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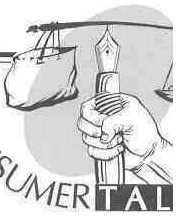


# Quality Assurance Mechanisms for Air Pollution Impacts on Vegetable Systems in India

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> "Health and nutrition are as much dependent on the wholesomeness of food and its freedom from microbial and chemical contamination, as on its adequacy with respect to quantity and nutritive value."
>
> (Bhatt, 1992: 1).

## Prevalence and perception of food contamination

In general, it is often the poor, the underprivileged and the undernourished who bear the brunt of the lack of adequate and nutritious quantities and damaging effects of food contamination (Bhatt, 1992).

A number of food hazards can be distinguished and food scientists, toxicologists and nutritionists prioritise them in order of importance as (Malik, 1993):

1. microbiological hazards
2. nutritional inadequacies
3. natural intoxicants and environmental contaminants
4. hazards from improper use of pesticides and food additives

However, consumers in developed and developing countries have different perceptions about the prioritisation. Consumers in developed countries perceive that the number one problem is chemicals in food, like pesticide residues and food additives. This is reflected in the current increase in popularity of 'organic' produce to the detriment of products that are produced with the assistance of chemical fertilisers, pesticides and herbicides. Similarly, the movement against genetically modified food products is gaining in importance in western countries and is a concern particularly of wealthier consumers.

In contrast, consumers in developing countries regard adulteration of food as the dominant problem. While in developed countries food is predominantly sold in packaged form, in countries like India it is very common to purchase small quantities from bulk containers, enhancing the potential of unscrupulous retailers to tamper with the goods.

As such there is a clear paradox between the actual importance of microbiological food-borne diseases – the most important in the Indian context (Bhatt, 1992) - and the perception of consumers in this respect. A possible explanation is that although consumers are aware of the dangers and the underlying sources like contaminated water and food, poor personal hygiene and unsanitary living conditions, due to its endemic prevalence people treat it with less attention. Also at the level of the government, food-borne diseases are not routinely recorded in the health statistics in India.

## Contamination factors in the production – consumption chain: natural – human handling - environment

Food toxins can occur in the natural state, for instance in Lathyrus sativus, a lentil consumed in some of the central and southern states of India, which can lead to lathyrism. Otherwise, extraneous contaminants of food take the shape of toxin-producing micro-organisms (like moulds, yeast) or chemicals.

Besides natural produce characteristics, contamination of food products in the producer-consumer chain and associated health impacts can however also be a result of poor handling practices and, increasingly, of environmental pollutants.

The environment within which the consumer prepares the food can be an important source of food hazards. Unsanitary living conditions will increase the chances of contamination. This is often a feature of poor urban areas with overcrowding and lack of safe and adequate water supply and sanitation facilities.

Consumer handling practices of food products can have both beneficial and also detrimental effects on food safety. Storage, cooking, washing, processing etc influence contamination levels. For instance, the usage of aluminium cooking utensils may lead to food contamination by this heavy metal.

However, before the consumer is involved in the actual consumption of the food product, the product often has gone through a range of transactions. Rarely does the urban consumer purchase food products directly from growers. Produce usually changes hands between traders, wholesalers, retailers and vendors and on the way it may be processed, transported and stored. The production-consumption marketing chain involves a wide range of activities offering potential points of contamination and opportunities for deliberate food adulteration.

A number of recent food adulteration scares have surfaced in India. The mixing of argemone seeds with mustard seeds leading to contaminated mustard oil resulted in almost 60 cases of dropsy-deaths and numerous other victims in Delhi during 1999. In the same year, milk vendors took to the streets to protest announcements by the government to have stricter control on the common practice of adulterating milk and the production of 'synthetic milk', an artificial brew comprising urea and chalk, nevertheless marketed as milk.

At the producer level, in developing countries, obsolete types of pesticides and usage not in accordance to instructions has lead to pesticide residues in food crops. According to WHO "the little published information that there is, suggests significant exposure of the general population" (http://www.who/int/fsf/fctshtfs.htm). Furthermore, veterinary drug use residues have shown in milk products in a study of Hyderabad (Bhatt and Mmathur, 1997).

## Food contamination in urban and peri-urban environments

In urban and peri-urban areas particularly highly perishable vegetable crops are grown, so while providing landless poor and marginal farmers with a livelihood, these areas also cater to a large extent to the daily needs of urban consumers for fresh produce. For example, 50-70% of cauliflower and 70-90% of spinach that is marketed in Azadpur mandi, is produced within Delhi and the six surrounding peri-urban districts. Mother Dairy, the main co-operative providing vegetable produce to Delhi consumers through its Safal retail outlets, also procures 70% of its produce from these UP areas (Marshall et al, 2000).

With the combined presence of polluting sources like industries and motorised vehicles and areas of agricultural production the exposure of food crops to pre-harvest contamination is relatively high in urban and peri-urban areas. For instance, in Indian industrial cities like Ludhiana, Parwanoo, Faridabad and Chandigarh the application of sewage-irrigation water, often polluted with industrial effluents, has been reported to result in heavy metal contamination of vegetable crops (Vig et al, 1987).

## Air pollution

Air pollution is an environmental factor popularly known for its detrimental effects on health through respiratory diseases rather than its deleterious impacts on food quality and quantity. However, studies reveal that its effects are not limited to health and architectural heritage.

## Impacts of air pollution on crop output, value and crop safety

Phytotoxic gases in particular SO2, NO2 and ground level ozone have been found to cause yield reductions of 40% or more on rice and wheat output on the outskirts of Lahore, Pakistan, and on wheat, spinach, mustard and mung bean on the outskirts of Varanasi and Delhi, 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.

**Exposure to heavy metals has been linked with developmental retardation and reduced IQ among children**

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 safety solutions: the role of information and quality assurance mechanisms

In economic terms, food safety is a 'luxury' good rather than a necessity. Besides income and prices, the demand for food safety probably depends also on perceived risk – which is a function of the level and value of available information and of individual attributes such as age and education.

Information about food commodities has proved to be a crucial ingredient for making improvements towards food safety. Interpreted as a quality attribute, the elements of food safety can be 'search' goods if the consumer is able to obtain information through inspection. Alternatively, food safety is an 'experience' good if the consumer can access readily available information (eg. through labelling), or through repeated purchases or reputation effects (eg. branding) (Nelson, 1970). Goods for which information cannot be discerned even after repeated consumption are named 'credence' goods (Darby and Karni, 1973).

Where incentives and information flows are imperfect, the market alone may fail to provide the level of food safety demanded by society. In such a situation, quality specifications with the appropriate monitoring and enforcement methods may serve as a quality assurance mechanism to provide consumers with the right level of information and internalise the health benefits within the food chain.

## The public-private sector balance

Approaches to public food regulation range from low to high levels of intervention: from the provision of information, through the development and enforcement of standards, to prior approval. Food safety regulations can take two broad forms: performance or process standards. Process standards specify procedures required to produce output of the desired quality. Performance standards specify a quality level that a firm's output must meet, involving enforcement through testing, but allowing the firm autonomy over its production process. In India, regulation often takes place in the form of performance standards.

Information-based incentives for private market solutions may be provision of information to consumers, lowering information costs through improved testing mechanisms, branding, labelling, (self-)certification schemes, and laws creating enforceable liability. Reputation effects and trust are additional private mechanisms which are of considerable importance in advanced economies, and probably no less important in developing economies.

As an example, attributes, the incentives and potential QA mechanisms for hazards resulting from airborne contaminants are summarised in Table 1.

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 increase supply of unadulterated wholesome milk. The measures involved the formation of cooperatives, the adoption of quality standards, improved product testing, provision of technical assistance, subsidies for improved processing facilities, and the adoption of branding by the cooperatives. 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).

**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 | ·information through behaviour and reputation effects: repeat purchase; labelling; branding; trust; provenance |
| 'Credence' goods | ·production and post-harvest technologies<br>·nutritional value: nutrient content, especially vitamins and minerals; freedom from environmental contaminants such as heavy metals | ·public policy incentives and constraints;<br>·mandatory interventions<br>·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<br>·information on 'best practice' production technology, post-harvest and household handling |

## Lessons for food safety

Efficient, effective

and relevant QA mechanisms are likely to involve improved scientific knowledge, accompanied by technical and institutional responses through both regulatory and market mechanisms involving the range of actors in the production-consumption chain: producers, intermediaries and consumers. Therefore, 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.

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.

**The development of consumer power is likely to be one of the most powerful forces for impelling improved 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-organization in order to exploit the benefits of market scale, concentration and ease of vertical coordination. Associative organizations 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, the role of human handling, environmental factors and standards through the appropriate public bodies and NGOs 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.

Improved market organization and vertical coordination in particular are likely to be fundamental to improve the flow of incentives and information. Again, a facilitatory approach by the state administration is indicated. Emulating the successes of Operation Flood, the public authorities can implement standards and introduce limited scale testing in such a way as to increase transaction costs. A role in testing could be perceived for non-governmental organisations as well. Together with heightened public awareness and public action, this has the potential to provide incentives for institutional innovation to mitigate the transaction costs by improving market organization 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 organizations. 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 organizations, and second may serve to empower the decisions of consumers, even those of limited purchasing power. In addition, the release of consistent information may further help to erode the discrepancy between actual prevalence and consumer perceptions of food hazards.

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