or that they reduce time spent on the production of health or nutrition.
5. Where changes in agricultural production results in higher incomes, individuals and households may choose to save some of these higher incomes in the form of assets—such as improved shelter—that improves health.
6. Finally, 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, then this may affect how households spend money, how food is allocated, and the types of assets that are accumulated. Holding all other factors constant, this may improve health and nutrition.

What should be clear from these examples is that, *ex ante*, it is ambiguous whether a change in agricultural production will improve or worsen health and nutrition. There are a number of factors to consider.

First, how large are the income effects of this change? Are these gross income changes or net, after accounting for input costs? How does income derived from other, nonagricultural, income sources change? Next, 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? Or do households spend these higher incomes on goods that have no effect, or even a negative effect, on health and nutrition? Policymakers are sometimes surprised by the weak effect that sometimes emerges between increased incomes and health and nutrition. Households and individuals face many competing demands for their limited financial resources. They may want to increase the level or quality of their food consumption, but they may also want to reduce labor drudgery, be better dressed, be able to send their children to school, and so on.

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, for example, 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?

5. Summary

Three components make up this framework: the settings within which agricultural production takes place and health and nutrition status are determined; gender-differentiated resources; and the processes involved in the production of agricultural goods, health, and nutrition. Policy levers and private sector actions can act on all these core components.

This framework illuminates how agriculture, health, and nutrition are linked at the household and individual levels. As noted in the introduction, however, this framework can be applied at the national, regional, or global level. One could use this framework, for example, to trace out how global innovations in telecommunications and transport (part of the global, physical setting), together with changes in legal and economic settings, facilitated the expansion of Western-style supermarkets into developing countries. In turn, this affects developing country food markets, with implications for farmers' incomes, food prices, and the quality and variety of foods on offer. The framework can be used to trace through the possible consequences of this for health and nutrition. Climate change is a second example. It represents a change in physical setting with direct implications for agriculture and health.

The links among agriculture, health, and nutrition are most complex when one considers smallholder households. However, the framework is equally applicable to rural landless households and to urban wage earners. As landless rural households and urban households are typically net food consumers, changes in agriculture affect health and nutrition largely through changes in the quality, variety, and prices of foods available to them. The direct links between agricultural production and health are less important. For rural landless households, the economic setting within which they gain their livelihood includes rural labor markets and so changes in agricultural production—for example, brought about by the introduction of new crop technologies—affect these landless households through their impact on rural employment and wages. In turn, if the structure of agricultural production changes—for example, if it shifts away from smallholders toward plantations—or if there are changes in the structure of a country's economy—if, for example, population shifts out of smallholder agriculture and into urban wage employment—some of the linkages described in this framework may become more important, others less so.

A strength of this framework is that it illustrates that *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. A limitation of this framework is that it does not tell us which pathways are most important. But as the examples demonstrate, the relative strength of different links will clearly depend on the population being considered and the nature of agricultural production. The importance of different links is context specific.³ Mindful of these many links, and their context-specific nature, the challenge for policymakers is to ensure that changes occurring in agricultural production, processing, and marketing come about in a way that benefits human health and nutrition.

³ This limitation also reflects the fact that while some pathways are well understood (for example, the links between changes in income and the acquisition of calories) others, such as the implications of changed gender roles resulting from changes in the agricultural sector are less well understood.

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