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Exploring Agricultural Levers for Mitigating the Overnutrition Burden in India

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ABSTRACT

The current concern for and policy response to malnutrition in India is solely restricted to undernutrition diagnosed on the basis of body size (anthropometry). However, recent evidence indicates that the burden of overnutrition and related morbidities is rapidly escalating to alarming proportions. This research first examines the need to address overnutrition in India and subsequently explores the potential of the agricultural sector to mitigate the burden of overnutrition and related non-communicable diseases. The demographic, economic, and dietary transitions seen in India are causing rapid escalation in overnutrition and related morbidities, particularly in urban areas and higher-income groups but also among the poor, with faster escalation expected to occur among this group in the future. Evidence is provided that agricultural policies and production practices affect diet through their influence on food availability, price, and nutrient quality, which, in turn, affect the food choices available to consumers. Agricultural policies are amenable to intervention, but interventions should avoid two potential failings: (1) mitigation of one component of the dual burden (undernutrition and overnutrition) should not inadvertently escalate the other, and (2) socioeconomic equity should not worsen rather than improving. The author concludes that cost-effective strategies that may produce the largest health gains in the shortest timeframe include (1) fiscal measures that increase the price of unhealthy food content or reduce the cost of healthy foods and (2) regulatory measures that improve nutritional information or restrict the marketing of unhealthy foods, particularly to children. Possibilities meriting consideration, as prioritized by the author, include (1) increasing access to and consumption of pulses, vegetables and fruits, and coarse grains and (2) taxation and regulatory measures to curtail the consumption of unhealthy vegetable fats and oils, and processed foods with a high content of oils, fats, sugars, and salt.

Keywords: agriculture, overnutrition, undernutrition, India

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1. INTRODUCTION

The current concern for and policy response to malnutrition in India is solely restricted to undernutrition diagnosed on the basis of body size (anthropometry). However, recent evidence indicates that the burden of overnutrition and related morbidities is rapidly escalating to alarming proportions. This paper first examines the need to address overnutrition in India and subsequently explores the potential for the agricultural, nutrition, and health sectors to work together to mitigate the burden of overnutrition and related non-communicable diseases. The paper is organized as follows: Section 2 presents evidence documenting the trend in the burden of overnutrition and associated morbidity, Section 3 addresses the main likely drivers of the trend in the overnutrition burden, Section 4examines the relations between agricultural policy and production practices and the trends in overnutrition, and Section 5 discusses the future role of the agricultural sector in preventing and controlling overnutrition.

2. THE RAPIDLY ESCALATING BURDEN OF OVERNUTRITION AND ASSOCIATED MORBIDITY

Trends Based on Body Size

India is undergoing a rapid transition on economic, demographic, epidemiologic, nutritional, and sociological fronts (Griffiths and Bentley 2001; Popkin et al. 2001; Shetty 2002; Popkin 2006; Ramachandran 2007a; Wang et al. 2009). Specifically, in the context of nutrition, there is evidence of a decline in undernutrition with a simultaneous increase in overnutrition, as assessed by body size or anthropometry (Krishnaswamy et al. 1997; Sachdev 1997, 2003; Shetty 2002; Ramachandran 2007a; Sachdev and Shah 2007; Wang et al. 2009). Local, regional, and national surveys indicate that the prevalence of overweight and obesity, as defined by international criteria, has increased over the past decade in children, adolescents, and adults (Ramachandran 2007a, 2007b; Wang et al. 2009; Finucane et al. 2011). An evaluation of the changes in the prevalences (percentages) of underweight (body mass index [BMI] < 18.5 kg/m^2) and overweight (BMI > 25 kg/m^2) in adults in regional and national surveys in India (Table 2.1) outlines the basis of this inference. This escalation has been relatively rapid in urban areas and in high socioeconomic strata. The most recent national estimates (National Family Health Survey [NFHS] 3 in 2005–06) of overweight in adults in rural and urban areas were 7.3 percent and 22.2 percent in men and 8.6 percent and 28.9 percent in women, respectively. The current magnitude of overweight in adults in some groups is relatively high (30 to 40 percent) (Ramachandran et al. 2001; Reddy et al. 2006; Singh et al. 2007; Wang et al. 2009). An increase in overweight has also been documented among the poor population (rural areas and urban slums), as illustrated in Figure 2.1. In some parts of Chennai, in a span of 14 years (between 1989 and 2003), the rural population had a more rapid escalation of overweight (2 percent to 17.1 percent, or 8.6-fold) in comparison to urban areas (Ramachandran and Snehalatha 2010).

A recent analysis from low- and middle-income countries documented that in 27 of 37 countries, higher socioeconomic status (SES) (vs. lower) was associated with higher overweight prevalence gains, while in the remaining 10 countries, lower SES (vs. higher) was associated with higher overweight prevalence gains (Jones-Smith et al. 2011). Gross domestic product (GDP) was positively related to a faster increase in overweight prevalence among the lower-wealth groups. Among higher-GDP countries, lower income inequality was associated with faster overweight growth among the poor. The findings thus highlight faster overweight growth among the poor in association with higher economic development contexts, particularly when combined with lower income inequality. It is therefore likely that with greater balanced economic growth in the future in India, the poor will experience a more rapid escalation of overnutrition.

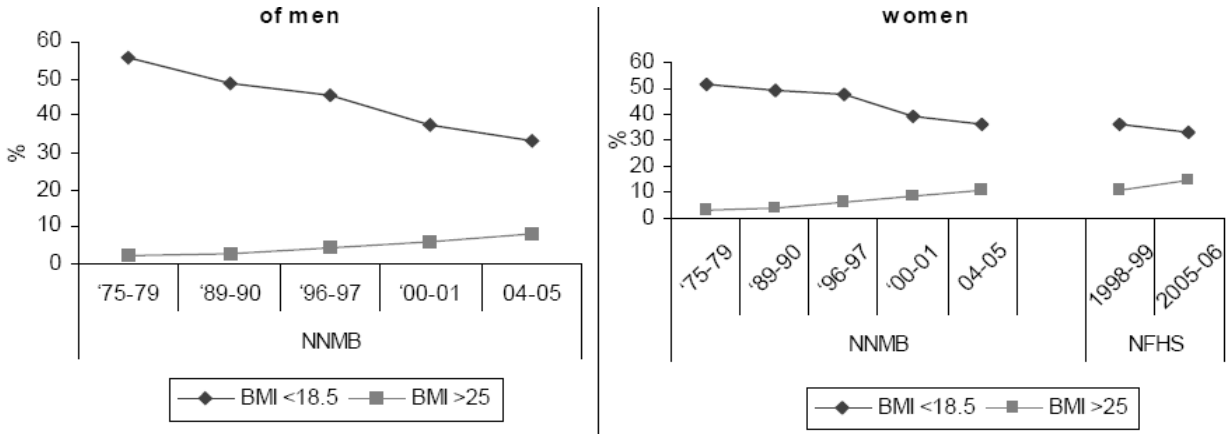
Table 2.1—Changes in the prevalences (percent) of underweight (BMI < 18.5) and overweight (BMI > 25) in adults in regional and national surveys in India

				Rural	Urban	Men	Women
Underweight	NNMB	Rural	1975–79	53.2		55.6	51.8
			1989–90	49		49	49.3
			1996–97	48.5		45.5	47.7
			2000–01	38.6		37.4	39.3
			2004–05	34.8		33.2	36
		Urban slum	1993–94		20.3	22.2	19.4
	INP	Urban and rural	1995–96	34.6	27.7	28.6	36.3
	NFHS–3	Men	2005-06	33.1	17.5	26.1	
	NFHS–2	Women	1998–99	40.6	22.6		35.8
	NFHS–3		2005–06	38.8	19.8		33
Overweight	NNMB	Rural	1975–79	2.9		2.3	3.4
			1989–90	3.1		2.6	4.1
			1996–97	4.5		4.1	6
			2000–01	6.6		5.7	8.2
			2004–05	9.6		7.8	10.9
		Urban	1993–94		8.8	5	10.6
	INP	Urban and rural	1995–96	4.1	6	4.3	4.6
	NFHS–3	Men	2005-06	7.3	22.2	12.1	
	NFHS–2	Women	1998–99	5.9	23.5		10.6
	NFHS–3		2005–06	8.6	28.9		14.8

Source: Reproduced from Ramachandran (2007a).

Notes: Based on National Nutrition Monitoring Bureau 1988–90, 1996–97, 2000–01; India Nutrition Profile 1995–96; National Family Health Survey 2005–06. Survey Population: NNMB Rural (1975–79, 1988–90, 1995–96, 2000–01) and Urban (1993–94; INP (1995–96). Sample size: NNMB, 11,973 (1975–79); 21,398 (1989–90); 30,773 (1996–97); 11,074 (2000–01); INP, 177,841 (1995–96), 2,772 (1993–94). NNMB (National Nutrition Monitoring Bureau), INP (India Nutrition Profile), NFHS (National Family Health Survey).

Figure 2.1—Changes in the prevalences (percent) of overweight (BMI > 25) in adult men (left side) and women (right side)



Source: Reproduced from Ramachandran (2007a) based on Data from the National Nutrition Monitoring Bureau (NNMB) surveys in rural areas of southern states in India. NFHS – National Family Health Survey; NNMB – National Nutrition Monitoring Bureau.

International Anthropometric Cut-0ffs Underestimate the Overnutrition Burden

The population burden of overnutrition or adiposity is generally quantified through BMI (weight in kilograms/square of height in meters) distribution because of the relatively cheap cost and convenience of acquiring the data. However, BMI is recognized to be a crude indicator of adiposity (fat percentage); subjects could have an abnormally high BMI due to excessive lean tissue or fat or both. Further, the relationship between BMI and adiposity varies with age. BMI gains during infancy and early childhood predict adult lean mass more strongly than adult adiposity, while greater BMI gains in late childhood and adolescence predict increased adult adiposity (Sachdev et al. 2005).

The magnitude of the health and economic burden attributable to overnutrition is substantially underestimated from projections based solely on international anthropometric cut-offs, particularly in children under the age of five. Adult obesity appears to precede child obesity (Popkin 2006). Absolute rates of *increase* in overweight plus obesity tended to be higher among adults than among children in most of the seven countries examined (Popkin 2006). A shift from a regimen of under- to overnutrition can thus be associated with the paradoxical situation of double burden, with both obese adults and undernourished children coexisting in the same family (Doak et al. 2005; Garrett and Ruel 2005; Popkin 2010).

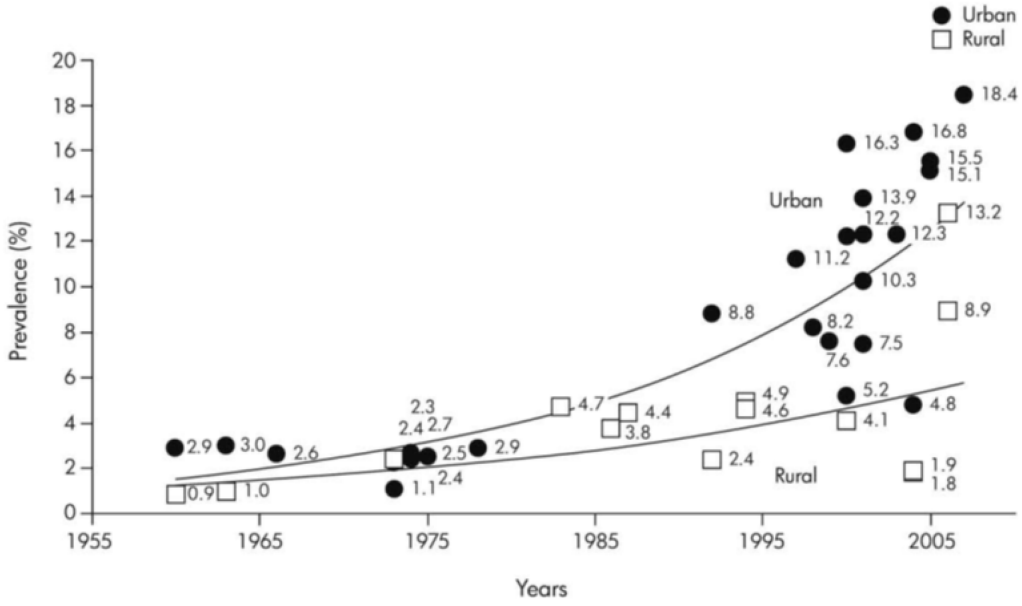
South Asians, particularly Indians, appear to be "metabolically obese" although BMI levels may fall in the category of "non-obese" (Misra et al. 2009; Misra and Khurana 2009). This phenomenon is partially explained by excess body fat, high intra-abdominal and subcutaneous fat, and ectopic fat deposition in various organs despite being in the "normal" range of BMI. In other words, South Asians have a higher body fat percentage (adiposity) as compared to Caucasians for a given BMI (Chandalia et al. 1999; Yajnik et al. 2002; Misra and Khurana 2008). Thus, morbidities related to excess adiposity (diabetes, hypertension, dyslipidemia, and metabolic syndrome) occur at lower BMI levels. A BMI $\geq$ 23 kg/m^2 (instead of $\geq$ 25 kg/m^2) is therefore now recommended to define overweight in adult Indians (WHO Expert Consultation2004; Misra et al. 2009). This lowering of the cut-off naturally elevates the magnitude of the overnutrition burden, with recent estimates from some urban areas ranging from 51 percent to 80 percent (Prabhakaran et al. 2005; Reddy et al. 2006; Huffman et al. 2011).

Trends in Overnutrition-Associated Morbidity

Realistic estimates of the overnutrition burden should also be based upon the trends in related morbidities, including diabetes mellitus, coronary artery disease, hypertension, and metabolic syndrome. During the 1960s and 1970s, adult diabetes mellitus prevalence was reported to be 1 to 4 percent in urban areas and 1 to 2 percent among rural populations. Studies since the late 1980s have reported diabetes mellitus in 5 to 15 percent of urban populations, 4 to 6 percent of semi-urban populations, and 2 to 5 percent of rural populations (Gupta and Misra 2007; Mohan et al. 2007; Ajay et al. 2008; Gupta and Kumar 2008; Mohan 2011). Data from 2005 documented a prevalence of 15 to 18 percent in urban areas and 8.9 percent in a rural study (Gupta and Kumar 2008). Thus, a significantly increasing trend has been observed in urban populations (exponential trend, $R^2 = 0.74$), whereas the increase is slower ($R^2 = 0.29$) in rural populations (Figure2.2). The International Diabetes Federation predicts that 87 million adults are likely to be afflicted with diabetes mellitus in India by 2030 (Sicree, Shaw, and Zimmet 2009). From 1942 to 1997, there was a significant increase in the mean levels of systolic blood pressure, particularly among urban men aged 40–49 years (from 120.4 mm to 130 mm Hg) (WHO 2004). A review published in 2004 estimates that hypertension is present in 25 percent of urban and 10 percent of rural subjects in India (Gupta 2004). A more recent meta-analysis documents that on average, the global population systolic blood pressure has decreased slightly since 1980 (0.8 to 1.0 mm Hg per decade), whereas it has increased (mean increase ranging from 0.8 to 2.7 mm Hg per decade) in South Asia, including in India (Danaei et al. 2011) Projections suggest that the number of hypertensive individuals in India will rise from 118.2 million in 2000 to 213.5 million in 2025 (Kearney et al. 2005). The prevalence of coronary heart disease is also increasing and is currently reported to be between 6.5 and 13.2 percent in urban areas and between 1.6 and 7.4 percent in rural regions (Gupta 2008; Gupta et al. 2008). Recent evidence suggests that metabolic

syndrome afflicts about one-fourth to one-third of the middle- and high-SES urban adult population, 12 percent of adults in urban slums in some metros, and 18.4 percent of women and 26.9 percent of men in some areas of rural Andhra Pradesh (Misra et al. 2007; Chow et al. 2008). Longitudinal data from New Delhi Birth Cohort document an alarming annual incidence of obesity (2 percent for men and 2.2 percent for women), diabetes (1 percent for men and 0.5 percent for women), and hypertension (4.2 percent for men and 1.8 percent for women) among middle-SES urban young adults (29 years) followed up for an average duration of seven years (Huffman et al. 2011).

Figure 2.2—Trends in prevalence of diabetes mellitus in Indian adults in urban and rural areas



Source: Reproduced from Gupta and Kumar (2008).

Summary of Trends in the Overnutrition Burden

In conclusion, the burden of overnutrition and associated morbidities is rapidly escalating to alarming proportions, particularly in urban areas and high-SES groups. The poor are not spared from this transition. It is predicted that a more rapid transition may occur among poor populations in the future with higher economic development. A swift adaptation of the agricultural and public health policy response is vital to simultaneously address the dual burden of undernutrition and overnutrition. The need to address overnutrition may arguably be greater, if not equal, because anthropometric undernutrition is declining, albeit slowly, while overnutrition and the associated lifelong morbidities are rapidly increasing, even among the poor.

3. THE MAIN LIKELY DRIVERS OF THE ESCALATING OVERNUTRITION BURDEN

A complex range of interacting factors have been linked to the rising trend of overnutrition and associated non-communicable diseases from a global perspective (Popkin et al. 2001; Shetty 2002; WHO 2003; Nishida et al. 2004; Popkin 2006, 2010; Ramachandran 2007a, 2007b; Miranda et al. 2008; Misra and Khurana 2008, 2009; Ramachandran, Ma, and Snehalatha 2010; Ramachandran and Snehalatha 2010; Mohan 2011). Most of these determinants are also operative in the Indian context; however, the relative contribution of different contributors is likely to vary from place to place. The main postulated proximal and underlying drivers in the Indian context are summarized below.

Rapid Demographic Transition

Life expectancy is increasing, while birth rates are on the decline (Shetty 2002; RGI 2004; India 2007a; Ramachandran 2007a, 2007b). The share of the population over 60 years of age is growing at a rapid pace and is projected to increase from 54.7 million in 1991 to 113 million in 2016 (107 percent increase), or from 6.4 to 8.9 percent of the population; it will increase further to 179 million in 2026 (227 percent increase). The age group under 15 years is simultaneously declining. Consequently, the population likely to be afflicted with the overnutrition burden is expanding rapidly. The changes in the population age pyramid are highly variable within the country; Kerala is approaching that of developed countries, while that of Uttar Pradesh resembles less-developed countries (RGI 2004; India 2007a). This may partly explain the greater overnutrition-associated burden in states like Kerala.

Socioeconomic Transition

Increasing affluence is fueling the primary drivers of overnutrition, including greater availability of unhealthy foods and decreased physical activity (Ramachandran 2007a, 2007b).

Rapid Urbanization

Urbanization fuels the transition because of the adoption of lifestyle (dietary habits and physical activity) changes that are conducive to the development of overnutrition and associated morbidity (Shetty 2002). The average annual growth rate of the urban population from 1990 to 2007 was 2.8 percent, and by the year 2030, 41 percent of India's population is expected to be living in cities and towns. The pace of urbanization is variable across the states, with the southern states urbanizing much faster than the northern states (Ramachandran 2007a, 2007b; UNDP/India 2009).

Changing Patterns of Disease

There is a decline in infectious and communicable diseases, with a resultant nutrition sparing effect. This has also partly contributed to the development of overnutrition and a substitution with chronic non-communicable diseases (WHO 2005, 2009).

Dietary Changes

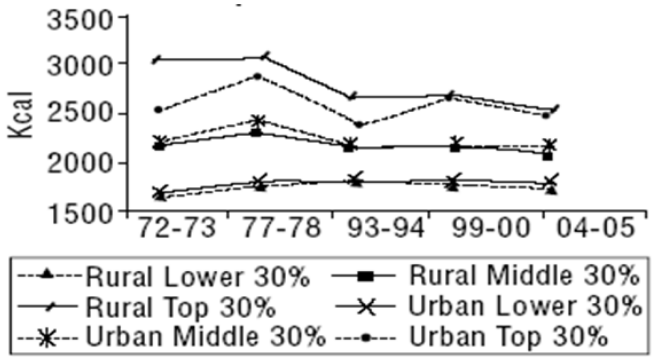
Dietary changes are of particular importance to the subject under review. Although direct high-quality evidence (for example, from randomized controlled intervention trials) is not available for a majority of aspects, observational data strongly suggest the important role of dietary changes in fueling the epidemic of overnutrition and associated non-communicable diseases (Popkin et al. 2001; WHO 2003; Nishida et al. 2004; Popkin 2006, 2010). It would therefore be pertinent to examine the relevant trends in dietary consumption patterns in India to evaluate the potential role of the agricultural sector in addressing the overnutrition burden.

Data from the National Sample Survey Organization's (NSSO's) consumer expenditure surveys are extensively used for economic aspects and also for deriving estimates on dietary consumption patterns (Ramachandran 2008).The NSSO has carried out consumer expenditure surveys since 1972–73 (27th, 32nd, 38th, 43rd, 50th, 55th, and 61st rounds of the NSS) at roughly five-year intervals for assessing the impact of economic, agricultural, and food distribution–related interventions on food consumption over time in different states in urban and rural areas and in different income groups. The strengths of the food consumption data from NSSO are the sampling design, sample size, explicitly stated estimation procedure, national coverage, and uniformity of data collection over decades. However, the data pertain to households and not to individual consumption and the reliability and validity of data on consumer expenditures collected by a single interview has been questioned. Also, the data cannot be directly related to the anthropometric profiles of individuals.

The surveys conducted by the National Nutrition Monitoring Bureau (NNMB) record anthropometry and dietary consumption through 24-hour recalls. However, the data are not nationally representative, pertaining to either the rural poor or urban slums of primarily southern states. The raw data are generally not available to researchers for secondary analyses.

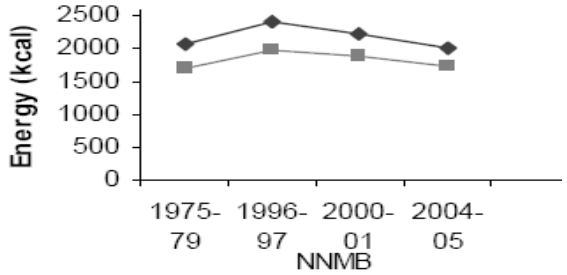
In both NSSO and NNMB datasets, a sustained decline in per capita calorie consumption is evident in all socioeconomic strata, but particularly so in the higher-SES groups (Figures 3.1 and 3.2) (Krishnaswamy et al. 1997; Ramachandran 2007a, 2007b, 2008). This has been associated with declines in protein and carbohydrate intake, particularly in recent years, and the decline is of a greater magnitude in urban areas (Table 3.1 and Figure 3.3). However, daily fat consumption has increased, especially in urban areas (Table 3.1 and Figure 3.4). Consequently, a greater percentage of the average daily energy intake is due to fat ingestion, but in rural areas it is still below the recommended 15 percent level (Table 3.1). Of particular concern is the increasing trend toward imbalanced consumption of fats and oils, which may have potentially deleterious metabolic and glycemic consequences (Misra, Singhal, and Khurana 2010). Data show an increase in the supply of animal fats and increased intake of saturated fatty acids obtained from coconut oil, palm oil, and ghee (clarified butter). In addition, the intake of n-6 polyunsaturated fatty acids (obtained from sunflower, safflower, corn, soybean, and sesame oils) and trans-fatty acids is increasing (Popkin et al. 2001; Misra et al. 2007; Mohan et al. 2007; Misra and Khurana 2009; Misra, Singhal, and Khurana 2010; Mohan 2011).

Figure 3.1—Time trends in average per capita intake of energy, by expenditure classes



Source: Reproduced from Ramachandran (2008) based on Data from the National Sample Survey Organisation quinquennial surveys (NSSO 2006).

Figure 3.2—Time trends in average per capita intake of energy from National Nutrition Monitoring Bureau repeat surveys



Source: Reproduced from Ramachandran (2007a).

Table 3.1—Changes in the sources of dietary energy intake in adults

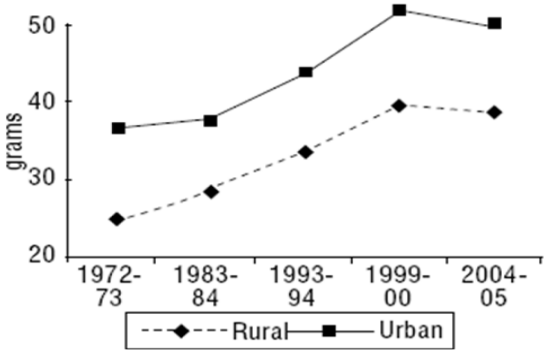
			Men	Women
			> 18[a]	
Total dietary energy intake (kcals)	NNMB	1975–79	2,065	1,698
		1996–97	2,488	2,106
		2000–01	2,225	1,878
		2004-05	2,000	1,738
	INP	1995–96	2,592	2,293
Dietary energy from fat (percent)	NNMB	1975–79	8.9	9.1
		1996–97	12.4	13.9
		2000–01	13.9	13.9
		2004-05	12.1	11.3
	INP	1995–96	12.2	12.6
Dietary energy from protein (percent)	NNMB	1975–79	10.8	10.7
		1996–97	10.2	9.9
		2000–01	10.6	10.6
		2004-05	11.0	10.7
	INP	1995–96	12.3	12.4
Dietary energy from carbohydrates (percent)	NNMB	1975–79	80.3	80.2
		1996–97	74.8	76.2
		2000–01	75.5	75.5
		2004-05	76.9	78.0
	INP	1995–96	75.5	75.0

Source: Reproduced from Ramachandran (2007a).
Notes: Based on data from the National Nutrition Monitoring Bureau Surveys (NNMB) and India Nutrition Profile (INP).
[a] No disaggregation of data age-wise after 18 years of age.

Figure 3.3—Time trends in average protein consumption

Source: Reproduced from Ramachandran (2008) based on Data from the National Sample Survey Organisation quinquennial surveys (NSSO 2006).

Figure 3.4—Time trends in average fat consumption



Source: Reproduced from Ramachandran (2008) based on data from the National Sample Survey Organisation quinquennial surveys (NSSO 2006).

There is also a greater intake of milk, milk products, and animal products (designated flesh foods) (Table 3.2). The consumption of healthful diet components such as fruits and vegetables, fiber, legumes, and coarse grains is reduced in absolute or relative terms (Table 3.2). Processed foods with a high content of unhealthy fats, sugar, and salt are being increasingly preferred, particularly in urban areas (Popkin et al. 2001; Shetty 2002; Prabhakaran et al. 2005; Popkin 2006; Ramachandran 2007a, 2007b, 2008; Misra, Singhal, and Khurana 2010; Ramachandran, Ma, and Snehalatha 2010; Ramachandran and Snehalatha 2010).

Table 3.2—Changes in average intake of food items (g/day) among adults

	Cereals and millets	Dairy products	Pulses and legumes	Vegetables	Green leafy vegetables	Others (includes tubers)	Fruits	Fats and oil	Sugar and jaggery
NNMB									
Men									
1975-79	495	66	37	59	13	55	14	11	18
1988-92	531	86	32	51	9	53	23	16	23
1996-97	541	74	35	56	17	54	31	15	21
2000-01	457	85	34	75	18	57	28	14	17
2005-06	418	94	31	68	17	63	27	16	15
Women									
1975-79	386	56	31	51	11	47	11	9	16
1988-92	445	92	32	40	8	45	30	14	23
1996-97	434	72	29	53	16	49	24	13	21
2000-01	389	67	26	69	18	50	20	12	16
2005-06	365	80	27	63	18	52	26	13	14
INP (1995-96)									
Men	543	119	41	112	41	81	20	17	19
Women	468	113	37	101	37	72	19	26	18
RDI									
Men	460	150	40	50	40	60	*	20	30
Women	410	100	40	50	100	40	*	20	35

Source: Reproduced from Ramachandran (2007a).

Notes: Based on data from repeat National Nutrition Monitoring Bureau (NNMB) Surveys. The India Nutrition Profile (INP) survey provides data on dietary intake (by 24-hours dietary recall) and nutritional status of adults in non-NNMB states in mid-1990s. * = not available.

This dietary transition is being fueled by underlying major economic, marketing, and social changes, including those in infrastructure, pricing and farm policies, food distribution, globalization of the food trade, supermarkets, and marketing media (Shetty 2002; Haddad 2003; WHO 2003, 2005; Pingali and Khwaja 2004; Popkin 2006, 2010, 2011; Narayanan 2007; Kearney 2010).

Physical Activity

There are no time-trend data evaluating direct measures of physical activity. However, some inferences appear justified on the basis of indirect evidence, including the growth in the number of motorized vehicles and use of labor-sparing devices, and the current physical activity patterns, including leisure activities (Shetty 2002; Ramachandran 2007a, 2007b, 2008; Teo et al. 2009; Headey, Chiu, and Kadiyala 2011). Physical activity and energy expenditure has declined due to a sedentary lifestyle—motorized transport, labor-saving devices in the home, the phasing out of physically demanding manual tasks in the workplace, and leisure time that is preponderantly devoted to physically undemanding pastimes.

Summary of the Main Drivers of the Overnutrition Burden

In conclusion, dietary changes are one of the main drivers of the escalating overnutrition burden. Consumption of food components that promote overnutrition (fat, vegetable oil, sugar, salt, and animal products) has increased, while that of healthful components (fruits and vegetables, fiber, legumes, and coarse grains) has decreased or is relatively low. It would therefore be logical to examine whether the agricultural sector has contributed to some of these dietary changes.

4. THE RELATION BETWEEN AGRICULTURAL POLICY/PRACTICE AND RISING LEVELS OF OVERNUTRITION

India-Specific Search Strategy

The search strategy applied to retrieve India-specific literature examining the relationship between the agricultural sector and overnutrition is detailed in the Appendix. Among the 71 citations for which the full text was retrieved, no report provided information directly relevant to this subject.

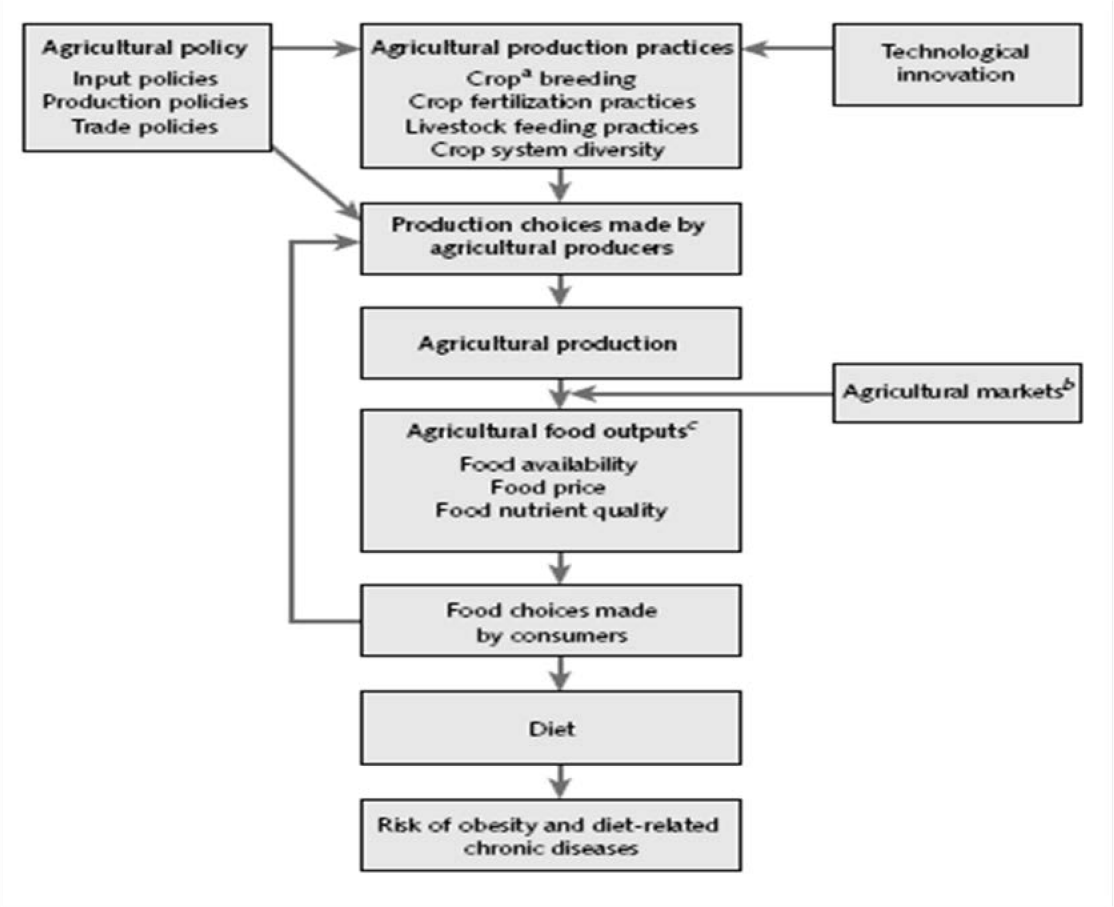
Leads from Global Experience

It would be logical to hypothesize that the agricultural sector can contribute to overnutrition in the population by influencing changes in the quantity and quality of food consumption. Surprisingly, it is only recently that this possibility has gained recognition and relevant research has been conducted on this subject (Nugent 2004; Hawkes 2007; Hawkes, Ruel, and Babu 2007).

A contemporary analysis of multiyear data for 29 low- and middle-income countries (Webb and Block 2010) provides interesting information, which can be summarized as follows: (1) structural economic transformation is associated with poverty reduction, and the reduction is facilitated (especially in rural areas) if agriculture is supported during the process; (2) poverty reduction strongly supports a reduction in child undernutrition (both stunting and wasting) when there is support for agriculture; because there are larger numbers of undernourished children in rural areas, and agricultural support increases rural incomes faster than urban incomes, the decline in undernutrition is more pronounced in rural settings; and (3) even as undernutrition and poverty decline, the processes involved in economic transformation promote a surprisingly rapid increase in obesity, even in rural areas, and this increase brings with it the health and economic dangers associated with chronic diseases. Thus, the transition process must be managed better, through targeted support for smallholder agriculture and health interventions, if the negative consequences of obesity and chronic non-communicable diseases are to be mitigated (Webb and Block 2010).

A recent conceptual framework (Figure4.1) identified two general points of intervention in the agricultural sector that could be leveraged to promote healthy diets and tackle obesity and diet-related chronic diseases: agricultural policies and agricultural production practices (Hawkes 2007). *Agricultural policies* refers to the political economic processes put into place to achieve agricultural goals, such as providing food, contributing to economic development, or supporting rural environments. *Agricultural production practices* refers to agronomic practices adopted to cultivate various foods. Production practices are a major means through which agricultural policy is implemented; their adoption has thus been strongly influenced by agricultural policies. Their development has also been strongly influenced by technological innovation. Agricultural policies and production practices are thus intimately linked, and, because they are applied differentially to different food crops, they create incentives and disincentives to produce different foods relative to each other. These incentives and disincentives affect decisions made by agricultural producers about what to grow and produce. These decisions in turn affect agricultural production and the outputs of that production: the relative availability, price, and nutrient quality of different foods in the marketplace, and therefore the choices consumers have available to them. Food choices then affect diets and risk exposure to obesity and diet-related chronic diseases. It is important to note that agricultural production choices are also influenced by consumer food choices, and that food choices are also influenced by the functioning of agricultural markets, but this is not encapsulated in the conceptual framework (Hawkes 2007).

Figure 4.1—Conceptual framework: The relationship between agricultural policies and production practices and diet



Source: Reproduced from Hawkes (2007).
Notes: [a] "Crop" refers to all food crops, livestock, and fish.
[b] The functioning of agricultural markets is not explored here but also has dietary implications.
[c] Agricultural food outputs: food availability refers to the relative amount and diversity of different types of food available; food price refers to the cost of these foods; food nutrient quality refers to the nutrient content and density of foods.

Agricultural policies and production practices thus affect diet through their influence on food availability, price, and nutrient quality, which, in turn, affect food choices available to consumers. Agricultural policies amenable to intervention include input, production, and trade policies; agricultural production practices amenable to intervention include crop breeding, crop fertilization practices, livestock-feeding practices, and crop systems diversity (Nugent 2004; Hawkes 2007). Surprisingly, there is scant direct evidence, even in the global context, exploring the relation between agricultural policies and production practices and escalating overnutrition. However, some case studies detailed below illustrate the potential role of the agricultural sector in mitigating overnutrition in the Indian context.

Examples of Dietary Implications of Agricultural Policies

An example for input policies is the development of irrigation and investment in infrastructure, which stimulated the adoption, production, and consumption of sugar in the 17ththrough 19th centuries in Western countries (Mintz 1986; Grigg 1995; Hawkes 2007). The entrenched taste for sugar is likely more a reflection of past rather than current agricultural policies, which actually tend to make sugar more

expensive in these regions (Mitchell 2004; Hawkes 2007). With respect to production policies, corn subsidies in the United States increased the production of corn sweeteners and encouraged larger portion sizes of soft drinks. Similarly, the EU Common Agricultural Policy increases the availability of dairy fats and reduces the availability of fruit and vegetables. Also, in China the dismantling of state monopolies encouraged greater meat production (Popkin et al. 2001; Popkin 2006, 2011; Hawkes 2007). All of these examples are likely to facilitate dietary consumption changes conducive to overnutrition.

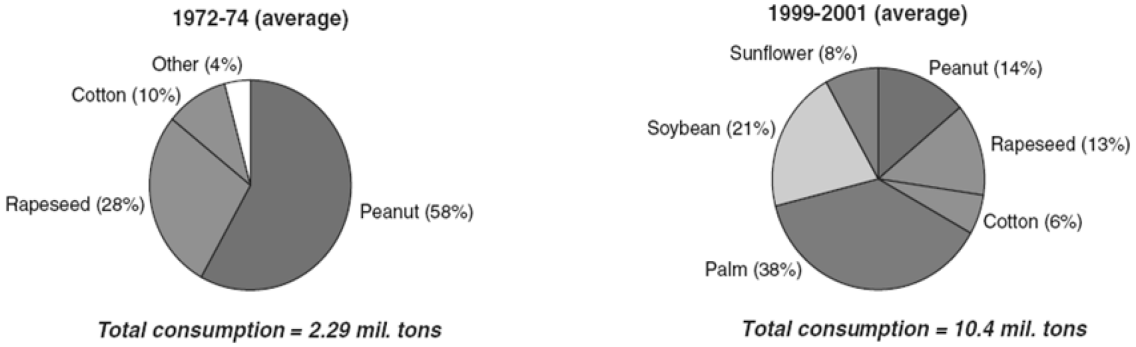
Agricultural trade policies have had a significant influence on the quantity and quality of oil consumption. Palm oil contains increased saturated fatty acids, and its excessive intake is considered to increase the risk factors for chronic non-communicable diseases (Misra, Singhal, and Khurana 2010). Reduced barriers to palm oil exports in Indonesia and Malaysia created incentives for further production and export, and thus availability in the world market (ICN 2003; Hawkes 2007). Concomitant reductions of trade barriers in major importing countries (India and China) led to increased availability, lower prices, and greater consumption (Hawkes 2006). In India, the lower price of palm oil contributed to increased imports and consumption: by the end of the 1990s, palm oil accounted for 38 percent of all vegetable oil consumption (Figures 4.2a, 4.2b), representing a shift away from the relatively healthy but higher-priced domestically produced rapeseed, groundnut, and cottonseed oils (Dohlman, Persaud, and Landes2003).

Figure 4.2a—Composition of India's edible oil imports

Source: Reproduced from Dohlman, Persaud, and Landes2003.

Note: "Other" includes coconut, palm kernel, and cottonseed.

Figure 4.2b—Changes in type of vegetable oil consumption in India

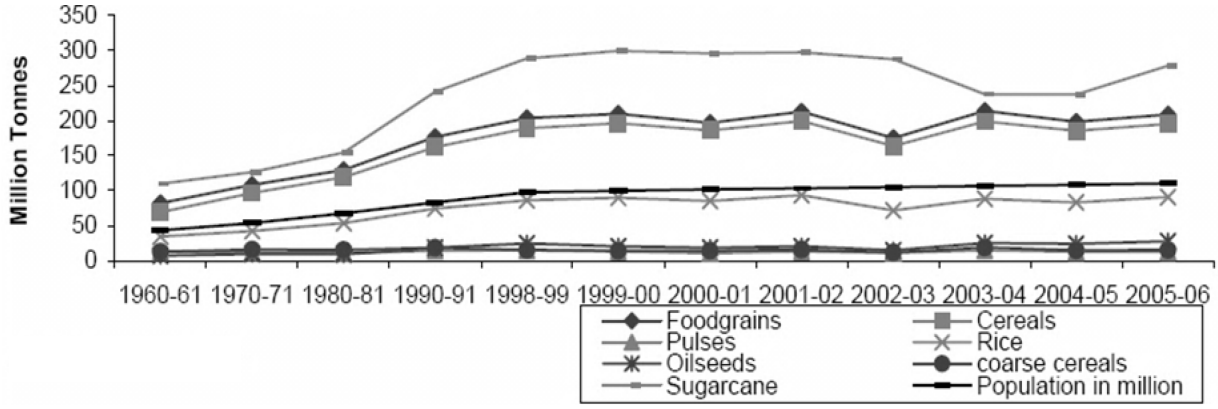


Source: Reproduced from Dohlman, Persaud, and Landes2003.

Examples of Dietary Implications of Agricultural Production Practices

Over the past decades, agricultural research has resulted in the introduction of new crop breeds that have substantially influenced dietary consumption patterns. The impact of breeding on relative food availability is illustrated by the breeding and adoption of high-yielding cereal varieties during the Green Revolution of the 1960s–70s (Hawkes 2007). In India during this period, rice and wheat production and consumption increased significantly, but pulse production and consumption declined (Figures 4.3a and 4.3b). These changes were influenced by the adoption of high-yield breeds and other technologies, which made rice and wheat more profitable to produce relative to pulses (Pinstrup-Andersen 2005). Ever since then, in India the per capita availability of pulses has declined, prices have risen, and consumption has declined (Price, Landes, and Govindan 2003). The greater availability and lower prices of rice and wheat also displaced other widely consumed coarse grains (Gopalan 1999). Likewise, breeding of oilseeds has contributed to the rapid increase of global vegetable oil availability in the last 40 years (Hawkes 2007). In Brazil, the breeding of tropical soybean in the 1960s dramatically increased yields (Schnepf, Dohlman, and Bolling 2001). Soybean oil has become the dominant vegetable oil in Brazil and is now widely exported and consumed globally (Hawkes 2006). Similarly, in India in the last two decades, the introduction of newer oilseeds has led to increased production of groundnut, soybean, rapeseed, and mustard oils (Figure4.4) (India 2007b; Ramachandran 2007a). In a chronic disease context, rapeseed breeding in Canada in the 1970s led to the development and increased consumption of canola oil, resulting in, according to an economic analysis, less heart disease (the oil is believed to have a relatively healthful fatty acid profile) and reduced public healthcare costs (Gray and Malla 2001).

Figure 4.3a—Time trends in production of important food items in India



Source: Reproduced from Ramachandran (2007a) based on Data from the Economic Survey of India 2006–2007 (India, Ministry of Finance 2007c).

Figure 4.3b—Time trends in per capita net availability per day of cereals and pulses in India

Source: Reproduced from Ramachandran (2007a) based on data from the Economic Survey of India 2006–2007 (India, Ministry of Finance 2007c).

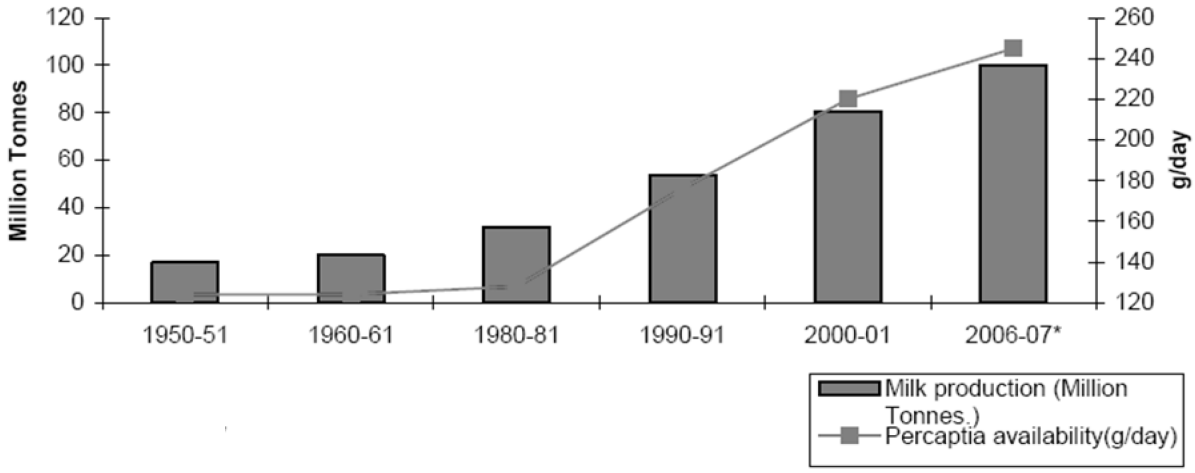
Figure 4.4—Time trends in production of various edible oils in India

Source: Reproduced from Ramachandran (2007a) based on data from the Economic Survey of India 2006–2007 (India, Ministry of Finance 2007c).

Vast areas of India have tropical agroclimatic conditions, which are well suited for the cultivation of horticulture and plantation crops. In addition to providing nutritional and livelihood security and helping poverty alleviation and employment generation, this subsector can sustain a large number of agro-industries, which can generate huge additional nonfarming employment opportunities. These factors have led to a greater area being brought under horticulture and a consequent increase in the production of fruits and vegetables. The horticulture sector contributes about 24.5 percent toward agricultural GDP, from only about 8 percent of the cultivated area (Ramachandran 2007a). India ranks number one in vegetable production and number two in fruit production in the world; however, the share of the population with adequate intake of these products is low (21 to 27 percent), particularly in deprived settings (Ramachandran 2007a, 2007b, 2008). India has identified horticultural crops as a means of diversification for making agriculture more profitable through efficient land use, optimum utilization of natural resources (soil, water, and the environment), and creating skilled employment for the rural masses, especially women (Ramachandran 2007a). However, the low availability and high cost of fruits and vegetables are attributed to the following factors, for which remedial measures are being contemplated. Their shelf life ranges from a week to three months, unlike the shelf life of three years or more for foodgrains. There is a paucity of essential infrastructure for preservation, cold storage, refrigerated transportation, rapid transit, grading, processing, packaging, and quality control. Losses during packaging and transport are estimated to be nearly one-third (Ramachandran 2007a).

The phenomenal success of the *white revolution* in India in the past three decades has been acclaimed globally: there has been almost a fivefold increase in milk production since independence (Figure4.5), which has led to greater consumption of milk and milk products, even in deprived settings (Ramachandran 2007a). Milk is an important source of animal protein in a traditionally vegetarian society. This success has been largely possible through cooperative movements and establishing efficient distribution mechanisms.

Figure 4.5—Time trends in production and per capita availability of milk in India



Source: Reproduced from Ramachandran (2007a) based on data from the Department of Animal Husbandry, Dairying and Fisheries (India, Ministry of Agriculture2007d).

Processed Foods

Ideally, the processed food industry cannot be considered to be a central part of the agricultural sector. However, this related sector deserves a brief mention because it is increasingly believed to be contributing to overnutrition, particularly in the Western world (Popkin et al. 2001; WHO 2003, 2005; Nishida et al. 2004; Nugent 2004; Pingali and Khwaja 2004; Popkin 2006, 2011; Narayanan 2007; Ramachandran 2007b; Misra and Khurana 2009; Ramachandran and Snehalatha 2010). In India, the rapid expansion of food processing and the globalization of trade have dramatically influenced dietary consumption patterns, particularly in urban areas. This has led to greater consumption of unhealthy processed foods, resulting in an excessive intake of calories through oils, fats, and sugar (sugar-sweetened beverages), and of salt (which contributes to hypertension). There is convincing epidemiological evidence that a rising intake of fats and sugar, especially from sweetened beverages, is contributing to an increase in obesity and metabolic syndrome (Drewnowski 2007; Hu and Malik 2010; Malik et al. 2010a, 2010b). It has, however, been proposed that much of past epidemiologic research is consistent with a single parsimonious explanation: obesity has been linked repeatedly to consumption of low-cost foods (Drewnowski 2007). Refined grains, added sugars, and added fats are inexpensive, good tasting, and convenient. The fact that energy-dense foods (megajoules/kilogram) cost less per megajoule than do nutrient-dense foods means that energy-dense diets are not only cheaper but may be preferentially selected by the lower-income consumer. In other words, the low cost of dietary energy (dollars/megajoule), rather than specific food, beverage, or macronutrient choices, may be the main predictor of population weight gain (Drewnowski 2007).

Summary of the Agricultural Sector and Overnutrition Link

In summary, evidence suggests that changes in the agricultural sector are contributing to overnutrition. Agricultural policies and production practices affect diet through their influence on food availability, price, and nutrient quality, which, in turn, affect the food choices available to consumers. Agricultural policies amenable to intervention include input, production, and trade policies; agricultural production practices amenable to intervention include crop breeding and crop systems diversity. The rapid expansion of food processing and the globalization of trade have also dramatically influenced dietary consumption patterns, particularly in urban areas, resulting in an excessive intake of calories through oils, fats, and sugar, and of salt.

5. THE FUTURE ROLE OF THE AGRICULTURAL SECTOR IN PREVENTING AND CONTROLLING OVERNUTRITION

The current national concern and policy response is solely restricted to tackling anthropometric undernutrition. Policymakers and other stakeholders should urgently and simultaneously address overnutrition and associated lifelong morbidities. While doing this, in principle, two potential failings should be avoided: (1) interventions designed to mitigate one component of the dual burden (undernutrition and overnutrition) should not inadvertently escalate the other and (2) socioeconomic equity should not worsen rather than improving—for example, the livelihoods of poor agricultural producers should not be threatened (Cecchini et al. 2010).

Although agrifood systems are intimately associated with the escalation of overnutrition, the agricultural and health sectors are largely disconnected in their priorities, policies, and analysis, with neither side considering the complex interrelation between agritrade, patterns of food consumption, health, and development (Lock et al. 2010). There is an obvious need to develop an insightful convergence between these sectors where the policy and scientific domains are concerned. Simultaneously, urgent research must be initiated to understand (1) whether agricultural policies and production practices are contributing to, or detracting from, efforts to attain dietary goals; (2) where and how agricultural interventions could help achieve dietary goals; and (3) whether there are trade-offs between agricultural interventions for tackling diet-related non-communicable diseases and other important concerns.

It is apparent that dietary changes are merely one of the important drivers of the escalating overnutrition burden. Interventions in the agrifood sector will therefore only partially mitigate overnutrition at the population level. The benefits of a healthy diet policy will vary considerably between different populations, not only because of population dietary intake but also because of agricultural production, trade, and other economic factors. Recent work has shown the importance of connecting these perspectives through estimation of the effects of adopting a healthy diet on population health, agricultural production, trade, the economy, and livelihoods, with a computable general equilibrium approach (Lock et al. 2010).The findings suggest that the United Kingdom would accrue pronounced health benefits and associated low costs from the adoption of a healthy diet, whereas Brazil would gain few health benefits but would experience far more substantial economic costs(Locket al. 2010). In the Indian setting, the potential benefits may likewise vary among regions, urban or rural settings, and rich or poor.

A recent report presents detailed analyses and assessments of public health strategies designed to tackle behavioral risk factors for chronic diseases that are closely linked with obesity, including aspects of diet and physical inactivity, in Brazil, China, India, Mexico, Russia, and South Africa (Cecchini et al. 2010). The United Kingdom was included for comparative purposes. The findings indicate that several population-based prevention policies can be expected to generate substantial health gains while entirely or largely paying for themselves through future reductions in healthcare expenditures. These strategies include health information and communication strategies that improve population awareness about the benefits of healthy eating and physical activity, fiscal measures that increase the price of unhealthy food content or reduce the cost of healthy foods rich in fiber, and regulatory measures that improve nutritional information or restrict the marketing of unhealthy foods to children. It was concluded that a package of measures for the prevention of chronic diseases would deliver substantial health gains with a very favorable cost-effectiveness profile.

In this detailed comparative analysis (Cecchini et al. 2010), the cost per head (calculated for 2005) of agrifood interventions was estimated to be among the least in India. Extrapolating from these data, the following cost-effective agrifood strategies may produce the largest health gains in the shortest time frame in India: (1) fiscal measures that increase the price of unhealthy food content or reduce the cost of healthy foods rich in fiber (less than US$0.01 per head) and (2) regulatory measures that improve nutritional information or restrict the marketing of unhealthy foods, particularly to children (less than US$0.01 per head for food advertising regulation and US$0.05 per head for food labeling). Health gains

from interventions targeting children will occur only in the long term. The fiscal measures were estimated to result in cost savings after 20 and 50 years of intervention. The cost-effectiveness ratios (US$ per disability-adjusted life year averted) for food advertising regulation and food labeling after 20 years of intervention were estimated to be 3,186 and 952, respectively. The corresponding estimates after 50 years of intervention were 332 and 776, respectively.

In view of the importance of regulating the marketing of foods and nonalcoholic beverages to children, the World Health Organization recently issued recommendations on this subject (WHO 2010). The role of taxation of processed foods, particularly of sugar-sweetened beverages, is a subject of contemporary debate in the United States (Brownell et al. 2009; Powell and Chaloupka 2009; Dellava, Bulik, and Popkin 2010). A systematic review (Powell and Chaloupka 2009) concluded that the limited existing evidence suggests that small taxes or subsidies are not likely to produce significant changes in BMI or obesity prevalence but that nontrivial pricing interventions may have some measurable effects on Americans' weight outcomes, particularly for children and adolescents, low-SES populations, and those most at risk for overweight.

It is obvious that no robust evidence from randomized controlled trials is available to definitively guide agrofood interventions for mitigating the overnutrition burden at the population level. However, some exploratory leads do emerge from the available evidence reviewed in the earlier sections. In the Indian context, these possibilities need refinement within the two overarching principles of maintaining equity and preventing escalation of undernutrition. These include the following specific agrofood strategies for priority consideration: (1) increased production and lowered cost of pulses to enhance their consumption; (2) improvement in the perennial availability of vegetables and fruits at an affordable cost; (3) increased production of coarse grains, which could also be used to meet the energy requirements of below-poverty-line families at lower cost; (4) taxation of unhealthy (non-communicable-disease-promoting) vegetable oils and fats and possibly, after careful consideration of trade-offs, taxation of all edible oils; (5) taxation of sugar added to beverages; (6) regulatory measures to control the amount of sugar, oil/fat, and salt in processed foods, coupled with their nutritional content labeling; and (7) regulatory measures to restrict the marketing of unhealthy foods, particularly through advertisements. It would be prudent to caution that these possibilities would need detailed research and analyses prior to considering interventions, preferably on a pilot basis.

Summary of the Future Role of the Agricultural Sector in Overnutrition

In summary, agrofood interventions should avoid two potential mistakes: (1) mitigation of one component of the dual burden (undernutrition and overnutrition) should not inadvertently escalate the other and (2) socioeconomic equity should not worsen rather than improving. Cost-effective strategies that may produce the largest health gains in the shortest time frame include (1) fiscal measures that increase the price of unhealthy food content or reduce the cost of healthy foods and (2) regulatory measures that improve nutritional information or restrict the marketing of unhealthy foods, particularly to children. The following possibilities merit priority consideration: (1) increasing access and consumption of pulses, vegetables and fruits, and coarse grains and (2) taxation and regulatory measures to curtail the consumption of unhealthy vegetable fats and oils, and processed foods with a high content of oils, fats, sugars, and salt.

APPENDIX: DETAILS OF SEARCH STRATEGY FOR INDIA-SPECIFIC SEARCH

Table A.1—Search terms

Nutrition and practices		Agriculture and income		Location		Other
Diet*	AND	Agricultur*	AND	India*	AND	1990-current
Nutrition*		Crop*				
Food*		Farm*				English language
Anthropomet*		"agri* product*"				
Maln*		"agri* growth"				NOT animal terms or water (returns too many irrelevant references)
Wast*		"agri* income"				
Stunt*		"farm* product*"				
Underweight		"farm* growth"				
BMI		"farm* income"				Human only (where possible to select)
Health*		(Female employ*)				
Micronutrient*		(wom?n employ*)				
Calorie*		"rural growth"				
"child* grow*"		"agri* polic*"				
"car* practice*"		"farm* polic*"				
"car* capacity*"						
"food expend*"						
"health* expend*"						
"non-food expend*"						
"household expend*"						
"energy expend*"						
Consum*						
"intra household allocation"						
Poverty						
(food price*)						
(food cost*)						
(health* cost*)						
"purchasing power"						

Source: Author's compilation.

Table A.2—Databases and resources searched

Resource	Description
CAB Abstracts via Ovid	Searchable database of peer-reviewed journal articles and published literature; focus on applied life sciences, including agriculture and nutrition
MEDLINE via Ovid EMBASE via Ovid	Searchable, complementary databases of peer-reviewed journal articles and published literature; focus on health, including nutrition and care
Global Health Archive via Ovid	Searchable database of journal articles, conference proceedings, books, and gray literature; focus on international public health
RePEc	Searchable database of journal articles and gray literature in economics
WorldCat	Wide-ranging library search, filtered by IFPRI
AgEcon Search	Searchable database of research in agricultural and applied economics
EconLit	Searchable database of journal articles and gray literature; focus on economics
Scopus	Searchable database of peer-reviewed literature
ADB Asian Development Review	Searchable database of economic and development research from the Asian Development Bank
ELDIS	Searchable website hosted by IDS, archiving gray literature including case studies; policy briefings; statistics; research reports; working papers or conference papers from NGOs and international, national, or governmental organizations, academic bodies, and private companies. Can focus on agriculture or health.
Government of India websites	Ministries of Agriculture, Women and Child Development, and Health and Family Welfare
Research institute websites	World Bank; GCIAR, including IFPRI
Other sites	Right to Food, India; UNSCN; FAO

Source: Author's compilation.

Table A.3—Initial search results

	Searches	Results
	CAB Abstracts via Ovid	
1	Agriculture	155,296
2	Nutrition	237,918
3	India	291,811
4	1 and 2 and 3	381
5	Limit 4 to (English language and yr="1990 -Current")	293
	MEDLINE via Ovid	
1	(diet* or nutrition* or food* or anthropomet* or maln* or wast* or stunt* or underweight or BMI or health* or micronutrient* or calorie* or "child* grow*" or "car* practice*" or "car* capacity" or "food expend*" or "health* expend*" or "non?food expend*" or "household expend*" or consum* or "intra?householdallocat*" or poverty or food price* or food cost* or health* cost* or "purchasing power").mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]	2,787,189
2	(agricultur* or crop* or farm* or "agri* product*" or "agri* growth" or "agri* income" or "farm* product*" or "farm* growth" or "farm* income" or female employ* or wom#n employ* or "rural growth" or "agri* polic*" or "farm* polic*").mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]	104,681
3	India.mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]	70,965
4	1 and 2 and 3	852
5	Limit 4 to (humans and yr="1990 -Current")	331
	EMBASE via Ovid	
1	(diet* or nutrition* or food* or anthropomet* or maln* or wast* or stunt* or underweight or BMI or health* or micronutrient* or calorie* or "child* grow*" or "car* practice*" or "car* capacity" or "food expend*" or "health* expend*" or "non?food expend*" or "household expend*" or consum* or "intra?householdallocat*" or poverty or food price* or food cost* or health* cost* or "purchasing power").mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]	3,777,129
2	((agricultur* or crop* or farm* or "agri* product*" or "agri* growth" or "agri* income" or "farm* product*" or "farm* growth" or "farm* income" or female employ* or wom#n employ* or "rural growth" or "agri* polic*" or "farm* polic*") not animal* not bird* not livestock not cattle not sheep not pig* not chicken* not goat* not duck* not water*).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]	87,141
3	India.mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer]	91,290
4	1 and 2 and 3	590
5	Limit 4 to (human and embase and yr="1990 -Current")	155

(continued)

Table A.3—Continued

	Searches	Results
	Global Health Archive via Ovid	
1	(diet* or nutrition* or food* or anthropomet* or maln* or wast* or stunt* or underweight or BMI or health* or micronutrient* or calorie* or "child* grow*" or "car* practice*" or "car* capacity" or "food expend*" or "health* expend*" or "non?food expend*" or "household expend*" or consum* or "intra?householdallocat*" or poverty or food price* or food cost* or health* cost* or "purchasing power").mp. [mp=abstract, title, original title, broad terms, heading words]	847,132
2	((agricultur* or crop* or farm* or "agri* product*" or "agri* growth" or "agri* income" or "farm* product*" or "farm* growth" or "farm* income" or female employ* or wom#n employ* or "rural growth" or "agri* polic*" or "farm* polic*") not animal* not bird* not livestock not cattle not sheep not pig* not chicken* not goat* not duck* not water*).mp. [mp=abstract, title, original title, broad terms, heading words]	33,579
3	India.mp. [mp=abstract, title, original title, broad terms, heading words]	65,414
4	1 and 2 and 3	891
5	Limit 4 to yr="1990 -Current"	650
	RePEc	
	Agriculture + nutrition + India	6
	WorldCat	
	Agriculture AND nutrition AND India [1990-2011; English; articles]	234
	AgEcon Search	
	((keyword: agriculture) AND (keyword: nutrition) AND (keyword: India))	28
	EconLit via Ovid	
1	(diet* or nutrition* or food* or anthropomet* or maln* or wast* or stunt* or underweight or BMI or health* or micronutrient* or calorie* or "child* grow*" or "car* practice*" or "car* capacity" or "food expend*" or "health* expend*" or "non?food expend*" or "household expend*" or consum* or "intra?householdallocat*" or poverty or food price* or food cost* or health* cost* or "purchasing power").mp. [mp=heading words, abstract, title, country as subject]	158,658
2	(agricultur* or crop* or farm* or "agri* product*" or "agri* growth" or "agri* income" or "farm* product*" or "farm* growth" or "farm* income" or female employ* or wom#n employ* or "rural growth" or "agri* polic*" or "farm* polic*").mp. [mp=heading words, abstract, title, country as subject]	68,230
3	India.mp. [mp=heading words, abstract, title, country as subject]	16,757
4	1 and 2 and 3	1,435
5	Limit 4 to yr="1990 -Current"	1,297
	Scopus	
	Nutrition AND Agriculture AND India	93
	ADB Asian Development Review	
	Agriculture, nutrition, India	140

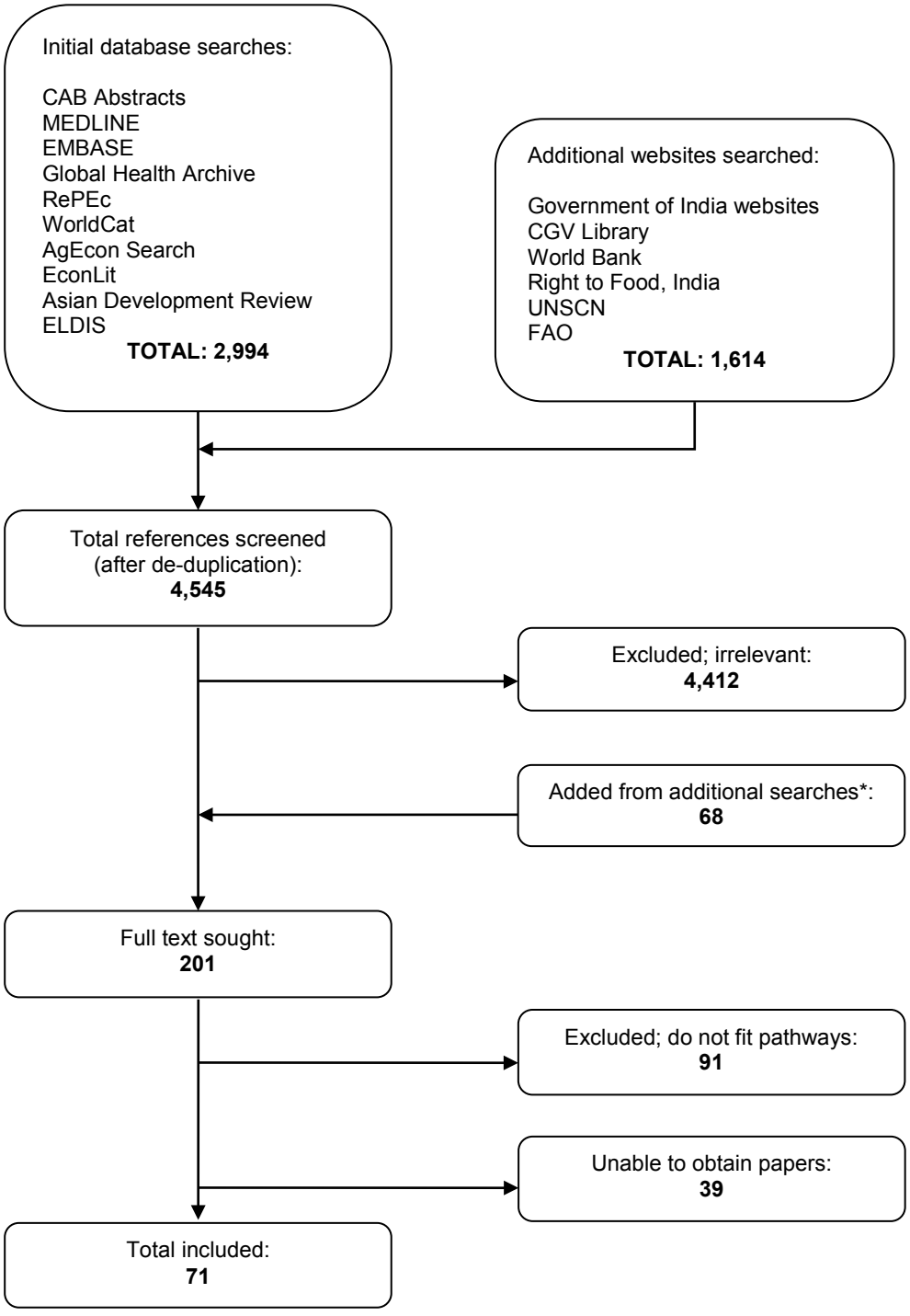
(continued)

Table A.3—Continued

Searches	Results
ELDIS	
South Asia → India → Agriculture[Find keywords 'nutri' or 'food' in title and synopsis]	146
South Asia → India → Health[Find keyword 'agriculture' or 'food' in title and synopsis]	237
FAO	
Agriculture, nutrition, India	2
UN SCN (SCN News)	
No search engine. Searched titles for: Agriculture. Checked article titles for: India	1
Right to Food, India	
No search engine. Checked titles of available publications; screened those with potentially relevant titles	6
World Bank	
Agriculture AND nutrition AND India	668
CGIAR (CGVsearch)	
Nutrition AND India	207

Source: Author's compilation.

Figure A.1—Searches and screening



Source: Author's compilation.

Notes: * Additional searches (November 24, 2010) included the Scopus database, which became available later, and yielded 93 potentially eligible papers, of which 5 were included. Also additional searches of CAB Abstracts, MEDLINE and EMBASE using search terms [overweight OR obese* OR (food policy) AND agriculture AND India], yielding 6 potentially eligible papers, 1 of which was relevant but had already been included. Also added were several potentially eligible papers supplied by Stuart Gillespie and Suneetha Kadiyala (IFPRI staff) that had not been found through previous searches.

REFERENCES

Ajay, V. S., D. Prabhakaran, P. Jeemon, K. R. Thankappan, V. Mohan, L. Ramakrishnan, P. Joshi et al. 2008. "Prevalence and Determinants of Diabetes Mellitus in the Indian Industrial Population."*Diabetic Medicine* 25(10): 1187–1194.

Brownell, K. D., T. Farley, W. C. Willett, B. M. Popkin, F. J. Chaloupka, J. W. Thompson, and D. S. Ludwig. 2009. "The Public Health and Economic Benefits of Taxing Sugar-Sweetened Beverages." *New England Journal of Medicine* 361(16): 1599–1605.

Cecchini, M., F. Sassi, J. A. Lauer, Y. Y. Lee, V. Guajardo-Barron, and D. Chisholm. 2010. "Tackling of Unhealthy Diets, Physical Inactivity, and Obesity: Health Effects and Cost-Effectiveness." *The Lancet* 376(9754): 1775–1784.

Chandalia, M., N. Abate, A. Garg, J. Stray-Gundersen, and S. M. Grundy 1999. "Relationship between Generalized and Upper Body Obesity to Insulin Resistance in Asian Indian Men." *Journal of Clinical Endocrinology and Metabolism* 84(7): 2329–2335.

Chow, C. K., S. Naidu, K. Raju, R. Raju, R. Joshi, D. Sullivan, D. S. Celermajer, and B. C. Neal. 2008. "Significant Lipid, Adiposity and Metabolic Abnormalities amongst 4535 Indians from a Developing Region of Rural Andhra Pradesh." *Atherosclerosis* 196(2): 943–952.

Danaei, G., M. M. Finucane, J. K. Lin, G. M. Singh, C. J. Paciorek, M. J. Cowan, F. Farzadfar et al. 2011. "National, Regional, and Global Trends in Systolic Blood Pressure since 1980: Systematic Analysis of Health Examination Surveys and Epidemiological Studies with 786 Country-Years and 5.4 Million Participants." *Lancet* 377(9765): 568–577.

Dellava, J. E., C. M. Bulik, and B. M. Popkin. 2010. "Price Changes Alone Are Not Adequate to Produce Long-Term Dietary Change." *Journal of Nutrition* 140(10): 1887–1891.

Doak, C. M., L. S. Adair, M. Bentley, C. Monteiro, and B. M. Popkin. 2005. "The Dual Burden Household and the Nutrition Transition Paradox." *International Journal of Obesity* 29(1): 129–136.

Dohlman, E., S. Persaud, and R. Landes. 2003. *India's Edible Oil Sector: Imports Fill Rising Demand*. Washington, DC: US Department of Agriculture, Economic Research Service.

Drewnowski, A. 2007. "The Real Contribution of Added Sugars and Fats to Obesity." *Epidemiologic Reviews*29: 160–171.

Finucane, M. M., G. A. Stevens, M. J. Cowan, G. Danaei, J. K. Lin, C. J. Paciorek, G. M. Singh et al. 2011. "National, Regional, and Global Trends in Body-Mass Index since 1980: Systematic Analysis of Health Examination Surveys and Epidemiological Studies with 960 Country-Years and 9.1 Million Participants." *Lancet* 377(9765): 557–567.

Garrett, J. L., and M. T. Ruel. 2005. "Stunted Child–Overweight Mother Pairs: Prevalence and Association with Economic Development and Urbanization." *Food and Nutrition Bulletin*26 (2): 209–221.

Gopalan, C. 1999. "The Changing Epidemiology of Malnutrition in a Developing Society: The Effect of Unforeseen Factors." *NFI Bulletin* 20(1): 1–5.

Gray, R., and S. Malla. 2001. "The Evaluation of the Economic and External Health Benefits from Canola Research." In *Agricultural Science Policy*, edited by J. M. Alston, P. G. Pardey, and M. J. Taylor, 211–237. Baltimore and London: Johns Hopkins University Press.

Griffiths, P. L., and M. E. Bentley. 2001. "The Nutrition Transition Is Underway in India." *Journal of Nutrition* 131(10): 2692–2700.

Grigg, D. 1995. "The Nutritional Transition in Western Europe." *Journal of Historical Geography*21 (1): 247–261.

Gupta, R. 2004. "Trends in Hypertension Epidemiology in India." *Journal of Human Hypertension* 18(2): 73–78.

———. 2008. "Recent Trends in Coronary Heart Disease Epidemiology in India." *Indian Heart Journal* 60(2 Suppl B): B4–18.

Gupta, R., and P. Kumar. 2008. “Global Diabetes Landscape—Type 2 Diabetes Mellitus in South Asia: Epidemiology, Risk Factors and Control.”*Insulin*3: 78–94.

Gupta, R., and A. Misra. 2007. “Type 2 Diabetes in India: Regional Disparities.” *British Journal of Diabetes and Vascular Disease* 7(1): 12–16.

Gupta, R., P. Joshi, V. Mohan, K. S. Reddy, and S. Yusuf. 2008. “Epidemiology and Causation of Coronary Heart Disease and Stroke in India.” *Heart* 94 (1): 16–26.

Haddad, L. 2003. *What Can Food Policy Do to Redirect the Diet Transition?* Food Consumption and Nutrition Division Discussion Paper No. 165. Washington, DC: International Food Policy Research Institute.

Hawkes, C. 2006. “Uneven Dietary Development: Linking the Policies and Processes of Globalization with the Nutrition Transition, Obesity and Diet-Related Chronic Diseases.” *Globalization and Health* 2: 4.

———. 2007. “Promoting Healthy Diets and Tackling Obesity and Diet Related Chronic Diseases: What Are the Agricultural Policy Levers?” *Food and Nutrition Bulletin*28 (Supplement 2): S312–S322.

Hawkes, C., M. T. Ruel, S. Babu. 2007. “Agriculture and Health: Overview, Themes, and Moving Forward.” *Food and Nutrition Bulletin* 28(Supplement 2): S221–S226.

Headey, D., A. Chiu, and S. Kadiyala. 2011. *Agriculture’s Role in the Indian Enigma: Help or Hindrance to the Undernutrition Crisis*. Discussion Paper. Washington, DC: International Food Policy Research Institute.

Hu, F. B., and V. S. Malik. 2010. “Sugar-Sweetened Beverages and Risk of Obesity and Type 2 Diabetes: Epidemiologic Evidence.” *Physiology and Behavior* 100(1): 47–54.

Huffman, M. D., D. Prabhakaran, C. Osmond, C. H. Fall, N. Tandon, R. Lakshmy, S. Ramjiet al. 2011. “Incidence of Cardiovascular Risk Factors in an Indian Urban Cohort: Results from the New Delhi Birth Cohort.” *Journal of the American College of Cardiology*57 (17):1765-1774.

ICN (*Indonesian Commercial Newsletter*) 2003. “CPO Industry Still Open for New Investment.”2003. No. 29: 7–21.

India. 2007a. *Tenth Five-Year Plan, 2002–2007*. New Delhi: Planning Commission.

———. 2007b. *Agricultural Statistics at a Glance 2007*. New Delhi: Department of Agriculture and Cooperation, Ministry of Agriculture. http://eands.dacnet.nic.in/At_Glance_2007.htm. Accessed April 3, 2012.

———. 2007c. *Economic Survey of India 2006–2007*. New Delhi: Ministry of Finance. http://indiabudget.nic.in/es2006-07/esmain.htm.Accessed September 24, 2007.

———. 2007d. *Dairy*. New Delhi: Ministry of Agriculture, Department of Animal Husbandry, Dairying and Fisheries. http://dahd.nic.in/dahd/statistics/animal-husbandry-statistics.aspx. Accessed April 4, 2012.

Jones-Smith, J. C., P. Gordon-Larsen, A. Siddiqi, and B. M. Popkin. 2011. “Cross-National Comparisons of Time Trends in Overweight Inequality by Socioeconomic Status among Women Using Repeated Cross-Sectional Surveys from 37 Developing Countries (1989–2007).”*American Journal of Epidemiology*173 (6): 667–675.

Kearney, J. 2010. “Food Consumption Trends and Drivers.” Philosophical Transactions of the Royal Society of London, Series B, Biological Sciences 365(1554): 2793–2807.

Kearney, P. M., M. Whelton, K. Reynolds, P. Muntner, P. K. Whelton, and J. He. 2005. “Global Burden of Hypertension: Analysis of Worldwide Data.” *Lancet* 365(9455): 217–223.

Krishnaswamy, K., K. Vijayaraghavan, J. G. Sastry, D. H. Rao, G. Radhiah, K. Kashinath, and M. V. Rao. 1997. *25 Years of National Nutrition Monitoring Bureau*. Hyderabad, India: National Institute of Nutrition.

Lock, K., R. D. Smith, A. D. Dangour, M. Keogh-Brown, G. Pigatto, C. Hawkes, R. M. Fisberg, and Z. Chalabi. 2010. “Health, Agricultural, and Economic Effects of Adoption of Healthy Diet Recommendations.” *Lancet* 376(9753): 1699–1709.

Malik, V. S., B. M. Popkin, G. A. Bray, J. P. Després, and F. B. Hu. 2010a. “Sugar-Sweetened Beverages, Obesity, Type 2 Diabetes Mellitus, and Cardiovascular Disease Risk.” *Circulation* 121(11): 1356–1364.

Malik, V. S., B. M. Popkin, G. A. Bray, J. P. Després, W. C. Willett, and F. B. Hu. 2010b. "Sugar-Sweetened Beverages and Risk of Metabolic Syndrome and Type 2 Diabetes: A Meta-Analysis." *Diabetes Care* 33(11): 2477–2483.

Mintz, S. W. 1986. *Sweetness and Power*. New York: Penguin Books.

Miranda, J. J., S. Kinra, J. P. Casas, G. Davey Smith, and S. Ebrahim. 2008. "Non-communicable Diseases in Low- and Middle-Income Countries: Context, Determinants and Health Policy." *Tropical Medicine and International Health* 13(10): 1225–1234.

Misra, A., and L. Khurana. 2008. "Obesity and the Metabolic Syndrome in Developing Countries." *Journal of Clinical Endocrinology and Metabolism* 93(11 Supplement 1): S9–30.

———. 2009. "The Metabolic Syndrome in South Asians: Epidemiology, Determinants, and Prevention." *Metabolic Syndrome and Related Disorders* 7(6): 497–514.

Misra, A., N. Singhal, and L. Khurana. 2010. "Obesity, the Metabolic Syndrome, and Type 2 Diabetes in Developing Countries: Role of Dietary Fats and Oils." *Journal of the American College of Nutrition* 29(3 Supplement): 289S–301S.

Misra, A., R. Misra, M. Wijesuriya, and D. Banerjee. 2007. "The Metabolic Syndrome in South Asians: Continuing Escalation and Possible Solutions." *Indian Journal of Medical Research* 125(3): 345–354.

Misra, A., P. Chowbey, B. M. Makkar, N. K. Vikram, J. S. Wasir, D. Chadha, S. R. Joshi, S. Sadikot et al. 2009. "Consensus Statement for Diagnosis of Obesity, Abdominal Obesity and the Metabolic Syndrome for Asian Indians and Recommendations for Physical Activity, Medical and Surgical Management." *Journal of the Association of Physicians of India* 57 (2): 163–170.

Mitchell, D. 2004. "Sugar Policies: Opportunity for Change." Trade note.

Mohan, V. 2011. "Diabetes Epidemic in India: Why and What Can Be Done?" *NFI Bulletin* 32(1): 1–4.

Mohan, V., S. Sandeep, R. Deepa, B. Shah, and C. Varghese. 2007. "Epidemiology of Type 2 Diabetes: Indian Scenario." *Indian Journal of Medical Research* 125(3): 217–230.

Narayanan, S. 2007. "A Revolution in the Making: The Case of Agro-Food Retailing in India." In *Food Policy for Developing Countries: The Role of Government in the Global Food System*, edited by P. Pinstrup-Andersen, F. Cheng, S. E. Frandsen, A. Kuyvenhoven, and J. von Braun. Ithaca, NY, US: Cornell University.

Nishida, C., R. Uauy, S. Kumanyika, and P. Shetty. 2004. "The Joint WHO/FAO Expert Consultation on Diet, Nutrition and the Prevention of Chronic Diseases: Process, Product and Policy Implications." *Public Health Nutrition* 7(1A): 245–250.

NSSO (National Sample Survey Organisation). 2006. "NSSO Surveys 1973–2005." http://mospi.nic.in/mospi_nsso_rept_pubn.htm.Accessed March 4, 2008.

Nugent, R. 2004. "Food and Agriculture Policy: Issues Related to Prevention of Non-communicable Diseases." *Food and Nutrition Bulletin*25 (2): 200–207.

Pingali, P., and Y. Khwaja. 2004. *Globalisation of Indian Diets and the Transformation of Food Supply Systems*. ESA Working Paper No. 04-05.Rome: Food and Agriculture Organization of the United Nations, Agricultural Development Economics Division.

Pinstrup-Andersen, P. 2005. "Agricultural Research to Improve Human Nutrition." In *The World Life Sciences Forum. Health for All? Agriculture and Nutrition, Bioindustry and Environment: Analyses and Recommendations*. Vol. 2, 7–20. Weibheim, Germany: World Life Sciences Forum.

Popkin, B. M. 2006. "Global Nutrition Dynamics: The World Is Shifting Rapidly toward a Diet Linked with Noncommunicable Diseases." *American Journal of Clinical Nutrition* 84(2): 289–298.

———. 2010. "Does Global Obesity Represent a Global Public Health Challenge?" *American Journal of Clinical Nutrition* 93 (2): 232–233.

———. 2011. “Contemporary Nutritional Transition: Determinants of Diet and Its Impact on Body Composition.” *Proceedings of the Nutrition Society* 70(1): 82–91.

Popkin, B. M., S. Horton, S. Kim, A. Mahal, and J. Shuigao. 2001. “Trends in Diet, Nutritional Status, and Diet-Related Noncommunicable Diseases in China and India: The Economic Costs of the Nutrition Transition.” *Nutrition Reviews* 59(12): 379–390.

Powell, L. M., and F. J. Chaloupka. 2009. “Food Prices and Obesity: Evidence and Policy Implications for Taxes and Subsidies.” *Milbank Quarterly* 87(1): 229–257.

Prabhakaran, D., P. Shah, V. Chaturvedi, L. Ramakrishnan, A. Manhapra, and K. S. Reddy. 2005. “Cardiovascular Risk Factor Prevalence among Men in a Large Industry of Northern India.” *National Medical Journal of India* 18(2): 59–65.

Price, G. K., R. Landes, and A. Govindan. 2003. *India’s Pulse Sector: Results of Field Research*. Washington, DC: US Department of Agriculture, Economic Research Service.

Ramachandran, P. 2007a.*Nutrition Transition in India 1947–2007*. New Delhi: Nutrition Foundation of India.

———. 2007b. *Dual Nutrition Burden in India: National Report for FAO*. New Delhi: Nutrition Foundation of India.

———. 2008. “Changing Food Consumption Patterns in India.” *NFI Bulletin* 29(2): 1–5.

Ramachandran, A., and C. Snehalatha. 2010. “Rising Burden of Obesity in Asia.” *Journal of Obesity*. DOI: 10.1155/2010/868573.

Ramachandran, A., R. C. Ma, and C. Snehalatha. 2010. “Diabetes in Asia.” *Lancet* 375 (9712): 408–418.

Ramachandran, A., C. Snehalatha, A. Kapur, V. Vijay, V. Mohan, A. K. Das, P. V. Rao et al. 2001. “High Prevalence of Diabetes and Impaired Glucose Tolerance in India: National Urban Diabetes Survey.” *Diabetologia* 44 (9): 1094–1101.

Reddy, K. S., D. Prabhakaran, V. Chaturvedi, P. Jeemon, K. R. Thankappan, L. Ramakrishnan, B. V. M. Mohan et al. 2006. “Methods for Establishing a Surveillance System for Cardiovascular Diseases in Indian Industrial Populations.” *Bulletin of the World Health Organization* 84(6): 461–469.

RGI (Registrar General of India). 2004. *Population Projections for India and States 2001–2026*. Report of the Technical Group on Population Projections. New Delhi.

Sachdev, H.P.S. 1997. “Nutritional Status of Children and Women in India: Recent Trends.” *NFI Bulletin* 18(3): 1–5.

———. 2003. “Recent Transitions in Anthropometric Profile of Indian Children: Clinical and Public Health Implications.” *NFI Bulletin* 24(2): 6–8.

Sachdev, H. P. S., and D. Shah. 2007. “Epidemiology of Maternal and Fetal Malnutrition in South Asia.” In *Perinatal and Newborn Care in South Asia*, edited by Z. Bhutta, 75–105. Oxford, UK: Oxford University Press.

Sachdev, H. S., C. H. Fall, C. Osmond, R. Lakshmy, S. K. Dey Biswas, S. D. Leary, K. S. Reddy et al. 2005. “Anthropometric Indicators of Body Composition in Young Adults: Relation to Size at Birth and Serial Measurements of Body Mass Index in Childhood in the New Delhi Birth Cohort.” *American Journal of Clinical Nutrition* 82(2): 456–466.

Schnepf, R. D., E. Dohlman, and C. Bolling. 2001. *Agriculture in Brazil and Argentina: Developments and Prospects for Major Field Crops*. Washington, DC: Economic Research Service, US Department of Agriculture.

Shetty, P. S. 2002. “Nutrition Transition in India.” *Public Health Nutrition* 5(1A): 175–182.

Sicree, R., J. Shaw, and P. Zimmet. 2009. “Diabetes and Impaired Glucose Tolerance.” In *Diabetes Atlas*, edited by D. Gan, 1–105. Brussels, Belgium: International Diabetes Federation.

Singh, R. B., D. Pella, V. Mechirova, K. Kartikey, F. Demeester, R. S. Tomar, R. Beegom et al. 2007. "Prevalence of Obesity, Physical Inactivity, and Undernutrition: A Triple Burden of Diseases during Transition in a Developing Economy. The Five City Study Group."*Acta Cardiologica* 62(2): 119–127.

Teo, K., C. K. Chow, M. Vaz, S. Rangarajan, and S. Yusuf. 2009. "The Prospective Urban Rural Epidemiology (PURE) Study: Examining the Impact of Societal Influences on Chronic Noncommunicable Diseases in Low-, Middle-, and High-Income Countries." *American Heart Journal* 158(1): 1–7 e1.

UNDP (United Nations Development Programme)/India. 2009. *India: Urban Poverty Report*. New Delhi: UNDP and Ministry of Housing and Urban Poverty Alleviation, India.

Wang, Y., H. J. Chen, S. Shaikh, and P. Mathur. 2009. "Is Obesity Becoming a Public Health Problem in India? Examine the Shift from Under- to Overnutrition Problems over Time." *Obesity Review* 10(4): 456–474.

Webb, P., and S. Block. 2010. "Agriculture Development and Nutrition Security Special Feature: Support for Agriculture during Economic Transformation: Impacts on Poverty and Undernutrition." *Proceedings of the National Academy of Sciences of the United States of America*. DOI: 10.1073/pnas.0913334108.

WHO (World Health Organization). 2003. *Diet, Nutrition and the Prevention of Chronic Diseases*. Report of a Joint WHO/FAO Expert Consultation. WHO Technical Report Series 916. Geneva.

———. 2004. *The Atlas of Heart Disease and Stroke*. Geneva.

———. 2005. *Preventing Chronic Disease: A Vital Investment*. Geneva.

———. 2009. "The Global Burden of Disease: 2004 Update."http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html. Accessed April 4, 2012.

———. 2010. *Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children*. Geneva.

WHO Expert Consultation. 2004. "Appropriate Body-Mass Index for Asian Populations and Its Implications for Policy and Intervention Strategies." *Lancet* 363 (9403): 157–163.

Yajnik, C. S., H. G. Lubree, S. S. Rege, S. S. Naik, J. A. Deshpande, S. S. Deshpande, C. V. Joglekar, and J. S. Yudkin. 2002. "Adiposity and Hyperinsulinemia in Indians Are Present at Birth." *Journal of Clinical Endocrinology and Metabolism* 87(12): 5575–5580.

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