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## How can health, agriculture and economic policy actors work together to enhance the external food environment for fruit and vegetables? A qualitative policy analysis in India

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### ABSTRACT

The benefits of fruit and vegetables are well established, particularly their role in preventing general micronutrient-deficiencies and chronic diseases. However, global food systems are not delivering diverse and high quality diets: healthy food is unavailable and too expensive for many. Creating food environments that foster consumer access to fruit and vegetables will require coordinated policy action across sectors, mostly outside of the health sector. The aim of this paper is to identify opportunities to strengthen food system policy for nutrition, through an analysis of the policies relevant to the external food environment for fruit and vegetables in India. We conducted interviews based on policy theory with 55 stakeholders from national and state level, from within government, research, private sector and non-government agencies, and from health, agriculture and economic sectors. Specific strategies identified in this study to improve consumers' external food environment for fruit and vegetables in India were: development of strategic Public-Private Partnerships to increase access to diverse expertise across the supply chain; linking health and economic/agricultural policy agendas; and strengthening surveillance of policy impacts on consumer access to fruit and vegetables. We also found that public health actors can play an important role in advocating for 'consumer oriented' fruit and vegetable supply policy. This study demonstrates the usefulness of 'policy learning'-oriented qualitative policy analysis in identifying 'points of entry' for food policy change, and extends understanding of political dynamics in engendering agricultural policy change for nutrition. Improving access to affordable fruit and vegetables is a global priority, and given common global food supply challenges, the findings from this study are also likely to be relevant for other low and middle income countries.

### 1. Introduction

Malnutrition is a major global cause of poor health, death, and low economic productivity (IFPRI, 2016). Specifically, low consumption of fruit and vegetables is a key dietary contributor to malnutrition in all its forms (Siegel et al., 2014). Fruit and vegetables are naturally rich sources of micronutrients particularly antioxidants such as carotenoids, vitamin C, minerals including iron and zinc. The benefits of fruit and vegetables are well established, particularly their role in preventing general micronutrient-deficiencies and chronic diseases (Kaulmann and Bohn, 2014, Lin et al., 2014). However, global food systems are not

delivering diverse and high quality diets: healthy food is unavailable and too expensive for many (Global Panel on Agriculture and Food Systems for Nutrition, 2016).

As a result, many countries, including India, are experiencing a double burden of malnutrition. The prevalence of undernutrition (48% stunting, 42% wasting and 39% underweight) and micronutrient deficiencies in India remains high, especially among young children (Kotecha and Prakash, 2011, Rukmini and Bansal, 2016). At the same time, risk factors for non-communicable disease continue to increase (Gupta et al., 2011, Misra et al., 2011), and intakes of fruit and vegetables are inadequate (Venkaiah et al., 2002, Kotecha and Lahariya,

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2010, Shaikh et al., 2016). The dietary guidelines of India emphasize a need for whole grains and a variety of fruit and vegetables but implementation of these recommendations is sub-optimal. The average consumption of fruit and vegetables in India is 149–152 g/day/person (< 3 servings) (Sachdeva et al., 2013), compared to the World Health Organization (WHO) recommendation of 400 g/day.

Evidence suggests that to tackle the factors influencing consumption of fruit and vegetables, a comprehensive approach includes addressing structural factors that influence supply (Kamphuis et al., 2006, WHO, 2013, Gelli et al., 2015, Gillespie et al., 2015b, McDermott et al., 2015). Consumers' choices about what to eat are made in a specific food environment, influenced by personal factors (such as desirability, accessibility, convenience and affordability), as well as external factors, such as the availability, price, marketing and vendor and product properties of foods (Global Panel on Agriculture and Food Systems for Nutrition, 2016, Turner et al., 2017). The focus of this research is the external aspect of food environments, which can be strongly influenced by food supply policies. The impact of these policies on external food environments can be enabling or supportive for good nutrition, or can hinder access to affordable, healthy foods (Gillespie and van den Bold, 2017).

Creating an enabling external food environment requires coherent policies across sectors that govern the food system. A wide range of policies across multiple sectors influence processes and costs associated with production, processing, transport, wholesale, and retail marketing practices of fruit and vegetables. These include Agriculture, as well as economic sectors such as Trade, Finance, Commerce and Industry (Hawkes et al., 2013, WHO, 2013, Downs et al., 2015, Thow et al., 2016, Walls et al., 2016). While health actors have an interest in supporting the accessibility of affordable healthy foods – including fruit and vegetables – the health sector has little jurisdiction over the food supply chain. Engaging with food policy making across sectors thus becomes an imperative for health policy makers, but one that is fraught with challenges due to existing policy incoherence (OECD, 2012). There is a need for win-win solutions for food policy, that identify shared policy agendas between health and the sectors governing the food supply chain, and create mutually beneficial outcomes across sectors (Kadiyala et al., 2012). This means that research must engage with the existing policy and governance structures, and build capacity for change among public health practitioners (Hawkes et al., 2012, Gillespie et al., 2015a).

India has favorable climatic conditions to produce a variety of fruit and vegetables, and is the largest producer of fruits in the world and second largest producer of vegetables after China. However, the majority is exported, with limited production for domestic consumption (Kusuma and Basavaraja, 2014, Vanitha et al., 2014). Domestic supply also remains limited due to wastage, including high post-harvest losses, and costs to consumers are relatively high compared to less nutritionally dense foods (Sachdeva et al., 2013, Rais and Sheoran, 2015). The Government of India has made significant investments in The National Food Security Act, which aims to provide subsidized food grains to two-thirds of the population of India (Government of India, 2013). The Act articulates the provision of food as a legal entitlement and leverages several existing food security programmes, such as the Midday Meal Scheme, the Integrated Child Development Services (ICDS) scheme, and the Public Distribution System (PDS). However, the vast National Food Security Act structure distributes only rice, wheat and coarse grains (millets) – not fruit and vegetables.

The aim of this study was to identify specific, contextually appropriate and feasible policy recommendations and strategies for collaboration across sectors to improve the external food environment for fruit and vegetables in India, with the ultimate objective of improving nutrition. We use a 'policy learning'-oriented, qualitative approach to policy analysis that emphasizes the political context, policy processes and actors relevant to the content area (fruit and vegetables) as critical factors in enabling policy change (Walt et al., 2008). The study thus complements other work on the potential impact of specific agricultural

policy interventions on nutrition (Pandey et al., 2016).

## 2. Method

### 2.1. Study design

We conducted a qualitative policy analysis, focused on policies relevant to fruit and vegetable supply (in particular, relating to the 'external' food environment). The primary research question for this study was: *What are opportunities to strengthen fruit and vegetable supply chain policy, in order to improve external food environments for nutrition in India?* This question implies a focus on policy change, and we thus drew on theories of policy learning and policy change to inform the study design, development of instruments and analysis. These theories posit that policy change is influenced by the ideas and beliefs held by policy makers and other actors about the issue, the nature of the policy problem, and the existing policy and political context (Sabatier, 1987, Hall, 1993, Kingdon, 2003). Data were collected from knowledgeable policy actors through semi-structured interviews, based on supply chain structure and Walt and Gilson's framework for policy analysis (Walt and Gilson, 1994), coded thematically with reference to our research question, and analysed with reference to the theories of policy learning and policy change.

### 2.2. Data collection

We conducted interviews with 55 stakeholders knowledgeable about the policy context and process relating to fruit and vegetable supply in India. Interviewees were from national and state level (Agriculture is a state responsibility in India), from within government, research, private sector and non-government agencies, and from agriculture, economic and health sectors (Table 1). Recruitment of interviewees was through formal (written) approaches to the heads of ministries and relevant agencies with responsibilities relevant to the fruit and vegetable supply chain. Once approval was obtained from each Ministry/Agency, we contacted relevant departments to request interviews. At the end of each interview, we asked interviewees to identify further relevant interviewees (within and/or outside of their policy area). The research study was approved by Institutional Ethics Committee of the Public Health Foundation of India (TRC- IEC- 267/ 15).

The interviews were focused on understanding opportunities to strengthen policies relating to fruit and vegetables, and barriers and facilitators to policy reform. The questions were developed based on Hawkes' Consumption-Oriented Supply Chain analysis framework (Hawkes, 2009), the Walt and Gilson policy analysis triangle (Walt and Gilson, 1994), complemented by insights from the policy theory underpinning the study (in particular, the role of ideas, the nature of the policy problem, and the existing context.) Interviews were focused on the following themes relating to fruit and vegetable supply, affordability and accessibility in India:

- What is the existing policy content (across the supply chain), and

**Table 1**  
Summary of interviewees.

Jurisdiction (n = 55)	Agencies (n = 55)	Sector (n = 55)
<b>National level (n = 34)</b>	<b>Government (n = 17)</b>	<b>Agriculture (n = 29)</b>
<b>State level (n = 21; Madhya Pradesh, Punjab, Karnataka, Andhra Pradesh and Maharashtra)</b>	<b>Academia/research (n = 16)</b> <b>Private sector (n = 17)</b>	<b>Trade/economics (n = 8)</b> <b>Public health (n = 18)</b>
	<b>Non-government organizations (n = 5)</b>	

where are there gaps or disincentives that might need to be addressed?

- Who (actors and institutions) makes and implements these policies, and what processes are in place to review or update these policies?
- Which actors are influential in the policy process, and how is their ‘voice’ integrated (or not) into the policy making process?
- Why are these policies made, and what historical precedents, political issues, international commitments, etc. influence these policies?

All interviews were conducted by the research team in the preferred language of the interviewee (English (n = 48) or Hindi (n = 7)) and were recorded. All interviews were transcribed in full by the interviewer within 3 days of the interview being completed. The interviews conducted in Hindi were transcribed in Hindi and then translated into English. The translation quality was cross checked by a second team member.

Throughout data collection, interview transcripts were analysed using an iterative approach, to identify relevant additional interview questions and new potential interviewees. We continued to collect data to the point of theoretical saturation (when minimal new information is obtained from interviewees, and no further interviewees are identified via snowball sampling). Eleven potential interviewees declined to be interviewed, and 97 provided no response to the initial interview request. The non-responders were fairly evenly spread across respondent groups, although government and industry invitees were slightly less likely to respond than researchers.

### 2.3. Analysis

The data were independently coded by four researchers, using predetermined themes based on the study frameworks. The themes/codes included: institutions and actors; existing policies, policy context, factors influencing policy development, factors influencing policy implementation, strengths in existing policies, opportunities/gaps in existing policies, barriers to policy change, facilitators to policy change, and actor roles and interests. Additional codes were identified based on themes emerging from the data, including: factors influencing agricultural/farmer decision-making, political factors influencing policy change, framing, and role for public health. After the first 6 transcripts were coded, we developed a code-book to guide the remainder of the coding. Each transcript coded was checked by a second researcher, to confirm the coding was correct, and any unclear texts were referred to the lead researcher.

The data were then analysed by the lead researcher in response to our main research question: *What are opportunities to strengthen fruit and vegetable supply chain policy, in order to improve external food environments for nutrition in India?* In line with the theoretical framework underpinning the study, our analysis – and the Results presented below – focused on *what*, specifically, policy change might entail (current policy context and opportunities), *who* might be critical in policy change (actors and institutions), and *how* policy change might be influenced (particularly, through strategic framing of policy proposals).

## 3. Results

### 3.1. Current policy context and content

Interviewees highlighted a number of specific strengths of the policy context and content in India. These included a high level of agricultural diversity across the country and acknowledgement of food as a human right in the Constitution. There has been recent government investment in horticulture, and these interventions were successful in increasing production of fruit and vegetables. These initiatives have occurred throughout the fruit and vegetable supply chain, through production, storage, marketing, distribution and surveillance, and are detailed

below.

The government has made significant investments in fruit and vegetable production over the past decade. The key schemes are the Mission for Integrated Development of Horticulture and the National Horticulture Board (and Mission). Interviewees highlighted the successes of these schemes in increasing production through investments in technology and farmer training.

*Mission for Integrated Development of Horticulture is really doing well, it has increased the production of fruits and vegetables per area, and its contribution towards India's GDP. It happens to be very good in every aspect of horticulture sectors.*

[PID24, Research Institute-Agriculture]

The National Crop Insurance Scheme was also identified by several interviewees as a specific policy strength. This scheme is designed to reduce the vulnerability of farmers to weather events, and now has been extended to include some vegetable crops.

Government policy has targeted infrastructure development for storage of horticultural products, including fruit and vegetables, under these broad agricultural production schemes, as well as under agro-processing schemes. This has included research to support infrastructure development for storage of fruit and vegetables at the farm-level and training for farmers in post-harvest management techniques (e.g. through the Integrated Scheme for Marketing Development). These are aimed at reducing the significant post-harvest losses faced by fruit and vegetable farmers.

Complex market structures have arisen to protect farmers from being exploited by buyers. While these have increased the transparency of transactions, the small-hold nature of much fruit and vegetable farming has meant that they have also resulted in long and complex supply chains.

The Government of India has been leading agricultural marketing reform, to increase the ability of farmers to sell through multiple channels and maximize their economic return. This has also included new innovations in information technology-based approaches to fruit and vegetable marketing, including the new National Agriculture Market (eNAM).

At the state level – where Agricultural Marketing policies are implemented – there have been a range of innovative approaches to supporting farmers to market primary produce. For example:

*[in Karnataka], we have for the agriculture promotion, Krishi Bhagya... in which farmers are encouraged to work in Farmer's Professional Associations, and they can produce well, they can adapt new technologies, they can have their own real marketing system.*

[PID24, Research Institute- Agriculture]

Interviewees were optimistic about the existing Government of India policy initiatives to increase distribution of fruit and vegetables. In particular, some states have been taking up opportunities to include fruit and vegetables in public procurement initiatives, such as the Public Distribution System (PDS) and the Integrated Child Development Scheme (ICDS).

Interviewees reported a culture of monitoring and surveillance of projects throughout agriculture and food processing, at the national and state level, utilizing independent monitoring approaches.

*... people get their money only after we have confirmed that they have progressed ... we have engaged private sector agencies like financial consultancy group and they are the one who hold the ground look at the progress and progress report is send to us, we look at the progress, then we release funds in that way*

[PID7, National Government- Food processing]

However, a challenge within this approach was the potential for schemes to then focus on ‘measurable’ outcomes.

*In the National Horticulture Mission, the emphasis is more on area*

*expansion rather than on post-harvest, because area expansion is easy to monitor.*

[PID8, Private sector- Agriculture]

Despite this recent investment in horticulture, including fruit and vegetables, interviewees from all sectors noted that existing infrastructure in India is oriented to staple crops, which been an ongoing focus of investment. There has also been long-term investment in export oriented agriculture, which means that fruit and vegetable infrastructure is often available only for high-value export crops.

*There is always been emphasis on food grain production and production is now switching over cash crops. So production of green leafy vegetables is stuck between production of staples and cash cropsk.*

[PID50, Non Government Organization- Food]

Interviewees across all sectors also identified dietary change in both rural and urban areas as contributing to limited demand for fruit and vegetables. There was recognition that the nutrition transition in India has been characterized by declining consumption of coarse staple grains and pulses, and rising consumption of meat, refined grains and processed foods. However, interviewees perceived awareness of the health benefits of fruit and vegetables as very low.

### 3.2. Actors and stakeholders

Key actors and stakeholders in the fruit and vegetable policy space in India spanned the public and private sectors. The interviewees identified influential actors as spanning both the policy and practice arenas. For example, farmers and private sector supply chain actors as influencers and recipients of policy, as well as Government policy makers. Notably, civil society actors were rarely mentioned in the context of fruit and vegetable related policy.

#### 3.2.1. Farmers

The key stakeholder in production is farmers, and interviewees highlighted that farmers are increasingly diverse, in terms of their background and education. Many farmers are illiterate, and face challenges in managing basic aspects of production. However, interviewees noted that there were many new farmers who were turning to farming as an entrepreneurial activity, and were thus more receptive to innovative and high-tech approaches to farming.

*But now those young entrepreneurs who are coming to these field, they are very much concerned about all those things. Like at what time fruits needs to plucked from the tree, how to pack it, and at what temperature it needs to be stored.*

[PID30, State Government- Agricultural research]

Interviewees from the Agricultural sector highlighted a need for improved policy support for farmers. Fruit and vegetable supply chains are diversifying, with traditional, commercial and modern value chain approaches co-existing. At the same time, the size of farms is decreasing and farming as a career is becoming less attractive. Interviewees identified a need to strategically design policy support in a way that increases the attractiveness of farming as a profession. A few interviewees from the Agriculture sector highlighted the benefits of fruit and vegetables, as a high value crop economically and nutritionally. A related barrier to farmer livelihoods was identified by interviewees in Agriculture and Food Processing as a lack of access to transport and storage. This creates perverse incentives for farmers – they must sell quickly (often at less-than-ideal prices) or to simply dump produce. A gap in the policy environment identified by was the lack of investment in transport for fruit and vegetables produced in India, targeting the local market.

*Because we have Transport assistance scheme only for the exporters. They are exporting ... how our children will get proper diet?*

[PID5, National Government- Food processing]

#### 3.2.2. Government actors

The key government department involved in governing the fruit and vegetable supply is the Ministry of Agriculture and Farmer's Welfare, which includes the National Horticulture Board and oversees the Mission for Integrated Development of Horticulture. Agriculture policy – particularly implementation – is also the responsibility of State Governments in India and there is variation between States regarding agricultural policy priorities. The Department of Consumer Affairs has been working with State governments towards deregulating marketing of fruits and vegetables, to keep the regulations in the fruit and vegetables market to a minimum.

The Ministry of Food Processing Industry is engaged in upgrading technology, providing subsidies and establishment of modern food processing industries. They play a significant role in leveraging fruits and vegetable consumption by preserving fruits and vegetables for processing.

The Department of Health and the Department of Women and Child Development, both at the national and state level, play an important role in consumer demand for fruit and vegetables.

Niti Ayog, the central government agency at national level, plays primarily an advisory role. Niti Ayog experts are involved in implementation of programs and schemes and work closely on National Food Security Mission and Rashtriya Krishi Vikas Yojana.

Responsibility for policies related to fruit and vegetables in India is thus shared between government sectors (mainly Agriculture, Food Processing, Commerce and Industry, Health), and across the Central Government and State levels. All of these actors have policy responsibilities for different aspects of the supply chain. Coordination of policy across sectors remains a challenge, and interviewees across sectors identified the need to improve integration and coherence in fruit and vegetable policies across the supply chain.

*Obviously nutrition is somebody else's role, but how do you align? ... agriculture has a role to play in surpluses, food processing has a role to play in surpluses ... and the Ministry of Human Resources have a role to play ... all of these are working separately. So if you are looking at nutrition, there needs to be a policy which is integrating all this.*

[PID32, Private sector- Agriculture]

However, interviewees also noted that interests of policy actors are not always aligned, suggesting a need to investigate scenarios that consider the multiple stakeholders involved in fruit and vegetable supply chains, in developing policy solutions. In particular, a tension was perceived between the multiple policy objectives served by policies related to fruit and vegetable supply, including employment, economic and rural development, revenue raising and nutrition. For example:

*There should be contract farming and direct farming. But the states do not promote this because the states earn revenue through APMCs [Agricultural Produce Marketing Committees].*

[PID36, Private sector agriculture]

Another need regarding coordination and implementation of policy initiatives was strengthening the interface between policy makers (particularly at national level) and farmers. Several stakeholders from across all sectors highlighted the potential benefits from reviewing institutional mechanisms for collaboration between different sectors. In relation to this, one interviewee highlighted the benefits of convergence, or integration, of related schemes:

*If you look at Pradhan Mantri Sansad Adarsh Gram Yojana, it doesn't have money it simply says you converge all the social protection, welfare and measures available everything can be done in the village. Agriculture can be improved, rural industries can be improved, roads can be improved, school can function because that much money is available.*

[PID21, Research Institute-Social Science]

### 3.2.3. Private sector

Other stakeholders identified by interviewees were the private (agribusiness) sector, research institutes, and Non-Government Organizations (NGOs). The private sector related to fruit and vegetable consumption is diverse. Technology firms provide technology-based solutions to agro-based businesses, including early forecast, traceability, knowledge to the farmers on inputs. Agro-based supply chain companies deal with procurement and collaborative farming, wherein they provide quality inputs and extension services to the farmers. Health care start-ups have been promoting healthy eating and lifestyle to consumers. Government and independent research institutes were identified as a key stakeholder in providing both evidence to underpin policy development, and direct support to farmers. The role of NGOs was seen as integrating consumer concerns into government policy making related to food, particularly consumer organizations.

Changing market dynamics have also brought in new stakeholders into the policy space, with increasing formal retail. In particular, formalized processing and retail now includes global actors, and this in turn is shaping policy objectives.

*The existing APMC [Agricultural Produce Marketing Committee] Act forces the farmers or the sellers to bring their produce to the mandi only. Now [the] Integrated Scheme for Agricultural Marketing ... would allow by amending their APMC Act that wholesale buyers ... can procure directly from the farmers. That is what are the 'reforms' and what we have been pursuing with the states.*

[PID37, National Government-Agriculture policy]

### 3.2.4. Roles for public health actors

A benefit of health sector engagement – articulated by interviewees across all sectors – was seen as bringing a 'consumer' and 'nutrition' orientation to agriculture and supply chain policy, as well as considerations of equity. For example:

*...there is need of revolution in [fruit and vegetable] marketing also. And it should be consumer oriented.*

[PID24, Research Institute-Agriculture]

An opportunity was identified for the Health sector to directly support agricultural priorities regarding fruit and vegetables by promoting kitchen gardens in communities, including through nutrition centres and health service advice. Gardening has been shown to have broad health and nutrition benefits, and thus represents a shared agenda. Three interviewees also recommended promotion of fruit and vegetables production on under-utilised land. This is an area where public health could take the lead from the perspective of health equity, particularly access for poor and other vulnerable populations, and advocate for consideration of equity in food supply sectors. For example, advocating for improved access to local fruit and vegetables for Tribal groups and for the urban poor. There is also an opportunity for government to partner with health sector NGOs in identifying high risk populations, and developing targeted interventions.

## 3.3. Opportunities for influencing policy change

The interviewees identified several opportunities to reframe the policy problem of fruit and vegetable supply, such that policy could expand from a focus on production to engage more comprehensively with issues of both supply and demand from a supply chain perspective. Our analysis indicated that these opportunities aligned closely with aspects of the external food environment: availability, price, product characteristics, vendor characteristics and marketing.

### 3.3.1. Availability

As detailed above, the current policy context contained a wide range of very small-scale initiatives targeting availability of fruit and vegetables, that could be scaled up. In addition, several interviewees from

Agriculture and Public Health identified specific opportunities to increase the focus on fruit and vegetables in existing schemes, in order to increase incentives for farmers to produce fruit and vegetables. For example, expanding crop insurance to include fruit and vegetables, or inclusion of fruit and vegetables as a focus area for food processing initiatives. In addition, several interviewees suggested that support for fruit and vegetable production, particularly compared to staple grain production, could be scaled up significantly.

*There is no separate scheme for fruits and vegetables, only grains we are doing. If you are doing for grains, why can't we do for fruits and vegetables, this is where our country is lacking.*

[PID5, National Government-Food processing]

Within the existing policy content, four specific avenues for supporting farmers were identified. First, improving access to credit, as this was a significant barrier to producing quality, fruit and vegetables at a commercial level. Second, price stabilization measures are a mechanism through which farmers could be incentivized to produce fruit and vegetables. This would address the impact of fluctuations in prices – mainly associated with seasonality and gluts in the market – which currently create a disincentive for producing fruit and vegetables rather than staple crops. Third, support for organization of producers could help small-hold farmers to gain access to larger and more lucrative markets. There may be opportunities to achieve this through the scaling up or expansion of existing schemes, such as the National Initiative for Urban Cluster, designed to increase access to urban markets. Finally, regulation of contract farming was also identified as a critical opportunity to improve farmer livelihoods, including requirements for contractors to support farmers in high quality production and limit their ability to reject a large proportion of contracted production without remuneration.

Interviewees from all sectors suggested that such improvements to policy could be informed by sharing and learning from innovation in fruit and vegetable supply chains, at both a sub-national scale in India and from overseas. A forum to share innovations – either for replication or scaling up – would facilitate broader policy learning from these initiatives.

Interviewees identified the new opportunities afforded by information and mobile technology as a key opportunity to enhance understanding of the policy problem across the supply chain, and to improve farmers' access to information on production techniques and markets. A specific opportunity appears to exist to scale up the government AgMarkNet and Market Research and Information Network initiatives, which provide data on prices in markets. The research also identified the importance of information regarding farmers' experience in informing policy, and monitoring impacts.

*... if you don't know the problems [farmers] are facing now, how are you going to help him! If the farmer doesn't know what are the new policies which are going to help him what is the use of creating those policies...*

[PID36, Private sector-Agriculture]

An opportunity for the Health sector to support targeted agricultural interventions was the recommendation by two interviewees to use nutrition surveillance data to identify populations at high risk of malnutrition. This was seen as a way to strategically advise policy making in specific districts, based on population needs.

*Focus on the 100 districts where there is poverty, 100 districts where there is malnutrition; I will not be surprised if they are the same districts where there is no water available... I would focus all my resources to tackle those 100 districts because value for money would be maximum there.*

[PID34, Farmers Association]

### 3.3.2. Price

Many of the strategies outlined above to increase availability and

access to markets, would also serve to decrease the price of fruit and vegetables. However, several interviewees also highlighted tax policy as impacting directly on agricultural pricing and incentives. The current tax policy structure has a positive impact on prices, and creates some positive incentives for production at national level, as the new Goods and Services Tax excludes horticulture. However, non-uniform taxation creates some disincentives at sub-national level, with a range of different taxes applied. A key issue raised was the need to consider how to support a taxation structure related to fruit and vegetables that would avoid unnecessary costs to farmers and consumers, and incentivize investments in transport and storage infrastructure.

### 3.3.3. Commodity characteristics

The characteristic of fruit and vegetables as a perishable, seasonal crop presented both challenges and opportunities. Post-harvest losses are extremely high, and interviewees across all sectors identified the wastage of fruit and vegetables as a high priority policy concern.

*We are the world's 2nd leading producer in fruits and vegetables ... but we are wasting so much of crop, wastage of around 92,000 Crores.*

[PID5, National Government-Food processing]

Seasonality and geography were recurring, commodity-specific characteristics that were raised by interviewees across sectors. The key challenges were seen as seasonal gluts in the market, which reduce farmer incomes at peak production periods.

*Seasonality in fruits and vegetables creates a glut in the market and then they drastically cut the prices which is paid to the farmers or producers and many times discourages the production and this kind of cyclic impact has lot of impact on the availability side.*

[PID13, National Government- Economic policy]

Interviewees also identified opportunities presented by seasonality, which could be harnessed to improve supply during periods of peak production for different commodities. For example, a coordinated approach to surpluses, the potential to localize and diversify food processing infrastructure to better engage with seasonality in production, and an opportunity to align promotion with seasonality. For example, the private sector has been innovating in the use of indigenous technology, particularly for storage of fruit and vegetables, which would benefit from increased public support.

*...community level food processing units could be opened which are smaller, convenient, low cost where farmers can come into it and do it themselves.*

[PID20, State Government- Public health]

There appeared to be an existing “framing” of fruit and vegetable policy goals that focused on quality, among interviewees across sectors.

*We don't need 170 million tons of vegetables what we need is go for quality production of these vegetables.*

[PID16, National Government- Agriculture policy]

The quality lens has a clear link to food safety, and is something that the Public Health sector could build on, in promoting a shared agenda with the Agriculture sector around fruit and vegetable supply. It also links to dietary diversity (with respect to quality diets), as a broader concept than food security. Using this framing may help to start to shift some of the existing policy focus on staple grains as the primary focus of agricultural support.

*... if you have eaten rice, dal and chapatti, it is presumed that your diet is full, we are lacking the education among people, [that] apart from cereals, we need to consume ... vegetables and fruits.*

[PID13, National Government- Economic policy]

### 3.3.4. Vendor characteristics

Interviewees across sectors noted the absence of Public Health

actors in the food supply policy space, and a limited consideration of consumers in making fruit and vegetable policy (which focuses on production). A range of interviewees from Agriculture and Public Health suggested that public procurement would be an effective way to increase demand for fruit and vegetables, including through the school midday meal program, fair price shops, the ICDS and the army. This would have an added benefit of providing a regular purchaser for farmers.

Public-Private Partnerships (cooperative arrangements between government agencies and private sector actors) were seen by interviewees in both the government and non-government sectors as an opportunity to engage stakeholders strategically in order to benefit from diverse expertise across the supply chain. One opportunity for Public-Private partnership was the potential to use community based organizations to connect farmers with buyers. For example:

*It's the quality of the seeds, it is the agronomic practices. Now we believe that the government will do this, but the government cannot do it on its own. There are krishi vidya Kendras (KVKs) all over the country. Now how do we link the KVK's with these large organized sector [when they] will not work with private companies ... so how do we ... make KVK's really the linking pin between the farmers and agricultural practices and the market?*

[PID25, Private sector- Agriculture]

However, there were also risks identified with Public-Private Partnerships due to diverse actor interests. For example, one interviewee highlighted the potential for engagement with the private sector to reduce government promotion of kitchen gardens and other small scale, local production [PID21, Research Institute- Social Science].

### 3.3.5. Marketing

With respect to marketing, interviewees identified a lack of awareness of the benefits of fruit and vegetable consumption among consumers:

*Awareness programmes are important ... Department of Welfare should talk about why is it important to consume fruit and vegetables other than your traditional diets (cereals, pulses, etc.).*

[PID27, Research Institute- Agriculture]

Several interviewees also suggested that the government should investigate new opportunities for public health marketing of fruit and vegetables. They indicated that poorly funded public health marketing campaigns were having limited effect, and that Public Health actors need to use more strategic approaches to engaging with the media in promotion of fruit and vegetables.

Interviewees from across all sectors also identified childhood as a critical period for developing healthy habits, and the need for promotion to support accessibility of fruit and vegetables to children. Avenues for this included mandating gardening and nutrition education in school curricula, and also in the ICDS through Anganwadi centres (operational centres of the ICDS, for mother and child development).

Interviewees from Agriculture and Economic sectors also raised opportunities to improve fruit and vegetable marketing from a practical perspective. Post-harvest losses in India are still significant, and there is a need for improved storage in the post-harvest period, particularly at markets:

*APMCs [Agricultural Produce Marketing Committees] do not have that cold storage facility; that is where government can create cold storage facility.*

[PID15, Agricultural research]

A few interviewees from Agriculture also raised the fact that farmers are also consumers, and thus a potential target for awareness and promotion initiatives on nutrition, particularly regarding the health benefits of traditional crops. For example, there may be an opportunity to combine education/ awareness for farmers with agricultural

education, as part of a collaboration between Health and Agriculture, since agricultural students are required to do field work in rural areas.

### 3.3.6. Strategic frames and approaches

Interviewees from Agriculture, Economics and Health all identified a need for strategic approaches to engage policy makers in the issue, using language they can understand – particularly, drawing on economic frames that resonate with decision-makers. For example:

*1% investment in nutrition will contribute to GDP by 2–6%, so Policy makers understand this language. India is middle income country, so GDP has to grow...*

[PID50, Non Government Organization- Food]

Overall, there was a perception among interviewees across sectors of a shared agenda between Health, Agriculture and Economic sectors in promoting increased fruit and vegetable production and supply, as a high value crop both economically and nutritionally. In particular, the high economic value of fruits and vegetables was highlighted by some interviewees from Agriculture as providing benefits for both farmers and the economy (as well as for health).

Among the Agriculture sector interviewees, there appeared to be a perception that nutrition could ‘wait’ as a policy agenda, with a need to first address basic food sufficiency:

*We are concerned [more] on implementation than thinking about the nutrition aspects. The people are not getting two times food properly how can we talk about nutrition rich food.*

[PID9, National Government- Agriculture policy]

This suggests an opportunity to target policy makers strategically with evidence for the benefits of fruit and vegetable consumption for addressing the dual burden of malnutrition. Media was identified as a critical player in setting the policy agenda, but uninterested in fruit and vegetables. Production and supply of fruit and vegetables was seen as far-removed from the urban experience of many policy makers, and not related to any emotive constructs, like hunger or acute illness.

*... hunger as a health problem drove the green revolution.....Hunger is emotionally a very strong construct which the press will take and everyone will take and say we got a story. But when we say a chronic disease it's almost like they say oh well you can exercise and you can eat less, but actually the diversity of food at an early stage is an extremely important part of chronic disease.*

[PID6, Research Institute- Nutrition]

There is an opportunity for Health and Agriculture sectors to communicate a shared message about the affected populations (both poor farmers and consumers) and the need to improve the food supply for mutual benefit.

## 4. Discussion

This study has identified several areas with significant potential for strengthening policy coherence across sectors regarding fruit and vegetables, with the aim of improving external food environments and outcomes for nutrition in India. The existing policy context is characterised by growing government support for agriculture over the past decade, with a focus on employment, livelihoods and economic growth, but little integration of nutrition and health considerations in agricultural practice and policy.

Our findings also resonate with those of previous research in India, has highlighted barriers such as limited agricultural technologies, framing and perceptions among policy makers, and the need for system-wide incentives for decision makers to support nutrition (Downs et al., 2015, Gillespie et al., 2015b, Thow et al., 2016). This study identified three practical strategies for fruit and vegetable supply policy actors in India, which are likely to help address the interdisciplinary disconnect between nutrition on the one hand, and economics and agriculture on

the other (Kadiyala et al., 2014). These strategies include: strategic Public-Private Partnerships to increase access to diverse expertise across the supply chain; linking health and economic/agricultural policy agendas; and strengthening surveillance of policy impacts on consumer access to fruit and vegetables. These are considered in detail below, with reference to the international literature.

First, the need for innovation in production, transport and retail suggests that strategic Public-Private Partnerships could be used to harness diverse expertise across the supply chain. Many of the challenges facing the supply chain in India that were identified in this study – for example, the need for market reform, and improved storage and transport – will require collaboration between public and private sector actors (Rais and Sheoran, 2015). For example, in Thailand, urban supply of fruit and vegetables was improved by Public-Private Partnerships between supermarkets and the public sector. This enabled streamlining of urban supply chains via a central distribution center, scaled up certification schemes and training for producers, wholesalers and retailers (Vorley et al., 2016, p7).

Second, synergies exist between the agriculture/economic sectors and the health sectors in promoting increased fruit and vegetable supply – including both production and processing methods that maximize nutrition outcomes. Public health interventions and promotion of fruit and vegetable consumption can support demand in ways that align with seasonality and locality of production, and target specific populations. In particular, childhood is a critical time in which to support the development of healthy dietary habits (Hawkes et al., 2015). Such advocacy would also help to increase awareness among policy makers of the nutritional benefits of increased production and consumption of fruit and vegetables, which was identified as a challenge, particularly by health sector respondents. Other studies across Asia and Africa have also found limited awareness of, and understanding of, issues of nutrition among agriculture policy actors (Levitt et al., 2009, Gillespie et al., 2015b). However, we found a consistent openness among respondents from agriculture and economic sector to strategic framing of key issues by the health sector – including an emphasis on quality, economic benefits and the benefits of a consumer-oriented approach. These frames will be critical in fostering a shared agenda across sectors.

Better understanding of supply chain agendas among public health policy actors will also enable the strategic design of interventions to increase consumer access to – and demand for – fruit and vegetables. Innovation in demand side interventions is proving effective, for example, recent mHealth interventions to reduce NCD risk factors (Pfammatter et al., 2016). By tailoring such intervention to regional or seasonal supply characteristics, public health actors could further bring together supply and demand to create more consistent markets. In addition, bringing together sectoral agendas may identify new opportunities for collaborative financing of interventions. For example, Aid for Trade funding has been identified as a potential source of funding for increasing supply of fruit and vegetables (Thow and Priyadarshi, 2013).

Third, bringing together data from Health and Agriculture will be critical for developing effective policy interventions (McDermott et al., 2015, Gaihre et al., 2016). From the health side, nutrition surveillance data can help design agricultural interventions that target the most vulnerable populations. From the perspective of agricultural respondents, data on the impact of policies on production and consumer access was seen as a useful strategy to identify the most effective opportunities for intervention. Emerging global evidence suggests that strategic agricultural investment can have immediate positive nutritional benefits at the farm level (Carletto et al., 2015). This thus suggests that there would be joint benefits to agriculture and health, from effectively designed interventions. Public health actors can play a critical role in sharing – and scaling up – small-scale, local- and state-level innovation in fruit and vegetable supply chains.

Limitations of the research include the potential for self-selection among the respondents, given the large number choosing not to participate. This may have biased the participants in favour of those

interested in nutrition and health issues. This potential bias may have been exacerbated by the nature of the (public health) research team, and the focus of the study, and thus the interviews on outcomes for nutrition. The implications of this could be a more ‘optimistic’ assessment of the interest of actors in agriculture and economic sectors regarding the utility of a consumer/nutrition orientation to food supply policy. However these findings are consistent with other research in these sectors (Downs et al., 2015, Gillespie et al., 2015b, Thow et al., 2016, Walls et al., 2016).

Despite these limitations, the research presented here highlights a wide range of opportunities to improve coordination of food policy making, and to strengthen specific policy initiatives to enhance the quality of fruit and vegetable production, transport, storage and marketing to increase availability, affordability and accessibility for consumers. The research sheds light on possible approaches to addressing the global challenge of strengthening policy across sectors for nutrition and health outcomes (Global Panel on Agriculture and Food Systems for Nutrition, 2016). In particular, this study adds to the understanding of barriers and opportunities to policy coherence across sectors and further explores the politics, governance and policy surrounding nutrition and healthy food environments (Gillespie and van den Bold, 2017). The research identified key opportunities as coordination of diverse actors, focused support for farmers and the private sector, and strategic use of actor influence to integrate nutritional concerns into fruit and vegetable supply policy decision-making. With respect to the nature of the problem, opportunities to support improved fruit and vegetable supply include reframing the ‘policy problem’ as an issue of both supply and demand, and one in which public health can play a strategic role in linking demand to supply. In line with this, policy opportunities can be harnessed by expanding the ‘frames’ used for fruit and vegetable policy to include: the nutritional benefits of action; quality as a shared agenda between agriculture and nutrition; consumer orientation.

## 5. Conclusion

This study has identified specific opportunities to strengthen policy for improving the supply of fruit and vegetables in India throughout the supply chain. Public health actors can play an important role in bringing together agricultural/economic policy agendas regarding fruit and vegetables, with health sector policy efforts to increase access and consumer demand. Key opportunities within the supply chain include developing strategic Public-Private Partnerships, linking health and economic/agricultural policy agendas, and strengthening surveillance of policy impacts on consumer access to fruit and vegetables.

Improving access to affordable fruit and vegetables is a global priority, and thus the findings from this study are also relevant for other low and middle income countries. In particular, in line with global recommendations for food supply research to improve nutrition (McDermott et al., 2015, Haddad et al., 2016), this study demonstrates the usefulness of policy learning-oriented qualitative research in identifying ‘points of entry’ for food policy change. In doing so, we extend understanding of political dynamics in engendering agricultural policy change for nutrition (McDermott et al., 2015).

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