

**National strategies for vegetable production
and
status of hybrid seed technology development in
sub-tropical and tropical Asia**

M.P. Devarrewaere

Vegetable Seed Specialist, FAO, Bangladesh

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BACKGROUND

In November 1994, FAO organized an Expert Consultation Meeting of the Regional Network on Vegetable Crops in Bangkok (29/11/94 - 2/12/95) during which representatives of 17 countries and territories of the Asia-Pacific region reviewed the status of vegetable production in the region, the research and discussed the need for promoting the development of hybrid seed. The meeting drafted a list of recommendations to improve vegetable production in the Region and enhance cooperation on research between countries.

The countries represented in the meeting were: India, Pakistan, Bangladesh, Nepal, Sri Lanka, Myanmar, Philippines, Thailand, Malaysia, Indonesia, Vietnam, Republic of Korea, China, Japan, New Zealand, Western Samoa, and Fiji. The 3 last countries were not included in this document.

This paper was prepared on the basis of the country presentations, and discussions help during the meeting.

In order to compare the data provided by 14 different countries, I have extracted from the country presentations figures related to production, area, and yield of vegetable crops propagated by seeds only (excluding potato and other tuber crops) and rearranged them to fit the format of this presentation.

In the first part of this paper, I will outline common trends and findings regarding vegetable production in the whole region, achievements made by research, constraints for further development of the vegetable production, of status of hybrid technology and the vegetable seed industry.

In the second part, country specific information - including detailed figures - regarding the vegetable and vegetable seed industry is presented in the form of a one page **Country Vegetable Industry Profile**.

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1. INTRODUCTION

Asia is the most populated continent in the world, with almost 3 billion inhabitants in 1992, increasing at the rate of 1.8% per year. The general policy of promoting a balanced diet with proteins, vitamins and fibers from plants to complement a predominantly carbohydrates diet, has resulted in an increasing demand for fresh vegetables. It is estimated that by the year 2000, the production of vegetable should be doubled.

In spite of a reputation that Asian cuisine, and food habits in Asia are very much based on vegetables, most countries have a yearly per capita availability of vegetables considerably below the minimum per capita consumption requirement of 55 kg/caput/year (Siemonsma, 93) **Table 1**.

Table 1 Population and nutrition indicators for selected countries in Asia (1992)

Country	Total Population in Millions	Population density in/km ²	Population growth rate in %	Agricultural population in %	Vegetable availability Kg/cap/year
South Asia					
Pakistan	121.4	151.3	2.9	52	31.17
India	866.3	269.6	1.9	62	62.79
Nepal	20.0	148.0	2.4	91	48.01
Bangladesh	119.4	830.0	2.4	67	18.31
Sri Lanka	17.6	268.7	1.2	51	24.36
South-East Asia					

Myanmar	42.6	63.0	1.9	45	32.47
Thailand	57.0	112.3	1.4	59	44.47
Malaysia	18.0	55.8	2.4	29	14.21
Indonesia	195.0	102.0	1.7	43	30.69
Philippines	67.1	223.0	2.0	46	
Vietnam	68.9	209.0	2.0	59	47.92
East Asia					
China	1,200.0	122.3	1.6	66	114.89
Republic of Korea	44.0	448.0	1.1	20	215.92
Japan	124.4	329.0	0.4	5	105.2
Total Asia					
	2,857.3	211.5	1.8	58	83.95

Source: the new Grolier encyclopedia multimedia 92, RAPA 94/24

vegetable availability has been calculated from the total domestic production in 1993 divided by the total population.

Realizing this problem, the policy makers in most Asian countries, who were giving a low priority to horticultural crop in their development programs have started reversing this process, with noticeable success.

2. STATUS VEGETABLE PRODUCTION IN ASIA

2.1 Vegetable Production/ Area/ Productivity

The overall vegetable production in the region has increases from 190 million tons in 1983 to around 240 million tons in 1993, which represents an annual growth rate of 2.7 % Table 2. The world average production growth rate (83-93) is 1.8% per year.

The production increase is due to the expansion of area under vegetable cultivation, and to the overall growth of productivity. The total cultivable land in all Asian countries is almost at saturation, but the proportion under vegetable cultivation is increasing, which indicates that crop diversification is taking place.

In Thailand, where the industrialization process is very fast, the areas under vegetables are regressing, and so is the production (-0.3%). In Bangladesh and Sri Lanka, areas and production are stagnant or also regressing, with 0.2% and -3.8% growth respectively.

Table 2. The reason for stagnant development can be explained by the land pressure, and competition with essential grain production.

The percentage areas under vegetables of the total cropped area ranges from 0.3% for Malaysia to 15% for Korea. **Table 2.**

Table 2 Vegetable production indicators for selected countries in Asia (1993)

Country	Total cropped area	Area under vegetable	% of total cropped area	Annual veget. Prod growth (83-93)	Total production	Yield
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	in 000 ha ¹	in 000 ha ¹	in % ²	rate in % ³	in 000 tons ¹	in T/ha ¹
South Asia						
Pakistan	21,110	307.3	1.46	5.5	3,784	12.31
India	222,321	5,667.4	2.55	2.6	55,650	9.91
Nepal	2,959	140.5	4.75	8.2	960	6.83
Bangladesh	14,080	429.6	3.05	0.2	2,186	5.09
Sri Lanka	1,905	57.1	3.00	-3.8	428	7.32
South-East Asia						
Myanmar	4,330	212.0	2.11	1.0	1,383	7.38
Thailand	23,160	239.2	1.03	-0.9	2,535	10.60
Malaysia	4,880	14.5	0.3	3.1	254	17.50
Indonesia	22,500	822.5	3.66	5.6	5,984	7.28
Philippines	9,190	61.8	1.46	2.3	2,532	7.72
Vietnam	6,697	279	4.17	3.5	3,264	11.7
East Asia						
China	148,460	3,935.6	2.65	5.6	137,869	35.03
Republic of Korea	2,285	349.3	15.29	2.0	9,500	27.20
Japan	5,165	411.0	7.96	-0.8	13,065	31.79
Total Asia	489,042	12,927.1	2.64%	2.70	239,394	18.52

¹ Data extracted from authors presentations, and excluding potato

² Calculated from available data

³ Source: RAPA 94/24

* Estimated production from diverging information available (average between 722 and 4,342 thousand tons)

The average vegetable productivity (yield/ha/year) is found fluctuating from year to year, mainly because of the change in proportion of area under different vegetables, and also because of climate factors.

In the longer term, the yield of major vegetable crops has significantly increased which also indicates a growing impact of the dissemination of crop technology.

The average vegetable yield ranges from 5 T/ha in Bangladesh to 30 T/ha in China. Table 2.

This wide yield range sets a benchmark of progress to be achieved for countries having the lowest yields. Countries having higher productivity should further improve their yields, if they want to meet the challenges of the year 2000 to feed an ever increasing population.

2.2 Quality versus quantity of vegetable

A wide range of vegetable crops is grown in Asia (100 major, and another 125 minor species). There are two distinct groups of vegetables grown, the most important group are "tropicalized" and temperate vegetables (such as tomato, cabbage, cauliflower, radish, watermelon, squash) and for which a large number of hybrid varieties are available. The second group is the tropical and the indigenous vegetables (such as eggplant, chili, kale, amaranth, kang kong, mustard leaf, yard long bean, and many cucurbits).

In the more advanced countries of South-East and East Asia, the first group of vegetables is gaining more and more importance with the sophistication of the markets. The rapid economic development of these countries, along with the life standard improvement, the creation of supermarkets, and the opportunities for export, have increased the need for standardized, clean, and diversified vegetables.

In the other low income countries (Myanmar, Cambodia, Laos, Vietnam, and in South Asia), traditionally popular vegetables as well as temperate vegetables are grown, but the consumers of these countries have lower standards in the choice of their vegetables; availability is the prime concern. This concept is changing gradually with the overall development of the region.

Another factor gaining importance in the more advanced countries of Asia, is the concept of “Save vegetables” or “Green Food”. Consumers are being informed about pesticide residues in the vegetables they are usually consuming, this concern has lead national research programs and the private seed sector to develop new and safer agricultural practices combined with the use of hybrid seed (having multiple disease resistances). This concept has not yet reached the countries with lower incomes, but it is due to make its way in the longer term.

2.3 Production Techniques

Vegetable production is a high income generating activity (better than cereals) but requires high inputs (labor, fertilizer). It offers large employment opportunity, but in countries where daily wages are increasing, vegetable cultivation is not so profitable and attractive any longer.

In most Asian countries, vegetables are produced on small land holdings, on small size commercial plots or in homestead for home consumption.

In the more advanced countries, the vegetable production sector is under pressure deserted, because of low profitability (high input cost, labor), so the production techniques and concepts are changing drastically to cultivate larger areas and mechanize or to increase productivity per unit area by round the year cultivation and more sophisticated agriculture.

In China, Korea, and Japan for example, besides the development of hybrids, the most remarkable advancement in vegetable production have been:

- the steadily increasing area under protected cultivation (green houses, plastic tunnels, and plastic mulch)
- the improved transplant production system (mechanized transplanting, development of seed coating, seed taping)
- grafting techniques to avoid soil borne diseases (in Japan a mechanized grafting machine has been developed)
- development of soilless culture (hydroponics)

These sophisticated agricultural practices require more and more standard material which hybrid seed can provide:

- mechanization of transplant and grafting requires uniformity in germination and seedling production

2.4 Import and export of vegetables

Import and export of vegetables is done by most countries in the form fresh, frozen or processed vegetables as follows:

fresh: all types but mainly onion, garlic, cabbage
frozen/chilled vegetables: potato, pea, sprouted soya bean, sweet corn
processed vegetables: *salted or pickled:* cucumber, eggplant
canned vegetables: asparagus, tomato, sweet corn, bamboo shoots.

Export

Most countries in Asia are exporting vegetables in either form, to various neighboring countries, or to Europe, and Middle East. Export oriented vegetable production is frequently promoted in National Policies.

In South Asian, although domestic vegetable availability is very low, fresh vegetables (mainly to countries of Europe and Middle East, where the demand is created by the large South-Asian expatriate community working or residing abroad. **Table 3**

Import

Very few information is available regarding import of fresh vegetables, although most countries are known to import, especially off season vegetables, in moderate or large quantities. Malaysia, and Japan, for which data was available, imported (1992) 334,000 tons and 329,000 tons of fresh vegetables respectively, with as major import commodity: onion, and garlic, for Malaysia, and onion, pumpkin, cabbage for Japan.

In Malaysia, fresh vegetables are imported in large quantities to compensate for the limited domestic production. This has drawn the attention of local government authorities, which intend to reduce the import volume of fresh vegetables.

The case of Malaysia is peculiar because the country is also exporting fresh vegetables to Singapore (70% of export). The main cause for low domestic production, is that the rapid industrialization process has resulted in transfer of resources from vegetable to more competitive sectors.

Table 3 Export volumes of vegetables from selected countries in Asia (1993)

Country	Export of vegetables ¹	
	in Tons	in equivalent currency
South Asia		
Pakistan	36,100	365.5 million Rs
India	468,492	N.A.
Nepal	N.A.	N.A.
Bangladesh	7,679	76.8 million Taka
Sri Lanka	9,791	225.4 million Rs
South East Asia		
Myanmar	N.A.	N.A.
Thailand	164,000	160 million \$

Malaysia	N.A.	48 million \$
Indonesia	116,068	20 million \$
Philippines	22,628	22 million \$
Vietnam	N.A.	N.A.
East Asia		
China	N.A.	70 million \$
Rep. of Korea	N.A.	N.A.
Japan	1,243	2.8 million \$

Source: Figures from authors presentation

¹ Some export figures presumably include potatoes

South Asian countries (Nepal, Bangladesh, Sri Lanka, Pakistan) are improving officially or unofficially onions and off-season vegetables such as: tomatoes from neighbor India.

3. STATUS OF PUBLIC RESEARCH IN VEGETABLE CROPS

3.1 Major achievements of public research

The major contribution of National Research and Development Institutes to vegetable crops have been to produce and disseminate well adapted production technology packages. However, the public research has not contributed much in variety and hybrid development (except in India, and China), and seed production leaving this role of public research in most countries was limited to the development of varieties in crops where the private sector was not showing any interest (mostly field crops, and high volume low value vegetable crops such as bean, peas).

In general, the public research achievements have had little impact on vegetable growers because of the weak and slow transfer of technologies by the public extension services. On the other hand, very little has been done in areas where vegetable production could really be boosted, because research priorities were poorly identified.

Importance should be given to resistance to biotic and abiotic stresses, hybrids, off-season cultivation, and protected cultivation.

The major achievements of public research in Asia have been:

- to collect and document local germplasm
- to introduce material, adapt it to local growing conditions and develop related cultivation packages.
- To develop seed production related packages (mainly for OP varieties)
- to develop crop management packages (IPM, biological control, pesticide application)
- to develop techniques to prevent post harvest losses.

3.2 Public research and hybrid technology

In most Asian developing countries, hybrid technology with public research institutes has not yet started or is at embryonic stage.

In Bangladesh, the national research institute started a program on hybrid varieties with eggplant and watermelon, but was not very successful with the farmers. Similarly, in Nepal a hybrid Chinese cabbage,

developed by AVRDC, was introduced and seed is produced locally as well as inbred lines. In Vietnam, some research program on heterosis on tomato, cucumber, and watermelon was started, but this not yet led to commercial varieties.

On the other hand, in India and China, many successful hybrids with in-built disease resistance have been developed by public research institutes, and are widely used by farmers, in specific areas. This was made possible by the strong commitment of these two countries to vegetable research and development, as well as by the very large pool of scientists available in the many agricultural research centers all over the country.

3.3 Cooperation between public research and the private sector

Direct or indirect cooperation between public research and the private seed sector can play a very essential role in the improvement of vegetable production and development of vegetable hybrids.

In countries where the private vegetable seed sector is not very strong, seed companies, which are mainly seed traders, have not always the means or the technical capabilities to improve their operations to produce quality seeds and to develop hybrids.

In that case, the public research and development institutes could play a significant role in the development of the sector by means of providing training in vegetable breeding, seed production, and by handing over varieties developed by research institutes for organized multiplication. This could prepare the private seed sector for larger ambitions, including joint ventures with international seed companies.

This type of cooperation is effective in Bangladesh, Bhutan, and Nepal, where vegetable seed development projects are operating.

In countries (Japan, Korea, India, China) where the seed sector is already effectively established and mature, public research and private seed sector are directly cooperating by either contract research or mandatory research with as output:

- half-bred material,
- parental lines,
- specific seed oriented technologies (e.g. seed coating)
- specific breeding techniques on disease resistance and pest resistance.

Public institutes and private sector may also cooperate indirectly in ways of developing the crop technological skills of the farmers and to produce quality seeds.

After all what is the use of hybrid seed if the farmers do not know how to use it properly?

4. MAJOR CONSTRAINTS FOR VEGETABLE SECTOR DEVELOPMENT IN ASIA

With the urgent need to further increase vegetable production in Asia, all countries have stressed similar limitations and constraints, even though some of them have reached a reasonable level of productivity. The major common constraints are:

4.1 lack of quality seed hybrid seed

Adequate varieties (hybrid and OP) responding to specific production constraints are not always available. Moreover, there is never enough quality seed available.

4.2 Seasonality of the production

Seasonality of vegetable production is a general problem in tropical Asia. During the winter season, abundant vegetables are available often leading to market price fluctuations and a low profitability for the growers during that season. During the monsoon season (in summer) critical weather condition prevent to grow temperate crops, and this results in a scarcity of these vegetables and very high prices.

In East Asia (China, Korea, Japan), in the cold temperate areas, seasonality is reversed. The winter season is the critical period for vegetable growing, whereas in summer, vegetables are abundantly available.

4.3 Post harvest losses

After production, up to 40 % of the produce is lost due to poor handling, difficult transport, storage, and many other problems through the various stages in the marketing chain. National research programs have come up with some technical solutions to post-harvest problems, but the situation will not be improved if the marketing channels themselves are not improved.

4.4 Lack of trained farmers, and all other entrepreneurs in the vegetable industry

The technology and hardware alone will not lead to an increased vegetable production, if the farmers and all other entrepreneurs in the marketing chain are not trained and informed properly.

4.5 National research institutes have stressed the lack of bilateral and multilateral cooperation.

Many of the problems encountered in vegetable production are common to neighboring countries or to entire regions. Why duplicating the research in field already investigated successfully in other countries? Progress could also be achieved if information and material could be exchanged among countries of the region.

5. DEVELOPMENT OF HYBRID SEED TECHNOLOGY IN ASIA

5.1 Vegetable seed requirement

With the present hectareage of vegetables grown in Asia, the total vegetable seed requirement is around 90,000 tons with India, and China having the highest requirements with 35,498 tons and 33,791 tons respectively. **Table 4** The majority of seed presently used is form open pollinated varieties, whereas the demand of hybrid seeds is gradually increasing.

Table 4 Vegetable seed indicators of selected countries in Asia

Country	Annual seed requirement in Tons ²	Vegetable seed import in Tons ²	Vegetable seed export in Tons ²
Pakistan	2,171	N.A.	N.A.
India	35,498	170	2,197
Nepal	949 ¹	N.A.	11
Bangladesh	3,050	509	Nil
Sri Lanka	516	33.6	Nil
Myanmar	224 ¹	N.A.	N.A.

Thailand	1,968	607	1,131
Malaysia	260 ¹	N.A.	N.A.
Indonesia	6,000	427	N.A.
Philippines	387	164	16.3
Vietnam	N.A.	N.A.	N.A.
China	33,791	200	200
Rep. of Korea	1,199,000 liters	2,773,000 liters	517,000 liters
Japan	3,412 ¹	6,368	904

¹ Figure calculated from present areas with a standard sowing rate

² Source: the authors country paper

5.2 Use of Hybrids

Hybrid seed, in a certain number of vegetable crops, contributes greatly to increase the yields, to reduce the use of pesticide by in built disease resistance, and to produce standard products, with improved keeping quality. Unfortunately the use of hybrid vegetable seed sold at high price remains the privilege of the farmers with the highest income. The majority of the farmers in Asia have had little or no exposure to hybrid seed or quality seed before, and most of them are still using their own saved seed.

The potential for hybrid seed is enormous, but the development and seed production of open pollinated varieties will have to be continued, in order to provide affordable planting material to the poorer farmers and for homestead gardening.

Hybrids have made a major breakthrough in most temperate crops (such as cabbage, cauliflower, tomato, cucumber, watermelon, pumpkin...) The coverage of vegetable hybrids in percent of vegetable area could not be collected for all countries and is found variable. Table 5. The percentage of area planted to F1 gives only an indication, and this percentage should always be related to the importance of the crop.

Keeping this in mind, hybrid technology for cruciferous crops have the highest coverage in % and in absolute value, as these crops are in the top 10 of each country in Asia. As regard to the origin of seed, Japan seed companies are the leader of cabbage and cauliflower F1 market.

Table 5 Percentage of area planted to hybrid seeds for selected crops

Crop name	Selected countries in Asia						
	India	Bangladesh	Thailand	Philippines	China	Rep of Korea *	Japan *
Cabbage	21	68	85	75	90	100	94
Cauliflower	0.6	41			low		97
Chinese cabbage			60	80	80	91	96
Radish		0.1	10		40	74	82
Cucumber			5	1	40	93	89
Bitter gourd	1.2		80	50			
Luffa (ridge)	1.2		50	5			
Watermelon	2.1	84	60	1		93	95
Melon	2.1		70			79	90

Pumpkin						89	83
Tomato	24.2	0.5		3	60	100	68
Chili	0.5		1		60	100	
Eggplant	4			10	40		86
Capsicum						100	57
Onion					low	51	63
Spinach					low	63	85
Okra	0.7	0.2					

(*) percentage estimated from ratio of F1/OP from total registered varieties since 1976

Source: authors country presentation

The second highest group as regard to hybrid technology is the cucurbit, where watermelon, and melon have the highest coverage in percent. The main sources for these F1's are Taiwan, and Japan.

Hybrid technology in gourd (bitter-, bottles, luffa-, ash- gourds) being relatively new is gaining importance, and offers a great scope for further development, especially if we consider that these are indigenous vegetables and are being increasingly popular as summer vegetables. Hybrid gourds are very area specific, and the F1's are being developed by local companies.

The coverage of the hybrids in Solanaceous crops is rather in developing countries in Asia but highest in India. The relative success of tomato hybrids in India is due to a sustained marketing effort from seed companies at farmers level, as well as overall improvement of growing techniques. The lower technological level in other developing countries in tomato cultivation can explain the lack of interest in the hybrids. In the developed countries, tomatoes cultivated under protection are all hybrids. The success story of Indian tomato hybrids can be repeated in other developing countries.

Moreover hybrids is available have been developed by the private seed sector. Seed companies able to breed, to produce, and to market quality and hybrid seed in Asia are limited in number and have activities in a few countries. **Table 6.**

Table 6 Countries where seed companies/institutes having hybrid technology are established

Country in Asia	Stage of development
Japan	Mature
Korea	Mature
Taiwan	Mature
India	Growth
China	Growth
Thailand	Growth
Philippines	Infancy
Indonesia	Infancy
Nepal	Embryonic
Bangladesh	Embryonic
Pakistan	Embryonic

In those countries major private seed companies have developed remarkably during the past 20 years. Most of them started as a contract seed producers for foreign seed companies (Europe, USA, Australia),

and gradually expanded and included breeding activities. Another development path was the association with foreign seed companies, through joint venture, which opened a new dimension to the seed business.

In all other Asian countries the activities of the private vegetable seed industry is limited to seed trade (import), seed production of local vegetables (mainly OP varieties), and procurement of seeds from local sources. The quality of the seed distributed by those companies is often doubtful.

This gap between countries in Asia regarding the supply and availability of quality vegetable seed tends to indicate that the development of the vegetable industry is linked to the direct availability of quality seeds in the country. Experience has shown that varieties (OP or F1) of vegetable crops developed locally for the domestic market have a better success and acceptability with farmers. In view of this, and considering a long term strategy, it is of interest to all countries in Asia to strengthen their vegetable seed industry. It is also likely that the private sector will play the key role in this development.

5.4 Achievements of hybrid technology and hybrid seed production

The major achievements of hybrid technology results in the development of various hybridization mechanisms used in different crops which are:

- hand emasculatation/ pollination
- Genic male sterility (GMS) and gene-cytoplasmic sterility (CMS)
- Self incompatibility
- Gynoecious lines

Hand emasculatation/ pollination is the main technique in hybrid seed production for solanaceous crops (such as: tomatoes, eggplant, and sweet pepper), some cucurbits (melon, watermelon, cucumber), and okra.

This laborious method has generated tremendous employment opportunities for women in rural areas in India, and Thailand, but is becoming very expensive in countries where daily wages are on the rise. In consequence, seed companies are shifting their production of hybrids to countries where labor is relatively cheap. This should offer a good opportunity to those countries, which have not yet entered the era of hybrid technology, to develop their seed industry.

Other hybridization mechanisms have been developed for hybrid seed production of onion, carrot, chili pepper through CMS, and chinese cabbage, cabbage, radish through GMS. Cabbage, radish, and chinese cabbage hybrids can also be produced through Self Incompatibility, whereas gynoecious lines are used for cucumber and come melons. All these mechanism are widely used for cost effective commercial production of hybrids.

5.5 Seed Import and Export

The vegetable seed trade (import and export) in Asia is a multi million \$ business. The biggest seed trader (import + export) is Japan with 80 million \$, followed by Korea with 23 million \$, and Thailand 20 million \$. China, and India seed sector are in full growth, and their export capabilities will presumably increase. All other countries are importing vegetable seeds only.

It can be observed that even countries with a very strong vegetable seed industry, have high volumes of import, of which the value is compensated by the value of export.

The high imports include seed for domestic market which is produced abroad, because, either for economic, or climatic reasons, the production is not possible locally.

This practice of custom seed production abroad has become very common for developed seed companies.

A lot of developing countries are concerned about their dependency on foreign seeds, and the loss in their trade balance. Some had even taken measures to restrict import of seed. The fact is that some countries with tropical climate will always need to import seed of certain crops such as cabbage and cauliflower for which seed cannot be produced locally. Moreover, countries like India which has restricted import of seed for a long time, and reversed the decision in 1988, realized the positive change it had brought to the vegetable industry.

For this reason, vegetable seed import should not be restricted nor banned anywhere, so that the best material available can be made available to the farmers. These policies should be accompanied by the proper quarantine measures, in order to avoid the spread of unwanted diseases.

5.6 National seed policies

Sound and comprehensive seed policies have always been at the start of the development of the seed industry. It meant that the government bodies had interest in the sector. Unfortunately, these policies were not always very clear, and sometimes too restrictive, which slowed the development of the seed industry down.

Some countries which did not immediately realized that the vegetable seed industry was to be privatized, maintained a very strong presence of the public sector, sometimes subsidized the seed, and competed with the private sector.

In other countries the word “privatization” was launched, but the policy makers failed to support it with appropriate measures.

Policy makers, and government bodies have now generally realized that the development of the vegetable seed sector will depend mainly on the private sector with the support of the public sector, and will require fundamental changes in actual seed policies and accompanying measures to implement them.

Recently, and following the GATT agreement, Plant Variety Protection (PVP) also called Plant Breeders’ Right (PBR) has initiated a lot of discussion and debates at policy level in Asia, but not country has yet implemented it, except Japan.

It is usually considered that implementation of PVP in Asia is too early, because the enactment of strong PVP cannot be supported by an adequate administrative and legal system. Moreover it will be practically impossible to collect royalties.

The private sector, which normally seeks variety protection to obtain a return on self pollinated crops, sees a very little benefit of PBR on hybrid seeds which are self protected in the form of a trade secret; but apprehend potential problems if ultimately the inbred lines have to be handed over to other agencies for registration.

6. POLICIES AND STRATEGIES TO IMPROVE VEGETABLE PRODUCTION

6.1 Development of hybrid seed technology and availability of good quality seed

In view of the importance and the progress achieved by hybrid technology in vegetables, the use of hybrids should be popularized further and its development strengthened. Each country, depending on the level of public research and private seed sector should analyse the benefits of hybrid technology, and decide whether to start programs on hybrid development.

Private companies should develop more hybrid varieties in more vegetable crops that offer hybrid vigor. Multiple disease resistance or tolerance should systematically be incorporated in hybrids. Attention should be focused on reduction on hybrid production costs through development of male sterility, self-incompatibility, gynoecious lines...

In low income developing countries, where the farmers are not in an economic position to purchase hybrid seed, research and development on open pollinated varieties should be continued and good quality open pollinated varieties should be made available to them.

6.2 Strengthening of research and incentive to private research

It has been stressed that research in horticulture and especially in vegetables should be strengthened. Both public and private research have their role to play in overall development of the sector.

Public research

Collection, evaluation, conservation and exchange of indigenous and exotic germplasm is essential, and should be considered as a top priority before hybrids of today sweep away all landraces. This collection should be extended to new or marginal indigenous vegetables.

Those countries with access to the large germplasm collections, will provide the best chances for a strong seed system.

The fields of research should be clearly identified, and prioritized, in order to provide best support to the private seed companies, and to avoid duplication with the private research.

Private research

The private seed sector is known to play the key role in the hybrid seed industry, because it can expect high returns on investment. The strengthening of the private research by adequate and conducive policies is essential for the betterment of the whole vegetable seed industry.

6.3 Regional collaboration between National Research Institutes, and linkages with International Research Institutes

The cooperation between national research institutes in Asia was initiated with the efforts of an FAO/UNDP funded project aiming at creating a Network of Vegetable Research Institute, by means of sharing germplasm, exchange of scientists, publication of a newsletter, and strengthening communication facilities. The initial phase included, Nepal, Bangladesh, Pakistan, Democratic, Popular Republic of Korea, China, and Thailand. It is proposed in the near future to extend the Network to Cambodia, Laos, Vietnam, and Myanmar.

Similarly, AVRDC (Asia Vegetable Research and Development Center), based in Taiwan, and the leading international center for development and promotion of vegetable production in Asia, and Pacific region,

has been very supportive to National Research Institutes for the last twenty years. One regional center was established in Thailand known as ARC-AVRDC.

In addition, three separate Networks known as AVNET, CLVNET, SAVERNET, for South-East Asian countries, Indochina peninsula (Cambodia, Laos, Vietnam), and South Asia respectively, have been created and should facilitate the exchange of research information, and germplasm.

This type of cooperation under an international umbrella is a first step, national research institutes will have to regularize their relation and overcome their political differences.

6.4 All year round vegetable production

East Asian countries, where a cold climate prevails in winter, have been able to produce vegetables round the year by increasingly adopting protected cultivation techniques.

In tropical countries of Asia, the technology of raised bed or plastic covered cultivation are mere improvements, but much more needs to be done.

During the hot and humid season, protected cultivation under greenhouses or plastic tunnels appears to be a problem. In the hot dry areas, cooling pads can be used to cool down the temperature by a few degrees, but this technique is not applicable under tropical humid climates.

The only possibilities to limit the effects of seasonality remains to choose adequate cultivars for specific areas and season, or to shift the production in the appropriate location for each season (highland production in summer)

6.5 Reduction of post harvest losses, and improvement of marketing channels

National research programs have developed technical solutions to post harvest losses, and improved varieties with better keeping quality can be used, but the main problem remains the improvement of the marketing channels.

These are national policies to be addressed, which include improvement of collection centers, wholesale markets, availability of suitable packaging material, improvement of infrastructure, incentive to private vegetable marketing business...

In the more advanced countries, the vegetable marketing through supermarkets, and modern grocery stores, with modern facilities, have reduced considerably the post harvest losses, but the price of vegetables has become very expensive, and beyond reach of the poor classes.

Traditional markets prevail in all Asian countries and are very complex. Wholesalers and middlemen are controlling the marketing of vegetables at all levels, which is also creating barriers to development.

Appropriate government policies, information (market information), training, and incentives to the private sector are the only keys to improve the marketing of vegetables.

7. CONCLUSION AND OUTLOOK

Vegetable production in Asia has increased significantly since 1983 at the rate of 2.7% per year, to meet the demand of the population in the region increasing at the rate 1.8% annually. Despite the growing vegetable production, most Asian countries have less vegetable available per capita than the dietary requirement of 55 kg/caput/year.

The total cropped area is almost reaching saturation in Asia, but in average the areas under vegetables have increased; similarly, but at a slower rate, the productivity has also improved.

This achievement is a result of the recent interest of government programs in developing the vegetable industry. The public research started ground work in most developing countries in order to uplift the technical and managerial level of the farmers, by developing and disseminating (slowly) improved agricultural practices.

The private seed sector has also contributed considerably to the overall growth of the vegetable industry, by developing and making available superior hybrids and quality seeds to the farmers, the demand for quality seed and hybrids is steadily increasing with the improving technological skills of the vegetable farmers.

Some 10 to 15 years ago, the private vegetable seed sector was in active only in a limited number of countries in Asia (Japan, Korea, Thailand, India), and was developing hybrids adapted to local markets and exporting them to other countries.

Today however, the vegetable seed sector development has expanded to many more countries. The seed sector is under going fundamental changes, because local governments have realized the importance of the seed as major agricultural input for the development of the vegetable industry and the key role that private sector has to play in it. Actions have already been initiated in some countries in that line.

In future, and with adequate support from government policies, the vegetable seed sector is expected to be active and dynamic in all countries of Asia with hybrid varieties being developed locally for domestic markets and commercial farmers and superior open pollinated varieties produced for the benefit of marginal farmers and homestead gardens. With improved hybrid seed production practices it is hoped to bring down the price of hybrids seed to make it accessible to the majority of farmers.

Finally there is a great scope for development of the vegetable seed industry and hybrids in Asia. The market is immense, and the farmers are gradually picking up the technology. The time is also right to develop the seed sector in the respective countries and to start programs on hybrids through public and private sector.

VEGETABLE INDUSTRY COUNTRY PROFILE

PAKISTAN¹

Country Summary

Total country population in Millions (1992 estimate)	121.400
Total cropped area in 000 ha	21,110.000
Total area under vegetables in 000 ha	307.000
% coverage of vegetable from total cropped area	1.46%
Annual growth rate of vegetable production (83-93)#	5.50%
Productivity in T/ha	12.31
Vegetable Availability in Kg/caput/year	31.171

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons
1	Onions	67.600	12.63	853.70	482.00
2	Capsicum	45.400	1.66	75.30	234.50
3	Melon	22.500	19.65	442.20	101.89
4	Tomato	13.400	1.78	23.90	8.50
5	Kohlrabi	12.900	19.15	247.00	33.42
6	Okra	11.100	14.83	164.60	181.33
7	Carrot	8.600	16.74	144.00	127.48
8	Cauliflower	8.500	16.76	142.50	8.89
9	Garlic	7.600	8.71	66.20	
10	Squash	7.500	16.08	120.60	20.75
11	Radish	7.300	15.88	115.90	39.41
12	Eggplant	6.800	10.72	72.90	3.07
13	Spinach	5.700	9.25	52.70	112.45
14	Bottle gourd	4.500	11.04	49.70	20.05
15	Bitter gourd	4.300	10.05	43.20	
16	Garden pea	3.500	4.14	14.50	384.42
17	Cabbage	2.600	13.31	34.60	3.59
18	Pumpkin	2.000	11.95	23.90	2.07
19	Other	65.500	16.75	1096.80	407.20
20	Total	307.300	12.31	3784.20	2171.03

Source: Banaras 94

Vegetable Production

Vegetable is produced mainly on small landholdings. The varied agro-ecological zones enables round the year production, however off season vegetable are not widely available. Protected cultivation techniques under plastic tunnel is being experimented, but not yet very popular.

Constraints for vegetable production development

- low priority crop in the National program.
- Lack of quality seed and adequate varieties
- limited technological development of the farmers
- improper marketing channels
- post harvest losses
- weak linkages between research, extension services, and growers.
- Lack of irrigation in specific areas

Vegetable seed industry information

Pakistan vegetable seed industry status

The vegetable seed sector in Pakistan is at embryonic stage, where public and private seed entrepreneurs (mainly traders) are the main suppliers. Seed traders mainly import seed, or procure locally produced seed of very low quality.

Seed companies in Pakistan, having R &D capabilities and which might play an important role in vegetable seed
Pioneer Pakistan Seed Co Ltd
Cargill Seed Ltd
Sandoz Pakistan Co Ltd
Lever Brothers Ltd

Import/export of vegetable seeds in Pakistan Seed Production system

Vegetable Export and Import

Data of import of vegetable fresh, frozen or processed is not available.

Pakistan exported (in 1993) 36,000 tons of fresh vegetables for a total value of fresh vegetables for a total value of 365.5 million Rs.

Strategies/policies to improve vegetable production

- promote vegetable cultivation to increase daily consumption, and promote vegetable cultivation for export
- improvement of marketing channels
- free import of seed enables best available material to be grown by farmers
- increase investment on irrigation systems
- monitoring of vegetable prices
- strengthening of the seed sector

Import:

Pakistan imports large amounts of seeds from two main sources:

- packed seed from Europe, USA, and Japan (mainly hybrids or popular OP)
- bulk seed from neighbor India, very often cheap, substandard seed.

Export:

Since there is no organized vegetable seed production, no seed is being exported.

Hybrid Technology

None of the local companies is known to be involved in breeding nor in hybrid development. A few multinational seed companies dealing mainly with cereal hybrid seeds have the capabilities to develop hybrid varieties, and have recently started.

The main vegetable seed producer in Pakistan remains the Department of Agriculture and the

Seed Corporations which accounts for 4% of the annual requirement.

The remaining demand is met by private trading, and by farmers retained seed.

- A weak/unclear seed policy regarding the role of public and private sector has left the development of the vegetable seed industry in the dark
- the certification scheme is weak for vegetable seeds, and quality of seed cannot be assured by any legal way to the farmers
- no information regarding Plant Breeder's Right

Seed and seed related government policies

INDIA ¹

Country Summary

Total country population in Millions (1992 estimate)	886.300
Total cropped area in 000 ha	222,321.000
Total area under vegetables in 000 ha	5,667.380
% coverage of vegetable from total cropped area	2.55%
Annual growth rate of vegetable production (83-93)#	2.60%
Productivity in T/ha	9.82
Vegetable Availability in Kg/caput/year	62.790

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1993)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons	Areas under hybrid seed in %
1	Chili	787.20	0.88	691.00	1,338.24	0.45%
2	Tomato	454.00	15.16	6,884.48	227.00	24.22%
3	Eggplant	447.12	13.08	5,848.37	447.12	4.00%
4	Gourds	389.48	9.94	3,871.46	1,557.93	1.18%
5	Onions	331.74	14.18	4,705.66	2,653.89	
6	Radish	284.22	12.39	3,521.46	1,136.87	
7	Bean	226.73	2.20	498.25	11,336.35	
8	Okra	221.99	8.50	1,887.08	3,329.90	0.77%
9	Cauliflower	202.79	14.78	2,998.06	101.39	0.60%
10	Cabbage	178.35	15.68	2,796.43	89.18	21.14%
11	Garden pea	177.68	7.29	1,296.01	10,660.80	
12	Sweet pepper	173.62	0.28	48.98	173.42	

13	Melon+watermelon +musk melon	156.50	14.94	2,338.11	469.50	2.10%
14	Leafy vegetables	139.80	6.80	950.51	419.40	
15	Cucumber	20.36	6.75	137.40	81.44	
16	Miscellaneous	1,476.00	11.64	17,177.30	1,476.00	
	Total	5,667.38	9.82	55,650.55	35,498.13	

Source:Kalloo 94

(1) Calculated from present areas with standard sowing rate

Vegetable Production

Production of vegetable is a monoculture in some selected areas, but is in majority produced on small landholdings in various cropping patterns or in homestead gardens. India being a vast country with a large variety of climates, can produce vegetables the year round by cultivating, well adapted varieties to climate and time. Several states have become specialized in a type of vegetable crop for a particular time of the year.

Constraints for vegetable production development

- Lack of adequate number of improved varieties, and quality seeds
- pest and diseases infestations for which no effective control measures have yet been found
- Lack of proper irrigation facilities in many areas of the country
- The poor and marginal farmers of the country cannot afford to grow vegetable because of the high initial investment (cost of hybrid seed, input, and high risk crop)
- Improper marketing channels of fresh vegetables, lack of infrastructure, and social problems related to the strong hold of middlemen in the marketing chain

Vegetable seed industry information

India vegetables seed industry status

The growth of Indian private seed sector has started in early seventies. Major achievement has been obtained with the development and successful introduction of F1 tomato varieties. Today the Indian vegetable seed sector is a multi million dollar business with hundreds of local and

Vegetable Export and Import

Data of **Import** of vegetable (fresh, frozen chilled) is not available.

India **exported** (in 1993) 468,492 tons of fresh vegetables (onions, garlic and melons) and 17,085 tons of frozen, chilled vegetables. (Arora, 1994).

Strategies and policies to improve vegetable production

- increase and promoted vegetable cultivation in tribal area of Madhya Pradesh, Orissa, and U.P.
- develop effective production technology for hybrids
- promote Integrated Pest Management, for environment friendly and chemical safe production of vegetable
- improve post harvest technology for export of fresh vegetables
- promote new and improved irrigation systems
- strengthen public research, and extension services

international seed companies, of which few dozens are involved in breeding and F1 development

Company name	Major field of activity
Indo American Hybrid Seed	tomato/okra/melon/watermelon
Maharashtra Hybrid Seed Company Ltd	eggplant, gourds, okra
Hoechst India Ltd	eggplant, okra
Bejo Sheetal Seed Co Ltd	tomato

Century Seeds Co Ltd	okra, eggplant
Nath Seed Co Ltd	watermelon
Pioneer Seed Co Ltd	okra, tomato
Sungro Seeds	tomato, eggplant
Namdhari Seeds Pvt, Ltd	watermelon, tomato
Sandoz (India) Ltd	tomato, chili, cabbage

Source: Arora 94

Import/export of vegetable seed in India (1993)

Import:

India imported (in 1993) 170 tons of vegetable seeds, of which the main items are cabbage, capsicum radish, tomato, cucumber, squash, chili, and cauliflower. Most popular cabbage F1 varieties are still imported from Japan.

Export:

Seed production system

Most of vegetable seed industry is handled by private sector. Today all hybrid seed production of tomato, cucurbits, and okra is done on contract with farmers who were well trained by private operations, and the companies themselves.

Public institutes, especially NSC (National Seed Corporation) or SFCI have concentrated mainly on high volume, low value crops such as okra and peas. The distribution is made by over 10,000 dealers spread all over the country, very well controlled by the private sector. Varieties released by public research institutes can be multiplied by private sector with no royalties.

Seed and seed related government policies

NEPAL¹

Country Summary

Total country population in Millions (1992 estimate)	20.000
Total cropped area in 000 ha	2,959.000
Total area under vegetables in 000 ha	140.497
% coverage of vegetable from total cropped area	4.75%
Annual growth rate of vegetable production (83-93)#	8.20%
Productivity in T/ha	6.83
Vegetable Availability in Kg/caput/year	48.014

Source RAPA 94/24

With the development of the seed sector in the past decade, India has been exporting officially or unofficially a lot of vegetable seeds to neighboring countries.

Qualities exported in tons in 1992

Country	Qty in Tons 1992
Pakistan	1,814.062
Bangladesh	348.518
Sri Lanka	8.189
Nepal	11.000
Maldives	15.000
Total	2,197.769

Source: Arora 94

- In 1998 a new seed policy was promulgated, the motive of which was to ensure that farmers should have access to best material available. This opened the gates to the importation of seed.
- In theory, official registration or notification of new varieties is to be made and is a prerequisite for certification. Practically, the private sector receive their evaluation at the hands of the farmers
- A draft act on Plant Variety Right (consequence of GATT) has been proposed but is being discussed and debated between public and private sector which have different interests.

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons(1)
1	Cauliflower	19.267	7.80	150.28	9.63
2	Cabbage	15.514	9.70	150.49	7.76
3	Tomato	10.530	6.90	72.66	5.27
4	Chili	9.510	1.40	13.31	14.27
5	Eggplant	9.283	7.00	64.98	4.64
6	Onions	8.001	13.75	110.01	17.60
7	Leaf mustard	7.495	6.10	45.72	16.49
8	Radish	7.331	9.10	66.71	21.99
9	Okra	7.244	7.00	50.71	21.73
10	Garden pea	6.688	1.50	10.03	267.52
11	Bean	5.991	8.00	47.93	539.19
12	Gourds	5.116	9.70	49.63	12.79
13	Pumpkin	4.109	9.00	36.98	10.27
14	Other	14.418	3.72	90.83	N.A.
	Total	140.497	6.83	960.27	949.15

Source: Arora 94

(1) Calculated from existing areas with a standard seed rate (direct sowing)

Vegetable production

Vegetable are produced on small lands in different evaluations at different times of the year, which enables round the year production. There are three major vegetable production zones: the Terai, the Hills, the Mountain, of which Terai contributes for

60%. The production of vegetables has increased remarkably for the last 15 years, and is showing the highest annual growth rate of 8.2% in Asia. This improvement is mainly due to the activities of a vegetable seed project by FAO, which started in

1981 and introduced and popularized the use of better quality seed.

Vegetable Export and Import

Data of Import of vegetable (fresh, frozen chilled) is not available.

The quantities of fresh vegetables exported are not known precisely, but it is known that there is a

Constraints for vegetable production development

- Lack of adequate number of high yielding varieties, (F1, OP) and availability of quality seeds.
- Lack of irrigation facilities in some areas, although the climate is suitable
- lack of technology support to the farmers
- poor marketing system, due to hilly area, and inadequate transport facilities
- lack of competitiveness among seed companies.

Strategies/policies to improve vegetable production

- the strong commitment of the Nepal government to develop the vegetable seed industry has proven to contribute significantly to the development of the vegetable industry
- private seed sector has access to public sector facilities for research, processing, packing of seed
- promotion of vegetable kitchen gardening as a way to eradicate malnutrition problems, and malnutrition related diseases
- promotion of vegetable cultivation in specialized areas where communication and easy access to cities are available.

Vegetable seed industry indicators

Nepal vegetable seed industry status

The vegetable seed sector has changed remarkably in Nepal since the FAO Vegetable seed project has been in operation in 1981. The private seed sector has developed with the support of public institutes, and has started the organized seed production of introduced OP varieties, in addition to their previous activities of import, and seed trade.

No companies are yet involved in breeding, and hybrid development, and seed produced is mainly from public sector released varieties. However, the organized seed production contributed to the overall improvement of the quality of seed.

Seed production system

The vegetable seed produced in Nepal is mainly the result of a collaboration between public sector and private sector. The private seed companies have produced in 1992, 224.1 tons of seed in the organized system. The varieties were mainly those introduced and released by the public sector.

flow of fresh vegetables from Nepal to neighboring states in India during off season.

Import/export of vegetable seeds in Nepal (1993)

Import:

Nepal is importing packed hybrid seed from Japan, Taiwan, and Netherlands, and bulk seed from India. In 1993, an estimated quantity of 1 ton of hybrid seed was imported. Unofficially larger quantities of seed are imported from neighbor India among others.

Export:

The emerging private started exporting seed locally produced to neighbor countries. The main item is radish seed and, in 1993, 11.2 tons were exported.

Hybrid seed production of Chinese cabbage was attempted with success with a variety from AVRDC, who could provide the inbred lines without restriction.

Seed and seed related government policies

- Strong commitment from government to support the private seed industry, and amendment of seed policy.
- A Variety Release Committee has been setup to ease the registration of new varieties with National Seed Board
- Plant Breeder's Right is under process and will be handle by the National Seed Board.

BANGLADESH ¹

Country Summary

Total country population in Millions (1992 estimate)	119.400
Total cropped area in 000 ha	14,080.000
Total area under vegetables in 000 ha	429.622
% coverage of vegetable from total cropped area	3.05%
Annual growth rate of vegetable production (83-93)#	0.24%
Productivity in T/ha	5.09
Vegetable Availability in Kg/caput/year	18.314

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1993)

	Vegetable Name excl.potato	Area under vegetable(1) 000 ha	Yield(2) in T/ha	Production (3) in 000T	Annual seed consumption(4) in Tons	Areas under hybrid seed(5) in %
1	Amaranth	73.457	4.43	325.41	321.00	
2	Chili	60.000	0.74	44.40	120.00	
3	Bottle gourd	35.831	8.14	291.66	143.30	
4	Radish	35.618	8.63	307.38	567.50	0.09%
5	Onions	34.320	4.12	141.40	171.60	
6	Tomato	21.875	7.62	166.69	21.90	0.46%
7	Eggplant	21.419	6.40	137.08	25.70	
8	Okra	20.507	3.06	62.75	246.10	0.20%
9	Pumpkin	18.702	6.72	125.58	93.50	
10	Bean(dolichos + french)	16.600	4.70	78.02	665.00	
11	Bitter gourd	15.632	3.80	59.40	70.30	
12	Cucumber	14.946	4.27	63.82	44.80	
13	Cabbage	11.370	8.66	98.46	5.70	68.42%
14	Cauliflower	8.553	7.98	68.25	6.00	41.67%
15	Luffa	7.691	3.99	30.69	46.10	
16	Indian spinach	7.200	4.73	34.06	144.00	

17	Ash gourd	6.685	6.05	40.44	33.40	84.00%
18	Watermelon	6.223	9.42	58.62	7.50	
19	Spinach beet	5.600	4.66	26.10	168.00	
20	Snake gourd	5.093	4.10	20.88	25.50	
21	Yard long bean	2.300	2.42	5.57	46.00	
22	Others	4.120	5.21	21.47	77.10	
	Total	429.622	5.09	2,186.67	3,050.00	

Main Source: Weening 94 perso comm.

(1) Calculated from seed consumption and sowing rate in use with farmers

(2) Source: Bangladesh Bureau of Statistics (1993)

(3) Calculated from area and yield

(4) Seed consumption includes seed traded (1,455 tons) as well as estimated farmers retained seed (1,596 tons)

(5) Estimated from area sown with imported seed at standard sowing rate

Vegetable Production

Vegetable are grown on small land holdings, and commercial production have concentrated around major cities. The North West, and West part of the country, flood free, have developed as the main vegetable production areas. Land pressure is so acute that areas under vegetables cannot be further expanded. Production increase can only be achieved by yield improvement. Off season shifting of vegetable production is difficult because

Constraints for vegetable production development

- Lack of adequate varieties, and quality seeds
- pest and diseases infestations for which no effective control measures have yet been found
- Seasonality and difficulties to produce vegetable round the year
- Lack of adequate technology transfer to farmers
- Floods just after monsoon, drought in march-April, and cyclones in November and March are affecting vegetable production

Vegetable seed industry information

Vegetables seed industry status in Bangladesh

The vegetable seed industry is in the hands of both public and private sector. The private seed sector

there is little variation of climates and no elevation in Bangladesh.

Vegetable Export and Import

Data of **Import** of vegetable (fresh, frozen chilled) is not available. But it is known that onion/chilies are being imported from India all year round.

Bangladesh **exported** (in 1993) 7,679 tons of vegetables for a total value of 76.8 million \$: mainly indigenous vegetable for expatriate workers in Middle East and Europe.

Strategies and policies to improve vegetable production

- strengthen the private seed industry through government institutions.
- promote vegetable production for domestic and export markets
- promote homestead vegetable gardening as a way to eradicate malnutrition related illnesses.
- Strengthen the public research for better support to the private seed industry.

is handling 60% of the market, the public sector only contributes to 2-4%. The remaining is farmers retained seed.

Private companies started emerging with the new seed policy declared in 1992, and the activity of a FAO seed project in operation since 1986, and are gradually improving their operations, limited so far to import, and unorganized production/procurement of seed.

Main Seed Company in Bangladesh
Mollika Seed Company
United Seed Store
Nadim Beez Bhandar
Kashem Beez Bhandar
Dhaka Seed Store

Source: Weening perso, comm.

Import/export of vegetable seed in Bangladesh (1993)

Import:

Seed production system

In 1994, private seed companies have produced 50 tons of seed under organized seed production techniques and through contract growers system, with the support of public development institute. Besides, some companies multiply their own varieties through contract growers (standard local landraces). Seed is also procured from farmers without quality check.

Bangladesh imported (in 1993) 509,1 tons of vegetable seeds for 3.1 million US\$. Main items are temperate F1 vegetables such as cabbage, cauliflower, watermelon, and OP radish, mainly from Japan, Korea, Taiwan. Unofficially onion seed is introduced in large quantities from India.

Export:

Since the organized vegetable seed production is at embryonic stage, there is no official record of export from Bangladesh.

Hybrid technology

Public sector developed of hybrids in eggplant (2) and watermelon (1), but were not found popular with farmers nor attractive for private sector to multiply.

Seed and seed related government policies

- New seed policy ass of 1992, amendment to Seed ordinance of 1978 and seed rules under preparation.
- Registration of seed entrepreneurs, and newly released and introduced varieties with the MOA (Seed Wing) has been simplified.
- Vegetable seed does not officially require certification
- No initiative regarding Plant Breeder's Right.

SRI LANKA¹

Country Summary

Total country population in Millions (1992 estimate)	17.600
Total cropped area in 000 ha	1,905.000
Total area under vegetables in 000 ha	57.057
% coverage of vegetable from total cropped area	3.00%
Annual growth rate of vegetable production (83-93)#	-3.80%
Productivity in T/ha	7.52
Vegetable Availability in Kg/caput/year	24.366

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1993)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons
1	Eggplant	9.055	6.90	62.48	2.71
2	Okra	7.240	5.20	37.65	33.34
3	Bean	6.429	4.40	28.29	404.22
4	Pumpkin	5.784	10.50	60.73	11.57
5	Tomato	4.246	7.30	31.00	1.37
6	Bitter gourd	3.647	5.90	21.52	18.94
7	Capsicum	3.126	4.00	12.50	2.87
8	Cabbage	2.907	11.70	34.01	1.45
9	Snake gourd	2.825	7.90	22.32	16.73
10	Radish	2.146	9.40	20.17	10.49
11	Cucumber	2.059	8.90	18.33	3.15
12	Carrot	1.957	12.60	24.66	1.96
13	Leaf beet	1.510	10.20	15.40	0.76
14	Kohlrabi	1.411	8.80	12.42	0.71
15	Ash gourd	1.267	7.30	9.25	2.53
16	Leeks	1.048	41.70	15.41	2.36
17	Leafy vegetables	0.400	6.80	2.72	1.20
	Total	57.057	7.52	428.84	516.35

Source: Jayawardena 94

Vegetable Production

Production of vegetable is done on average small land holdings and cropping system varies from small intensive vegetable areas in the hills to inter cropping in paddy fields. Homestead gardens also plays a significant role for domestic production/consumption of vegetables.

Vegetable Export and Import

Data of Import of vegetable (fresh, frozen chilled) is not available.

Sri Lanka exported (in 1993) 9,791 tons of fresh vegetables equivalent to 225,4 million Rs, mainly to Middle East, Maldives, and to Europe. The government is promoting export of vegetables for the last 10 years with an annual growth of 10% (84-94).

Constraints for vegetable production development

- Lack of adequate number of high yielding varieties, (F1, OP) and availability of quality seed
- lack of knowledge on improved agricultural practices
- pest and diseases problems
- important post harvest losses estimated to 10-40%, no refrigerated transport available, no grading of fruit vegetables
- poor extension services, and lack of awareness of improved agricultural practices

Strategies/policies to improve vegetable production

- promotion of vegetable production for domestic and export markets
- improvement of marketing channels by developing low cost appropriate technology for reducing post harvest losses.
- Strengthen the vegetable seed sector, revise seed policy and encourage private seed companies to do a better job.
- Encourage training to farmers and creation of farmers organizations, and pension schemes.

Vegetable seed industry indicators

Sri Lanka vegetable seed industry status

The vegetable seed sector in Sri Lanka is at early development stage, and is shared by public and private sector.

Private seed companies in the country are mainly traders, selling seed of poor quality, and importing. Little quantities of hybrid are being used by farmers, but no hybrids so far have been developed locally. All hybrid seed, and seed of temperate crops are imported at high price.

In addition the DOA is multiplying seed of tropical and subtropical crops (all OP) released by the Public research, but hardly contribute to 10% of the annual seed requirement.

Hybrid Technology

Hybrid technology is limited to the use of F1 seeds by farmers in moderate quantities. Neither public, nor private sector are reported to have started development of hybrids.

Import/export of vegetable seeds in Sri Lanka (1993)

Import:

Sri Lanka imported (in 1993) 33.6 tons of seeds of temperate vegetable crops.

Export:

Since vegetable seed industry with private sector is at primitive stage no seed is being exported.

Seed and seed related government policies

- Seed and Planting Material Policy liberalized seed import after 1984.
- However, confusions, and unclear seed policy have created many obstacles to the development of the seed industry.
- Realizing the importance of a clear policy, the government recently, in consultation with private sector, foreign seed experts, and donors, outlined the requirements for a revision of the seed policy.

MYANMAR¹

Country Summary

Total country population in Millions (1992 estimate)	42.600
Total cropped area in 000 ha	4,330.000
Total area under vegetables in 000 ha	187.448
% coverage of vegetable from total cropped area	4.33%
Annual growth rate of vegetable production (83-93)#	1.00%
Productivity in T/ha	7.38
Vegetable Availability in Kg/caput/year	32.473

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons(1)
1	Tomato	46.675	6.00	280.05	23.34
2	Onions	26.304	6.69	175.97	105.22
3	Garlic	13.383	3.40	45.50	
4	Cabbage	9.869	17.71	174.78	4.93
5	Cauliflower	6.648	11.64	77.38	3.32
6	Melon	6.536	11.90	77.78	13.07
7	Radish	5.695	8.30	47.27	45.56
8	Bottle gourd	4.642	10.23	47.49	23.21
9	Carrot	1.580	11.72	18.52	4.74
10	Lettuce	1.559	3.90	6.08	1.56
11	Other	64.557	6.70	432.53	
	Total	187.448	7.38	1383.35	224.95

Source: Myint 94

(1) Calculated from existing area considering a standard seed rate (direct sowing)

THAILAND

Country Summary

Total country population in Millions (1992 estimate)	42.600
Total cropped area in 000 ha	4,330.000
Total area under vegetables in 000 ha	187.448
% coverage of vegetable from total cropped area	4.33%
Annual growth rate of vegetable production (83-93)#	1.00%
Productivity in T/ha	7.38
Vegetable Availability in Kg/caput/year	32.473

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl.potato	Area under vegetable 000 ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons	Areas under hybrid seed in %
1	Chili	39.200	8.67	340.00	117.60	1.00%
2	Garlic	26.200	12.40	325.00		
3	Cucumber	25.310	10.71	271.00	101.24	5.00%
4	Capsicum	17.910	8.88	159.00	53.73	
5	Yard long bean	17.830	7.46	133.00	1,069.80	
6	Tomato	13.630	12.62	172.00	6.82	
7	Chinese cabbage	12.630	11.01	139.00	101.04	60.00%
8	Shallot	12.140	13.51	164.00	97.12	
9	Kale	9.750	10.26	100.00	9.75	
10	Cabbage	9.300	16.56	154.00	4.65	85.00%
11	Pumpkin	8.700	14.14	123.00	34.80	

12	Chinese chive	7.930	11.10	88.00	31.72	
13	Ceylon spinach	7.500	5.60	42.00	90.00	
14	Leaf Mustard	6.970	14.20	99.00	55.76	
15	Bitter gourd	3.820	5.24	20.00	15.28	80.00%
16	Luffa	3.100	5.48	17.00	12.40	50.00%
17	Ash gourd	3.040	14.47	44.00	12.16	
18	Radish	2.870	13.94	40.00	11.48	10.00%
19	Cauliflower	2.800	11.43	32.00	1.40	
20	Onions	2.500	19.20	48.00	20.00	
21	Kang Kong	2.500	3.60	9.00	50.00	
22	Lettuce	2.500	3.60	9.00	5.00	
23	Bean	0.600	6.67	4.00	36.00	
24	Garden pea	0.510	5.88	3.00	30.60	
	Total	239.240	10.60	2,535.00	1,968.35	

Source:Thongjiem 94

Vegetable production

As in most Asian countries, vegetables are grown on average small land holdings. The total area under vegetable has been slightly decreasing over the years. The reason is the rapid industrialization around cities which caused vegetable areas to be shifted to the provinces.

Constraints for vegetable production development

- high production cost under intensive field management (among which labor contributes to 50-60% of total costs)
- lack of adequate varieties to be grown
- improper knowledge of improved agricultural practices
- instability of the production because of post-harvest losses, and climatic hazards, and occurrences of diseases and pests

Vegetable seed industry information

Thailand vegetable seed industry status

The vegetable seed industry in Thailand is in full development and is mostly in the hands of private

Vegetable Export and Import

Very little is know about import of fresh vegetables in Thailand

However Thailand exported a lot of fresh, frozen, and processed vegetables to the countries of the region. In 1993, 164,000 tons of vegetables of all kinds were exported for a value of 160 million \$.

Strategies/policies to improve vegetable production

- promotion of vegetable production for processing for domestic and foreign markets
- improvement of marketing channels
- promotion of biological cultivation practices for chemical free vegetables.

sector. A dozen companies are operating in Thailand and are involved in breeding, hybrid development, seed production, and marketing. The

Northern belt has a very suitable climate for vegetable seed production, and is being exploited by private companies.

Main vegetable seed companies in Thailand
Chia Tai
East West Seed Thailand Ltd
Known You Seed Thailand Ltd
Asgrow Thailand Ltd
Adam International
Hsin Seed

Source Thompson, 94

Import/Export of vegetable seed in Thailand

The vegetable seed sector is very active in Thailand and this is reflected in the volumes of import and export of seed:

Import	Export
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Seed Production system

Vegetable seed is available from 3 main sources: farmers retained seed, seed produced by government sector for crops for which private sector has not shown any interest (5% of annual requirement) and finally private sector with the biggest market share. Hybrid seed production which requires hand emasculation/pollination is still carried out by skilled labor in the North of the country. However with increasing wages, hybrid seed production is gradually shifting to countries with relatively lower wages.

Year	Tons	Million\$	Tons	Million\$
1991	695	4.3	1,454	17.6
1992	637	5.0	1,869	21.6
1993	607	5.4	1,131	15.9

Source Thongjiem 94

The main import source are Japan 41%, Taiwan 224%, and USA 15%, whereas seed is mainly exported to Taiwan 36%, USA 25% and Netherlands 7%.

- Thailand has stressed at very early stage the importance of the private sector in the vegetable seed industry, and has adapted a constructive seed policy and related liberal economic policies, so that Thailand seed sector could develop
- In theory registration of new varieties is necessary, practically vegetable seed companies are free to market their produce, and evaluation is left to the farmers
- A draft act on Plant Variety Right (consequence of GATT) has been proposed but not yet implemented.

Seed and seed related government policies

MALAYSIA¹

Country Summary

Total country population in Millions (1992 estimate)	18.000
Total cropped area in 000 ha	4,880.000
Total area under vegetables in 000 ha	14.465
% coverage of vegetable from total cropped area	0.30%
Annual growth rate of vegetable production (83-93)#	3.10%
Productivity in T/ha	28.33

Vegetable Availability in Kg/caput/year	14.120
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Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl.potato	Area under vegetable 000ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons(1)
1	Chinese mustard	3.347	9.27	31.04	3.35
2	Bean	1.985	20.16	40.02	198.50
3	Capsicum	1.635	15.22	24.88	3.27
4	Eggplant	1.217	38.78	47.20	1.22
5	Lettuce	1.064	10.98	11.69	1.06
6	Cabbage	0.855	17.20	14.70	0.43
7	Spinach beet	0.713	8.01	5.71	10.70
8	Kang Kong	0.673	7.83	5.27	26.92
9	Okra	0.533	26.76	14.26	4.26
10	Kale	0.443	12.49	5.53	2.22
11	Tomato	0.387	36.17	13.99	0.39
12	Cucumber	0.311	11.41	3.55	0.93
13	Chinese cabbage	0.291	50.53	14.70	0.29
14	Radish	0.286	14.30	4.09	2.29
15	Luffa	0.262	25.50	6.68	0.13
16	Pumpkin	0.138	30.60	4.22	0.41
17	Garden pea	0.117	6.24	0.73	3.51
18	Carrot	0.113	36.20	4.09	0.34
19	Leeks	0.037	24.05	0.89	0.07
20	Asparagus	0.027	17.81	0.48	0.11
21	Cauliflower	0.019	4.21	0.08	0.02
22	Bitter gourd	0.012	28.33	0.34	0.06
	Total	14.465	17.57036	254.15	260.47

Source: Saharan 94

(1) Calculated from existing area considering a standard seed rate (direct sowing)

Vegetable production

Vegetable are produced on small land holdings (avg less than 1 ha) and are mainly concentrated (80%)

on Peninsular Malaysia, in the states of Perak, Selangor, Johore, Pahang. The vegetable coverage compared to the total cropped area is the lowest in

Asia, and despite good yields, vegetable availability per capita remains very low.

Vegetable export and Import

The low vegetable availability from domestic production resulting in high volumes of import of

Constraints for vegetable production development

- desertion of vegetable production sector to more competitive sectors as a result of rapid industrialization
- excessive use of pesticide resulting in vegetable pollution
- scattered and unorganized production resulting in marketing problems
- increased production costs
- post-harvest losses

fresh vegetable has been of great concern to the Malaysian government. In 1993 Malaysia imported 334,000 tons of fresh vegetables for a value of 114 million \$. The main import commodities are potato, onion, garlic from Thailand, Indonesia, and Australia.

On the other hand Malaysia exported fresh vegetables for a total value of 48 million \$ mainly to Singapore (70%).

Strategies/policies to improve vegetable production

- self sufficiency in vegetable attained by 2010
- encourage the production and consumption of indigenous vegetables
- encourage chemical free vegetables
- strengthen R&D activities of Malaysian Agricultural Research & Development Institute (MARDI)
- encourage vegetable production for local and export markets through improvement of post harvest handling

Vegetable seed industry information

Malaysia vegetable seed industry status

Very little is known about the Malaysian seed industry. Private companies are known to be mainly trader importing most of the seed.

Hybrid are not being developed nor produced in Malaysia, but hybrid seed being used by farmers, which explains the relatively high yield obtained (28.33 T/ha)

Hybrid technology

The hybrid technology is limited to the use of hybrids by farmers. Neither public, nor private sector have started the development of hybrids. The public sector is not yet ready to invest time and energy in the development of local hybrid.

Import/export of vegetable seeds in Malaysia

No information regarding import or export of seed

INDONESIA¹

Country Summary

Total country population in Millions (1992 estimate)	195.000
Total cropped area in 000 ha	22,500.000
Total area under vegetables in 000 ha	822.490
% coverage of vegetable from total cropped area	3.66%
Annual growth rate of vegetable production (83-93)#	5.60%
Productivity in T/ha	7.28
Vegetable Availability in Kg/caput/year	30.690

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

	Vegetable Name excl potato	Area under vegetable 000ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons	Area under Hybrid seed(1) in %
1	Chili pepper	162.520	4.33	703.80	80.26	1.28%
2	Yard long bean	102.960	4.18	430.10	2059.20	
3	Shallot	86.910	6.49	564.39	-	
4	Red bean	61.790	1.55	95.50	1853.70	
5	Cabbage	55.320	21.93	1213.40	6.70	76.67%
6	Cucumber	55.040	8.74	481.30	165.12	0.78%
7	Eggplant	44.820	6.08	272.70	22.41	2.46%
8	Tomato	44.620	8.99	401.30	32.31	2.47%
9	Chinese cabbage	37.740	9.82	370.70	18.87	65.09%
10	Amaranth	34.680	3.65	126.50	346.80	
11	Bunching onion	31.060	8.05	250.00	62.12	0.13%
12	Beans	28.110	6.08	171.00	1124.40	
13	Garlic	20.980	7.28	152.76	-	
14	Kang Kong	20.550	10.61	218.00	51.38	
15	Carrot	16.570	14.09	233.50	66.28	2.67%
16	Chayate	8.050	24.58	197.90	64.40	

17	Radish	5.830	8.89	51.80	46.64	48.03%
18	Others	4.940	10.10	49.90	N.A.	
	Total	822.490	7.28	5984.55	6000.59	

Source: Sosroharsono 94

(1) Estimated from area sown from imported at standard seed rate

Vegetable Production

Vegetable can be produced on a wide range of islands offering different agro-ecosystems. The low, and lower high lands are considered best suitable for vegetable cultivation.

Constraints for vegetable production development

- Lack of quality seeds
- limited technological and management skill of the farmers
- lack of information about production centers of vegetables and the marketing channels due to geographic dispersion of the country.
- Post harvest losses

Vegetable seed industry information

Indonesia vegetable seed industry status

The development of the vegetable seed industry is very recent and started in 1987, when government decided to organize the seed production of some commodities with the private sector. Presently, the public sector is providing 10% of the annual requirement, the private seed sector is handling 77%, whereas the remaining is farmers retained seed. A few seed companies are operating in the country, and only one is known to have started the development and production of hybrids.

Seed companies in Indonesia

PT East West Seed Indonesia

Vegetable Export and Import

Data of import of vegetable fresh, frozen or processed is not available. However, Indonesia, exported in 1993 116,000 tons of fresh vegetables for an equivalent 20 millions \$. Export is oriented mainly to neighbor countries such as Malaysia, Singapore, Thailand.

Strategies/policies to improve vegetable production

- promote vegetable cultivation to meet the domestic demand, and improve the nutrition base of the people
- promote the vegetable seed industry, and the use of quality seed and hybrids
- improve linkages between extension services and farmers for better transfer of technology

PT Bibit Baru
PT Tahinco Subur Prima
PT Dian Makmur Abadi
PT Santoso Prima Maju
PT Agro Mandiri Sentosa
PT Intl. Tani Agro Kimindo
PT Indolan Pratama

Source: Sosroharsono 94

Import/Export of vegetable seeds

Indonesia imports high quantity of vegetable seed amounting to 427 tons. Main imported hybrid commodities are cabbage from Japan, and Thailand, cucumber from Netherlands, Japan,

South Korea and Japan, and chili from South Korea Taiwan, and Thailand.

There is no information regarding export of seed.

Hybrid Technology

Most commercial farmers use hybrids and are making good use of them, whereas smaller farmers, cannot yet afford to pay the high price for them. The situation is gradually changing and the demand of hybrid increasing. One international based

company is known to have started the development of hybrids suitable to the country.

Seed production system

For some commodities, the seed is produced locally jointly by public sector for Breeder and Foundation seed, and by private sector for the commercial seed. For other crops the seed is entirely in the hands of private, which produces through contract growers, or procure the seed from farmers without quality check.

Seed and seed related government policies

- Endorsement by the national Seed Board required a test to be conducted in the areas where the varieties is to be recommended.
- The Seed control and Certification (BPSB) is responsible to check on the seed labeling and certification
- the government is thinking to prepare a proposal for Plant Breeder's Right.

PHILIPPINES¹

Country Summary

Total country population in Millions (1992 estimate)	67.100
Total cropped area in 000 ha	9,190.000
Total area under vegetables in 000 ha	134.000
% coverage of vegetable from total cropped area	1.46%
Annual growth rate of vegetable production (83-93)#	2.30%
Productivity in T/ha	7.72
Vegetable Availability in Kg/caput/year	10.771-64.650

Source RAPA 94/24

* Vegetable availability ranges from 10 to 64 kilos according to domestic production sources

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (avg1989-92)

	Vegetable Name excl potato	Area under vegetable(1) 000ha	Yield(1)) in T/ha	Production(1) in 000T	Annual seed requirement(1)) in Tons	Area under Hybrid seed(2) in %
1	Tomato	19.240	9.16	176.316	9.620	3.00%
2	Eggplant	18.589	8.80	163.583	9.953	10.00%
3	Cabbage	6.959	10.89	75.784	3.480	75.00%
4	Onion	6.363	6.99	44.494	37.818	
5	Squash	5.923	9.47	56.095	17.769	
6	Pole bean	5.405	2.62	14.180	86.480	
7	Watermelon	5.047	13.73	69.319	15.141	1.00%
8	Bitter gourd	4.912	3.92	19.269	58.944	50.00%
9	Petsai	3.665	5.51	20.197	10.995	
10	Snapbean	2.670	3.67	9.786	42.720	
11	Sponge gourd	2.481	3.14	7.799	19.848	5.00%
12	Kangkong	2.125	4.36	9.262	21.250	
13	Bottle gourd	2.122	7.22	15.328	8.488	
14	Okra	1.819	3.46	6.297	12.733	
15	Carrot	1.235	11.67	14.411	0.618	
16	Radish	1.165	5.64	6.571	20.970	
17	Cucumber	1.158	4.41	5.108	0.695	1.00%
18	Hot pepper	1.073	2.53	2.715	0.644	
19	Sweetpepper	0.970	2.91	2.827	0.582	
20	Mustard	0.718	4.70	3.374	8.616	
21	Others	40.361	N.A	N.A	N.A	
	Total	134.000	7.72	722.715(*)	387.36	
	Total production in 1992 as per RAPA 94/24			4342(*)		

(1) Information collected in Philippines from Bureau of Agricultural Statistic and Bureau of Plant Industry

(2) Source Asian Seed Vol 1 N^o3 June 1994

(*) Different of total production data is explained in “Vegetable production”

Vegetable production

Important different in total vegetable production (1992) was found between the Bureau of Agricultural Statistic (Philippines) with 722,000 tons and RAPA food indicators (RAPA 94/24) with 4,342,000 tons. The first divided by the total population (67.21 millions) would give a domestic vegetable availability of 10.7 kg/cap/year (which is very low), whereas the latter divided by the population would give 64.6 kg/cap/year. The real

picture regarding the vegetable production in Philippines would be somewhere in between.

Vegetable export and import

In 1993, Philippines imported 946.73 tons of fresh vegetables for an amount of 520,000 \$, and 11,081 tons of processed vegetables for 22.67 million \$. The export of fresh vegetables amounted to 22,628 tons and contributed to 16 million \$, whereas processed vegetable export was 1,796 tons for an equivalent 1.52 million \$.

The import volume of fresh vegetable is found relatively low considering the little domestic

production reported in the statistics.

Vegetable seed industry information

Philippines vegetable seed industry status

The recent development of the vegetable seed industry in Philippines was triggered by the venture in 1982 of an international company with a local partner. The company started breeding, developing hybrids, and marketing and distributing the seed. The government through the Bureau of Plant Industry is also producing and distributing seed. The rest of the market is in the hands of seed trader which mainly import or procure locally produced seed of uncontrolled quality, and in the hands of farmers retaining their own seed.

Seed Companies in Philippines

East West Seed Philippines

Pilipinas Kaneko Seed Company

Source: Van Selling 94 pers.comm.

Import/ export of vegetable seeds

Seed production system

Majority of seed is produced by private sector through contract growers. Foundation seed is provided, and the production is closely supervised. The public sector is also producing seed, but they contribute to small amounts.

Quantity of seed produced by public and private sector in 1993-94 in tons

Year	Public sector	Private sector	
	OP	OP	F1
1993	10,865*	71,963	500
1994	7,982*	70,249	2,500

* includes soya bean

Source: Van Selling Pers.comm.

The seed is distributed through small traders/dealers which are also selling other agricultural inputs. Seed distribution of improved varieties is still a problem in remote communities.

Philippines imported in 1993, around 64 tons of seed amounting to 2.7 million \$. The main imported commodities were carrot (OP), cabbage (F1), and onion (OP and F1).

With the development of the private seed sector, foreign seed companies have started to produce seed in Philippines on contract, taking advantage of low production cost and favorable climate. In 1990, 16.3 tons were exported for a value of 105,000 \$.

Hybrid Technology

Farmers are slowly realizing the advantage of using hybrids, and two seed companies so far are involved in the development and production of hybrids for the local market. The main progress in hybrids have been achieved in bitter gourd, sponge gourd, bottle gourd and tomato.

Seed and seed related government policies

- The release of varieties and registration procedures have been revised recently. The cultivar release scheme by which the performance of the varieties are assessed is voluntary.
- No certification for vegetable seed is required.
- No legal protection is accorded to new varieties as intellectual property.

VIETNAM¹

Country Summary

Total country population in Millions (1992 estimate)	68.900
Total cropped area in 000 ha	6,697.000
Total area under vegetables in 000 ha	279.000
% coverage of vegetable from total cropped area	4.17%
Annual growth rate of vegetable production (83-93)#	3.50%
Productivity in T/ha	11.70
Vegetable Availability in Kg/caput/year	47.377

Source RAPA 94/24

Vegetable production Indicators

No detailed information on production of vegetables by kind available

Vegetable production

The best areas for vegetable production are the North hilly area, Central region, and Central high land. However, vegetable belts concentrated around big cities contribute to 40% of the total planted area. The average landholding for vegetable production is less than 2000m²

Constraints for vegetable production development

- lack of trained manpower in research, and training.
- Poor post harvest handling, and transport facilities makes the cultivation risky for farmers
- improper knowledge of improved agricultural practices
- irregular distribution of vegetables growing pockets in the country

Vegetable seed industry information

Vietnam vegetable seed industry status

Very little is known about the vegetable seed industry in Vietnam. With recent opening of the country, the seed sector is just starting its development, and is shared by public (30% of annual seed requirement) and private sector/farmers.

Hybrid technology

Vegetable Export and Import

No detailed information on export nor import of fresh vegetables is available. Vegetables are exported to Europe, Japan, and Hong Kong, and contribute significantly to the foreign exchange.

Strategies/policies to improve vegetable production

- strengthen the research in the fields of breeding, pathology, agronomy
- promote the vegetable gardening, and include systematically vegetable in the crop rotation.
- Establish technology for pollution free vegetable production and transfer it to the farmers
- promote the vegetable seed industry
- provide training in all fields of research, production, and extension.

No seed companies are reported to have started hybrid development in Vietnam. However, the public research started a few programs in this line on: cucumber, tomato, and watermelon, but has not yet reached the production level

Import/export of vegetable seeds

Vietnam is importing most of their seed in the form of hybrids from Japan, Taiwan, Thailand,

and Korea. Annual the government is importing 2.3 tons of vegetable seed.

No information is available regarding export of seeds. However, it is know that international seed companies could start custom hybrid seed

Seed Production system

The public sector is producing vegetable seed (mainly OP) on 14 state farms scattered around the country. The private sector has not yet started organized seed production, and is mainly trading seed and importing. There is a great scope to develop the sector if foreign seed companies decide to produce labor intensive in Vietnam.

production in Vietnam (taking advantage of the relatively cheaper and skilled labor as well as good climatic conditions) which would ensure an export market.

Seed and seed related government policies

- The government of Vietnam has stressed the importance of the development by both public and private sector.
- No clearly policy, and action plan for the development of the vegetable seed industry has yet been proposed.
- No information on Plant Breeders Right.

CHINA¹

Country Summary

Total country population in Millions (1992 estimate)	1,200.000
Total cropped area in 000 ha	148,460.000
Total area under vegetables in 000 ha	3,935.900
% coverage of vegetable from total cropped area	2.65%
Annual growth rate of vegetable production (83-93)#	5.60%
Productivity in T/ha	35.03
Vegetable Availability in Kg/caput/year	114.891

Source RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetable crop (1993)

Vegetable Name	Area under	Yield	Production	Annual seed	Areas under
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	excl potato	vegetable 000ha	in T/ha	in 000T	requirement in Tons	Hybrid seed in %
1	Chinese cabbage	605.9	59.1	35,808.69	2,357.30	80%
2	Radish	326.2	39.6	12,917.52	1,370.10	40%
3	Garlic	295.4	16.8	4,962	-	
4	Pakchoi	249.9	29.6	7,397.04	2,099.20	80%
5	Cabbage	241.5	36.0	8,694.00	235.50	90%
6	Chili	238.8	19.3	4,608.84	429.70	60%
7	Tomato	216.8	38.6	8,368.48	195.10	60%
8	Cucumber	197.2	39.0	7,690.80	524.30	40%
9	Eggplant	174.1	33.2	5,780.12	156.70	40%
10	Green onion	157.5	35.8	5,638.50	614.30	low
11	Spinach beet	129.7	24.7	3,203.59	700.40	low
12	Celery	125.2	43.4	5,433.68	225.40	
13	Snap bean	122.3	21.3	2,604.99	14,309.10	
14	Lettuce	111.4	28.8	3,208.32	217.20	
15	Yard long bean	110.9	24.3	2,694.87	8,650.00	
16	Carrot	109.7	27.6	3,027.72	246.80	
17	Chinese chive	105.3	35.6	3,748.68	394.80	
18	Leaf mustard	96.4	34.2	3,296.88	282.00	
19	Cauliflower	94.5	26.3	2,485.35	170.10	low
20	Sweetpepper	87.1	27.2	2,369.12	118.10	50%
21	Onions	61.4	29.5	1,811.30	179.60	
22	Squash	54.0	29.9	1,514.60	315.90	
23	Asparagus	24.7	20.4	503.88		
	Total	3,935.9	35.03	137,869.69	33,791.60	

Source: Table 1, Dongyu 94

Vegetable grown under protected cultivation in 000ha

	Greenhouse	Plastic tunnel	Plastic house	Mulch
1991	30.5	48.2	30.3	344.6
1992	33.3	133.3	33.3	333.3

1993	40	143.3	40	333.3
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Vegetable Export and Import

Import of vegetable (fresh, frozen chilled) is not available.

China has exported for an equivalent 70 million \$ of fresh vegetable

Constraints for vegetable production development

- shrinking vegetable production areas around cities as a result of rapid industrialization
- long distance transportation of fresh vegetables causing heavy post harvest losses
- shortage of basic agricultural inputs and their high price
- lack of adequate technology transfer to farmers

- improvement of marketing channels (improvement of roads, and market construction)
- protection of urban vegetable production pocket from expansion of industrial zones
- strengthening of private seed sector, and hybrid development by cooperation between public and private sector

Strategies/policies to improve vegetable production

- promotion of protected cultivation techniques

Vegetable seed industry information

China vegetable industry status

Company/Institute Name	Major field of activity
TCI Tianjing AAS	Cucumber
HVI, Hunan AAS	Cabbage/ Sweet pepper
Laizhou Xiyou Seed Co*	Chili pepper
Liaoling Seed Co	Chinese cabbage
Shandong cabbage Service Center*	Tomato export
Xingtai Vegetable Seed Co	Cabbage
Shanxi Seed Co	Pepper cabbage

* Company entirely privatized

Source: Dongyu 94

China vegetable seed industry has recently developed with the opening of the country, and most public institutes which were breeding and developing hybrids started commercial activities.

Seed Production system

Before 1984, the seed business was monopoly controlled by state owned companies.

After 1984 seed business and management have been separated, and new institutions, collective groups, and joint ventures have started activities in the seed sector.

It is estimated that 100,000 seed entrepreneurs are active in China: 60% of those are private, 40% are state owners.

Import/export of vegetable seeds in China (1993)

After 1980, China opened its borders to import and export of seed. The movement of seed is relatively low compared to the size of the country and its potential market. The export sector is almost entirely controlled by state companies (90%).

Year	Import		Export	
	Tons	Million\$	Tons	Million\$
1992	200	100	200	75

Source: Dongyu 94

The imports are mainly for temperate crops such as lettuce, celery, cabbage, broccoli, watermelon

Seed and seed related government policies

- Newly introduced varieties should be evaluated and registered
- seasonal seed production license is required
- liberalization of seed export
- trade mark and parental lines are protected under parent right since 1994.

REPUBLIC OF KOREA¹

Country Summary

Total country population in Millions (1992 estimate)	44.000
Total cropped area in 000 ha	2,285.000
Total area under vegetables in 000 ha	349.300
% coverage of vegetable from total cropped area	15.29%
Annual growth rate of vegetable production (83-93)#	2.00%
Productivity in T/ha	27.20
Vegetable Availability in Kg/caput/year	215.920

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1993)

	Vegetable Name excl potato	Area under vegetable 000ha	Yield in T/ha	Production in 000T	Annual seed requirement in Liters	Areas under Hybrid seed(1) in %
1	Chili	77.200	2.10	162.10	54,040	100.00%
2	Chinese cabbage	54.700	71.40	3905.60	38,290	91.00%
3	Garlic	43.800	9.00	394.20		
4	Watermelon	36.600	24.00	878.40	21,960	93.00%
5	Radish	35.900	44.50	1597.60	287,200	74.00%
6	Welsh onion	20.800	25.20	524.20	145,600	60.00%
7	Onion	10.600	50.90	539.50	53,000	51.00%
8	Oriental melon	9.200	22.80	209.80	9,200	79.00%
9	Cucumber	8.700	31.70	275.80	11,310	93.00%
10	Spinach	8.600	13.20	113.50	430,000	63.00%
11	Pumpkin	7.800	19.21	149.80	31,200	98.00%
12	Lettuce	7.300	18.90	138.00	21,900	52.00%
13	Strawberry	7.300	15.00	109.50		
14	Carrot	5.900	23.59	139.20	88,500	66.00%
15	Ginger	4.100	9.20	37.70		
16	Cabbage	3.900	37.69	147.00	2,730	100.00%
17	Tomato	3.500	32.60	114.10	2,450	100.00%
18	Sweet pepper	2.200	19.59	43.10	1,540	100.00%
19	Eggplant	1.200	17.83	21.40	840	
	Total	349.300	27.20	9500.50	1,199,760	

Source: Kim 94

(1) estimated from F1/OP ratio from total registered varieties since 1980

Vegetable grown under protected cultivation in ha

Year	Greenhouse	Plastic tunnels
1992	1,200	29,256
1993	8,100	33,440
1994	13,600	37,793

Source: Kim perso.comm

The areas under protected vegetable cultivation are consistently increasing, which enables a sufficient supply of fruit bearing vegetables during winter.

Constraints for vegetable production development

- Continuous cropping causes soilborne diseases to build up.
- Over-fertilization is deteriorating the soils by accumulation of salt
- Seasonality of the production, and fluctuation of market price

Vegetable seed industry information

Korean vegetable seed industry status

The Korean vegetable seed industry has developed significantly during the last 20 years and is mostly in the hands of the private sector. About 40 companies are active in Korea, and most them have the full range of activities of a seed company. Hybrids are being developed and every year hundreds of varieties are registered by private seed companies.

Leading Vegetable Seed Companies in Korea

Hungnong Seed Co Ltd

Vegetable Export and Import

No information on export nor import of fresh vegetables are available.

- labor shortage in vegetable production industry

Strategies/policies to improve vegetable production

- mechanization to overcome labor crisis and increase profitability
- efforts are made by the government to control prices
- promotion of grafting on most cucurbit crops.

Seoul Seed Company
Choongang Seed Co Ltd
Hannong Seed Co Ltd
Nongwon Seed Co Ltd
Dongweon Nangsen Seed Co
Nangjin Seed Company

Source: Kim perso.comm.

Import/export of vegetable seeds in Korea (1992)

In 1992 Korea imported 2,773 thousand liters of seed for a value of 13 million \$ (mainly radish,

onion, spinach), whereas exports accounted for 517 thousands liters for a value of 10 million \$ (mainly radish, Chinese cabbage, cucumber). The import volumes are high and includes the custom seed production made abroad.

Hybrid technology

Hybrid technology is fully developed in Korea. In 1993, 120 varieties were registered of which 80%

Production system

Seed are mainly produced by private seed companies with contract farmers. Public sector is producing seeds for crops for which private sector has not shown any interest (mainly field crops). Recently domestic seed production suffered an acute crisis due to labor shortage and increasing wages, making the business unprofitable. This resulted in increasing custom seed production, and is reflected in the volume of imports.

F1. In total, since 1980, 2,874 varieties were registered, out of which 75% hybrids. Korean private seed industry has strong programs on radish, and Chinese cabbage.

Seed and seed related government policies

- Vegetable seed is governed under “Seed and seedling control law”
- New varieties need to be registered with Ministry of Agriculture after passing performance tests (of which at least one official test), a selling permit is then given.
- No law regarding PBR is being implemented, and Korea intends to sign UPOV convention shortly.

JAPAN¹

Country Summary

Total country population in Millions (1992 estimate)	124.400
Total cropped area in 000 ha	5,165.000
Total area under vegetables in 000 ha	411.000
% coverage of vegetable from total cropped area	7.96%
Annual growth rate of vegetable production (83-93)#	-0.8%
Productivity in T/ha	31.79
Vegetable Availability in Kg/caput/year	105.024

Source: RAPA 94/24

Vegetable Production Indicators

Production and seed requirement/use of major vegetables (1992)

Vegetable Name excl potato	Area under vegetable 000ha	Yield in T/ha	Production in 000T	Annual seed requirement in Tons(1)	Areas under Hybrid seed in % (2)

1	Radish	59.000	39.76	2346.00	295.00	82.00%
2	Cabbage	41.000	39.34	1613.00	12.30	94.00%
3	Onions	30.000	46.57	1397.00	120.00	63.00%
4	Chinese cabbage	27.000	44.63	1205.00	13.50	96.00%
5	Spinach	27.000	13.52	365.00	810.00	85.00%
6	Green Onion	25.000	22.60	565.00	75.00	19.00%
7	Carrot	24.000	28.75	690.00	96.00	63.00%
8	Lettuce	23.000	23.30	536.00	23.00	2.00%
9	Watermelon	21.000	35.10	737.00	42.00	95.00%
10	Cucumber	19.000	47.32	899.00	57.00	89.00%
11	Pumpkin	18.000	15.44	278.00	36.00	83.00%
12	Melon	17.000	23.35	397.00	17.00	90.00%
13	Eggplant	16.000	32.44	519.00	3.20	86.00%
14	Tomato	14.000	55.14	772.00	2.80	68.00%
15	Young soybean	14.000	7.14	100.00	700.00	
16	Young snap bean	11.000	7.64	84.00	1100.00	
17	Broccoli	10.000	10.10	101.00	4.00	88.00%
18	Turnip	7.000	28.29	198.00	2.80	88.00%
19	Capsicum	4.000	41.75	167.00	0.60	57.00%
20	Cauliflower	3.000	16.67	50.00	1.20	97.00%
21	Celery	1.000	46.00	46.00	1.50	
	Total	411.000	31.79	13,065.00	3,412.90	

Source: Oda 1994

(1) Calculated from existing area considering a standard seed rate

(2) estimated from F1/OP ratio from total number of released varieties since 1976

Vegetable grown under protected cultivation in 000ha

Year	Green house	Plastic tunnel	Plastic house	Plastic mulch
1993	0.9	51.2	35.4	123.5

Source: Oda pers.comm.

The areas under protected vegetable cultivation are consistently increasing, which enables a sufficient supply of fruit bearing vegetables during winter.

Constraints for vegetable production development

- labor shortage in vegetable production sector, because aging farming population.

Vegetable Export and Import

Japan is importing large quantities of fresh vegetables. In 1993, 329,000 tons were imported, mainly from New Zealand, Mexico, and USA (onion 70%)

Japan exported 1,243 tons of fresh vegetables for a total value of 2.8 million \$

- Continuous cropping under greenhouse causes soilborne diseases to build up, and increases replant failure.

- Increasingly high quality standards is requested from the consumers requires constant changes in varieties, moreover Japanese consumers are demanding more “chemical free vegetables”

Strategies/policies to improve vegetable production

- mechanization of many laborious works reduce the requirement of labor

- promotion of grafting techniques in many crops reduce the replant failure
- develop and promote techniques for non destructive quality checks) like sweetness in melon, by infra red spectrophotometry)

Vegetable seed industry information

Japan vegetable seed industry status

Private seed companies in Japan have been among the pioneer in the world seed industry, and hybrids have been developed as early as 1940. Hundreds of seed company are in activity of which 100 are involved in breeding, seed production, and marketing.

Leading vegetable seed companies in Japan
Sakata Seed Co
Takii Seed Co
Mikado Seed Co
Kaneko Seed Co
Tokita Seed Co
Kyowa Seed Co
Shimizu Seed Co

The size of traditional seed companies is usually small except for few leading companies, which have established in other countries and continent.

Seed production system

Most seed is produced by the private sector through local contract growers or through custom production abroad.

The domestic seed production accounted for 1,520 tons (in 1993) and was produced by 13,000 contract farmers. The increasing costs for seed production in Japan has resulted in shifting seed

Import/export of vegetable seed in Japan (1991)

In the last 10 years vegetable seeds have been increasingly imported to reach in 1991, 6,861 tons for a value of 40.3 million \$, whereas exports following the same trend amounted to 904 tons for a value of 41 million \$. The high imports are mainly radish, and mungbean for sprouting.

The seed are imported mainly from North America Europe, whereas export is made to the rest of Asia.

Hybrid technology

Hybrid technology has reached a very high development in Japan. Between 1976 and 1993, 3400 varieties have been released by various seed companies, out of which 68% are hybrids. Japan has become the leader in development of hybrids of cabbage, and Japanese radishes in Asia.

production abroad, especially for labor intensive hybrid seed production such as solanaceous crops.

Seed and seed related government policies

- Japan having an advanced vegetable seed industry has comprehensive seed rules and legislation.
- Japan established PBR and patent under “Seeds and Seedlings law” of 1978
- Japan signed UPOV convention in 1982.