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A quick review of the production and commercialization of the main vegetables in Brazil and the world from 1970 to 2015

Waldemar P Camargo Filho; Felipe P Camargo

Instituto de Economia Agrícola (IEA), São Paulo-SP, Brasil; camargofilho@iea.sp.gov.br; felipe@iea.sp.gov.br

ABSTRACT

In the biennium 2013-14, the world produced 1,134.27 million tons of vegetables annually. The production of garlic, onion, potato, tomato and watermelon accounted for 66.5% of the total. Brazil, in 2012, considering 40 vegetables, produced around 23 million tons, in 900.0 thousand hectares. Potatoes, tomatoes (table and processing), onions, watermelons, carrots, sweet potatoes, lettuce and cabbage, the main vegetables in Brazil, accounted for 64.0% of the total. This work presents the evolution of production, commercialization, and availability of garlic, onions, potatoes, tomatoes and watermelons in Brazil and in the world. In Brazil, the work focused on two distinct periods: 1970-1990 [when the Support Program for Production and Commercialization of Horticultural Products (PROHORT) was implemented] and 1990-2012 (the globalization period). In 13 years (1977-1990), PROHORT succeeded in inducing the modernization of production of fruits, vegetables, and poultry products, enabling the sector to compete in the world market, especially after 1990, with the market opening and the establishment of MERCOSUR. In the 22-year period from 1990-2012, despite the initial difficulties with the commercial opening and internal economic instabilities, production and availability of garlic, onion, potato, tomato and watermelon continued to evolve in Brazil. The horticultural sector advanced in incorporating technologies and in modernizing, stimulated by the market expansion due to both the population growth (33%) observed in Brazil in this period and real gains in Brazilians' income owed to inflation control. In the world scenario, the work discusses the same aspects for these five vegetables in the period 2001-2013. The analysis of the initial and final triennia of this period showed vegetable production increasing 30.3% in the world and 24.4% in Brazil. In both contexts, gains in yield were the main driver of expansion of production, and yield increase came mainly from the use of improved cultivars, especially hybrids.

Keywords: cultivated area, production, public policies, garlic, onion, potato, tomato, watermelon.

RESUMO

Uma rápida revisão da produção e comercialização das principais hortaliças no Brasil e no mundo de 1970 a 2015

No período 2013-14, a produção mundial de hortaliças foi de 1.134,27 milhões de toneladas por ano. Alho, batata, cebola, melancia e tomate participaram com 66,5% do total. Já no Brasil, em 2012, considerando 40 espécies de hortaliças, a produção ficou ao redor de 23 milhões de toneladas em uma área de 900 mil hectares. Batata, tomate (mesa e processamento), cebola, melancia, cenoura, batata-doce, alface e repolho, as principais hortaliças no Brasil, representaram 64,0% do volume produzido. Este trabalho apresenta a evolução da produção, comercialização e disponibilidade de alho, cebola, batata, tomate e melancia no Brasil e no mundo, com foco sobre etapas distintas no Brasil: 1970-1990 [período do Programa de Apoio à Produção e Comercialização de Produtos Hortigranjeiros (PROHORT)] e 1990-2012 (período da globalização). Em 13 anos (1977-1990), o PROHORT modernizou a produção de frutas, hortaliças e produtos granjeiros, dando condições para que o setor concorresse no mercado mundial, em especial a partir de 1990, com a abertura do mercado e a implantação do MERCOSUL. No período de 22 anos compreendidos entre 1990-2012, apesar das dificuldades iniciais com a abertura de mercado e as instabilidades econômicas internas, a produção e a disponibilidade de alho, cebola, batata, tomate e melancia evoluíram no Brasil. A horticultura continuou incorporando tecnologias e se modernizando, com impulso do aumento de mercado devido ao crescimento populacional (33%) observado no Brasil neste período e aumento da renda dos brasileiros conseguido através do controle da inflação. No mundo, o trabalho discute os mesmos aspectos para essas cinco hortaliças no período 2001-2013. A análise dos triênios iniciais e finais do período mostrou que a produção de hortaliças aumentou 30,3% no mundo e 24,4% no Brasil. Nos dois contextos, o aumento da produtividade foi o principal responsável pelo aumento da produção, advindo principalmente do uso de cultivares melhoradas, especialmente híbridos.

Palavras-chave: área cultivada, produção, políticas públicas, alho, cebola, batata, tomate, melancia.

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THE VEGETABLES IN FIGURES

In 2013-14, the world produced 1,151.9 million tons of vegetables annually, with a 29.8% increase in 2005-14 (FAO, 2015, apud AGRIANUAL,

2016). In 2013, garlic, onions, potatoes, tomatoes and watermelons accounted for 66.5% of the total (FAO, 2015, apud AGRIANUAL, 2016). China responds for 51.0% of the world vegetable production and, considering official

figures, Brazil is the 13th largest producer, with 11.4 million tons. However, estimates of the Brazilian production do not include all vegetables produced in the country. According to Embrapa (Embrapa Hortaliças, 2016), in 2012

Brazil produced 19.5 million tons of 40 different vegetables, in 810.0 thousand ha. This volume would place Brazil as the 6th largest producer in the world.

In addition to Embrapa Hortaliças, other Brazilian institutions also present figures for vegetable production in the segments in which they operate. The Brazilian Association of Seed and Seedling Trade (ABCSEM) estimated that in 2011, the 17 main vegetables propagated by botanical seeds covered 533.2 thousand hectares in Brazil, producing 17.3 million tons (ABCSEM, 2017). The production of this group of vegetables represented 5.7 billion US dollars or around 84.0% of the value of the total vegetable production in the country. Vegetatively propagated vegetables, such as potato, were not included in these figures. Potatoes, in the same year, occupied an area of 147 thousand hectares and produced 3.9 million tons, with an estimated value of US\$ 2.4 billion. If other vegetatively propagated vegetables (sweet potatoes, garlic, taro, yams, arracacha, chayote), besides leafy vegetables not considered by ABCSEM, such as cabbage, broccoli, cauliflower, coriander, parsley, chives, and rocket are added, estimates are that, in 2012, vegetables were cultivated in more than 900 thousand hectares in Brazil, producing over 23 million tons.

Potatoes, tomatoes (for processing and fresh consumption), onions, watermelons, carrots, sweet potatoes, lettuce and cabbage are the leading vegetables in Brazil. Together, they represent 64.0% of the production. Considering only leafy vegetables, the fifteen main species account for 15.0% of the total volume produced. Garlic, onions, potatoes and tomatoes had specific-dedicated policies through the Support Program for Production and Commercialization of Horticultural Products (PROHORT) (PROHORT, 1977), which organized the production and the trade of seeds and final products in Brazil in the 80s. Undoubtedly, PROHORT was the main public policy for vegetable production in the country whatsoever. For garlic, potatoes and onions, PROHORT was instrumental in ensuring production sustainability in the South, Southeast, Northeast and

Midwest after the opening of world trade in 1990. Although only garlic, onions, potatoes, and tomatoes were priorities for PROHORT, the modernization of production and commercialization of these four vegetables resulted in positive impacts in the chains of many others.

Brazil participated with 1.72% of the global vegetable production. The country main imports are garlic, onion, seed potatoes and processed potatoes. The state of São Paulo is the main vegetable producer and consumer in Brazil (21.5% of the total). In 2016, São Paulo cultivated 161.1 thousand hectares, producing 4.7 million tons of 53 different vegetables. Considering the national scenario, the production of garlic, onions and watermelons is highly important in the South, Southeast, Northeast and Midwest. Onion production is concentrated in the three southern states, in addition to the states of Bahia, Pernambuco, São Paulo and Goiás. Potato is produced in two main seasons, namely the dry and the winter seasons. The Southeast and South regions are the main producers, but the production in the states of Bahia (Northeast) and Goiás (Midwest) is also representative. Considering tomatoes, São Paulo is the main national producer of table tomatoes, while the production of processing tomatoes is concentrated, in addition to São Paulo, in the states of Minas Gerais and Goiás (78.0%). All major Brazilian geographic regions produce watermelons. Main producing states are Tocantins (North), Bahia and Rio Grande do Norte (Northeast), São Paulo (Southeast), Rio Grande do Sul (South) and Goiás (Midwest).

Objectives and work methodology

This work aimed to draw the general lines of the production profile of the main vegetables in Brazil and in the world. It also sought to show how the Support Program for Production and Commercialization of Horticultural Products (PROHORT) (PROHORT, 1977) helped to organize and to modernize the production of garlic, potatoes, onions and tomato between 1970-1990 in Brazil, pointing out impacts of PROHORT on the expansion of the agricultural frontier in the Brazilian main geographic regions, as well as on

the productivity and availability of vegetables. The article also showed that in the subsequent period, 1990-2015, the globalization phase, the Brazilian production continued expanding. Finally, it compared the growth of global and Brazilian production of garlic, onion, potato, tomato and watermelon in the period 2001-2013.

Information from the 1970s to 1990s was retrieved from literature. For the period 2001-2013, the analysis of global and Brazilian production was carried out using data from the Food and Agriculture Organization and the Systematic Survey of Agricultural Production (LSPA), from the Brazilian Institute of Geography and Statistics (IBGE, 2015). Calculations of area and yield contributions to the expansion of production was based on Vera Filho & Tollini (1979), as follows: $AC = (At - Ao) \times Y_0 \times 100 / (Pt - Po)$ and $YC = 100 - AC$, where AC = area contribution; YP = yield contribution; At = average area in the last triennium; Ao = average area in the first triennium; Yo = average yield in the first triennium; Pt = average production in the last triennium; Po = average production in the first triennium. The first three years of the period under review were 2001-2003 and, the last, 2011-2013.

As production is a result of cultivated area multiplied by yield, it is possible to use the soil productivity to infer the technological incorporation. Information for the state of São Paulo was obtained on www.iea.sp.gov.br and www.cati.sp.gov.br.

THE MAIN VEGETABLES

The discovery of America revealed various food plants from the new continent to the world, such as corn, potato, tomato, cassava and cocoa. Corn has become the leading cereal in the world, followed by wheat and rice. Combined, these three crops produce 2.24 billion tons of food per year, of which 38.6% are corn. Potato and tomato produced jointly 536.15 million tons annually in the 2011-13 triennium (IBGE, 2015), which corresponded to approximately 80.0%

of world wheat production. Such figure becomes even more representative if it is considered that wheat is perhaps the most characteristic food in the history of humankind. Besides potato and tomato, garlic, onion and watermelon are vegetables that stand out for the volume and value of production in the world and also in Brazil (Tables 1 and 2). These five vegetables are the focus of this work (Tables 1 and 2).

Garlic (*Allium sativum*) and onion (*Allium cepa*)

Garlic and onion belong to the Alliaceae family that includes also, among others, chives and leeks. All these vegetables are cultivated for millennia for their spice, nutritional and medicinal values. The Alliaceae main characteristic is their disk-shaped stem. Onion has tunicate bulbs, while the garlic bulb is an aggregate of bulblets. Bulbs present resistance to storage, which makes it possible to transfer stocks over time between regions, an essential feature for globalized markets.

Garlic has its origins in Central Asia. Later, its cultivation has expanded throughout the Mediterranean Sea. In Egypt, there are records of garlic buried with the Pharaohs in the pyramids. Garlic world production in 2011-13 was 23.6 million tons, with 6.4% being traded on the world market (FAO, 2015, apud AGRICULTURAL, 2016). China and USA accounted for 79.5% and 8.0% of world production, respectively. In the triennium considered, 2011-13, China's share in world's exports was as high as 83.0%. The main importer is Indonesia, with 31.3%, while Brazil accounts for 12.2% of world imports. Brazilian imports in the period 2011-13 reached 166,049 tons, coming from China (62.3%) and Argentina (35.0%).

Like garlic, onion also has its origins in Asia, but in the region of Pakistan and Iran. Onion world production in the period was 84.2 million tons, but only 0.47% was traded on the world market. In 2011-13, China produced 26.4% of the global onion production, India 21.2%, USA 4.3%, Iran 2.7%, Russia 2.45% and Brazil 1.8%, these six countries accounting for 58.9% of the global onion production. Despite its importance as an onion producing

country, Brazil is also a major importer, ranking among the first ten (FAO, 2015, apud AGRICULTURAL, 2016). In this period, the share of imported onion in the Brazilian internal market was higher than usual since a drought caused severe drops in the national production. Until 2011, the regular share of imported onion in the Brazilian supply was 15.0%.

Potato (*Solanum tuberosum*)

Potato, originating from the Andes, was taken to Europe where it gained fundamental importance in the daily diet, especially in the United Kingdom. Potato became so integrated at the British eating habits that, although South American, it became known worldwide as the British potato (in some countries, the Irish potato), a name that grew in popularity also due to the economic dominance of the UK in the world at the time potato became a universal food. In the UK, potatoes were so important that in the 19th century, the outbreak of a fungal disease, late blight (*Phytophthora infestans*), which had no control at that time, drastically reduced production, leading to a huge crisis in the food supply and hunger. As result, several families, especially Irish Catholics, including the Kennedy family, were forced to leave the country.

The importance of potatoes to Europe remained enormous along the years, both as food and as a source of seed tubers in international trading. Such a relevant business demanded the development of specific policy guidelines in Europe and elsewhere. The US, for example, banned imports of tubers for consumption and each producer has to collect US\$ 1.00/sac to maintain the policy. The trade of processed potato, especially French fries and chips, is the leader in revenue generation in fast food chains. To preserve potato as a resource for humanity, the International Potato Center (CIP) was installed in Peru, the potato cradle. CIP is a member of the CGIAR (Consultative Group for International Agricultural Research) network, and among other duties, CIP keeps a potato germplasm bank with nearly all the potato cultivars developed so far in the world, as well as a large

number of wild relatives.

In Brazil, the potato has its own plot. Embrapa (the Brazilian Agricultural Research Corporation) organized the potato seed production in the state of Santa Catarina in the 70's and 80's, while the Brazilian states developed regional cultivars. In São Paulo, the state Bureau of Agriculture, through its research institutes, had a major importance in the potato production chain, impacting even the national economic context.

The world produced in the 2011-13 triennium 374.041 million tons of potato annually. China produced 24.7% of this total, USA 5.4%, France 1.9%, Peru 1.2%, Turkey 1.2% and Brazil 1.0%. These six countries accounted for 36.6% of the world production. Of the global production, 2.6% are traded on the world market. France accounts for 19.7% of exports, while Belgium, the Netherlands and Russia are the main importers, with 31.4% of the total.

Tomato (*Solanum lycopersicum*)

Tomato, as well as potato, originated from the Andes and was introduced in Europe as an exotic product. Afterwards, nutritionists became aware of its food characteristics as a vegetable for both *in natura* consumption and sauce preparation. Over time, tomato and potato turned out to be the two most important vegetables worldwide. Tomato world production in the 2011-13 triennium was 161,166 million tons, 21.5% of the total for processing (WPTC, 2016). The world's largest tomato producers in 2012-13 were (in %) China (30.4), India (10.0), USA (7.9%), Turkey (7.1%), Egypt (5.0%), Spain (2.4%), Brazil (2.4%) and Mexico (1.9%). These ten countries produced 74.2% of the tomato world production (FAO, 2015, apud AGRICULTURAL, 2016). China, USA, Turkey, Italy, Iran, Spain and Brazil are the largest producers of purée and processed tomato paste, accounting for 80.3% of world volume of processed tomato products in 2011-13 (Table 3).

The world production of tomato for processing grew 19.0% between the triennia 2001-03 and 2011-13 (10 years). In the following triennium, 2014-16, it increased 14.5% in relation

to 2011-13. In the triennium 2011-13, world exports summed up to 7,184.93 tons, with Mexico, the Netherlands and Spain holding 48.40% of the total, while imports were 5,894.21 thousand tons, with USA, Russia and Germany accounting for 51.44% of the total. The US is the main market in the world: it imports 25.6% and exports 3.1% of the world production.

In Brazil, the history of tomato is part of the economic context of both the country and the state of São Paulo, having Embrapa and the Bureau of Agriculture of the state of São Paulo as coordinators of the main public policies. Brazil is one of the leading producers of tomatoes for table and for processing in the world.

Watermelon (*Citrullus lanatus*)

The watermelon comes from Africa. The most ancestral types found in Brazil were introduced by slaves. Later, in the nineteenth century, the Americans who founded the city of Americana, in the state of São Paulo, brought imported watermelon seeds. In the triennium 2011-13, the world produced 106.384 million tons of watermelon, in 3.475 million hectares (yield of 30.6 t/ha). China participated with 66.8% of world production, Peru 3.8%, Iran 3.6% and Brazil 2.1%. The world trade in 2011-13 reached 1.6 million tons/year (1.8% of the total produced). Brazil, during this period, exported 31,627 t/year, around 1.5% of the national production. The largest world exporters are Spain, Mexico and USA, which together hold 46.0% of the sales. The largest importers are USA, Germany and Canada, which participate also with about 46.0% of the purchases.

DISCUSSION

The main vegetables in Brazil from 1970 to 1990

PROHORT (PROHORT, 1977) was a program to support vegetable production. It covered research and rural extension and was carried out in all Brazilian major geographical regions, modernizing the commercialization of both vegetables and vegetable seeds in the country. PROHORT established

patterns for product grading that turned out to be essential to leverage commercialization, while Supply Centers promoted the wholesale distribution of horticultural products, generating and disseminating market information to the productive chains. Altogether, this articulation was called the National System of Centralized Supply (SINAC). Nevertheless, supermarket chains changed this scenario, which was common to all capitals and large cities in the 1980s. Supermarket chains started buying fruits and vegetables directly from producers, forming their prices according to the wholesale statistics from the regulated warehouses [State Supply Center Corporation (CEASA's)]. In the productive sector, by modernizing production, PROHORT opened room for new producing regions to appear and to the development of regional cultivars and innovative cropping technologies, for example, in soil preparation, irrigation, cultivar testing and pest and disease management.

In the period 1970-1990, the Brazilian population grew from 93 million to 150 million inhabitants, a 61.3% increase. In the same period, the production of the main vegetables grew much more (Camargo Filho, 2011). In this period, garlic production increased by 111.6%. Although the area used for planting

garlic has expanded, yield contributed to the growth of garlic production with a strong 61.5% increase. Onion production increased 174.1%, with increases of 93.0% and 42.4% in yield and area under cultivation, respectively. Potato production increased by 145.1% and the main factor was again advances in yield, which contributed 161.3% to the expansion of potato production, as the area declined. Tomato production in the 1970s, in São Paulo, was segmented into tomatoes for processing and for consumption *in natura* (table tomatoes). In this period, the area occupied with table tomatoes shrank (13.0%) and yield practically remained stagnated (3.0%). On the other hand, the production of tomatoes for processing (industry) expanded 38.3% in São Paulo and 140.0% in the states of Pernambuco and Bahia. In the aggregate, the availability of tomato (table and industry) increased 113.8%.

The vegetables in the globalized market, 1991-2012

The vegetable market is dynamic with daily transactions of fresh products: leaves, fruits, roots, bulbs and tubers. It is also a market in which production adjusts quickly to prices, with its inherent seasonal variations. Due to these characteristics, the consecutive economic plans launched to control

Table 1. Cultivated area, production and yield of garlic, onion, potato, tomato and watermelon in the world, in different periods. São Paulo, IEA, 2017.

Period	Area (ha)	Production (1000 t)	Yield (t/ha)
Garlic			
2001-2003	1,121.76	12,582.10	11.22
2011-2013	1,426.33	23,584.30	16.53
Onion			
2001-2003	2,949.02	51,312.60	17.40
2011-2013	3,161.63	84,200.60	26.60
Potato			
2001-2003	19,177.00	314,633.30	16.41
2011-2013	19,356.30	374,041.30	19.36
Tomato			
2001-2003	4,142.11	110,824.78	26.76
2011-2013	4,793.64	161,166.00	33.62
Watermelon			
2001-2003	3,308.13	87,571.41	26.47
2011-2013	3,475.10	106,384.54	30.60

Source: Food Agriculture Organization (FAO), apud Agriannual, 2005 and 2016.

inflation in Brazil disorganized, at least temporarily, the vegetable production: 1986, Cruzado Plan, Sarney government; 1990, Collor Plan and market opening; 1994, Real Plan, Fernando Henrique Cardoso government (FHC).

At the beginning of globalization, 1990-1993, the vegetable market in Brazil faced some volatility due to the instability of the Collor government and to the competition from the world market. During this period, production support services (research, technology transfer and rural extension) began to deteriorate. In 1994, the FHC government launched the Real Plan that allowed for the expansion of the market due to the success in controlling inflation. In the case of vegetables, price swings have declined. In addition, in the wake of the growing purchase power, Brazilians intensified significantly the frequency of meals outside the home and consumption of processed food. Both habits, in addition to the inflation control, were also driven by globalization. In the period of 22 years between 1990 and 2012, the production and availability of the vegetables that are the focus of this work accompanied such changes. Horticulture continued to incorporate technologies and to modernize, even for facing the 33.3% growth in the Brazilian population in this period.

The area planted with garlic decreased by 38.0% in the period 1991-2012, but, as yield more than doubled, garlic production increased by 32.7%. From 1995-1999 to 2012, the domestic production supplied only 40.6% of the Brazil's demand, which shows the relevance of garlic imports. In the same period, garlic availability increased from 890 to 1,264 g/inhabitant/year (Camargo Filho & Camargo, 2015a). The 42.0% increase in the garlic per capita consumption in Brazil reflects the growth in consumption of processed foods, once garlic is the main condiment used in the processing industry. For onion, from 1990-1994 to 2010-2014, the domestic production increased by 56.7%. Nevertheless, national production was below demand. In the period, imports responded for 14.4% of the demand. Onion availability

reached 7.0 kg/inhabitant/year, clearly demonstrating the change of plateau in the volume of production in the vegetable market (Camargo Filho & Camargo, 2015b). Potato production increased by 49.0% in the period 1990-2012, due to the impressive increase in yield (88.3%) that compensated for the area reduction. In this period, imports of processed potato grew quickly, evidencing an increase in product availability and a diversification in consumption patterns (Camargo Filho & Camargo, 2014).

The yield of table tomatoes increased by 83.0% from 1990 to 2015, while production increased by 178.0%, due to the expansion of the cultivated area. Production and yield of tomatoes for processing increased by 114.4% and 122.8%, respectively, with reduction in area. In the period, the availability of both table and processing tomatoes had significant increases (Camargo Filho & Camargo, 2015c). Tomato availability, considering the apparent consumption of table and processing tomatoes, grew from 15 to 20.9 kg/inhabitant/year. For watermelon, considering the initial and

final triennia in the period 2001-13, cultivated area and yield increased 15.5% and 27.8%, respectively, resulting in 47.6% expansion in production and normalization of watermelon supply along the year, independent of the season.

Behavior of the vegetable sector in the world and in Brazil, 2001-2013

In this section, the article limits the discussion to more recent years, whose statistics are available in an aggregate form. The article studies the initial and final triennia of the period 2001-2013 to garlic, onion, potato, tomato and watermelon, in the world and in Brazil (Tables 1 and 2). Brazilian databases allowed the segmentation of tomato statistics into table tomatoes (*in natura* consumption) and industrial tomato (for processing, determinate growth habit). Carrying out the calculations proposed by Vera Filho & Tollini (1979), it was possible to evaluate and compare Brazilian results to those of the globalized market.

Garlic - world production of garlic in the analyzed period increased 87.4%, with 47.3% and 27.0% gains in yield

Table 2. Cultivated area, production and yield of garlic, onion, potato, table and processing tomato and watermelon in Brazil, in different periods. São Paulo, IEA, 2017.

Period	Area (ha)	Production (t)	Yield (t/ha)
Garlic			
2001-2003	14,986.00	112,831.00	7.53
2011-2013	10,806.00	117,217.00	10.85
Onion			
2001-2003	67,006.00	1,155,612.00	17.25
2011-2013	57,812.00	1,409,413.00	24.38
Potato			
2001-2003	154,179.00	3,007,359.00	19.51
2011-2013	135,273.00	3,653,700.00	27.00
Tomato (processing)			
2001-2003	17,000.00	1,326,000.00	78.00
2011-2013	20,000.00	1,640,000.00	82.00
Tomato (table)			
2001-2003	43,500.00	2,275,000.00	50.00
2011-2013	48,500.00	2,821,000.00	62.00
Watermelon			
2001-2003	78,361.00	1,615,754.00	20.62
2011-2013	94,783.70	2,146,850.80	22.65

Source: Brazilian Institute of Geography and Statistics (IBGE), apud Agriannual, 2005 and 2016.

Table 3. World production and main producing countries of processing tomato in different periods. São Paulo, IEA, 2017

Country	Year					
	2001	2003	2014	2015	2016	2017
	(thousand tons)					
United States of America (USA)	9,147	11,643	13,247	13,375	11,926	10,978
China	2,033	4,624	6,300	5,600	5,150	5,500
Italy	4,816	4,510	4,914	5,393	5,180	5,000
Spain	1,602	1,857	2,700	3,028	2,950	3,200
Turkey	1,483	1,947	1,800	2,700	2,100	2,000
Iran	2,058	1,833	2,200	1,350	1,150	1,500
Brazil	1,117	1,461	1,400	1,300	1,450	1,400
Portugal	861	1,084	1,197	1,660	1,507	1,500
Tunisia	537	775	720	935	650	670
Chile	626	715	810	850	800	1,050
Greece	927	380	470	500	440	480
Other	3,957	3,890	4,614	4,694	4,725	4,948
Total	29,164	34,719	39,905	41,384	38,008	38,226

Source: Calculations carried out by Camargo Filho & Camargo over figures of the World Processing Tomato Council (WPTC) (www.wptc.to) Figures for 2017 are estimates.

and expansion in the cultivated area, respectively. Area contribution to increases in production was 31.0%, while yield contributed 69.0%. In Brazil, despite the competition with Argentine and Chinese garlic, the domestic production increased 39.0%. The area planted with garlic in the country decreased 27.9%, but the yield increase (44.1%) offset the area reduction: area contribution to the expansion of the Brazilian garlic production was negative (14.7%), while yield contribution was 114.7%.

Onion - its world production increased significantly (64.0%) in the period. Yield grew 52.3% and contributed 88.8% to the growth of world production. In Brazil, as the cultivated area shrank, area contribution to gains in production was negative (62.5%). However, yield grew by 41.3% and contributed 162.5% to the expansion in production, offsetting area reduction. Progresses in yield result mainly from the use of more productive cultivars, especially hybrids, both in the world and in Brazil.

Potato - potato world production increased 19.0% in the analyzed period, considering the initial and final triennia. The area cultivated with

potato in the world increased by 0.9%, while yield advanced 18.0%, thus contributing 96.8% to the expansion of production. In Brazil, the area cultivated with potato declined in this period, contributing negatively to the expansion of production (57.0%). However, yield offset the decline, contributing 157.0% to the increase in production.

Tomato - world production of tomato (table and industry) increased 45.4% in the period. Area and yield contributed 34.6 and 65.4% for the expansion, respectively. Tomato for processing represented 26.3% of the production in the first triennium of the period, decreasing to 21.5% in the last triennium. In Brazil, the cultivated area and yield of table tomatoes contributed 45.8% and 54.2%, respectively, to the expansion of production, 14% in the period. The national production of tomatoes for processing, in its turn, increased 23.7%, with increases in area (74.5%) and yield (25.5%). The tomato yield in the world advanced due to the use of hybrids. In Brazil, besides the hybrids, improvements in cropping technology were equally instrumental for the gains in yield.

Watermelon - its world production increased 21.5% over the period 2001-

2013. Area and yield contributed 23.5% and 76.5% to the expansion of production, respectively. In Brazil, watermelon production increased 32.9% in the period analyzed. The area cultivated with watermelon contributed more (61.2%) than yield (38.8%) to the expansion of production. Watermelon yield in the world and in Brazil increased due to advances in cropping technology and to the use of improved cultivars, especially hybrids.

Final remarks

In the post-war period (1939-45), USA created the Marshall Plan to rebuild the affected countries. One of the Plan's goals was to modernize the world agriculture by intensifying the use of "modern" inputs and machines. Brazil, due to the coffee crisis in the late 1920s, was already diversifying agricultural production in the Southeast, South, Midwest and Northeast regions. In 1964, a military coup removed the president in Brazil. The governments that followed were concerned with the development of the agricultural sector, seeking conditions to develop an agro-industrial system, which was finally consolidated in the 1970s. In 1967, during the Abreu Sodré government, the state of São Paulo created the Study Group for the Administrative Reform (GERA), which was implemented in the following term, of governor Laudo Natel. The reform organized the Bureau of Agriculture (SA) in three coordination units: Research, Technical Assistance (for support and assistance) and Natural Resources. In the national level, the Garrastazu Medici government created the Brazilian Agricultural Research Corporation (Embrapa), with decentralized units in all regions, and Embrater (Brazilian Company of Technical Assistance and Rural Extension), to coordinate these services. The country has also implemented policies to support agriculture, such as financing production with subsidized credits, minimum price guarantees and storage. For the horticultural sector, Brazil established the National System of Centralized Supply (SINAC), which gathered monthly information on supply and prices in all its wholesale centers (CEASAS).

In this context, in 1977 Brazil implemented the Support Program for Production and Commercialization of Horticultural Products (PROHORT). In 13 years (1977-1990), PROHORT modernized the production of fruits, vegetables and poultry products, enabling the sector to compete on the world market, even after the opening of the Brazilian market and the establishment of MERCOSUR, from 1990 onwards. The Collor government, which opened the Brazilian market to world competition, drastically cut the funding to research, extension and other support services to agribusiness and family farming. Such policy resulted from a neoliberal vision (imported from the Northern hemisphere) that remains until today, in both the governments of Brazil and the state of São Paulo.

Nevertheless, the vegetable production continued to grow. The worldwide trend over these years has always been to intensify trade and

increase production, with gains in yield and expansion of the agricultural frontier. The same trend prevailed intensively in Brazil.

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