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HOW FRUIT CONSUMPTION MIGHT BE FRUITFUL FOR THE ECONOMY: ANALYZING EFFECTS OF IMPROVEMENTS IN FRUIT AND VEGETABLE AVAILABILITY AND ACCESSIBILITY IN UZBEKISTAN

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1 INTRODUCTION

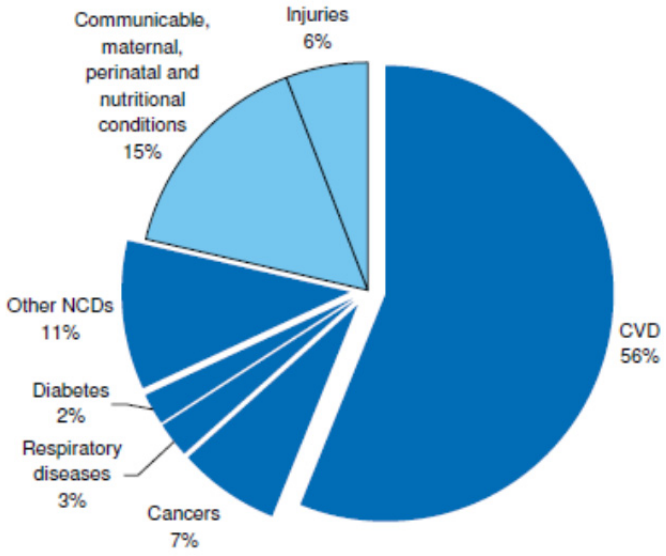
Over the past years, Uzbekistan has achieved a stable economic growth: Gross domestic product (GDP) has been growing over 8% per year for several years (The World Factbook, 2013). While economic growth has been relatively high, it has not significantly increased living standards: in 2003, 47 percent of the population was living beneath the absolute poverty line of US$2.15 per day (World Food Programme, 2008).

Findings from the most recent Uzbekistan Health Examination Survey (UHES 2002) showed that for all Uzbekistan, 21% of children less than five years of age were moderately/severely stunted and 7% were moderately/severely wasted, whereas 49% of children have some degree of anemia.In addition, vitamin A deficiency and Iodine deficiency are among another important public health challenges in the country.The prevalence of anemia among women of reproductive age (15–49 years) in Uzbekistan (60.4%) is the highest found in Central Asia (Kamatsuchi, 2006).Among both women and men age 40 and older, more than 50 percent were overweight and for women, about one-third of these were in the obese category.This indicates that many older individuals have an unhealthy lifestyle (i.e., low levels of physical activity and unsound dietary habits), predisposing them to disease and presenting a serious health challenge for Uzbekistan.

In general, the above-mentioned indicators of poor nutrition and food poverty are directly related to serious health consequences. In fact, although life expectancy has not decreased since the collapse of the Soviet Union, it still exhibits low value: in 2010, life expectancy at birth was 68 years in Uzbekistan compared with 79.6 years in European Union (World Development Indicators, 2013).

According to *The Global Burden of Disease Study 2010*, in terms of the number of years of life lost (YLLs) and disability-adjusted life years (DALYs) due to premature death in Uzbekistan, ischemic heart disease (16.32% of total YLLs; 11.48% of total DALYs), lower respiratory infections (16.35% of total YLLs; 11.06% of total DALYs), and cerebrovascular disease (7.53% of total YLLs; 5.17% of total DALYs) were the highest ranking causes in 2010.

Figure 1. Proportional mortality (per cent of total deaths, all ages) in Uzbekistan

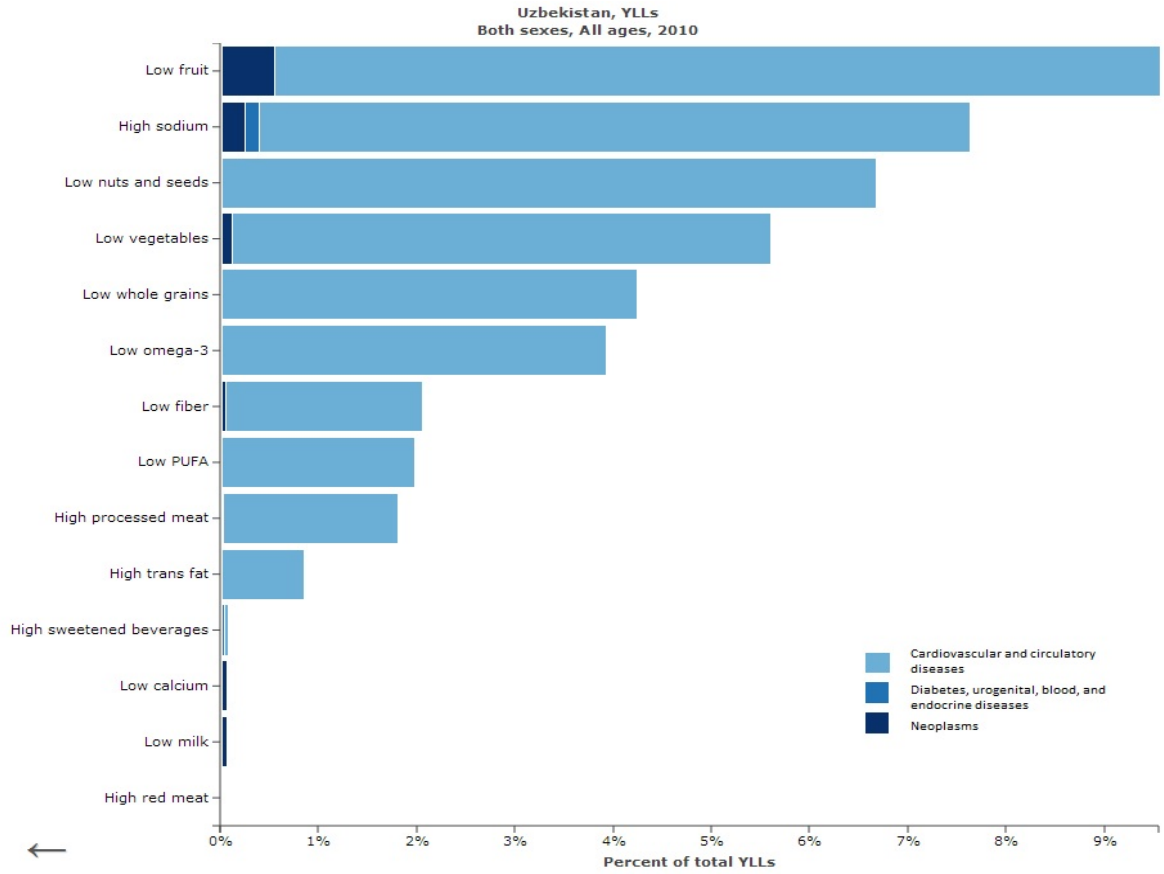


Source: WHO and WHO, 2011

At the national level, threats and impacts of NCDs include large-scale loss of productivity as a result of absenteeism and inability to work, and ultimately a decrease in national income. In 2010, the World Economic Forum placed NCDs among the most important and severe threats to economic development, alongside the financial crisis, natural disasters and pandemic influenza (WEF, 2010).

What are the main drivers of the less favourable health outcomes in Uzbekistan? The leading risk factor in Uzbekistan is dietary risks (22.07% of total YLLs; 15.81% of total DALYs) with 'diet low in fruits' and 'diet low in vegetables' being among the top constituent factors. Within this category, diet low in fruits attributes to burden of disease the most: burden of cardiovascular and circulatory diseases due to diet low in fruits is estimated at 9.01% of total YLLs (6.28% of total DALYs), and burden of neoplasms is 0.54% of total YLLs (0.37% of total DALYs) in 2010. Diet low in vegetables attributes to 341,925 YLLs due to cardiovascular and circulatory diseases and 6,904 YLLs due to neoplasms (GBD Compare, 2013).

Figure 2: Burden of disease attributable to leading dietary risk factors in 2010, expressed as a percentage of Uzbekistan YLLs



Source: GBD Compare, 2013

The natural and climatic conditions of the country provide ample opportunities for the development of fruit and vegetable production and food processing industry. Unfortunately, institutional transformations in agriculture in the past have promoted significant growth of cereal production, but not for fruit and vegetable production. As a result, consumption of healthy food in Uzbekistan is constrained by its seasonal and spatial availability and considerable price differences throughout a year, especially for rural population.

For example, the National statistics for 2004 shows considerable variation of carrot prices (from UZS 155 to UZS 1002, or more than six times) and tomato prices (from UZS 128 to UZS 1277, or ten times). A similar situation was observed in 2005 (Uzbekistan Economy, 2006).

The database of retail food prices collected by ZEF project "Economic and Ecological Restructuring of Land- and Water Use in the Region Khorezm (Uzbekistan)" demonstrates significant price fluctuations for tomato (by 610%) as well as for cucumber (by 355%) between winter and summer 2007. The data for 2008 show also significant inter-seasonal price differences (however, to less extent).

In their analysis of the results of the World Bank's Uzbekistan Regional Panel Survey (URPS) of 2005, Musaev, Yakshilikov and Yusupov (2010) argued that the diet of poorest households is

mostly comprised of cereals, which is an inexpensive source of nutrients and much less consumption of other crops, especially fruits (Table 1).

Table 1. Mean consumption amount of food items (grams / capita / day) in Uzbekistan

	Cereals*	Dairy	Meats	Eggs**	Vegetables	Fruits
By region/urban and rural area						
Tashkent	426	130	74	0.27	219	46
Andijan	516	140	33	0.13	218	30
Kashkadarya	566	156	44	0.21	196	30
Urban	444	124	66	0.24	223	42
Rural	558	159	35	0.17	200	28
By income group						
Poorest	427	68	12	0.09	129	8
2nd quintile	505	124	22	0.13	176	17
3rd quintile	531	157	35	0.17	199	28
4th quintile	509	149	47	0.21	214	36
Richest	525	182	101	0.33	286	66

* Includes grains, flour products, and pulses.
** In number of pieces.
Source: Musaev, Yakshilikov and Yusupov (2010)

Given the current volume of vegetable production and the stratification of the population in Uzbekistan according to income level only high income earners consume fruits and vegetables. Because of low solvency, a large number of citizens cannot buy natural sources of vitamins, especially during off-season. According to the Ministry of Health of Uzbekistan, vegetable consumption should be 142 kg per capita annually, 28 kg thereof in the winter period. The average Uzbek has access to only 84 kg of vegetables, 5 kg thereof in winter (Askarov and Nuppenau, 2010).

The consumption pattern of fruit and vegetables is therefore prone to considerable fluctuations. For instance, national household expenditure surveys over 2002-2005 identified that the share of grapes in the pattern of fruit and vegetable consumption varied from 0.06% in March to 24.2% in May, while for tomatoes the range of fluctuation was between 0.05% in February and 14.0% in June (Uzbekistan Economy, 2006). As a result, seasonal shortage in fruit and vegetables may contribute to NCD burden (Powles et al, 1996). In addition, one has to consider the fact that Uzbekistan, given its remoteness from major transportation routes, cannot easily resort to imports to smooth seasonality in consumption and is mainly oriented to domestic output, which is seasonal due to climatic conditions.

The harsh climate of Uzbekistan limits year-round production and therefore improvements in vegetable production under protective shelters are required. In fact, only 15% of the region's total vegetable production in Central Asia is available from November to March (Ali et al, 2006). In 2010 entrepreneurs, larger private farmers (up to 150 ha) and dekhan farmers set up 522 greenhouses covering 290 ha in Uzbekistan(IFAD 2011), which pales in comparison to that, for example, found in Italy (9,000 ha), Turkey (10,000 ha) and Spain (11,000 ha). Many farmers producing greenhouse vegetables can not cover their production costs, which keep them from commercial farming and encourage subsistence farming. It is necessary to enlarge this production area for reducing seasonality of vegetable supplies as well as for smoothening price fluctuations. For this to occur, the greenhouses require modernization as in most existing greenhouses, mechanized production systems do not operate, soil heating systems are absent, structures are not energy-efficient, and the soils are poorly drained and of low fertility (Buriev, Zuev and Medzhitov, 2003), (Askarov and Nuppenau, 2010).

The assortment of vegetable and fruit crops is extremely limited. Only about 20 vegetable varieties are cultivated to any extent with six main vegetable crops (tomato, watermelons, carrot, bulb onion, white cabbages and cucumber) and around 20 fruit varieties with three main fruit crops (grapes, apples, apricots). At the same time, crops from across the world are well suited for cultivation and seed production in Uzbekistan. The introduction of new varieties can increase yields and food quality, as well as provide consumers with a broader assortment of foods to select from (Mavlyanova, 2005), (Buriev, Zuev and Medzhitov, 2003).

2 PROBLEM STATEMENT

Vast majority of Uzbek population consume daily lower than 400 g of fruit and vegetables (146 kg/person/year), the minimum amount recommended by leading health agencies (WHO and Consultation, 2003), and the intake of fruits and vegetables for the poorest population is even worse (Musaev, Yakshilikov and Yusupov, 2010). Reciprocal determinism asserts that environmental and personal factors can dynamically interact with behaviors, such as fruit and vegetable consumption. There is some evidence that availability of fruits and vegetables (an environmental factor) may increase fruit and vegetable intake (Bere & Klepp, 2005; Cullen et al., 2003; Granner, 2004). Meanwhile, improvement of fruit and vegetable consumption has been associated with decreased incidence of cardiovascular events and cancers (Graham et al. 2007; He et al. 2007; Lock et al. 2005; WCRF & AICR, 2007; WHO and Consultation, 2003), the biggest contributors to the global mortality.

Given the importance of healthy diet and especially the adequate intake of fruit and vegetables, the current state of inefficient agricultural production in Uzbekistan has serious adverse consequences on the yields of fruit and vegetables, and thus on income of such farmers (mostly, dehkan farms and households), and would raise the prices paid by consumers of such food products, especially in off season. The impact of higher food prices would have the most significant effect on the poorest rural people for whom the necessity of healthy food consumption is of major importance due to the poor nutritional status.

The purpose of this research is, therefore, to investigate the effects of improved fruit/vegetable availability and accessibility on demand and public health in Uzbekistan. In addition, potential and existing constraints and opportunities to improve the availability and accessibility of fruit and vegetables as a key determinant of healthy diet will be explored.

No studies have examined the seasonal availability of fruit and vegetable supply in Uzbekistan, given its crucial role in contributing to healthy diet and thus to the people's well-being. The central contribution of this study is to provide a quantitative approach to the analysis of the sustainability of agricultural production systems that is based on solid scientific foundations. In addition, public health effects through increased fruit and vegetable consumption will be investigated for the first time in the context of Uzbekistan.

3 RESEARCH QUESTIONS

The main research question I address is as follows: What will be the effects of improved fruit and vegetable availability and accessibility on demand and public health in Uzbekistan?

The sub-questions include: What policies should be used to increase year-long fruit and vegetable supply to meet recommended dietary intake in Uzbekistan? What would be the effect of improved fruit and vegetable availability (supply) on the population consumption (demand)? What would be the effect of improved fruit and vegetable consumption on public health?

Objectives of the research include the following:

- To promote production and consumption of fruit and vegetables so as to improve nutrition and health and to help prevent non-communicable diseases;
- To advance science in the areas of fruit and vegetable production, distribution, increased consumption, and benefits for health.

4 METHODOLOGICAL APPROACH

Following the design of institutional framework of fruit and vegetable value chains in Uzbekistan (by example of Khorezm region) developed by Rudenko (2008), the existing value chains of fruit and vegetable supply (including both fresh and processed products) will be constructed and analyzed.

In the context of Uzbekistan, the horticulture and vegetable sectors are presented by various actors. Among them, main contributor of fruit and vegetable supply is a large group of rural small-holding households (*dehkans*) who are characterized by high share of home consumption. Another supplier domains include private farms that are specialized in gardening and vegetable growing as well as small processing units attached to private farms. As for food processing sector, the major suppliers consist of private companies, joint stock companies and joint ventures that are specialized in processing of fruit and vegetables, as well as regional associations of "MevaSabzovot", the coordinating structure for processors (Rudenko, 2008). Although import supply of fruit and vegetables plays minor role in Uzbekistan, it will be analyzed separately.

The destinations of fresh fruit and vegetables include the following consumer domains: home consumption by rural households, private consumers through local or regional fresh markets, municipal organizations (hospitals, schools, kindergartens, etc), agro-processing plants and wholesalers for further export.

For fruit and vegetable sectors of Uzbekistan the research of value chain will start with functional analysis (identification of functions along each chain, production stages and flows) and institutional analysis (identification and description of agents involved in the chain). Next, financial analysis will be performed to calculate value added, profits and transaction costs for each agent and the chain as the whole. In addition, financial profitability of activities within the chain, overall efficiency of the chain, the processes of price determination and transfers between agents will be identified. Following financial analysis, economic analysis will be performed to identify the boundaries of the value chain and the position of various actors within the chain and to develop the economic accounts corresponding to their activities.

Another method to be used in the current research is multimarket modeling. Multimarket models are policy tools that can be used to analyze a wide range of sectoral policy issues. Unlike partial equilibrium models, which typically focus on the dynamics in a single sector, multimarket models measure the interaction and interrelationships between markets in an economy. While lacking the sophistication of general equilibrium models in incorporating macro-level effects of the economy, multimarket models are useful in their ability to analyze the impact of changes in public policy at a sectoral level.

These policy changes can be traced to examine their effects on production, demand, household incomes, government revenue, international trade, and poverty levels. Further, since they are less demanding in terms of data and modeling requirements, generic multi-market models can readily be adapted to local circumstances to produce timely analyses that are comprehensible for policy makers (Lundberg and Rich, 2002; Stifel and Randrianarisoa, 2006).

A number of policy simulations could be conducted with the multimarket model. The specification of supply of fruit and vegetables, for instance, gives the practitioner the ability to consider policies aimed at improving agricultural productivity. A wide range of pricing policies can also be conducted with the model. This could include examining the impact of the removal of commodity and input subsidies on food supply, consumption patterns, and household income. In addition, policies related to exchange rate movements and tariff liberations can be conducted.

Based on data generated by value chain analysis multimarket simulation model will be set up in order to understand what policy is more preferable in terms of maintenance a year-long availability of fruit and vegetables in Uzbekistan and its effect on the population consumption. Therefore, in this research a multimarket model adaptable to the agricultural production system and policy environment of Uzbekistan will be used to analyze the effect of policy on fruit and vegetable supply and demand.

Separate markets for vegetables and fruits (including processing components) will be explicitly analyzed in the model with markets for cereals and animal products (meat and eggs) implicitly included in the model. Household survey information such as URPS 2005 as well as other statistical sources (FAO, previous studies) will be used to derive estimates of income and own-price and cross-price elasticities of demand for the entire set of interlinked markets. Producer survey

information will be used to derive estimates of own-price and cross-price elasticities of supply for the set of interlinked markets. These estimates will be combined to create an appropriate system of demand and supply functions.

In this study, seasonal patterns for supply of fresh and processed fruit and vegetables will also be considered. This seasonal price variation and the inability of households to smooth their annual food consumption also manifest themselves in seasonal variation in calorie intake. Fruit and vegetable farming may vary in Uzbekistan depending on the region and corresponding climate conditions. According to the calendar of farming activities in the example of Khorezm region by Rudenko (2008), vegetables are mainly harvested in August-October whereas fruits and grapes are harvested starting from June until October depending on variety. There is some import of early fruits from neighboring regions available in spring and some fruits (for example, apples) can be found in the markets all year round. Vegetables from greenhouses appear on sale starting late spring, and some early vegetables are imported from other regions. Thus, to appropriately model the agricultural sector in Uzbekistan, a seasonal component must be built into the model and consider the welfare effects of policy efforts to reduce the observed price variability.

The model will be constructed with a combination of national/regional production and trade data and manipulation of household/farmer survey data. The survey will target fruit and vegetable producers (such as small-scale *dehkan* farmers, private farms, greenhouse farmers as well as fruit and vegetable processing farmers) in three regions of Uzbekistan. The main questions of interest during the survey will include: output flow for each fruit and vegetable crop (type of crop, area, yield, harvest, home consumption, selling quantity and price, storage), input flow (fuel, fertilizers and pesticides, labor), distance to markets, main production activities, other expenses (taxes and other payments, transportation).

For consumption component of the model, the national-representative data will be taken from the Uzbekistan Regional Panel Survey 2005 modeled after the World Bank's standard Living Standards Measurement Survey (LSMS). The survey covered about 3,000 households from three regions – Andijan, Kashkadarya and Tashkent city.

In order to better understand functioning of agricultural system, public health and labor supply in Uzbekistan, the meetings with the following representatives are also planned during the field work: local Governments (*Khokimiyats*), national/regional officials from the Ministry of Agriculture and Water Resources, the Ministry of Health and Institute of Health and Medical Statistics, the Ministry of Labour and Social Protection, State Statistics Committee, water consumer associations, community (*makhallya*) leaders. In addition, discussions with health and nutrition experts from WHO, UNICEF and other international organizations will be very helpful.

In order to connect fruit/vegetable consumption with the health outcomes, comparative assessment of the contribution of potentially modifiable risk factors for the corresponding diseases is essential as it leads to prevention of disease burden. Starting from 1990, the Global Burden of Disease Study (GBD) with its updated versions of 2000 and 2010 provided global and regional comparative assessment of mortality and disability-adjusted life-years attributable to major risk factors (Lopez and Murray, 1996; Ezzati et al. 2004; Lim et al. 2013). Other factors that determine health outcomes (smoking, diets) will be controlled for.

Following the basic approach for assessing the effect of improved fruit and vegetable consumption on public health presented by Lim et al. (2013), the portion of disease burden caused by "diet low in fruits" and "diet low in vegetables" risk factors will be calculated holding other independent factors unchanged. In particular, the estimation of disease burden attributable to each risk factor will have five steps:

1) Selection of risk-outcome pairs to be included in the analysis based on criteria about causal associations (for instance, high-quality epidemiological studies and evidence to support generalisability of effect sizes to populations other than those included in the available epidemiological studies or satisfactory models for extrapolating them).For "diet low in fruits" risk factor the following outcomes were selected: the aggregate of oesophageal cancer, mouth cancer, the aggregate of nasopharynx cancer, cancer of other part of pharynx andoropharynx, and larynx cancer;trachea, bronchus, and lung cancers; IHD; ischaemic stroke; haemorrhagicand other non-ischaemic stroke. As for "diet low in vegetables", the outcomes included the aggregate of mouth cancer, nasopharynx cancer, cancer of other part of pharynx andoropharynx, and larynx cancer; IHD; ischaemic stroke; haemorrhagic and other non-ischaemic stroke. In the current research, disease burden attributable to two dietary factors ("diet low in fruits" and "diet low in vegetables") in Uzbekistan will be assessed for the above-mentioned risk-outcome pairs;

2) Estimation of distributions of exposure to each risk factor in the population of Uzbekistan. The national-representative data on dietary intake of fruit and vegetables will be obtained from the consumption module of the URPS2005;

3) Estimation of etiological effect sizes, often relative risk per unit of exposure for each risk-outcome pair. These relative risks will be obtained from the new meta-analysis of Lim et al (2013);

4) Choice of an alternative (counterfactual) exposure distribution to which the current exposure distribution is compared. An optimum exposure distribution (termed the theoretical-minimum-risk exposure distribution) was selected at the level of mean 300 g/day (SD 30 g/day) for dietary intake of fruits and mean 400 g/day (SD 30 g/day) for the one of vegetables according to Lim et al. (2013); and

5) Computation of burden attributable to categorical exposures of each risk factor with reference to a reference category (that is alternative (counterfactual) distribution of exposure) for each age, sex and cause according to the following formula:

$$PAF = \frac{\sum_{i=1}^{n} P_i(RR_i - 1)}{\sum_{i=1}^{n} P_i(RR_i - 1) + 1}$$

Where PAF is the population attributable fraction (burden attributable to risk factor), RR_i is the RR for exposure category i, P_i is the fraction of the population in exposure category i, and n is the number of exposure categories (Murray and Lopez, 1999).

5 EXPECTED RESULTS

In general, development of vegetable and fruit sector in Uzbekistan has been limited for many reasons, such as the weakening of agri-business that supported commercial operations, absence of specialization and regionalization of farming operations, rising costs of fertilizers and other inputs, and ineffective marketing structures (Buriev, Zuev and Medzhitov, 2003).

Presently, some vegetables and fruits not produced in Uzbekistan are still imported. Imported products compete in the internal market, despite their high prices, due to their high quality, packaging and standards. However, statistical data reflects the effect of import substitution and trade protectionism policies: the share of imports in food consumption in 2005 was relatively low for vegetables (0.2 %) and fruits (6.51 %). Self-sufficiency policy pursued by Uzbekistan so far is providing certain level of food availability in terms of quantity. However, ensuring the availability of varied and economically accessible food to the population requires a liberalized trade policy. Additionally, a more open trade policy will provide incentives to increase efficiency in food production and lower the market prices of internally produced foodstuffs (Musaev, Yakshilikov and Yusupov, 2010).

Since 2006, the Ministry of Health jointly with the WHO experts have introduced the main principles of healthy nutrition to prevent chronic non-communicable diseases in Uzbekistan such as diversifying the diet with various vegetables and fruits (preferably fresh locally grown), control over consumption of fats (replace a natural fat with plant oil), substitute tea drinking with consumption of fruit and vegetable juices and drinking water, and others (Khudayberganov, 2008). However, these propaganda measures on their own cannot increase the nutritional status of the population and increase the quality of life.

As dietary habits are embedded in cultural, economic and political structures, there should also be greater emphasis on promoting policies that target the determinants of fruit and vegetable consumption rather than simply targeting individual behavioural change because health education may be less important than lowering the price and improving the availability of vegetables and fruit especially in the context of developing countries such as Uzbekistan. Policy should aim to remove obstacles and enhance people's ability to eat healthy diets, including action on agriculture, subsidies, food labelling, nutritional claims, advertising, nutrition programmes, and differential food taxation. Priority should be given to the implementation of practical and affordable best buy interventions (Lock et al, 2005; WHO, 2011). As agricultural products already receive subsidies, it would make sense to modulate these in accordance with the scientific evidence on health benefits (Joffe and Robertson, 2001).

There is a need to investigate the impact that agricultural policy has on the structure of production, processing and marketing systems and, ultimately, on the availability of foods that support healthy food consumption patterns. Intersectoral initiatives should encourage the adequate production and domestic supply of fruits, vegetables and wholegrain cereals, at affordable prices to all segments of the population, opportunities for all to access them regularly without drastic seasonal fluctuations, and individuals to undertake appropriate levels of physical activity. (WHO, 2002).

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