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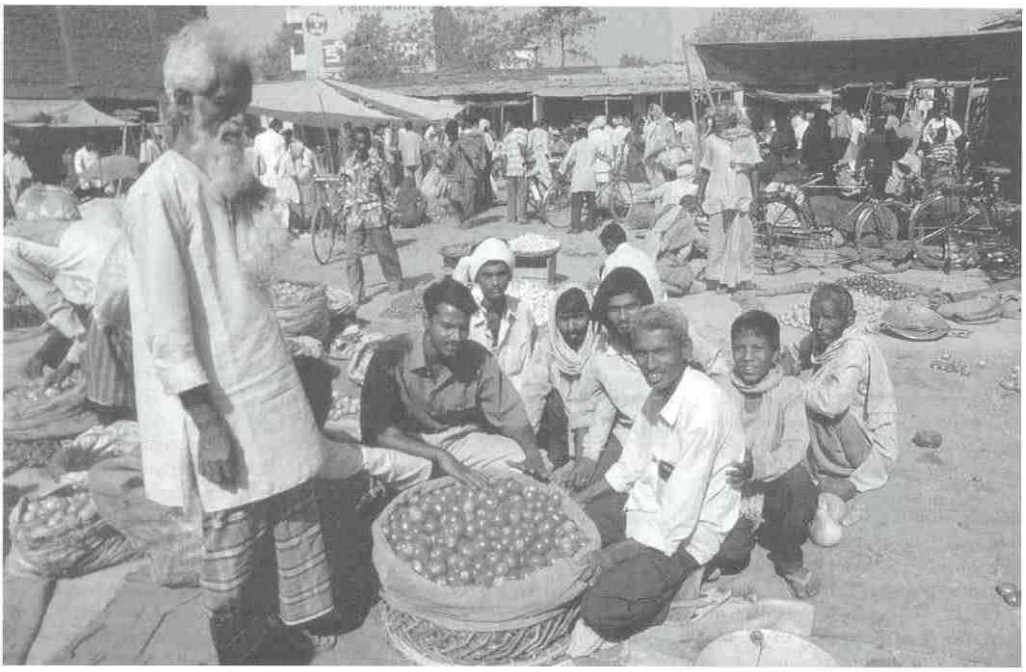


A wholesale market in Varanasi, India.
(Pictures by Nigel Poole)

AIR POLLUTION

Quality and safety of vegetables in India

Searching for quality assurance mechanisms.
By Nigel Poole, Fiona Marshall and Dolf te Lintelo

"... behind the rising prosperity in the developing world lurks the shadow of lethal air pollution from motor vehicles, smokestacks and hearths" (World Bank, 1998: 99). Among the most serious environmental problems in cities is air pollution, which is reaching crisis dimensions in many 'megacities' (urban populations greater than ten million) of the developing world (United Nations Environment Programme, 1999). Respiratory hazards from air pollution in urban areas are widely acknowledged. Another reason for concern is the major threat posed by air pollution to crop production in urban and peri-urban (UPU) areas, where the livelihoods of urban inhabitants are dependent on access to cheap and safe food of high nutritional quality.

The majority of highly perishable products, including many vegetables that are consumed in cities, are produced in UPU areas. For example, 50-70 percent of cauliflower and 70-90 percent of spinach that is marketed in Azadpur, Delhi (the largest fruit and vegetable market in Asia) is produced within the city and the six surrounding peri-urban districts. Mother Dairy, the main co-operative providing produce to Delhi consumers, also procures 70 percent of its produce from these UPU areas.

Air pollution reduces both the yield and nutritional quality of crop plants, with important implications for consumers and producers, particularly the poor. Air pollution is also a major source of metals such as lead, cadmium, zinc and copper which can accumulate at toxic levels in the edible portion of crop plants. Public awareness of the health, education and economic implications of unsafe food systems in developing economies is growing fast.

Sources of pollution

The adverse effects of air pollution have been associated with three major sources. They are sulphur oxide and solid particulates from fossil fuels, photochemical oxidants and carbon monoxide from motor vehicles, and miscellaneous pollutants such as hydrogen sulphide, lead and cadmium emitted by smelters, refineries,

manufacturing plants and vehicles (Birley and Lock, 1999). Increased numbers of motor vehicles, power generation, domestic fuel use, refuse burning and other sources all contribute to the problem. Particular cities present particular problems: India's economy relies heavily on coal, which contributes high levels of SO_2 emissions. In Delhi, where the population is growing at 3.8 percent per annum, and in Mumbai, levels of particulate matter exceed World Health Organization recommended levels by a factor of three (United Nations Environment Programme, 1999).

Impacts on crop output and value

Phytotoxic gases have been found to cause yield reductions of 40 percent or more on rice and wheat output on the outskirts of Lahore, Pakistan, and on spinach and mustard on the outskirts of Varanasi, India. Air pollution also has the potential to reduce the nutritional quality of crop plants, with important implications for consumers, particularly the poor. Air pollution can cause visible damage to the edible portion of the crop, increase susceptibility to post-harvest pest and disease, and reduce shelf life, with important economic losses throughout the market chain.

Impacts on crop safety

There are also major concerns over toxicity in food crops caused by emissions of fluorides (particularly associated with brick kilns that are prevalent in peri-urban areas) and heavy metal deposition (for example lead, cadmium, zinc and copper). These can accumulate at toxic levels in the edible portion of crop plants. Exposure to heavy metals has been linked with developmental retardation and reduced IQ among children, various cancers, kidney damage, and the development of autoimmunity.

Food quality and assurance mechanisms

The food quality attributes associated with vegetables, the suggested incentives and potential QA mechanisms for hazards resulting from airborne contaminants are summarised in Table 1.

Efficient, effective and relevant food QA mechanisms in advancing economies are likely to involve improved scientific knowledge, accompanied by technical and institutional responses through both regulatory and market mechanisms, and commercially propitious business attitudes. Information and incentives are likely to play a part in QA mechanisms at least as important as policy, especially where the regulatory environment is weak.

Various authors have raised doubts about the generally weak institutional framework in India. Nevertheless, evidence suggests that there is potential in India for public sector institutions to verify the quality of food products. An example is Operation Flood, launched in the early 1970s by the National Dairy Development Board to combat milk adulteration. The measures involved the formation of co-operatives, the adoption of quality standards, improved product testing, provision of technical assistance, subsidies for improved processing facilities, and the adoption of branding by the co-operatives. There was a significant improvement to the quality of milk, and incomes of a million producers in the target area were doubled by 1979 (World Bank, 1998: 73).

Table 1: QA for airborne pollution effects on UPU horticultural products

Quality/safety attributes	Example	Likely incentive framework	Potential assurance mechanisms
'Search' goods	• physical appearance: freshness; variety; size and shape; colour; maturity; visible injury	• market-mediated	• information through inspection
'Experience' goods	• organoleptic characteristics: freshness; flavour; texture; smell	• market-mediated	• inspection and information through behaviour and reputation effects: repeat purchase; labelling; branding; trust; provenance
'Credence' goods	• production and post-harvest technologies • nutritional value: nutrient content, especially vitamins and minerals; freedom from environmental contaminants such as heavy metals	• public policy incentives and constraints; • mandatory interventions • public information provision	• control through: scientific testing and implementation of accepted standards; (self-) certification; self-regulation through market structure and conduct;institutions creating and enforcing liability • information on 'best practice' production technology, post-harvest and household handling

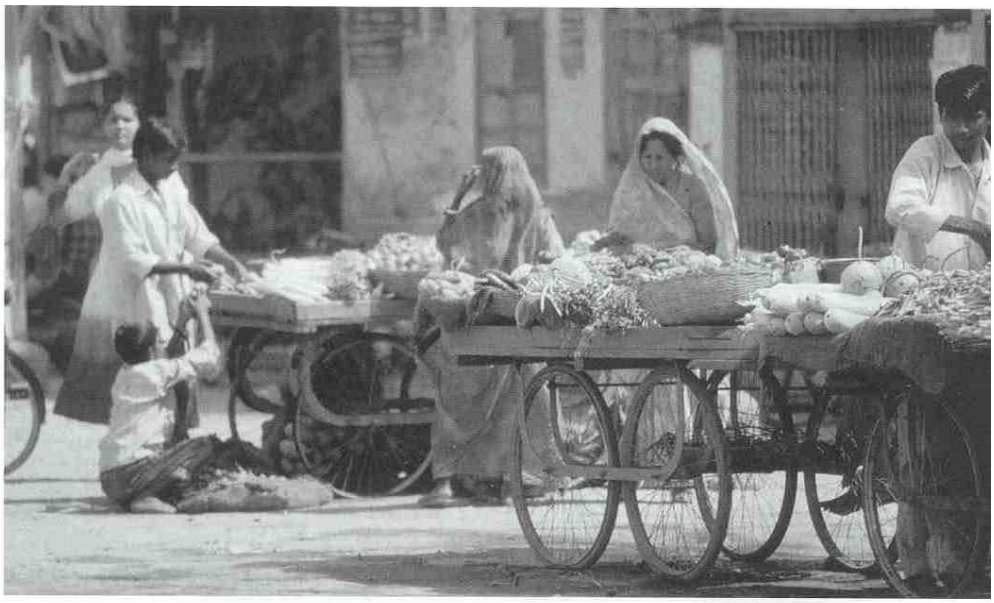
Lessons for food safety

Within this broad policy scenario, there are lessons for food safety. There may be a place for industry and national initiatives, but local interventions provide the precision to tackle specific problems. They are likely to take the form of incentives rather than controls. They must account for a range of stakeholder interests (in particular consumer interests, but also those of poor labourers, producers and intermediaries). The objectives should not just fall within the narrow confines of food policy interventions but take into account also the broader health and education imperatives. Strong political support and public awareness and action are essential for an effective state role in food policy.

It would be presumptuous to present a framework for food QA in India, with its huge economy, diverse society and complex institutions. However, the foregoing discussion of QA issues serves to highlight areas which must be considered in tackling critical food safety hazards associated with air pollution in Delhi and other UPU areas.

Identification of hazards

A measured policy approach must be predicated on a better understanding of the hazards within UPU horticultural markets. Subsequently, the determination of critical points employs a range of techniques involving scientific testing for cont-



Street sales in Varanasi, India.

Table 2: Critical point determination

Quality and safety characteristics	Market system stages: - field-level production - wholesale handling and marketing - retail handling and marketing - household-level consumption
Safety and contaminant levels	Monitoring ambient pollutant levels Product testing
Other objective & subjective attributes	Product testing Quantitative surveys of stakeholders
Technology & handling practices	Quantitative surveys of stakeholders Observation and appraisal

aminants and objective nutritional quality, quantitative surveys of consumer perceptions, and participant observation of technology, handling practices and exposure to hazards (Table 2). Quantification of hazards and identification of critical points is to be conducted in relation to accepted national and international standards.

Low levels of health hazard awareness and high rates of poverty mean that effective demand for food safety is probably low. Market failure is likely, and public intervention is probably necessary to tackle the social costs. Direct public intervention is likely to be necessary for improving food quality through implementing emission controls in line with national and international standards.

Three final points can be made. First, in an environment such as Delhi in which the Mother Dairy co-operative structure is flourishing, evidently there is an enabling role for the state to facilitate horticultural market re-organisation in order to exploit the benefits of market scale, concentration and ease of vertical co-ordination. Associative organisations involving producers will enable mechanisms such as branding, labelling and self-certification to become feasible.

Secondly, creative public intervention can address the awareness issues that are preconditions for effective public participation. Dissemination of knowledge about health hazards and standards through the appropriate public bodies can be allied to support for consumer groups, in the expectation that awareness will lead to the kind of participatory public action referred to above.

The challenge of achieving fruitful public sector co-ordination can only be highlighted here, however: among the constraints affecting healthy city initiatives generally are significant difficulties in im plementing an integrated approach, an also securing political backing by local de cision-makers.

Improved market organisation an vertical co-ordination in particular are like ly to be fundamental to improve the flo of incentives and information. Again, a fa cilitatory approach by the state adminis tration is indicated. Emulating the succes es of Operation Flood, the public author ties at the level of cities such as Delhi ca implement standards and introduce limi ed scale testing in such a way as to ir crease transaction costs. Together wit heightened public awareness and publi action, this has the potential to provide ir

centives for institutional innovation to mitigate the transaction costs by improving market organisation and adopting best practice technologies throughout the horticultural chain.

Finally, consistent information should be provided through the range of different public entities involved in horticultural production and extension, market regulation, food policy initiatives and consumer organisations. The development of consumer power is likely to be one of the most powerful forces for impelling improved standards, and may take two forms. Firstly, awareness creates the possibility of lobbying by informed local and national consumer organisations, and second may serve to empower the decisions of consumers, even those of limited purchasing power.

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Vegetables arriving through the morning smog at Azadpur market, Delhi, India.

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