

Unique Feature of Horticulture in Asia and Its Global Impact

Jung-Myung Lee

Department of Horticulture, Kyung Hee University, Suwon 449-701, Republic of Korea

ABSTRACT Asia has 60% of the world population and only about 34.5% of the world arable land. However, Asians traditionally consume very large amount of horticultural produce and depend heavily on vegetables for the sources of horticultural food crop. The vegetable production in Asia is highly intensive and multiple and successive cropping are routinely practiced. Concomitant with the rapid economic growth in many east Asian countries, the demands for high-quality horticultural crop have been drastically increased among many Asians and their interest in high-quality products, outstanding cultivars, machinery and equipment, production technology has been sharply increased in recent years. It is therefore believed that establishing and maintaining closer and regular relations among scientists and societies could provide an excellent momentum for promotion of horticulture on a global basis and both the ISHS and the ASHS could play decisive roles for this kind of promotion.

Additional key words: international association, international trade, Korean horticulture, production and consumption, seeds and germplasm, society members

1. Introduction

It is rather difficult and often impossible to precisely describe the status of horticulture in Asia, especially under the circumstance of undergoing such rapid and abrupt changes in economical and political status during the last decades. The significance of agriculture has always been emphasized with respect to food crops and this trend is especially serious in many developing countries with high population and very limited and poor arable land. Even though horticultural crops can also be regarded as food crops in many countries and circumstances, horticulture also provides different, interesting, and refreshing aspects in human life and environment. Growing horticultural crops should be distinguished from securing the food crops because many horticultural crops are being evaluated in terms of their quality rather than the quantity as in many major field crops. Janick (1994) describes, "Horticulture can be defined as the branch of agriculture concerned with intensively cultivated plants directly used by people for food, for medicinal purposes, or for esthetic gratification". It should be pointed out that the term 'horticulture' is being called as 'Gardening Art' (rather than cultivation of garden in Greek) here in the Orient or in East Asia from ancient times.

The major objectives of this paper are

- 1) to describe present status and characteristics of horticulture in Asia in production and international trade,
- 2) to compare the present status of horticulture of the world in relation to other crops,
- 3) to find out and analyze problems associated with production and utilization of horticultural crops in Asia,
- 4) to search for ways to strengthen horticultural activity in Asia in terms of research and international affairs on global basis, and
- 5) to provide future directions for horticultural industry as well as research for the 21st century.

2. Population in Asia and the world

According to FAO statistics (FAO, 1995 and 1996), there are 50 countries in Asia among the 200 countries in the world (Table 1). Total population in Asia is 3.5 billion, which is more than 60% of the total world population of 5.76 billion. Among the population in Asia, 60% of the people are engaged in agriculture so that agriculture is far and away the primary industry in Asia as well as in the whole world.

Table 2 shows detailed data on some Asian countries with large population. In China, 71.1% of the total population of 1.23 billion (21.4% of the world total) is engaged in agriculture. The

※ 이 논문은 국제원예학회 Acta Horticulturae(495:123~141)에 게재된 것을 전제한 것입니다.

Table 1. Population of the world and the percentage of agricultural population.

Continent (No. of countries)	Total population (×1,000)	Agricultural population (×1,000)	Percent agr population (%)	Econ-Active population (×1,000)	Econo-act. agric popul. (×1,000)	Percent agr population (%)
World (200)	5,767,775	2,592,410	44.9	2,767,970	1,305,054	47.1
Africa (55)	738,730	421,120	57.0	314,106	186,878	59.5
NC America (30)	461,248	50,959	11.0	217,572	20,855	9.6
S America (13)	322,305	63,440	19.7	136,355	26,389	19.4
Asia (50)	3,488,027	1,959,085	56.2	1,729,709	1,031,128	59.6
Europe (40)	728,778	71,636	9.8	356,069	37,065	10.4
Oceania (12)	28,687	5,696	19.9	14,160	2,738	19.3

Table 2. Total and agricultural population in Asia (population unit:1,000).

Country*	Total pop.	Agric. Pop.	Percentage	Active Pop.	Act. Ag. Po	Percent Ag P
China	1,232,083	876,475	71.7%	731,538	520,355	71.1%
India	944,580	540,845	57.3%	409,545	250,556	61.2%
Indonesia	200,453	97,719	48.7%	93,101	49,169	52.8%
Pakistan	139,973	70,484	50.4%	50,176	23,637	47.1%
Japan	125,351	6,270	5.0%	66,443	3,490	5.3%
Bangladesh	120,073	73,095	60.9%	60,522	36,804	60.8%
Vietnam	75,181	51,782	68.9%	37,945	26,136	68.9%
Iran	69,975	24,482	35.0%	21,327	7,665	35.9%
Philippines	69,282	28,570	41.2%	28,763	11,931	41.5%
Turkey	61,797	28,542	46.2%	28,274	14,271	50.5%
Thailand	58,703	32,117	54.7%	34,333	20,154	58.7%
Myanmar	45,922	33,003	71.9%	23,409	16,824	71.9%
Korea, ROK	45,314	5,195	11.5%	22,008	2,823	12.8%
Korea, DP	22,466	7,504	33.4%	11,275	3,762	33.4%
Uzbekistan	23,209	7,706	33.2%	9,526	3,163	33.2%
Iraq	20,607	2,209	10.7%	5,455	586	10.7%
Malaysia	20,581	4,272	20.8%	8,321	1,844	22.2%

*17 countries of population higher than 20 million.

Table 3. Land area distribution in the world (unit: 1,000 ha).

	Total area	Land	Arable	Permanent	Non-arable	%arable land
World	13,383,471	13,048,404	1,361,711	114,667	11,571,926	10.4
Africa	3,031,169	2,963,568	173,408	19,448	2,070,612	5.9
NC America	2,239,057	2,137,042	269,821	7,432	1,859,789	12.6
S America	1,783,189	1,752,925	99,087	21,426	1,632,412	5.7
Asia	3,174,845	3,085,414	470,062	42,369	2,568,983	15.2
Europe	2,298,773	2,260,320	299,159	17,302	1,943,859	13.2
Oceania	856,438	849,135	50,174	2,690	796,271	5.9

percentages of agricultural population in Bangladesh and Vietnam are over 60% and Thailand, India, and Pakistan have agricultural population of 50% or higher. More than 40% of the entire population is engaged in agriculture in Indonesia, Turkey, and Philippines. In contrast, only a few countries have low agricultural population rate; 5.3% in Japan, 10.7% in Iraq, and 12.8% in Korea (S), thus showing extreme variations in agricultural population in Asia.

3. Total and arable land in Asia and the world

Tables 3 and 4 show the total and arable land areas of the world. Asia has 3.14 billion ha of total land area, which is 23.7% of the world total of 13.38 billion ha. Asia also has 0.47 billion ha of arable land which is 34.5% of the world arable land of 1.36 billion ha. Per capita arable land in Asia is far below the world average of 0.236 ha. North-Central (NC) America and Europe have 0.585 and 0.470 ha, respectively. Arable land area per capita engaged in agriculture is 0.240 ha in Asia which is

Table 4. Per capita land area in Asia and in the world.

	Arable land (1000 ha)	Total popul. (×1,000)	Mean arable land/capita (ha)	Agr. Pop. (×1,000)	Mean arable land per agr. pop. (ha)
World	1,361,711	5,767,775	0.236	2,592,410	0.525
Africa	173,408	738,730	0.235	421,120	0.412
NC America	269,821	461,248	0.585	50,959	5.295
S America	99,087	322,305	0.307	63,440	1.562
Asia	470,062	3,488,027	0.135	1,959,085	0.240
Europe	299,159	728,778	0.410	71,636	4.176
Oceania	50,174	28,687	1.749	5,696	8.809

Table 5. Crop production area in the world in 1996 (unit: ha).

Crop	World	Africa	NC Amer	S. Amer	Asia	%Asia	Europe	Oceania
Cereals	710,457	97,774	99,990	36,830	328,232	46.2	131,057	16,574
Wheat	231,056	11,309	39,104	9,571	101,304	43.8	57,904	11,053
Rice	150,758	7,260	1,695	1,133	135,124	89.6	651	147
Coarse grain	329,543	79,205	59,281	21,377	91,804	27.9	72,502	5,374
Barley	66,551	6,389	7,951	764	15,770	23.7	32,340	3,336
Maize	140,106	25,751	40,614	18,714	41,841	29.9	13,105	81
Rye	17,262	895	2,826	493	1,047	6.1	11,083	918
Oats	11,280	61	315	58	767	6.8	10,046	33
Millets	36,529	19,067	120	43	16,414	44.9	842	44
Sorghum	47,155	24,212	6,808	1,160	14,141	30.0	182	653
Subtotal	1,740,697	271,923	258,704	90,143	746,444	42.9	329,712	38,213
Roots & tubers	49,032	16,864	1,301	3,705	17,227	35.1	9,661	274
Potatoes	18,353	688	796	819	6,183	33.7	9,655	49
Sweet potato	9,156	1,532	171	109	7,226	78.9	5	113
Cassava	16,322	10,078	201	2,481	3,544	21.7		17
Yams	3,173	3,033	61	44	17	0.5		18
Pulses	71,034	14,200	5,021	6,085	38,454	54.1	5,267	2,006
Dry beans	27,470	3,147	3,620	5,688	14,281	52.0	685	49
Dry Br. beans	2,355	669	80	177	1,152	48.9	182	90
Dry peas	6,515	506	715	116	1,575	24.2	3,279	324
Soybeans	62,588	949	26,690	18,100	15,774	25.2	1,042	32
Sub-total	265,998	51,666	38,656	37,324	105,433	39.6	29,776	2,972
Vegetables	565,523	35,478	45,646	16,623	376,119	66.5	88,727	2,930
Fruits	413,932	54,394	53,844	66,728	161,182	38.9	72,818	4,966
Nuts	4,996	446	890	797	2,333	46.7	1,022	36

far below the world average of 0.525 ha, 5.29 ha in NC America, and 4.176 ha in Europe. These data provide the evidence that struggles and perhaps wars for securing food sources would be inevitable for the very existence and maintenance of human life in many parts of Asia. It should also be pointed out that there are great variations in the standards of living depending upon the countries in Asia and the same is true for the rest of the world. There has been a fantastic economic growth in some Asian countries for the last several decades. However, the unbalanced economic towers in some of those countries have been thoroughly shaken up recently and they had to shed all the showy leaves and flowers. Whether they are ready or not, they should now undergo a long, cold winter with naked branches waiting for the spring. However, it is generally

accepted that the financial ruin or collapse in some East Asian countries also influences the economy of developed countries such as Japan, Singapore, Taiwan, and perhaps China, and may eventually influence the world economy stability too.

4. Cultivation area of agricultural crops

Cultivation area of agricultural crops is shown in Table 5. Asian people grow and consume rice for the major food crop and thus about 90% of the world rice is produced in Asia. Percent cultivation area of rye and oats is much lower than the world average (6.1 and 6.8% of the world total). Sweet potato is also important crop in Asia. Among the horticultural crops, it is worthwhile to note that vegetables are quite popular among

Asian people. The percent share of Asia in world vegetable cultivation area is 66.5%, which may be regarded as extremely high as compared to the world average or to those of other continents. The cultivation area of vegetables in Asia is 2.33 times larger than that of fruits. However, in most other countries, the cultivation area of fruits are considerably larger than vegetables (Lee et al., 1994). This indicates that vegetables are the major and most important horticultural crops in Asia not only in cultivation areas but also in other aspects such as life style, environment, economy, industry, research and education as described later in detail.

Table 6 shows that per capita production (or consumption) of horticultural crops in some Northeast Asian countries (Lee et al., 1994). It can be easily seen that vegetables are the major horticultural crops in Northeast Asian countries especially in China, Japan, Korea (North), Korea (South), and Taiwan. The ratios of vegetables to fruits are very high in these countries from 1.93 in Taiwan to 5.38 in Korea (S). This preference of vegetables among the Asian people has resulted in similar consequences in general horticultural areas; a large number of industries involved with vegetable seeds and seedlings production, fertilizer and agrochemical production and distribution companies, storage and processing industries, and others. In addition, it is quite natural to find a larger number of research scientists working on vegetables in universities and colleges, governmental and private research institutes, and consequently a large number of research papers being presented at annual meetings of horticultural society and other related academic societies in many Asian countries. Research fund and budget also show similar trends, in general.

Fermented and partially preserved vegetables are quite popular in Northeast Asian countries such as Japan, China, and Korea. For an example, the history of pickles in Japan is dated back to the pre-historic times, approximately 4,500 years ago. Many vegetables such as radish, Chinese cabbage, cucumber, and

eggplant are pickled in many homes in Japan and other countries, but fairly a large amount of pickled vegetables are being traded between China, Thailand, Taiwan, and other nearby Asian countries (Inden et al., 1997).

Kimchi is a traditional fermented vegetable mix originated in Korea but now is being traded all over the world. Kimchi has its unique palatability giving sour, sweet, and carbonated taste. Approximately 300,000 ton of commercial kimchi products was produced by 337 processing factories in Korea in 1996 (Park, 1997) and export of kimchi has been increased drastically since last year. Hot pepper and garlic are vital ingredients for many kinds of kimchi. There are at least 187 different types of kimchi with distinctive recipes (Koo et al., 1991). These unique types of processed vegetables can now be found at any parts of the world from Australia to Canada (Nguyen et al., 1997, Wang, 1997) manufactured in commercial scale.

5. Production of individual horticultural crops

Data on individual horticultural crop is shown in Table 7. Tomato, watermelon, cabbages, onion, and cucumber are 5 major vegetables in Asia and this coincides with the order in world total. Among the vegetables, garlic and eggplants are cultured mainly in Asia (87.3% and 90.3%), but carrot and green pea are not receiving much attention in Asia, as compared to other continents. Fruit data is expressed in production (1,000 ton) rather than cultivation area. Banana, including plantain, is by far the most abundant fruit in the world followed by oranges, grape, and apple. However, in Asia, apple is the first one followed by banana, mango, grape, and orange. There has been a tremendous increase in apple planted acreage in China and this will undoubtedly influence the apple industry in the East Asia and in the world in the near future. (FAO, 1997, Internet Search, fao.org/default.htm). Except for mango, the percentage is rather low in many fruits. The vegetable cultivation in Asia is indeed very advanced and characterized by the followings.

- 1) Various different cultivation types and techniques including numerous cultivars for each type.
- 2) Highly intensive cropping and frequent successive cropping in the suburban areas.
- 3) Well-advanced seedling growing techniques including grafting different types of herbaceous materials on commercial scale.
- 4) Considerable portions of the produces are being processed or preserved in various types.

Vegetable and fruit production acreage in some Asian

Table 6. Per capita production* of horticultural crops (Lee et al., 1994)

Country	Per capita production (kg/year/person)			Ratio of vegetables/fruits
	Vegetable	Fruit	Total	
China	102.6	19.9	122.5	5.16
Japan	121.1	42.6	163.7	2.85
Korea (N)	201.1	60.0	261.1	3.35
Korea (S)	236.4	43.9	280.3	5.38
Taiwan	162.3	84.3	246.6	1.93
USSR	107.8	50.4	158.2	2.14
USA	128	98	226.0	1.31
Malaysia	17.6	60.5	78.1	0.29
Philippines	66.5	107.1	173.6	0.62
Thailand	44.6	101.8	146.4	0.44

Table 7. Horticultural crop production in the world in 1996.

	World	Africa	NC Amer	S. Amer	Asia	%Asia	Europe	Oceania
A. Vegetables*								
Cabbage	46656	780	2208	526	28758	61.6	14265	119
Tomato	84873	9591	14899	5671	36250	42.7	17947	515
Pumpkin+Gourd	9822	1174	497	828	5236	53.3	1915	925
Pepper, Chili	14068	1839	1575	248	7905	56.2	2476	25
Onion	35644	2252	3082	2434	21341	59.9	6288	246
Garlic	10401	197	308	203	9075	87.3	618	1
Cucumber	23051	391	1473	65	17667	76.6	3427	22
Carrot	16477	820	2327	664	5911	35.9	6511	246
Watermelon	39725	1979	2509	1118	30168	75.9	3871	81
Melons	16190	1039	2045	295	10234	63.2	2502	75
Eggplant	11981	550	83	5	10816	90.3	524	2
Green beans	491	32	38	34	258	52.5	120	9
Green peas	806	53	151	60	241	29.9	283	19
B. Fruits**								
Grape, fresh	57410	2983	5625	5268	12405	21.6	30005	1125
Apple	53672	1479	5967	2978	25906	48.3	16520	822
Pear	13093	443	751	819	7256	55.4	3629	195
Peach	10409	344	1123	724	3690	35.5	4472	95
Orange	59558	4374	15152	24318	10491	17.6	4769	453
Tangerine	15954	1018	918	1524	10384	65.1	2026	85
Lemon	9104	575	2183	1720	3471	38.1	1117	38
Grapefruits	5004	402	3129	385	1011	20.2	49	29
Citrus	4129	2666	149	27	1254	30.4	21	12
Apricots	2387	262	78	72	1147	48.1	813	42
Avocado	2093	192	47	378	177	8.5	55	17
Mango	19215	1892	212	872	14421	75.1		37
Pineapple	11757	1945	1405	1811	6417	54.6	2	178
Plum	6761	134	919	200	3019	44.7	2455	178
Banana	55787	6803	8508	15052	24082	43.2	423	919
Plantain	29746	21736	1448	5712	845	2.8	0	5
Papaya	5867	775	549	2653	1873	31.9	0	67
Strawberry***	2570	40	858	57	457	17.8	1145	13
Walnut*	1023	3	207	23	495	48.4	294	0

*Vegetable harvest area (1,000 ha) and fruit (production, 1,000 ton), respectively.

***Other berries and nuts include raspberry (743), current (687), pistachio (610), hazelnut (590), cashew nut (721), chestnut (505), and others

countries are further shown in Tables 8 and 9. China and India are the leading countries for vegetable production acreage followed by Turkey and Indonesia. However, fruit production acreage is highest in China followed by Turkey, Iran, and Indonesia. As far as production acreage is concerned, Asia has 66% of the world total vegetable production acreage as compared to only 44% of the world fruits production acreage. China has about 50% of the total Asian vegetable production acreage and 43.9% of the total Asian fruit production acreage, thus indicating that the Asian trade of horticultural products can be significantly influenced by only a few countries in Asia or by China alone! During the last 10 years, the protected cultivation acreage in China has been increased 17 times and the per capita consumption of vegetables also was almost doubled from 119.8

kg/year/person to 217.2kg/year/person (Zhang 1997). Average yield of vegetables per unit area was also more than doubled during the last 10 years. Introduction of promising, new hybrid cultivars may be responsible for this remarkable increase in yield per unit area. On the contrary, however, the use of hybrid seeds for vegetable production is extremely low in India (Table 10), thus needing urgent attention and introduction of good hybrid cultivars (Agrawal, 1997).

Individual vegetable production statistics are further shown in Table 9. Potatoes are the major vegetable crop in many Asian countries, not as vegetables in many circumstances but as an important food crop. Cauliflower, carrot, and eggplant are being cultivated only in some countries whereas cabbage, tomato, pumpkin, cucumber, onion and watermelon are being cultivated

Table 8. Horticultural crop production in Asian countries.

Country	Vegetables and Melons			Fruits		
	1996	1997	Mean	1996	1997	Mean
China	11,799,460	12,109,460	11,954,460	8,859,933	9,413,353	9,136,643
India	4,880,400	4,880,400	4,880,400	3,267,075	3,267,075	3,267,075
Turkey	878,903	878,903	878,903	1,025,285	1,025,158	1,025,221
Indonesia	843,521	843,521	843,521	940,000	940,000	940,000
Philippines	595,070	595,076	595,073	864,395	859,895	862,145
Iran	535,000	535,000	535,000	1,010,445	1,010,445	1,010,445
Japan	500,600	500,600	500,600	273,710	273,710	273,710
Korea (S)	447,757	452,657	450,207	171,440	171,440	171,440
Vietnam	376,400	376,400	376,400	331,237	331,237	331,237
Thailand	325,758	325,758	325,758	632,889	632,889	632,889
Pakistan	320,671	323,600	322,065	583,494	582,070	582,782
Korea (N)	307,400	307,400	307,400	158,600	158,600	158,600
Sub-total	21,810,940	22,128,635	21,969,788	18,118,503	18,665,872	18,392,188
Asia total	24,063,100	24,392,070	24,227,585	20,518,880	21,112,900	20,815,890
World total	36,438,660	36,757,520	36,598,090	46,556,560	47,157,550	46,857,055

Table 9. Vegetable cultivation area in 1996 (unit: 1,000 ha).

Country	Population	Cabbage	Tomato	Cauliflower	Pumpkin*	Cucumber
China	1,232,083	600	504	154	154	683
India	944,580	200	320	270	23	-
Indonesia	200,453	72	50	-	-	56
Pakistan	139,973	4	28	50	22	-
Japan	125,351	67	14	12	18	18
Bangladesh	120,073	9	12	2	4	4
Vietnam	75,181	5	-	2	-	-
Iran	69,975	-	95	-	70	70
Philippines	69,282	8	17	-	2	2
Turkey	61,797	29	175	4	41	41
Thailand	58,703	19	11	5	25	25
Myanmar	45,922	-	-	-	-	-
Korea (S)	45,314	49	4	-	10	10
Korea (N)	22,466	43	9	-	6	6
Uzbekistan	23,209	14	-	-	28	28
Iraq	20,607	1	55	3	38	38
Malaysia	20,581	1	-	-	2	2
Country	Eggplant	Onions	Carrot	Watermelon	Melons	Potatoes
China	481	386	163	919	291	3502
India	-	384	-	-	2	1089
Indonesia	45	77	18	-	-	66
Pakistan	7	76	10	19	27	79
Japan	16	30	24	20	19	105
Bangladesh	-	34	-	-	12	132
Vietnam	-	61	-	18	-	28
Iran	-	43	-	145	88	155
Philippines	20	9	-	6	1	5
Turkey	31	98	12	135	110	210
Thailand	11	19	-	28	-	1
Myanmar	-	27	-	-	-	19
Korea (S)	10	10	7	35	10	18
Korea (N)	5	7	-	6	10	140
Uzbekistan	-	8	1	62	-	48
Iraq	10	8	1	37	21	25
Malaysia	-	-	-	6	-	-

*Pumpkins also include squashes and edible gourds.

Table 10. Vegetable cultivation area and percentage of area under hybrid seed production in India (data: 1997 Chronica Horticulture).

Crop	Total area (Ha)		% area under hybrid prod.
	FAO	TVIS	
Brinjal	NL	474,352	13.9
Cabbage	299,000	239,743	22.9
Cauliflower	270,000	446,644	1.7
Chillies+Peppers (green)	5,000	567,851	0.9
Cucumber	NL	250,000	3
Gourds	315,000	405,218	2
Melons	2,000	166,030	2.6
Okra	NL	367,986	5.2
Tomato	320,000	480,713	28.3
Onion	384,000	NL	-
Garlic	86,000	NL	-
Pimento (all spice)	1,000,000	NL	-
Pepper (White/Long/Black)	200,000	NL	-

Source: Revised from Seed Association of India.

*Include bottle gourd, ridge gourd, bitter gourd, and sponge gourd (FAO includes pumpkin and squash).

**Includes watermelon and muskmelon.

NL: Not listed.

Table 11. Major pepper producing acreage in the world in 1997 (Data: FAO Internet search, fao.org/default.htm)

Country	Chillies*	Paprika**	Pepper***	Pepper total
China	352,430	30,000	11,000	393,430
India	5,000	1,000,000	200,000	1,205,000
Indonesia	200,000	420	72,600	273,020
Pakistan	-	95,000	-	95,000
Japan	4,800	-	-	4,800
Bangladesh	-	66,000	-	66,000
Vietnam	-	-	7,400	7,400
Iran	-	1,450	-	1,450
Philippines	1,000	-	-	1,000
Turkey	58,000	6,500	-	64,500
Thailand	950	18,000	3,500	22,450
Myanmar	-	74,000	-	75,000
Korea (S)	105,000	-	-	105,000
Korea (N)	2,000	-	-	2,000
Uzbekistan	-	-	-	-
Iraq	3	-	-	3
Bhutan	2,500	1,600	-	4,100
Cambodia	-	9,500	-	9,500
Israel	1,900	100	-	2,200
Laos	-	2,200	-	2,200
Syria	2,900	-	-	2,900
Nepal	-	15,500	-	15,500
Sri Lanka	2,900	-	-	2,900
Malaysia	-	-	10	10

*Chillies also include green peppers.

**Data obtained by direct internet search (not in FAO Yearbook). Pimento all belonging to spices.

***Peppers of white, long, and black. Other pepper producing countries are Ghana (5,200), Nigeria (95,000), Mexico (90,000), and USA (20,000 ha), respectively.

in most Asian countries. Data base used in this report was mostly obtained from FAO Yearbook or internet FAO (fao.org/default.htm). However, even these data were not quite accurate and sometimes classified in different ways so that true data could not be easily accessible. Table 11 gives the production statistics on peppers. Dried hot peppers are one of the important vegetable crops (or spice) and frequent international trades have been taken during the last 10 year. The data shows that the pepper producing area in India is more than 1.2 million ha. However, the FAO classification is very confusing and expressed improperly so that more reliable as well as more accurate data should be compiled and available for precise evaluation and comparison of production statistics on a global basis. The data shown in Tables 10 and 11 indicate again that more precise data is needed for possible accurate analysis of present production status and to set up goals for future guide for production and international trade.

6. Public or international organization

The significance and preferences of vegetables among Asian people can be easily proven by the earlier establishment and maintenance of the Asian Vegetable Research and Development Center (AVRDC), an international research center financed by USA, ADB, Taiwan, and other Asian countries. AVRDC is the international research and training organization established in 1970, responsible for improving production and quality of selected vegetables and legume crops in the hot, humid low and tropics. AVRDC had the following initial objectives (Malowe, 1989) and the activities are considered to be very fruitful, especially in southeast Asian countries.

- 1) Conduct research on production and marketing programs to assist participating countries in developing their own adaptive research programs.
- 2) Carry out training in production and marketing programs and to assist participating countries in developing more efficient training and marketing programs.
- 3) Develop and provide basic information on improved production and marketing for use in extension services in participating countries.

7. International trade of horticultural products

World trade of some major crops is shown in Tables 12 and 13. Due to the high population and limited arable land area, many Asians are experiencing food scarce and thus depend highly on imported foods from other continents or countries. As

Table 12. World trade of food crops in 1995 (unit: 1,000 US \$).

Crop	Import	Percentage	Export	Percentage	Imp/Exp ratio
Cereals	4,690,910	50.6%	41,941,600	50.7%	1.12
Wheat & Flour	21,860,520	23.6%	19,360,330	23.4%	1.13
Maize	12,467,940	13.4%	10,872,520	13.1%	1.15
Rice	7,600,646	8.2%	7,191,984	8.7%	1.06
Barley	3,163,255	3.4%	2,724,033	3.3%	1.16
Rye	385,074	0.4%	331,079	0.4%	1.16
Oats	321,686	0.3%	301,784	0.4%	1.07
Sub-total	92,708,281		82,723,330		

Table 13. World trade of field & horticultural crops in 1995 (unit: 1,000 US \$).

	World	Africa	NC. America	S. America	Asia	Europe	Oceania
<u>EXPORT</u>							
Potatoes	2,309,881	157,753	194,943	83,172	202,253	1,707,715	13,409
Tomato	2,296,865	75,664	727,313	123,196	157,947	1,820,839	7,047
Onions	1,205,930	28,200	288,677	88,692	270,487	444,468	85,406
Banana	4,595,696	468,288	4,675,778	1,228,810	298,954	1,223,236	1,384
Grape	1,928,043	111,918	409,682	366,561	126,923	888,411	24,548
Grape (raisin)	752,212	6,261	59,706	28,111	133,507	506,315	18,313
Apple	3,008,217	109,737	454,639	341,481	200,195	1,575,052	327,113
Ora+Tanger.	3,686,334	407,056	379,818	128,530	380,487	2,320,896	69,547
Lemon	740,311	18,326	174,114	130,603	88,482	376,707	4,152
Peach	893,701	8,471	69,575	64,063	8,732	739,256	3,604
Pineapple	300,205	55,336	85,674	6,120	31,260	120,628	187
Pineap. (can)	562,986	79,649	8,865	781	416,336	53,823	3,532
<u>IMPORT</u>							
Potatoes	2,584,211	192,638	179,967	42,394	231,247	1,929,846	8,119
Tomato	2,709,768	5,112	628,282	501,868	149,292	1,914,390	7,047
Onions	1,303,294	24,802	207,909	72,809	405,067	584,860	7,847
Banana	6,951,210	51,329	158,566	114,245	817,773	4,353,545	27,603
Grape	2,252,059	9,975	625,576	51,498	288,381	1,260,773	15,856
Grape (raisin)	742,214	6,261	59,706	28,111	133,507	506,315	18,313
Apple	3,255,616	55,281	282,811	223,874	593,228	2,093,844	6,578
Ora+Tanger.	3,967,420	9,259	215,289	11,037	766,839	2,944,719	20,277
Lemon	841,649	916	64,013	40,656	199,483	574,555	2,271
Peach	920,436	1,521	106,137	25,250	26,375	759,763	1,390
Pineapple	445,716	1,102	59,702	4,900	70,044	307,350	2,618
Pineap. (can)	647,566	1,835	208,045	19,690	129,044	276,413	12,539
<u>RATIO OF EXPORT/IMPORT</u>							
Potatoes	0.89	0.82	1.08	1.96	0.87	0.88	1.65
Tomato	0.85	14.80	1.16	0.25	1.06	0.95	1.00
Onions	0.93	1.14	1.39	1.22	0.67	0.76	10.88
Banana	0.66	9.12	29.49	10.76	0.37	0.28	0.05
Grape	0.86	11.22	0.65	7.12	0.44	0.70	1.55
Grape (raisin)	1.01	1.00	1.00	1.00	1.00	1.00	1.00
Apple	0.92	1.99	1.61	1.53	0.34	0.75	49.73
Ora+Tanger.	0.93	43.96	1.76	11.65	0.50	0.79	3.43
Lemon	0.88	20.01	2.72	3.21	0.44	0.66	1.83
Peach	0.97	5.57	0.66	2.54	0.33	0.97	2.59
Pineapple	0.67	50.21	1.44	1.25	0.45	0.39	0.07
Pineap. (can)	0.87	43.41	0.04	0.04	3.23	0.19	0.28

shown in Table 12, grains account for more than 50% of the world trade followed by wheat and flour (23%), maize (8-9%), and rice (3%). Among the horticultural crops (Table 13), banana, sometimes including plantains, is ranking number one in total

amount of international export followed by oranges (including tangerines and mandarins), apple potatoes and tomato. Pineapple (canned) is the only item which is mainly exported from Asia and most other horticultural crops are mostly exported from

other continents. Asia does not import a large amount of horticultural crops, either. Major importer of horticultural crops is Europe, accounting for 50-80% of the total import for most horticultural crops. Potatoes and tomatoes are the major vegetables being traded worldwide.

Total amounts of export and import in Asian countries and some other countries are shown in Table 14. International trade of fruits and vegetables in Asian countries and some other countries of the world can be obtained from FAO Homepage (fao.org/default.htm). Based on the total amount of export excess value, major exporting countries in Asia are Philippines, Israel, Syria, Turkey, and Myanmar, in that order. On the world-wide

basis, however, Chile upsurged recently as the largest exporting country followed by Costa Rica, Ecuador and New Zealand, in that order. The largest importing countries in the world are Canada and Russia, which are located in cold northern hemisphere. The largest importing countries in Asia are Israel, Hong Kong (now in China), Pakistan, Oman, and Philippines, in that order. However, the trade difference (export-import) is largest in Oman, followed by Hong Kong, Bahrain, Qatar, and Pakistan. It is interesting to note that many of these importing countries are developing countries rather than developed ones, thus indicating that accumulation of high production technology rather than man-power is vital for producing and exporting high

Table 14. International trade of fruits and vegetables in Asian countries and some other countries in the world in 1993-1995 (unit: 1,000 US \$).

Country	IMPORT				EXPORT				Differences (Exp-Imp)
	1993	1994	1995	Total	1993	1994	1995	Total	
Bahrain	70313	70380	69693	210386	322	322	352	996	-209,390
Bangladesh	48482	49005	37439	134926	2842	2842	2842	8526	-126,400
China	4825	5608	6581	17014	26351	33209	37273	96833	79,819
Cypnis	17406	25420	30300	73126	98866	111688	170862	381416	308,290
Hong Kong	141141	152262	161387	454790	56161	58942	61545	176648	-278,142
India	41567	52268	29893	123728	54766	65212	62534	182512	58,784
Indonesia	13193	19771	24021	56985	29633	30386	29953	89972	32,987
Israel	148476	175222	180171	503869	525009	532266	586725	1644000	1,140,131
Japan	48671	57828	62943	169442	1110	1152	1132	3394	-166,048
Jordan	63206	61069	78957	203232	101095	96202	99847	297144	93,912
Korea (South)	34548	43708	46363	124619	22231	27884	33359	83474	-41,145
Kuwait	22150	24297	25642	72089	532	625	732	1889	-70,200
Macao	24804	25946	25199	75949	2388	2695	2086	7169	-68,780
Malaysia	33185	37444	45110	115739	20869	19734	19129	59732	-56,007
Myanmar	0	0	10	10	123566	128130	222230	473926	473,916
Oman	126309	118310	102418	347037	14953	15433	15605	45991	-301,046
Pakistan	122247	94390	136121	352758	59617	59364	57306	176287	-176,471
Philippines	73779	117150	121849	312778	600302	571624	581213	1753139	1,440,361
Qatar	62119	61515	69614	193248	719	322	256	1297	-191,951
Saudi Arabia	5611	5458	5606	16675	892	686	650	2228	-14,447
Singapore	79819	81379	87172	248370	28981	36773	39962	105716	-142,654
Syria	31604	21063	103434	156101	292986	338295	315164	946445	790,344
Thailand	13910	17811	19408	51129	160866	149157	149175	459198	408,069
Turkey	10107	4771	8750	23628	166963	200332	217919	585214	561,586
UAE	41714	61110	60618	163442	13032	14747	13313	41092	-122,350
Vietnam	5135	8050	11500	24685	59456	73871	73186	206513	181,828
USA	65469	69944	75484	210897	63743	71043	75017	209803	-1,094
Mexico	41100	46147	32501	119748	184961	205723	263888	654572	534,824
Canada	267324	259517	216198	743039	68444	82765	103736	254945	-488,094
Costa Rica	14996	30529	37412	82937	509675	754128	899726	2163529	2,080,592
Columbia	73926	129878	171949	375753	481786	543348	497010	1522144	1,146,391
Ecuador	9436	19074	28737	57247	588224	734514	804980	2127718	2,070,471
Chile	56375	59433	78441	194249	104213	117070	137483	3587672	3,393,423
France	49130	54786	63073	166989	29332	31797	36191	97320	-69,669
Italy	20596	24431	25964	70991	37484	42223	44741	124448	53,457
Russia	98706	205512	176671	480889	4587	4465	6245	15297	-465,592
New Zealand	144824	159877	181289	485990	591806	653913	825785	2071504	1,585,514

quality horticultural products.

Some Asian countries with large population, for example China, India, Indonesia, and Japan (71.7% of total Asian population in these 4 countries) do export and import horticultural products. However, the total amount and the differences between export import are surprisingly low, thus meaning that production system for self-supply is well stabilized in these countries. Even though vegetables are very much favored by many Asian people, most of these horticultural products are being traded mostly among nearby countries with the exception of some fruits and ornamental plants. For example, Korea (S) imported a large amount of fresh and processed vegetables from China (Lee, 1994) and the amounts have been increasing steadily (FAO, 1996, 1998; Lee et al., 1994). On the contrary, Korea (S) exports considerable amount of fresh and processed vegetables such as pine mushroom, kimchi, dried mushroom, onion, and cucumber exclusively to Japan (FAO, 1998 Internet). Kimchi, which symbolizes the Korean traditional eating preferences because of its unique delicate flavor and taste, is exported to all over the world, sometimes even under wrong name of "kimuchi" and now officially regarded as the well-known delicacies of the world and in every Olympic Games! In spite of the large amount of horticultural products, the amount of international trade has never been impressive until recently. The bulk of horticultural crops compared to cereals or grains may be partially responsible for this. The maintenance of freshness in fresh vegetables and fruits would be possible only for short-distance transport. The dissimilarity in crops is another reason for this trend of international trade.

Furthermore, following regions or so called free trade agreements (or areas) all over the world tended to aggravate the local trade tendency in some way or another.

These are ASEAN (Association of South East Asian Nations, 9 countries), NAFTA (North American Free Trade Agreement, 3 countries), CERTA (Close Economic Relation Trade Agreement, 2 countries), EU (European Union, 15 countries), LAIA (Latin American Integration Association, 9 countries), and many more agreements or areas such as Asian Pacific Region (APEC), East African Community, etc. The role and significance of ASEAN and AFTA (ASEAN Free Trade Area) have been drastically increasing until recently. However, financial crisis or ruin in some Asian countries such as Indonesia, Thailand, and Korea will greatly influence the ASEAN activities at least for 5-10 years. The role of OECD and APEC will be emphasized with relation to economies in Asian countries especially with the launching of WTO (World Trade Organization).

8. Professional workers engaged in Horticultural research and their activity

Horticultural activities such as research, education, production and industries are depending critically upon the number of horticulturists and specialists. In a given country, the number of registered members in any international horticultural society could be a good indication for the measure of global horticultural activities. More detailed information on paid-up membership can be obtained from both ISHS and ASHS. A more detailed study on researchers active in the field of horticulture will be available from ISHS within the coming years, under the new publication HRI (Horticultural Research International) directory.

9. Expanding horticultural research and industry in Korea (case study)

The Republic of Korea is probably one of the very few countries in the world with huge annual increases in governmental as well as Research foundation fund for horticultural research. The importance of horticultural products has been recognized in various different ways. For example, the percent share of the total amount of horticultural produce in all agricultural produces (including livestock and forest products) in 1995 was increased up to 24.4% for vegetables and 11.3% for fruit. These values clearly indicate the importance of horticulture and horticultural industry. Similar trends have been maintained for last 5 years. The activity of the Korean Society for Horticultural Science (KSHS) members can be clearly confirmed by the number of registered KSHS members (+1,500), number of registered ASHS members and ISHS members, number of papers presented at the annual meeting of the KSHS (Table 15 and 16), and the occupation of authors delivering the papers at the meeting (Table 17). At the spring and fall meetings, several well-known scientists or horticulturists have been officially invited from other countries for special lectures. The KSHS also held several ISHS international symposia for the last few years and plans to host several more symposia in the next few years; on pepper, postharvest, and use of bioregulators in fruits, etc. At the last ISHS international symposium on vegetable quality which was held in Seoul, Korea from October 27 to 30, 1997, we had 120 participants from 23 countries. Acta containing about 55 papers will be published in July this year (before the 1998 IHC in Belgium). The KSHS plans to celebrate its centennial anniversary of the official launching of modern horticultural research in Korea. The Agricultural Demonstration Station was

Table 15. Number of research papers presented at the annual meeting of the Korean Society for Horticultural Science.

Subject area	1997				1990			
	V	F	O	Total	V	F	O	Total
Plant improvement								
Genetic-Gene Bank	12	11	6	29	2	1	0	3
Breeding	21	7	11	39	6	1	0	7
Biotechnology	25	3	21	49	2	0	6	8
Propagation-Nursery	28	5	37	70	4	3	5	12
Pest-disease and Disorders	17	14	18	49	6	14	5	25
Integrated Crop Production systems								
Cultural Techniques	70	31	44	145	11	4	5	20
Environment Implications	8	5	10	23	3	0	0	3
Quality implications	19	10	20	49	4	2	1	7
Post-harvest (Storage, Packing, and Processing)	17	32	21	70	1	3	2	6
Economics, Management and Marketing	-	-	-	-	-	-	-	-
TOTAL	217	118	188	523	39	28	24	91

V: Vegetables, F: Fruits, and O: Ornamentals, respectively.

Table 16. Number of papers presented at the annual meeting of the Korean Society for Horticultural Science.

Crops	1995			1996			1997		
	Spring	Fall	Total	Spring	Fall	Total	Spring	Fall	Total
Vegetables	90	109	199	64	143	207	145	117	262
Fruits	35	33	68	50	43	93	59	45	104
Ornamentals	69	65	134	88	102	190	127	94	221

Table 17. Professional status of senior author of each presentation at the annual meeting of the Korean Society for Horticultural Science.

Profession	1986	1996	Total
University			
Professors	50	160	210
Graduate Students	18	154	172
Research Institutions (RI)			
National Horticultural RI	17	85	105
Provincial and Other RIs	0	41	42
RDA and Other RIs	2	64	66
Seed company & Others	4	18	22
Total	91	523	614

established in 1906 in Suwon and, after several changes of its official name, has now become the Rural Development Administration (RDA) of the Korean Government, the center for agricultural researches in Korea.

The RDA now has National Horticultural Research Institute, Horticultural Sections in 3 Agricultural Experiment Station, 9 Provincial RDAs, and 23 Commodity Experiment Stations mandated with horticultural crop. In addition to about 40 universities and colleges which have the department of horticulture, there are many private research institutes including 42 seed companies. Considering the total population of 45 million and only about 10% agricultural population (as of Dec 1997), the

figures are rather too high as compared to most other developed countries. The export of horticultural produce is not impressive either except for some crops. For example, more than 70% of the grafted cacti being auctioned at Netherlands flower markets are exported from Korea. Korea also exports lilies and roses to Japan. Detailed data will be presented at the conference. Unfortunately, import has always well exceeded export as far as floricultural crops are concerned. With the booming of horticulture in Korea, the KSHS is very anxious to have the chance to become the host country for the 2006 IHC here in Korea rather than continual every other host in European countries.

10. Role of seed companies and handling of germ plasm

Since vegetables are the major horticultural crops in Asia, considerable efforts have been focused on vegetable breeding and a large amount of vegetable seeds are being exported to Western countries. Brassica crops (cabbage, Chinese cabbage, broccoli and cauliflower) and radishes are some of the vegetables for export from Asia. Some seed companies in Japan, Korea (S), and perhaps Taiwan have been operating overseas companies or branch stations in other countries including the USA and also exporting considerable amount of seeds. However,

we expect some significant changes in seed industry because multinational seed companies such as Novatis and others began to operate official business in some Asian countries with their good seeds, advanced seed processing and cultivar identification technology in addition to the modern purity test methods.

11. Conclusions

With the rapid expansion of globalization under the influence of WTO, the world market for agricultural and horticultural produces has been increasing very rapidly and this, along with the introduction of noble cultivars with accurate identity so that the breeding efforts can be protected by the UPOV. However, such a rapid change does not likely take place due possibly to the very conservative attitude of Asian people, especially in their diet habit. In addition to good seeds of excellent traits, gradual and persuasive approaches are thought to be vital for the successful operation and maintenance of branch companies and persistent sales and distribution of seeds and other propagation materials. In spite of the sudden recent break on economic growth in some Asian countries, the role and significance of Asian horticulture will be persistently increased in the future, particularly in breeding, production, and utilization of horticultural products, especially of the vegetables. Horticulture in Asia will be continuing its steady progress and exert significant role in world horticulture based on the following fact.

- 1) Asia has endless list of excellent germ plasm for various horticultural crops especially for cruciferous crops including Brassicas, legumes, and native herb (Zhu et al., 1997).
- 2) The number of Asians living in other continents of the world has been increasing drastically in recent years and it is more likely that they will certainly maintain their conservative palate (Kim et al., 1997; Sakiyama, 1997).
- 3) There are good markets developed, especially for processed horticultural products because of the recent economic growth in some Asian countries.
- 4) The preferences for vegetables and very intensive and labor-dependent culture will be maintained in most Asian countries.

References

- Agrawal, P. K. 1996. The Indian Seed Industry. TVIS Newsletter 1(2): 4-5. AVRDC. Tainan, Taiwan.
- FAO. 1995. 1996. Yearbooks on Trade and Production.
- FAO. 1998. Internet Homepage. FAO. <<<http://www.fao.org/default.htm>>>
- Inden, H., Y. Kawano, Y. Kodama, and K. M. Nakamura. 1997. Present status of vegetable pickling in Japan. Proc. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea) Acta Hort. 48, p. 421-428.
- ISHS, 1986. Horticultural Research International. Published by International Society for Horticultural Science, ISBN 90 6605 3321.
- Janick, J. 1994. Horticultural Science. W. H. Freehan Co.
- Kim, M. L., H. S. Choi, and M. S. Chung. 1997. Flavor patterns of fresh vegetables and some aspects for improved diet. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 P. 69-82.
- Koo, Y. J. and S. Y. Choi. 1991. Scientific Technology of Kimchi (2nd ed.). Kor. Food Res. Institute.
- Lee, J. M., J. H. Jung, K. W. Park, and I. O. Yu. 1994. Outline of vegetable growing and research in the Republic of Korea.
- Lee, J. M. 1988. Research and development of vegetables in the Republic of Korea Vegetable Research in Southeast Asia. AVRDC Publication No. 88-303, ISBN: 92-9058-034-8.
- Lee, S. K. and J. Y. Yoon (eds). 1994. Horticulture in Northeast Asia: Past, Present and Future.
- Marlowe, G. A. 1988. Vegetable research at AVRDC: Achievements and future thrusts. Vegetable Research in Southeast Asia, AVRDC Publication No. 88-303, ISBN: 92-9058-034-8.
- McLean, B. T. (editor) 1988. Vegetable Research in Southeast Asia. AVRDC Publication No. 99-303, ISBN: 92-9058-034-8.
- Nguyen, V. Q., R. C. Coogan, and R. B. H. Wills. 1997. Effect of planting time on the growth and quality of Japanese white radish (*Daikon*, *Raphanus sativus* L) grown on the Central Coast of New South Wales, Australia. Proc. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 p. 83-94.
- Park, W. S. 1997. Present status of kimchi industry and its prospect. Proc. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 p. 397-404.
- Sakiyama, R. 1997. Needs for research on vegetable quality in Asian countries. Proc. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 p. 25-32.
- Wang, S. L. 1997. Recent development of oriental vegetable production and processing in Canada. Proc. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 p429-436.
- Zhang, S. 1997. Vegetable production and its future development in China. Chr. Horti. 37(4): 16-17.
- Zhu, Y., X. Wu, Q. Yuan, S. Song, and Z. Wu. 1997. Analysis and evaluation of nutrient components in Chinese traditional and wild vegetables. 7th Intern. Symp. Veg. Quality, ISHS (Seoul, Korea). Acta Hort. 483 p. 111-116.