(7) There should be concerted efforts to change the mindset, so data sharing becomes a reality among researchers. This may even require strict guidelines from DST with minimum timeframes for data sharing.

(8) The public-funded geospatial data must adhere to a certain quality standard which should be the responsibility of a PI thus enabling confidence in shared data.

(9) DST should fund network projects and some benchmark sites where aerial LiDAR, camera and other sensor data along with ground truth should be collected and shared with all researchers involved. It may be noted that LiDAR and other high-resolution data once collected for a site can be utilized in multiple research and development projects catering to different application areas, thus maximizing the investment put on data generation.

(10) Startups should be promoted to work in geospatial data, specially high-resolution, thus tapping the potential of developing technologies in India. Startups should be provided free access to public-funded data.

With the possibilities that new data policy offers, the onus now lies on the stakeholders as to how they take advantage of the new regime and produce technologies and solutions for solving the problems faced by India.

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COMMENTARY

Food and nutrition security: analytical fallacies and way forward

Sudipta Paul and Shivendra Kumar Srivastava

Food and nutrition security (FNS) being a key priority area in development planning, requires good predictive models for holistic analysis of the concept, representative of the multi-dimensional linkages associated with the complex phenomenon. The present article discusses the conceptual dissents, and the popular proxy measures from which FNS is being most often inferred in practice. We suggest possible integration of the measures within the scope of a multifaceted framework in light of the limitations and potential risks in using them in isolation.

Food and nutrition security (FNS) is a key priority area in development planning, and has therefore been attached the highest priority, especially in the impoverished parts of the world. It is estimated that one in every nine (820 million) people in the world suffers from hunger. The prevalence of undernourishment has virtually remained unchanged over the years (slightly below 11%). It is quite worrisome that the total number of undernourished over the years produces a slowly inclining trend[1]. The FAO has recently shared its concern over the extreme inadequacies lying with present FNS drives to achieve Zero Hunger by 2030, and has estimated that more than 840 million people (9.8% of the total global population) may get affected by hunger-related issues by the year 2030 (ref. 2). This is quite an alarming situation even if we keep aside the potential impacts of the present COVID-19 pandemic which is expected to have worsened the overall prospects of FNS. In order to achieve the goal of FNS, it is imperative to have sound policy interventions such that limited resources can be allocated more efficiently. The same requires good predictive models which holistically analyse the subjective concept of FNS. The Sustainable Development Goals (SDG) framework of the United Nations lays emphasis upon two FNS indicators for monitoring the SDG target – (i) prevalence of undernourishment and (ii) prevalence of moderate to severe food insecurity[1].

Food (and nutritional) (in) security is a multi-dimensional, social concept that has dramatically evolved over a period of time. Traditionally, the concept of FNS was restricted only to food availability, and the measurement framework had been rooted in the Malthusian theory which suggests that the growth rate of food production should not be lower than the population growth rate for maintaining a food security balance. The earlier concepts of FNS have been extensively used as household level welfare measures, and do hardly encompass nutrition security. However, individual household level nutritional outcomes to a great extent depend upon a set of non-food factors like, hygiene and sanitation, water quality, disease and infection, and access to primary health care services, and therefore these should also be accounted for in FNS measures[3,4]. Near about 45% of child mortality in the world can be attributed to maternal and child under nutrition however, about 50% of malnutrition is associated with unsafe water, poor hygiene and inadequate sanitation[5]. The inadequacies of the traditional concepts can also be explicitly found out in the work of Drèze and Sen[6]. The entitlement approach in understanding FNS in a more comprehensive manner, the underlying relationship between food intake and nutritional achievement, the role of access to different complementary inputs other than age, sex, pregnancy, metabolic rates, climatic conditions, and activities in determining nutritional outcomes offer new perspectives to the existing FNS framework.

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Measurement of FNS surely is not straightforward, albeit being conventionally referred from individual nutritional status directly consequent upon food intake and/or metabolism. In absence of an objective test to readily determine nutritional status of individuals, it is generally determined based on clinical signs and symptoms, biochemical indicators, dietary surveys, and anthropometric measurements[7]. The analyses make use of individual and/or household level data. The household level FNS measures mostly are carried out on calorie intake which is considered as a 'gold standard measure'[8]. Below is a brief description of the most popular measures from which FNS in practice is currently referred.

Anthropometry: It provides detailed information on different components of body structure, especially muscular and fat components. Among the most widely used, significant and reliable anthropometric indices are body mass index (BMI) and mid-upper-arm-circumference (MUAC).

Dietary diversity (DD): The dietary habit of people is contingent upon demographic characteristics, individual lifestyles and preferences, and of course geographical differences[9,10]. DD is an important measure indicating to the extent to which an individual/household consumes a rich and healthy diet over a period of time. The Simpson Index is often used in measuring DD[11].

Food consumption score (FCS): It was developed as a food security indicator by the World Food Program for measuring household dietary diversity with a seven days recall period[12]. A composite index made up of nine weighted food groups is used, and the frequency of consumption of each food group is considered in estimating the FCS for each household.

Coping strategy index (CSI): The CSI is a combined measure of present status of food security within a household as well as any probable vulnerability of the household to become food insecure in the future. It is intended to probe into specific behaviour of households in food deficit conditions[13].

Household food insecurity access scale (HFIAS): It is the adaptation of an approach used in the United States to estimate the annual prevalence of food insecurity[14]. The scale is the culmination of the idea that peoples' reaction and responses to their experiences of food insecurity can be captured and quantified through a survey and summarized in the form of a scale[15].

Food insecurity experience scale (FIES): In recent times, a Rasch model based procedure to develop an eight-item FIES for monitoring food insecurity at the global level has been proposed[16].

The above measures are not free from criticisms as they have their own limitations of use. For example, the anthropometry is an inexpensive and non-invasive method which has a long tradition of use but using them in isolation has often been criticized as problematic[8] due to the fact that nutritional outcomes on several occasions are determined by factors other than food security[3,4]. Calorie intake and dietary diversity may not go hand-in-hand in fact, a higher level of dietary diversification may be associated with considerably lower calorie intake[17]. As these measures necessitate household/ individual level probing, they are quite time consuming, expensive, and often cumbersome to implement owing to their practical limitations due to administrative and financial constraints. Therefore, these measures are rarely used outside the scope of research applications especially in developing countries. Besides, a single indicator based FNS estimation procedure is significantly risky as it may represent altogether quite a different phenomenon by not taking into account the multidimensional issues of FNS. As a result, they may end up with underestimation and misclassification of possible food insecure households[12,13]. The conceptual framework proposed by the FAO in this regard gives a more inclusive and comprehensive idea, and indicates the possible integration of the above measures in a meaningful way to represent FNS more holistically.

Food security is achieved, if adequate food (quantity, quality, safety, socio-cultural acceptability) is available and accessible for and satisfactorily utilized by all individuals at all times to live a healthy and happy life[18].

As implied by the above, FNS has the following three dimensions:

Availability: It is a measure of the amount of food that is and will be physically available in a population during a certain period of time[17]. The condition can theoretically be reached only if adequate food is ready within a geographical boundary to have at peoples' disposal at any point of time. The FAO highlights average dietary supply adequacy (ADSA) to refer to food availability. ADSA is proposed to be estimated as the total food supply converted into energy units in comparison to total calories needed to maintain a population's long term health which comprises the ability of reproduction, and carrying out physical activities[19].

Accessibility: It may refer to the condition in which all the households within a geographical boundary and all the individuals within these households have sufficient resources to obtain safe and nutritious foods through food production, purchase, donation, etc.[16]. So, adequate accessibility is a function of requisite physical infrastructure and social inclusion.

Utilization: It is defined as a population's ability to get sufficient nutritional intake leading to nutrient absorption during a given period of time[20]. Utilization ensures nutritional wellbeing, and is consequent upon hereditary conditions and bodily capacity to absorb nutrients from adequate diet under the influence of clean water, hygienic and sanitary conditions[21].

It is obvious that when we employ the term 'food and nutrition security' to indicate to the subjective welbeing of people in their most fundamental capabilities, the measurement framework should become more holistic and representative to the direct and indirect linkages of food, nutrition and health. In this regard, the present FAO's conceptual framework may be satisfactorily used with necessary cautions. For example, the measure of availability should consider the magnitude of agriculturally suitable land and manpower for sustainable food production apart from the actual availability of various food commodities. The accessibility dimension should be measured in such way that, if not all, the representative factors like, education, health care, credit and market facilities, social safety net, etc. which facilitate access to food and nutrition get captured. The utilization dimension may be representative of the outcome of availability and accessibility like, extent of malnutrition prevailing at a given point of time. The all-inclusive framework should also take care of a measure of people's happiness as highlighted in the definition. Many a countries in fact lay lot of emphasis on Gross National Happiness Index[22], and of course individual happiness measures may be meaningfully included as an important indicator in the FNS analytical

framework, hitherto not being considered.

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