INTERNATIONAL FOOD POLICY
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IFPRI Discussion Paper 01263

April 2013

Measuring Food Policy Research Capacity

Indicators and Typologies

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PARTNERS AND CONTRIBUTORS

IFPRI gratefully acknowledges the generous unrestricted funding from Australia, Canada, China, Denmark, Finland, France, Germany, India, Ireland, Italy, Japan, the Netherlands, Norway, the Philippines, South Africa, Sweden, Switzerland, the United Kingdom, the United States, and the World Bank.

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ABSTRACT

Addressing emerging global poverty, hunger, and malnutrition challenges requires prudent evidence-based policymaking at the country level. Capacity for generating evidence remains a major constraint in the policy process in developing countries. We surveyed 30 countries to measure the capacity of their individuals, organizations, and policy process system to undertake food and agricultural policy research. Our Food Policy Research Capacity Index, constructed using measures of human capacity (PhD full-time equivalent researchers per million rural residents), human capacity productivity (publications per PhD full-time equivalent researcher), and strength of institutions (the government effectiveness pillar of the Worldwide Governance Indicators), showed substantial variation across countries, with the Republic of South Africa, Colombia, and Ghana scored far higher than countries with similarly sized rural populations such as Liberia, Laos, Burundi, and Afghanistan. Initial analysis showed that the index is strongly positively correlated with the Global Food Security Index and negatively correlated with the Global Hunger Index. Further work is planned to refine the indicators, particularly with regard to the effects of country size (population) and quality of the underlying data.

Keywords: capacity indicators, Food Policy Research Capacity Index, country typologies

ACKNOWLEDGMENTS

The authors thank Shenggen Fan, Director General of IFPRI for initiating the study and Margaret McMillan, Catherine Ragasa and Regina Birner for the initial discussion on the capacity indicators. Data reported in this paper was a collective effort of several in-country collaborators. We thank them for their collaboration and for providing insights on the food policy research capacity of their countries. Gershon Feder provided feedback on the indicator collected. Nilam Prasai and Sylvia Blom provided research assistance in compiling the data and preparing the paper. We alone are responsible for the contents of this paper.

1. INTRODUCTION

The world food system is facing a new set of challenges. The policy issues that confront us on global, regional, and local levels range from high food prices and climate change to biodiversity loss and water scarcity (FAO 2012). Their nature and magnitude necessitate a renewed focus on localized research and policymaking in the developing world, where such issues exacerbate the problems of food insecurity and poor economic growth (IFPRI 2012a). Despite massive investments by donors and developed countries into food and agricultural research and food assistance programs, low-level in-country capacity continues to thwart the design of relevant, evidence-based policies and the implementation of country-led and country-owned programs.

In the past three decades, discussion has increased regarding evidence-based policymaking in an attempt to replace “ideologically-driven politics with rational decision making” (Sutcliffe and Court 2005). The definition of *evidence-based policymaking* is still evolving in the literature and can refer to the use of pilot program evaluations conducted by governments or research conducted by independent, politically neutral organizations to inform policy (Marston and Watts 2003). In general, it refers to the transformation of a policy process to a more systematic, rational, decision-making approach to designing policy. However, evidence-based policymaking is dependent on both supply, the capacity of countries to undertake high-quality evidence generation that is relevant to policymakers and conducted in a transparent manner, and demand, the capacity of policymakers to acknowledge the importance of such evidence to inform policymaking and to allocate sufficient resources for evidence-generation activities.

The centrality of the agricultural sector in developing-country economies, and the dependency on agriculture of up to 80 percent of developing-country populations, reinforce the need for strong state capacity in the agricultural sector (World Bank 2008). Kydd (2009) points out the paradox that state failure is most prevalent in the early stages of development, when it is needed the most. Kherallah et al. (2000) offer three arguments for weak agricultural development: (1) overintervention or arbitrary intervention in the markets; (2) declines in public investment in research, extension, and infrastructure; and (3) weak attention to policies that improve market coordination. All three arguments boil down to weak state capacity, in particular, to weak policy research and policy formation capacity.

Local capacity is important to design policies that are highly context specific. This requires not only building up technical and analytical skills but also enhancing the level of trust between policymakers, politicians, constituents, researchers, and advocates as well as the credibility and reputation of each of these players. As these factors improve, everyone’s incentives to enhance their own contributions to the policymaking process will improve, thereby increasing ownership of policies and programs.

Technical assistance and technical cooperation, well intentioned though they may be, can undermine local capacity. When external efforts dominate local policy strategy and development, policies are less likely to be appropriately designed for the local socioeconomic environment, and the ownership of policies and programs deteriorates. Moreover, excessive reliance on external assistance causes underinvestment in local capacity-strengthening activities and may cause a downward spiral of local capacity and an increasing reliance on assistance. As such, strengthening the capacity of the partner countries in terms of policymaking, implementation, and monitoring and evaluation is a key commitment in the Paris Declaration on Aid Effectiveness (OECD 2005).

The development community spends an estimated US\$20–\$25 billion¹ per year on capacity development (Otoo, Agapitova, and Behrens 2009); however, it has not been able to enhance the effectiveness of policy design and implementation at the local and national levels. Most of these efforts of capacity development are fragmented and uncoordinated (Otoo, Agapitova, and Behrens 2009). Although some capacities may have been enhanced by past interventions, the specific areas, levels, or stages of the development processes that require further capacity development are not clear. An understanding of where the capacity bottlenecks lie can help to maximize their return on investment in capacity building.

¹ All dollar amounts are expressed in U.S. dollars.

² *Food policy* and *agricultural policy* are used interchangeably here.

³ *Organizations* and *institutions* have often been used interchangeably in the literature; in this paper we use the term

Where and how do countries fall short in their capacity to conduct evidence-based food policy research? Significant capacity constraints at individual, organizational, institutional, and policymaking levels are faced by many developing countries, and these severely impede the effective research and design of evidence-based policies. Furthermore, since individual, organizational, and institutional capacities are codependent, should any one of them fall short, the whole process short circuits.

Little is known about what capacity is needed to design policies and programs, or how available capacities can be effectively mobilized or strengthened to enhance the policymaking process. The importance of measuring public-sector capacity to assess the ability of countries to research, develop, and implement policies in order to stimulate and sustain development has been recognized globally (Poulton 2006; Polidano 2000; World Bank 1997). However, efforts to measure and monitor policy research capacity remain in infancy. The intention of this study is to conduct a preliminary assessment of the existing food policy research capacity of countries by identifying and measuring selective indicators and typologies.

To date, there is no service assessment of policy research capacity within a country. Studies that systematically look at capacity constraints and bottlenecks in development and policy processes within a country are limited. Development of a multicountry database that measures and classifies various countries in terms of their capacity for research and policymaking in food and agriculture would facilitate an assessment and comparison of in-country policy research capacities.

Capacity assessments for the purpose of enhancing development efforts are a major challenge; they involve assessing a number of different sectors, organizations, and individuals as well as the interactions between them. Our focus is *food policy² research capacity*, defined here as the ability of a country—including its policy process system, organizations, and individuals—to support and undertake socioeconomic or policy-related research in the food, agriculture, and natural resource sectors. These sectors include a wide range of subsectors from input (fertilizer, seeds, machinery) markets, storage and distribution, transportation, marketing, and export markets, to research and development, extension, and community development. We address the capacity to conduct policy-oriented research in these subdomains—not technical agricultural research, which is covered by other data sources (such as IFPRI's Agricultural Science & Technology Indicators).

The motivation for developing the Food Policy Research Capacity Index (FPRCI) stems from a pressing need to understand a country's primary constraints to undertake food policy research and for that research to be effectively used in the policymaking process. Given the centrality of the agricultural sector in developing-country economies and development strategies, as well as the high prevalence of food insecurity, malnutrition, and hunger, a focus on the food policy system could provide widely impactful insights. The FPRCI was conceived as a first step in evaluating the level of a country's current food policy research capacity and to be able to compare these levels of capacity longitudinally and cross-sectionally. This will have a three-fold benefit of sensitizing domestic policymakers to the importance of various components of food policy research, of allowing donors to set priorities for interventions across countries, and lastly, of identifying the specific areas of capacity in which to invest to maximize returns. More specifically, the FPRCI will provide insights as to which countries to invest in, how much to invest (based on their capacity shortcomings) at each level of capacity, and how to combine capacity-strengthening investments at the system, organizational, and individual levels.

Within this context, the intention of this paper is to identify and collect data on a set of indicators that could be combined to form an index that is theoretically justified, simply constructed, empirically meaningful, and practically useful. The rest of the paper is set up as follows: Section 2 reviews the literature on policy process capacity and on capacity and development indexes. Section 3 presents two conceptual frameworks—the first discusses food policy research within the policy process and the second assesses a country's investments in the formation, maintenance, and effective utilization of human capacity. Section 4 describes our food policy research capacity indicators, details the data collection methodology, and presents our food policy research capacity index. The results of our index construction, along with our robustness checks and comparisons to other indexes, are presented in Section 5. The analysis follows in Section 6, the discussion is presented in Section 7, and Section 8 concludes.

² *Food policy* and *agricultural policy* are used interchangeably here.

2. LITERATURE REVIEW

The primary objective of capacity-strengthening efforts is to enable developing countries to take on the roles that development and technical agencies and bilateral partners currently perform; however, the ideal process to achieve this is unclear. Definitions of *capacity* vary from organization to organization and from country to country, and hence assessments of capacity and capacity-building initiatives vary immensely as well. This is due in part to the complexity of the issue of capacity; the multitude of factors that affect it and that it affects; a country's individual social, economic, historical, and environmental characteristics that contribute to or hinder capacity building at different levels; and the stage of development that a country is in, necessitating individualized, country-specific capacity-strengthening strategies and action plans. However, some trends in capacity assessments have emerged over the years, which provide us with a starting point for defining capacity and identifying the best indicators of policy process capacity. We start with a discussion of the different types of capacity and their interactions, and then review indicators and indexes that assess different types of capacity or development progress.

Capacity for Public Policy Research

The subjective nature of capacity has resulted in a variety of definitions and assessment techniques. Capacity, in the context of public-sector management, generally refers to the “ability of an organization to act effectively on a sustained basis in pursuit of its objectives” (Polidano 2000). The United Nations Development Programme (UNDP) defines *capacity* as “the ability of individuals, institutions, and societies to perform functions, solve problems, and set and achieve objectives in a sustainable manner” (UNDP 2010, 2). It measures capacity development through the transformation of inputs such as human, financial, and physical resources as well as competencies in four outputs: institutional arrangements, leadership, knowledge, and accountability. The European Centre for Development Policy Management 5-C approach describes capacity as the intersection of five core capabilities of organizations: capability to commit and engage, capability to carry out tasks, capability to relate and attract resources and support, capability to adapt and self-renew, and capability to balance diversity and coherence. It assesses individual and system-level capacities through the lens of the organization (Baser and Morgan 2008). In this paper, *capacity* is defined as the summation and interaction of the capabilities of the food policy research system's individuals and organizations, as well as the enabling environment that sets the conditions and incentives for such interaction.

Various combinations of these capacities are used in different public-sector capacity assessments. The African Capacity Building Foundation used a three-pronged approach of assessing individual, organizational, and institutional capacities in the formation of their 2012 Africa Capacity Indicators Report on agricultural transformation and food security (ACBF 2012). Similarly, in a chapter on national innovative capacity in the 2001-2002 *Global Competitiveness Report*, Porter and Stern (2002, 107) notes that “national innovative capacity depends in part on the technological sophistication and the size of the scientific and technical labor force in a given economy, and it also reflects the array of investments and policy choices of the government and private sector.” In other words, it is the combination of individual skills and the way that the public and private sectors are managed.

Individual capacity consists of the aggregate skills and qualifications of a population and reflects the capability of individuals to engage in a specific type of work. Educational attainment is frequently used to proxy for individual capacity and is commonly used in indexes that measure technological and innovation achievements (for example, the United Nations' Technology Achievement Index, the National Innovative Capacity index, and the Knowledge Economy Index). Akin to needing a certain level of knowledge in order to make substantial contributions to science or technological fields, individuals within the policy realm must also reach a minimum level of capacity to effectively engage in policy analysis and discussions. Poor understanding of the issues or weak analytical ability will either restrain certain players from participating effectively or result in overly simplistic solutions being passed through.

Organizational capacity reflects the ability of organizations to attract, retain, and effectively utilize their amassed individual capacity; to set clear objectives; and to efficiently allocate resources so that their objectives can be met. Some elements of organizational capacity can be measured by employee retention rates, incentive structures, or output per individual, although it is difficult to obtain a comprehensive picture of organizational capacity by one measure alone. The UNDP measures capacity development progress using three measures: performance, stability, and adaptability. *Performance* refers to the effectiveness of the organization in its ability to meet its objectives and the efficiency in which it does so. The *stability* of an organization can be seen from its institutionalization and sustainment of performance improvements and the risk-mitigation measures it has taken. An organization's *adaptability* to the environment in which it operates is reflected in the investments it makes for improvement and its follow-through on those investments (UNDP 2010).

The interactions of individuals and organizations within the policymaking system depend on the institutions that govern the system, which is also referred to as the enabling environment. North (1991, 97) defines *institutions*³ as “the humanly devised constraints that structure political, economic, and social interactions.” Proper institutions foster the relationships between players in the research, analysis, and policy processes. This includes both formal and informal institutions at the household, community, regional, and national levels as well as the political environment of a country.

Within this definition of the enabling environment, it is important to distinguish between the political economy of a country and the policy process system itself. Political economics dictate the way in which players interact with each other within the policy process. The policy process refers to the pathways through which a policy issue is introduced or reintroduced, discussed, researched, and analyzed and how policy changes are implemented, monitored, and evaluated.

Richerzhagen and Scholz (2007) refer to the creation of an enabling environment as *systemic capacity*⁴, which the UNDP (2010, 9) defines as being structured by the “policy, economic, regulatory, and accountability frameworks within which individuals and organizations operate,” and includes the mandates of organizations and their formal and informal interactions among one another. Richerzhagen and Scholz suggest that there are three parts of systemic capacity: economic-technical, political-institutional, and cognitive-informational. The first two dimensions are contained within North's definition of institutions, but the third dimension suggests that systemic capacity is also dependent on the existence of information or data and public perceptions about the issues under discussion. Richerzhagen and Scholz also emphasize that sectoral capacity is dependent on government effectiveness, which in turn is dependent on policy coordination, rule of law, and control of corruption. This differs from the political-institutional dimension of systemic capacity in that the latter refers to the structural arrangements, procedures, and activities of public administrative bodies and any relevant laws and regulations.

Both institutions and human (individual) capacity have been carefully scrutinized in the literature for their causal effect on economic growth. Acemoglu, Johnson, and Robinson (2002) argue that European colonial powers shaped the institutions of African nations 500 years ago, which dictated countries' current relative levels of wealth. However, Glaeser et al. (2004) argue that the instruments used in this paper were unsuitable and find evidence suggesting that human capital⁵ is a stronger predictor of growth. Acemoglu and Dell (2010) find similar evidence of both human capital and institutions influencing between-country and between-municipality income differences in the Americas. Human capital is a much easier concept to measure, facilitating more rigorous analysis, whereas analyses of institutional effects on growth will always be thwarted by a lack of objective data. Human capital is also

³ *Organizations* and *institutions* have often been used interchangeably in the literature; in this paper we use the term *organizations* to refer to a coordinated group of individuals and *institutions* to refer to a society's norms, rules, and customs as defined by North (1991).

⁴ In this paper, we use the term systemic capacity and enabling environment interchangeably to refer to North's (1991) definition of institutions.

⁵ Human capital is a component of human capacity, where *human capital* refers to the skillset or educational achievement of a populace, and *human capacity* refers to the broader ability of a population to use and adapt their skills to adapt to changing environments and identify opportunities for growth and development.

much less variable than institutions in both the short and long run; institutions can fluctuate for a variety of reasons, whereas human capital degrades or improves as generations pass on. Even so, South Korea and China exemplify how political institutions can play a key role in stimulating economic growth. Despite promoting the evidence that human capital is the predominant predictor of growth, Shleifer (2012) iterates the importance of institutions in political cycles, the financial sector, the judiciary system, and other public systems; and he acknowledges that the difficulty in measuring institutions should not exclude them from economic growth analyses.

Organizational capacity in the public sector is arguably more difficult to monitor than institutions, although there is a host of literature on organizational capacity within firms and its relationship with profitability (Armour and Teece 1978; Chandler 1992; Covin and Slevin 1991). While all three types of capacity (individual, organizational, and systemic) have been assessed in the literature with regard to long-term growth, only limited research exists on the way in which these capacities affect the functioning of the policy process and the channels through which they do so, particularly in the context of agricultural-sector growth. A more thorough understanding of these capacities in the context of food policy processes in developing countries and how and where weak capacities are restricting the functioning of the policy process is essential to determining how and where to concentrate capacity-strengthening efforts.

Efforts from both researchers and development agencies to pinpoint the key aspects of capacity in the context of public-sector management have yielded differing approaches to capacity strengthening; however, a convergence to the tridimensional definition of systemwide capacity is evident in terms of individual, organizational, and institutional capacities. Measurements of these dimensions of capacity, however, vary widely due to choice of indicator and valuation technique. Moreover, the importance of the different aspects of capacity will vary depending on the context. For example, the availability of laboratory supplies affects technical research capacity more than it would policy research capacity. This has yielded a variety of indicators and indexes that rank or score the capacity of various sectors or dimensions of an economy, government, or society.

Capacity and Development Indicators and Indexes

Although no food or agricultural policy research capacity indexes exist to our knowledge, indicators and assessments of technical agricultural research capacity and policymaking capacity in general do exist. The Agricultural Science and Technology Indicators (ASTI) initiative, facilitated by IFPRI, reports technical agricultural research indicators including spending on research and development and number of full-time equivalent researchers. The Statistics on Public Expenditure for Economic Development data reports agricultural public expenditure for economic development and the ratio of this expenditure to agricultural gross domestic product (GDP). Another indicator, loosely indicative of agricultural policy capacity, is agricultural total factor productivity (TFP). It is suggested that a high agricultural TFP may indicate strong agricultural policies through its valuation of the efficiency of input use (IFPRI 2012a). Josling and Valdes (2004) suggest possible quantitative agricultural policy indicators: rate of protection, rate of assistance, and producer subsidy equivalent. Such indicators, while having the advantage of being objective, are dependent on a country's growing environment, input and output markets, availability of technology, and other factors, and hence serve better as longitudinal comparison indicators within a country than as cross-sectional comparators.

Objective indicators of policy capacity are sparse primarily because of the subjective nature of capacity. However, Delpuech and Poulton (2011) suggest a quantitative approach, measuring state capacity as a function of resources (for example, research staff or budget) and incentives (wage rates or divergence between budgeted and actual research expenditures). As food policy research is usually a subsection of agricultural or economics research and hence these share overhead costs and resources, the precise expenditure allocated specifically to food policy research is difficult to parse. KPMG and the Overseas Development Institute (ODI) argue the case for a capability index that measures states' abilities to manage change. They suggest measuring three pillars—economic capabilities, governance and

institutional capabilities, and social capabilities—but do not offer indicators for these pillars (KPMG and ODI 2012). USAID (2000) uses questionnaires and scorecards that ask organizations to self-report their ability to fulfill their mission, retain staff, provide adequate compensation, train staff, and implement transparent and democratic processes to elect board members to assess their organizational capacity. USAID acknowledges that this strategy does not yield cross-sectionally comparable data, but it can be used for longitudinal assessments, which are important for government entities such as federal ministries of agriculture.

Development Indexes: A Review

A plethora of indexes has been created in the last few decades in an attempt to measure and compare advancements in science and technology, levels of governance, public-sector capacity and corruption, poverty, economic development, and other qualitative concepts; however, the quality of these indexes varies as widely as the indexes themselves. These indexes tend to be mash-up indexes (Ravallion 2010), composed of indicators of the constructor's choosing, which are also aggregated as the constructor sees fit. Herein lies the problem of the credibility of an index and, as Ravallion (2010) notes, necessitates transparency in the conceptual intention of the index, in the trade-offs made in its construction, in data collection methods and data quality, and in aggregation methodology, as well as a comprehensive analysis of the index's robustness.

Perhaps the most commonly referenced index in development is the Human Development Index (HDI), constructed with the intention of generating a single statistic “to serve as a frame of reference for both social and economic development” (UNDP 2012). It has three dimensions: health, proxied by life expectancy at birth; education, proxied by mean years of schooling and expected years of schooling; and living standards, proxied by gross national income per capita. Each indicator is normalized using goal-posted minimum and maximum values, and the index is aggregated by geometric averaging. Prior to 2010, the index was composited by arithmetic mean, which implied direct substitutability of its components, an assumption not thought to be robust in the case of the HDI, resulting in the change to geometric averaging in 2010. Although the HDI has served well to bring a voice to the social aspect of development, a number of criticisms have emerged on the grounds of data quality (Wolff, Chong, and Auffhammer 2011), choice of indicators and goal posts (Caplan 2009), and its inability to allow for intertemporal comparisons (McGillivray 2006).⁶

Subjective though the choice of indicators may be, the use of hard data in the HDI has contributed to its continued acceptance and recognition as a general indicator of progress. The HDI, however, does not necessarily reflect a country's capacity to contribute to economic and social progress, as the HDI does not differentiate between contributions to progress initiated by the country itself or through foreign assistance. Transparency International's Corruption Perceptions Index (CPI), the World Bank's Country Policy and Institutional Assessment (CPIA), and the World Bank's Worldwide Governance Indicators (WGI) have attempted to gauge a country's institutional and public-sector capacity to both actively engage in the policy process and successfully implement policy changes and resulting programs or projects. These indexes are primarily constructed from soft data—surveys of individuals', firms', or organizations' opinions or subjective assessments by experts in the field. Extensive use of soft data decreases the reliability of an index; however, the nature of governance, institutions, and public-sector capacity does not allow for the sole use of hard data, and thus a balance must be sought (Polidano 2000).

The CPI is a well-established country ranking that assesses both administrative and political aspects of corruption in the public sector using surveys from 13 institutions. Because of the subjectivity of corruption, country scores are the rescaled rankings of countries on specific factors related to transparency, accountability, and corruption. Although this allows for cross-country comparisons in a

⁶ Intertemporal comparisons are a problem for this index because some components are calculated relative to the minimum or maximum levels of the underlying variable for other countries for that year. Because the minimum and maximum values change each year, an increase in a country's relative score from year to year may occur even when the absolute level of the underlying variable declines or is unchanged.

specific year, it does not allow for longitudinal comparisons of countries (Transparency International 2011). Regardless, the media attention given to the CPI has increased discussions about public-sector corruption, particularly in developing countries where the potential returns to public-sector investment are the highest.

The CPIA was initiated by the World Bank in the 1970s as a tool to allocate funds where they may be most effectively used. It attempts to “measure the extent to which a country’s policy and institutional framework supports sustainable growth and poverty reduction” (World Bank 2007, 260) through 16 criteria rated on a scale of 1 to 6 and grouped into four equally weighted clusters: economic management, structural policies, policies for social inclusion and social equity, and public-sector management and institutions. Criticisms of the CPIA are similar to those of subjective indexes in general, such as choice of indicators and their weightings, and assessment methodology (IEG 2009). An assessment commissioned by two German ministries added more specific criticisms to this list, including the lack of attention given to education, poverty reduction, and environmental issues (Steets 2008).

The WGI measure six categories of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption. For their calculation, the World Bank draws on data from 30 different sources, rescales the data within the data range, and then aggregates the indicators into the six dimensions using an unobserved components model. This methodology assumes the data to be a linear function of an unobserved level of governance, which corrects for the noncomparability of the various data used and weights highly correlated data sources more heavily. The dimensions are reported as units of a standard normal distribution, with an error term that reflects the relative number of data sources used, which must be taken into account when analyzing countries longitudinally and cross-sectionally (Kaufmann, Kraay, and Mastruzzi 2010).

The World Bank, in collaboration with the International Finance Corporation, also assesses countries on their private-sector regulations through their Ease of Doing Business Index (EDB). EDB uses standardized case studies to measure 11 quantitative indicators of four aspects of doing business—starting a business, expanding a business, the operations of a business, and insolvency—in 183 economies. It focuses on understanding regulations and policies as they apply to small and medium-sized enterprises in an attempt to gauge the extent to which a government stimulates private-sector growth through the entrepreneurial activities of its lowest income earners. Following trial constructions of the index using such methods as principal components and unobserved components, it was determined that rankings were robust to different construction types; and hence the simplest method—arithmetic average of equally weighted pillars composed of equally weighted components—was used (World Bank and IFC 2012).

In addition to the HDI, a number of indexes reflecting development outcomes have been constructed, including two complementary indexes that reflect a country’s food security: the Economist Intelligence Unit’s Global Food Security Index (GFSI) and IFPRI’s Global Hunger Index (GHI). The GFSI is constructed from 25 indicators of drivers of food security within the categories of affordability, accessibility, and quality and safety (Economist Intelligence Unit 2012), whereas the GHI is the arithmetic average of three indicators of food insecurity in a country: proportion of the population that is undernourished, prevalence of underweight in children under age five, and proportion of children dying before the age of five (IFPRI 2012b).

IFPRI’s Women Empowerment in Agriculture Index (WEAI) is one of the newest development indexes, developed to monitor the impact of the U.S. Feed the Future⁷ interventions on women’s empowerment. The WEAI is the first attempt to assess women’s empowerment in the field of agriculture, which will serve to augment discussions on both agricultural development and gender equality (IFPRI 2012c). It is an index constructed from two subindexes; the first measures women’s empowerment in their households and communities across five domains (production, resources, income, leadership, and time), and the second assesses gender parity at the household level, based on the five domains of empowerment. The first subindex is calculated using the Alkire-Foster measurement method of multidimensional

⁷ Feed the Future is the U.S. government’s global hunger and food security initiative.

poverty, which accounts for both the incidence and the intensity of poverty. The intensity is determined by the number of deprivations an individual or household suffers, which indicates the extent to which people are impoverished and in which regard.

Although the methodologies for index conceptualization, data collection, and index construction vary widely across indexes, several trends are clear across indexes that have sustained the test of time. First, the indexes have all been carefully conceptualized by teams of in-house experts in consultation with external experts for additional verification. Several have requested formal assessments, and most update previously published indexes as new data become available. Following such external assessments, the UNDP changed its methodology after 20 years from arithmetic averaging to geometric averaging. Second, data sources have been scoured for validity and quality and are either updated or expanded upon each index update. Third, the index constructions have been carefully selected based on their robustness, interpretability, and applicability. The transparency of these discussions, in addition to the transparency of the methodology itself, lends to the overall validity of these indexes.

Understanding why countries end up with different rankings on such indexes has led to the development of a number of typology assessments. Yu, You, and Fan (2010), concerned about how to assist developing countries affected by the recent food and financial crises, categorized countries into five levels of food security based on their status of trade security (secure or insecure), level of food production, soil fertility, and favorability of their climate. Their results suggest that *developing countries* is too vague a classification in terms of food security and that external interventions need to be individualized to country-specific conditions. Zhang, Rockmore, and Chamberlin (2007) classify countries in Africa South of the Sahara (SSA) by their risk related to agriculture in attempts to determine how to target investment in agricultural development, which they argue is essential to improving the socioeconomic status of SSA countries. They determine each country's level of agricultural risk by its rainfall and growth period, and they differentiate each country within each level by its resource endowment and adjacency to a coast.

We used the aforementioned literature on capacity, indicators, indexes, and typologies to develop two frameworks to analyze food policy research capacity and assess the relevancy of our selected food policy research capacity indicators.

3. CONCEPTUAL FRAMEWORK

Understanding the capacity to undertake food policy research requires an understanding of the food policymaking process itself as well as an understanding of a country's commitment to building the capacity of the policymaking process. We first explore the policy process in general, to determine how and where research capacity comes into play and who affects the demand and supply of research for policymaking. We broaden the scope to understand the potential implications of a strong research capacity on livelihoods and well-being, given the existence of other relevant capacities, and then narrow our focus to identify the specific dimensions of food policymaking to identify tractable indicators.

Our second conceptual focus aims to understand the formation and maintenance of human (individual) capacity. We look at the three dimensions of capacity (individual, organizational, and systemic) and examine the effect of formal and informal institutions and organizational capacity of a country's government on human capacity formation, management, and utilization. Understanding how organizations and institutions affect individual capacity will further shed light on how and where to prioritize capacity-strengthening investments within a country. From this framework we develop country typologies based on past investments in individual capacity so as to understand why countries have fared the way they have.

Food Policymaking Process

Prior to assessing the food policy research process and the myriad of complexities this introduces due to its cross-sectoral nature, we must assess the policymaking process to understand how and where policy research capacity comes into play. This requires an overview of the policy process cycle, its stages, and potential short-circuit sites; the players and actors involved, their relationships with each other, and their interactions within the policy process system; and the capacity required at all levels for the system to function productively. This understanding will aid in indicating appropriate indicators of food policy research capacity.

The policy process can be thought of, at its simplest, as a six-stage cycle with a one-directional feedback loop, and at its most complex, as a cycle with feedback loops between all stages and short-circuit opportunities at and between every stage. Figure 3.1 depicts the former cycle in its simplest form, which commences with problem identification and policy-agenda setting and then cycles in turn through the stages of policy analysis formulation, policy decisionmaking, policy implementation, monitoring and evaluation, and policy revision, before returning to the stage of problem identification and policy-agenda setting. In reality, the policy process is much more complex because of the myriad players involved, the varying capacities of each of the players, the organizational capacities of the entities involved, and the enabling environment. The process can be further complicated when multiple tiers of government are involved, when the problem itself is viewed differently by different stakeholders and their incentives for finding a solution are misaligned, or when different social or cultural groups within a country are affected differently by the issue.

Figure 3.1—The six stages of the policy process

Source: Authors.

The various players in a policy process can be categorized into six groups: government officials, agricultural research organizations, higher education institutes, policy think tanks, civil-society organizations (CSOs), and the private sector (see Figure 3.2). These individuals and organizations come together at various stages and with different purposes, and may also be involved in national task forces or subject-specific research or advocacy groups composed of representatives from different sectors and organizations. Each entity's role within the policy process is formed by its individual and organizational capacities, which are in turn influenced by factors ranging from its level and source of funding, educational achievement and experience of its members, the structure of the entity, its interactions with parent or sibling organizations, and the history of its formation.

Figure 3.2—The players of the policy process

Source: Authors.

Notes: CSO, civil-society organization; NGO, nongovernmental organization.

The interactions between the players in a policy process will change as their individual and organizational capacities change and as the sector in which they operate transforms. Theoretically, as the policy process and its elements improve, it will lead to policy outcomes that yield improved agricultural productivity and growth, which will in turn lead to improved capacities through increased demand for such capacities, which will be facilitated by economic growth. Improved capacity will then continue to facilitate stronger policymaking, and the cycle will continue. This hypothesis is expanded upon in Section 6.

The intention of strengthening the policymaking process is to effect ground-level outcomes. Because food and agriculture play such important roles economically and socially in developing countries, well-implemented policies can have strong effects, positive or negative. Figure 3.3 presents a production-function approach to illustrate the transformation of inputs to outputs to outcomes to impact, where research capacity is affected by the provision of inputs and affects their translation into policy outputs. The policymaking process, which generates the outcomes in the production function in Figure 3.3, is illustrated in detail in Figure 3.4, which outlines a modified, five-stage policymaking process in the context of the food and agriculture sector and suggested indicators of capacity at each stage.

Figure 3.3—Production-function approach to measuring food policy capacity

Source: Authors.

Figure 3.4—Stages of the food policymaking process and potential measures of the relevant capacity in each stage

Source: Based on consultations with Catherine Ragasa and Regina Birner.

Food policy research is defined here as any socioeconomic or policy-related research in the food, agriculture, and natural resource sectors. The capacity to conduct such research that results in policy impact requires the effective functioning and interacting of all three types of capacity: individual, organizational, and systemic. CSOs and the private sector play a part in initiating the food and agriculture policymaking process illustrated in Figure 3.4, by drawing policymakers' attention to specific food and agriculture issues. This creates demand for evidence, which characterizes the first stage. Higher education institutes, agricultural research institutes, and think tanks play a substantial role here in supplying unbiased evidence. Strong research capacity at these organizations is needed to be able to generate the requisite information, while sufficient demand for this information and respect for and trust in its suppliers and their methods are essential to ensuring that the research is used in the policymaking process.

A country's ministry of agriculture (or equivalent organization) leads the second stage, drafting of policies, based on the research produced in the first stage. This requires individual analytical capacity and an environment that incentivizes efficient use of time and commitment to producing high-quality policy strategies. However, high-quality policy strategies are not drafted in silos; they require consultations with all relevant stakeholders. The third stage requires strong interpersonal skills from all players, as the quality of policy documents requires that all perspectives are voiced and that these views are recognized and respected by the policymakers. Researchers and analysts must communicate their research results, and CSOs and private-sector representatives must deliver the opinions of the individuals and firms they represent. A strong enabling environment is required to facilitate such consultative processes, and strong capacities are needed from all players to be able to make substantial contributions to these dialogues.

The fourth stage involves the implementation of the policy, which requires overseeing capacity of the ministry, an adequate number of trained extension workers, and cooperation with relevant CSOs and the private sector. Organizational capacity of the ministry of agriculture is essential in this stage as it involves vertical and horizontal information flows—the policy is signed into motion by the minister of agriculture but its implementation will depend on how directives are passed from the top leadership ranks down through the ministry and out to its extension and other implementation arms. Depending on the implementing agency, it may also require strong organizational capacity of regional or subregional departments of agriculture as well.

The final stage, often overlooked, is the monitoring and evaluation of the implemented policies. Strong informal institutions within a government ensure that government officials take ownership of their policies and monitor their progress to determine if the desired impact occurred. This ownership should result in sufficient demand for organizations, governmental or nongovernmental, to undertake evaluations and publish their data. This stage is essential for holding politicians and policymakers accountable for their work. It also completes the policy process loop; the information gathered in this stage should be fed back to policymakers to determine if policies should be continued, amended, or discarded.

This initiative focuses primarily on research capacity and its potential use in the policy process, and hence aims to capture the active capacity of the first stage and the potential capacity of the second and third stages. The difference between active and potential capacity is that the former is a measure of the actual activity through the assessment of the outputs as a function of the inputs, whereas the latter measures the inputs alone. The assessment of both inputs and outputs enables an analysis of the efficiency of the inputted resources. This further indicates the quality of the research environment vis-à-vis the implication that a high output-to-input ratio implies the existence of incentives encouraging the efficient undertaking of research.

The next subsection takes an alternative look at policy research capacity by assessing the extent to which conscious decisions are made about investments in one specific input—human capacity.

Country Typology

Although the Food Policy Research Capacity Index (FPRCI) can indicate the relative performance of different countries and provide an overarching view of food policy research capacity in developing countries, it does not explain why certain countries perform better than others, nor does it differentiate between low-performing countries by the constraints that hinder their capacity development. The typology presented here is intended to be a starting point to understand why some countries have stronger food policy research capacities than others and to delineate the variables that contribute to the development of adequate and effective research capacity that is sustained over time. It will also indicate where to focus investments in capacity-strengthening efforts so as to make the largest impact.

A country's individual and organizational capacities depend on its ability to develop, maintain, and effectively utilize its human capacity, which in turn, depends on its investment choices and governance effectiveness. A country must invest in the creation of human capacity to ensure its store of researchers and analysts will be replenished, while an effective governing system should be in place to ensure this human capacity is retained and used effectively. A country that invests in creation of human capacity must either have a strong and accessible higher education system or provide incentives (through scholarships or bursaries) to students who seek training abroad. A country can maintain its amassed human capacity by ensuring that it has competitive salaries and optimal incentives to prevent brain drain to the private sector or foreign soil. Lastly, the effective utilization of human capacity depends on organizational factors such as sufficient support or resources to fulfill one's job duties or the correct incentives to ensure effective use of one's time, and informal institutions such as personal motivation and work ethic.

In this section, we classify countries into typologies based on their ability to create human capacity, maintain human capacity, and effectively utilize human capacity. We have identified three factors here for our typology framework to keep our analysis tractable, but we recognize that many others also contribute to the development and sustainment of effective human capacity. Each country is measured on a three-point scale (low, medium, or high) with regard to its capacity to create human capacity, maintain human capacity, and effectively utilize human capacity for food policy research. The scores are based on several sources of information. First, the country collaborators who conducted the surveys of the food policy organizations contributed brief country summaries that identified issues, constraints, and challenges to developing and managing food policy research capacity. Second, key local informants were consulted to locate their country in the typology, and finally, international experts who have worked in the countries provided additional feedback to corroborate the first two information sources.

The scores for each country can be found in Table 3.1, and the corresponding typology can be found in Table 3.2. Although there are 27 potential typologies, the countries presented here fall into only 1 of 11 of these typologies, with the majority falling in the typology characterized by low capacity to create, maintain, and effectively utilize human capacity for food policy research.

Table 3.1—Assessment of country capacity to create, maintain, and effectively utilize human capacity for food policy research

Country	Create Human Capacity	Maintain Human Capacity	Effectively Utilize Human Capacity
Afghanistan	1	1	1
Bangladesh	2	1	1
Benin	1	1	1
Burundi	1	1	1
Colombia	2	1	1
Ethiopia	2	1	1
Ghana	2	2	1
Guatemala	1	1	1
Honduras	1	1	1
Kenya	2	2	1
Laos	1	1	1
Liberia	1	1	1
Madagascar	1	1	1
Malawi	2	1	1
Mali	1	2	2
Mozambique	1	1	1
Nepal	1	1	1
Niger	2	1	2
Nigeria	3	2	1
Peru	2	2	1
Rwanda	1	2	3
Senegal	1	2	1
South Africa	3	3	3
Swaziland	1	2	2
Tanzania	2	2	2
Togo	1	1	1
Uganda	2	1	2
Vietnam	3	2	1
Zambia	2	1	1
Zimbabwe	2	1	1

Source: Authors, in consultation with local collaborators, key informants, and country experts.

Note: Country capacity scores are based on the following scale: 1 = low capacity, 2 = medium capacity, 3 = high capacity.

Table 3.2—A typology of capacity to create, maintain, and effectively utilize human capacity for food policy research

Capacity to Create	Capacity to Maintain	Capacity to Effectively Utilize		
		Low	Medium	High
Low	Low	Afghanistan		
		Benin		
		Burundi		
		Guatemala		
		Honduras		
		Laos		
		Liberia		
		Madagascar		
		Mozambique		
		Nepal		
Medium	Low	Togo		
		Senegal		
	Medium		Mali	Rwanda
			Swaziland	
	High			
		Bangladesh		
		Colombia		
		Ethiopia		
		Malawi		
		Zambia		
		Zimbabwe		
	Medium		Niger	
			Uganda	
		Ghana		
		Kenya		
		Peru		
			Tanzania	
High	High			
		Nigeria		
			Vietnam	
	High			South Africa

Source: Authors, in consultation with local collaborators, key informants and country experts.

This assessment of the three types of capacity can be used to suggest key areas for investment or institutional change. To the extent that the marginal costs of improving capacity are similar across all three types of capacity, a country should simply prioritize investment strategies by addressing the lowest-scoring capacity investments first. In some cases, however, it may be very difficult or costly to improve one or more of the components. An assessment is also needed of the entire policymaking process to determine if the level of capacity matches its outputs or if the outputs fall short. In the former case, systemwide capacity-strengthening efforts may be most appropriate; in the latter case, attention should focus on the components of the policy process.

Although preliminary, the typology presented here could also help in deciding investment priorities for capacity development across countries, concentrating on countries most in need, by developing partners and identifying key countries for food policy research and capacity strengthening. For example, the countries in the top left corner of Table 3.2 are the same countries targeted by the United States Agency for International Development (USAID) for participation in the Feed the Future initiative. The International Food Policy Research Institute's (IFPRI's) Country Strategy Support Programs (CSSPs) focus on the countries that are in the leftmost column. The development objective is to move the countries from the top left box to the bottom right box. We use this typology and the scores in Section 6 to further analyze the selected food policy research capacity indicators.

4. FOOD POLICY CAPACITY INDEX

The central aim of this paper is to introduce an index that is theoretically valid, easily and annually expandable and replicable, and simple to understand. We first describe our selected indicators and explain our practical and theoretical rationale for their inclusion in the index, then detail how we collect the data to construct our indicators, and last, present our index construction.

Food Policy Capacity Indicators

The realization of a simply constructed index is dependent on using a set of easily and annually obtainable indicators. To assess the feasibility of collecting primary data on food policy research capacity, a survey that assessed human resources, financial and physical capacity, research–policy linkages, evidence-based policymaking, and policymaking capacity was distributed to collaborators in 30 countries. Collaborators consistently reported that the collection of human resources data was the easiest to obtain accurately, while financial and policy data proved to vary widely due to misinterpretation of the questions. The frequent use of human resource or educational achievement data in other capacity indexes (Knowledge Economy Index, National Innovative Capacity Index, and Human Development Index) implies that this is also conceptually sound. Shleifer (2012) compared human capital and institutions with regard to their predictive power of economic growth and income per capita and found that the empirical literature suggests that human capital is a more consistent predictor of growth than institutions. Even so, he does not discount the importance of institutions in political cycles, public-sector efficiency, and economic outcomes. This suggests that human capital also predicts the long-term success of a food policy research environment within a country, as public-sector capacity and economic growth are bicausal, whereas institutions predict the shorter-term effectiveness of food policy research. This further justifies the selection of human resources as the first indicator in the Food Policy Research Capacity Index (FPRCI).

We measure human capacity here as the number of food policy researchers scaled by their education level, and suggest that this is indicative of individual capacity. Individual capacity may be built by recruiting foreign researchers in the short term and investing in a country's higher education system in the long term. Although the latter strategy is optimal for ensuring a steady supply of researchers in the future, the former is a potential first step for countries in the earliest stages of development. However, an abundance of human capacity is not sufficient to ensure quality outputs and outcomes; it must be used effectively and efficiently within the policy process. Because effective use of human capacity depends on organizational capacity and strong institutions, countries that have a high number of researchers but use them inefficiently or ineffectively are likely in the earliest stages of development.

Efficiency, vis-à-vis outputs per unit of input, can be thought of as publications per researcher in the research realm. The inclusion of outputs in innovation capacity indexes or science and technology assessments is common (National Innovative Capacity Index, Global Competitiveness Index, Technology Achievement Index); however, the inclusion of an efficiency indicator measured as outputs per input in a (capacity) index does not seem to be common practice. We argue that this efficiency measure is representative of organizational capacity of research organizations as it suggests that the organization has a focused vision and dedicated research resources and efficiently manages its financial, physical, and human resources to achieve its goals. It is also partially representative of a country's informal institutions because the social norms and cultural practices that govern work ethic, commitment to one's job, and motivation also play a strong role in the quality of outputs. This is particularly true in the research field, where one must take initiative to stay up-to-date on current research and methodology, to connect with external researchers for collaboration and peer review, to make a concerted effort to produce internationally publishable research, and to prepare journal-specific research papers.

The third indicator in this index must be representative of the country's enabling environment to utilize the research outputs within the policymaking cycle. This indicator should holistically assess a country's public-sector capacity to engage in the policy process and implement reforms such that it represents a country's ability to produce relevant, evidence-based, and sustained reforms and to effectively make use of foreign assistance, which is of particular concern to donors attempting to maximize the social returns on their investments. The enabling environment is determined by a country's institutions, and Shleifer (2012) asserts that although institutions are quite volatile, they do matter for current public-sector and legal-system functioning.

Although an enabling environment is a subjective concept, a number of objective indicators were compared in an attempt to use only objective data for the FPRCI. One indicator considered but discarded due to lack of data was the nominal rate of assistance, a measure that assesses the extent to which a government intervenes to raise farmers' incomes (Anderson 2009). Other objective measures compared were a country's information and communication technology infiltrations rates (the Knowledge Economy Index, or KEI) and public research expenditure as a percentage of agricultural gross domestic product (the Agricultural Science and Technology Indicators, or ASTI), but these were thought to not sufficiently represent a country's current institutions or its enabling environment for the policy process.

A number of well-established institutional indicators and indexes are constructed from subjective or objective assessments, or both, including the economic incentive regime pillar of the KEI, the government effectiveness pillar of the Worldwide Governance Indicators (WGI), the institutional environment pillar of the Innovation Capacity Index (ICI), and the Public Sector Management pillar of the Country Policy and Institutional Assessment (CPIA) index. Comparisons of these pillars yielded correlation coefficients between 70 percent and 91 percent, implying that a subjective assessment as to which indicator best represents the enabling environment for the policy process can be made without cause for concern.

In comparing index constructions using different institutional indicators, the index with the WGI government effectiveness pillar as the institutional indicator yielded the highest and most consistent correlation coefficients to the Global Hunger Index (GHI) and Global Food Security Index (GFSI). This pillar "captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann, Kraay, and Mastruzzi 2010, 4). It is constructed from a plethora of surveys and assessments that incorporate the views from a variety of respondents including citizens, firms, public officials, nongovernmental organizations (NGOs), donors, and international agencies, facilitating a comprehensive view of government effectiveness. Moreover, it is also the most expansive dataset, covering more than 200 countries, and is updated annually.

The government effectiveness pillar captures both formal and informal institutions in that it assesses the policy process and public-service systems as well as the quality of these systems. It is also indicative of the organizational capacity of government entities and, to a lesser extent, of the capacity of individuals who work for the government. Although strong government effectiveness undoubtedly influences the efficient use of human resources, a strong score of output efficiency and a low score of government effectiveness suggests that government effectiveness does not play a strong role in research organizations (perhaps they are more autonomous in this hypothetical country), and more importantly, it suggests that the research is not being put to good use. Conversely, strong government effectiveness and poor research efficiency suggests that there is likely sufficient demand for research but weak supply, which may be an organizational or institutional problem.

Combined, these three indicators—human capacity, human capacity efficiency, and institutions—are representative of individual, organizational, and systemic capacity. Inconsistent levels of these indicators may also be indicative of countries in different stages of development; for example, strong human capacity but poor efficiency and institutions may suggest that a country is in early stages of development, while a country with high government effectiveness suggests a country in a higher level of development and the human capacity and human capacity efficiency indicators represent the government's commitment, or lack thereof, to building capacity.

Data Collection and Indicator Standardization Methodology

Below we detail how data for each of the three indicators, human capacity, human capacity efficiency, and institutions, are collected and standardized.

Human Capacity

Human resource capacity is representative of the quantity of inputs allocated by a country to food policy research. Because of the scaling by educational achievement, it can also be thought of as indicative of the financial inputs dedicated to food policy, a figure much harder to capture particularly in institutions where a variety of research is undertaken and overhead costs are often shared. These data were obtained by surveying government agencies, research organizations and think tanks, and higher education institutes that were engaged in food policy research. Local food and agricultural experts were consulted to ensure that at least 80 percent of a country's research capacity was assessed through the organizations selected for surveying. The quality of the data was also checked by a comparison with the ASTI database, which collects data on full-time equivalent (FTE) agricultural researchers, which yielded a correlation of 68 percent, ensuring the validity of the data.

A country's aggregate human resources capacity is valued as the number of FTE PhD-level researchers per one million rural inhabitants, weighted by the researcher's education, where a PhD degree is equivalent to either two master's degrees or four bachelor's degrees, and by the time the researcher spends on research specific to food policy. The latter factor determines the full-time equivalency of the number of food and agricultural policy researchers by type of organization and research focus. The guiding assumptions are as follows: agricultural policy think tanks and agricultural-policy-specific research groups or units: 70 percent; agricultural economics departments at higher education institutes: 50 percent; ministries of agriculture: 30 percent; and general policy think tanks, other government ministries, technical agricultural research organizations, and other departments at higher education institutes: 10 percent.

These estimates were determined from a combination of stakeholder interviews and surveys; however, where firsthand knowledge of an organization's specific research activities and foci are available, this is used instead.

In constructing the index, we divide the number of FTE PhD-level researchers by the rural population. Such an approach is typical for assessing the size of a country's extension effort relative to the number of farmers or the level of financial and manpower commitment relative to population. To the extent that the size of the rural population reflects the complexity of food policy, calculating per capita values of FTE PhD-level researchers is an improvement over simply using the number of FTE researchers. The per capita variable is also a better indication of government (or society's) commitment to policy analysis. However, food policy is complex, and a minimum level of analysis (and number of analysts) may be required to cover all the production, market, trade, consumption, and nutrition issues, even in a small country. Thus, five FTE researchers in a country of 50 million people (one FTE researcher per 10 million people) may be far more effective than one sole FTE researcher in a country of 10 million people. Because of these issues of scale, comparisons of human capacity are most valid for countries with similar sizes, and data for countries with very small (less than 10 million) or very large (greater than 100 million) populations should be treated with caution.

Human Capacity Efficiency (Productivity)

To assess the efficiency (productivity) of a nation's human capacity in terms of its research outputs, the number of internationally published journal articles related to food policy was determined. This is representative of the quality of research undertaken and, when divided by the number of PhD FTE researchers, representative of the efficiency of a country's inputs. We used the number of articles published in the last five years to account for the length of the research and publishing process and the

variability this would create if only annual data were used. It is an objective indicator that can be easily updated annually through desk research.

The number of articles was found through comprehensive searches of the Web of Science and EconLit databases. In Web of Science, articles were searched using the following criteria: year published (2007–2011 for our 2011 data), author’s organizational affiliation (in the country of interest, its capital city or major city identified by the existence of an organization conducting food policy research), topic (*policy* or *policies*), and subject area (nonnutrition medical fields excluded).⁸ The resulting articles were then filtered to exclude any articles that were not relevant according to our above definition of food policy research or that were authored at organizations not known to conduct food policy research. A quality check was then performed by searching for any articles written by affiliates at the surveyed organizations that were related to food policy. EconLit was searched using the same criteria for year published and author’s affiliation (country, capital, or other major city). The search criteria were then refined by subject area, where articles in pure macroeconomics or finance were filtered out. Any articles authored by organizations not surveyed were removed, as well as articles not related to food policy research according to our definition. Articles from both databases were cross-checked to ensure no double counting.

Institutions

The WGI government effectiveness data were obtained from the World Bank (2011). The data and its methodology are freely available online. The WGI uses data from 30 sources from household and firm surveys, commercial business information providers, NGOs, and public-sector organizations. The government effectiveness pillar uses survey questions related to concepts such as bureaucracy, institutional effectiveness, infrastructure, primary education, transportation system, provision of public goods, public administration, budgetary and financial management, rural development investment, trust in government, independence of public service and political system, policy process, consensus building, and resource efficiency. The data are initially rescaled to range from 0 to 1, and then the unobserved components model is used to construct a weighted average of the data from each source for each country. The WGI are reported in standard normally distributed units, with a mean of zero and standard deviation of 1.

The raw data and scaled data of these three indicators can be found in Table 4.1, and the methodology to construct the Food Policy Research Capacity Index using these three indicators is outlined in the following section.

⁸ Note that the use of these English language literature databases likely misses significant research in non-English-speaking countries. Further work is needed to capture this other literature.

Table 4.1—Food policy research capacity indicators, 2011

Country	Human Capacity		Human Capacity Efficiency		Institutions
	Head count of researchers	PhD FTE researchers per million rural residents	Publications (2007–2011)	Publications per PhD FTE researcher	WGI government effectiveness pillar (standard normally distributed)
Afghanistan	43	0.11	0	0	–1.46
Bangladesh	66	0.212	39	1.703	–0.85
Benin	38	0.858	18	4.186	–0.46
Burundi	39	0.671	0	0	–1.07
Colombia	85	0.556	24	3.721	0.24
Ethiopia	74	0.318	28	1.253	–0.4
Ghana	95	1.687	46	2.269	–0.03
Guatemala	45	1.606	5	0.42	–0.7
Honduras	33	1.651	4	0.653	–0.58
Kenya	155	0.999	55	1.741	–0.54
Laos	9	0.423	1	0.571	–0.91
Liberia	34	1.437	0	0	–1.21
Madagascar	187	0.802	7	0.607	–0.87
Malawi	50	0.812	6	0.57	–0.43
Mali	60	0.975	0	0	–0.83
Mozambique	37	0.286	16	3.404	–0.55
Nepal	27	0.144	4	1.096	–0.79
Niger	29	0.669	3	0.34	–0.67
Nigeria	349	0.946	22	0.284	–1.12
Peru	54	1.069	16	2.238	–0.15
Rwanda	37	0.362	1	0.313	0.07
Senegal	71	1.268	5	0.538	–0.44
South Africa	198	2.617	217	4.312	0.37
Swaziland	32	3.391	3	1.053	–0.69
Tanzania	91	0.613	12	0.578	–0.54
Togo	81	1.789	11	1.612	–1.36
Uganda	34	0.375	14	1.281	–0.51
Vietnam	175	0.537	5	0.154	–0.28
Zambia	29	0.647	8	1.509	–0.65
Zimbabwe	42	1.134	16	1.803	–1.4

Source: Authors; World Bank 2011.

Notes: FTE, full-time equivalent; WGI, Worldwide Governance Indicators.

Index Construction

A common approach to constructing an index in the field of social sciences is to first identify conceptually the thematic dimensions that influence the index of interest. Each theme, or pillar, is then constructed using a set of indicators that can be subjectively or objectively measured, and the pillars are then combined to formulate the final index. The identification of component dimensions, indicators, and the variables should be rooted in a theoretical framework and empirically tested (OECD 2008).

The variables used to track indicators are often not measured with the same units or are scaled differently. To allow for aggregation, raw data must be transformed by rescaling, ranking, or standardizing. This eliminates the scale effects of the different units of measurement without changing the ranking of observations. Rescaling or normalizing, which is done by subtracting the mean and dividing by the range, shifts the data to fall within the interval $[0,1]$ but is highly susceptible to skewing if the dataset contains outliers. The range can be calculated using the dataset's maximum and minimum values, 95 percent of the range (removing outliers in the 2.5 percent tails), or can represent specifically chosen subsistence levels or optimal goal posts, which require careful consideration to avoid unintentional skewed weighting of certain indicators in the final index. The Human Development Index is constructed using the latter strategy for the choice of minimum values; for example, the minimum life expectancy was chosen to be 20 years. In the FPRCI, this implies that maximum levels of capacity must be determined, which is no small task and likely to be country specific. Ranking the data has the benefit of being robust to outliers as it utilizes only the relative positions of the data; however, it ignores the relative levels of the data, which is important for the purposes of this index. It also makes longitudinal comparisons impossible if the dataset either shrinks or expands.

Standardizing data converts data to have a mean of zero and standard deviation of 1, creating unitless data that can easily be aggregated. This requires the broad assumption of having normally distributed data, an assumption that will likely increase in validity as this index expands in the future. Despite this assumption, standardization is conceptually the most useful technique for the FPRCI as it retains relative differences in levels between countries and eliminates the need for "optimal" levels of capacity. Correlation checks of the final index constructed from normalized data (using the actual range and a goal-posted range) and our standardized data yielded coefficients greater than 0.96, suggesting the data transformation technique is not significantly influential on the index.

Since the normalization procedure depends on the variance and mean of each dataset, which are expected to change from year to year, longitudinal comparisons to earlier calculated indexes will be inaccurate. However, previously published indexes can easily be recalculated each year using aggregated data allowing for longitudinal analyses of countries.

The weighting of the indicators in each pillar and of the pillars themselves in the final index may be determined by regression analysis, factor analysis, or principal component analysis, or through expert consultations (OECD 2008). The pillars are then aggregated, depending on the intention of the index, its conceptual framework, thematic dimensions, indicators, and data quality and availability (Rehman and Askari 2010). Indexes that are constructed to represent a concept or subjective issue more frequently base index constructions on expert opinions because the endogeneity problem in regressions is harder to overcome (OECD 2008). The importance of human capacity versus institutions is still a debated topic in development economics (Shleifer 2012) and, by extension, in understanding policy process effectiveness. Because of this, and the objective of constructing an index that can be easily interpreted, the indicators were given equal weighting. The robustness of these weightings and their influence on the final rankings is described in the following section.

An index may be constructed by arithmetic or geometric averaging, each with its own pros and cons. Arithmetic averages are the simplest constructions but imply substitutability of the thematic pillars, whereas geometric averaging accommodates codependent pillars. Because the results of food policy research are dependent on the existence and strength of all three of the indicators simultaneously, geometric averaging was the method chosen for composition of the index. This construction forces any

index value to zero if any of the components have a value of zero, and thus all standardized indicators were shifted to have a mean of 10 (maintaining a standard deviation of 1) to avoid this.

Thus, the final construction of the food policy research capacity index is as follows:

$$\text{Food Policy Research Capacity Index} = HC^{\frac{1}{3}} * HCE^{\frac{1}{3}} * Inst^{\frac{1}{3}}, \quad (1)$$

where HC is human capacity, the standardized and shifted number of FTE PhD-equivalent researchers per one million rural residents; HCE is human capacity efficiency, the standardized and shifted number of internationally published journal articles per FTE PhD-equivalent researcher; and $Inst$ is the standardized and shifted government effectiveness pillar of the WGI. The index values have been normalized by their own range to lie in the interval [0,10].

The scores and rankings of the FPRCI are presented in the following section, along with robustness checks, comparing the index to measures of food security, to other development and capacity indexes, and to alternative indicator standardization methods and index construction types.

5. RESULTS

The index and resulting rankings of the 30 countries surveyed in 2011 are reported in Table 5.1. The distribution of scores is strongly left skewed, with six countries achieving scores above 5, and almost half of the countries with scores between 2.5 and 3.5. The highest scorer is unsurprisingly South Africa, buoyed by its efficient research capacity and effective government scores. South Africa is generally thought to be the most developed country of the 30 in this sample and a hub of research, particularly in Africa. Both factors—strong economic performance and a solid research base—aid in facilitating self-sustaining food policy research capacity.

Table 5.1—Food policy research capacity index, 2011

Rank	Country	Raw Score	Normalized Score	Standardized and shifted PhD FTE researchers per million rural residents	Standardized and shifted publications per PhD FTE researcher	Standardized and shifted WGI government effectiveness pillar
1	South Africa	12.289	10.0	12.243	12.434	12.191
2	Colombia	11.038	6.5	9.444	11.961	11.906
3	Ghana	11.028	6.5	10.980	10.797	11.312
4	Swaziland	10.880	6.0	13.294	9.823	9.862
5	Benin	10.801	6.0	9.854	12.333	10.367
6	Peru	10.647	5.5	10.141	10.773	11.048
7	Mozambique	10.262	4.5	9.077	11.707	10.169
8	Kenya	10.203	4.5	10.046	10.374	10.191
9	Honduras	10.162	4.0	10.931	9.503	10.103
10	Senegal	10.066	4	10.411	9.411	10.411
11	Guatemala	9.988	3.5	10.870	9.316	9.840
12	Rwanda	9.923	3.5	9.180	9.230	11.532
13	Zambia	9.898	3.5	9.567	10.189	9.949
14	Malawi	9.878	3.5	9.792	9.436	10.433
15	Togo	9.858	3.5	11.119	10.271	8.389
16	Ethiopia	9.851	3.5	9.121	9.983	10.499
17	Uganda	9.810	3.0	9.198	10.006	10.257
18	Vietnam	9.735	3.0	9.418	9.103	10.763
19	Tanzania	9.713	3.0	9.521	9.443	10.191
20	Zimbabwe	9.601	2.5	10.229	10.424	8.301
21	Bangladesh	9.594	2.5	8.977	10.344	9.510
22	Niger	9.581	2.5	9.597	9.252	9.905
23	Madagascar	9.569	2.5	9.778	9.466	9.466
24	Mali	9.506	2.5	10.013	8.980	9.554
25	Nepal	9.452	2.0	8.884	9.858	9.642
26	Liberia	9.409	2.0	10.640	8.980	8.719
27	Laos	9.359	2.0	9.263	9.437	9.378
28	Nigeria	9.355	2.0	9.974	9.207	8.916
29	Burundi	9.198	1.5	9.600	8.980	9.026
30	Afghanistan	8.655	0.0	8.838	8.980	8.169

Source: Authors.

Notes: FTE = full-time equivalent, WGI = Worldwide Governance Indicator.

Three of the five lowest-scoring countries are those marked by substantial periods of civil war or violence in recent decades: Liberia, Burundi, and Afghanistan. These countries are either still in conflict or are struggling to maintain order, and their development efforts are prioritized to security issues and national cohesion efforts rather than food and agricultural policy issues.

The results unsurprisingly support the hypothesis that richer, more developed countries have stronger food policy research capacities (correlation coefficient of 0.71) and, to a lesser extent, that countries with larger rural populations have relatively weaker food policy research capacities (0.25) as they have achieved some economies of scale from food policy research investments.

Comparisons to other Development and Capacity Indexes

An index's validity must be verified by comparisons to conceptually similar indicators or indexes. As there is no perfect measure of a country's food policy research outcomes and the impact they yield, two complementary proxies were chosen: the International Food Policy Research Institute's (IFPRI's) Global Hunger Index (GHI) and the Economist Group's Global Food Security Index (GFSI). The former is constructed from health and development indicators that represent individual-level outcomes of a country's food security situation; while the latter measures the affordability, availability, quality, and safety, which are indicative of policy efforts to improve food security. Comparisons yielded correlations of 67 percent and 68 percent with the GHI and GFSI, respectively. Graphical representations of these comparisons can be seen in Figures 5.1 and 5.2. Note that neither the GHI nor the GFSI covers the same set of countries as the Food Policy Research Capacity Index (FPRCI), and the country coverage drops to 29 and 25 countries for the GHI and GFSI, respectively. Neither the GHI nor the GFSI report figures for the lowest-scoring country, Afghanistan.

Figure 5.1—Global Hunger Index and the Food Policy Research Capacity Index

Source: Authors; IFPRI 2012b.

Figure 5.2—Global Food Security Index and the Food Policy Research Capacity Index

Source: Authors; Economist Intelligence Unit 2012.

The index was also compared with general indicators of socioeconomic development, including the Human Development Index, which yielded a correlation coefficient of 0.56 ($n = 30$). The correlation coefficient between the index and the Innovation Capacity Index (ICI) is 0.76 ($n = 26$) and 0.71 ($n = 29$) between the index and gross domestic product per capita.

Robustness of Methodology

Choice of Institutions Variable

Using the same methodology (equally weighted geometric mean of standardized variables), indexes were constructed and compared using three alternate institutions proxies: the institution environment pillar of the ICI, the public-sector management pillar of the Country Policy and Institutional Assessment, and the economic incentives pillar of the Knowledge Economy Index. All three are strongly correlated (coefficients greater than or equal to 0.92) to the index using the Worldwide Governance Indicators' government effectiveness pillar. Additionally, none of the three alternate indexes is more strongly correlated with the GHI or GFSI than our proposed index.

Indicator Calculation

The index was also constructed using indicators that were normalized by different methods, which did not yield substantially different results. The index constructed using indicators that were normalized by their own range yielded a correlation coefficient of 99 percent with the index constructed using standardized variables, and the index constructed with indicators that were goal posted⁹ yielded a correlation coefficient of 96 percent.

⁹ The goal posts chosen were as follows: 5 for researchers, 5 for publication per researcher, and 2.5 for government effectiveness.

Index Construction

The index (calculated by geometric mean of its indicators) yielded a correlation coefficient of 99.93 percent with the index calculated by arithmetic mean with the same standardized variables and was similarly correlated with the GHI and GFSI.

Weightings

The robustness of the index to varying weightings for each indicator was also tested. Three comparison indexes were constructed, weighting one indicator 50 percent and the remaining two at 25 percent. All three indexes yielded correlation coefficients more than 95 percent with the equally weighted index and more than 89 percent with each other. The index that weighted the number of full-time equivalent PhD researchers more heavily performed better than the equally weighted index when using the GHI and GFSI as metrics of comparison, but only minimally.

6. ANALYSIS

The above results warrant further analysis to understand the main determinants of the scores and rankings of the various countries. We first analyze the index scores in the context of the country typologies presented earlier. The country typologies indicate a country's current investments in creating, maintaining, and effectively utilizing human capacity, while the Food Policy Research Capacity Index (FPRCI) theoretically reflects past capacity-strengthening investments made. Ideally, the optimal comparison would be between typologies that reflect the situation 5 to 10 years ago and current FPRCI scores; however, as we are still in the early stages of this research, our typology analysis is restricted to same-year comparisons. The second portion of our analysis assesses the relationship between food policy research capacity and the agricultural transformation process.

Country Typology

We compare the country typology presented earlier to our FPRCI with the aim of determining to what extent a country's food policy research capacity can be explained by its commitment to creating, maintaining, and effectively utilizing human capacity. We calculate an average typology score for each country by taking the mean of its scores for creating, maintaining, and effectively utilizing human capacity, as reported in Table 4.1. These mean typology scores are presented in Table 6.1, along with the index scores. The correlation between the two scores is 50 percent, which suggests that for a significant number of countries, their investments in human capacity are yielding lower returns than expected because of weak organizational and institutional capacity at the national level. In other words, the typology score is overinflated because it fails to account for the fact that the lowest capacity will bottleneck a country's capacity. For example, even if a country demonstrates strong abilities to create and maintain capacity, its potential capacity is limited by the degree to which it can effectively utilize its capacity. The weakest link, or lowest capacity, bottlenecks the entire system. Geometric averaging accounts for this minimally, are increasing the correlation by 2 points. Comparing the lowest score of the three capacities to the index is futile, as 28 of the 30 countries have the lowest possible score for at least one capacity.

Nigeria is the greatest anomaly in this dataset, with the second highest typology score and the third lowest food policy research capacity score. This may be due to a number of reasons. First, it may reflect the time delay in the translation of capacity investments to enhanced food policy research capacity. Second, Nigeria has the highest head count of researchers engaged in food policy research capacity, which accurately reflects its investments in creating and maintaining capacity; however, when scaled by education and time spent on food policy research capacity, it has only average human capacity. This suggests that Nigeria may have invested in increasing the quantity but not the quality of its researchers, and that its research capacity may be stretched too thin and involved in too many nonfood policy projects to produce high-quality food policy research. Last, Nigeria has a very low government effectiveness score, so despite efforts to invest in capacity, other governance factors may be hindering its food policy research capacity. The typologies developed here are designed to be a starting point to understand a country's bottlenecks, but case study analysis is required to shed light on potential historical, economic, cultural, social, or geographical factors that may have helped or hindered a country to develop its food policy research capacity. Such analyses would illustrate the high variability in a country's total capacity and the various factors that obstruct a country from actively engaging its full capacity, from which one can learn that there is no one-size-fits-all ideal policy process or institutional framework. This means that countries must take careful stock of their own capacities and identify internal bottlenecks, and look to countries with similar historical, cultural, political, and economic characteristics for possible reform measures or best practices.

Table 6.1—Country index and typology scores

Rank	Country	Index Score	Typology Score
1	South Africa	10	3
2	Colombia	6.5	1.3
3	Ghana	6.5	1.7
4	Swaziland	6	1.7
5	Benin	6	1
6	Peru	5.5	1.7
7	Mozambique	4.5	1
8	Kenya	4.5	1.7
9	Honduras	4	1
10	Senegal	4	1.3
11	Guatemala	3.5	1
12	Rwanda	3.5	2
13	Zambia	3.5	1.3
14	Malawi	3.5	1.3
15	Togo	3.5	1
16	Ethiopia	3.5	1.3
17	Uganda	3	1.7
18	Vietnam	3	2
19	Tanzania	3	2
20	Zimbabwe	2.5	1.3
21	Bangladesh	2.5	1.3
22	Niger	2.5	1.7
23	Madagascar	2.5	1
24	Mali	2.5	1.7
25	Nepal	2	1
26	Liberia	2	1
27	Laos	2	1
28	Nigeria	2	2
29	Burundi	1.5	1
30	Afghanistan	0	1

Source: Authors.

Development, Agricultural Transformation, and Levels of Capacity

Economic development is typically characterized by a reduction in the share of agriculture in the economy even in countries that experience a rise in agricultural productivity. Our index scores yielded a correlation coefficient of -0.58 with agriculture value added (as a percentage of gross domestic product, or GDP), indicating an inverse relationship between food policy research capacity and dependency on agriculture. Certainly this relationship is bicausal—countries whose economies are more dependent on industries that are more profitable than agriculture are often richer and thus have more resources available to invest more in food policy research, while countries that invest more in food policy research are able to more quickly transform their agricultural sector, ultimately steering their economies away from agriculture to more profitable industries.

Agricultural transformations have been analyzed in great detail in an attempt to generate the wealth that the Green Revolution brought in Asia to Africa. Understanding the channels through which policy changes triggered the Green Revolution and other such agricultural transformations is crucial to facilitating similar transformations in other countries.

Timmer (1988) characterizes four stages of agricultural transformation by economic criteria:

1. Agricultural productivity per laborer increases, generating a surplus of agricultural commodities.
2. The surplus generates direct or indirect resources, which incentivizes nonagricultural-sector growth.
3. The agricultural sector's importance within the macroeconomy increases, noticeable through improved infrastructure and market-equilibrium linkages.
4. The agricultural sector reaches the same status as other sectors, such as the manufacturing or financial sectors.

In the traditional, land-constrained model, this transformation can also be viewed through increases in agricultural intensification. Intensification of agriculture is achieved by intensifying the use of the factors of production, relative to the factor with the highest opportunity cost (Delgado 1995). Byerlee (1992) contextualizes four stages of agriculture transformation relative to the Green Revolution: The pre-Green Revolution stage is characterized by increased land productivity; the Green Revolution stage is defined by widespread use of newly developed crop varieties; the post-Green Revolution stage sees intensification of input usage; and the post-post-Green Revolution stage occurs when there is an efficiency gain in input use. Classification of countries into these stages will indicate the type of strategy necessary for agricultural development. Lele and Stone (1989) emphasize the role that policymaking had in facilitating the Green Revolution, whereby policies led to a widespread increase in irrigation and fertilizer use to cultivate the new crop varieties designed for such increased input use.

We suggest that a country's progress through the levels of agricultural transformation is accompanied by simultaneous transformations of its policy process capacity, as illustrated in Figure 6.1. Although the entities that interact within the policy process system remain the same, the quality and quantity of their contributions and interactions will increase as their individual and organizational capacities improve. Systemic improvements in capacity will also be characterized by improved informal institutions, such as increased trust between players and actors, increased accountability of the policy system to the country's citizens, improved accountability of the processes, and increases in both the quality and quantity of discussions taking place. This transformation of the policy process is likely triggered by three factors: First, the improvements in the agriculture sector will increase demand for additional policy support if agricultural-sector entities can attribute agricultural-sector growth to policy changes. Second, agricultural growth will induce economic growth, with spillovers to all sectors and profits to be reinvested in further agricultural development including capacity building. Third, ownership of policies that caused the initial agricultural transformation will entice contributors to the policy process to improve their own capacity to be able to further contribute.

Figure 6.1—Capacity transformation for agricultural transformation

Source: Authors.

Notes: CSO, civil-society organization; NGO, nongovernmental organization.

Following Timmer's lead, we seek to characterize the 30 countries in our dataset into stages of agricultural transformation using agriculture value added per worker as our proxy for agricultural development. In Figure 6.2, we see a strong correlation between agricultural laborer productivity and GDP per capita, and we identify three potential stages of agricultural transformation: The first is the cluster in the lower left corner, characterized by low productivity and low income; the second contains countries that have reached a minimum agriculture valued added of \$1,000 per worker; and the third contains only South Africa. With the exception of Peru, we see a step sequence, suggesting that for each minimum level of agriculture value added per worker reached, a corresponding level of GDP per capita is attained. Peru is most likely an outlier because its dependency on agriculture is extraordinarily low—only 1 percent of its employed population is employed in agriculture.

Figure 6.2—Gross domestic product (GDP) per capita and agriculture value added per worker, 2011 Food Policy Research Capacity Index countries

Source: World Bank 2011.

Notes: PPP = purchasing power parity, Int\$ = International dollar.

We expanded our dataset to include all countries with a GDP per capita under \$10,000 and agriculture value added per worker under \$10,000, and find similar evidence of such steplike stages (see Figure 6.3). Here we find that when a country reaches a threshold level of \$1,500 agriculture value added per worker, it has a minimum GDP per capita of approximately \$2,200, with most countries averaging \$6,000. A second step is evident when agriculture value added reaches approximately \$4,500, with no country having a GDP per capita lower than \$4,500. The increasing noise above the parity line is in line with evidence that as countries progress economically, they expand into nonagricultural sectors, facilitating larger gains in income.

Figure 6.3—Gross domestic product (GDP) per capita and agriculture value added per worker, expanded dataset 2011

Source: World Bank 2011.

Notes: PPP – purchasing power parity, Int\$ – International dollar.

Which capacities are required for each step of the transformation process? This question is illustrated in Figure 6.4. Figure 6.4a disaggregates countries by the number of researchers; Figure 6.4b disaggregates countries by the number of publications per researcher; and Figure 6.4c disaggregates countries by their level of government effectiveness. We assess countries here on a case-by-case basis to understand the various constraints to their food policy research capacity. Figures 6.4a–c demonstrate that countries' food policy research capacity varies for different reasons.

Figure 6.4a—Food Policy Research Capacity Index and agriculture value added per worker, disaggregated by number of researchers per million rural residents

Source: Authors; World Bank 2010.

Figure 6.4b—Food Policy Research Capacity Index and agriculture value added per worker, disaggregated by number of publications per researcher

Source: Authors; World Bank 2010.

Figure 6.4c—Food Policy Research Capacity Index and agriculture value added per worker, disaggregated by deviation from mean of government effectiveness

Source: Authors; World Bank 2010.

A noticeable trend here is the cluster of Latin American countries exhibiting relatively high agricultural productivity, despite not having significantly stronger capacity than the other countries in our sample. These Latin American countries (Peru, Honduras, Guatemala, and Colombia) benefited significantly from the improved seed varieties that were developed in the 1960s by the International Center for Wheat and Maize Improvement in Mexico (Evenson and Gollin 2003). (Why Latin American countries were able to translate this externally generated research into impactful agricultural strategies while African countries could not is a question not of policy research capacity but rather of policy implementation; access to markets, credit, and inputs; geographical and political constraints; and other factors.) However, for Latin American countries to continue increasing their agricultural productivity, greater investments in their research capacity will be required. Honduras and Guatemala, for example, have relatively low levels of research efficiency (both have fewer than one publication per researcher) compared to the number of researchers they have and the strength of their policy process (proxied by government effectiveness). Conversely, Colombia is constrained by a relatively low number of researchers per rural capita, whereas Peru exhibits high research efficiency but a relatively low number of researchers and poor government effectiveness.

Similar conclusions can be drawn from case studies of African countries. Benin and Mozambique are both primarily constrained by a low number of researchers, despite demonstrating high efficiency of their research capacity. Their government effectiveness scores were both below average but within one standard deviation from the country mean. Thus their investment priorities should be first to increase their human resources and second to increase their policy process capacity. Conversely, Swaziland has a strong research capacity but only average research efficiency and institutions; thus improvements in these two weaker capacities would have the strongest impact on food policy research capacity.

Finally, we see a cluster of primarily African countries scored medium to low in all dimensions of food policy research capacity, and these countries should prioritize capacity-strengthening investments by

their lowest score. One notable exception in this cluster is Rwanda. Since the devastating civil war in the early 1990s and the horrific genocide in 1994, Rwanda has made great strides in rebuilding its government and improving the effectiveness of its limited resources. In 2011, it was ranked fourth out of more than 50 countries in Africa south of the Sahara on Transparency International's Corruption Perceptions Index, indicating that political commitment to good governance and public-sector services exists. Despite prioritization of agricultural and food security issues, Rwanda is hindered by a young, uneducated workforce that is unable to fill all the positions in its public sector (World Bank 2004), and this is true in the agricultural research sector as well (Flaherty and Munyengabe 2011). In the short term, Rwanda recruited foreigners to fill its vacancies but must invest in enhancing its higher education institutes to ensure a steady supply of researchers in the future (Musafiri 2011).

These results suggest that catalyzing an agricultural transformation is not as simple as developing and implementing policies that improve agricultural productivity. With regard to policy research alone, countries vary widely in their capacities, and hence in their constraints and capacity-strengthening needs. Strengthening the weakest link in a country's food policy research capacity is a good step toward improving their food policy capacity and hence in enabling a country to move to the next stage of the agricultural transformation process.

7. DISCUSSION

The primary intention of this research project is to initiate a discussion on food policy research capacity. Little is known about what constitutes sufficient capacity, in quantity and quality; how to strengthen capacity; what factors affect the development, maintenance, and effective utilization of capacity; and to what extent capacity is affected by intangible, immeasurable factors. Assessing a country's capacity to undertake food policy research is the first step in developing a capacity-strengthening strategy; diagnostic work must be done first to determine what and where capacity-building activities will be most effective.

We present our preliminary findings in this paper with cautionary words. Broad ambitions to assess physical, financial, and human capacities in developing countries were thwarted by logistical challenges, and the data presented in this paper represent those that were both easily obtainable and representative of the most important aspects of capacity, in our opinion. However, data collection methods are still being refined, and we continue to research alternative indicators. By no means do we intend to imply that the three indicators presented here are fully representative of a country's capacity to do food policy research, but we suggest that they provide a good starting point for measuring food policy research capacity.

The first indicator is the number of domestic PhD full-time equivalent (FTE) food policy researchers. This variable is indicative of a country's potential capacity to undertake research but not necessarily its active capacity for a number of reasons. First, the quality of researchers' education cannot be ascertained. Second, the availability of resources (financial, technical, physical) limit the ability of researchers to undertake high-quality research. Third, weak organizational capacity in terms of poor management of research staff, ineffective resource allocation, and inadequate incentives discourage researchers from undertaking rigorous research projects. Poor organizational structure may also result in PhD-level researchers being promoted to managerial positions, making ineffective use of their research skills. Informal institutions, particularly the social norms that govern work ethic and commitment, can dramatically influence the effective utilization of human capital.

The head count of researchers within each country ranged from 27 (Nepal) to 349 (Nigeria). Following scaling by time spent on food policy research, educational attainment, and number of rural residents, the number of researchers dropped to a comparable range between 0 and 3, with one outlier: Swaziland. However, Swaziland's apparently inflated number of researchers is justifiable from a theoretical standpoint and a logistical one. Food policy research capacity can achieve economies of scale in a country with a large population and homogeneous agricultural production. We scaled human capacity on a per capita basis but did not account for economies of scale, because information is insufficient to indicate when or at what rate a country achieves economies of scale in its food policy research capacity. The low-populated Swaziland has likely not yet been able to achieve such economies of scale in its food policy research capacity. Additionally, Swaziland's relatively high gross domestic product per capita (fourth highest in our dataset) suggests that it has the resources to invest in building a higher-than-average per capita research capacity.

Scaling the number of researchers by a country's rural population rather than its total population may underestimate capacity in some countries and overestimate it in others. Heavily urban countries that suffer from food-insecurity issues unrelated to their agricultural production will have overestimated capacity relative to their needs. Conversely, heavily rural but relatively food-secure countries will appear to have a weak research capacity relative to their needs.

Human capital is worthless unless it is effectively managed and utilized. We assess the efficiency of human capital by calculating a simple input–output ratio of researchers to internationally published journal articles. The condition that research is published internationally ensures that a minimal level of quality has been met, since the quality of local publications varies tremendously. We recognize that the capability to publish, particularly in international journals, is only one facet of research, and that publications do not necessarily reflect other research communication avenues, such as policy briefs, research seminars, opinion pieces in local media, and meetings with policymakers or politicians.

However, we do feel that international publication is indicative of the existence of several elements of strong research capacity, such as creativity, knowledge of current research methods and similar research projects, strong analytical skills, and the ability to write cogently and persuasively. We do not mean to suggest that publishing research is a stepping-stone in the pathway to achieving ground-level impacts, but simply that it is indicative of the strength of a country's policy research capacity and moreover of the strength of the organizational capacity of the institutions where research is conducted.

The strong ability of Mozambique's researchers to publish in international journals has buoyed its food policy research capacity, perhaps even overinflating it. Although we average our indicators geometrically to account for the independence of the dimensions of capacity, this may not have sufficiently restrained Mozambique's overall food policy research capacity score. A case study analysis may shed light on how its research capacity came to be so efficient despite its relatively few researchers and average government effectiveness and, more importantly, why it has yet to yield food-secure outcomes.

We find that the number of journal articles is a right-skewed distribution; although research requires a high initial investment (for example, in data collection, identification of novel research ideas, or learning how to write publishable journal articles), at some point research investments demonstrate increasing returns to scale. This is because research projects are rarely isolated initiatives; successful projects often have several related offshoots that benefit from accumulated knowledge and the sunk costs of data collection for the original project. South Africa exemplifies this. It has become a hub of research in Africa, with a strong reputation, and is able to capitalize on its earlier research success and accumulated resources and expertise to continue producing high-quality research. However, the impacts of policy research will not be realized unless a country has a strong policy process environment to translate research results into policies. This enabling environment includes both formal and informal institutions and the structure and flow of the policy process itself. Due to the difficulty of condensing this concept into one quantitative measure, we looked to external indexes of public-sector management and governance, opting for the Worldwide Governance Indicator (WGI) government effectiveness pillar to be our third indicator. The lack of objective data reflecting a country's enabling environment, particularly the inclusiveness, transparency, effectiveness, and impartiality of its policy process, hinders the possibility of constructing an entirely objective index; but our robustness checks suggest that the WGI is the next best thing.

The correlations between the three indicators are low: 0.17 between researchers and publications and 0.11 and 0.51 between the WGI governance effectiveness pillar and publications and researchers, respectively. This suggests that the dimensions of food policy research capacity identified here are unique to each other, justifying their inclusion in an aggregated index.

We constructed a Food Policy Research Capacity Index (FPRCI) by standardizing the indicators and calculating their geometric mean. The index was positively correlated with measures of food security (67 percent with the Global Hunger Index and 68 percent with the Global Food Security Index). However, although we measure food policy research capacity, an unmeasured gap remains, comprised of policy implementation capacity, monitoring and evaluation capacity, and policy revision capacity. This requires individual and organizational capacity of the entities responsible for implementing or policing policies, the existence and functioning of a data collection system, data analysts themselves, and commitment of policymakers and politicians to ensuring that their policies are creating ground-level impacts—a dimension of informal institutions that goes beyond ownership.

Informal institutions, the term given to intangible aspects of culture, society, and history that govern how people interact with each other in various conditions, are probably the most elusive dimension of capacity. Personal motivation, work ethic, trust, dedication, and integrity are not only difficult to measure but also difficult to instill. The causation of these factors and the extent to which they affect country capacity will vary from country to country, so even if they could be quantified, appropriate strategies will have to be developed on a case-by-case basis to address the underlying causes of the weak institutions.

To understand the extent to which informal institutions matter in the context of capacity, further analysis of how a country's formal institutions dictate its potential capacity should be undertaken. The gap between a country's potential and active capacity will indicate the influence of informal institutions on its capacity and allow more directed capacity-strengthening efforts.

Our proxy for food policy research outcomes, the Global Hunger Index (GHI) and Global Food Security Index (GFSI), are measures of food security within a country, which is subject to a number of factors external to the policy process, such as geography, endowment of natural resources, internal or external conflict, and socioeconomic factors, among others. This is noted as a reminder of two issues. First, the FPRCI is not to be indicative of a country's ability to improve its food security on the whole, but to highlight some elements that can be improved by political and social will in order to enhance policies relevant to food security. Second, neither the GHI nor the GFSI can be regarded as perfect metrics for assessing the impacts of food policy research capacity because of the plethora of other elements that affect food security outcomes as well as the gap between policy research and policies in action.

Furthermore, the vastly differing conditions that each country faces with regard to food security imply that no universally ideal level of capacity exists. Some countries have better growing conditions, stronger markets, and better economic conditions that lead to a more food-secure population and less need for strong policy research capacity. The rankings are intended to initiate a discussion on what capacities are important for different countries and why. The typologies introduced in this paper are intended to provide additional context for this, in understanding the capacity investments made by countries and how they translate into efficient policy research environments. The number of different typologies that emerged from our analysis indicates that capacity-strengthening priorities differ broadly across countries, with varying outcomes. Two implications emerge from the analysis: (1) Attention should be given to components of the index with the lowest scores for consideration for concerted efforts to improve country food policy research capacity, and (2) significant opportunities exist to learn from countries that have achieved high levels of food policy capacity and from the policies and strategies they implemented.

Furthermore, as exemplified by Swaziland, economies of scale exist in policy research capacity. Given relatively homogeneous growing conditions, a doubling of a country's population will require less than a doubling of its capacity as policy research outcomes will be widely applicable. Conversely, a country with a high degree of heterogeneity in its agricultural production, geography, climate, socioeconomic factors, infrastructure, access to communication, technology, and market conditions will require substantially higher policy research capacity to generate localized, condition-specific policies that address the differing environments.

Within the cluster of countries that scored low on the FPRCI and demonstrate less than \$1,000 agriculture value added per worker, variation is noticeable in the bottlenecks that various African countries face. These countries must prioritize capacity investments by their lowest-scoring dimension of capacity. Mozambique exemplifies this: it has fewer researchers than average, high efficiency of its researchers, and midlevel government effectiveness.

Looking cross-country, Rwanda's highly effective government and low, ineffective human capacity imply that even minimal investments in improving its human capacity may yield high returns. Although this research is a starting point to understand how and why countries fall short in their ability to design effective food policies and understand how similar countries rank, determining effective strategies to improve their capacity will require further individualized analysis. A country may be short on food policy researchers simply because of a lack of supply—in which case, it might need to recruit external

researchers in the short-term and invest in higher education institutes and scholarship programs in the long term. If there is a sufficient supply, a country may need to reevaluate the incentives it has in place to recruit and maintain employees in order to compete with international organizations, the private sector, or other industries altogether. Sufficient demand for high-quality research to develop evidence-based policies may also be a restricting factor. There is no one correct method to approach this problem, but a solid contextual understanding of its current capacity and how it was developed or, in some cases, diminished will suggest opportunities to move from a capacity assessment to a capacity-strengthening strategy.

8. CONCLUDING REMARKS

Capacity for food policy research and analysis is a key determinant of how evidence-based policies are conceived, designed, and implemented. Development partners and country governments alike have attempted to rebuild such capacity in the developing world but with little success. However, several developing countries have shown increased capacity to do their own research and analysis and effectively use such capacity to guide the food policy process. By measuring and comparing country capacity for food policy research, factors that contribute to improved capacity could be identified and strengthened. In this paper, we document a set of indicators of food policy research capacity collected from a set of 30 developing countries. We use the data collected to generate useful information on where countries stand compared with their peers in regard to their food policy research capacity, and we develop a typology of food policy research capacity. Further research will refine these indicators and expand the data collection to a wider spectrum of countries, particularly more populated countries such as the BRIC countries (Brazil, Russia, India, and China), Pakistan, and Indonesia. This will aid in generating a benchmark for food policy research capacity in different geographical and cultural contexts and allow us to test two hypotheses: first, whether economies of scale in food policy research capacity lead to a decreasing per capita number of researchers as population increases, and second, whether research hubs develop in more capable countries, yielding a more-than-linear increase in publications as researchers increase.

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